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**State of the Lakes Ecosystem Conference
Peer Review Report
Part 2: Stakeholder Review of the Great Lakes
Indicators**



**January 27-28, 2004
Detroit, Michigan**

**State of the Lakes Ecosystem Conference
Peer Review Report
Part 2: Stakeholder Review of the Great Lakes Indicators**

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SECTION 1.0

Introduction:

In 1992, the State of the Lakes Ecosystem Conferences (SOLEC) were established to provide coordinated and consistent reporting on the state of health of the Great Lakes basin ecosystem, as called for in the Great Lakes Water Quality Agreement (GLWQA). In addition, the *State of the Great Lakes* reports derived from SOLEC information fulfill another part of the reporting requirements to the International Joint Commission and to the public. While the conference and its associated reports have yielded significant transfers of information, have increased awareness of Great Lakes conditions and issues, and have influenced decision makers and the public, a review and evaluation of the SOLEC process and its products would provide an opportunity for growth and improvement as an independent, science-based reporting body.

The Approach:

SOLEC is a multi-faceted system for assessing and reporting on environmental conditions. It is relevant on a global scale, as well as to the individual communities of a local watershed. As such, it needed to be evaluated and observed from several perspectives. A two-part evaluation, first by external observers and then by internal Great Lakes basin data users, provided an objective, comprehensive evaluation of SOLEC as a whole.

The first session, or External Peer Review, was held in October 2003 and consisted of a select group of individuals who were independent from the SOLEC process. They were technical experts with experience and renown for their own contributions to the field of indicator development and use. They offered their objective evaluations of the products of SOLEC and on the SOLEC process, approach and efficiency compared to other national and international indicator reporting systems.*

The second session, or the Indicator Review Workshop, asked participants to focus on the entire suite of Great Lakes indicators used by SOLEC, to evaluate their utility, success and effectiveness in influencing decision makers, and to make recommendations for improvements where necessary. At a special session during SOLEC 2002, senior managers in the Great Lakes basin explored important connections between the assessments of the health of the Great Lakes system and the decisions they face in managing the system. The session afforded frank exchanges of ideas and information about the state of the Great Lakes, implications for management activities, and opportunities for collaboration. In planning this Review Workshop, the organizers foresaw a similar exchange among Great Lakes managers, managers of the Lakewide Management Plans (LaMPs) and other stakeholders in the basin to help answer the question: is SOLEC achieving one of its primary objectives of influencing management, and if not, how can the indicator system be improved to meet this objective?

* See associated summary report of the October session, prepared by Computer Sciences Corporation, "*State of the Lakes Ecosystem Conference Peer Review Report.*"

SECTION 2.0

The agenda for the Indicator Review Workshop is presented below to provide insight into how the review of the indicators was conducted. The Workshop was organized into four main components. 1) At an opening plenary, SOLEC organizers presented a brief history of SOLEC and the indicator development process, a description of SOLEC products, and an explanation of progress to date on indicators of coastal wetlands and forest lands. 2) A free-ranging group discussion was held to explore the utility and influence of SOLEC and Great Lakes indicators on agency programs. 3) As a group, participants reviewed the suite of indicators within the categories of chemical, physical, biological, human health, and land use and offered suggestions regarding the utility of the indicators and changes that would strengthen the assessment of the Great Lakes basin ecosystem. 4) At separate breakout sessions for each of the groupings of indicators, participants reviewed each indicator and offered recommendations for acceptance, modifications, or deletions.

SOLEC Indicator Review Workshop Agenda January 27-28, 2004

DAY 1: Tuesday, January 27, 2004

10am-10:30am, Plenary:

- Welcome and Introduction
- Objectives of this Review Workshop
- Presentation of some SOLEC background
 - SOLEC objectives
 - Brief indicator history and development (Paul Bertram)
 - Brief description of SOLEC products (Harvey Shear)
 - Brief explanation of the coastal wetlands and forestry indicators (Karen Rodriguez)
- Charge to participants

10:30am-12:00pm, Group Discussion:

(Open session dedicated to discussing the utility and influence of SOLEC and the Great Lakes indicators)

SUGGESTED FOCUS QUESTIONS

- How has SOLEC influenced decisions in your agency? What are some examples? What are some barriers?
- How can SOLEC better fulfill its purpose to provide coordinated and consistent reporting on the state of health of the Great Lakes basin ecosystem?
- How can we collectively accelerate the identification of endpoints of indicators to better reference progress towards the goals of the Great Lakes Water Quality Agreement?

-How can we better influence coordination of monitoring to make more progress toward reporting on the full suite of indicators?

LUNCH

Afternoon session: 1pm-5pm:

Charge to Participants:

To review the Great Lakes indicators as organized in five categories: Chemical, Physical, Biological, Human Health and Land Use. Indicators in each category will be presented with a short description and a narrative of status. Participants are asked to review the indicators within each category based on the following questions:

- 1) Does this set of indicators provide information that is useful to your program or agency?
- 2) Would the set of indicators provide additional information that is useful to your program or agency if the set were fully implemented?
- 3) What changes to this set of indicators would strengthen the assessment of the Great Lakes basin ecosystem?
- 4) How can we, as stakeholders, support the more complete monitoring and reporting of these indicators?

Adjourn Day 1

DAY 2: Wednesday, January 28, 2004

Objective: Detailed discussion about problem indicators as identified in Day 1.

8:30am-9:00am,

- Welcome, recap and charge to participants
- Opportunity for questions and discussion relating to Day 1

9:00am-11:30pm, Breakout Groups:

- Participants will be grouped according to one of the five categories (Chemical, Physical, Biological, etc) to examine problem indicators and propose resolutions (groups to focus on metrics, frequency of monitoring, space and time scales, etc).

11:30-12pm,

- Wrap-Up to include reactions, advice, and open-floor discussion
- Thank you to participants

Adjourn Day 2

SECTION 3.0

Highlights of Discussion

Participants at the Indicator Review Workshop were encouraged to offer critiques and suggestions on SOLEC processes and products. Additional excerpts of written comments were included in this report from the Great Lakes Commission. The responses summarized in this section of the Indicator Review Report reflect the opinions of the participants, but they are not necessarily those of the SOLEC organizers.

Has SOLEC influenced decisions in your agency?

One respondent stated that SOLEC has been a key factor in identifying needs in agencies like the U.S. Fish and Wildlife Service (FWS), and it serves as a positive “forcing function” that gets people working together on issues. In particular, SOLEC has been influential in the decision by the FWS to focus on an ecosystem/watershed basis despite present political boundaries. Internal funding resources have been shifted to pursue funding of indicators. It is exciting that senior management is seeing the demand for additional environmental information and activities, and it prompts them to collaborate to see how things could be done differently and to be more responsive.

How can SOLEC better fulfill its purpose to provide coordinated and consistent reporting on the state of health of the Great Lakes basin ecosystem? How can we collectively accelerate the identification of endpoints of indicators to better reference progress towards the goals of the Great Lakes Water Quality Agreement?

- Regarding **consistency**: the language used seems to vary among indicators in describing toxic contaminants. Specifically, the term “PBT” is a narrower definition than terms used in other indicator descriptors. This is important when talking about pharmaceuticals. The overall comment is that we have to define contaminants more broadly to reflect what is in the Binational Toxics Strategy and the GLWQA. We also need to be sure that indicator development and reporting is sensitive to changes in program needs.
- One participant stated that in regards to **consistent reporting**, the assessment titles are not always sufficient or helpful. For example, the terms “mixed” or “mixed deteriorating,” etc. are ambiguous, hard to compare to previous years’ assessments, and ultimately are not providing useful information. In a related issue, some indicators do not have **endpoints**, but in some cases, endpoints could be ambiguous. For example, a topic such as “hydrology” does not automatically have a good or bad connotation associated with it.
- It was suggested that SOLEC propose the **endpoints** for indicators that can be quantified objectively. That is, SOLEC should be the entity with the ability to define endpoints, rather

than “the bureaucracy”. This approach would allow more **consistent reporting** because SOLEC would “do the harmonization” in identifying endpoints.

- One of the main challenges that SOLEC currently faces regarding **consistent reporting** is implementing as many indicators as possible on a basin-wide scale. Presently, many indicators are narrowly reported on because of lack of monitoring. Also, there has to be a strong emphasis on the major challenge of more consistent frequency and intensity of reporting. At the same time, however, indicators have to be sensitive to changing needs. For instance, priority contaminants will change over time. That is, present chemicals of concern are different from the ones recognized in the original GLWQA.

In addition to changing needs, it is important to remember that defining **endpoints** “is easier said than done”. Each of the lakes is different and an endpoint that is adequate for Lake Erie may be different for Lake Superior. For instance, total phosphorus levels that are sufficiently low to prevent nuisance algal blooms in one lake may not be enough to support a large fish community in another. It is easy to oversimplify issues, and this is why there is still not a common approach. Endpoints should be determined at the lakewide level.

One participant suggested that by defining what each indicator is responding to and defining the spatial and temporal boundaries, endpoints can be determined. One suggestion was for indicators to be scaled in units of distance from/closeness to regional endpoints, not necessarily in units of measurement of raw data, e.g.: complete Impairment of a Beneficial Use regionally = 0; regional endpoint achieved = 100; and each area gets a ranking along this scale. In this way, the indicators would not have to be measured in raw units. If we can define our endpoints and units locally, we can integrate our indicators from place to place and come up with common measures.

Related suggestion: Use an indicator that is already integrative as an example (such as the Sediment Quality Index). The approach is based on the idea that at each place, experts have defined what constitutes locally good conditions and the index is the number of parameters and frequency with which measures are compliant. The index is taken as an equation incorporating frequency, spatial magnitude and amplitude, and the scale would be good, fair, or poor (depending on whether goals are met on the local level or integrated across the basin). One must keep in mind with this approach that developing an index involving migratory organisms such as the lake sturgeon would make the results much more difficult to obtain and complicate the process.

One participant stated that the Wetlands Consortium is using a similar “index” approach where the standard is the reference condition of specific groupings of things we want to attain. Everything else is scaled against that, permitting different regions to be compared.

How can we better influence coordination of monitoring to make more progress toward reporting on the full suite of indicators?

- A critical question to ask is how does indicator development and monitoring tie in with other ongoing work so efforts are not being duplicated? For example, Agriculture Canada is presently working on a national initiative under tough guidelines and time lines. How will our recommendations [from this workshop] match what they come up with when they want to propose ideas to SOLEC? AgCanada is using a slightly different approach in that many of their indicators are derived from predictive models, e.g. wind erosion, habitat fragmentation,

salinization in prairies, phosphorus generated by agriculture. The report is being written now. If we know about a developmental initiative, we need to try to link to the initiative to see if it will help us determine the status of the basin. We need to contact them, explain our problem/work and see if they can help us by showing us how to adapt their approach for Great Lakes needs.

What changes to this set of indicators would strengthen the assessment of the Great Lakes basin ecosystem?

From Peer Review:

- It would be very useful to “bundle” some indicators together (e.g. “nutrients”) and then as a next step, to determine what is really important at the lake level. For example, nutrients are extremely significant for the lower lakes.
- It might be useful to determine key questions and in trying to answer these questions, bundle indicators to represent the information related to the question(s). For example, in the SOLEC fact sheets for human health there are three key questions related to: drinkability, fish edibility, and swimming in the water. The indicators are then grouped under the theme.
- Ideally the goal is to categorize information to come up with a shorter list of information categories or “bundles”. It is acknowledged that we may still need all 80 indicators, but we want to put them into more manageable categories.
- We should be bundling complementary indicators that reflect spatially explicit areas. For example: *Hexagenia*, *Diporeia*, rocky substrate benthos, and wetlands benthos. We should do the same for complementary fish species.
- Suggested indicator groupings/bundles include:
 - Toxics in wildlife/food chain: indicator numbers 113, 114, 115, 121, 4083, 8135, and 8147, but work out redundancies with contaminants in fish.
 - Toxics in media (because collectively they tell us how contaminants move through the food web): indicator numbers 117, 118, and 119 - if the measurements are consistent with one another. There was some concern that this would be comparing apples to oranges. Do not include air quality in here since it fits more so in the Air Quality Agreement reporting.
 - Toxic sources and loadings, if possible from Binational Toxic Substance reports on persistent toxics. Also includes indicators 4176, 7059, 4178, and 117. In addition, the indicator would need to report on point source contributions.
 - Nutrient issues: Combine the proposed Nutrient Management indicator *with* Phosphorus Concentrations and Loadings (#111) and Phosphorus and Nitrogen Levels (#4860)
- What is missing in the indicator and suite development process is a middle step of taking suites of chemicals, for example, and presenting them to panels of experts and have them

integrate these to determine where the indicator “needle should be pointing”. The key is to determine how to assess all the measurables and learn what those are telling us.

