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TRIECA 2019 Conference
Pearson Convention Centre,
Brampton, March 21, 2019

Striking a Balance: A Consensus-based Guide for Effectiveness Monitoring of Stream Rehabilitation Projects in Ontario

Stream Rehabilitation Effectiveness Monitoring Working Group

Dean Young MES BSc,
Toronto and Region Conservation Authority


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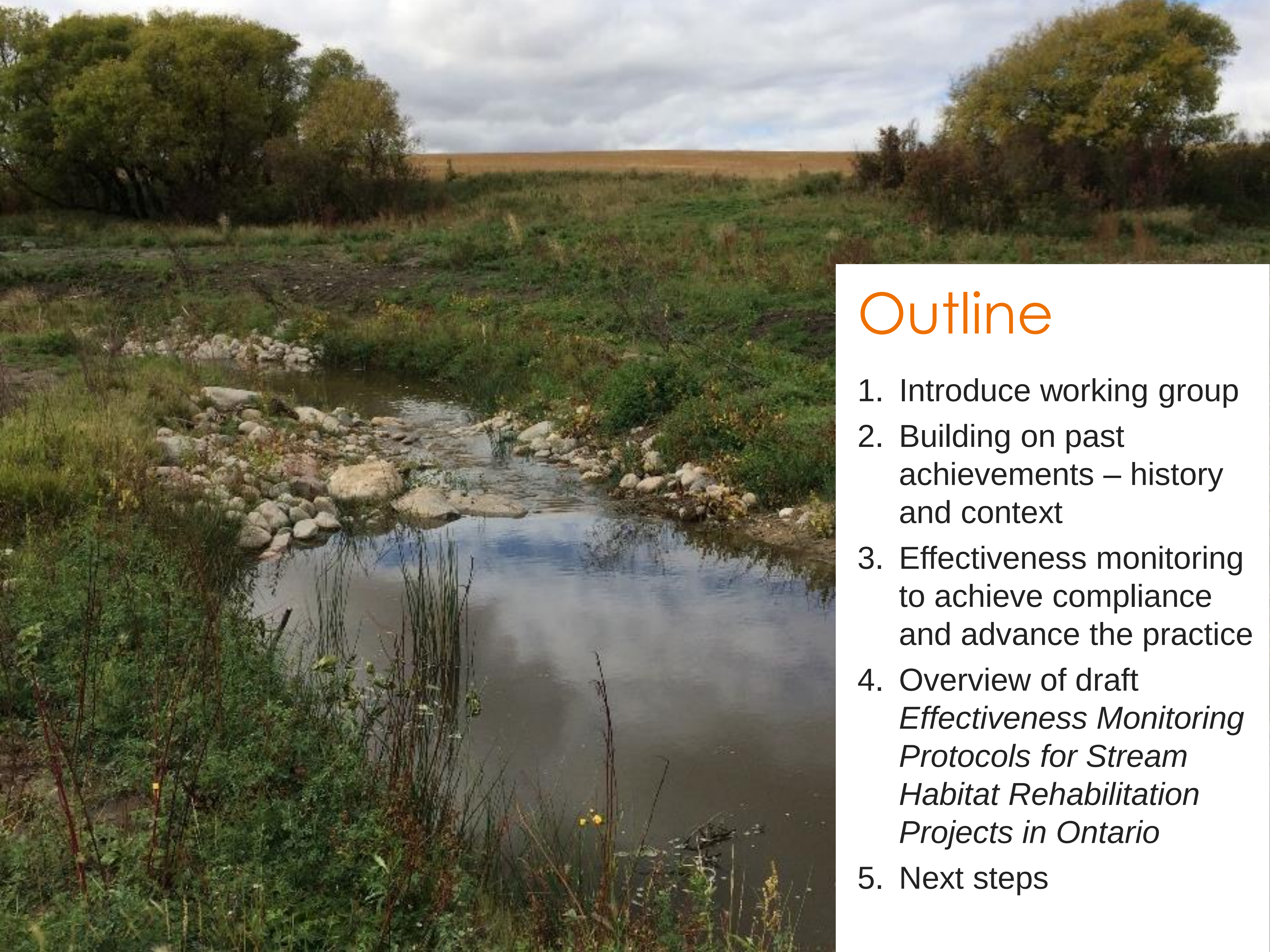
CAT



Outline

1. Introduce working group
2. Building on past achievements – history and context
3. Effectiveness monitoring to achieve compliance and advance the practice
4. Overview of draft *Effectiveness Monitoring Protocols for Stream Habitat Rehabilitation Projects in Ontario*
5. Next steps

