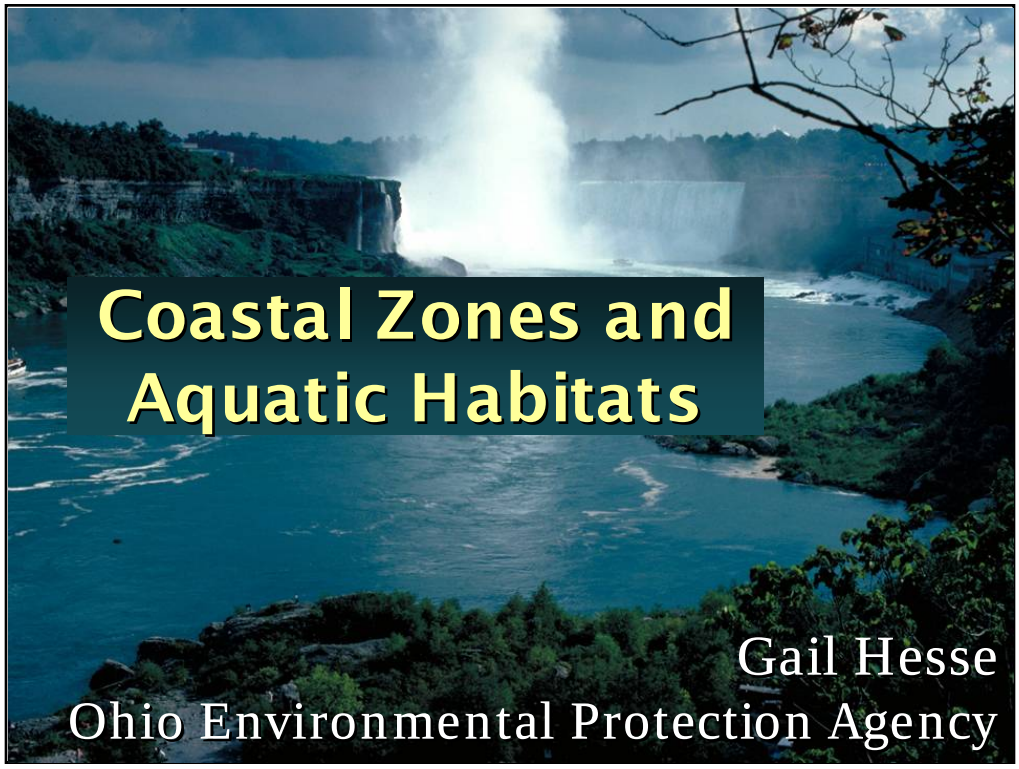


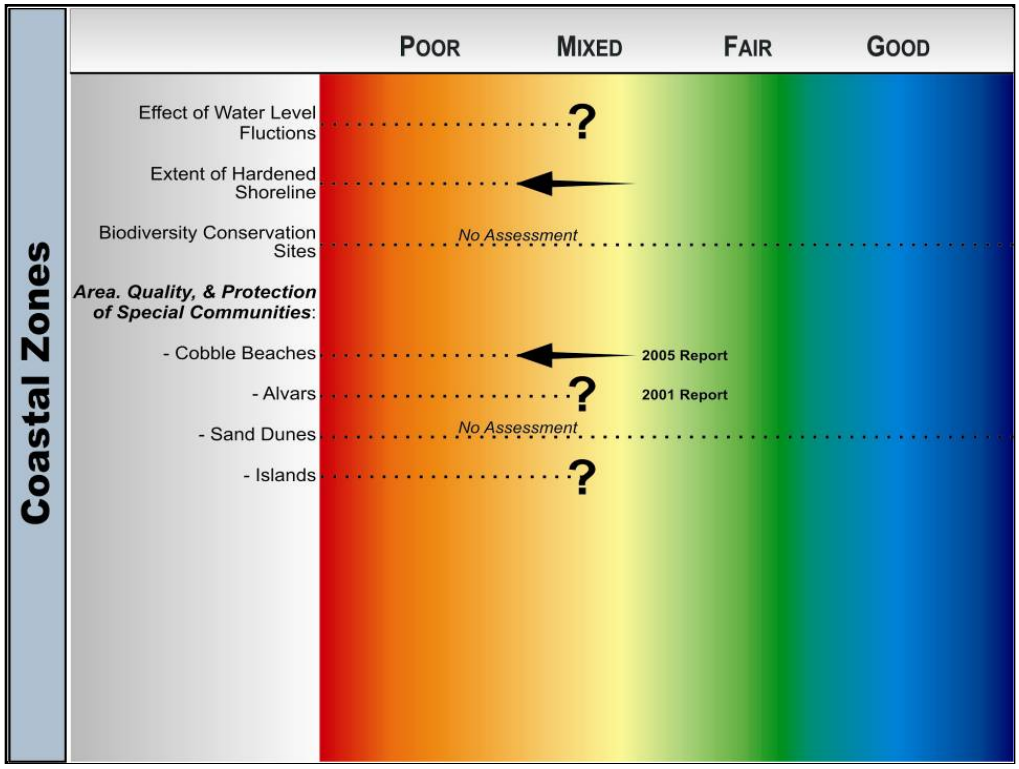
Good morning.

Anecdote—Haley story

•We all know there is good and bad in the water. And today I will be talking about the good and the bad in coastal zones and aquatic habitats.

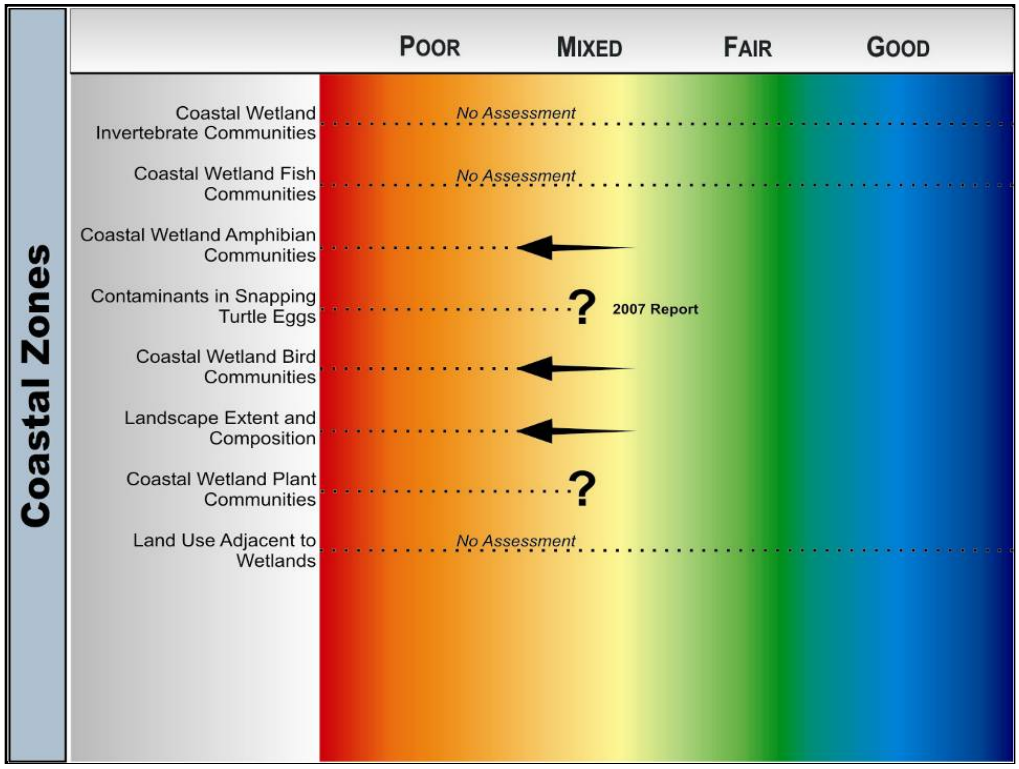
•What's important about coastal zones and aquatic habitats is that they give character to the Great Lakes—they define the Great Lakes as unique and rare in the world of freshwater ecosystems.

