Canadian Water Network

State of the Knowledge and Practice: Assessing the Adequacy of Urban Nutrient Load Measurements

Supporting Document 1: Workshop Capture

March 2018

Contents

Acknowledgements

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Preface

Designing policies and establishing best management practices for controlling nutrient inputs to water bodies from municipal point and nonpoint sources is an important component of watershed management. Estimates of nutrient loadings from runoff contributing areas as well as tributary nutrient loadings to downstream receiving water bodies are typically derived from point measurements of nutrient concentrations combined with measured or modeled discharge rates to calculate loadings. These kinds of measurements are also frequently used to derive export coefficients for different types of land use to yield loading estimates over larger scales.

However, the validity and effectiveness of this approach depends largely on whether the point measurements of nutrient concentrations and flows are sufficiently representative of conditions at the desired spatial and temporal scales to meet study objectives. Evaluating how well nutrient loading estimates meet management decision needs requires clear objectives that will depend on how the results are to be used (e.g. model calibration, computation of annual, seasonal or event loads, etc.). A better understanding is required of how well typical loading calculations reflect actual loadings, and the degree to which variability in factors such as land use, flow, and nutrient water quality compromise decision making based on current practices.

With financial support from Environment and Climate Change Canada (ECCC), Canadian Water Network (CWN) undertook a project to assess how well existing tributary nutrient loading measurements and statistical approaches in urban areas meet the requirements of urban wet weather water management and of water managers. The objectives of this work were to help improve the alignment between nutrient loading study objectives and methods, and to clarify under what circumstances current practices may be inadequate to support management decisions.

CWN convened an advisory group of eight leading experts with diverse expertise in municipal wastewater and stormwater management, nutrient transport and loading, water quality and tributary monitoring, environmental impacts and landscape modelling. Led by advisory group Chair Mr. Duncan Boyd, and supported by input from advisory group members, a whitepaper was developed to provide an assessment of the state of the knowledge and practice on measuring urban nutrient loads, including the state of the knowledge on the utility achieved through various nutrient monitoring methods typically used in Canada.

In February 2018, CWN hosted a 1.5 day experts' workshop in Toronto, Ontario with advisory group members and an expanded group of experts from across southwestern Ontario. This expanded group included leading decision makers, researchers and practitioners with strong combined knowledge and credibility in areas of urban water management, nutrient transport and loading, water quality and tributary monitoring, environmental impacts and landscape modelling. The workshop discussions, together with the experts' responses to a pre-workshop questionnaire, were designed to help validate, augment and update the whitepaper knowledge and assess gaps in existing knowledge and inform decisions.

A culminating framework document has been developed based on insights from the draft whitepaper together with workshop discussions. The framework document will help guide future actions and decisions by water managers, including the future development of a decision support system that guides the progression from preliminary to more detailed assessments across multiple scales.

As a supporting document to the framework, the current document provides a high-level summary capture of the rich discussions that took place at the February 2018 experts' workshop.

Introduction

Workshop objectives and participants

The experts' workshop was convened on February 6-7, 2018 in Toronto by CWN. Using the whitepaper developed by the advisory group chair as a starting point, the workshop was designed to validate, augment and update the whitepaper knowledge and inform development of a framework for decisions related to management of urban nutrient sources.

Led by the advisory group chair and supported by the advisory group, a list of potential participants was developed comprising decision makers, researchers and practitioners from across southwestern Ontario with strong combined knowledge and credibility in areas of urban water management, nutrient transport and loading, water quality and tributary monitoring, environmental impacts and landscape modelling. Invitations were extended in January 2018, resulting in a group of 28 participants (see Appendix 1A: Experts' workshop participant list).

Both the participants' list and the workshop agenda (see Appendix 1B: Experts' workshop agenda) were designed with two goals in mind:

- Promote discussion between water management decision-makers and science practitioners to clarify urban nutrient load information requirements and the acceptable degree of uncertainty, and assist with the development of a whitepaper; and
- Inform the future development of a decision-making framework to maximize the utility of urban nonpoint source monitoring and modeling resource allocations.

