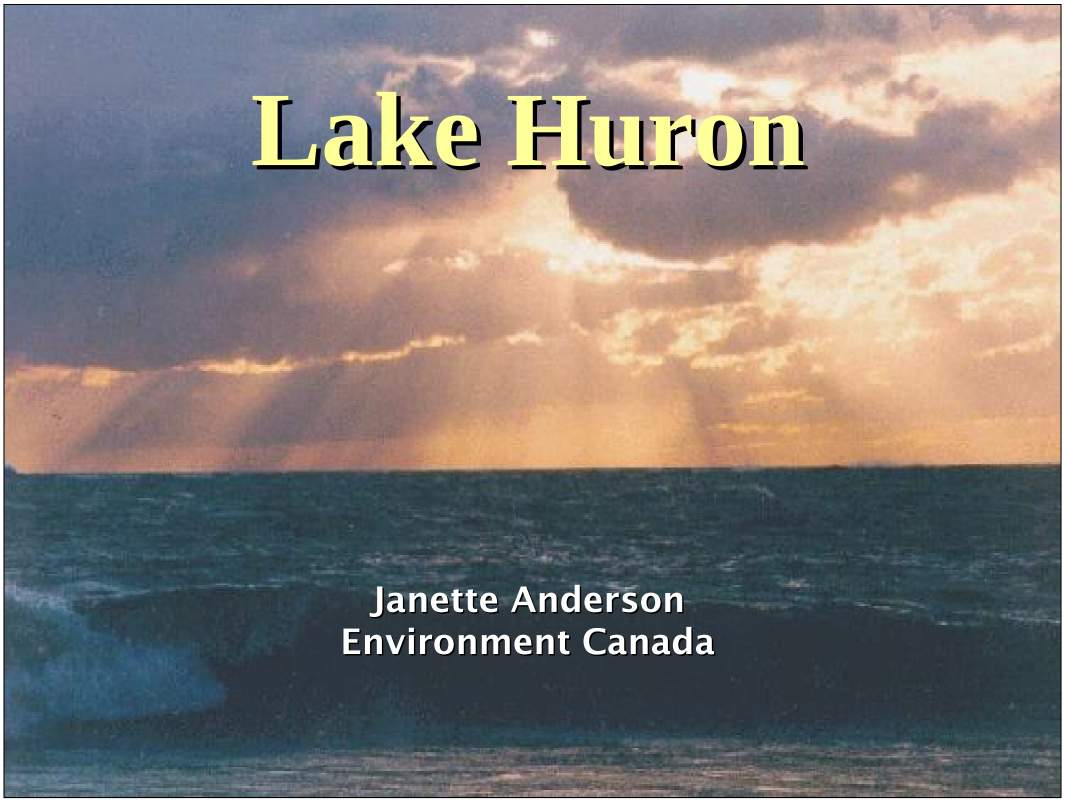



The scheduled presenter, Jeff Schaeffer, could not give this presentation because he is carrying out a trawl survey on Lake Huron.

•On behalf of the US EPA’s Great Lakes National Program Office, Environment Canada, and the State of Michigan, I will be providing our overview of the physical integrity of Lake Huron. The physical integrity of Lake Huron is mixed: although progress has been made in several areas, but there are emerging issues that I will discuss in today’s presentation.

# Basins of Lake Huron

- Total area = 58,000 km$^2$
  - Main: 67%
  - Georgian Bay: 24%
  - North Channel: 4%
  - Saginaw Bay: 5%


•During the talk I will be referring to specific areas of Lake Huron.

•The main basin is shared by U.S. and Canada, and dominates the surface area of the lake.

•The north channel and Georgian Bay lie wholly within Canadian waters.

•Michigan’s Saginaw Bay represents only about 5 percent of the total surface area of the lake, but has produced on average 50 % of the Lake’s annual commercial fish harvest.

# Threats to Physical Integrity
## Main Great Lakes indicators

- Habitat loss
  - *Coastal wetlands*
  - Shoreline alteration
    - Cottage and home development
    - Extent of hardened shoreline
- Habitat degradation
  - *Sedimentation*
- Habitat fragmentation
  - *Dams*

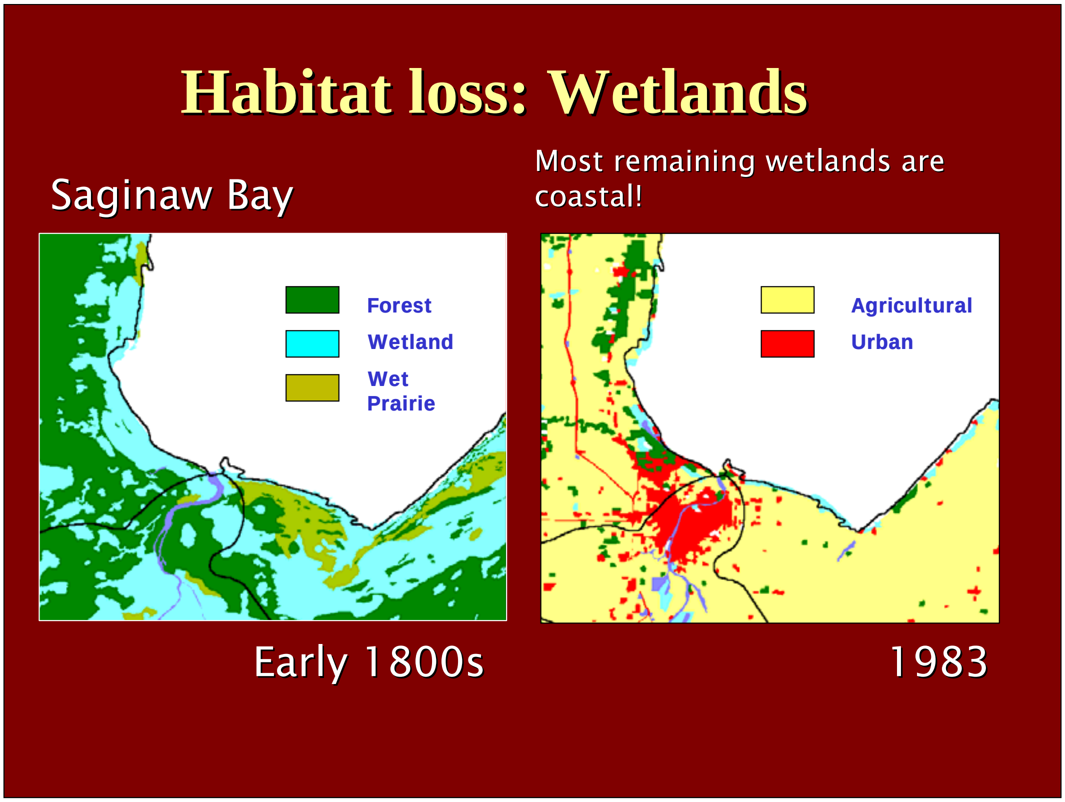
•The major threats to physical integrity of Lake Huron are Habitat loss, habitat degradation, and habitat fragmentation.