From the Great Lakes Commission (GLC):

- The current list of indicators includes many that are unnecessary and/or redundant. The total number of indicators should be reduced.
- State-Pressure-Activities indicators are not adequately linked to show the relationship among state, pressure and action (response). They should be linked accordingly or a different model should be adopted that better reflects the interrelationships of the type of indicator.
- A suggestion was made to replace the “biological, physical, chemical” theme approach with a more habitat-based approach. While we recognize the effort of SOLEC organizers to be responsive to the provisions of the Great Lakes Water Quality Agreement, we also recognize an inherent paradox in assigning indicators as measures of physical, biological, or chemical integrity given the interdependent nature of ecosystem dynamics. Future SOLEC events could reinstitute a focus on a particular geographic zone (e.g., “nearshore terrestrial”), the state of the habitats therein as well as stressors, and actions. (If the physical integrity theme is retained for SOLEC 2004, we suggest that organizers clearly link each selected “physical” indicator with one or more geographic zones and habitat types within each of those.)
- The indicators should be grouped by topic/issue. For SOLEC 2004, breakout sessions could be organized by habitat type under the larger framework of the 4 geographic zones. Cross-cutting and issue indicators will necessarily and appropriately be addressed in each one of these breakouts. Societal/human indicators are important and the current framework and reporting system does not adequately integrate them with the ecosystem indicators.

On the Indicator Review Process:

- GLC: The process for changes to the indicator suite should be more transparent. This SOLEC Review Workshop in January addresses this to some extent, but those unable to participate should be informed about the proposed revised framework and indicators presented at the last SOLEC and have additional, ongoing opportunities for input.
- Those involved in the writing and peer-review should be formally identified and have the responsibility for delivering the peer-reviewed indicator report by a specified time, well in advance of the conference.
- The development of indicator reports and the peer-review process should occur in off-years, well enough in advance so that the final, vetted indicator reports are published at the conference. This would reinforce the science basis of SOLEC.
- A draft State of the Lakes Report could be prepared and provide the basis for break-out sessions at SOLEC.

Additional General Recommendations:

- All indicators, with the associated background information (e.g., measure, purpose, endpoint, etc.), should be posted on the Internet and SOLEC organizers should institute a process for periodic review and comment on individual indicators, related indicators (e.g., SPA) and indicator groupings (e.g., geographic zones).
- A gap analysis for the indicator suite is necessary. Such an analysis would be most effective after the suite has been assessed and reduced.

SECTION 4.0

Summary of Major Comments and Themes

- Identify related ongoing projects and developmental initiatives in the Great Lakes basin so that efforts can be coordinated with SOLEC instead of duplicated.
- Assessment titles such as “mixed” and “mixed-deteriorating” are not always sufficient or helpful and are sometimes ambiguous.
- For more consistent reporting, SOLEC should move as many indicators as possible to basin-wide reporting.
- There is a need for endpoint development, especially for those indicators where a quantified endpoint is possible.
- It would be useful to bundle some related indicators together, which would serve to categorize information.
- The current list (as of January 2004) contains many indicators that are unnecessary and/or redundant. The number of indicators should be reduced.
- The indicators are not adequately linked together using the State-Pressure-Activities framework. A different model should be adopted that better reflects the interrelationships of the indicators.
- Instead of biological, chemical and physical themes, SOLEC should adopt a habitat-based approach to presenting indicators, including geographic zones and within those, habitat types.
- A draft State of the Lakes report should be prepared and provide the basis for breakout sessions at SOLEC.
- All indicators should be posted and available on the Internet, and a process should be instituted for ongoing comment and periodic review.

SECTION 5.0

Peer Review Workshop Meeting, January 27-28, 2004

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SECTION 6.0

ADDENDUM

**Summary of Individual Indicator Comments
from the Indicator Review Workshop**

Summary of Indicator Comments from Workshop Participants

Note: In order to facilitate discussion at the Indicator Review Workshop the Great Lakes indicators were placed into the following categories: Chemical (includes nutrients and contaminants), Physical (includes hydrology and habitat), Biological, Human Health, Land Use (includes societal and groundwater), Coastal Wetlands and Forest Lands. Each indicator name and ID number are followed by the purpose statement, taken from The Selection of Indicators for the Great Lakes Basin Ecosystem Health, v.4, then the comments pertaining to that indicator. Some indicators fall into more than one grouping – where this occurs the comments have been compiled and they are the same in each category. Comments may also seem to be contradictory – however the intent of this section is to summarize most of the comments heard at the workshop.

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Chemical Indicators (includes Nutrients & Contaminants)

Phosphorus Concentrations and Loadings (Indicator #111)

This indicator will assess the total phosphorus levels and loadings in the Great Lakes, and it will be used to support the evaluation of trophic status and food web dynamics in the Great Lakes.

- Put in Nutrient bundle with the proposed Nutrient Management indicator and Phosphorus and Nitrogen Levels (#4860).

Contaminants in Recreational Fish (Indicator #113)

This indicator will assess the levels of PBT chemicals in fish, and it will be used to infer the potential harm to human health through consumption of contaminated fish.

- This was proposed to be a market basket average index; have never made those calculations.
- Put in Toxics in Wildlife/Food Chain bundle.
- There are 3 indicators that refer to contaminants in edible fish tissue (Contaminants in Recreational Fish #113, Contaminants in Whole Fish #121, and Contaminants in Edible Fish Tissue #4083). The group suggests SOLEC experts look at the data quality, geographic range, etc for each and select the best indicator. If all 3 provide valuable and different information, they should be reported in one bundle on contaminant impacts on fish.
- Propose to delete - it is not being measured and is covered in #4083, Contaminants in Edible Fish Tissue.

Contaminants in Young-of-the-Year Spottail Shiners (Indicator #114)

This indicator will assess the levels of PBT chemicals in young-of-the-year spottail shiners, and it will be used to infer local areas of elevated contaminant levels and potential harm to fish-eating wildlife.

- Put in Toxics in Wildlife/Food Chain bundle.

Contaminants in Colonial Nesting Waterbirds (Indicator #115)

This indicator will assess chemical concentration levels in a representative colonial waterbird, and it will be used to infer the impact of these contaminants on colonial waterbird physiology and population characteristics.

- Put in Toxics in Wildlife/Food Chain bundle.
- Propose to delete.
- Index of Water birds?
 - Invent a metric.
 - Separate contaminants in birds out of the Biological category.

Atmospheric Deposition of Toxic Chemicals (Indicator #117)

This indicator will estimate the annual average loadings of priority toxic chemicals from the atmosphere to the Great Lakes, and it will be used to infer potential impacts of toxic chemicals from atmospheric deposition on the Great Lakes aquatic ecosystem, as well as to infer the progress of various Great Lakes programs toward virtual elimination of toxics from the Great Lakes.

- Put in Toxics in media bundle with Toxic Chemical Concentrations in Offshore Waters (#118), Concentrations of Contaminants in Sediment Cores (#119) and Contaminant Exchanges Between Media (#120) – but need to ensure the measurements are consistent with one another. There was some concern that this would be comparing apples to oranges. Do not include air quality in this bundle since it fits more so in the air quality agreement.
- Put in Toxic sources and loadings bundle.

Toxic Chemical Concentrations in Offshore Waters (Indicator #118)

This indicator will assess the concentration of priority toxic chemicals in offshore waters, and it will be used to infer the potential impacts of toxic chemicals on the Great Lakes aquatic ecosystem, as well as to infer the progress of various Great Lakes programs toward virtual elimination of toxics from the Great Lakes.

- Put in Toxics in media bundle with Atmospheric Deposition of Toxic Chemicals (#117), Concentrations of Contaminants in Sediment Cores (#119) and Contaminant Exchanges Between Media (#120) – but need to ensure the measurements are consistent with one another. There was some concern that this would be comparing apples to oranges. Do not include air quality in this bundle since it fits more so in the air quality agreement.

Concentrations of Contaminants in Sediment Cores (Indicator #119)

This indicator will assess the concentrations of toxic chemicals in sediments, and it will be used to infer potential harm to aquatic ecosystems by contaminated sediments, as well as to infer the progress of various Great Lakes programs toward virtual elimination of toxics from the Great Lakes.

- Put in Toxics in media bundle with Atmospheric Deposition of Toxic Chemicals (#117), Toxic Chemical Concentrations in Offshore Waters (#118) and Contaminant Exchanges Between Media (#120) – but need to ensure the measurements are consistent with one another. There was some concern that this would be comparing apples to oranges. Do not include air quality in this bundle since it fits more so in the air quality agreement.

Contaminant Exchanges between Media: Air to Water and Water to Sediment (Indicator #120)

This indicator will estimate the loadings of priority pollutants to the Great Lakes, and it will be used to infer the potential harm these contaminants pose to human, animal and aquatic life within the Great Lakes, as well as to infer the progress of various Great Lakes programs toward virtual elimination of toxics from the Great Lakes.

- Seems to be too much. There's already lots of information. Does this index tell the needed information about the status of the system?
- Propose to delete - three indicators (Atmospheric Deposition of Toxic Chemicals #117, Toxic Chemical Concentrations in Offshore Waters #118, Concentrations of Contaminants in Sediment Cores #119) should be bundled together and #120 should be dropped. The group suggested that #120 is more research oriented and that contaminant presence in the media is already covered under #117, #118, and #119.

Contaminants in Whole Fish (Indicator #121- New)

This indicator will assess trends in the concentration of PBT chemicals in the open waters of the Great Lakes using fish as biomonitors, as a measure of the success of remedial actions and to infer real or potential effects of contaminants on fish, fish-consuming wildlife and human consumers of sport fish species.

- Put in Toxics in Wildlife/Food Chain bundle.
- There are 3 indicators that refer to contaminants in edible fish tissue (Contaminants in Recreational Fish #113, Contaminants in Whole Fish #121, Contaminants in Edible Fish Tissue #4083). The group suggests SOLEC experts look at the data quality, geographic range, etc for each and select the best indicator. If all 3 provide valuable and different information, they should be reported in one bundle on contaminant impacts on fish.

Contaminants in Edible Fish Tissue (Indicator #4083)

This indicator will assess the concentration of persistent, bioaccumulating, toxic (PBT) chemicals in Great Lakes fish, and it will be used to infer the exposure of humans to PBT chemicals through consumption of Great Lakes fish caught via sport and subsistence fishing.

- Propose to delete.
- Do we need both #113 and #4083? It seems that #4083 is more germane.
- Put in Toxics in Wildlife/Food Chain bundle.
- There are 3 indicators that refer to contaminants in edible fish tissue (Contaminants in Recreational Fish #113, Contaminants in Whole Fish #121, Contaminants in Edible Fish Tissue #4083). The group suggests SOLEC experts look at the data quality, geographic range, etc for each and select the best indicator. If all 3 provide valuable and different information, they should be reported in one bundle on contaminant impacts on fish.

- It is recommended to keep this indicator; however, First Nations consumption needs to be considered (the Ontario Ministry of Environment Sport Fish Advisory Guide is based on average consumption rates not on subsistence fishers). Special communities need to be included within this indicator.
- Recommend combining the Edible Fish Tissue #4083 and Contaminants in Recreational Fish #113 indicators into Contaminants in Sport and Commercial Fish.

Chemical Contaminant Intake from Air, Water, Soil and Food (Indicator #4088)

This indicator will estimate the daily intake of PBT chemicals from all sources, and it will be used to evaluate the potential harm to human health and the efficacy of policies and technology intended to reduce PBT chemicals.

- Too research oriented and not sure how it will be measured.
- Propose to delete because it is unclear what to do with this information if it could be collected and how it relates to the Great Lakes impact on human health (largest contaminant intake is from the food component – most people get their food from the supermarket and a lot of this comes from outside of the basin).

Drinking Water Quality (Indicator #4175)

This indicator will assess the chemical and microbial contaminant levels in drinking water, and it will be used to evaluate the potential for human exposure to drinking water contaminants and the efficacy of policies and technologies to ensure safe drinking water.

- The public doesn't believe water quality reports, judging by sales of bottled water; also Walkerton tragedy; perhaps we should include new indicator on human diseases in drinking water.
- The indicator is made up of 10 parameters, some in raw water and some in treated water; mainly looks at water at the outlet of the water treatment plant, not when it reaches the house → this is a different issue.
- It is recommended that the description for this indicator be revised since it lists a huge number of parameters. We could consider primary and secondary parameters. We also need to ensure we are measuring the right things in order to increase consumer confidence.

Air Quality (Indicator #4176)

This indicator will monitor the air quality in the Great Lakes ecosystem, and it will be used to infer the potential impact of air quality on human health in the Great Lakes basin.

- Put in Toxic Sources and Loadings bundle.
- The decision for this indicator is on hold – we need to determine if it should be reported on through SOLEC or through the Air Quality Agreement.

Chemical Contaminants in Human Tissue (Indicator #4177)

This indicator will assess the concentration of PBT chemicals in human tissues, and it will be used to infer the efficacy of policies and technology to reduce PBT chemicals in the Great Lakes ecosystem.

