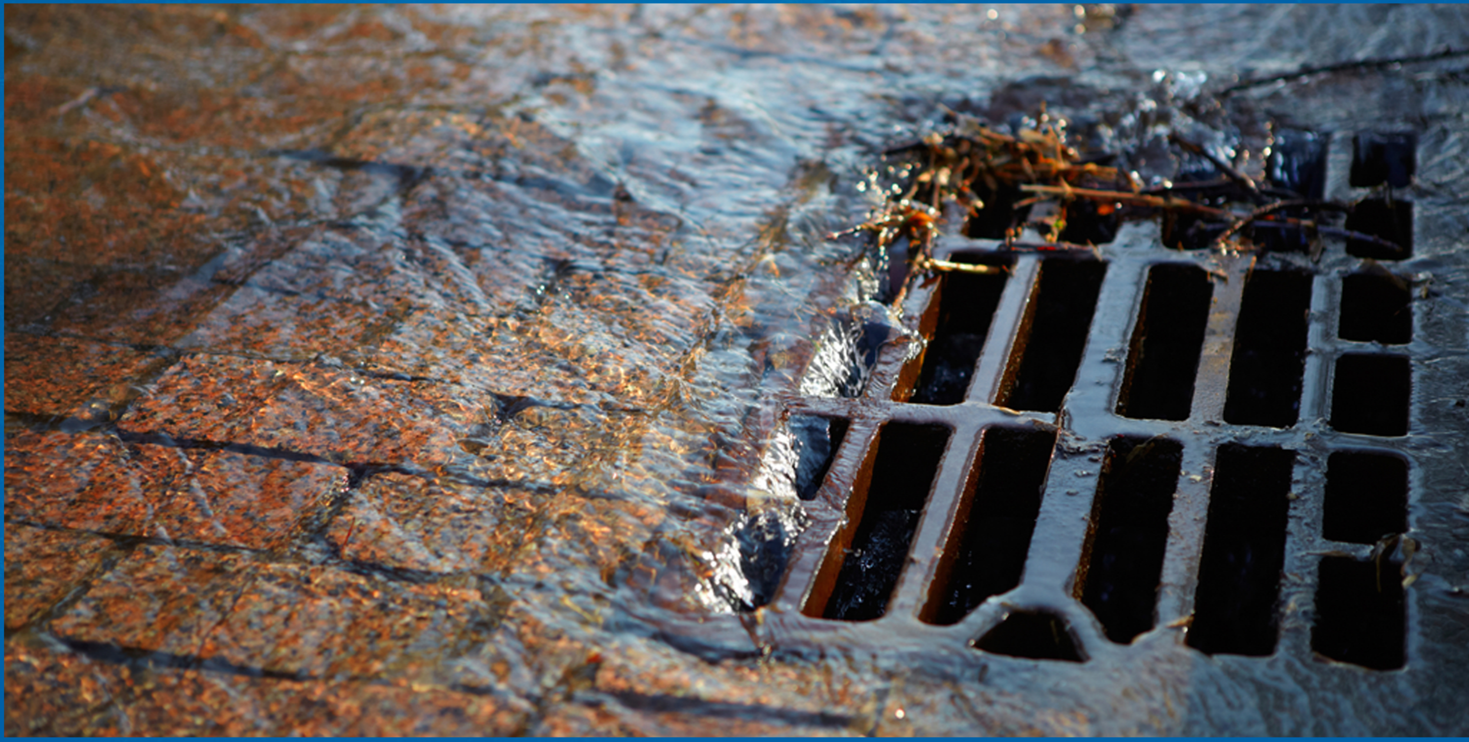
Canadian Water Network

Assessing the Adequacy of Urban Nutrient Load Measurements

A Framework for Addressing Urban Non-point Source Nutrient Loading in Watershed Management



March, 2018

Prepared for Environment and Climate Change Canada

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Acknowledgements

Canadian Water Network would like to acknowledge the important contributions made by advisory group members to this project, and thank them for sharing their time and expertise.

This framework document has been prepared by Canadian Water Network. It draws on insights from project activities as well as discussions with advisory group members, and does not necessarily represent the views of their employers.