•Let's begin by looking at the coastal zones category of indicators.



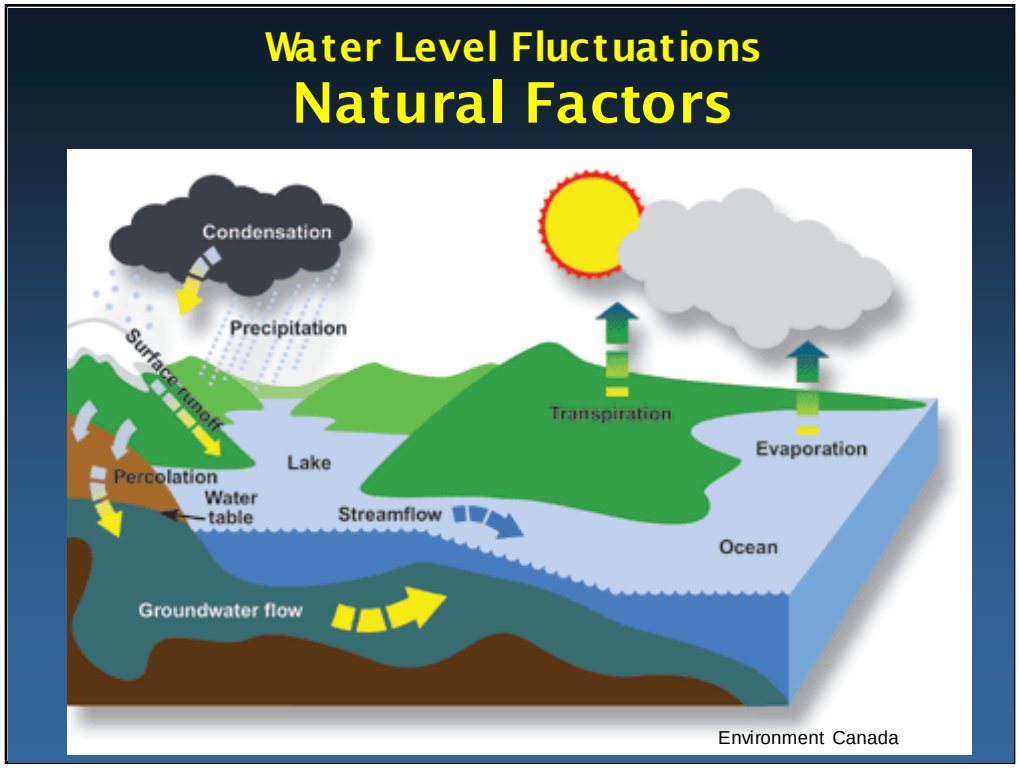
•I have 2 slides summarize the indicator reports for coastal zones.

•The overall status of the coastal zone is mixed and the trend is either deteriorating or undetermined based on the overall analysis of all the indicators included in this category.



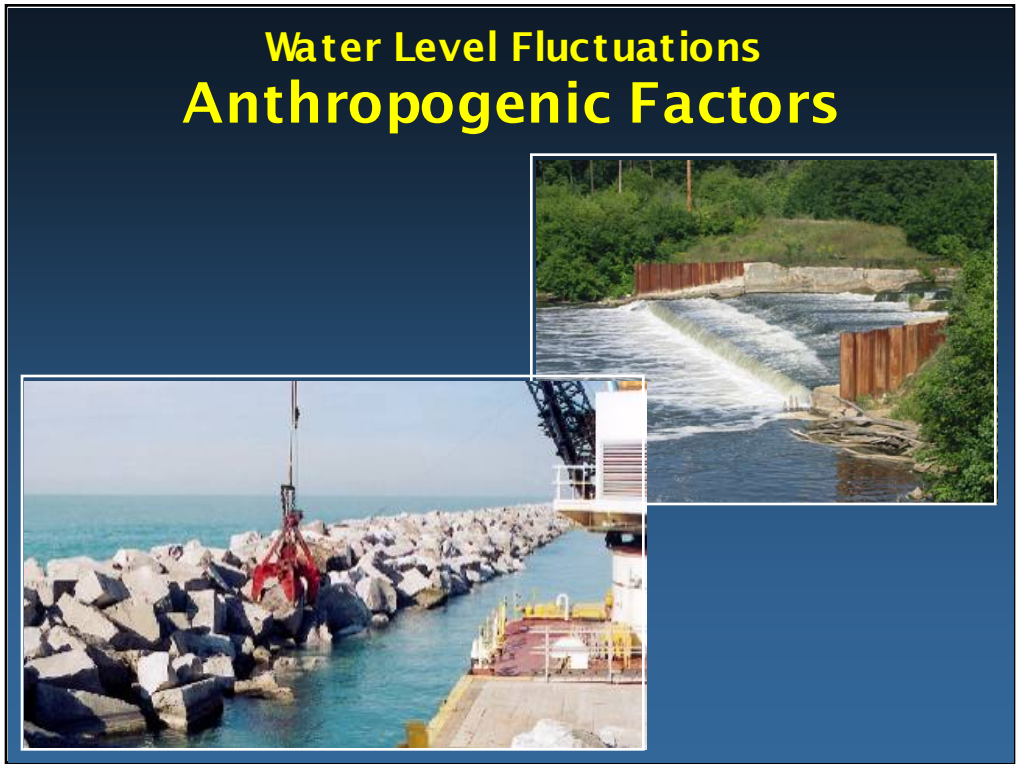
•I will summarize the findings of these indicators and in addition, I will briefly summarize the poor status and deteriorating trend of coastal wetlands, an important coastal region system.

•Let's begin with the first two indicators, water level fluctuations and extent of hardened shoreline, which tell us a great deal about the overall condition of the Great Lakes coastal zone.



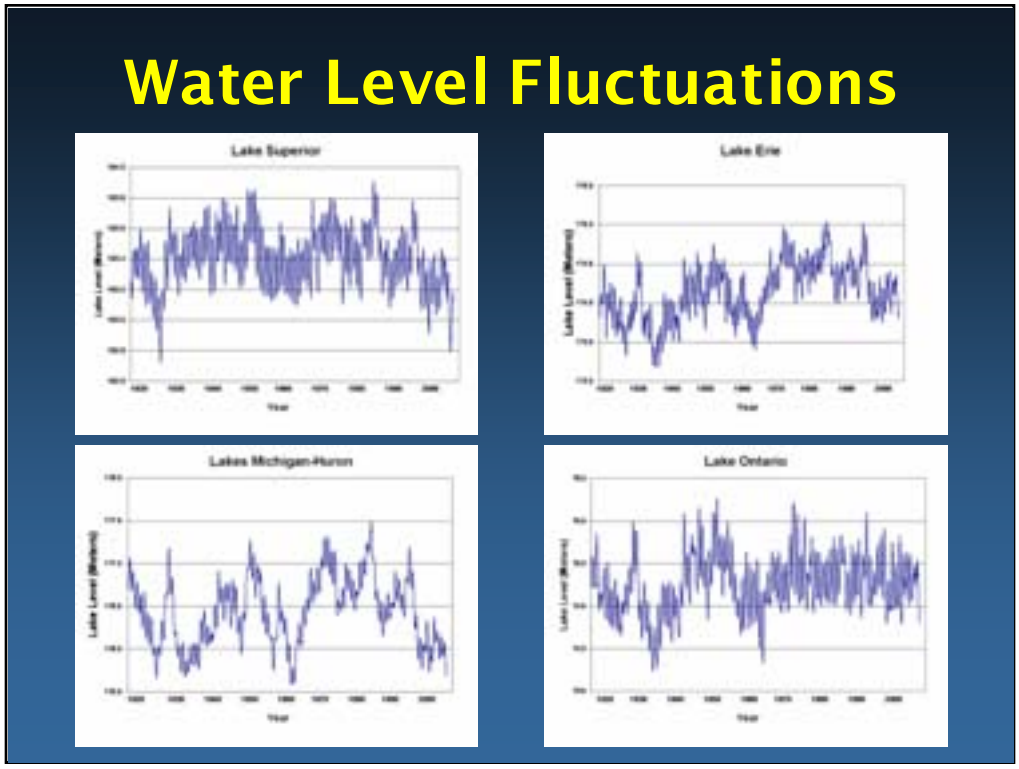
Let's begin with water level fluctuations.