- Potentially very important; it is a way of putting into context the importance of some of the things we've been monitoring. The source is due to market fish; Great Lakes fish are an issue but the supermarket is a significant source; and finger is pointed only to Great Lakes fish; numerically, there aren't enough fish to account for half of the PCBs in people.
- People do eat Great Lakes fish, especially tribes. This will be important for as long as we have contaminants in Great Lakes fish, and it will continue to affect a major industry. Fishing is important to Great Lakes, whether or not people eat the fish, from the point of view of the economy. This is a different question than "where do we get our contamination"; both are important.
- Too research oriented and not sure how robust the data will be since humans move throughout and outside of the basin
- Propose to delete. There are other indicators to cover the information provided within this indicator. It is difficult to tease out non-migratory humans (and therefore, the human health impacts of living within the Great Lakes basin). However, we do need to review the Jacobson Study and First Nations Communities studies (i.e. the EAGLE project would provide a snapshot for this indicator) before deciding whether or not to delete.

Radionuclides (Indicator #4178)

This indicator will assess the concentrations of artificial radionuclides in cow's milk, surface water, drinking water, and air, and it will be used to estimate the potential for human exposure to artificial radionuclides.

- Put in Toxic Sources and Loadings bundle.
- Propose to delete. There are two sources of radiation that can be measured currently, background levels and radiation from nuclear testing. Background levels cannot be changed and there has been no fallout from nuclear testing in the recent past. Also, the last sentence in the Limitations section states: "The trend illustrated by these data...is not especially useful to policy makers and regulatory agencies."

Wastewater Pollution (Indicator #7059)

To assess the loadings of wastewater pollutants discharged into the Great Lakes basin, and to infer inefficiencies in human economic activity (i.e., wasted resources) and the potential adverse impacts to human and ecosystem health.

- Put in Toxic Sources and Loadings bundle.

Contaminants Affecting Productivity of Bald Eagles (Indicator #8135)

This indicator will assess number of fledged young, number of developmental deformities, and the concentrations of organic and heavy metal contamination in Bald Eagle eggs, blood, and feathers. The data will be used to infer the potential harm to other wildlife and human health through the consumption of contaminated fish.

- Put in Toxics in Wildlife/Food Chain bundle.
- Change to population metrics, not contaminants.
- Rename and convert to population metrics.

Contaminants Affecting the American Otter (Indicator #8147)

This indicator will assess the contaminant concentrations found in American otter populations within the Great Lakes basin, and it will be used to infer the presence and severity of contaminants in the aquatic food web of the Great Lakes.

- Put in Toxics in Wildlife/Food Chain bundle.
- Change to population metrics, not contaminant focus.
- Rename and convert to population metrics.
- US Fish and Wildlife Service is looking at otter and mink.

External Anomaly Prevalence Index for Nearshore Fish (Indicator #124 – New)

This indicator will assess the combination of external anomalies in nearshore fish that will be used as an estimate of ecosystem health within the Great Lakes.

- Converted from DELT in Nearshore Fish #101.

Nutrient Management (Indicator #7061 – New)

This indicator will determine the number of Nutrient Management plans and to infer environmentally friendly practices in place, to prevent ground and surface water contamination.

- Put in Nutrient bundle with Phosphorus Concentrations and Loadings (#111) and Phosphorus and Nitrogen Levels (#4860).

Integrated Pest Management (Indicator #7062 – New)

This indicator will assess the adoption and uptake of Integrated Pest Management practices by farmers and to infer environmentally friendly practices in place, to prevent ground and surface water contamination.

- Move to Land Use.

Natural Groundwater Quality and Human-Induced Changes (Indicator #7100 – New)

This indicator will assess the quality of groundwater for drinking water and agricultural purposes, and for ecosystem function. The consumption of groundwater that is degraded in quality may lead to both animal

and human health effects. This indicator may also reveal areas where contamination is occurring, and where programs for remediation and prevention of non-point contamination should be focused.

- The group agreed that this indicator is worth keeping with the following modifications: This indicator needs to be restructured such that it addresses the quality of recharge and discharge water, keeping in mind the influence of recharge due to storm water runoff. This indicator also needs to address recharge water protection. After these modifications, this indicator may overlap with Water Withdrawal #7056 and could be merged with it.

Deformities, Eroded Fins, Lesions and Tumors (DELT) in Nearshore Fish (Indicator #101)

This indicator will assess the combination of deformities, eroded fins, lesions and tumors (DELT index) in nearshore fish, and it will be used to infer areas of degraded habitat within the Great Lakes.

- Proposed to be deleted prior to Indicator Review Workshop. This indicator has been replaced by a new indicator, External Anomaly Prevalence Index for Nearshore Fish (#124) that is more inclusive and representative.

Deformities, Eroded Fins, Lesions and Tumors (DELT) in Coastal Wetland Fish (Indicator #4503)

This indicator will assess the combination of deformities, eroded fins, lesions and tumours (DELT index) in fish of Great Lakes coastal wetlands, and it will be used to infer ecosystem health of Great Lakes coastal wetlands.

- Proposed to be deleted prior to Indicator Review Workshop. This indicator has been replaced by a new indicator, External Anomaly Prevalence Index for Nearshore Fish (#124) that is more inclusive and representative.

Physical Indicators (includes Hydrology and Habitat)

Fish Habitat (Indicator #6)

This indicator will assess the quality, quantity and location of aquatic habitat in the Great Lakes ecosystem, including the percent of habitat that has been disturbed or destroyed, and will be used to infer progress in rehabilitating degraded habitat and associated aquatic communities.

- The fish habitat descriptor is more of a place holder than a specific indicator.
- For which fish species and at what stage of the life cycle does this indicator attempt to measure?
- While the group agreed that this is a necessary indicator, they also agreed that it needs expert review to “flesh it out.” For now, it acts as a good placeholder.
- Needs work, change back to Aquatic Habitat.
- GLEI working on a similar indicator.

Climate Change: Number of Extreme Storms (Indicator #4519)

This indicator will assess the number “extreme storms” each year, and it will be used to infer the potential impact on ecological components of the Great Lakes of increased numbers of storms due to climate change.

- Everyone agreed that this is something that should be tracked, but that perhaps it should exist in a separate climate change category or bundle. However, they wanted to express their reservations about the usefulness of this particular indicator, and point out that other climate change indicators may be more influential. This indicator should be modified to include an assessment on the depth, amount, and duration of snow cover, which in their opinions would be much more useful and influential.

Climate Change: Ice Duration on the Great Lakes (Indicator #4858)

This indicator will assess the temperature and accompanying physical changes to each lake over time, and it will be used to infer potential impact of climate change on wetlands.

- All agreed that this is a good indicator that is very useful and does not require further modification.
- Climate change category is important and the water lily is a good measure, ice out is also good.
- Consider adding brook trout as it is related to global warming. Also, add nest initiation date of colonial water bird (what species?) for terrestrial signal.

Water Withdrawal (Indicator #7056)

This indicator will assess the amount of water used in the Great Lakes basin per capita, and it will be used to infer the amount of wastewater generated and the demand for resources to pump and treat water.

- Water Withdrawal has assumed much greater importance, but the measure (per capita) isn’t suitable because it won’t tell you anything. What’s more important is the sustainability of the aquifer, which depends on many other factors. Several things need to be bundled together.
- Anything here about water exports?
- It was suggested that the name of this indicator be changed to Water Budget, addressing both the quality and quantity aspects of a water budget, and undergo the following modifications:
 - This indicator should address the hydrologic cycle.
 - The metrics should be changed from per capita to a volume metric such as gallons per day; refer to the metrics used in the USGS report 00-4008.
 - This indicator should be divided into two areas, groundwater withdrawal and surface water withdrawal (example: 7056a-groundwater withdrawal and 7056b-surface water withdrawal).
 - This indicator should be modified such that it answers the following questions: Does the watershed, basin, etc. have a water budget? Is this watershed, basin, etc. meeting this water budget? Where are the water recharge areas? Are these areas being protected? Is there a source water protection plan? Are you meeting this plan? How far has this plan been implemented?
- Water Withdrawal (#7056), Ground Surface Hardening (#7054 Proposed), and Base Flow Due to Groundwater Discharge (Proposed) – it was unanimously agreed upon that these indicators should be merged, and adjusted in accordance with the aforementioned modifications.
- Put in Consumption category or bundle.
- Great Lakes Commission has a database; includes new “Groundwater and Land Use Intensity.”

- Actual water withdrawal vs. water use per capita.
- Consider the recycling of water; the returned water is often degraded.
- Incorporate Ground Water Use and Intensity.

Habitat Fragmentation (Indicator #8114)

This indicator will assess the amount and distribution of natural habitat remaining within Great Lakes ecoregions, and it will be used to infer the effect of human land uses such as housing, agriculture, flood control, and recreation on habitat needed to support fish and wildlife species.

- While it was unanimously agreed upon that this is a useful indicator, the group had several questions and modifications. The group wondered if satellite imagery from Land Conversion #7002 could be used to report on this indicator. They suggested that this indicator should include riparian and aquatic habitats.
- Put in Habitat and Biodiversity category or bundle.

Area, Quality, and Protection of Special Lakeshore Communities (Indicator #8129)

This indicator will assess the changes in area and quality of the twelve special lakeshore communities, and it will be used to infer the success of management activities associated with the protection of some of the most ecologically significant habitats in the Great Lakes terrestrial nearshore.

- While everyone agreed that this is definitely a useful indicator, they argued that the indicator needs to give a more realistic idea of how often this can actually be reported on. They point out that reporting on this indicator every 3-5 years could prove very costly.
- Put in Habitat and Biodiversity category or bundle.

Extent of Hardened Shoreline (Indicator #8131)

This indicator will assess the amount of shoreline habitat altered by the construction of shore protection, and it will be used to infer the potential harm to aquatic life in the nearshore as a result of conditions (i.e., shoreline erosion) created by habitat alteration.

- This was unanimously agreed upon as a good indicator that can be cost effective by using aerial photography.
- Protected Nearshore Areas (#8149), Extent of Hardened Shorelines (#8131), Nearshore Land Use (#8132), Extent and Quality of Nearshore Natural Land Cover (#8136), Sediment Available for Coastal Nourishment (#8142), Artificial Coastal Structures (#8146), and Area, Quality, and Protection of Special lakeshore Communities (#8129) – The group agreed that these indicators should be merged, and linked with Land Conversion (#7002) because they all address different aspects of the same idea.

Nearshore Land Use (Indicator #8132)

This indicator will assess the types and extent of major land uses throughout the Basin, and to identify real or potential impacts of land use on significant natural features or processes, including the twelve special lakeshore communities identified in the Biodiversity Investment Area work in SOLEC 1998-2000.

- Protected Nearshore Areas (#8149), Extent of Hardened Shorelines (#8131), Nearshore Land Use (#8132), Extent and Quality of Nearshore Natural Land Cover (#8136), Sediment Available for Coastal Nourishment (#8142), Artificial Coastal Structures (#8146), and Area, Quality, and Protection of Special lakeshore Communities (#8129) – The group agreed that these indicators should be merged, and linked with Land Conversion (#7002) because they all address different aspects of the same idea.
- Is information available for near the shore?
- Include in protection section but pull out the nearshore information.
- Put in Habitat and Biodiversity category or bundle.

Extent and Quality of Nearshore Natural Land Cover (Indicator #8136)

This indicator will assess the amount of natural land cover that falls within 1 km of the shoreline, and to infer the potential impact of artificial coastal structures, including primary and secondary home development, on the extent and quality of nearshore terrestrial ecosystems in the Great Lakes.

- Protected Nearshore Areas (#8149), Extent of Hardened Shorelines (#8131), Nearshore Land Use (#8132), Extent and Quality of Nearshore Natural Land Cover (#8136), Sediment Available for

Coastal Nourishment (#8142), Artificial Coastal Structures (#8146), and Area, Quality, and Protection of Special lakeshore Communities (#8129) – The group agreed that these indicators should be merged, and linked with Land Conversion (#7002) because they all address different aspects of the same idea.

Sediment Available for Coastal Nourishment (Indicator #8142)

This indicator will assess the amount of water and suspended sediment entering the Great Lakes through major tributaries and connecting channels, and to estimate the amount of sediment available for transport to nourish coastal ecosystems.

- Protected Nearshore Areas (#8149), Extent of Hardened Shorelines (#8131), Nearshore Land Use (#8132), Extent and Quality of Nearshore Natural Land Cover (#8136), Sediment Available for Coastal Nourishment (#8142), Artificial Coastal Structures (#8146), and Area, Quality, and Protection of Special Lakeshore Communities (#8129) – The group agreed that these indicators should be merged, and linked with Land Conversion (#7002) because they all address different aspects of the same idea.
- The group was undecided on what to do with this indicator, and suggested merging it, as mentioned above. They worried that it may be too localized for SOLEC; however, they pointed out that there was data available for this indicator on the U.S. side. They felt that it might be more of a LaMP issue. Nonetheless, all agreed that it does need to be reported.

Artificial Coastal Structures (Indicator #8146)

This indicator will assess the number of artificial coastal structures on the Great Lakes, and it will be used to infer potential harm to coastal habitat by disruption of sand transport.