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This project was undertaken with the financial support of:
Ce projet a été realisé avec l’appui financier de:

Environment and Climate Change Canada | Environnement et Changement climatique Canada

Introduction

Controlling nutrient inputs to water bodies to combat eutrophication, algal blooms and deterioration of water supplies is one of the major issues driving watershed management. Designing policies and establishing best management practices to control nutrient inputs from urban sources is a key part of that overall management picture. A consideration of whether or not existing methods to estimate urban loads are appropriate and adequate to support those designs is not only a question of the scientific and statistical rigor of the methods used. Rather, the key question of adequacy is fundamentally one of determining how well existing tributary nutrient loading estimates for urban areas serve the particular needs of the decisions they are meant to inform. Supported by funding 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.

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 a scientific 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 (Boyd, 2018, Supporting Document 3).

In February 2018, CWN hosted a 1.5-day expert 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 expert 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. Highlights of the rich discussions and findings from the workshop are included in Supporting Document 1, and a summary of the questionnaire results can be found in Supporting Document 2.

The following pages represent a culminating, high-level summary of the findings of this project, drawing on whitepaper insights and informed by workshop discussions. This document provides a recommended framework for decisions related to the design of policies and practices that achieve nutrient management from urban sources.

A framework for addressing urban non-point source nutrient loading in watershed management

Mitigation of water-quality impairments that are leading to eutrophication and harmful algal blooms is a major driver for the design of policies and practices to reduce nutrient loading to watercourses. Significant gains have been made in reducing nutrient inputs from key end-of-pipe sources, particularly municipal wastewater treatment effluent, but nutrient-related water-quality problems persist. Policy has now shifted to include the more complex task of reducing non-point sources of nutrients throughout watersheds. To date, the main focus in development of loading assessments, policies and best management practices (BMPs) has been on agricultural non-point sources given their significant contribution of nutrient loading in many watersheds. However, the ability to effectively understand and manage nutrient loading from urban non-point sources also requires consideration. Determining the adequacy of current methods of assessing loading to tributaries for urban sources, given their particular nature and different character relative to agricultural sources, is relevant to that consideration.

An in-depth exploration of the utility and application of approaches and methodologies for assessing nutrient loading from urban non-point sources is provided in the whitepaper prepared for this project (Boyd, 2018, Supporting Document 3). The following is a high-level take on the key themes that emerged from this work.

A matter of context

The consistent message, confirmed by workshop discussions, in considering the adequacy of nutrient loading approaches and methods to support management decisions was the following: "adequacy" is contextually defined by the purpose of the management question.

> *"Evaluating how well current approaches to estimating nutrient loads meet management decision needs requires clear management objectives that describe how the results are to be used. Well-defined objectives will make it possible to assess the degree to which uncertainty in the estimation of nutrient loadings compromises or constrains decision making and such an exercise will help improve the alignment between nutrient loading study objectives and methods. It will also clarify under what circumstances current practices may be inadequate to support management decisions." (Boyd, 2018, page 5)*

A matter of scale

When it comes to the significance of uncertainty in the representativeness of nutrient loading estimates, the scale at which policy or management questions are being considered is particularly relevant. In general, the workshop discussions found that the relevance of uncertainties associated with nutrient loading estimates increase in significance as the scale at which decisions are being made decreases. Similarly, the amount and resolution of data required to effectively answer questions related to nutrient behaviour generally increases as the scale of focus narrows. Although data deficiencies may certainly occur, or methods may be under-applied in some areas, available nutrient loading approaches and methodologies were generally seen to be:

- Good enough to support eutrophication models used to establish receiving-water (e.g., lake) objectives (watershed scale — defining need).

- Generally sufficient to identify the "hot spots" or priority areas most in need of action (sub-watershed or "*critical source areas"* scale — where to act).

- Less useful for evaluating the degree of impact achieved through site-specific (e.g., stormwater management) activities (local scale — assessing contributions to load reductions)

A matter of aligning goals and drivers for action

Workshop participants articulated shared experience of a disconnect between the level at which overall receiving-water objectives are set and the local issues that drive the majority of investment decisions that impact urban nutrient loads. Regulators seek to design policies that will clearly and defensibly connect local actions to overall receiving-water goals and local practitioners seek to integrate requirements to contribute to these goals within their local investment decisions. However, particularly if there is uncertainty about how well a given remedial action will contribute to larger-scale loading targets, attempts to drive local decisions primarily through their link to overall goals becomes problematic. People are motivated to solve problems they are most connected to, and local decisions that have direct relevance for decreasing nutrient loading may well be more effectively driven by other factors, like mitigating local flooding, upgrading parks, or efforts to improve public health of local beaches or waterways. By explicitly recognizing and aligning the different regional and local drivers for action and recognizing where they are complementary, there is greater potential to identify opportunities for policies that will achieve both effective progress and buy-in. Moving to performance-based regulatory approaches that focus on achieving local outcomes and continuous improvement in the face of inevitable uncertainty would address this need while incentivizing progress and innovation.

