Good morning.

I am reporting on four categories of Great Lakes indicators (Resource Use, Climate Change, Land Use/Land Cover and Human Health) and most of the indicators track trends in human resource use and waste generation. Overall, the pressures on Great Lakes resources are growing, primarily due to population growth in the basin, but also to some increasing rates in per capita resource use.
Just two weeks ago, the U.S. population topped the 300 million milestone and is expected to reach **400 million in about 37 years**. In the **Ontario Golden Horseshoe Area** alone, forecasts predict that portion of the Canadian population will grow by an additional **3.7 million people by 2031**.

Two PopClock websites provide **real-time estimates** of both country’s populations. The U.S. and Canadian populations posted on this slide represent estimates **as of 10 o’clock** this morning.

Given that roughly **10% of Americans and 30% of Canadians** live in GL Basin, the up to the hour GL Basin population is an estimated **39,812,870**.

Keep your eye on the counter.

Canadian PopClock  http://www.statcan.ca/english/edu/clock/population.htm
According to the U.S. Census Bureau, one person is added to the U.S. population every 11 seconds. In Canada one person is added to the population every minute and 36 seconds.

About 60% of the U.S. gain is from birth rates outpacing death rates and a whopping 40% is from net immigration.

Not only are there more of us, but increasingly, more of us are living alone. One-person households account for more than a quarter of the U.S. population (Population Reference Bureau). That means, on average, we are using more resources -- more housing, more water, more energy and more land.
By nature, most resources are finite. But **pressures on them are continually increasing** -- in the Great Lakes basin and the rest of the world.

If we monitor our use – of water, energy, land – and waste production, we gain a better understanding of our impact on the region and its carrying capacity.
The status of Great Lakes resource utilization is mixed, and the overall trend is often undetermined due to incomplete data, inconsistent reporting or a lack of assessment.
Great Lakes basin water withdrawal

• Net Basin Supply estimated at 132.3 BGD
• In 2000, 46 BGD withdrawn from basin, or 35% of the available daily supply
• 3% from groundwater
• Majority of water returned, 7% lost or depleted

The net basin supply of water is estimated at slightly more than 132 billion gallons per day. In 2000, water was withdrawn from the Great Lakes at a rate of 46 billion gallons per day. Three percent of the total comes from groundwater. That means we are using about 35% of the available daily supply.

The majority of water withdrawn is returned to the basin through discharge or run-off; however, approximately 7% is lost through evapo-transpiration or depleted by human activities.

This chart shows water withdrawals by user category for two periods of years.

- A little more than 80% of the total was withdrawn by thermoelectric and industrial users, with power plants using the greatest volumes;
- 13% was withdrawn for public water supplies;
- 2% by agricultural sectors; and
- 3% was withdrawn for environmental, recreational, navigational, and quality control purposes.

Canadian withdrawals have decreased by roughly 30% since the 1990s while U.S. withdrawals have decreased by more than 20% since 1980. However, the declines are largely due to reduced withdrawals by thermoelectric generators which mask generally increasing use for public water supply.

In the immediate future, the greatest pressure for increased withdrawals will come from communities bordering the basin, where existing water supplies are scarce or of poor quality. These localities might look to the Great Lakes as a source of water.

To reduce water demand, higher water prices have been widely advocated. Public education on water conservation and promotion of water-saving technologies will also help.
Canada and the U.S. are among the largest energy producers and consumers in the world.

Between 1999 and 2000, the per capita energy consumption decreased in the U.S. by nearly 1% but increased in Ontario by 2%. With growing populations, energy consumption will likely continue to rise.

The graph shows energy consumption by sector for Great Lakes states in 2000. Industries and electric utilities are generally the largest consumers with transportation a close third. Other data for Ontario (not shown on the chart), indicate the largest change in energy consumption between 2000 and 2002 was a 4.4% increase in the commercial sector.