- Needs better definition to accommodate new pressures.
- Can we reduce number that describe nearshore structures under one indicator and describe how those change?
- Protected Nearshore Areas (#8149), Extent of Hardened Shorelines (#8131), Nearshore Land Use (#8132), Extent and Quality of Nearshore Natural Land Cover (#8136), Sediment Available for Coastal Nourishment (#8142), Artificial Coastal Structures (#8146), and Area, Quality, and Protection of Special lakeshore Communities (#8129) – The group agreed that these indicators should be merged, and linked with Land Conversion (#7002) because they all address different aspects of the same idea.
- Put in Habitat and Biodiversity category or bundle.
- Propose to delete.

Protected Nearshore Areas (Indicator #8149)

This indicator will assess the kilometers/miles of shoreline in six classes of protective status. This information will be used to infer the preservation and restoration of habitat and biodiversity, the protection of adjacent nearshore waters from physical disturbance and undesirable inputs (nutrients and toxics), and the preservation of essential habitat links in the migration (lifecycle) of birds and butterflies.

- Protected Nearshore Areas (#8149), Extent of Hardened Shorelines (#8131), Nearshore Land Use (#8132), Extent and Quality of Nearshore Natural Land Cover (#8136), Sediment Available for Coastal Nourishment (#8142), Artificial Coastal Structures (#8146), and Area, Quality, and Protection of Special lakeshore Communities (#8129) – The group agreed that these indicators should be merged, and linked with Land Conversion (#7002) because they all address different aspects of the same idea.
- Put in Habitat and Biodiversity category or bundle.
- Propose to delete.

Acid Rain (Indicator #9000)

This indicator will assess the pH levels in precipitation and critical loadings of sulphate to the Great Lakes basin, and it will be used to infer the efficacy of policies to reduce sulphur and nitrogen acidic compounds released to the atmosphere.

- Propose to delete - the group felt that this indicator is not worth the effort and should be deleted.

Ground Surface Hardening (Indicator #7054 – New)

This will indicate the degree to which development is affecting natural water drainage and percolation processes and thus causing erosion, and other effects through high water levels during storm events and reducing natural ground water regeneration processes.

- Is this correlated with Urban Development? If so, it is redundant.
- Suggests that you can determine a threshold level for hardening and that is a cause for concern.
- The threshold for impervious surfaces varies according to surficial geology (permeability, slope, whether the precipitation is rain or snow, etc.).
- One can look at a number of conversion scenarios and can estimate the amount of impermeable area based on land conversion formulae. If concentrating on changes in land (#7002), one can pick up a lot of that information. Why not use one measure as a theme.
- It was unanimously agreed upon that this indicator should include a permeability percentage threshold.
- Water Withdrawal (#7056), Ground Surface Hardening (#7054 Proposed), and Base Flow Due to Groundwater Discharge (Proposed) – it was unanimously agreed upon that these indicators should be merged, and adjusted in accordance with the aforementioned modifications.
- Change title to “Percent Impervious Cover in Non-Urban Areas” (pressure).
- Put in Land Use - Land Cover category or bundle.
- It was questioned whether impervious cover is including urban area and if it is best to calculate it as a total percentage and is a higher percentage a good thing or a bad thing?
- How well can it be measured?
 - Satellite is the best way to measure.
 - Costs?
- How do we measure pervious areas? (e.g. small islands in the middle of roads with a small strip of grass.) Can we monitor it?

Groundwater and Land: Use and Intensity (Indicator #7101 – New)

This indicator measures land use and water use and intensity within political sub-divisions (or watershed boundaries) and is used to infer the potential impacts of these practices on the quantity and quality of the groundwater resource. Specifically referring to water use, the indicator also measures supply versus demand issues by assessing the reconstruction of water wells and the construction of new wells.

- No comments

Natural Groundwater Quality and Human-Induced Changes (Indicator #7100 – New)

This indicator will assess the quality of groundwater for drinking water and agricultural purposes, and for ecosystem function. The consumption of groundwater that is degraded in quality may lead to both animal and human health effects. This indicator may also reveal areas where contamination is occurring, and where programs for remediation and prevention of non-point contamination should be focused.

- The group agreed that this indicator is worth keeping with the following modifications: This indicator needs to be restructured such that it addresses the quality of recharge and discharge water, keeping in mind the influence of recharge due to storm water runoff. This indicator also needs to address recharge water protection. After these modifications, this indicator may overlap with #7056 Water Withdrawal and could be merged with it.

Base Flow Due to Groundwater Discharge (Indicator #7102 – New)

This indicator measures the contribution of base flow due to groundwater discharge to total stream flow by sub-watershed and is used to detect the impacts of anthropogenic factors on the quantity of the groundwater resource.

- Water Withdrawal (#7056), Ground Surface Hardening (#7054 Proposed), and Base Flow Due to Groundwater Discharge (Proposed) – it was unanimously agreed upon that these indicators should be merged, and adjusted in accordance with the aforementioned modifications.

Climate Change: Effect on Crop Heat Units (Indicator #9003 – New)

To assess the trends in Crop Heat Units in the Great Lakes basin as an indicator of climate change. A change in atmospheric temperature due to climate change has the potential to increase Crop Heat Units.

This indicator may also aid to infer the potential impact climate change has on species diversity and crop productivity.

- The group was unsure as to how climate change related to SOLEC. They agreed that this indicator should be moved to the biological indicators section and discussed by that group.
- Climate change category is important and the water lily is a good measure, ice out is also good. Consider adding brook trout as it is related to global warming. Also, add nest initiation date of colonial water bird (which species?) for terrestrial signal.

Landscape Ecosystem Health (Indicator #8164 – New)

To describe the makeup of land cover, especially the natural cover, and evaluate the state of the terrestrial ecosystem and the effects of landscape changes over time on the terrestrial ecosystem.

- The group was in agreement that this indicator is a duplicate of Land Conversion (Indicator #7002) and should be merged with it, producing a more comprehensive indicator.

Sediment Flowing into Coastal Wetlands (Indicator #4516)

This indicator will assess the severity of sediment yields flowing into coastal wetlands and potential impact on wetland health.

- Redefine so it is now expressed as coastline levels; suggest that we delete these.
- The group was under the impression that this indicator had already been deleted and did not devote much attention towards it.
- Proposed to delete this indicator prior to the Peer Review Workshop.

Effect of Water Level Fluctuations (Indicator #4861)

This indicator will assess the lake level trends that may significantly affect components of wetland and nearshore terrestrial ecosystems, and it will be used to infer the effect of water level regulation on emergent wetland extent.

- Redefine so now expressed as coastline levels; suggest that we delete these.
- From consortium's point of view they're not really explanatory, and water levels won't tell one about the quality of wetlands; background indicators.
- The group was under the impression that this indicator had already been deleted and did not devote much attention towards it.
- Proposed to delete this indicator prior to the Peer Review Workshop.

Groundwater Dependent Animal and Plant Communities (including amphibians) (Indicator #7130 – New)

- This indicator should also be included in the physical indicators section, as it can be used to assess the quality and quantity of groundwater discharge to water bodies. If this is not an option, an indicator should be created that will report on how biological resources are being impacted by groundwater discharge.
- Brook Trout; Amphibians.
- 2 Ministries in Ontario collect data: Conservation Authorities & Ministry of the Environment
- Sentinal species, related to global warming.

Biological Indicators

Fish Habitat (Indicator #6)

This indicator will assess the quality, quantity and location of aquatic habitat in the Great Lakes ecosystem, including the percent of habitat that has been disturbed or destroyed, and will be used to infer progress in rehabilitating degraded habitat and associated aquatic communities.

- Should this be included in the biological section?
- The fish habitat descriptor is more of a place holder than a specific indicator.
- For which fish species and at what stage of the life cycle does this indicator attempt to measure?
- While the group agreed that this is a necessary indicator, they also agreed that it needs expert review to “flesh it out.” For now, it acts as a good placeholder.
- Needs work, Change back to Aquatic Habitat.
- GLEI working on a similar indicator.

Salmon and Trout (Indicator #8)

This indicator will show trends in populations of introduced trout and salmon populations, as well as species diversity, and it will be used to evaluate the potential impacts on native trout and salmon populations and the preyfish populations that support them.

- It is very dependent on number of individuals stocked and does not say anything about integrity.
- Propose to delete.
- Leave it on the list for now, there are political motivations.

Walleye (Indicator #9)

This indicator will show the status and trends in walleye populations in various Great Lakes’ habitats, and it will be used in conjunction with the Hexagenia indicator, to infer the basic structure of warm-cool water predator and prey communities, the health of percid populations, and the health of the Great Lakes ecosystem.

- No changes needed.

Preyfish Populations (Indicator #17)

This indicator will assess the abundance and diversity of preyfish populations, and it will be used to infer the stability of predator species necessary to maintain the biological integrity of each lake.

- Indices
- Keep, but rename to Preyfish Populations and Communities.

Sea Lamprey (Indicator #18)

This indicator will estimate sea lamprey abundance and assess their impact on other fish populations in the Great Lakes.

- No changes needed.

Native Unionid Mussels (Indicator #68)

This indicator will assess the population status of native Unionid populations, and it will be used to infer the impact of the invading *Dreissenid* mussel on the Unionid mussel.

- Needs data.

Lake Trout (Indicator #93)

This Indicator will show the status and trends in lake trout populations, a major coldwater predator and subject of an international effort to rehabilitate populations to near historic levels of abundance.

- No changes needed.

Benthos Diversity and Abundance (Indicator #104)

This indicator will assess trends in time and spatial distribution of species diversity, abundance, production and yield in the aquatic benthic community, and it will be used to infer the relative health of the benthic community, including the relative abundance of non-native species.

- Ok - more general than oligochaetes.
- Except “Yield” - can’t monitor, measuring “Production” is hard.
- Put on the Index list.

Phytoplankton Populations (Indicator #109)

This indicator will assess the species and size composition of phytoplankton populations in the Great Lakes, and it will be used to infer the impact of nutrient enrichment, contamination and invasive exotic predators on the Great Lakes ecosystem.

- Change title to Phytoplankton Populations and Communities (not to imply biomass).

Contaminants in Young-of-the-Year Spottail Shiners (Indicator #114)

This indicator will assess the levels of PBT chemicals in young-of-the-year spottail shiners, and it will be used to infer local areas of elevated contaminant levels and potential harm to fish-eating wildlife.

- Keep
- Put in Toxics in Wildlife/Food Chain bundle.
- Move to chemical category.

Contaminants in Colonial Nesting Waterbirds (Indicator #115)

This indicator will assess chemical concentration levels in a representative colonial waterbird, and it will be used to infer the impact of these contaminants on colonial waterbird physiology and population characteristics.

- Put in Toxics in Wildlife/Food Chain bundle.
- Propose to delete.
- Index of Water birds?
 - Invent a metric.
 - Separate contaminants in birds out of the Biological category.

Zooplankton Populations (Indicator #116)

This indicator will assess characteristics of the zooplankton community over time and space, and it will be used to infer changes over time in vertebrate or invertebrate predation, system productivity, energy transfer within the Great Lakes, or other food web dynamics.

- Rename to Zooplankton Populations and Communities.

***Hexagenia* (Indicator #122)**

This indicator will show the status and trends in *Hexagenia* populations, and will be used to infer the health of the *Hexagenia* populations and the Great Lakes ecosystem.

- Add rocky substrate benthos and wetlands benthos.

Benthic Amphipod (*Diporeia* spp.) (Indicator #123)

This indicator will show the status and trends in *Diporeia* populations, and infer the basic structure of coldwater benthic communities and the general health of the ecosystem.

- Keep. Ok to split out and give a new number.

Presence, Abundance and Expansion of Invasive Plants (Indicator #4513)

This indicator will assess the decline of vegetative diversity associated with an increase in the presence, abundance, and expansion of invasive plants, and it will be used as a surrogate measure of the quality of coastal wetlands which are impacted by coastal manipulation or input of sediments.

- Propose to delete.
- This indicator has been replaced by a new indicator that is more inclusive and representative. Substitution – Wetlands Plant Community Health.

Climate Change: First Emergence of Water Lilies in Coastal Wetlands (Indicator #4857)

This indicator will assess the change over time in first emergence dates of water lilies as a sentinel of climate change affecting the Great Lakes.

- This could be an surrogate to "Climate Change" and would provide information at a local scale.
- Climate change category is important and the water lily is a good measure, ice out is also good.
- Consider adding brook trout as it is related to global warming. Also, add nest initiation date of colonial water bird (which species?) for terrestrial signal.

Nearshore Plant and Animal Problem Species (Indicator #8134)

This indicator will assess the type and abundance of plant and wildlife problem species in landscapes bordering the Great Lakes, and it will be used to identify the potential for disruption of nearshore ecological processes and communities.

- This is a collection of several species; deer, beaver (?), etc. - it is a catch all.
- Propose to delete – this topic is covered by #104 (revised), #8137 and other plant and animal diversity measures.
- Combine Nearshore Plant & Animal Problem Species as component of #8129.

Contaminants Affecting Productivity of Bald Eagles (Indicator #8135)

This indicator will assess number of fledged young, number of developmental deformities, and the concentrations of organic and heavy metal contamination in Bald Eagle eggs, blood, and feathers. The data will be used to infer the potential harm to other wildlife and human health through the consumption of contaminated fish.

- Put in Toxics in Wildlife/Food Chain bundle.
- Change to population metrics, not contaminants.
- Rename and convert to population metrics.