•With this slide of the water cycle, we see the natural factors associated with long term water level changes including over-lake precipitation, surface water runoff, groundwater discharge, and evapo-transpiration.



•The anthropogenic factors affecting the Lakes include the regulation of outflow and water levels, dredging, control structures, and use for thermoelectric power and the rest is returned to the Lakes.

•Non-consumptive uses such as hydroelectric power, transportation, and water-based recreation, return water to the Lakes.



•The alteration of natural lake level fluctuations in the Great Lakes has been a significant driver of degradation in nearshore and coastal wetland vegetation, with the most marked evidence demonstrated in Lake Ontario.

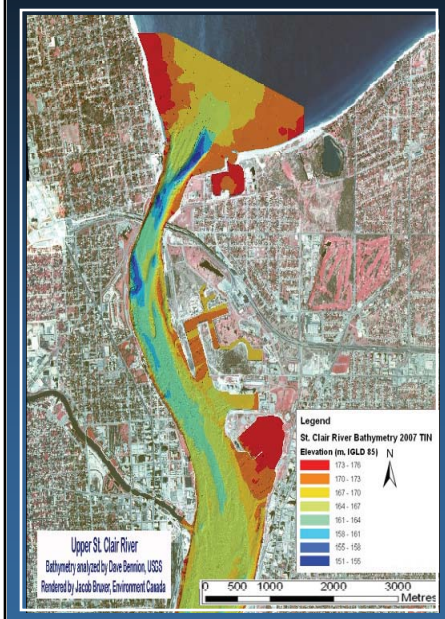
•Data gaps prevent a full assessment of impacts leading to a status of mixed and a trend of undetermined.

•You can see here that the graphs for regulated Lakes Superior and Ontario show tighter lines and less variability in lake levels.

•In the graphs for non-regulated Lakes Michigan, Huron, and Erie the lines appear to fluctuate more over the years.

•How are the International Joint Commission and the two federal governments managing the complex issue of water level fluctuations?

International Upper Great Lakes Study



- What is causing the declining head difference between Lakes Michigan/Huron-Erie?
- Has the St. Clair River flow regime changed with time and if so, why?
- Have the velocity patterns in the St. Clair River been modified and if so, what are the implications?
- Is the St. Clair River bed stable or eroding?
- If the bed of the St. Clair is eroding, what initiated it and when?
- Has the sediment budget for the St. Clair River changed and if so, what are the implications?

•Two studies will help us to better manage Great Lakes water levels.

•The International Upper Great Lakes Study was initiated by the International Joint Commission to improve our understanding of the effects of regulation on lake level changes in unregulated Lakes Huron, Michigan and Erie as well as the physical changes to the St. Clair River.

•41 projects are underway addressing issues such as:

- o Flow regime;
- o Velocity patterns;
- o Bed stability and erosion; and,
- o A sediment budget.

•The International Joint Commission created a study board to evaluate options for regulating Lake Ontario flows.

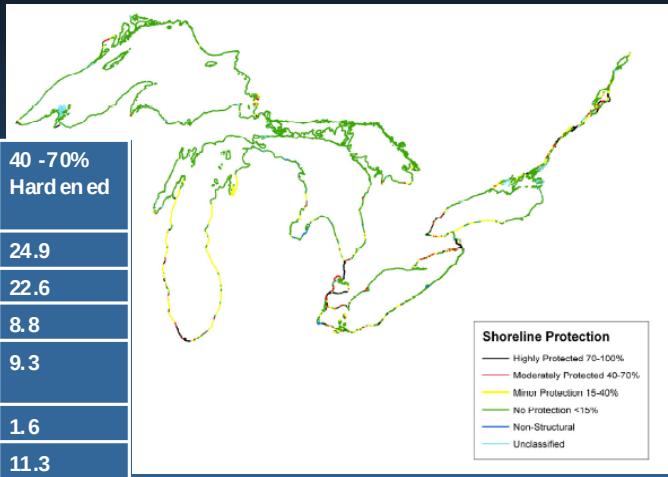
•A study was released in May of 2006; and, in 2008 a proposed Order of Approval was released.

•The IJC has since concluded that the Order of Approval needs to be revised and they have proposed a one year process to resolve outstanding issues.

•This will be talked about in more detail tomorrow in the Lake Ontario presentation.

Hardened Shoreline

Lake/ Connecting Channel	70 -100% Hardened	40 -70% Hardened
St. Clair River	69.3	24.9
Detroit River	47.2	22.6
Niagara River	44.3	8.8
St. Lawrence Seaway	12.6	9.3
St. Marys River	2.9	1.6
Lake Erie	20.4	11.3
Lake St. Clair	11.3	25.8
Lake Ontario	10.2	6.3
Lake Michigan	8.6	2.9
Lake Superior	3.1	1.1
Lake Huron	1.5	1.0



•Now let's turn to the second indicator that tells us about the coastal zones: the extent of hardened shoreline.

•The current state of shoreline hardening is mixed and the trend deteriorating

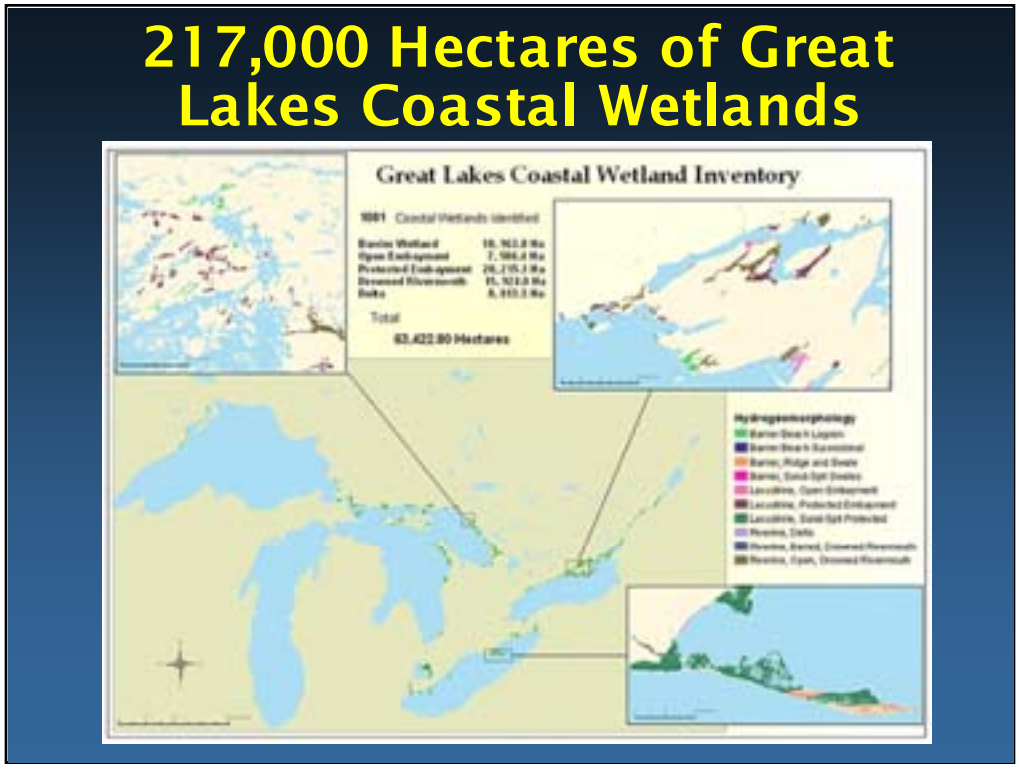
•As you can see, the St. Clair, Detroit, and Niagara Rivers are most impacted by shoreline hardening.