Workshop structure

Prior to the workshop, participants were invited to complete a brief online questionnaire. This pre-workshop questionnaire was developed to inform workshop discussions by assisting the advisory group in understanding urban planning and watershed management information requirements regarding water quality and loading estimates, as well as establishing gaps in available knowledge that decision makers need and want. For a summary of responses to the pre-workshop questionnaire, see Supporting Document 2.

The online questionnaire and the workshop sessions were developed based on a categorization of eutrophication and nutrient loading projects associated with management objectives at three scales:

1. Mass loadings from watersheds (basin-wide scale);
2. Critical source areas and land use effects (regional/sub-watershed scale); and
3. Best management practices, low impact development, infrastructure improvements (local scale).

During the workshop, within discussions pertaining to each of these three scales, participants were asked to consider two overarching questions:

1. What information do decision makers require to manage urban water quality and nutrient loads?

2. What are the principal sources, magnitude and implications of uncertainty in urban load measurements?

Workshop findings

Key considerations for advancing urban non-point source nutrient management

The following represents a high-level capture of the areas identified by workshop participants as key considerations for advancing non-point source nutrient management in southwestern Ontario.

Participants were asked to share key elements mentioned during the workshop that they wanted to see included in the framework document. Below is a reorganized compilation of suggestions provided, with like items bundled:

Governance

- Integrated, nested approach: "One water" approach to decision making, including a risk management framework, ensuring management goals and activities tie into overall targets.
- Evidence-informed decision making: Engaging decision makers through a process informed by science.

Management needs

- Value-based problem identification: Define local issues of value, specify priority issues and drivers, identify decision needs, clarify objectives and be clear on knowledge needs. Management questions should inform data requirements.
- From problems to solutions: Move nutrient load measurements beyond identifying problems toward solving problems (implementing, evaluating and adapting solutions).
- Guidance: Provide clear signals on management practices and behavioral changes, with flexibility for local individuals/organizations to innovate based on need and context.
- Uncertainty: Consider the implications of uncertainty/risks for decision makers at different scales.

Progression through multiple scales

- Major watershed scale: Inform watershed management goals using mass loading estimates.
- Regional/sub-watershed scale: Identify critical source areas (CSAs) to establish priorities for investment in urban non-point source reductions at a regional scale. Shift focus to protecting tributaries from impacts of land uses, treating tributaries as receiving water bodies.
- Local scale: Translate priorities into local best management practices, low impact development, and/or infrastructure improvements to manage urban runoff and reduce nutrient inputs. Focus on implementation based on specific needs at a local level, including operations and maintenance.

Implementation and assessment

- Context-specific: Understand the role and context of urban nonpoint source inputs in overall nutrient loading. Tailor needs to relevant context and appropriate scale.
- Action-oriented activities, performance-based outcomes: Call to action to move forward using best available knowledge, and support innovation that meets goals and targets for performance.
- Evaluation: Adequacy of loading measurements depends on management goals, not accuracy. Evaluate management practices and infrastructure improvements at both local and watershed scales to assess whether desired results and benefits are being achieved.
- Co-benefits: Consider the multiple benefits of a practice or infrastructure improvement throughout a watershed, beyond those realized downstream of a receiving water body.
- Cost-effectiveness: Analyze costs and benefits. Ensure best use of resources, value-added investment and appropriate allocation decisions in light of necessary trade-offs.
- Communications: Align on common messaging. Share success stories and lessons learned.
- Adaptive management: Track progress, adapt tools/actions and aim for continuous improvement.

Summary of key themes

The following provides a more detailed summary of themes and key points discussed during the workshop.

Urban context

Why are urban non-point sources of nutrients important? What are the critical differences between urban and rural landscapes that impact input measurements?

- Understand the role urban nonpoint sources play in overall nutrient loading.
- Key differences with urban nutrient inputs: seasonality and flashiness (i.e. little to no buffer due to impermeability, assimilative capacity).
- Context-specific development. Urban impacts can accentuate loads into water bodies, requiring different measurement protocols to answer what when, how, and why of nutrient loading.