Nearshore Species Diversity and Stability (Indicator #8137)

This indicator will assess the composition and abundance of plant and wildlife species over time within the nearshore area, and will infer adverse effects on the nearshore terrestrial ecosystem due to stresses such as climate change and/or increasing land use intensity.

- Needs work - focus on nearshore parts not already being addressed.
- Weave in as part of #8129 Special Lakeshore Communities.

Contaminants Affecting the American Otter (Indicator #8147)

This indicator will assess the contaminant concentrations found in American otter populations within the Great Lakes basin, and it will be used to infer the presence and severity of contaminants in the aquatic food web of the Great Lakes.

- Put in Toxics in Wildlife/Food Chain bundle.
- Change to population metrics, not contaminant focus.
- Rename and convert to population metrics.
- US Fish and Wildlife Service is looking at otter and mink.

Breeding Bird Diversity and Abundance (Indicator #8150)

This indicator will assess the status of breeding bird populations and communities, and it will be used to infer the health of breeding bird habitat in the Great Lakes basin.

- Develop as an index.
- Colonial waterbird, nearshore species, terrestrial species; also migrating water birds.
- Wetlands Ok as an area: needs work.

Threatened Species (Indicator #8161)

This indicator will assess the number, extent and viability of threatened species, which are key components of biodiversity in the Great Lakes basin, and it will be used to infer the integrity of ecological processes and systems (e.g., sand accretion, hydrologic regime) within Great Lakes habitats.

- Sounds like it should be expanded to include other species like eels, and *Diporeia*. That is things that aren't tracked as species at risk.
- Suggest changing name to "Species Under Threat" rather than "Threatened Species", which has a legal definition/connotation.

- Aren't these included in other biodiversity indicators?
- "Should be easy to report."

Non-Native Species (Indicator #9002)

This indicator will assess the presence, abundance and distribution of invasive exotic species in the Great Lakes basin ecosystem and their impacts on ecosystem functioning.

- Why doesn't this get more specific by giving number of new species identified and/or giving a 3-year running average? If number is > 0, that's a cause for concern. New invasions are things that are of most concern and it's obvious what the status is, so why not add some numbers?
- Why not measure the percentage of community taken up by invading species, of which plants and fish are two aspects?
- Does that take into account the amplification of damage caused by increasing numbers of invading species?
- Need a metric: relative rate of introduction of new species by functional groups: plants, invertebrates, fish.
- Develop an integrated index, include range expansion.
- Great Lakes Commission is working on Aquatic Nuisance Species - Early Warning System.
- Sea Grant agents deal with invasions, assembling information.
- Expand to terrestrial - whole basin? Example: Deer
- Develop 3 indices: Aquatic, Nearshore, Terrestrial
- Priority to develop aquatic & nearshore regions.
- Get involvement from The Nature Conservancy for terrestrial.

External Anomaly Prevalence Index for Nearshore Fish (Indicator #124 – New)

This indicator will assess the combination of external anomalies in nearshore fish that will be used as an estimate of ecosystem health within the Great Lakes.

- Converted from DELT (#101).

Integrated Pest Management (Indicator #7062 – New)

This indicator will assess the adoption and uptake of Integrated Pest Management practices by farmers and to infer environmentally friendly practices in place, to prevent ground and surface water contamination.

- Move to Land Use.

Groundwater Dependant Animal and Plant Communities (including amphibians) (Indicator #7103 – New)

This indicator will assess locations of groundwater intrusions, support measuring of the contribution of groundwater to stream and near shore flows, and contribute to evaluation of trophic status, food web dynamics, and location of groundwater-fed habitats and the groundwater-dependent fish, wildlife and plant communities at risk in the Great Lakes basin. By inference, this indicator will also describe certain chemical and physical parameters of groundwater, including changes in patterns of seasonal flows.

- Brook Trout; Amphibians
- 2 Ministries in Ontario collect data: Conservation Authorities & Ministry of the Environment.
- Sentinal species, related to global warming.
- This indicator should also be included in the physical indicators section, as it can be used to assess the quality and quantity of groundwater discharge to water bodies. If this is not an option, an indicator should be created that will report on how biological resources are being impacted by groundwater discharge.

Status of Lake Sturgeon in the Great Lakes (Indicator #125 – New)

Presence of lake sturgeon in abundance in the Great Lakes will indicate a healthy ecosystem. When the Great Lakes were still in pristine conditions (prior to European settlement) lake sturgeon were extremely abundant in the lakes. If the condition of the lakes were improved to the point where lake sturgeon numbers were able to increase, it would indicate a healthy improving ecosystem.

- Great Lakes Basin Ecosystem Team (a group of US FWS) to be responsible for reporting.

Climate Change: Effect on Crop Heat Units (Indicator #9003 – New)

To assess the trends in Crop Heat Units in the Great Lakes basin as an indicator of climate change. A change in atmospheric temperature due to climate change has the potential to increase Crop Heat Units. This indicator may also aid to infer the potential impact climate change has on species diversity and crop productivity.

- Move to physical category.
- Climate change category is important and the water lily is a good measure, ice out is also good.
- Consider adding brook trout as it is related to global warming. Also, add nest initiation date of colonial water bird (which species?) for terrestrial signal.

Health of Terrestrial Plant Communities (Indicator #8162 – New)

This indicator will assess the presence, abundance, distribution and trends over time of non-native insects and diseases infesting plants, and their impacts on plant mortality or damage (including deformities), as well as the impact of airborne and groundwater pollution on plant community health.

Landscape Ecosystem Health (Indicator #8164 – New)

To describe the makeup of land cover, especially the natural cover, and evaluate the state of the terrestrial ecosystem and the effects of landscape changes over time on the terrestrial ecosystem.

- The group was in agreement that this indicator is a duplicate of Land Conversion (#7002) and should be merged with it, producing a more comprehensive indicator.

Deformities, Eroded Fins, Lesions and Tumors (DELT) in Nearshore Fish (Indicator #101)

This indicator will assess the combination of deformities, eroded fins, lesions and tumors (DELT index) in nearshore fish, and it will be used to infer areas of degraded habitat within the Great Lakes.

- Propose to delete prior to Indicator Review Workshop.
- This indicator has been replaced by a new indicator, External Anomaly Prevalence Index for Nearshore Fish (#124) that is more inclusive and representative.

Deformities, Eroded Fins, Lesions and Tumors (DELT) in Coastal Wetland Fish (Indicator #4503)

This indicator will assess the combination of deformities, eroded fins, lesions and tumours (DELT index) in fish of Great Lakes coastal wetlands, and it will be used to infer ecosystem health of Great Lakes coastal wetlands.

- Propose to delete prior to Indicator Review Workshop.
- This indicator has been replaced by a new indicator, External Anomaly Prevalence Index for Nearshore Fish (#124) that is more inclusive and representative.

Suggested Indicators for Inclusion in Biological Category:

Water clarity measure is needed

- Some gross measure to show major shifts in the system

Indicator of Submergent Aquatic Plants needs to be developed

- Is indicator of light: Depth of rooted aquatic plants
- Is important to understand relative change in lakes

Human Health Indicators

Contaminants in Recreational Fish (Indicator #113)

This indicator will assess the levels of PBT chemicals in fish, and it will be used to infer the potential harm to human health through consumption of contaminated fish.

- This was proposed to be a market basket average index; have never made those calculations.
- Put in Toxics in Wildlife/Food Chain bundle.
- There are 3 indicators that refer to contaminants in edible fish tissue (Contaminants in Recreational Fish #113, Contaminants in Whole Fish #121, and Contaminants in Edible Fish Tissue #4083). The group suggests SOLEC experts look at the data quality, geographic range, etc for each and select the best indicator. If all 3 provided valuable and different information, they should at least be reported in one bundle reporting on contaminant impacts on fish.
- Propose to delete - it is not being measured and is covered in #4083, Contaminants in Edible Fish Tissue.

E. coli and Fecal Coliform Levels in Nearshore Recreational Waters (Indicator #4081)

This indicator will assess *E. coli* and fecal coliform contaminant levels in nearshore recreational waters, acting as a surrogate indicator for other pathogen types, and it will be used to infer potential harm to human health through body contact with nearshore recreational waters.

- No changes are needed.

Contaminants in Edible Fish Tissue (Indicator #4083)

This indicator will assess the concentration of persistent, bioaccumulating, toxic (PBT) chemicals in Great Lakes fish, and it will be used to infer the exposure of humans to PBT chemicals through consumption of Great Lakes fish caught via sport and subsistence fishing.

- Propose to delete.
- Do we need both #113 and #4083? It seems that #4083 is more germane.
- Put in Toxics in Wildlife/Food Chain bundle.
- There are 3 indicators that refer to contaminants in edible fish tissue (Contaminants in Recreational Fish #113, Contaminants in Whole Fish #121, and Contaminants in Edible Fish Tissue #4083). The group suggests SOLEC experts look at the data quality, geographic range, etc for each and select the best indicator. If all 3 provided valuable and different information, they should at least be reported in one bundle reporting on contaminant impacts on fish.
- It is recommended to keep this indicator; however, First Nations consumption needs to be considered (the Ontario Ministry of Environment Sport Fish Advisory Guide is based on average consumption rates not on subsistence fishers). Special communities need to be included within this indicator.
- Recommend combining the Edible Fish Tissue #4083 and Contaminants in Recreational Fish #113 indicators into Contaminants in Sport and Commercial Fish.

Chemical Contaminant Intake from Air, Water, Soil and Food (Indicator #4088)

This indicator will estimate the daily intake of PBT chemicals from all sources, and it will be used to evaluate the potential harm to human health and the efficacy of policies and technology intended to reduce PBT chemicals.

- Too research oriented and not sure how it will be measured
- Propose to delete because it is unclear what to do with this information if it could be collected and how it relates to the Great Lakes impact on human health (largest contaminant intake is from the food component – most people get their food from the supermarket and a lot of this comes from outside of the basin).

Drinking Water Quality (Indicator #4175)

This indicator will assess the chemical and microbial contaminant levels in drinking water, and it will be used to evaluate the potential for human exposure to drinking water contaminants and the efficacy of policies and technologies to ensure safe drinking water.

- The public doesn't believe water quality reports, judging by sales of bottled water; also Walkerton tragedy; perhaps we should include new indicator on human diseases in drinking water.
- The indicator is made up of 10 parameters, some in raw water and some in treated water; mainly looks at water at the outlet of the water treatment plant, not when it reaches the house → this is a different issue.
- It is recommended that the description for this indicator be revised since it lists a huge number of parameters. We could consider primary and secondary parameters. We also need to ensure we are measuring the right things in order to increase consumer confidence.

Air Quality (Indicator #4176)

This indicator will monitor the air quality in the Great Lakes ecosystem, and it will be used to infer the potential impact of air quality on human health in the Great Lakes basin.

- Put in Toxic Sources and Loadings bundle.
- The decision for this indicator is on hold – we need to determine if it should be reported on through SOLEC or through the Air Quality Agreement.

Chemical Contaminants in Human Tissue (Indicator #4177)

This indicator will assess the concentration of PBT chemicals in human tissues, and it will be used to infer the efficacy of policies and technology to reduce PBT chemicals in the Great Lakes ecosystem.

- Potentially very important; it is a way of putting into context the importance of some of the things we've been monitoring. The source is due to market fish; Great Lakes fish are an issue but the supermarket is a significant source; and finger is pointed only to Great Lakes fish; numerically, there aren't enough fish to account for half of the PCBs in people.
- People do eat Great Lakes fish, especially tribes. This will be important for as long as we have contaminants in Great Lakes fish, and it will continue to affect a major industry. Fishing is important to Great Lakes, whether or not people eat the fish, from the point of view of the economy. This is a different question than "where do we get our contamination"; both are important.
- Too research oriented and not sure how robust the data will be since humans move throughout and outside of the basin.
- Propose to delete. There are other indicators to cover the information provided within this indicator. It is difficult to tease out non-migratory humans (and therefore, the human health impacts of living within the Great Lakes basin). However, we do need to review the Jacobson Study and First Nations Communities studies (i.e. the EAGLE project would provide a snapshot for this indicator) before deciding whether or not to delete.

Radionuclides (Indicator #4178)

This indicator will assess the concentrations of artificial radionuclides in cow's milk, surface water, drinking water, and air, and it will be used to estimate the potential for human exposure to artificial radionuclides.

- Put in Toxic Sources and Loadings bundle.
- Propose to delete. There are two sources of radiation that can be measured currently, background levels and radiation from nuclear testing. Background levels cannot be changed and there has been no fallout from nuclear testing in the recent past. Also, the last sentence in the Limitations section states: "The trend illustrated by these data... is not especially useful to policy makers and regulatory agencies."

Geographic Patterns and Trends in Disease Incidence (Indicator #4179)

This indicator will assess geographical and temporal patterns in disease incidences in the Great Lakes basin population, and it will also be used to identify areas where further investigation of the exposure and effects of environmental pollutants on human health is needed.

- People have tried to say that epidemiology is a Great Lakes issue, but some are uncomfortable with the way the indicator is worded.
- Regarding human health and the biology of human diseases, what about losses of migrating birds succumbing to avian botulism?