•Habitat loss has occurred through loss of coastal wetland, and shoreline alteration via development.

•Habitat degradation has occurred primarily through sedimentation of coastal wetlands and bays.

•Habitat fragmentation resulted from dam construction in tributaries.

•I have highlighted coastal wetland loss, sedimentation, and dams, because these areas will be the focus of my talk.

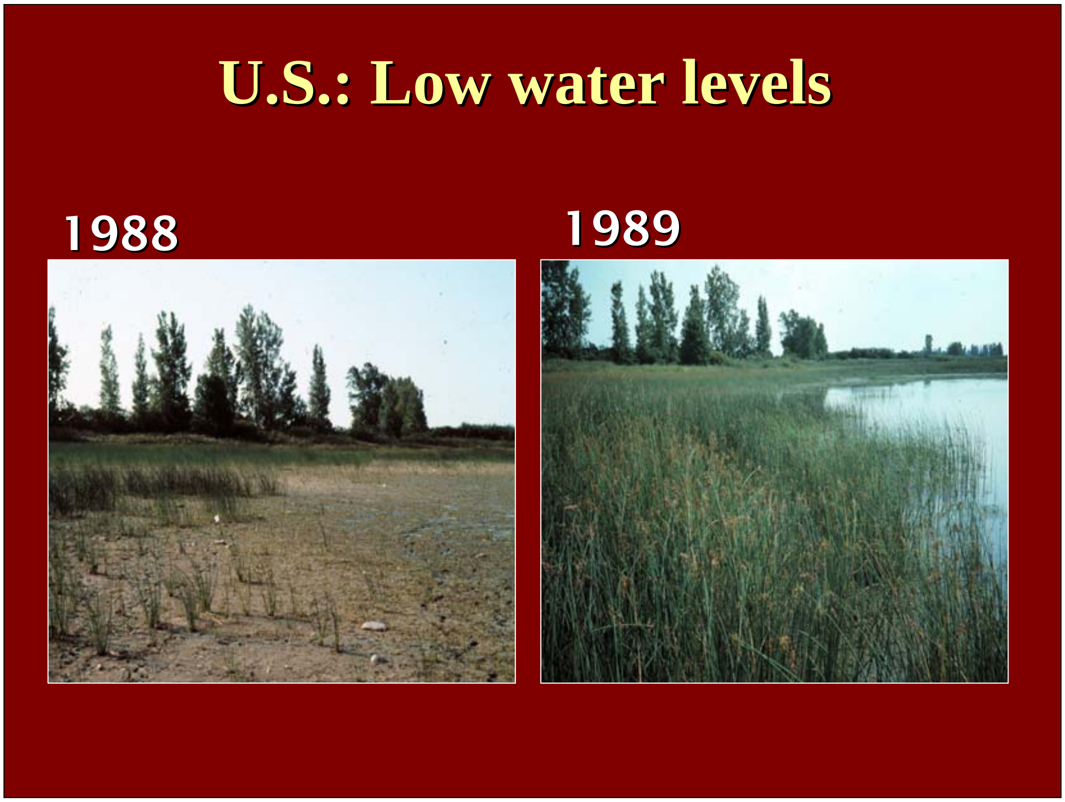



Land use around the lake has changed.

For example, in the 1800s, this area of Saginaw Bay was dominated by two types of wetlands, and forests. Today these habitats have been replaced by urban and agricultural lands.

**(animation)**

Most of the remaining wetlands are coastal- they have received heightened attention because they represent the only large tracts of wetland habitat that still exist, in fact – still the largest freshwater coastal wetland habitat in the United States