•Of the Lakes, Lake Erie has the highest percentage of its shoreline hardened, and Lakes Huron and Superior have the lowest.

•In addition to the economic costs, the ecological costs are of concern, particularly the degradation of coastal wetlands and sand dunes.

•Additional stretches of shoreline will continue to be hardened, especially during periods of high lake levels.

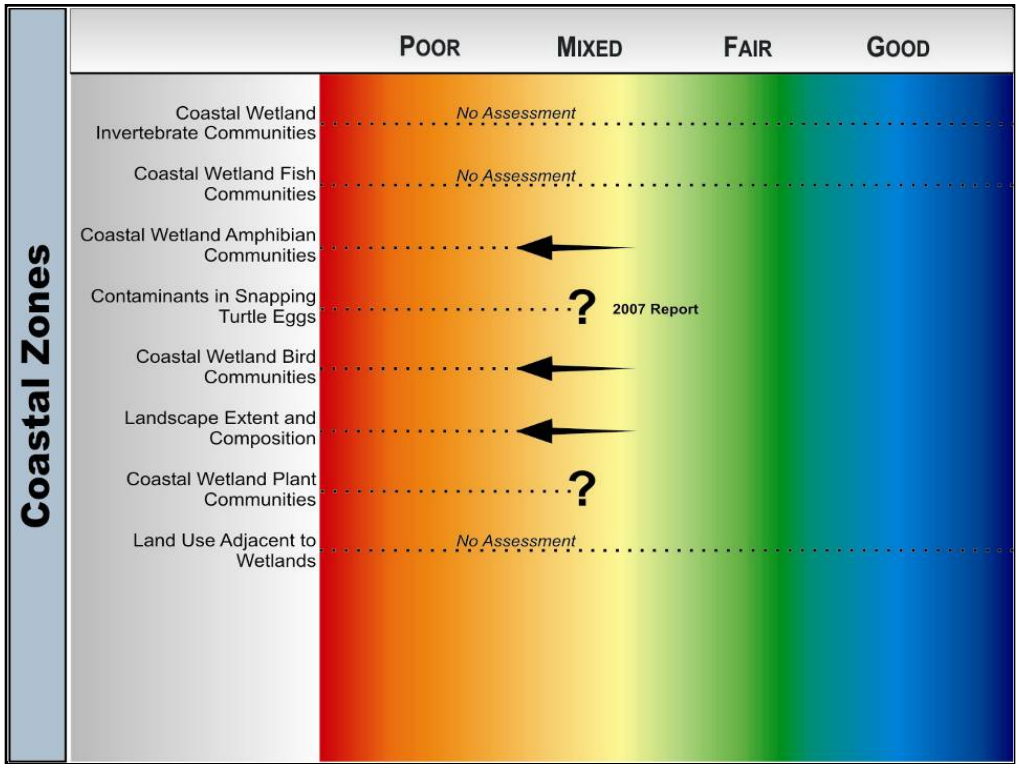
•It is uncertain whether the rate can be reduced and ultimately halted, and perhaps, there may come a time when we may be able to restore shorelines to a more a more natural state, similar to the way we are removing dams in our streams to restore our river corridors.



•We have a number of individual coastal wetland indicator reports; however, we have not been able to assess status and trends for invertebrates, fish and land use adjacent to coastal wetlands due to lack of data.

•The significant progress in coastal wetlands has been the development of a long term, binational coastal wetland monitoring program.

•Once implemented, this monitoring effort will help to better capture status and trends that will tell us more about resource integrity for coastal wetlands, and, help establish protection and restoration priorities.



•The Rainbow diagram reminds us that there is not enough information to assess invertebrates and fish.
•Our best data is for amphibians and birds and the results are mixed.
•Collectively for amphibians and birds, the status is mixed because there are both positive and negative population trends for different species.
•You will hear more about this process and the indicators in the nearshore coastal wetland presentation later today.

•Great Lakes islands, over 31,000 of them, form the world's largest freshwater island system and their biological diversity is of global significance.

•The islands range in size from large boulders to Manitoulin Island in Lake Huron, the largest freshwater island on Earth.

•The islands are of particular importance for colonial waterbirds, nearctic-neotropical migrant songbirds, endemic plants, arctic disjunct plants, endangered species, and fish spawning and nursery areas.

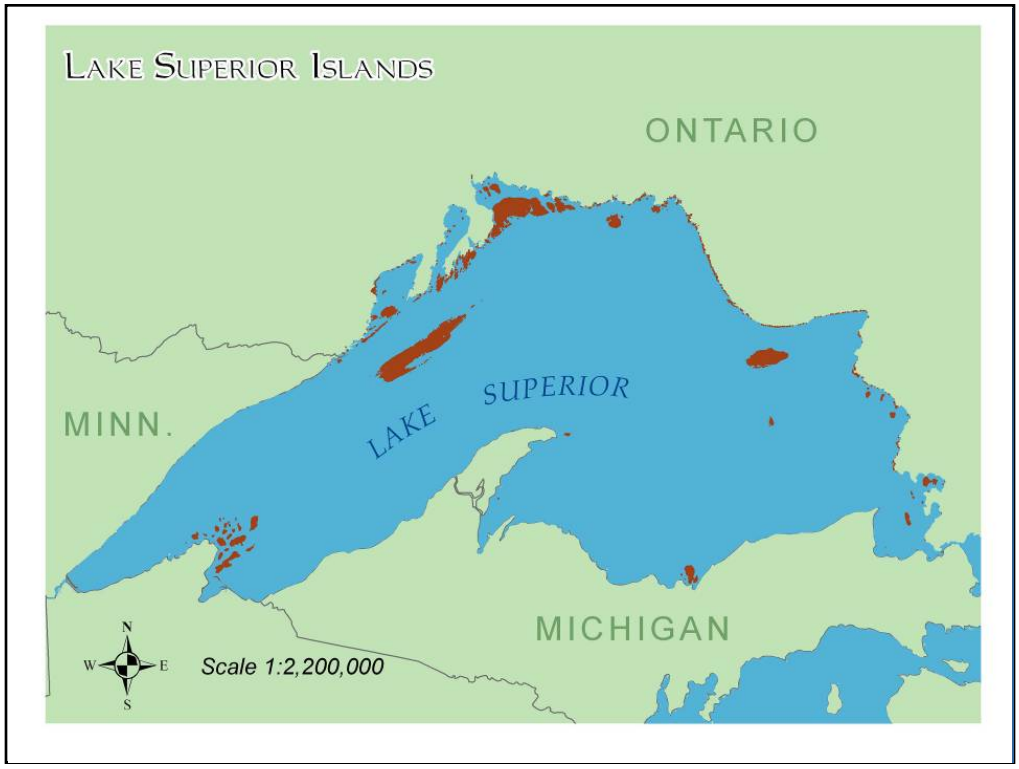
•Recent research has shown the importance of islands to the Great Lakes fishery, for example islands provide 58 percent of the fish spawning and nursery habitat in the Ontario waters of Lake Huron.

