



Watershed Indicators: The challenge of consistency

IISD REPORT



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TABLE OF CONTENTS

1.0 INTRODUCTION	1
2.0 WHAT IS CSIN?	2
3.0 THE CHALLENGE OF CONSISTENCY	3
4.0 CSIN ACTIVITIES: 2014–2015	6
4.1 Webinars.....	6
4.1.1 State of the Great Lakes Reporting	6
4.1.2 Great Lakes Indicators: Challenges and recommendations to assess a complex, binational ecosystem	6
4.1.3 Cultivating the Next Generation of Watershed Stewards: Engaging students in citizen science in the Red River Basin.....	6
4.1.4 Watershed and Human Health Indicators: Case studies from the Fraser Basin and Credit River	7
4.2 Workshop.....	7
4.3 Findings and Recommendations from 2015–2016 CSIN Activities.....	7
5.0 CONCLUSION	10
REFERENCE LIST	11
APPENDIX: WORKSHOP AGENDA	12



1.0 INTRODUCTION

Across Canada, different levels of government (federal, provincial, municipal, First Nations), non-governmental organizations, academics, citizen science groups and other stakeholders collect data related to watersheds and their health. Not only are environmental data (e.g., water quality, biodiversity) relevant to watershed health, but so too are data on social and economic measurements (e.g., human health, economic activities).

While a significant amount of data exists, shaping it into indicator frameworks to help measure and guide watershed management poses particular challenges. Foremost among these challenges is the fact that watersheds often cross borders. Not only do many cross municipal, provincial or territorial boundaries, a large number are also international watersheds, crossing the 8,891 km Canada–U.S. border (inclusive of the border between Alaska and B.C. and Alaska and the Yukon) (Sullivan, Bernhardt & Ballantyne, 2009). With this fragmentation of jurisdictions and wide range of stakeholders collecting data, there are often differences in data types and collection methods. This variation poses a challenge in getting a coherent picture of the entire watershed. When using different indicator sets within the same watershed, how can watershed managers and decision-makers ensure they are getting an accurate picture and comparing “apples to apples”?

Therefore, in 2014–2015, with support from Environment Canada, the Canadian Sustainability Indicators Network (CSIN) explored the question of watershed indicator consistency and coherency across Canada and between Canada and the United States. While a stronger emphasis on environmental indicators was inevitable given the watershed focus, efforts were made to bring social and economic indicators into consideration so that all three pillars of sustainability—social, environmental and economic—were recognized.

The ultimate goal was to advance understanding of indicator consistency between and among regions of Canada and to create a strengthened umbrella forum for organizations working on sustainability indicators at the local, regional and national levels. It is anticipated that the lessons learned about consistency and coherency in indicators can be transposed to non-watershed topics, as fragmentation of jurisdictions and differences in data collection techniques are hardly unique to watersheds.



2.0 WHAT IS CSIN?

CSIN is a network of indicator practitioners, primarily from within Canada, but also including members from other countries. It was founded in 2003 by a group of people at a meeting of the International Sustainability Indicators Network (ISIN) in Toronto who were interested in developing a Canadian indicator network. The International Institute for Sustainable Development (IISD) has coordinated CSIN since 2005. Participants in the network come from municipal and provincial departments, federal departments, watershed and other environmental groups, business and industry, consulting organizations and universities.

CSIN's activities are important because there are indicator practitioners across Canada working on similar sustainability topics, but with no national forum through which they can learn, network and share information. CSIN aims to fill this gap, helping members to learn best practices in measurement and sustainability indicator systems in Canada and beyond.

A particular interest of CSIN in 2014–2015 was exploring the topic of indicator consistency and coherency across Canada, as well as on a transboundary basis (e.g., between provinces/territories, between Canada and the United States). To explore this theme, webinars focused largely on watershed indicators, as watersheds cross provincial, state and international boundaries, catalyzing consideration of indicator consistency in different jurisdictions. The webinars and workshops explored this theme; webinar presenters offered reflections on indicator consistency/coherency and workshop participants discussed the topic.