Nested governance and scales

- Local issues and processes nested in geographic and time scales, e.g. annual loads versus seasonal loads, zooming in allows us to understand issues driven by what is causing them.
- Perspectives at each scale require a process to walk through in order to define values, invest in and implement actions, and achieve outcomes, nested within each scale.
- With watershed scale goals in mind, need to prioritize “critical areas,” and allocate resources for local implementation.

Three scales discussed:

1. **1.** Mass loading estimates: Means to an end, not an end in itself. The end is to predict and respond. Note: suggestion to remove "mass" as implies "lake," but in fact much broader.
2. **2.** Critical source areas (CSAs): Either sufficiently small scale for application; or, if large scale, possible to apply policy or management priorities. Moving up into watersheds, this scale considers over-contributing sub-watersheds or regional urban areas. Helps establish priority areas for investment (e.g. areas of concern). Note: suggestion to clarify CSA scale (more clearly differentiate, revise terminology, or consider removing).
3. **3.** Best management practices (BMPs), low impact development (LID), and infrastructure improvements: Local scale at which abatement/retrofits are rolled out. Includes built and 'unbuilt' practices. Need to assess efficacy and use of information for planning purposes. Stressed importance of long-term operations and maintenance.

Decision needs

- Value-based management: What are the local issues of value? These drive what we do, where and when. Must create alignment between valued issues (e.g. clean rivers, human health). Issues of value help define and achieve what needs to be done.
- Problem identification: What issues are we trying to solve/control? What management questions need answers? Need to be clear on our objectives.
- People-focused approach: Governance means people. People mean processes. Processes engage communities and help determine the issues that matter most. Monitoring and modelling need to inform decisions which influence behaviour.

Management questions

Participants were asked to identify the principle management questions driving tributary nutrient monitoring programs, as well as the questions driving critical source area prioritization and land use effect investigations.

- End goal: Why care about urban nutrient load measurements? What is the end goal of monitoring and modelling?
- Targets: What is the adequacy of estimates to support/justify targets? How do we integrate and predict the achievability of targets through LID? How do we forecast integrated effects and the achievability of targets?
- Sources: What are key nonpoint sources of phosphorus? There is no one source. Nutrient flow occurs in space and time. How do different land uses contribute to urban loads? Worthwhile to divide? Feasible to track?
- Issues: What issues/problems are urban nutrient sources creating? E.g. eutrophication, human health issues, beach closures, cumulative effects.
- Values and objectives: What is the value of the water/ecosystem services provided? What values are most important in a particular watershed/local area? What are the local issues nested in larger

watershed scale? How can nonpoint sources be addressed to achieve specific objectives? (e.g. maintain cold water fish)

- Significance: How big is the urban load compared to the overall nutrient load? How big are nonpoint tributary loads compared to point sources? How much phosphorus is in urban runoff? What is the concentration of that load? What are the processes driving the issue (N cycle, P cycle)?
- Quantity concerns: What is water flow at different spatial/time scales? How are flows changing (relevant to maintaining water balance)? How does flow and loading impact sensitive species? How frequently will it rain? How much?
- Quality concerns: Focussed on instream water quality and erosion. Driver is often eutrophication. How are algal blooms impacting ecosystem and human health?
- Assimilation: What is the assimilation capacity? What are evidence-informed targets for the tributary based on this capacity?
- Remediation: How much remediation is required to meet ecological goals, keep status quo? Which areas require remediation?
- Defining limits: If not loads, what requirement should be put in place? How should limits be set?
- Abatement: Given limited funds to invest, where are the best value solutions? Where is innovation required? May not require a new approach, but instead a new conversation (to shift behaviour).
- Selecting practices: Which management actions should be taken according to a particular context? What is best suite of practices in a given context? If there is no current regulatory push for low impact development, what is driving it, and how are decisions being made? What type of treatment is required?
- Evaluating practices: What impact will/do actions have? Demonstrate measurable impacts on the ground. Comes back to the management goal/s. For example, in working to maintain cold water fish populations: Are the fish healthy? Is the fishery sustained? What do loads tell us about the quality and quantity of water in supporting or restoring fish populations?
- Understanding long-term impacts and lag times: Are loads related to current nutrient sources, or a legacy issue? What are the long-term cumulative effects (valued ecosystem components)?