•But the special features of Great Lakes islands are vulnerable and sensitive to change.

•They are vulnerable due to their exposure to severe weathe;

•They are vulnerable to erosion and accretion as a result of changing water levels; and,

•They are vulnerable to all of the coastal processes that affect the shorelines—invasive species, algal blooms, changes in substrate, and shoreline development.



•But it's not too late.

•This map shows Lake Superior island and island complexes with the highest biodiversity scores. Biodiversity scores include a measure of species and community richness, physical diversity, and complexity of island shape.

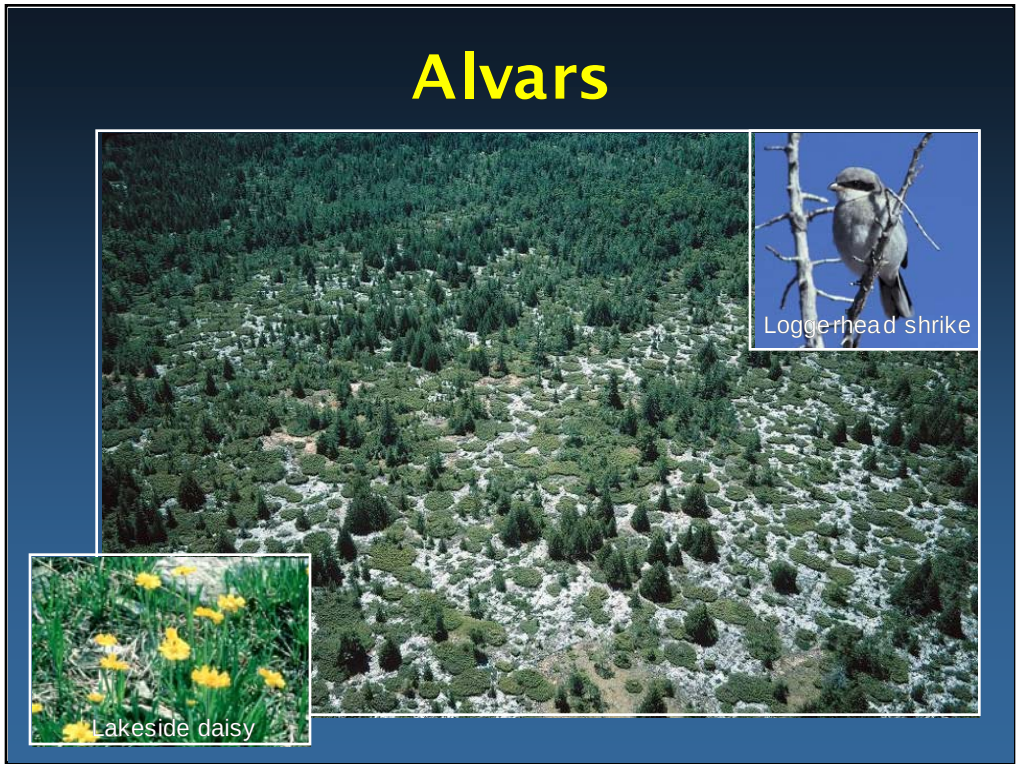
•In the past, we could not have done this assessment.

•But due to recent efforts by the Binational Collaborative for the Conservation of Great Lakes Islands, the islands and island complexes have been assessed for their biodiversity, potential threats to their biodiversity, and existing conservation status.

•Based on these assessments of island values, the Collaborative will soon recommend management strategies to preserve the unique ecological features that make these islands so important.

•This investment in time, energy and partnerships will allow us to prioritize our work on those 31,000 plus islands.

•This *Framework for Binational Conservation of Great Lakes Islands* will be completed in 2009.



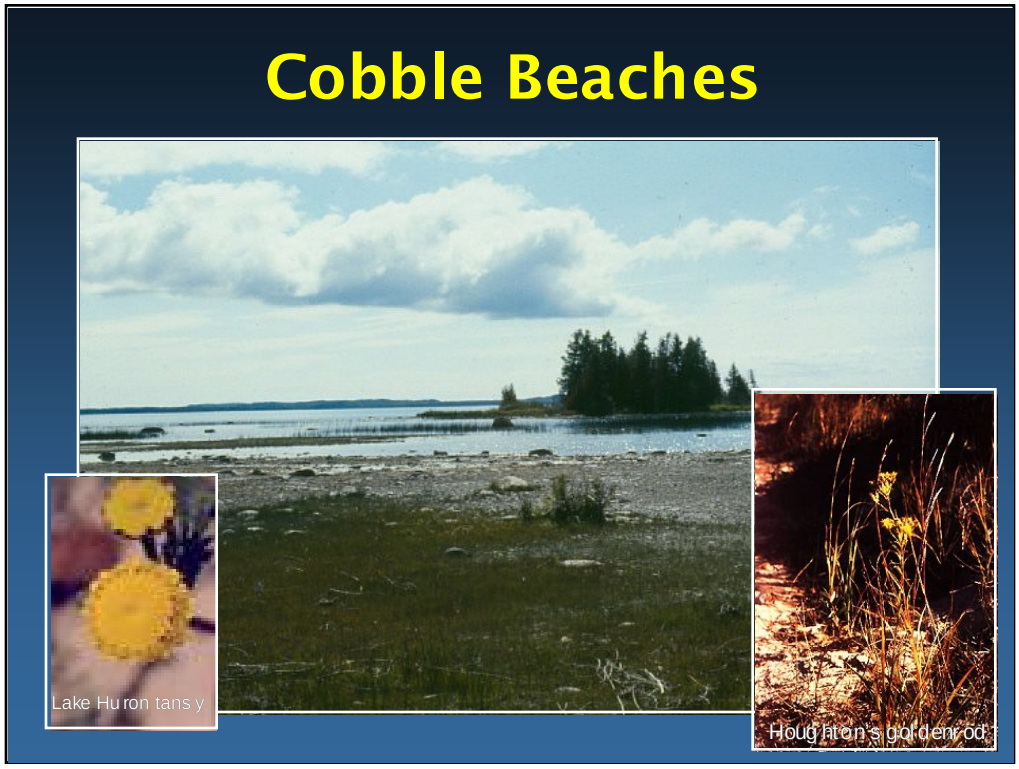
•Alvars are open habitats occurring on flat limestone bedrock.

•Approximately 95%, 27,200 acres, of all the alvars in the world are located in the Great Lakes.

•Alvar species endemic to the Great Lakes include the Lakeside daisy shown here and mollusks, birds and invertebrates that are rare elsewhere in the basin.

•Unfortunately, more than 90% of the original alvars have been destroyed or substantially degraded by human uses such trails and off-road vehicles, resource extraction, grazing, plant collecting, and non-native invasive plants.

•64% of remaining alvars are in Ontario, with much smaller percentages in New York, Michigan, Ohio, Wisconsin, and Quebec.



- The Lake Superior shoreline has 950 kilometers of cobble beach.
- In contrast, Lake Erie has only 26 kilometers of cobble beach.
- Considered globally rare due to scarcity, cobble beaches are home to many Great Lakes plant species such as the Lake Huron tansy and Houghton's goldenrod, shown here.
- The extent of cobble beaches is actually increasing from land to water due to water level declines; however, shoreline development is decreasing the number of cobble beach shoreline linear meters.
- Hence, the overall assessment for cobble beach has a status of mixed with a trend of deteriorating.