3.0 THE CHALLENGE OF CONSISTENCY

Watershed indicators in Canada and in most jurisdictions globally are a patchwork. The challenge of achieving some degree of watershed indicator consistency has been considered by various governments and academics in Canada, as well as stakeholders in other countries. A variety of factors influence the degree to which consistency can be achieved, including jurisdictional responsibility, degree of partnerships and cooperation, funding, level of knowledge and available data.

A report by the Government of Alberta (2012) reflected on challenges in indicator consistency in watershed reporting, particularly given the increasing popularity of watershed report cards. The authors remark that “there exists no guidance in Alberta on the selection of indicators for inclusion, and little or no consistency in the manner in which those indicators common to many reports are reported on” (p. 6). This excerpt details the frustrating questions faced by those tasked with selecting which watershed indicators to measure:

For example, consider nutrient levels—one of the most familiar indicators of water quality. In a state of watershed report, does one report on nutrient concentrations in relation to Alberta’s Surface Water Quality Guidelines, according to Canadian Council for the Ministers of the Environment (CCME) Water Quality Guidelines, or according to local objectives? Or perhaps, simply as a numeric value with no reference to any existing guidelines or objectives? Does one report on each parameter (or metric) individually, or within a multi-metric index? If the latter, which index should be used? Alberta Environment and Sustainable Resource Development’s overarching Surface Water Quality Index, the Nutrient Sub-index, or perhaps Alberta

Agriculture & Rural Development’s Water Quality Index for Agricultural Streams? Each differs and the subsequent values generated within each index are not comparable. (p. 6)

This list of options illustrates well the conundrum faced in designing an indicator system. The result is that watershed organizations choose different approaches, making it difficult to compare across watersheds. The authors note that, while complete standardization might not be desirable, given that there may be watershed-specific issues that would not be tracked by a completely harmonized set of indicators, it is also not particularly useful when each watershed designs an entirely different framework.

Similar challenges are faced across Canada. In her review of watershed report cards in Canada involving 13 case studies in seven provinces, Veale (2011) made several observations related to consistency. In particular, she notes that “no standard approach exists. The organizations producing the reports used indicators in their reporting, each developing their own unique approach to selecting, organizing and presenting indicators” (p. vi). She suggests that this inconsistency in measurement is one of the shortfalls of watershed report cards, which, in many other respects, are a positive development in sustainability management.

Cohen (2011) looks at the trend towards “rescaling” water governance from political to watershed boundaries in Canada and internationally and, in doing so, provides numerous valuable observations and insights related to indicator consistency. In particular, she notes imbalanced capacities in different watersheds to collect information and implement programming as a concern. One example given is that watersheds in northern Ontario have less institutional capacity in these new systems than ones in the more densely populated southern Ontario. As a result, comparisons between



watersheds in the province are challenging. Cohen writes that:

The uptake of a watershed approach raises questions about possible trade-offs between scaling down and the desirability of consistent standards or practices. Uneven institutional capacities of watershed organizations mean that shifting responsibility out (to watershed organizations), down (from provinces), and up (from municipalities) often entails a diversification of environmental practices, management strategies, and standards. In light of this diversity, it is worth considering to what extent rescaling is socially or environmentally beneficial inasmuch as it entails a move away from centralized standards. (p. 137)

Schultz (2001) also flagged consistency as a concern when data are used to develop indices. In his consideration of the U.S. Environmental Protection Agency's (EPA) Index of Watershed Indicators, he flagged concerns about consistency in data gathered from regional and national databases. Not only can approaches to collecting and reporting indicators vary across the country, but some watersheds did not have adequate data available for all indicators included in the index. Schultz writes: "If an indicator cannot be calculated, the EPA assigns it a score of zero, the lowest possible score on the value scale" (p. 439). While Schultz recognizes that the EPA used some approaches to address this issue, he suggests that findings may still be skewed.