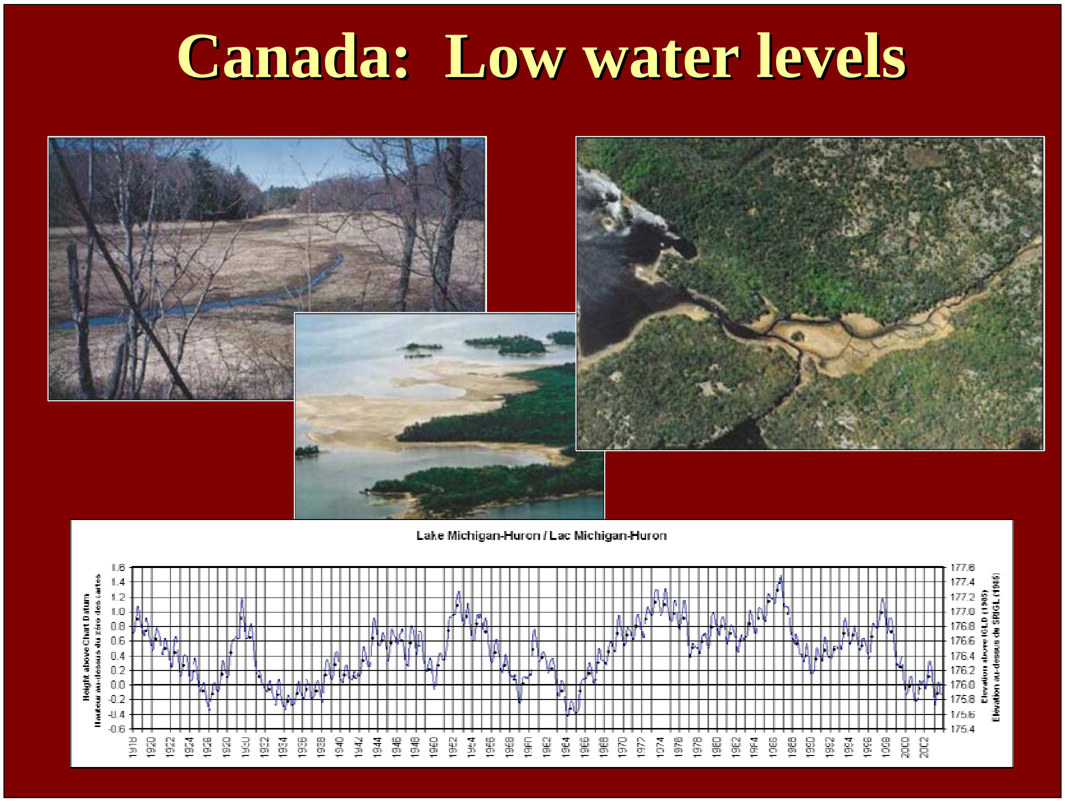



Lake Huron has experienced historic water level fluctuation, and recent levels are the lowest in over 30 years.

Low water levels exposed beaches and mudflats that were colonized quickly by native wetland plants. This has enhanced many coastal wetlands, which are the primary remaining wetland habitats in many areas.

This has caused controversy because lakeside property owners have sought to clear vegetation to re-establish beaches, and regulatory agencies have attempted to protect these areas from clearing.

Although several compromises have been proposed, the issue has not been resolved.



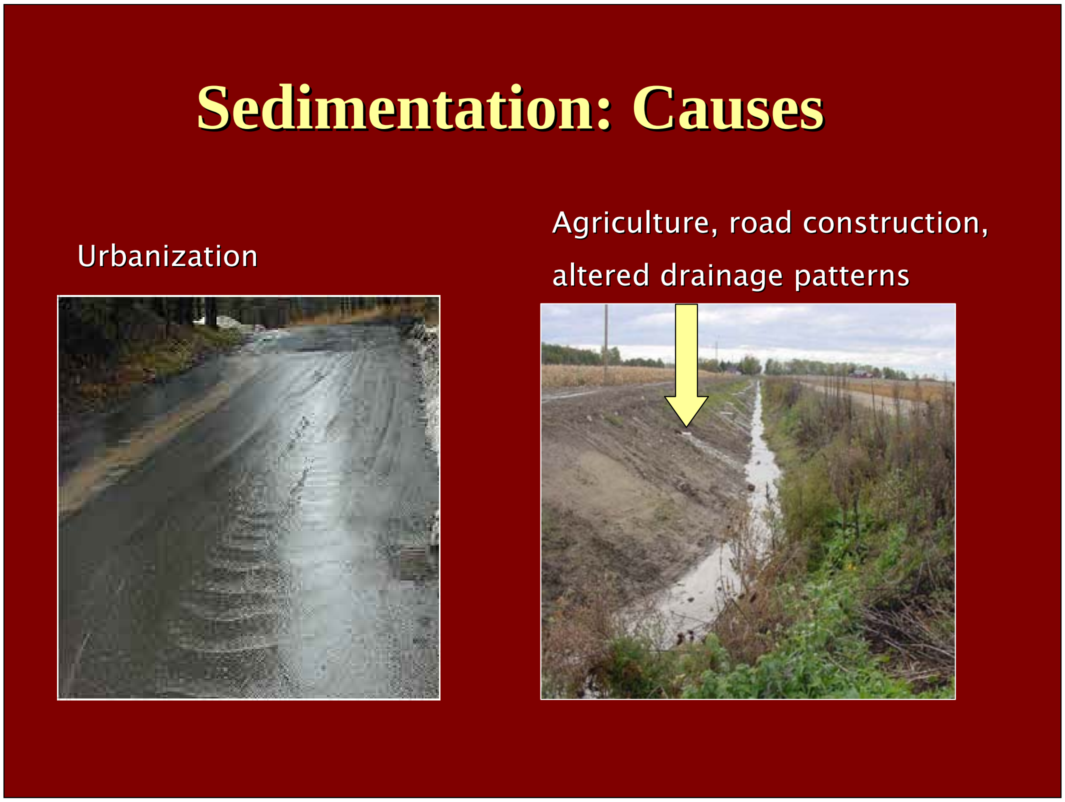

In Canada, many wetlands extend inland from the coast. Low lake levels have caused these wetlands to dry, which in turn prevents fish access.

On the western side of the Bruce Peninsula, a gently sloping shore has resulted in the water receding up to 1 kilometre. Many landowners are looking to blast bedrock to develop boat slips closer to their property.

Navigation in Georgian Bay has become an issue where low water has resulted in dangerous shoals being exposed that, in recent memory, were well below the water surface and not a concern.

In some cases, lower water has resulted in a lack of water exchange in bays and harbours, stagnation and degraded water quality. This can have a detrimental effect on people using these areas as a drinking water source.