•The Great Lakes are home to the world's largest collection of freshwater dunes, home to endemic and endangered species such as the Pitchers thistle shown here.

•We don't have enough data to assess Great Lakes sand dunes, but here's what we do know.

•First of all, it's difficult to assess overall sand dune loss or status because the degree of protection across jurisdictions varies and any locally collected information is not synthesized across the basin.

•Invasive species such as baby's breath have spread and sand mining continues to destabilize the system.

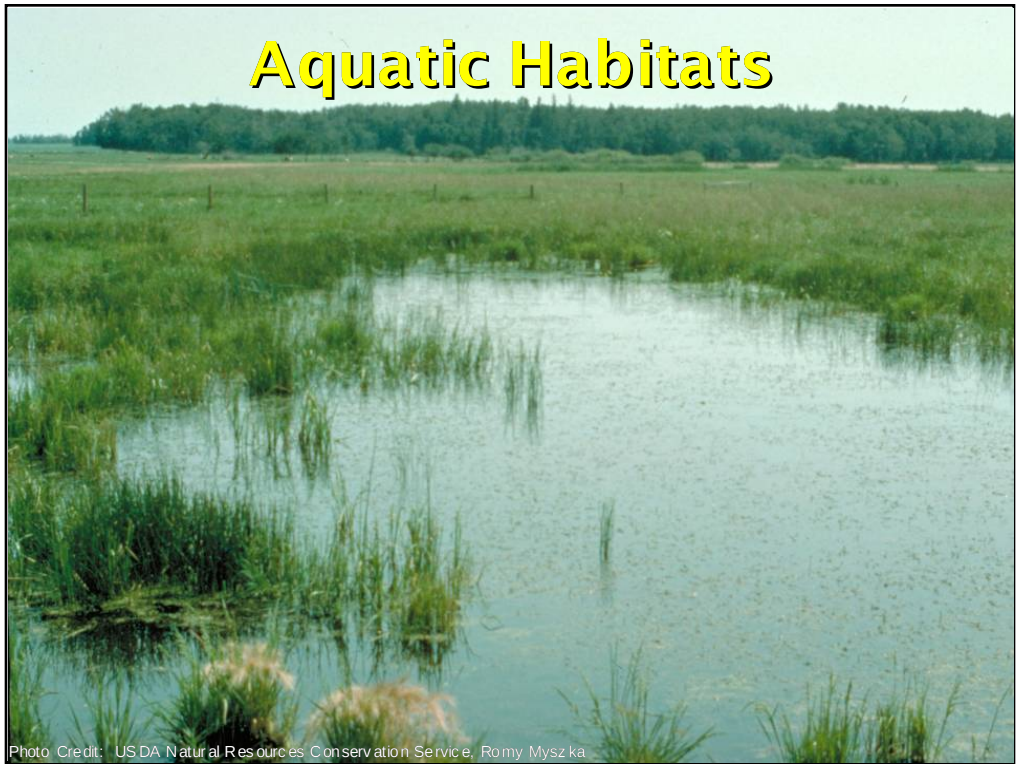
•Increasingly, human development such as shoreline condominium development damages the connectedness and quality of the dune system.

•In spite of the problems, there are many positive sand dune management actions taking place across the basin.

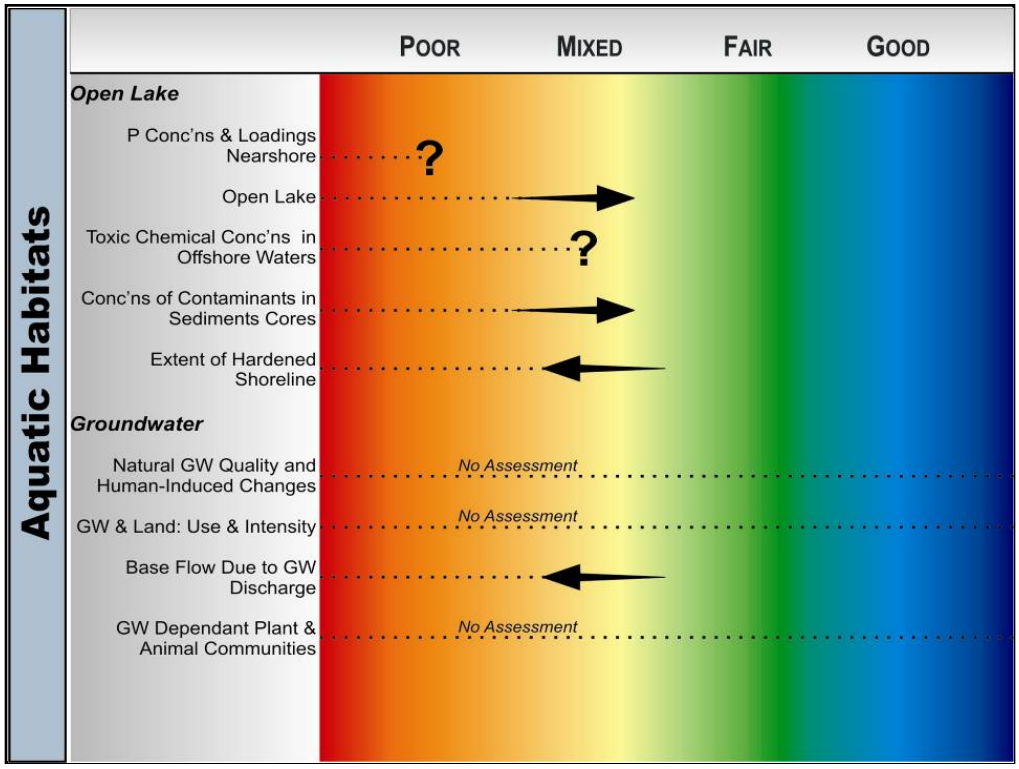
•For example, a 17 mile stretch of eastern Lake Ontario in the US has been actively managed for over 30 years.

•Today, biological diversity interests are driving many dune activities.

•The work of the Lake Ontario Dunes Coalition, the Michigan Dunes Alliance, and the Indiana Save the Dunes Council are making progress protecting and restoring critical dune habitats.



Just as Great Lakes coastal zones are unique and diverse, so too are aquatic habitats.



•The overall status of aquatic habitats is mixed or not assessed and the trend is uncertain and variable based on the indicators in this category.

•Now let's look at the findings of the indicators in the aquatic habitat category for the open lake and in particular, phosphorus concentrations and loadings.

Phosphorus Concentrations and Loadings

•We will be hearing from Murray Charlton about nearshore aquatic areas later in the conference. And while this indicator is unable to be assessed there is lot we have learned about phosphorus in recent years.