Fossil fuels are the leading source of energy consumption on both the U.S. and Canadian sides of the basin. However, many Great Lakes industries are now using bio-fuels, resulting in a decrease in fossil fuel consumption. And there is a growing investment in renewable energy sources.
Over time, the change in waste disposal tonnages can be used as an indicator for solid waste generation. But more consistent and comparable data are needed. Data are incompatible from one jurisdiction to the next.

The chart shows that recording periods between states and provinces vary. Further complicating the assessment, waste may be generated in one jurisdiction and disposed of in another.

There is good news in the three “Rs”. Programs that reduce, reuse or recycle waste are underway. Ontario’s Waste Diversion Act was passed in 2002, providing a mandate to reduce, reuse or recycle waste. The goal is to divert 60% of the waste by 2008.

In addition to prolonging the life of landfills, waste prevention and recycling also reduce greenhouse gases by decreasing methane emissions, saving energy, and increasing forest carbon sequestration, since fewer trees are harvested.
Population growth and urban sprawl in the Great Lakes basin has led to an increase in the number of vehicles on the roads, fuel consumption, and miles traveled.

This graph shows fuel consumption in thousands of gallons by states and provinces in the basin. While the total fuel consumed by the states is substantially larger, the rate of increase is slightly greater for the provinces. Over ten year periods (1994-2004 for U.S. data and 1993-2003 for Canadian data) fuel consumption increased by 17% in the U.S. portions of the Great Lakes basin and by 20% in the Canadian portion.
In addition to rising fuel consumption, we’re traveling more miles, and probably liking it less as the roads become more congested. This figure shows a trend similar to the previous graph. During 10 year time frames, the total number vehicle miles traveled in the U.S. portion of the basin was substantially greater than total miles for the Canadian portion. However, the rate of increase in miles traveled was greater in the Canadian portion. Miles traveled within the basin increased 20% for the U.S. and 54% for Canada.

Another upward trend is that the increase in registered vehicles continues to outpace the increase in licensed drivers. For example, in the Great Lakes states, the number of licensed drivers increased by 8% between 1994 and 2004, while the number of registered vehicles increased by about 11%.
Conclusions about the resource use indicators are:

While total water withdrawals from the basin declined slightly, demands from communities bordering the basin are expected to rise.

Per capita energy consumption has changed only slightly (down for U.S. and up for Canada), but total energy consumption may rise with increasing populations.

Population growth and urban sprawl have lead to an increase in the number of licensed drivers, number of vehicles on the road, gallons of fuel consumed and total miles traveled.

And the PopClock keeps ticking.
There is no scientific doubt that our climate is warming.
The status and trend of climate change and impacts to the Great Lakes ecosystem are incomplete.

Additional work is needed to develop robust indicators and establish long term monitoring that assesses impacts over time and helps coastal communities adapt to the changes that are coming.
Climate change signals and expectations

Computer models, still under development, suggest that the climate of the Great Lakes region will grow warmer and **possibly** drier during the 21st century. Any increases in precipitation are not expected to compensate for the drying effects of increased evapotranspiration in a warmer climate. Therefore, surface waters, groundwater and soil moisture are all predicted to decline.

Many impacts to the region are expected. Some of the changes ahead may include:

- Continued declines in the duration of winter ice cover and possible declines in lake levels as evaporation during winter increases.
- The costs of shipping and dredging would increase with lower lake levels; and the shipping season may become extended.
- Invasions by species found south of the region and by warmwater, non-native species will likely increase the stress on native species.
- A change in the distribution of forests and an increase in forest pests are expected.
- Lower water levels combined with warmer water temperatures may accelerate the bioaccumulation of mercury and other contaminants in the food chain.
- And an increase in the frequency of winter runoff and intense storms may deliver more non-point source pollutants to the lakes.
Climate change conclusions

- Duration of winters and ice cover are getting shorter
- Annual average temperatures are growing warmer
- Extreme heat events are occurring more frequently
- Heavy precipitation events, both rain and snow, are becoming more common
- Changes are expected to continue but future impacts are unclear

Known conclusions with regard to climate change are:
- Duration of Great Lakes winters and ice cover are getting shorter.
- Annual average temperatures are growing warmer.
- Extreme heat events are occurring more frequently.
- Heavy precipitation events, both rain and snow, are becoming more common.
- And changes are expected to continue, but the extent of future impacts remains unclear.
The entire Great Lakes basin encompasses an area of more than 765,000 square kilometers (295,000 square miles). The land drainage area is roughly two thirds of the entire basin or 521,000 square kilometers (201,000 square miles) while surface waters make up the remaining third.