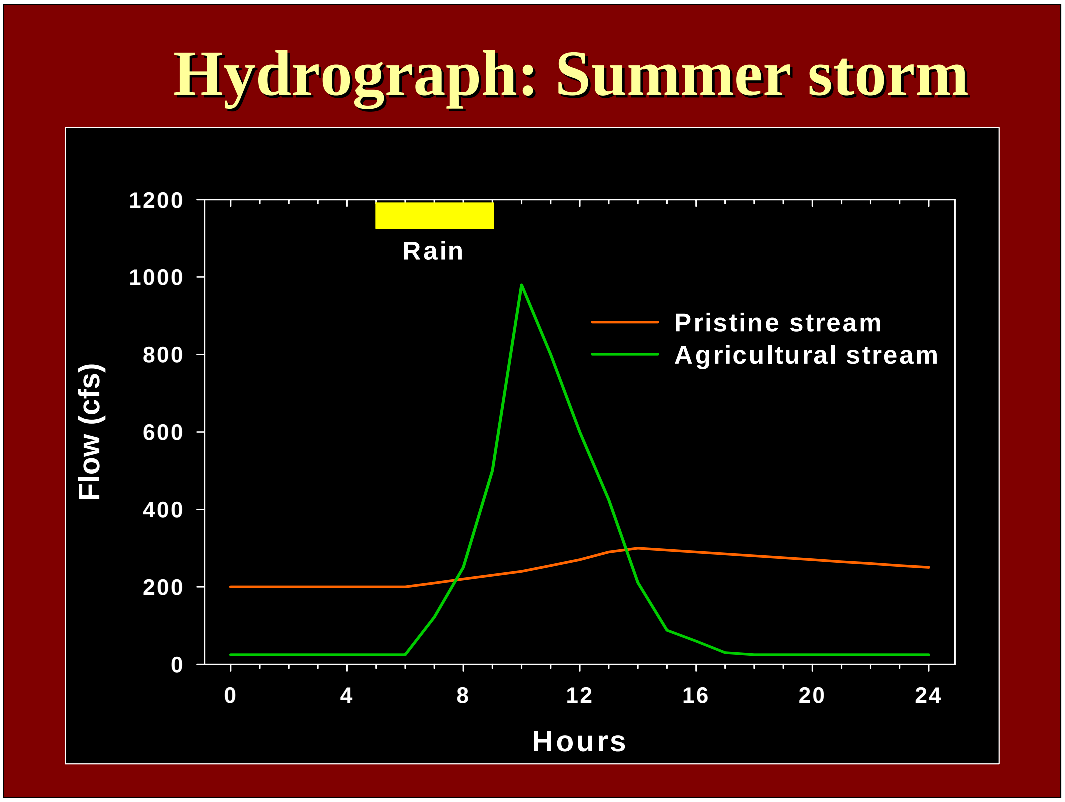
Lake levels on Lake Huron vary seasonally, annually and over longer time periods. Some alterations such as historical dredging at the ouflow of the lake have permanently lowered lake levels and is a major concern amongst many stakeholders. Some climate change model scenarios suggest that further permanent reductions are possible for the future.




A serious threat to the physical integrity of Lake Huron is sedimentation.

Sedimentation occurs when urbanization or other activities remove vegetation from the landscape, allowing water to flow freely across the surface.

Impermeable surfaces such as roads increase surface flows, and many agricultural fields have drain tiles to remove water quickly and divert it to drains or streams. The image on the right shows drain tiles (click) projecting from the slope, and each one is discharging a stream of water down the bank.

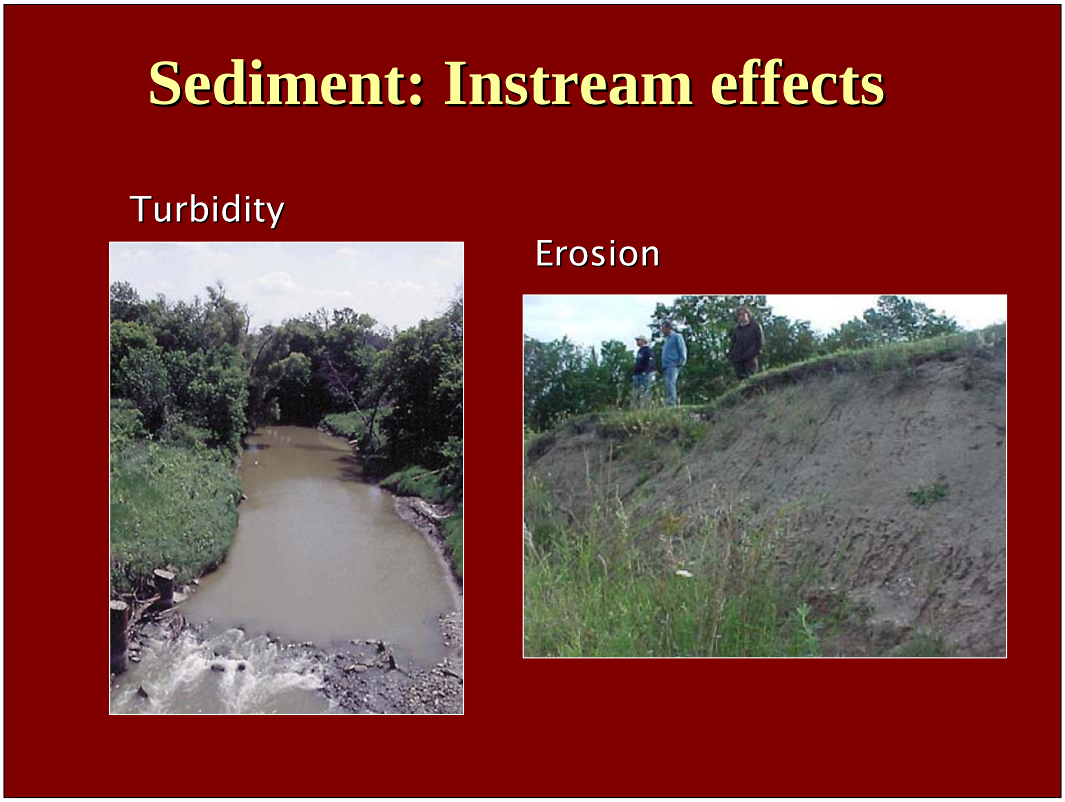



This image shows the short term effects of a summer thunderstorm on two streams. The graph covers 24 hours, midnight to midnight, with heavy storm occurring between 5 and 9 am.

The pristine stream shown in orange has a watershed that is completely vegetated. Water is held on the land, and moves into the stream slowly. Flows increase slowly, with no peaks.