Knowledge needs

- Why care? Must understand why we are measuring loads and collecting data. Is knowledge helping to identify or fix problems? What knowledge do we need to make decisions? How are data used to drive decisions? Or are decisions driving the data? Management questions should inform knowledge requirements. Need to bring decision needs to science.
- Well-designed monitoring program provides data needed to address an issue. What and when to measure depends on context. What type of monitoring is appropriate? What parameters? When to monitor? How often? Differences in loads between seasons? Between wet and dry years?
- Multiple lines of evidence and range of uses. Ensure range of potential data uses does not get overlooked.

- Relative sufficiency. Not striving for absolute correct data, but relative (adequate) sufficiency. Need enough info/evidence to move forward with management actions and work together to implement.

Implications of uncertainty

Participants were asked to comment on the implications for decision makers of uncertainties in mass loading estimates and in critical source area (CSA) estimates. What are the implications of what we do not know? What questions need to be asked to address uncertainties?

- Is there sufficient information to predict outcomes and/or make a decision? Information feeding model, aiming to predict.
- Methodological uncertainties – require standardization of sampling protocols.
- Uncertainty around outcomes. Require us to "know the truth." How can we characterize?
- What is the magnitude of uncertainty (risks) that comes with making decisions based on best available information? Must accommodate variability – no one number.
- Level of uncertainty is not critical at all scales. The broader the scale, the more tolerance for uncertainty. Uncertainty decreases with larger watershed scales.
- Not feasible to monitor all stormwater. Need strategic local monitoring within major receiving water bodies.
- Uncertainty requires us to be pragmatic and understand who is bearing the risk.
- Best-value solutions. Relative is good enough. Best-value is a driver given ongoing constraints and trade-offs.

Constraints, barriers and challenges

What, if anything, is holding back planning decisions? How do we move beyond barriers? Generally, participants felt the tools available to estimate urban nutrient loads are not constraining plans to achieve loading reductions; however, a number of ongoing barriers/challenges were discussed:

- Lack of clarity around management goals. Require clear values, direction, targets, and objectives. Must be able to answer the "why care?" of management goals and monitoring efforts.
- Resource and capacity issues. Cheaper to study an issue than to fix/abate. Sampling efforts involve intensive time and extensive resources. Costs drive/influence the investigation.
- Lack of (or too much) data. The availability of information is directly related to cost. – OR – Far too much data available, and not enough analysis to interpret and translate data to inform decisions. Analysis requires capacity and long-term investment.
- Cautious approach. Afraid of not getting results and required return on investment. Need to ground truth methods on sparse data sets – experiment, evaluate, adapt.
- Timing gap of legacy nutrients. How to characterize? Understand impacts/improvements over the long-term.

- Magnitude of problem. Despite all available actions, even if it was possible to do everything, at any cost, in some cases still would not achieve objectives. Consider nutrient removal.
- Lack of engagement/communication of importance of stormwater, lack of acceptance of alternative funding mechanisms. Requires getting communities involved in governance processes.
- Complexities associated with changing climate. E.g. According to "Planning for Extremes," total flows have not changed, but distribution has changed throughout year (e.g. no big spike in spring).
- Collaboration challenges. Bringing everyone to the table to agree on priorities and approach.

Prioritization

- Deciding what matters. What is appropriate and what matters most within a critical source area or regional land use scale? Need to align with values while adhering to constraints.
- Allocation of limited funds. Prioritize to help determine where to direct investments. Examples:
    - Sampling decisions: Where should we invest in more intensive (but cost-effective) sampling?
    - Asset management: How best to manage stormwater assets over long term? What are the management costs? How to appropriately budget infrastructure retrofits?
    - Funding options: How can we move stormwater treatment forward through alternative funding mechanisms? E.g. 1 stormwater fees. E.g. 2 phosphorus offsets (offsetting urban point sources through BMP/LID resulting in nutrient reductions).