How land is used impacts not only water quality of the Lakes, but also biological productivity, biodiversity, and human economies.
The land use/land cover category includes some 17 indicators. I will be reporting on only handful. The overall status of land use in the basin is mixed, and many indicators need more assessment,
but the trend is generally declining due to more development and the loss of productive agricultural lands and important habitats.
Remote sensing imagery from 1992 and 2001 were used to assess land use changes during the nine year period. The four major land use categories are: water as indicated by the blue color; forests in green; urban in red; and agriculture in orange and yellow.

Currently, forested land covers over 60% of the Great Lakes land area while agriculture makes up approximately 35% of basin land. Between 1992 and 2001, nearly 800,000 ha., or 2.5% of the basin's land area was converted to some other use. Within nine years, low-intensity development increased 33.5%, road area increased 7.5%, and forest cover decreased 2.3%.

As the proportion of impervious surfaces in urbanizing watersheds increases, the negative impacts on local water resources, as well as the Great Lakes, will also increase.
Between 1992 and 2001, agriculture lost 210,000 ha to development, mostly to urban and suburban sprawl, and slightly more than 16% of this ag land conversion occurred within 10 km of the Great Lakes shoreline.

Although reliance on pesticides in agriculture remains significant, pesticide use continues to decline due mostly to application of more effective pesticides and wide-spread use of Integrated Pest Management practices. Since the late 1980s, there has been increasing participation by basin farmers in various soil and water management programs. Conservation practices are now the norm and have reduced the rates of U.S. soil erosion by 38% in the last few decades.
Forests cover 61% of the total land area within the Great Lakes basin. About 9% of these lands (7.8% of forests in U.S. counties and 10.6% of forests in Canadian watersheds) are classified as protected, or held in public ownership and reserved from harvest. However, it must be noted that many privately owned forests are also reserved from harvest and many harvested timberlands are sustained through best management practices.

In fact, the acres of forested lands enrolled or certified under forest stewardship programs have increased dramatically in recent years, as forest industry professionals continue to make a greater commitment to sustainable management.

However, parcelization into smaller, privately-owned tracks is increasing, fragmenting forest ecosystems and disrupting habitats. The average size of land holdings is a proposed metric for forest ecosystem integrity.

The greatest threats to forest lands are seasonal home construction, urbanization and recreational use, along with disruptions from timber harvest and forest fires.
Forest cover in riparian zones is a significant metric for watershed health. The map shows the percent of riparian forest coverage for each Great Lakes watershed.

The overall average of riparian forest cover for the entire Great Lakes basin is approximately 70%. The U.S. watersheds have forest cover on 61% of the riparian zones (as of 1992) while Canadian watersheds have forest cover on 76% of the riparian zones (as of 2002).

Riparian buffers not only provide important habitat and migration corridors, they also help protect water quality by reducing nutrient and sediment loading and maintaining cooler stream temperatures required by cold water fish species such as trout.
The Nature Conservancy launched an initiative in 1997 to identify a collection of conservation targets which would represent the full range of biodiversity within the Great Lakes region.

They also identified more than 500 high priority conservation sites throughout the region. Only 5% of all U.S. conservation sites are fully protected. They estimate that 79% of the Great Lakes sites require conservation attention within the next ten years, while more than one-third of these sites need immediate attention in order to protect conservation targets.