- The decision for this indicator on hold until it is determined whether this indicator can be reported on. This is a red flag indicator and if it can be reported on, it would be quite useful.

Land Use Indicators (including Societal and Groundwater)

Capacities of Sustainable Landscape Partnerships (Indicator #3509)

This indicator assesses the organizational capacities required of local coalitions to act as full partners in ecosystem management initiatives. It includes the enumeration of public-private partnerships relating to the pursuit of sustainable ecosystems through environmental management, staff, and annual budgets.

- Propose to delete.

Organizational Richness of Sustainable Landscape Partnerships (Indicator #3510)

This indicator assesses the diversity of membership and expertise included in partnerships. Horizontal integration is a description of the diversity of partnerships required to address local issues, and vertical integration is the description of federal and state/provincial involvement in place-based initiatives as full partners.

- Propose to delete.

Integration of Ecosystem Management Principles Across Landscapes (Indicator #3511)

This indicator describes the extent to which federal, state/provincial, and regional governments and agencies have endorsed and adopted ecosystem management guiding principles in place-based resource management programs.

- Propose to delete.

Integration of Sustainability Principles Across Landscapes (Indicator #3512)

This indicator describes the extent to which federal, state/provincial, and regional governments and agencies have endorsed and adopted sustainability guiding principles in place-based resource management programs.

- Propose to delete.

Citizen/Community Place-Based Stewardship Activities (Indicator #3513)

This indicator will reflect the number, vitality and effectiveness of citizen and community stewardship activities. Community activities that focus on local landscapes/ecosystems provide a fertile context for the growth of the stewardship ethic and the establishment of “a sense of place.”

- Proposed to be deleted prior to Indicator Review Workshop.

Urban Density (Indicator #7000)

This indicator will assess the human population density in the Great Lakes basin, and it will be used to infer the degree of inefficient land use and urban sprawl for communities in the Great Lakes ecosystem.

- Agree that urban density is ambiguous; could be good or bad; urban sprawl could be captured under land conversion
- Put in Land Use - Land Cover category/bundle
- Split into 2 Indicators: Density of Development/Redevelopment in Metropolitan Statistical Areas (MSAs), Standard Metropolitan Statistical Areas (SMSAs), and Census Metropolitan Areas (CMAs) and Density of Development/Redevelopment Outside of MSAs, SMSAs, and CMAs
- 7000a—“Density of Development/Redevelopment in MSAs, SMSAs, and CMAs” (activity indicator)
 - includes #7006 Brownfield Development as a feature or endpoint
 - may include #7042 Aesthetics, with caution in interpreting density
 - it is recommended that this indicator does not measure population but the density of development acreage
 - the measure should be in acreages/hectares
- 7000b—“Density of Development/Redevelopment Outside of MSAs, SMSAs, and CMAs” (activity indicator)
 - it is recommended that this indicator does not measure population but the density of development acreage.

Land Conversion (Indicator #7002)

This indicator will assess the changes in land use within the Great Lakes basin, and it will be used to infer the potential impact of land conversion on Great Lakes ecosystem health.

- Very important.
- If we look at conversion we have the potential to measure human density.
- The biggest impact is conversion of forest to any other use.
- Change title to “Land Cover Change” (state indicator).
- Put in Land Use - Land Cover category/bundle.
- Combine #7000 Urban Density, #7006 Brownfield Redevelopment, and #7054 Ground Surface Hardening within this indicator.
- Percent change in land use type.
- Implementing satellite imagery for land cover would be ideal.
- Problem with satellite data: it can be misleading (e.g. difficult to differentiate between grass lands and crops, also wetlands are difficult to interpret).
- Basin Wide - Physical measurable aspect
- Subdivisions - Urban areas
 - Density
 - Brownfield redevelopment

Brownfield Redevelopment (Indicator #7006)

This indicator will assess the acreage of redeveloped brownfields, and it will be used over time to evaluate the rate at which society rehabilitates and reuses former developed land sites that have been degraded by poor use.

- Propose to delete, will be covered within other indicators.

Mass Transportation (Indicator #7012)

This indicator will assess the percentage of commuters using public transportation, and it will be used to infer the stress to the Great Lakes ecosystem caused by the use of the private motor vehicle and its resulting high resource utilization and pollution creation

- Put in Consumption category/bundle.
- Change title to “Vehicle Miles Travelled.” Need to include air emissions from vehicle use, time spent in vehicles, green house gas inventory, personal vs. commercial use.
- Measure air emissions and quality of life (how many hours spent in vehicles).
- Use green house gas inventory for possible resource of information.
- Specific metrics are needed as well as possible resources.
- Commercial vs. Private travel/vehicles.

Sustainable Agriculture Practices (Indicator #7028)

This indicator will assess the number of Environmental and Conservation farm plans, and it will be used to infer environmentally friendly practices in place, such as integrated pest management to reduce the unnecessary use of pesticides, zero tillage and other soil preservation practices to reduce energy consumption, and prevention of ground and surface water contamination.

- Number of farm plans, this is an easy measure to collect.
- Not an outcome indicator or state of environment indicator.
- Pesticide measure fluctuates frequently but this is the only agriculture indicator in the suite for the Great Lakes.
- Sustainable Agricultural Practices: should be its own category (not an individual indicator)
- Should be treated the same as a forestry or coastal wetlands category. *There is a need for the agricultural departments to provide information, similar to the forestry and coastal wetlands*
- Insufficient as the only agriculture indicator. Invite participation at SOLEC 2004 by agricultural staff working on indicators. Suggest the following agriculture categories with indicators under each as relevant for SOLEC:
 1. Pesticide consumption / application
 2. Chemical fertilizer consumption / application

- 3. Manure application and management
- 4. Agriculture erosion risk
- 5. Nutrient loadings / management

Aesthetics (Indicator #7042)

This indicator will assess the amount of waste and decay around human activities in the Great Lakes basin, and it will be used to infer the degree to which human activities are conducted in an efficient and ordered fashion consistent with ecosystem harmony and integrity.

- Needs a clearer description.
- Propose to delete, will be covered within other indicators.

Economic Prosperity (Indicator #7043)

This indicator will assess the unemployment rates within the Great Lakes basin, and it will be used in association with other Societal indicators to infer the capacity for society in the Great Lakes region to make decisions that will benefit the Great Lakes ecosystem.

- Should relate well being to the type of economic activity - that would give good information.
- Also want to know about the urban economy.
- What about trying to measure per capita income? This could be gathered by census blocks and could be used as a trend analysis rather than population averages.

Green Planning Process (Indicator #7053)

This indicator will assess the number of municipalities with environmental and resource conservation management plans in place, and it will be used to infer the extent to which municipalities utilize environmental standards to guide their management decisions with respect to land planning, resource conservation and natural area preservation.

- Propose to delete.

Water Withdrawal (Indicator #7056)

This indicator will assess the amount of water used in the Great Lakes basin per capita, and it will be used to infer the amount of wastewater generated and the demand for resources to pump and treat water.

- Water Withdrawal has assumed much greater importance, but the measure (per capita) isn't suitable because it won't tell you anything. What's more important is the sustainability of the aquifer, which depends on many other factors. Several things need to be bundled together.
- Should we include water exports?
- It was suggested that the name of this indicator be changed to Water Budget addressing both the quality and quantity aspects of a water budget and undergo the following modifications:
 - This indicator should address the hydrologic cycle.
 - The metrics should be changed from per capita to a volume metric such as gallons per day; refer to the metrics used in the USGS report 00-4008.
 - This indicator should be divided into two areas, groundwater withdrawal and surface water withdrawal (example: 7056a-groundwater withdrawal and 7056b-surface water withdrawal).
 - This indicator should be modified such that it answers the following questions: Does the watershed, basin, etc. have a water budget? Is this watershed, basin, and etc. meeting this water budget? Where are the water recharge areas? Are these areas being protected? Is there a source water protection plan? Are you meeting this plan? How far has this plan been implemented?
- Water Withdrawal (#7056), Ground Surface Hardening (#7054 Proposed), & Base Flow Due to Groundwater Discharge (Proposed) – It was unanimously agreed upon that these indicators should be merged, and adjusted in accordance with the aforementioned modifications.
- Put in Consumption category/bundle.
- “Water Withdrawal” – Great Lakes Commission has the database; includes new “Groundwater and Land Use Intensity.”
- Actual water withdrawal vs. water use per capita.
- Consider the recycling of water; the returned water is often degraded.
- Incorporate Ground Water Use and Intensity (Proposed Indicator).

Energy Consumption (Indicator #7057)

This indicator will assess the amount of energy consumed in the Great Lakes basin per capita, and it will be used to infer the demand for resource use, the creation of waste and pollution, and stress on the ecosystem.

- Put in Consumption category/bundle.
- Change title to “Fossil Fuel Consumption.”
- The long description needs to be revised with better endpoints and energy use categories.
- 30% of energy is used in the production of energy.
- Consider habitat threats (wind energy/turbines killing birds).

Solid Waste Generation (Indicator #7060)

This indicator will assess the amount of solid waste generated per capita per capita in the Great Lakes basin, and it will be used to infer inefficiencies in human economic activity (i.e., wasted resources) and the potential adverse impacts to human and ecosystem health.

- Put in Consumption category/bundle.
- “Solid Waste Generation”– include the new “Household Solid Waste.”
- Recycling has increased, but so has generation.
- The description needs to be revised.
- Use the Environment Canada Environmental Signals report as an example of how to report on this indicator.
- Environment Canada’s National Indicators Office is a possible resource of information.
- Incorporate Household Solid Waste Minimization (Proposed) in this indicator (no longer 2 individual indicators).

Habitat Fragmentation (Indicator #8114)

This indicator will assess the amount and distribution of natural habitat remaining within Great Lakes ecoregions, and it will be used to infer the effect of human land uses such as housing, agriculture, flood control, and recreation on habitat needed to support fish and wildlife species.

- While it was unanimously agreed upon that this is a useful indicator, the group had several questions and modifications. The group wondered if satellite imagery from #7002 Land Conversion could be used to report on this indicator. They suggested that this indicator include riparian and aquatic habitats.
- Put in Habitat and Biodiversity category/bundle.

Nearshore Land Use (Indicator #8132)

This indicator will assess the types and extent of major land uses throughout the basin, and to identify real or potential impacts of land use on significant natural features or processes, including the twelve special lakeshore communities identified in the Biodiversity Investment Area work in SOLEC 1998-2000.

- Protected Nearshore Areas (#8149), Extent of Hardened Shorelines (#8131), Nearshore Land Use (#8132), Extent and Quality of Nearshore Natural Land Cover (#8136), Sediment Available for Coastal Nourishment (#8142), Artificial Coastal Structures (#8146), and Area, Quality, and Protection of Special lakeshore Communities (#8129) – The group agreed that these indicators should be merged, and linked with Land Conversion (#7002) because they all address different aspects of the same idea
- Is information available for the nearshore?
- Include in protection section but pull out the nearshore information.
- Put in Habitat and Biodiversity category/bundle.

Community / Species Plans (Indicator #8139)

This indicator will assess the number of plans that are needed, developed, and implemented to protect, maintain or restore high quality, natural nearshore communities and federally listed endangered, threatened, and vulnerable species. This indicator will be used to infer the degree of human stewardship toward these communities and species.

- Seems to be an indicator of how many plans we need and we are not sure about the relevance of that.

- Propose to delete - *This is a programmatic indicator; it does not help with the understanding of the ecosystem.*

Financial Resources Allocated to Great Lakes Programs (Indicator #8140)

This indicator will measure the amount of dollars spent annually on Great Lakes programs and indirectly measure the responsiveness of Great Lakes programs by determining the adequacy of annual funding focused on research, monitoring, restoration, and protection of Great Lakes ecosystems by federal and state/provincial agencies and non-governmental organizations.

- Propose to delete - *This is a programmatic indicator; it does not help with the understanding of the ecosystem.*

Shoreline Managed Under Integrated Management Plans (Indicator #8141)

This indicator will assess the amount of Great Lakes shoreline managed under an integrated management plan, and it will be used to infer the degree of stewardship of shoreline processes and habitat.

- Propose to delete - *This is a programmatic indicator; it does not help with the understanding of the ecosystem.*

Artificial Coastal Structures (Indicator #8146)

This indicator will assess the number of artificial coastal structures on the Great Lakes, and it will be used to infer potential harm to coastal habitat by disruption of sand transport.

- Needs better definition to accommodate new pressures.
- Can we reduce number that describe nearshore structures under one indicator and describe how those change?
- Protected Nearshore Areas (#8149), Extent of Hardened Shorelines (#8131), Nearshore Land Use (#8132), Extent and Quality of Nearshore Natural Land Cover (#8136), Sediment Available for Coastal Nourishment (#8142), Artificial Coastal Structures (#8146), and Area, Quality, and Protection of Special lakeshore Communities (#8129) – The group agreed that these indicators should be merged, and linked with Land Conversion (#7002) because they all address different aspects of the same idea
- Put in Habitat and Biodiversity category/bundle.
- Propose to delete.