A matter of identifying co-benefits

In the face of uncertainty about how local actions contribute to achieving watershed-level targets for nutrient reduction, it is difficult to regulate tightly to ensure the right action, precisely because it is difficult to produce an evidence base that clearly demonstrates what is "right." Workshop participants affirmed that identification and support of activities that are likely to have co-benefits — those that achieve nutrient reduction and contribute to other public-good outcomes such as urban stormwater management — provide a more effective way forward. In addition, solutions that are shown to provide co-benefits are more likely to be successful in achieving uptake and local support because they are clearly linked to local drivers and provide multiple lines of evidence that help address uncertainties when examining costs and benefits of actions. This points to opportunities to gain intended receiving water benefits by incenting and recognizing beneficial actions within an overarching policy framework.

A matter of informed action

Managing nutrient impacts to water bodies represents one important issue of many to be addressed within the complex area of watershed management. Policy-makers and practitioners alike face familiar questions in deciding what to do: *Do we know enough to act? Do we know enough to prioritize actions and conduct a cost-benefit analysis to determine what makes most sense to do? Given the many uncertainties, what would be most useful to find out next?*

Workshop participants characterized the challenges of assessing nutrient loading to determine priorities for action as similar to all major watershed management activities: in need of a "One Water" integrated watershed management approach. Given the complexity of the issues, and the inevitability of scientific uncertainty, there was a bias for an informed, action-oriented approach. Participants favoured moving forward using best available science, knowing that information will change or improve over time, and considering trade-offs rather than waiting for the science to "catch up" to implement. Whereas continued research and advancement of understanding of system behavior was supported, it was not seen as a reason to avoid taking action.

For nutrient management decisions, an action-oriented stance moves the focus from deciding i) whether information provided by loading estimates is sufficient to demonstrate compliance, to ii) whether the information is sufficient to support decisions to take proactive and beneficial actions that are driven by more than just consideration of the receiving water goal.

Developing a decision process that is people-based *and* evidence-based

The project outcomes suggest it would be helpful to those involved in shaping policy and action for managing nutrient loading to develop a standardized, iterative decision-making process to guide watershed managers and decision makers. That decision framework should incorporate lessons learned in various jurisdictions, including the strongly reinforced idea that watershed management is a very people-oriented process. Attention to governance issues and methods for engaging water managers and the broader public who support their work are just as important to success as good science. Given the inevitable scientific uncertainties, engaging stakeholders through a clear, logical and adaptive decision frame is critical.

To establish a clear and logical approach to decisions, and to effectively engage stakeholders as a result, it is recommended that decision processes include the following progression of science integration to inform decisions on mitigation of urban non-point source nutrient loads:

1. Confirm a receiving water eutrophication problem (clarify the problem);
2. Confirm the relative significance of urban non-point sources compared with point sources and rural/agricultural non-point sources (confirm the opportunity for action to matter);
3. Identify critical source areas for urban non-point source nutrient inputs (identify priority areas);
4. Evaluate potential for nutrient reduction co-benefits (other improvements in water quality or flow management) related to policy, BMP or infrastructure improvement options;
5. Select appropriate policies, BMPs and infrastructure improvements to manage urban runoff that have co-benefits, including ameliorating urban non-point source nutrient inputs (select actions that make sense and engage local players through co-benefits); and
6. Confirm if implemented solutions are performing as anticipated and adjust as appropriate (commit to adaptive management).

The proposed approach should be iterative and should include Scientific-Management Decision Point discussions (SMDP) between each step to clarify and confirm management objectives and ensure consensus prior to proceeding with management actions or additional study.

> *"Such an iterative approach will intrinsically incorporate* ***adaptive management*** *into the decision-making process and will provide a strong, logical basis for evaluating the benefits of additional information gathering, and the refinement of existing monitoring and modeling tools, at any step from problem definition to implementation of solutions." (Boyd, 2018, page 39).*