Bottom line is the biodiversity of the Great Lakes region is not adequately protected.
Brownfields redevelopment

<table>
<thead>
<tr>
<th>State/Province</th>
<th>Acres remediated</th>
<th>Sites remediated</th>
</tr>
</thead>
<tbody>
<tr>
<td>WI</td>
<td>1,220</td>
<td>18,000</td>
</tr>
<tr>
<td>PA</td>
<td>13,229</td>
<td>1,097</td>
</tr>
<tr>
<td>OH</td>
<td>4,204</td>
<td>156</td>
</tr>
<tr>
<td>WI</td>
<td>Not tracked</td>
<td>5,539</td>
</tr>
<tr>
<td>MN</td>
<td>Not tracked</td>
<td>382</td>
</tr>
<tr>
<td>IL</td>
<td>7,047</td>
<td>462</td>
</tr>
<tr>
<td>IN</td>
<td>6,412</td>
<td>899</td>
</tr>
<tr>
<td>NY</td>
<td>555</td>
<td>161</td>
</tr>
<tr>
<td>ON</td>
<td>92</td>
<td>13</td>
</tr>
<tr>
<td>QC</td>
<td>741</td>
<td>309</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>33,143</strong></td>
<td><strong>26,873</strong></td>
</tr>
</tbody>
</table>

Since brownfields programs began in the basin, nearly **27,000 sites**, **covering over 33,000 total acres have been remediated** within the Great Lakes states and provinces. Nearly **two-thirds** of these **sites** were located in the state of **Wisconsin**, while **40%** of the total remediated area occurred within **Pennsylvania**.
Land use-land cover conclusions

• Urban sprawl and development continue to be major stressors to Great Lakes ecosystems
• Forested riparian zones act as buffers to reduce nutrient and sediment loads
• 79% of Great Lakes biodiversity sites require conservation attention in the next 10 years and one-third require immediate attention

Some key conclusions:
• Urban sprawl and development continue to be major stressors to Great Lakes ecosystems.
• Forested riparian zones act as buffers to reduce nutrient and sediment loads.
• 79% of Great Lakes biodiversity sites require conservation attention in the next 10 years and one-third require immediate attention.
The status of Great Lakes human health indicators is mixed and some trends remain undetermined.
• Drinking water quality remains good;
• there are overall improvements in air quality and contaminants in sport fish;
• but, fish consumption advisories and beach closings continue.

The overall trend is undetermined because some of the indicators, particularly biomarkers of human exposure, are not well understood or have mixed results.
The status of treated drinking water throughout the Great Lakes region can be considered good, and the trend is unchanging. Few, if any, violations of federally regulated standards have been reported. Therefore, the risk of human exposure to regulated chemical and microbiological contaminants is generally low and the potential for developing health complications as a result of drinking Great Lakes basin water is also low.

The status of this indicator is based on annual reports (U.S. Consumer Confidence/Water Quality Reports and Ontario Drinking Water Surveillance Program) from 133 water treatment plants serving populations > 50,000 in the U.S. and > 10,000 in Canada. Therefore the assessment provides a partial view of drinking water in the basin. The quality of smaller public systems or private wells are not included in this assessment. There are geologic regions where groundwater sources are naturally high in radium, arsenic or fluoride. Also, the information is based on finished, or treated water, not raw source water.

The greatest threat to source waters in the basin is degraded land runoff and contaminant infiltration to shallow aquifers.
Although the status of air quality in the Great Lakes basin is mixed and the trend is improving, there is still much work to be done.

Overall, there have been improvements in reducing urban/local air pollution over the past decade. For example, in 2004 the U.S. annual average concentration of particulate matter with a diameter of 2.5 microns or less, was the lowest since nationwide monitoring began in 1999. This graph shows a 9% decrease in particulate matter since 1999 for 119 industrial midwest monitoring sites. Emission reductions are believed to be largely responsible for this decline, and new standards for PM 2.5 will be going into effect in mid-December of this year.
However, some areas experience continuing air quality problems, notably the Detroit-Windsor-Ottawa corridor, portions of the Lake Michigan basin, and the Buffalo-Niagara area. Regional pollutants such as, ground-level ozone and fine particulates, are steadily increasing in areas across Ontario. Canada’s Clean Air Act was recently introduced which will strengthen regulation of air pollutants.