Stream Rehabilitation Effectiveness Monitoring Working Group

Fisheries and Oceans Canada / Pêches et Océans Canada

GeoProcess Research Associates

Rideau Valley Conservation Authority

Stantec

Credit Valley Conservation
inspired by nature

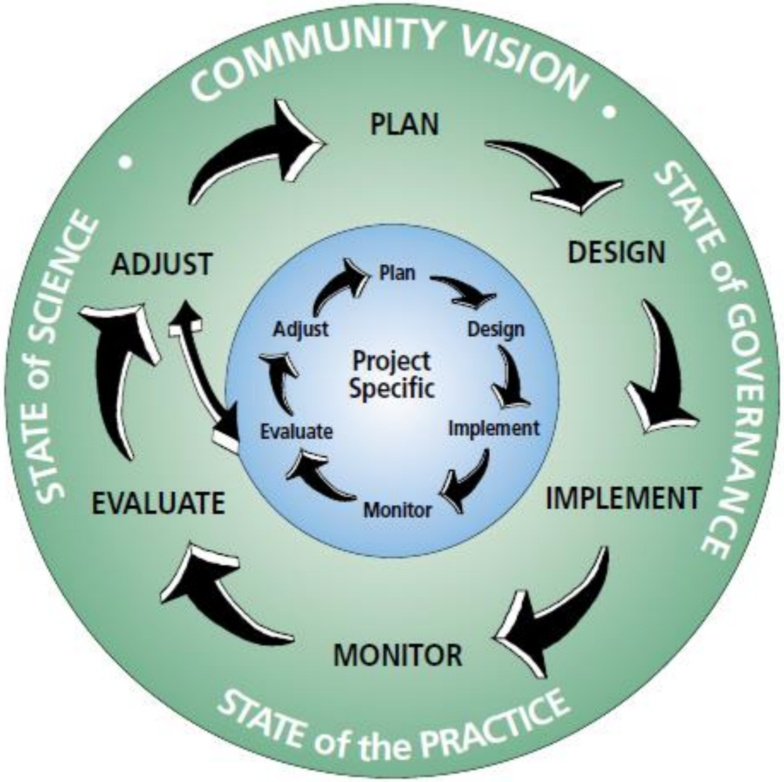
Toronto and Region Conservation Authority

- **Jenie Cooper***, Department of Fisheries and Oceans Canada;
- **Jeff Hirvonen**, GeoProcess Research Associates;
- **Jennifer Lamoureux**, Rideau Valley Conservation Authority;
- **Jeff Muirhead**, Stantec Consulting;
- **Jon Nodwell**, Credit Valley Conservation Authority;
- **Dean Young**, Toronto and Region Conservation Authority.

Evolving the practice requires monitoring and evaluation

- Stream rehabilitation involves complex and inter-related processes;
- In practice for 20+ years in Ontario but few systematic evaluations of outcomes, esp. over the medium to long term (5 to 15 years post-construction);
- Limits the ability of practitioners and regulators to apply an AEM process.

Adaptive Environmental Management Process



Not your typical "engineering" project

A stream is not the same as a road or a building.