Protected Nearshore Areas (Indicator #8149)

This indicator will assess the kilometers/miles of shoreline in six classes of protective status. This information will be used to infer the preservation and restoration of habitat and biodiversity, the protection of adjacent nearshore waters from physical disturbance and undesirable inputs (nutrients and toxics), and the preservation of essential habitat links in the migration (lifecycle) of birds and butterflies.

- Protected Nearshore Areas (#8149), Extent of Hardened Shorelines (#8131), Nearshore Land Use (#8132), Extent and Quality of Nearshore Natural Land Cover (#8136), Sediment Available for Coastal Nourishment (#8142), Artificial Coastal Structures (#8146), and Area, Quality, and Protection of Special lakeshore Communities (#8129) – The group agreed that these indicators should be merged, and linked with Land Conversion (#7002) because they all address different aspects of the same idea
- Put in Habitat and Biodiversity category/bundle.
- Propose to delete.

Ground Surface Hardening (Indicator #7054 – New)

This will indicate the degree to which development is affecting natural water drainage and percolation processes and thus causing erosion, and other effects through high water levels during storm events and reducing natural ground water regeneration processes.

- Is this correlated with Urban Development? If so, it is redundant.
- Suggests that you can put a threshold level to hardening and that is a cause for concern.
- The threshold for impervious surfaces varies according to surficial geology (permeability, slope, whether rain or snow, etc.).

- One can look at a number of conversion scenarios and can estimate the amount of impermeable area based on land conversion formulae. If concentrating on changes in land (#7002), one can pick up a lot of that information. Why not use one measure as a theme?
- It was unanimously agreed upon that this indicator should include a permeability percentage threshold
- Water Withdrawal (#7056), Ground Surface Hardening (#7054 Proposed), & Base Flow Due to Groundwater Discharge (Proposed) – It was unanimously agreed upon that these indicators should be merged, and adjusted in accordance with the modifications suggested above and in the Water Withdrawal indicator (#7056).
- Change title to “Percent Impervious Cover in Non-Urban Areas” (pressure indicator). The amount of impervious surface could be used as a physical indicator. The amount of impervious surface is a major determinant of groundwater recharge.
- Put in Land Use - Land Cover category/bundle.
- It is questioned whether impervious cover includes urban area and if it does is it best to calculate it as a total percentage? Is a higher percentage a good thing or a bad thing?
- How well can it be measured?
 - Satellite is the best way to measure.
 - Costs?
- How do we measure pervious areas? (e.g. small islands in the middle of roads with a small strip of grass.) Can we monitor it?

Commercial/Industrial Environmental Management Systems (Indicator #3517 – New)

This indicator will infer the level of commitment, on the part of industries and businesses in the Great Lakes ecosystem, to documenting and reducing environmental impacts.

- Propose to delete - *incorporate into Commercial / Industrial Eco-efficiency indicator.*

Commercial/Industrial Eco-Efficiency (Indicator #3514 – New)

This indicator will assess the commercial/industrial sector response to pressures imposed on the ecosystem as a result of production processes and service delivery.

- Put in Consumption category/bundle.

Community Engagement in Great Lakes Protection & Decision-Making (Indicator #3518 – New)

This indicator will assess the extent of community involvement in Great Lakes activities and organizations as a measure of community interest and sense of responsibility toward the health and sustainability of the Great Lakes.

- Propose to delete.

Cosmetic Pesticide Controls (Indicator #3515 – New)

This indicator will identify the communities that are invoking a ban on harmful pesticides, to explore the reasons for their decision and to raise awareness of this new policy in other communities in Canada as well the US that have not yet imposed such restrictions.

- Would it be more practical and more to the point to actually look at the amount of cosmetic pesticides sold - instead of talking about number of plans, talk about the quantities of materials so we can view it in the context of endpoints (i.e. zero pesticides sold). In other words, measure the outcomes, not the plans.
- Don't know what the product of this indicator is. Don't know what "cosmetic pesticide" means. These pesticides are legally sold on a regular basis and come with regulations for proper use. If used properly, what is the problem?
- Most people misuse fertilizer and herbicides indiscriminately; use more than they need, leading to runoff, etc.
- We are not sure that we KNOW they do this. We suspect that they misuse the pesticide. Golf courses hire licensed applicators who know the correct amounts to use. Sales data would only be of use if it could show that sales are twice as high as they should be for a specific area.
- It would be impossible to get a proper measure of pesticides sold in a given area because some areas have no agricultural chemical sales outlets and a county that has the home office of a registered

applicator may appear to show a county that's swimming in pesticides when in reality it is just the distributor that is skewing the data.

- On other hand can easily find Diazanone in the Don River, and could only come from urban lawns
- Put in Consumption category/bundle.
- Change title to “Residential and Commercial Pesticide Consumption and Application.”

Environmental Education (Indicator #3519 – New)

This indicator will explore the relationship between education and the level of commitment to and awareness of environmental issues.

- People may have good ideas and good intentions, but are we suggesting that we should be educating people not to drive SUVs? Where do we draw the line and how do we measure these things? Some "educated" people make conscious efforts not to promote "green" practices anyway!
- The group questioned the involvement of SOLEC with managing and reporting on environmental education. However, many noted the influential capabilities of environmental education.
- Propose to delete.

Household Solid Waste Minimization (Indicator #3520 – New)

This indicator will infer the level of societal response to ecosystem pressures related to household waste generation in the community, by measuring waste minimization efforts.

- Propose to delete - *include in solid waste generation indicator (#7060).*

Household Stormwater Recycling (Indicator #3516 – New)

This indicator will assess the level of public awareness and concern for the environmental consequences of stormwater runoff.

- Would this be more practical and more to the point to actually look at things like stormwater recycling, look at capacity of stormwater storage; amount of stormwater releases; instead of talking about number of plans, talk about the quantities of materials so we can view it in the context of endpoints (i.e. zero stormwater discharge). In other words, measure the outcomes, not the plans.
- Replace with new indicator “Urban BMPs” includes household stormwater recycling, rain barrel/roof garden (activity indicator).
- Put in Land Use-Land Cover category/bundle.

Municipal Wastewater Treatment (Indicator #7063 – New)

This indicator will assess the scale and scope of wastewater treatment as a measure of the relative amount of wastewater contaminants that are entering the waste stream and a measure of municipal commitment to protecting freshwater quality.

- Needs a clearer description.
- Part of the discussion goes back to building STPs (sewage treatment plants) in the 70's; haven't done much to them since then. The design life is 25 years, and it's been 35 years - over next 10-15 years, expect billions more dollars are going to be needed to support future infrastructure costs. In the 70's when phosphorus was a big concern, decided on concentration of 1 mg/L; this is a concentration, not a load. If we look at loads today, we will see that they are much greater due to population growth - have probably doubled the amount of Phosphorus coming out of a fully compliant STP. The STPs are old – we are at the point that rate of deterioration will accelerate a lot.
- This is a placeholder and the issue needs addressing. We cover this in looking at compliance with wastewater discharge according to NPDES; other issues may need to be addressed if it becomes apparent that the quality of effluent is deteriorating.
- When it comes to chemicals, lakes respond to total loads of chemicals, not just concentrations; can have a 50% increase in load with the same concentration as before. When building STPs, assumed a load that's been exceeded.
- When plants get decrepit, it's a major construction job to rebuild - it can take 15-20 years to rebuild. We need a financial system in place to sustain the system so we don't get into a huge deficit situation; need the cash flow principals in place to sustain the necessary maintenance and upgrading to stay compliant.

- This is all important and I agree, but the question is whether SOLEC *needs* to track this issue or even if SOLEC *can* track this issue. On the U.S. side, the permit has to be renewed every 5 years and needs an engineering review - this gives a chance to track deterioration and take corrective action.
- Put in Consumption category/bundle.
- Change title to “Number of CSOs in the Basin.”
- Replace with: Amount of Endocrine in Water – chemical section.
 - Filter out non-traditional pollutants
 - Pure number in basin
 - Pressure indicator

Taxes on Energy/CO2 (Indicator #3521 – New)

This indicator will determine the effect that economic incentives have on consumption rates of fossil fuels.

- Propose to delete.

Vehicle Use (Indicator #7064 – New)

This indicator will assess the amount and trends in vehicle use in the Great Lakes basin and to infer the societal response to the ecosystem stressed caused by vehicle use.

- No comments

Groundwater and Land: Use and Intensity (Indicator #7101 – New)

This indicator measures land use and water use and intensity within political sub-divisions (or watershed boundaries) and is used to infer the potential impacts of these practices on the quantity and quality of the groundwater resource. Specifically referring to water use, the indicator also measures supply versus demand issues by assessing the reconstruction of water wells and the construction of new wells.

- No comments

Natural Groundwater Quality and Human-Induced Changes (Indicator #7100 – New)

This indicator will assess the quality of groundwater for drinking water and agricultural purposes, and for ecosystem function. The consumption of groundwater that is degraded in quality may lead to both animal and human health effects. This indicator may also reveal areas where contamination is occurring, and where programs for remediation and prevention of non-point contamination should be focused.

- The group agreed that this indicator is worth keeping with the following modifications: This indicator needs to be restructured such that it addresses the quality of recharge and discharge water, keeping in mind the influence of recharge due to storm water runoff. This indicator also needs to address recharge water protection. After these modifications, this indicator may overlap with #7056 Water Withdrawal and could be merged with it.

Status and Protection of Special Places and Species (Indicator #8163 – New)

This indicator will assess the status and degree of protection (at the landscape level) in area and quality of special places and special species of cultural and spiritual significance especially to First Nations/ Tribes. Special places include: ecologically unique areas e.g. rocky outcrops, large dead trees; and cultural treasures, e.g. burial grounds and areas where medicinal herbs grow. Special or iconic species are ones such as pileated woodpeckers, turtle, wolf, martens, medicinal herbs, bald eagles, American Otter, or rare species. Additionally this indicator will infer the success of management activities associated with the protection of areas and species.

- Combine Protection of Natural Communities: rare, unique and endangered species and #8161 Threatened Species.
- Evaluate status (know the number on the list).
- Put in Habitat and Biodiversity category/bundle.

Coastal Wetlands Indicators

Note: The Coastal Wetlands indicators were not reviewed extensively at the Indicator Review Workshop because the Great Lakes Coastal Wetlands Consortium is still reviewing and revising the coastal wetlands indicator suite. Descriptions for new and revised indicators will be available for SOLEC 2004.

Coastal Wetland Invertebrate Community Health (Indicator #4501)

This indicator will assess the diversity of the invertebrate community, especially aquatic insects, and it will be used to infer habitat suitability and biological integrity of Great Lakes coastal wetlands.

- Propose to delete.
- Indices
- Put in Habitat and Biodiversity category/bundle.

Coastal Wetland Fish Community Health (Indicator #4502)

This indicator will assess the fish community diversity, and it will be used to infer habitat suitability for Great Lakes coastal wetland fish communities.

- Propose to delete.
- Indices
- Put in Habitat and Biodiversity category/bundle.

Coastal Wetland Amphibian Community Health (Indicator #4504)

This indicator will directly measure the species composition and relative abundance of frogs and toads and to indirectly measure the condition of coastal wetland habitat as it relates to the health of this ecologically important component of wetland communities.

- Propose to delete.
- Indices
- Put in Habitat and Biodiversity category/bundle.

Contaminants in Snapping Turtle Eggs (Indicator #4506)

This indicator will assess the accumulation of organochlorine chemicals and mercury in snapping turtle eggs, and it may be used to infer the extent of organochlorine chemicals and mercury in food webs of Great Lakes coastal wetlands.

- Move to Chemical Group.

Coastal Wetland Bird Community Health (Indicator #4507)

This indicator will assess the wetland bird species composition and relative abundance, and to infer the condition of coastal wetland habitat as it relates to the health of this ecologically and culturally important component of wetland communities.

- Propose to delete.
- Indices
- Put in Habitat and Biodiversity category/bundle.

Coastal Wetland Area by Type (Indicator #4510)

This indicator will assess the periodic changes in area (particularly losses) of coastal wetland types, taking into account natural variations.

- Put in Habitat and Biodiversity category/bundle.

Coastal Wetland Restored Area by Type (Indicator #4511)

This indicator will assess the amount of restored wetland area, and to infer the success of conservation and rehabilitation efforts.

- Put in Habitat and Biodiversity category/bundle.

Phosphorus and Nitrogen Levels (Indicator #4860)

This indicator will assess the amount of nitrate and total phosphorus flowing into Great Lakes coastal wetlands, and to infer the human influence on nutrient levels in the wetlands.

- Put in Nutrient bundle with the proposed Nutrient Management indicator and Phosphorus and Nitrogen Levels (#4860).

Habitat Adjacent to Coastal Wetlands (Indicator #7055)

This indicator will provide an index of the quality of adjoining upland habitat which can have a major effect on wetland biota, many of which require upland habitat for part of their life cycle.

- Proposed to delete.
- Put in Habitat and Biodiversity category/bundle.

Coastal Wetland Plant Community Health (Proposed Indicator)

Description is not available.

- Create an index.