Implementation drivers

What is currently driving actions on the ground? Which co-benefits are driving urban nutrient management decisions? Is nutrient loading encompassed in drivers/triggers regarding phosphorus? What is pushing urban nutrient management forward? How are decision needs translated into management actions?

- Context-specific: Drivers for management actions are often context- or area-specific. May not be able to make generalities, although there is regulatory overlay of what is required. Consider in terms of clear water quality objectives and regulations.
- Municipal planning/provincial policy: Prioritizing where long-term plans will be implemented at the municipal level, and best opportunities to achieve co-benefits. Requirements to deal with water flow and long-term infrastructure projects. Addressing challenges of climate change, population growth, or providing enhanced level of a municipal service (e.g. increased sewer capacity).
- Stormwater management rates: Fees are serving to address funding issues and gaining traction as a driver.
- Compelling success stories: A success story in a neighbouring municipality or watershed can motivate. Opportunities to showcase studies on how BMP/LID practices have been successful, providing proof of what has worked or what has needed improvement (lessons learned).

- Leaders addressing key issues of concern: Local champions from conservation authorities and municipalities coming together to address a significant issue (e.g. flooding). Leadership around adapting to extreme weather events has been a key driver to prevent flooding. Leadership on an issue is about relationship building and shared common goals. Need to address lack of funding mechanisms to implement LID demonstrations.

- Citizen engagement: Public assets to be protected/enjoyed are serving as driving force. Seeing increased willingness of individuals to act and benefit (or avoid as is the case with flooded basements). Examples: impervious driveways. Also, opportunities for eco-labelling and citizen science.

- Guidelines: MOECC LID manual is intended to be “guidance” as there is no legal requirement. However, some adhere to guidance as compliance with regulator (encouraged to meet guidance, and therefore drives investment). The intention is for guidance to encourage innovation, including flexibility around ideas that are not necessarily in guidelines. Guidance needs to be continuously updated to incorporate new knowledge and keep up with opportunities for innovative solutions.

- Asset management planning: The Ontario Ministry of Infrastructure has proposed through the Environmental Bill of Rights an assessment management planning regulation. If the proposed regulation becomes law, there would be a requirement to document wastewater and stormwater assets, and plan for infrastructure replacement or repairs. This would also link planning to the budget process (require conversations between water managers and finance).

- Agreements: The Great Lakes Water Quality Agreement has served as a driving force (Lake Erie target, and Lake Ontario target under development). Targets and expectations must be communicated.

- Codes and other regulations: E.g. building code. How to develop performance-based outcomes, versus prescriptive-based regulations?

- Maintenance: Quality of initial construction is important but must also prioritize operations and maintenance. Difficult investment when cannot guarantee outcomes over long-term life cycle. Growing litigation related to not properly maintaining stormwater infrastructure.

- Co-benefits: Need to integrate water quality into higher priority drivers to identify and realize multiple benefits within a watershed.

Assessment of management actions

How is the effectiveness of management actions being assessed? Are load data being used at a local level to inform and assess management decisions? How do we know if/when management actions are effective over time? How do we integrate lessons learned?

- Linking to targets: Need to link target setting to realistic estimates and evaluation of actions to help achieve targets. Data are important to evaluate effectiveness of BMPs at local scale, but not always helpful in estimating loads at larger watershed scale.

- Incorporating empirical studies: Need to find a better way to incorporate empirical studies in models. Mismatch between models developed with older data. Need to recalibrate with new information in order to access adequacy/effectiveness.