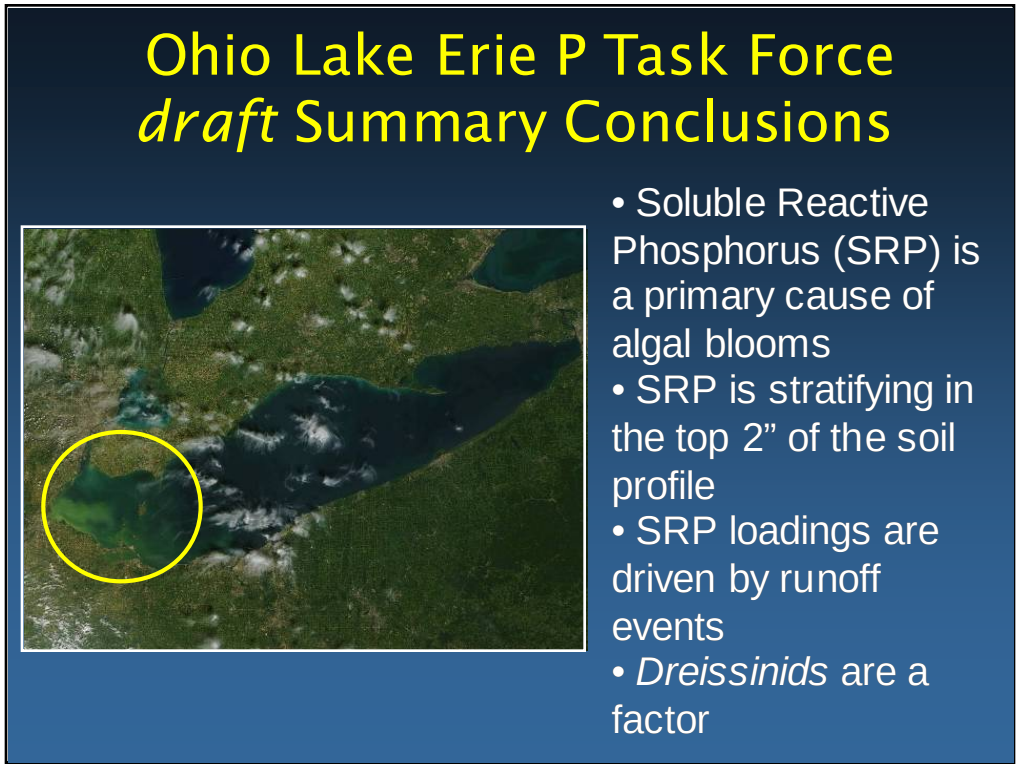
•This photo looks like it could be taken from a slide under a microscope but it is actually an aerial photo taken in Maumee Bay in the western basin of Lake Erie last month. Note the boat wake in the upper center portion of the photograph.

•What we are looking at is a massive bloom of *microcystis* growth.

•To address increasing trends of nuisance algae growth in Lake Erie, the State of Ohio convened a task force of scientists and program administrators.

•The Task Force is charged with analyzing these trends of nuisance algae along with corresponding trends of increases in loadings of soluble reactive phosphorus into Lake Erie. Interestingly, both of these trends began about the mid 1990's.

•So what have we found?



•The Task Force has not completed our work yet, but we do have some preliminary findings we can share with you today.

•A key conclusion to date is that while loadings of total phosphorus have deceased, SRP has increased.

•We have been analyzing what has changed on the landscape so that we can assess where it might be coming from and (attempt) to determine the relative contributions from the different sources.

•After evaluating a variety of point and non-point source contributions, we believe phosphorus is stratifying in the top 2" in the soil in agricultural fields, making it much more susceptible to runoff.

•And from looking at the loading data, we can conclude that phosphorus loadings are driven by storm events.

•And we know that *Dreissinids* contribute to the internal load and recycling of phosphorus by filtering the total phosphorus attached to sediment and excreting soluble phosphorus.

Ohio Lake Erie P Task Force *draft* Recommendations

- Manage P inputs
  - Land application of fertilizer
  - Land application of manure
- Amount, timing and incorporation are critical factors
- Management options include:
  - Increase use of soil tests
  - Update screening tools that account for agronomic need and environmental risk
  - Align with application recommendations

•Here is a preliminary look at a few of our recommendations to date.

•We know that we need to better manage the phosphorus inputs we are putting onto our agricultural fields. This includes both fertilizer and manure applications.

•The issue is not just how much we put on, but when we do it. Fall and winter applications can have severe consequences when it sits on frozen ground and flushes off with snow melt and storm events.

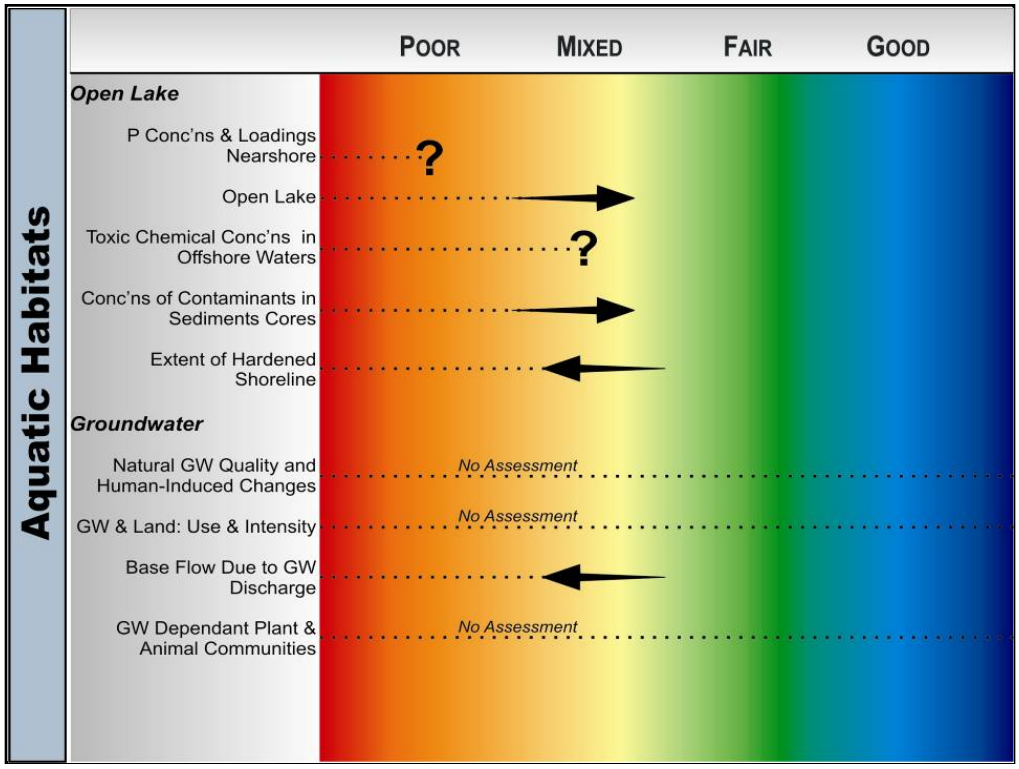
•Incorporating those applications into the soil profile is also critical to avoid phosphorus runoff.

•So how do we propose to manage these inputs?

•We know that we need to substantially increase and standardize the use of soil test to determine **if** and how much phosphorus a field actually needs to maintain crop yields.

•There are screening tools for use in the field—these need to be updated to better quantify the environmental risks of P inputs. Soil tests and screening tools need to become the primary drivers for application recommendations for agricultural producers.

•The Task Force has a number of other recommendations but we believe these will be key to "turning down the tap" of phosphorus inputs into Lake Erie. We expect to wrap up our work by the end of the year.