The agricultural stream shown in green exhibits a rapid response to the storm. Water moves into the stream quickly and results in a sharp peak in flow. High flows carry sediment, and can erode unstable stream banks.

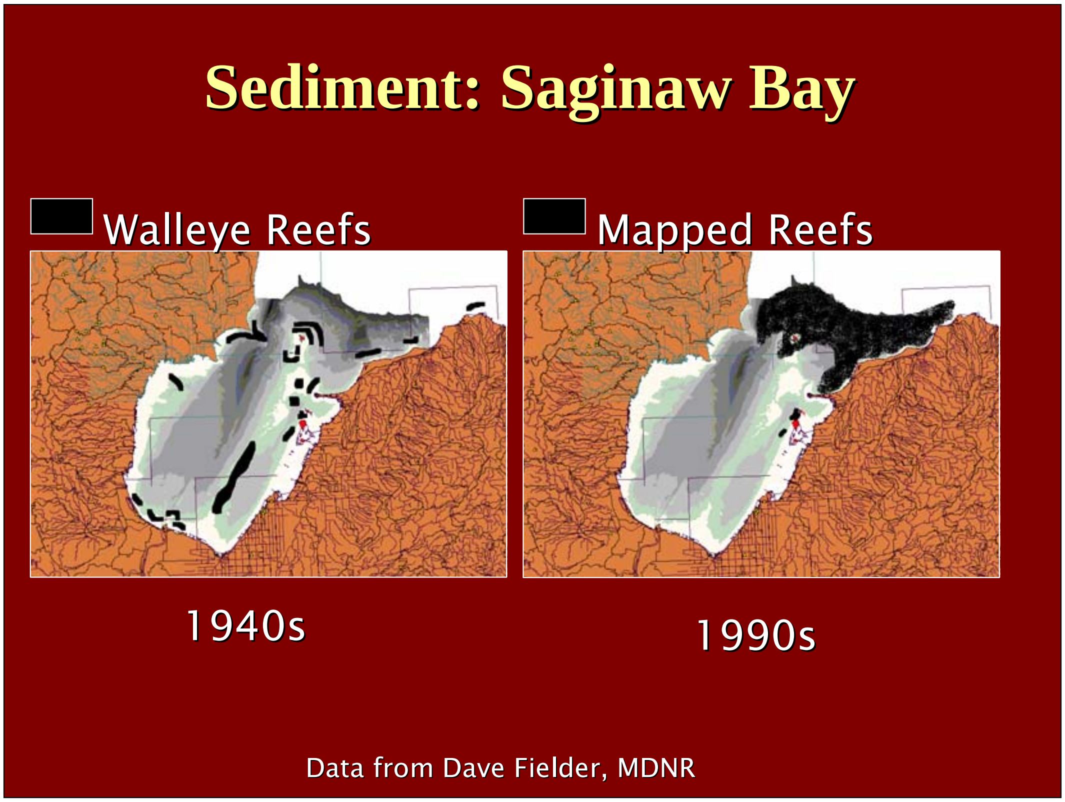
The pristine stream has a base flow that is much higher than agricultural stream. This is a characteristic of streams with vegetated watersheds, and contributes to higher diversity in undisturbed watersheds.




The effects of sedimentation are well known.

The image on the left shows a stream that has high turbidity from suspended sediment that was washed off the land's surface.

The image on the right shows a bank that was eroded. A large amount of sediment was deposited in the stream below.




Sedimentation has been severe enough to affect walleye spawning reefs in Saginaw Bay.

The map on the left shows historic spawning reefs identified by commercial anglers during the 1940's when these areas were fished.

On the right is a more recent map of the Bay. It looks as if reefs appeared in the outer bay, but this is not the case. Those reefs were there, but most were not fished so they did not appear on the original map.

What is important is the change within the inner bay. The reefs there are now buried under a layer of sediment, and support only low numbers of spawning walleyes.

# Sediment remediation: Chippewa River

- 11 kilometers of fencing
- 10 hectares filter strips
- 7 hectares of seeding
- 4 kilometers of bank stabilization

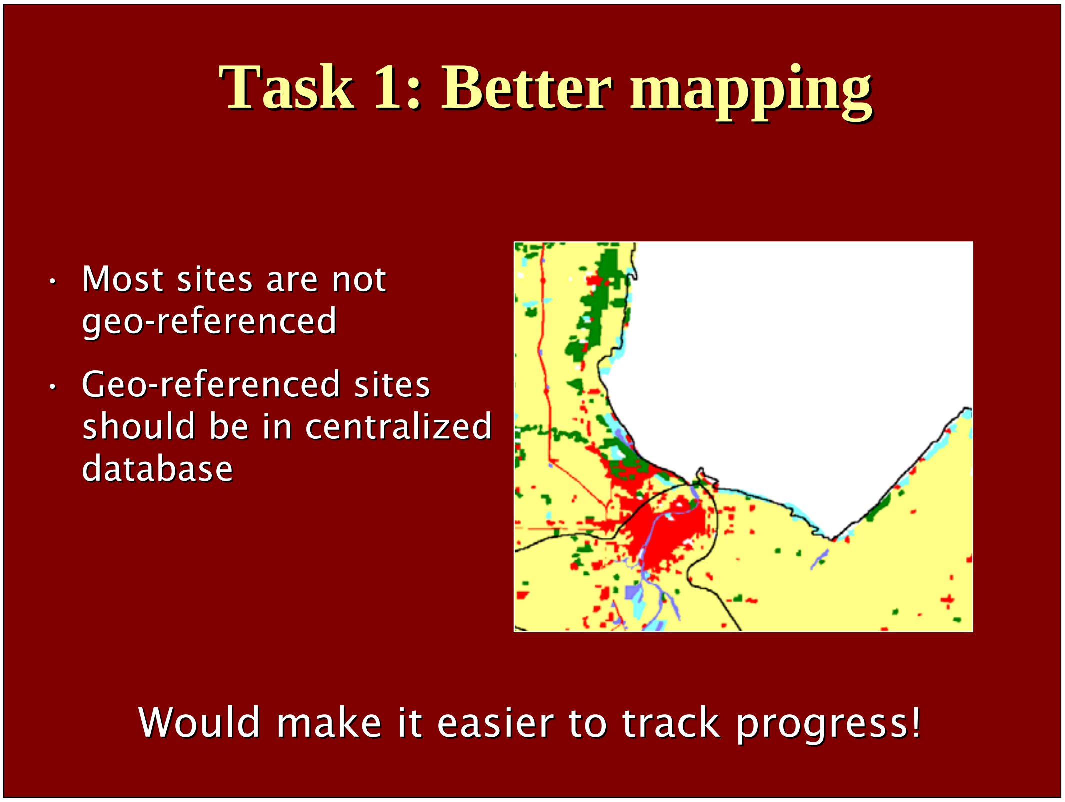
Prevented over *12,000 tons* of sediment from entering the stream