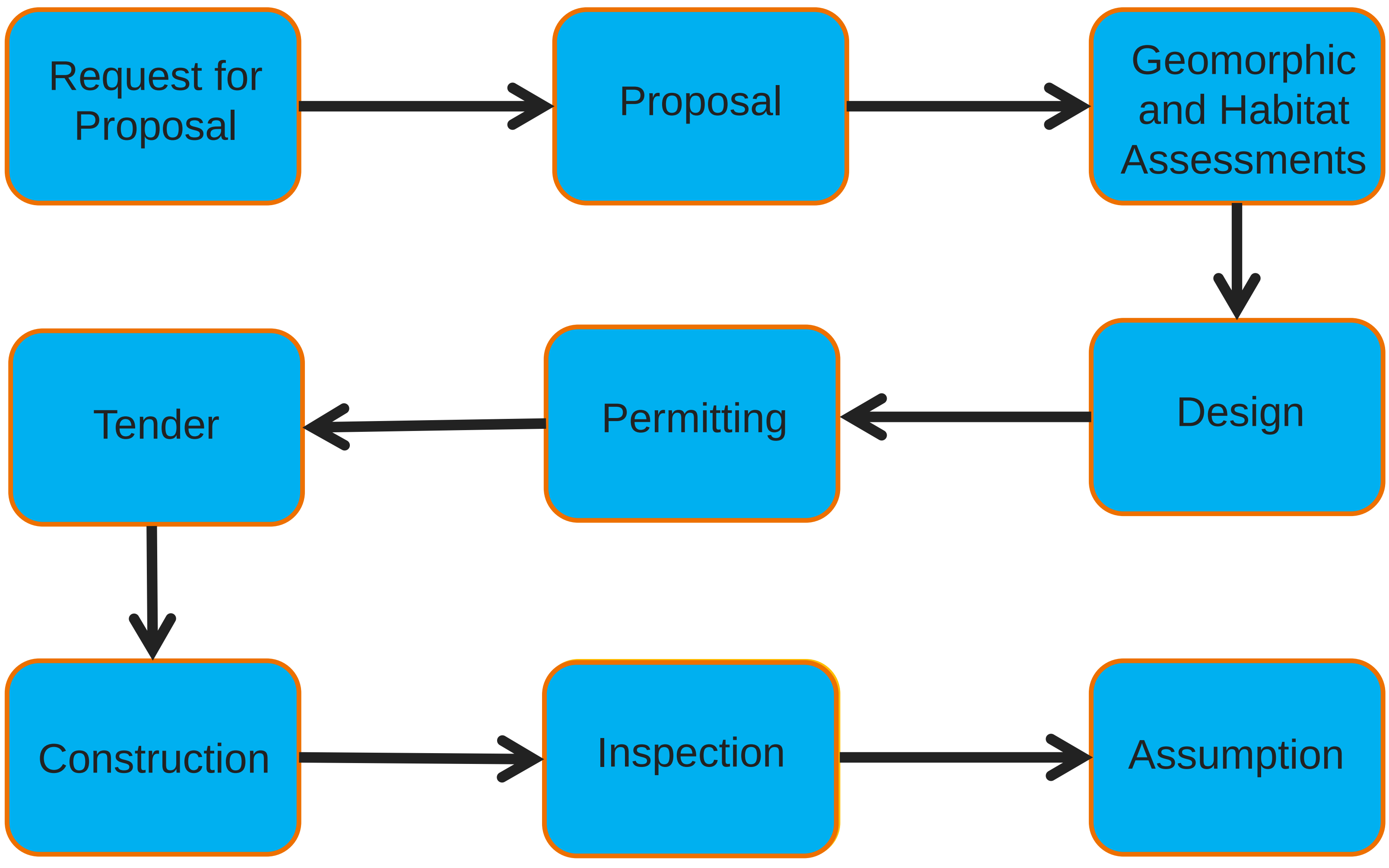
50 million cars in year 1 => no problem

50 year flood in year 1 => damage

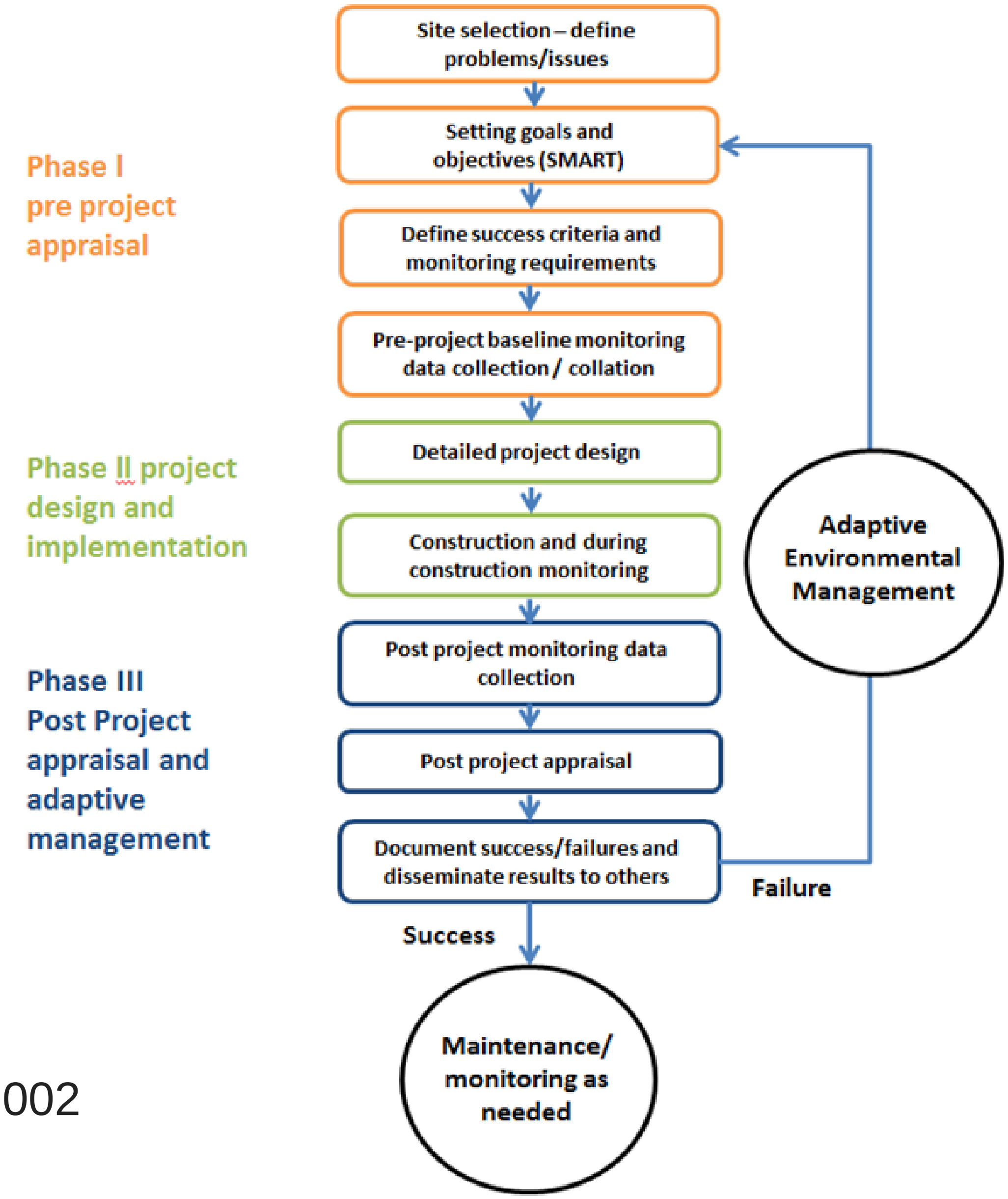
Stream reconstruction contracts typically follow engineering structure…