The challenge becomes even more difficult at an international scale, particularly where watersheds might exist in two or more countries. The United Nation's System of Environmental-Economic Accounting (SEEA) offers guidance for developing "internationally comparable statistics on the environment and its relationship with the economy" (United Nations, 2015a). In terms of water, SEEA developed the International

Recommendations for Water Statistics (IRWS), which "provides coherent principles, concepts and definitions for the collection and compilation of water statistics on a comparable basis" (United Nations, 2012, p. iii). They were developed to help "strengthen national information systems for water in support of design and evaluation of Integrated Water Resources Management (IWRM)" (United Nations, 2015b). With the existence of 276 transboundary lake and river basins in the world accounting for roughly 60 per cent of global freshwater flow (UN-Water, 2014), such efforts towards consistency could obviously improve our understanding of the state of and best management options for these waters.

The IRWS notes that coherence is one of the necessary elements for data quality, highlighting that coherence across geographic scale can pose a challenge:

Coherence is the degree to which data are logically connected and mutually consistent, that is, can be successfully brought together with other statistical information within a broad analytical framework and over space and time. ... Coherence across space is especially important for water statistics that are often collected and compiled at subnational levels and compared between countries. (United Nations, 2012, p. 121)

Johnson, Benn and Ferreira (2014) also encourage increased indicator consistency globally, observing wide variations in indicator approaches in different countries. While they were more focused on marine indicators, the lessons for transboundary regions are applicable to watersheds. As with watersheds, the variability makes understanding of indicators across borders and, hence, sustainable management much more challenging:



The establishment of transboundary or cross-border indicators is particularly challenging but their definition is extremely important as it promotes the establishment of a common understanding of transboundary ecosystem priorities for action...and monitoring. Such a common understanding is particularly pressing in times of scarcity of resources (including funding sources), when it is especially important to establish and maintain sustained monitoring efforts of key management aspects that may have cross-border implications. (p. 11-12)

Therefore, a review of literature commenting on consistency in watershed indicators reveals that whether one is working at a provincial, national or international level, achieving consistency is desired but also rife with challenges. In order to advance discussion and understanding of this topic among Canadian indicator practitioners, CSIN's activities in 2014–2015 focused on exploring indicator consistency and discussing approaches to address the various challenges that arise.



4.0 CSIN ACTIVITIES: 2014–2015

4.1 Webinars

Four webinars were held in the winter of 2015 to explore approaches to water-related indicators in different areas of Canada. Presenters were chosen for their ability to comment on challenges to indicator consistency. Factors related to geography, governance, funding, political boundaries and indicator availability were raised. Below is a summary of each of the webinars.

4.1.1 State of the Great Lakes Reporting

Presenter: Stacey Cherwaty-Pergentile (Environment Canada)

This webinar provided an overview of binational indicators used to report on the state of the Great Lakes and the results of the most recent assessment. Environment Canada and the U.S. EPA have been working together to develop and track Great Lakes indicators since 1994. Using status and trend assessments, the indicators help to answer the question: how are the lakes doing? This information helps to inform decision-making and environmental management in both countries. This was the first of two webinars on Great Lakes indicators. The second webinar was held on February 27, 2015 (see below).

Available at: <https://iisd.webex.com/iisd/lsr.php?RCID=cdf35bc3f3aaf8fb58303cda6fe8303>

4.1.2 Great Lakes Indicators: Challenges and recommendations to assess a complex, binational ecosystem

Presenter: Nancy Stadler-Salt (Environment Canada)

This was a follow-up webinar to the one held previously in the year (see above) and delved deeper into indicators related to the Great Lakes. This webinar considered questions such as: What challenges are there in developing binational

indicators? How are the assessments arrived at? What recommendations can be shared from the development of the Great Lakes indicators to help others develop integrated indicator sets for complex ecosystems?

Available at: <https://iisd.webex.com/iisd/lsr.php?RCID=83ebe62c77c96da7fe61c3dc8edbb624>

4.1.3 Cultivating the Next Generation of Watershed Stewards: Engaging students in citizen science in the Red River Basin

Presenters: Wayne Goeken (River Watch); Kent Lewarne (South Central Eco Institute)

This webinar included presentations from two related citizen science-monitoring initiatives in the Lake Winnipeg Watershed: the River Watch program that involves students from Minnesota and North Dakota, and the South Central Eco Institute (SCEI), involving students from Manitoba.