One project is on the Chippewa River in the Saginaw Basin. Through a variety of actions on this river alone 12,000 tons of sediment were prevented from entering the river.


Substantial progress has been made to reduce the amount of sediment flowing into many streams in the Lake Huron basin.

Once the stream bank is protected, habitat quality begins to improve immediately as vegetation becomes re-established.  This happens naturally, but the process can be enhanced by planting.

However, there are two tasks that would make the process more efficient.




The first is that we need better mapping.

Most projects are not geo-referenced, so we can't place them accurately on computer generated maps.

This information is important, and centralized databases should be developed that would make information available to both agencies and stakeholders. It would make it easier to monitor progress and would guide future efforts.

**(click)**

This problem exists because most stream restorations are carried out locally with many cooperators, and usually, no single agency is responsible for an entire project.


The second task is that we need some way of measuring our effectiveness.

The stream on the left represents an ideal condition: the entire stream is protected by vegetation.

The stream on the right represents reality: not all landowners participate in stream protection, and most streams have a patchwork of protected and unprotected areas. There is no such thing as a bad buffer strip: all of them help reduce sedimentation. But we need to know what percentage of stream banks must be protected before we see improvement in habitat quality within the stream itself. Another way to ask the question is: how much of the stream bank must we protect before we see sensitive species such as brook trout or silver shiners?

This is a research question, but the answer would help us make decisions about where to allocate limited funds.

(**animation now**)

And although progress is being made, we can not forget that conditions in some watersheds are getting worse.  One cause of this is urban development.

## Physical Integrity: Dams

- Block fish migration
- Impound high gradient habitat
  - Channel modification
  - Loss of large woody material
  - Loss of natural sediment transport
  - Alter nutrient transport
    - Delta wetlands
  - Connectedness

To improve the physical integrity we have to talk about dams on tributary streams.

Dams threaten physical integrity because they block fish migration and impound high gradient habitat. These are highlighted because I will talk about them in detail, but dams have additional effects that are also important.

They modify stream channels, they prevent transport of woody material, and the reservoirs behind dams serve as sediment and nutrient sinks. This has caused loss of delta wetlands that were present at many river mouths.

Overall, dams break important physical and biological connections that linked inland terrestrial habitats to the lake.


•Michigan’s Ausable River is an example of the effects of dams on fish migration.

•Before dam construction, native fishes had access to over 200 km of stream habitat. This estimate is conservative because it does not include tributaries and headwaters. This habitat was used by a variety of native species for spawning.

•At present, fish have access to only about 20 km of the river; this represents, at minimum, a 90 % reduction in the amount of available riverine habitat within this river system.

# Loss of high gradient habitat

Ausable River, MI circa 1910

Alcona Dam: 1920s

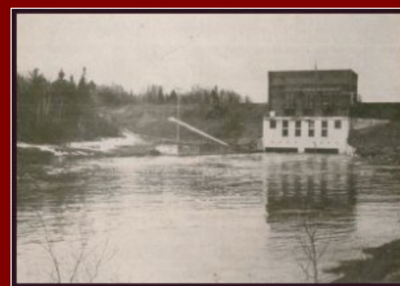


Photo Courtesy of Troy Zorn
Michigan Dept. of Natural Resources

•Dams have caused loss of high gradient habitat. Gradient is a measure of how fast a river drops in elevation- it is usually measured in feet per mile, or meters per kilometer. At high gradients, we see whitewater.

•The image on the left was taken on Michigan's Ausable River about 1910, and shows high gradient habitat. Dams were nearly always constructed at the downstream end of a high gradient area, because this maximized the height between the top of the dam and the and the stream below. It was this height that provided the mechanical force needed for power.

•The image on the right is an early photo of Alcona dam. The whitewater habitat would have been just upstream. Because of the large number of dams on the Ausable River, high gradient habitat is no longer present within the system.

# Lake sturgeon

- Largest native fish: highly valued
- Spawned in high gradient streams
- Listed as endangered or threatened by five Great Lakes states
- Lake sturgeon objective:
  - To increase the species' abundance to the extent that it no longer has threatened status in U.S. waters


One species affected by dams was the lake sturgeon. This was our largest native species, and they spawned in high gradient habitats in tributary streams.