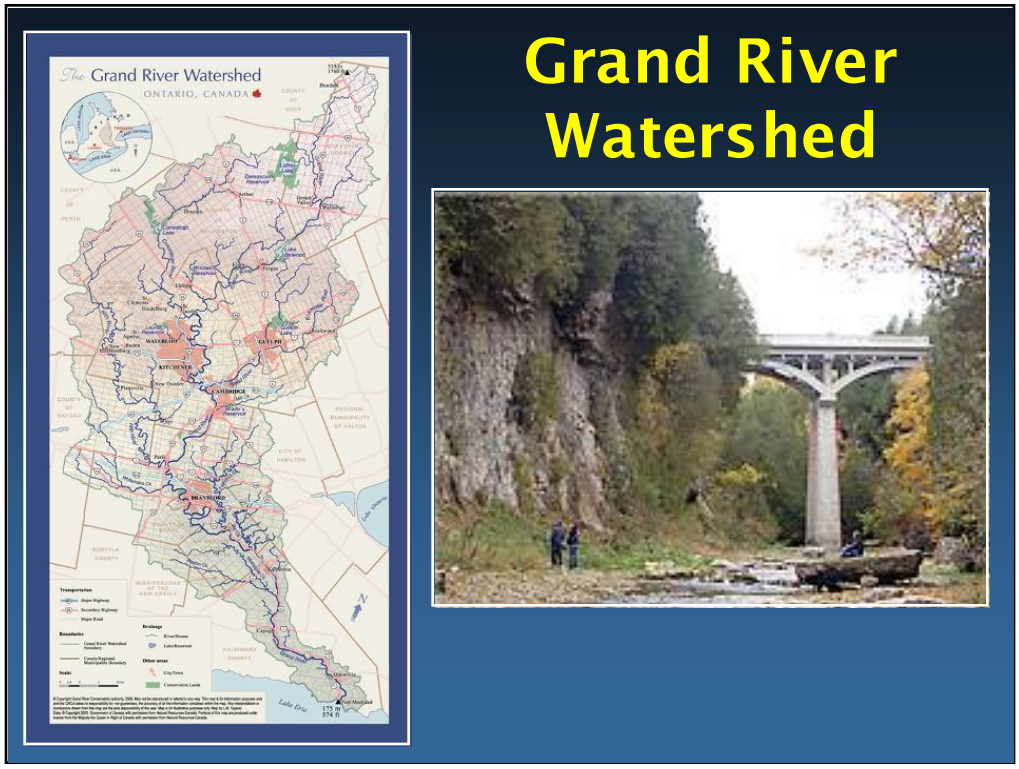


•There has not been a thorough assessment of the groundwater indicators.

•Of the four, we were only able to assess for base flow.

•This indicator shows a status of mixed and a deteriorating trend.

•But there is important work going on in the Grand River watershed that illustrates the potential for development of groundwater indicators.



•We do know that land use intensity has the potential to affect both groundwater quality and quantity, as well as streams and creeks which depend on groundwater for base flows to sustain aquatic plant and animal communities.

•The Grand River watershed of Ontario was used as a case study for analyzing ground water and land use in the Great Lakes basin. What they learned is…

•Intensive cropping practices and urban development are contributing to the degradation of sensitive landscapes that facilitate groundwater recharge. This is a significant threat to the watershed's groundwater resources.

•Another major stress that is impacting groundwater supplies is an increase in imperious surfaces.

•This will reduce the amount of water that can infiltrate into the ground and also ultimately reduces groundwater discharge into surface water bodies.

•In the future, global climate change may moderate the effect groundwater provides to aquatic stream habitat.

Coastal Zones
Management Challenges

- Water levels—learn the lessons and apply basinwide
- Protect and restore wetlands and associated uplands, islands, alvars, cobble beaches, sand dunes
- Support and implement new wetland monitoring protocols
- Develop remote sensing technologies
- Project by project and landscape level

Let's take stock of where we are.

The management challenges of the coastal zones category of indicators are:

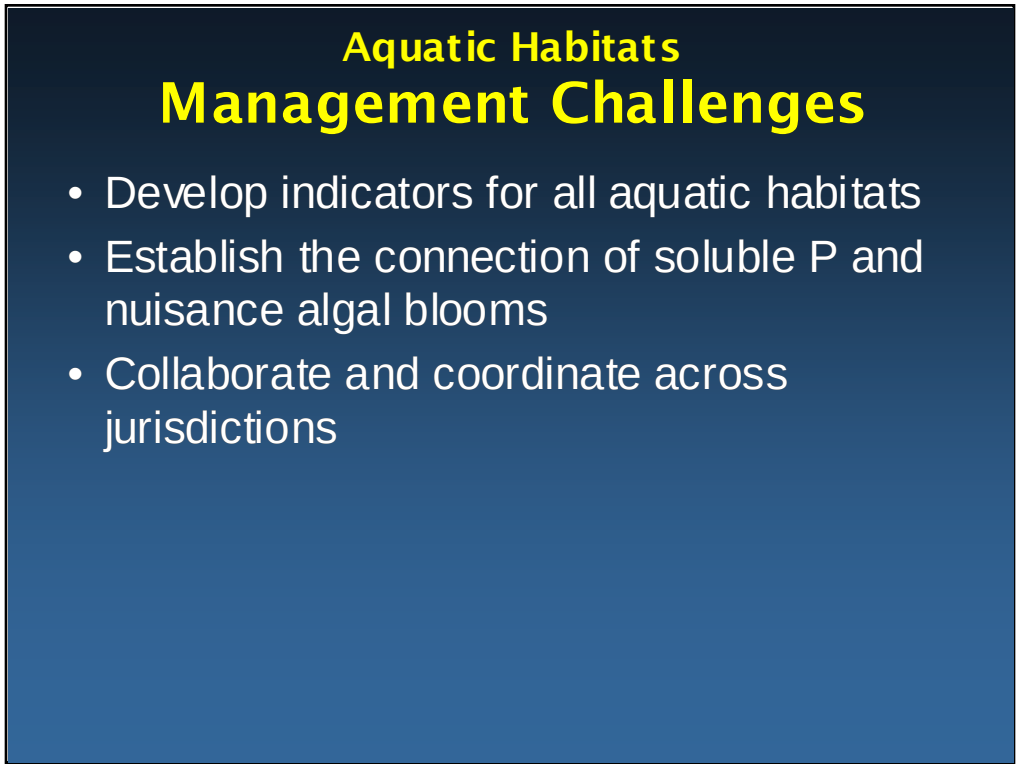
•We need to learn from the studies on water levels currently underway and apply those lessons to other parts of the basin. It is critical we monitor the impacts of changing lake levels to the nearshore areas.

•Because of the vulnerable areas in the Great Lakes, including islands, alvars, cobble beaches, sand dunes, and wetland habitats, we need to make a concerted effort to monitor trends and prioritize our strategies for protection and restoration.

•We need to support and implement the new monitoring protocols for coastal wetlands, and not just to understand status and trends but to identify our priorities for protection and restoration.

•We are aware we may need new tools to assist with these efforts. Development of improved, accessible, and affordable remote sensing technologies will aid in implementation.

•Restoration tends to happen on a project by project basis, but we also need to think at the landscape level to ensure holistic ecosystem restoration.



The management challenges pertaining to aquatic habitats are:

•While we have indicators for some aquatic habitats, we don't have indicators for groundwater or rivers or inland lakes or inland wetlands. This is crucial for us to understand what actions are needed to protect surface and groundwater resources.

•We need to understand the role of soluble phosphorus and the relationship to nuisance algal blooms.

•We need to reach across jurisdictions to collaborate on what we know about soluble phosphorus and coordinate our strategies. While I earlier described what we're finding in Ohio, we acknowledge different strategies may be called for in different parts of the basin.

•Protecting groundwater requires multifaceted strategies including regulation, land use planning, water resources management, voluntary adoption of best management practices, and public education.

•It's always nice to end with a picture of the resource we're trying to protect. This is the rugged coastline of Isle Royale in Lake Superior.

•In summary, indicators in the coastal zones have shown a mixed status and most of the indicators have an undetermined or deteriorating trend in condition and the status of aquatic habitats is mixed and the trend is deteriorating or undetermined.

•For this collection of indicators, we have a lot to learn in terms of the status of the ecosystem.

•We are on our way though, with the new protocols for monitoring coastal wetlands and we have further to go with groundwater indicators.

•But I am hopeful that for SOLEC 2010, we will have new data and new approaches towards managing towards managing the greatness of the Great Lakes.

•Thank you for all of your work in protecting and restoring these beautiful places.