The programs engage middle and high school students in gathering water quality data on their local watersheds and uploading the information to websites where they can be reviewed, graphed and analyzed. This information is publicly available and, in some instances, has been used by government agencies and watershed organizations for decision-making. Through their participation, students gain career and leadership skills, develop a sense of place and learn about water science.

The presenters commented on similarities and differences between the two programs, which both take place in the Red River Basin, but in two different countries. SCEI also engages with schools in the Assiniboine River Basin. Since the SCEI is modelled after River Watch, the programs have achieved a high degree of consistency, which enables comparability of data and potential for further transboundary collaboration in the future.

Available at: <https://iisd.webex.com/iisd/lsr.php?RCID=50fc6cd040880f9e90b1ed32946bc8ee>



4.1.4 Watershed and Human Health Indicators: Case studies from the Fraser Basin and Credit River

Presenters: Steve Litke (Fraser Basin Council); Tatiana Koveshnikova (Credit Valley Conservation); Martin Bunch (York University)

This webinar included presentations from practitioners working on watershed and human health indicators in two watersheds in two different provinces, the Fraser Basin (British Columbia) and the Credit River (Ontario).

Steve Litke from the Fraser Basin Council presented on a current initiative to report on the health of the Nechako River watershed in central British Columbia. The Fraser Basin Council, with input from regional partners, has collated data for several indicators of watershed health and has also developed an online digital atlas to view mapped data. Steve shared highlights of the results of this work and gave a short demonstration of the atlas.

Martin Bunch and Tatiana Koveshnikova presented some preliminary results of the ongoing initiative to develop and report on the Health and Well-being Indicators for the Credit River Watershed. They spoke about key challenges and accomplishments with respect to developing a set of indicators that relate the watershed's environmental conditions to the health and well-being of local residents. They provided a brief demonstration of the indicator communications and mapping tool.

Available at: <https://iisd.webex.com/iisd/lsr.php?RCID=93f0544b725c7c8e020cb9063a670de3>

4.2 Workshop

On March 6, 2015, CSIN hosted a free half-day workshop called Discussing Sustainability Indicators in Canada. Its purpose was to explore indicator best practices, common problems related to indicators, and possible solutions to address problems. Participants joined either via videoconference (Ottawa, Winnipeg, Vancouver) or remotely through web conferencing. In order

to inform discussion, presentations were given on: 1) the Canadian Environmental Sustainability Indicators (CESI) and 2) indicator consistency/coherency at regional, national and international scales. A discussion was then moderated by the IISD's Director of Knowledge for Integrated Decisions, Livia Bizikova.

Questions explored through plenary discussion during the webinar included:

1. What are current challenges regarding indicators in Canada?
2. What are potential opportunities to improve indicator collection and reporting?
3. Where should efforts be focused to improve indicators?

Those engaged included representatives from the Canadian federal government (Environment Canada; Health Canada; Department of Canadian Heritage; Agriculture and Agri-food Canada); the Manitoba government (Conservation and Water Stewardship; Manitoba Agriculture, Food and Rural Development; Natural Resources Canada); the Nova Scotia government (Department of Finance); academics (Université du Québec à Montréal; Simon Fraser University); conservation authorities; Manitoba Hydro; the St. Lawrence Action Plan; United Nations Educational, Scientific and Cultural Organization (UNESCO); and a sustainability consultant. The full workshop agenda can be viewed in Appendix 1.

4.3 Findings and Recommendations from 2015–2016 CSIN Activities

The webinars and workshop were valuable in introducing various case studies and perspectives on watershed indicators across Canada, as well as in a transboundary context. With inputs from watershed management groups, academics, non-governmental organizations, and federal and provincial government employees from different departments, conversations were facilitated on the state of and challenges for watershed indicators in Canada.