Contaminant Accumulation (Proposed Indicator)

Description is not available.

Sediment Flow and Availability (Proposed Indicator)

Description is not available.

Water Levels (Proposed Indicator)

Description is not available.

Land Use Adjacent to Wetlands (Proposed Indicator)

Description is not available.

Human Impact Measures (Proposed Indicator)

Description is not available.

- Propose to delete.

Forest Lands Indicators

Note: The Forest Lands indicators and their components were not reviewed extensively at the Indicator Review Workshop because the Great Lakes Forest Lands Task Group is in its initial stages and will be developing descriptions for these new indicators. These indicators should be included in the Habitat and Biodiversity category/bundle.

Conservation of Biological Diversity (Indicator #8500 – New)

- Extent of area by forest type relative to total forest area.
- Extent of area by forest type and by age class or successional stage.
- Fragmentation of forest types.
- Extent of area by forest type in protected area categories as defined by IUCN or other classification systems (indirect).

Maintenance of Productive Capacity of Forest Ecosystems (Indicator #8501 – New)

- Area of forest land and net area of forest land available for timber production.
- Total growing stock of both merchantable and non-merchantable tree species on forest land available for timber production.
- Annual removal of wood products compared to the volume determined to be sustainable.

Maintenance of Forest Ecosystem Health and Vitality (Indicator #8502 – New)

- Area and percent of forest affected by processes or agents beyond the range of historic variation, e.g. by insects, disease, competition from exotic species, fire, storm, land clearance, permanent flooding, salinization, and domestic animals.
- Area and percent of forest land subjected to levels of specific air pollutants (e.g. sulfates, nitrates, ozone) or ultraviolet B that may cause negative impacts on the forest ecosystem (indirect).
- Area and percent of forest land with diminished biological components indicative of changes in fundamental ecological processes (e.g. soil nutrient cycling, seed dispersion, pollination) and/or ecological continuity (monitoring of functionally important species such as fungi, arboreal epiphytes, nematodes, beetles, wasps, etc.) (indirect).

Conservation and Maintenance of Soil and Water Resources (Indicator #8503 – New)

- Area and percent of forest land with significant soil erosion.
- Area and percent of forest land managed primarily for protective functions, e.g. watersheds, flood protection, avalanche protection, riparian zones.
- Percent of stream kilometers in forested catchments in which stream flow and timing has significantly deviated from the historic range of variation.
- Area and percent of forest land with significantly diminished soil organic matter and/or changes in other soil chemical properties.
- Area and percent of forest land with significant compaction or change in soil physical properties resulting from human activities.
- Percent of water bodies in forest area (e.g. stream kilometers, lake hectares) with significant variance of biological diversity from the historic range of variability.
- Percent of water bodies in forest area (e.g. stream kilometers, lake hectares) with significant variation from the historic range of variability in pH, DO, levels of chemicals (electric conductivity), sedimentation to temperature change.
- Area and percent of forest land experiencing an accumulation of persistent toxic substances.

Note 1: Most of these indicators are considered as having a “direct” or “indirect” impact on water quality and/or quantity. The “indirect” indicators have been labeled as such.

Note 2: The forest lands categories and supporting indicators for SOLEC have been derived from the Montreal Process, its’ criteria and indicators. A Task Group will be studying these indicators further in order to determine data availability for these indicators and for the first category provide an assessment at SOLEC 2004.

SECTION 7.0

ADDENDUM: 2004 SOLEC Suite of Great Lakes Indicators

The following table displays the names and categories for the 2004 SOLEC suite of Great Lakes indicators. Based on suggestions received at the Indicator Review Workshop and also in writing since SOLEC 2002, new indicators have been proposed, some have been combined or modified, and several have been deleted.

| ID # | Indicator Name | Current SOLEC Indicator Category |
|-------------|--|---|
| 6 | Fish Habitat | Aquatic |
| 8 | Salmon and Trout | Aquatic |
| 9 | Walleye | Aquatic |
| 17 | Preyfish Populations | Aquatic |
| 18 | Sea Lamprey | Aquatic |
| 68 | Native Freshwater Mussels | Aquatic |
| 93 | Lake Trout | Aquatic |
| 104 | Benthos Diversity and Abundance | Aquatic |
| 109 | Phytoplankton Populations | Aquatic |
| 111 | Phosphorus Concentrations and Loadings | Aquatic |
| 114 | Contaminants in Young-of-the-Year Spottail Shiners | Aquatic |
| 115 | Contaminants in Colonial Nesting Waterbirds | Aquatic |
| 116 | Zooplankon Populations | Aquatic |
| 117 | Atmospheric Deposition of Toxic Chemicals | Aquatic |
| 118 | Toxic Chemical Concentrations in Offshore Waters | Aquatic |
| 119 | Concentrations of Contaminants in Sediment Cores | Aquatic |
| New-121 | Contaminants in Whole Fish | Aquatic |
| 122 | <i>Hexagenia</i> | Aquatic |
| 123 | Benthic Amphipod | Aquatic |
| New-124 | External Anomaly Prevalence Index for Nearshore Fish | Aquatic |
| New-125 | Status of Lake Sturgeon in the Great Lakes | Aquatic |
| New-3514 | Commercial/Industrial Eco-Efficiency | Societal - stewardship |
| New-3515 | Cosmetic Pesticide Controls | Societal - stewardship |
| New-3516 | Household Stormwater Recycling | Societal - stewardship |
| 4175 | Drinking Water Quality | Human Health |
| 4177 | Chemical Contaminants in Human Tissue | Human Health |
| 4179 | Geographic Patterns and Trends in Disease Incidence | Human Health |
| New-4200 | Beach Advisories, Postings and Closures | Human Health |
| New-4201 | Contaminants in Sport and Commercial Fish | Human Health |
| New-4202 | Air Quality | Human Health |
| 4858 | Climate Change: Ice Duration on the Great Lakes | Unbounded |
| 7000 | Urban Density | Societal - urban |
| 7002 | Land conversion | Watershed |
| 7006 | Brownfield Redevelopment | Societal - urban |

| ID # | Indicator Name | Current SOLEC Indicator Category |
|------------------------------------|---|----------------------------------|
| 7028 | Sustainable Agriculture Practices | Watershed |
| 7043 | Economic Prosperity | Societal - socio-economics |
| New-7054 | Ground Surface Hardening | Societal - urban |
| 7056 | Water Withdrawal | Societal - urban |
| 7057 | Energy Consumption | Societal - urban |
| 7059 | Wastewater Pollution | Societal - urban |
| 7060 | Solid Waste Generation | Societal - urban |
| New-7061 | Nutrient Management | Watershed |
| New-7062 | Integrated Pest Management | Watershed |
| New-7063 | Municipal Wastewater Treatment | Societal - urban |
| New-7064 | Vehicle Use | Societal - urban |
| New-7100 | Natural Groundwater Quality and Human-Induced Changes | Watershed |
| New-7101 | Groundwater and Land: Use and Intensity | Watershed |
| New-7102 | Base Flow Due to Groundwater Discharge | Watershed |
| New-7103 | Groundwater Dependant Animal and Plant Communities (including amphibians) | Watershed |
| 8114 | Habitat Fragmentation | Watershed |
| 8129 | Area, Quality, and Protection of Special Lakeshore Communities | Watershed |
| 8131 | Extent of Hardened Shoreline | Watershed |
| 8132 | Nearshore Land Use | Watershed |
| 8135 | Contaminants Affecting Productivity of Bald Eagles | Watershed |
| 8136 | Extent and Quality of Nearshore Natural Land Cover | Watershed |
| 8137 | Nearshore Species Diversity and Stability | Watershed |
| 8142 | Sediment Available for Coastal Nourishment | Watershed |
| 8146 | Artificial Coastal Structures | Watershed |
| 8147 | Contaminants Affecting the American Otter | Watershed |
| 8149 | Protected Nearshore Areas | Watershed |
| 8150 | Breeding Bird Diversity and Abundance | Watershed |
| 8161 | Threatened Species | Watershed |
| New-8162 | Health of Terrestrial Plant Communities | Watershed |
| New-8163 | Status and Protection of Special Places and Species | Societal - stewardship |
| 9000 | Acid Rain | Unbounded |
| 9002 | Non-Native Species | Unbounded |
| New-9003 | Climate Change: Effect on Crop Heat Units | Unbounded |
| Coastal Wetlands Indicators | | |
| 4501 | Coastal Wetland Invertebrate Community Health | Coastal Wetlands |
| 4502 | Coastal Wetland Fish Community Health | Coastal Wetlands |
| 4504 | Coastal Wetland Amphibian Community Health | Coastal Wetlands |
| 4506 | Contaminants in Snapping Turtle Eggs | Coastal Wetlands |
| 4507 | Coastal Wetland Bird Community Health | Coastal Wetlands |
| 4510 | Coastal Wetland Area by Type | Coastal Wetlands |
| 4511 | Coastal Wetland Restored Area by Type | Coastal Wetlands |
| 4860 | Phosphorus and Nitrogen Levels | Coastal Wetlands |
| 7055 | Habitat Adjacent to Coastal Wetlands | Coastal Wetlands |
| New | Coastal Wetland Plant Community Health | Coastal Wetlands |
| New | Contaminant Accumulation | Coastal Wetlands |
| New | Sediment Flow and Availability | Coastal Wetlands |

| ID # | Indicator Name | Current SOLEC Indicator Category |
|--------------------------------|---|----------------------------------|
| New | Water Levels | Coastal Wetlands |
| New | Land Use Adjacent to Wetlands | Coastal Wetlands |
| New | Human Impact Measures | Coastal Wetlands |
| Forest Lands Indicators | | |
| New-8500 | Forest Lands - Conservation of Biological Diversity | Watershed |
| New-8501 | Maintenance and Productive Capacity of Forest Ecosystems | Watershed |
| New-8502 | Maintenance of Forest Ecosystem Health and Vitality | Watershed |
| New-8503 | Forest Lands - Conservation and Maintenance of Soil and Water Resources | Watershed |

| ID # | The following indicators have been Deleted or Replaced | Current SOLEC Indicator Category | Delete or Replace |
|----------|---|----------------------------------|-------------------|
| 101 | Deformities, Eroded Fins, Lesions and Tumors (DELT) in Nearshore Fish | Aquatic | Replace by 124 |
| 113 | Contaminants in Recreational Fish | Human Health | Replace by 4201 |
| 120 | Contaminant Exchanges between Media: Air to Water and Water to Sediment | Aquatic | Deleted |
| 3509 | Capacities of Sustainable Landscape Partnerships | Societal - stewardship | Deleted |
| 3510 | Organizational Richness of Sustainable Landscape Partnerships | Societal - stewardship | Deleted |
| 3511 | Integration of Ecosystem Management Principles Across Landscapes | Societal - stewardship | Deleted |
| 3512 | Integration of Sustainability Principles Across Landscapes | Societal - stewardship | Deleted |
| 3513 | Citizen/Community Place-Based Stewardship Activities | Societal - stewardship | Deleted |
| New-3517 | Commercial/Industrial Environmental Management Systems | Societal - stewardship | Deleted |
| New-3518 | Community Engagement in Great Lakes Protection & Decision Making | Societal - stewardship | Deleted |
| New-3519 | Environmental Education | Societal - stewardship | Deleted |
| New-3520 | Household Solid Waste Minimization | Societal - stewardship | Deleted |
| New-3521 | Taxes on Energy/CO2 | Societal - stewardship | Deleted |
| 4081 | <i>E. coli</i> and Fecal Coliform Levels in Nearshore Recreational Waters | Human Health | Replace by 4200 |
| 4083 | Contaminants in Edible Fish Tissue | Human Health | Replace by 4201 |
| 4088 | Chemical Contaminant Intake From Air, Water Soil and Food | Human Health | Deleted |
| 4176 | Air Quality | Human Health | Replace by 4202 |
| 4178 | Radionuclides | Human Health | Deleted |
| 4503 | Deformities, Eroded Fins, Lesions and Tumors (DELT) in Nearshore Fish | Coastal Wetlands | Deleted |
| 4513 | Presence, Abundance and Expansion of Invasive Plants | Societal - stewardship | Replace by new |
| 4516 | Sediment Flowing into Coastal Wetlands | Societal - stewardship | Replace by new |
| 4519 | Climate Change: Number of Extreme Storms | Unbounded | Deleted |
| 4857 | Climate Change: First Emergence of Water Lilies in Coastal Wetlands | Unbounded | Deleted |
| 4861 | Effect of Water Level Fluctuations | Coastal Wetlands | Replace by new |
| 7012 | Mass Transportation | Societal - urban | Replace by 7064 |
| 7042 | Aesthetics | Societal | Deleted |
| 7053 | Green Planning Process | Societal | Deleted |
| 8134 | Nearshore Plant and Animal Problem Species | Watershed | Deleted |
| 8139 | Community / Species Plans | Watershed | Deleted |
| 8140 | Financial Resources Allocated to Great Lakes Programs | Watershed | Deleted |
| 8141 | Shoreline Managed Under Integrated Management Plans | Watershed | Deleted |
| New-8164 | Landscape Ecosystem Health | Watershed | Deleted |