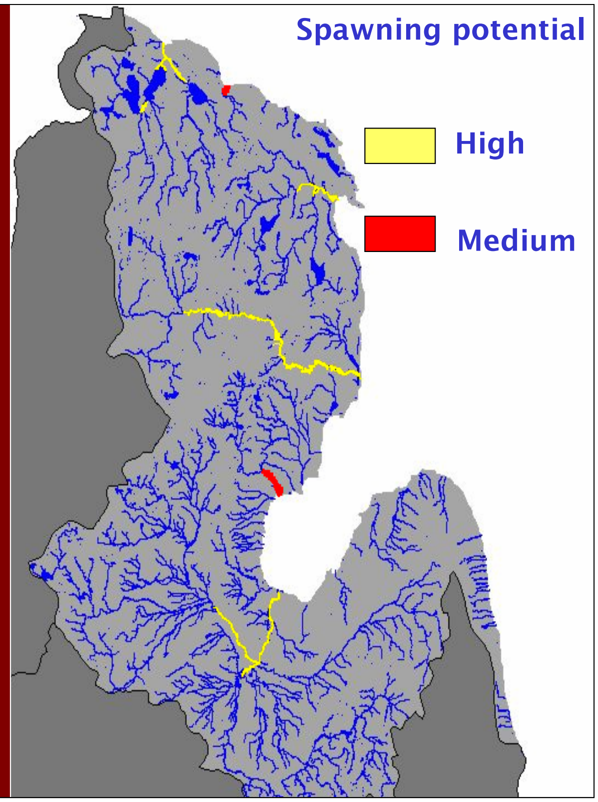
Lake sturgeon are highly valued commercially.  They are listed as threatened or endangered by five Great Lakes states but are not listed as threatened in Canadian waters. The population is not large, but supports a small fishery. The Canadian waters of Lake Huron have several relatively intact tributaries that support spawning

This is a case where a Great Lakes objective developed through the SOLEC process would help us meet fish community objectives for Lake Huron. The Lake sturgeon objective is to increase the species abundance to the extent that it no longer has threatened status in U.S. waters.

# Lake sturgeon

1. Identify potential spawning sites
2. Restore high gradient habitat
3. Provide fish passage

Two issues are unresolved …




To provide spawning habitat for lake sturgeon, we need to do three things.

First, we need to identify potential spawning habitats. This has largely been accomplished through the Lake Huron GIS project. The image shows areas of high and medium quality that would support lake sturgeon spawning.

Second, we need to restore high gradient habitat. In some rivers, this will require dam removal, because there are systems where all high gradient habitat has been impounded by dams.

Third, we need to provide fish passage around any dams that lie between the lake and restored high gradient habitats.

There are two issues that we need to resolve.

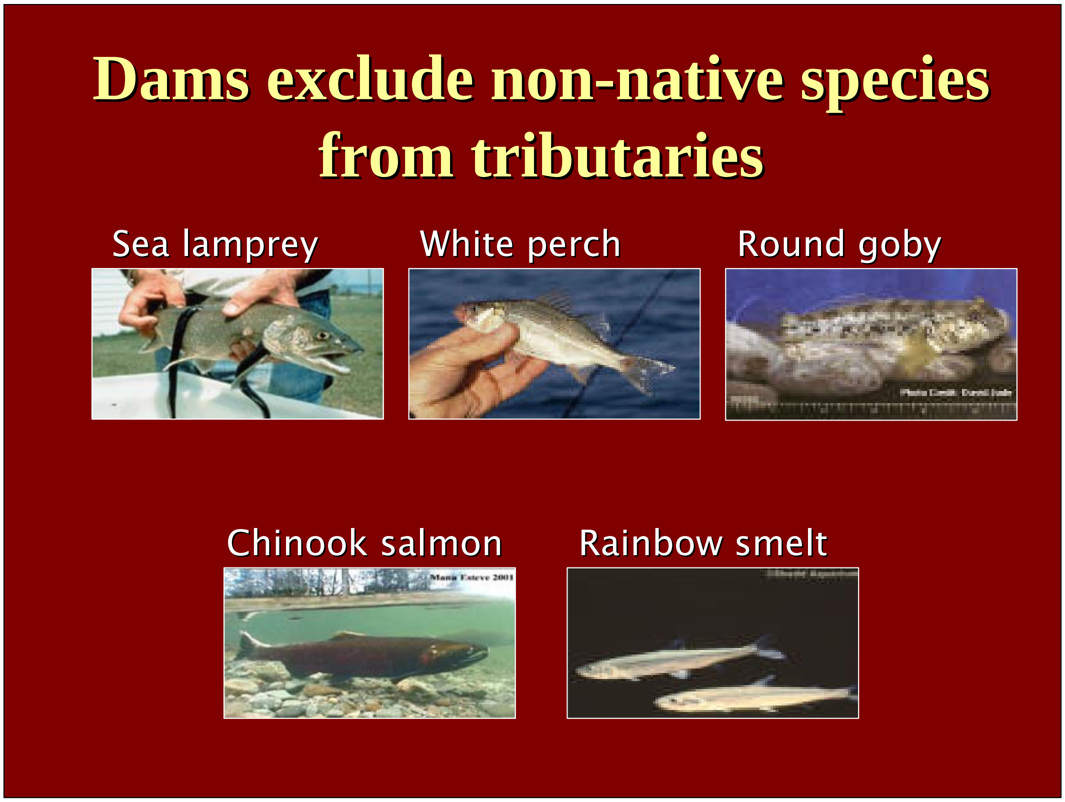
## Some dams have ongoing concerns

- Electric power generation
- Water supply
- Recreation
- Flood control

- Dams in poor condition

The first concern is that many dams provide societal benefits. They are used to generate electric power, they provide water supplies for cities, and they provide recreation and flood control. So in addition to the direct cost of removing a dam, there may be social costs as well.

One solution to this problem would be to identify dams that are no longer useful, and especially those dams that may be in poor condition. In those cases, it may be less expensive to remove them rather than repair them, and the habitat would benefit.