Below is a summary of insights gained, grouped by topic.

Challenges regarding indicators in Canada:

- It can be difficult to harmonize indicators on a watershed basis, given that data used are often gathered by a range of entities with varying methodologies for collection and reporting.
- Data approaches can vary within provinces themselves, not just across provincial and international borders; this variation can pose challenges even at a provincial level.
- When using data from a wide range of sources, relationships with these sources must be managed by the entity requesting the data (e.g., watershed group).
- Identifying the appropriate number of indicators is challenging, as too many indicators can be overwhelming while too few can miss critical information necessary for decision-making.
- Some data may not have a long-term collection plan into the future, putting the long-term value into question.
- Innovation in technologies and methodologies can lead to challenges in rectifying old data with new data and producing a consistent indicator (for instance, more recent agricultural technologies measure in different time frames than technology from the 1980s, posing challenges for long-term indicators).
- Linking policy back to indicators can be challenging (e.g., it might not be possible to state that cleaner water, shown by an indicator, is a result of a certain policy).

Insights and recommendations on development of indicators frameworks:

- If an indicator framework already exists in part of a watershed, consider if it would be beneficial to incorporate its approaches in order to improve consistency; an example

can be found in Canada's South Central Eco Institute, which modelled itself after the American River Watch program, resulting in high consistency between the international data sets.

- Consider consistency at the outset when indicators are first being developed.
- Where possible, incorporate social and economic indicators in addition to environmental ones.
- Obtain buy-in and support from partners at the beginning, and build relationships with relevant agencies and organizations, including on an international basis where applicable (i.e., in transboundary initiatives).
- When using data from partners, ensure some form of quality assurance and control; work with partners and data sources to resolve any concerns.

Insights and recommendations on improving existing indicators and indicator frameworks:

- Solicit feedback from people actively using indicators to learn how to improve indicators.
- Build internal mechanisms (e.g., working groups, workshops) for those involved to discuss indicators and provide opportunities for feedback and review.
- Encourage the collection of metadata (i.e., data about the data) in order to increase the ability to compare datasets.

Insights and recommendations on indicator reporting:

- While there is some tendency to report on all watershed indicators at one time (e.g., an annual report), the approach by CESI shows that there may be benefits in reporting indicators on a staggered basis. This approach enables the following benefits: 1) the most up-to-date information being released as it is available; 2) the information may be more digestible (i.e., one page instead of an entire report); and



3) it is more appropriate for indicators with longer timescales that do not require annual updates (e.g., status of species).

- If possible, provide different levels of data interpretation and information for different audiences. For example, CESI provides both a fairly easy-to-understand interpretation of the data (e.g., with graphs, plain language), as well as information on data sources and methodologies for those with a deeper interest.
- Explore data visualization to facilitate communication and understanding.

Insights and recommendations on linking indicators to policy:

- There is a need to inform policy-makers more directly about indicators and their relevance to policy even if the indicator is perceived as having some shortcomings (workshop participants remarked that there is hesitation to make policy recommendations based on indicators unless the indicator is perceived as flawless).

Insights and recommendations on improving national-level consistency in indicators:

- Increase and enhance communications about indicators between provinces and levels of government.
- Increase and enhance communications between different departments in different levels of government.
- Share data and indicator methodologies between provinces, different levels of government and different departments.

Notably, some participants also saw drawbacks to insisting on indicator consistency. Since data varies considerably between the provinces, with some provinces having much more advanced methodologies and data sets, creating consistency can result in “using the least common denominator.” In other words, data resolution can be lost when scaling an indicator up to a larger geography (e.g., national).

In addition, there may be value in having different types of indicators reporting on similar topics. Thrift points out that doing so “provides multiple lenses to the same issue. All of these lenses might be very valid, and each provide new insights into the topic. Ideally, it is important to have a sense of how you want the data to be used before developing an indicator set” (C. Thrift, personal communication, March 5, 2015).