- Inspection: Municipalities have stormwater facility inspection program, helps with evaluating effectiveness of sediment performance.
- Unintended impacts/consequences: If not designed, managed and maintained properly, BMPs such as ponds/wetlands can release nutrients back into the water.
- Continuous improvement/adaptive management: Must do the best we can with what we have, and circle back to assess if achieved desired outcomes. In some cases, dealing with an overwhelming amount of data, but lack required analysis and capacity for adaptive management. There are also considerable time gaps between action and results, while at the same time dealing with immediate pressures to act and prove effectiveness.
- Performance-based outcomes: Difficult to get approvals without guaranteed outcomes.
- Focus on tributaries: Focus on lakes to set targets and focus on sub-watersheds when trying to relate benefits and effectiveness to a local receiving water body. Best way to achieve benefits for lakes is to focus on tributaries and their health.
- Long-term lens: Understand trends, identify and address cumulative impacts.
- Implement practices using best available knowledge, demonstrate progress or areas requiring improvement, collate and highlight good work being done, and maintain/adapt over the long-term.

Appendix 1A: Experts' workshop participant list

Sean Backus	Environment and Climate Change Canada
Brad Bass	Environment and Climate Change Canada
Jonathan Bastien	Hamilton Conservation Authority
Nandita Basu	University of Waterloo
Gary Bowen	Toronto and Region Conservation
Duncan Boyd	Chair, Urban Nutrient Loads Advisory Group
Bernadette Conant	Canadian Water Network
Sandra Cooke	Grand River Conservation Authority
Alice Dove	Environment and Climate Change Canada
Katrina Hitchman	Canadian Water Network
Todd Howell	Ontario Ministry of Environment and Climate Change
Nancy Kodousek	Region of Waterloo
Luis Leon	Environment and Climate Change Canada
Tanya Long	Ontario Ministry of Environment and Climate Change
Madhu Malhotra	Ontario Ministry of Environment and Climate Change
Chris Manzon	City of Windsor
Jiri Marsalek	Consultant
Korice Moir	Contractor
Mohamed Mohamed	Ontario Ministry of Environment and Climate Change
Frank Quarisa	Toronto Water
Amanjot Singh	Credit Valley Conservation
Thom Sloley	Regional Municipality of Durham
Bill Snodgrass	Toronto Water
Eleanor Stainsby	Ontario Ministry of Environment and Climate Change
Michael Stone	University of Waterloo
Amna Tariq	Credit Valley Conservation
Sabrina Ternier	Ontario Ministry of Environment and Climate Change
Mirek Tybinkowski	Ontario Ministry of Environment and Climate Change
Matt Uza	Ontario Ministry of Environment and Climate Change
Barbara Veale	Conservation Halton
Christopher Wellen	Ryerson University
Ram Yerubandi	Environment and Climate Change Canada

Appendix 1B: Experts' workshop agenda

PROJECT PURPOSE

Canadian Water Network (CWN) is leading a project supported by Environment and Climate Change Canada (ECCC) to assess how well existing tributary nutrient loading measurements and statistical approaches in urban areas meet the requirements of urban planning and watershed managers. The assessment will help improve the alignment between nutrient loading study objectives and methods and clarify under what circumstances current practices may be adequate or inadequate in supporting management decisions.

The project has generated a draft whitepaper providing an assessment of the state of the knowledge and practice on measuring urban nutrient loads, including the state of the knowledge on the utility achieved through various nutrient monitoring methods typically used in Canada. The workshop and pre-workshop questionnaire are designed to help validate, augment and update the whitepaper knowledge, assess gaps in existing knowledge, and inform decisions. The overall goal is to improve the application of science to decision making, and consequently the workshop will be informed by a decision-making rather than purely scientific perspective.

The project will culminate in a framework document that delivers critical insights to inform science-policy linkages as well as to inform practice and investment decisions by urban water managers. The framework document will incorporate science-management decision points (SMDPs) that support the progression from preliminary assessments to more detailed, quantitative assessments.

WORKSHOP OBJECTIVES

The objectives of the workshop are to:

A. Promote discussion between management "decision-makers" and science practitioners to clarify information requirements and acceptable degree of uncertainty.

B. Inform the future development of a decision-making framework to maximize the utility of monitoring and modeling resource allocations.