Again, population growth and climate change may negatively impact air quality, and an increase in the number of identified toxins present in the air further complicates this assessment.
Although there has been a decline in many persistent bioaccumulative toxic (PBT) chemicals in the Great Lakes since the 1970’s, fish consumption advisories persist for all of the lakes. The contaminants that drive consumption advisories are shown for each lake.

Data collected for PCBs in coho salmon and lake trout show concentrations are generally declining in all of the lakes. Mercury levels in walleye are also declining, although no significant decline is evident in Lake Ontario. As organochlorine contaminant levels decline, mercury is expected to become a more important contaminant of concern. Contaminants such as mercury, PBDEs and dioxins need to be better understood and monitored more frequently.

Since each state, province and tribe are responsible for developing their advisories, the advice is sometimes different for the same lake and fish species within that lake. To eliminate this confusion and better protect fish consumers, the United States has developed a uniform fish advisory protocol for PCBs for the entire basin and protocols for chlordane and mercury are being finalized.

Consumption advisories are important for protecting the public from exposure risks, especially for sensitive populations. Education and outreach are also essential to help people choose and prepare their fish wisely, and to recognize that while some fish may pose health risks, others provide substantial health benefits.
Biological markers of human exposure

No routine programs presently exist to monitor biological markers of human exposure to persistent bioaccumulative chemicals. Individual epidemiological studies have been conducted, and additional studies are ongoing within specific Great Lakes populations. In these studies, blood serum from women of child-bearing age served as biomarkers for mercury, PCBs, and DDEs, and hair samples were also shown to be a good biomarker for mercury.

Generally, people who ate more frequent fish meals had the highest levels of contaminants. Because there have been no large-scale or basin-wide studies, the status of this indicator is mixed and no trends can be determined.
There has been an increase in beach monitoring and in the number of beaches reporting in both the United States and Canada. Over the last 8 years, the percentage of beaches open during the swimming season remains relatively constant in the U.S. (at roughly 70%) and is slightly declining in Canada (at 52%). This chart shows that in 2005, 67% of Great Lakes beaches in the U.S. and Canada had a low to moderate risk of closure while 33% were at high risk for closure.

Closures are due to a variety of reasons, including E. coli bacteria counts, poor water clarity, algae abundance, or preemptive beach closures based on storm events and predictive models.

Measures to track and remediate bacterial sources are being taken to improve conditions at many problematic Great Lakes beaches. However, as populations and coastal communities grow, additional point and non-point source pollution may result in additional beach postings, particularly during wet weather conditions.
Human health conclusions

• Quality of treated drinking water remains good.
• Urban and local air pollutants are decreasing, however, population growth may impact future air pollution levels.
• A decline in some contaminants has not eliminated the need for fish consumption advisories.
• One-third of Great Lakes beaches are at high risk for closures.

• Quality of treated drinking water remains good.
• Urban and local air pollutants are decreasing, however, population growth may impact future pollution levels.
• A decline in some contaminants has not eliminated the need for fish consumption advisories.
• There has been an increase in beach monitoring; however, a third of monitored beaches still have a high risk for closures.
<table>
<thead>
<tr>
<th>Great Lakes Basin Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States PopClock</td>
</tr>
<tr>
<td>300,117,695</td>
</tr>
<tr>
<td>(136 people added)</td>
</tr>
</tbody>
</table>

Great Lakes Basin Pop.  
39,832,041  
(18 people added)

During this presentation, the Great Lakes basin population has increased by an estimated **18 people**. By the **end of our conference**, this number will increase by nearly **2200** people.

As resource managers, we’re often challenged to do more with less. Perhaps **our greatest challenge is how do we do less damage to the Great Lakes with ever more people?**
Thank you.