5.0 CONCLUSION

Water does not respect borders, and most political boundaries were not created with watersheds in mind. Therefore, water-related data collection, indicator development and reporting in Canada present a range of challenges. However, as we explored through CSIN's activities in 2014–2015, these challenges are, to some degree, being managed by many watershed organizations across Canada. Through the application of indicator selection criteria, creation of partnerships, quality assurance and quality control of data, review and improvement of indicator frameworks and other approaches, indicator-based pictures of watersheds in Canada are emerging. These efforts sometimes extend to international watersheds shared with the United States.

It is common to have indicator selection criteria when creating an indicator framework, and consistency is commonly one such criteria. New Zealand's Ministry for the Environment includes "coherence/consistency," defined as "the degree to which statistical information can be successfully brought together with other statistical information within a broad analytical framework and over time," as one of its six key criteria when selecting environmental indicators. While, as an island nation, New Zealand does not have the challenge of transboundary watersheds, it nonetheless views consistency with international indicators as important, commenting that "this will allow us to benchmark against other countries where appropriate."

Results from CSIN's activities in 2014–2015 showed that indicator practitioners in Canada also see indicator consistency and coherency as important in the country, and that they can envision pathways to improvement. As a large country with multiple jurisdictions and many transboundary international watersheds, achieving greater indicator consistency in Canada will likely be challenging, but findings in this report can help those pursuing indicator consistency to address common pitfalls, consider consistency when developing new frameworks (or revising existing ones) and improve indicator reporting.

As Sir William Thomson (Lord Kelvin) once stated, "If you can not measure it, you can not improve it" (as cited by O'Farrell, 2015). This year's work by CSIN is a step towards assessing watershed indicator consistency in Canada. It is our hope that information gathered in this assessment can aid in improving indicator frameworks throughout Canada, helping to increase consistency and understanding between and among jurisdictions.



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Appendix: Workshop Agenda

Canadian Sustainability Indicators Network (CSIN) Workshop Agenda

Date: March 6, 2015

Time: 9:30–1:30 PST; 10:30–2:30 MST; 11:30–3:30 CST; 12:30–4:30 EST; 1:30–5:30 AST; 2:00–6:00 NST

Locations: Various: Gatineau – 10 Rue Wellington¹; Winnipeg – 161 Portage Avenue E., 6th floor²; other cities connected via videoconferencing and webinar software³

¹ Ottawa/Gatineau attendees should sign in upon arrival and provide Christina Clarke as a contact.

² Winnipeg attendees should provide Karla Zubrycki as a contact upon arrival.

³ More information on attending via videoconference or webinar will be provided in the near future. Please contact the CSIN coordinator at kzubrycki@iisd.ca with any questions.

Registration instructions:

Please register no later than March 3, 2015 by emailing the CSIN coordinator at kzubrycki@iisd.ca. When registering, please indicate how you would prefer to attend: on-site in Ottawa; on-site at the IISD office in Winnipeg; other videoconferencing site; or teleconference/webinar)

Agenda

12:30-1 (EST)	Arrivals
1:00	Welcome and introductions
1:15	Intro presentation <ol style="list-style-type: none"> i. Why are we having this workshop? ii. Define CSIN and outline the 2014-2015 project iii. Goals of this workshop: <ol style="list-style-type: none"> a. To familiarize attendees with CSIN and CESI b. To discuss areas of interest/success/issues in sustainability indicators in Canada c. To discuss how to improve sustainability indicators in Canada d. To identify how to improve indicator consistency/coherency regionally, nationally and on a transboundary basis
1:30	Warm up exercise
1:45	Presentation on Canadian Environmental Sustainability Indicators (CESI), followed by Q& A
2:45	Break
3:00	Presentation on the value of indicator consistency/coherency at regional, national and international scales
3:15	Discussion <ol style="list-style-type: none"> 1. What are current challenges regarding indicators in Canada? 2. What are potential opportunities to improve indicator collection and reporting? 3. Where should efforts be focused to improve indicators? <p><i>Break-out groups may be arranged.</i></p>
4:15	Outcomes/next steps
4:25	Wrap-up
4:30	Workshop evaluation

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