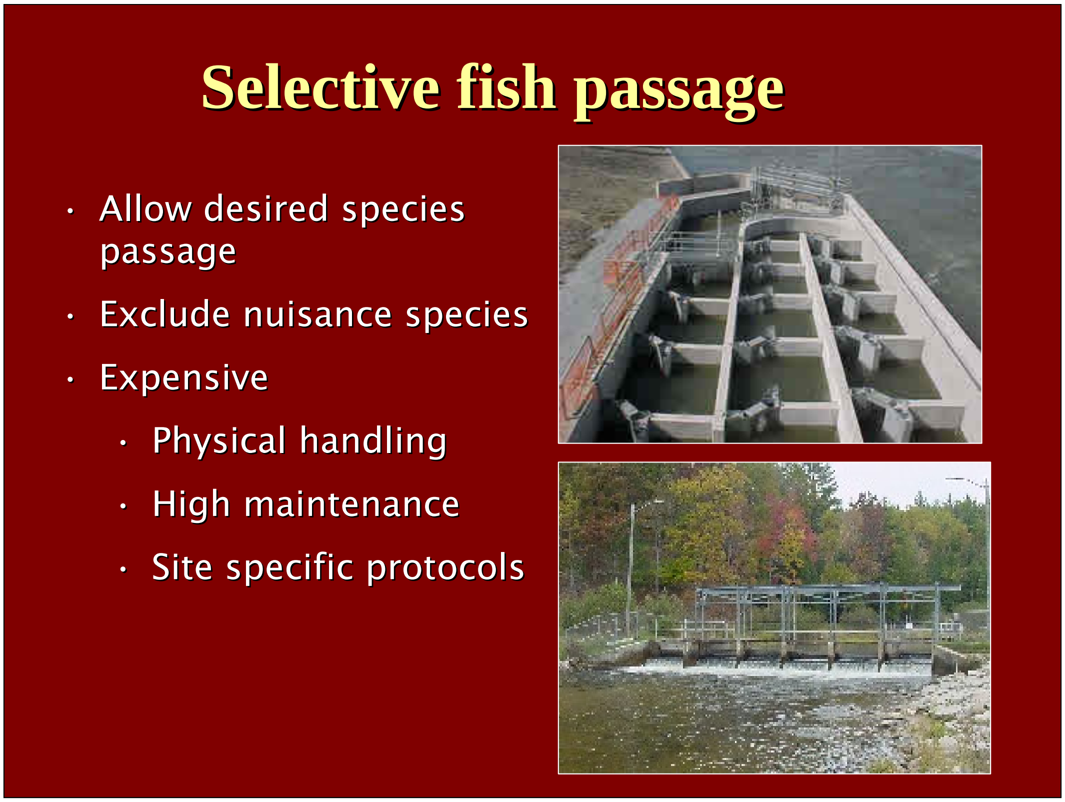



The second issue is that dams prevent invasive species from spawning in rivers. There are at least five non-native species that are rarely present in rivers, but would undoubtedly use restored habitats. I want to talk about two species in particular: sea lamprey and chinook salmon.

Sea lampreys are an invasive species that have been controlled successfully using a variety of methods. Opening tributary steams for sea lamprey would increase control costs, especially for chemical treatment of larval lampreys.

Chinook salmon are a popular game species in the open lake, but they are controversial in rivers. Some anglers would support allowing chinook greater access to tributaries, primarily because it would increase fishing opportunities. However, anglers that target native brook trout often object to chinook salmon, and there is some evidence that the two species can not co-exist. Many landowners do not want chinook salmon because of angler trespass and the fact that chinook die after spawning and their carcasses decompose along the river bank.

These types of problems require us to consider the issue of selective fish passage.



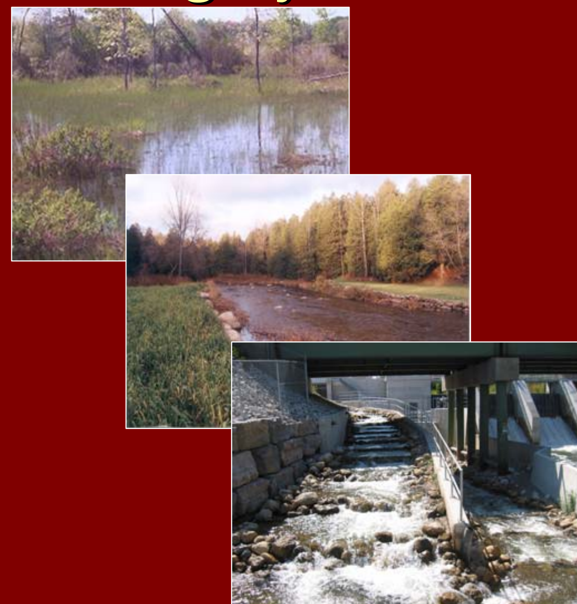

Selective fish passage is a process by which selected species would be allowed to pass over a dam, but non-desirable species would be excluded.

In nearly all cases, migrating fish would be diverted into a holding area, and desired species would be transferred above the dam. Non-native species would be returned to the stream, or removed.

Selective fish passage is expensive because in most cases it requires physical handling of fish. The structures are expensive to build and maintain. And undoubtedly, we would need site-specific protocols to determine which species should be given access. These are complex issues, but they must be discussed if we want to restore tributary habitats.

# Actions needed to maintain Physical Integrity

- Identify important coastal wetlands
- Stream bank protection/ rehabilitation
- Provide fish passage to high quality areas



To summarize this morning’s discussion, the major threats to physical integrity of Lake Huron are habitat loss, habitat degradation and habitat fragmentation.

Coastal wetland loss, sedimentation and barriers to fish passage were highlighted in this talk although shoreline alteration through cottage and home development and shoreline hardening are very much a threat as well.

Through the Lake Huron Binational Partnership, working together with the Great Lakes Fishery Commission, work is underway to identify important coastal wetland habitats.

Numerous streambank protection and rehabilitation projects are underway on both sides of the border to reduce erosion and sediment loads through multi-partner coordinated projects and through individual efforts.

The binational GIS project has assisted greatly in identifying and mapping out high priority areas to restore access for fish.

# Lake Huron Binational Partnership

USEPA
EC
MDEQ
MOE
MDNR
OMNR
USGS
NOAA
DFO
CORA
OMAF
USFWS

Through agency programs, local initiatives, partnerships and dedicated individuals, there have been many actions to restore and protect Lake Huron. The Lake Huron Binational Partnership will help to coordinate and communicate, encourage and guide those efforts.

Thank you to our partners in the development of this presentation and for your attention. There will be a break out session on Thursday afternoon to focus on Lake Huron, its future and how best to collect the information necessary to monitor our collective efforts. Please join us.