STRUCTURE OF WORKSHOP SESSIONS

The workshop sessions have been developed based on the following categorization of eutrophication and nutrient loading projects by management objectives:

1. Mass loadings from watersheds
    - relative significance of internal vs. external sources
    - relative significance of point and nonpoint sources
2. Critical source areas and land use effects
    - identification of "over-contributing" areas/regions
    - estimation of export coefficients for unmonitored regions
3. Best management practices, low impact development, and infrastructure improvements
    - planning and development criteria
    - allocation of abatement resources

Overarching Questions

Participants will be asked to consider two overarching questions:

1. Management needs: What information do decision makers require to manage urban water quality and nutrient loads?
2. Uncertainty: What are the principal sources, magnitude, and implications of uncertainty in urban load measurements? What level of certainty is required to make effective decisions?

In addition, three focus areas have been identified for each session in the agenda below.

Agenda

Day 1 (Tuesday, February 6) Hilton Toronto Airport Hotel & Suites, 5875 Airport Road, Mississauga	
9:00 am - 9:15 am	Introductions and Project Overview *Bernadette Conant, CEO, Canadian Water Network (CWN)*
9:15 am - 9:45 am	Setting the Stage: Workshop Objectives, Overarching Questions and Session Categories *Duncan Boyd, Chair, Urban Nutrient Loads Advisory Group*
9:45 am - 10:30 am	Session I: Mass Loadings from Watersheds Focus areas ● Decision-making questions that require information on nutrient loads from watersheds (e.g. understanding relative significance of tributary inputs on eutrophication problems in receiving waters) ● Geographical and time scale requirements for this information (e.g. watershed, sub-watershed, annual, seasonal etc.) ● How this type of information is being, or has been, translated into management decisions (e.g. target setting, foundation for assessment of land use effects and identification of sources within watersheds)
10:30 am - 10:50 am	Break
10:50 am - 12:00 am	Cont. Session I: Mass Loadings from Watersheds
12:00 pm - 1:00 pm	Lunch
1:00 pm - 2:40 pm	Session II: Critical Source Areas and Land Use Effects Focus areas ● Decision-making questions that require information on land-use impacts and identification of critical source areas (e.g. understanding relative significance of land use types and “over-contributing” areas within watersheds) ● Geographical and time scale requirements for this information (e.g. sub-watershed, sewershed, construction site, annual, seasonal, monthly, daily etc.)

	• How this type of information is being, or has been, translated into management decisions (e.g. identification and abatement of sources within sub-watersheds, generation of export coefficients/yields for estimation of contributions from unmonitored areas)
2:40 pm - 3:00 pm	Break
3:00 pm - 4:15 pm	Cont. Session II: Critical Source Areas and Land Use Effects
4:15 pm - 4:30 pm	Overview of Day 1 and Preparation for Day 2 *Bernadette Conant and Duncan Boyd*

Day 2 (Tuesday, February 7) Hilton Toronto Airport Hotel & Suites, 5875 Airport Road, Mississauga	
8:30 am - 8:45 am	Recap of Day 1, Introduction to Day 2 *Bernadette Conant, CWN*
8:45 am - 10:10 am	Session III: Best Management Practices (BMPs), Low Impact Development (LID), and Infrastructure Improvements Focus areas • BMP/infrastructure evaluations that have informed decision making (e.g. SWM infrastructure construction/maintenance, selection of BMPs, LID criteria for new development) • Planning decisions based on predicted outcomes of BMPs and LID (e.g. bylaws, development requirements) • How this type of information is being, or has been, translated into refinement of load reduction targets and/or tracking progress towards targets (e.g. decisions regarding allocation of abatement resources between NPS management projects and wastewater treatment upgrades)
10:10 am - 10:30 am	Break
10:30 am - 11:15 am	Cont. Session III: BMPs, LID and Infrastructure Improvements
11:15 am - 12:00 pm	Wrap Up: Review of Key Insights and Next Steps *Bernadette Conant, Canadian Water Network*