…not appropriate for natural channel design approaches

Typical engineering project life cycle



Project life cycle incorporating adaptive management



Adapted from PRAGMO 2002

The need for standard protocols

Project monitoring and evaluation requirements vary depending on:

- objectives;
- sensitivity;
- scale;
- risk;
- location;
- review agencies…

The need for standard protocols

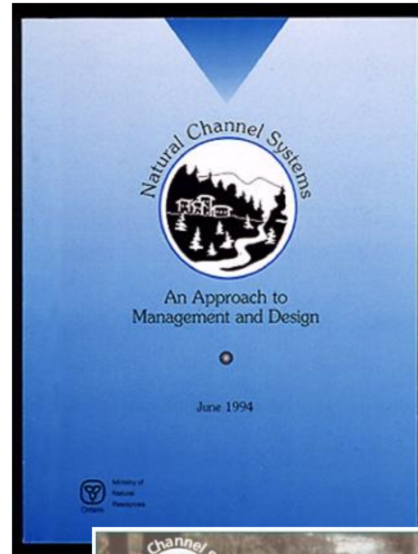
Standard approaches to monitoring plan design and data collection are needed to:

- ➢ Evaluate if design objectives and/or success criteria are being achieved;
- ➢ Assess condition and function over time, and compare between reaches, treatments or regions;
- ➢ Promote consistency and clarity for preparing budgets and contracts.

Natural Channel Systems initiative

Evolution of the initiative:

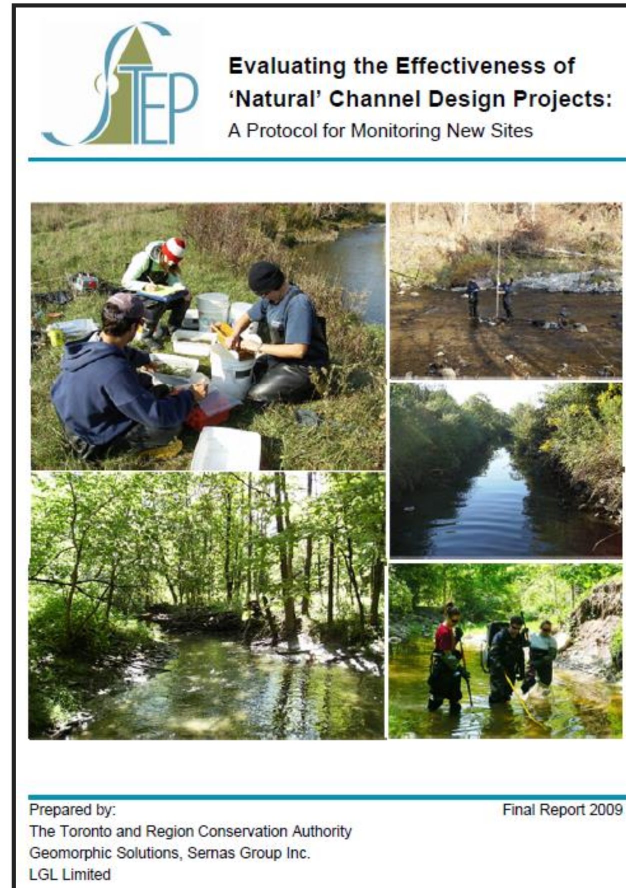
- 1992- MNR creation of public/private professional committee to develop the initiative;
- 1994 – Publication of the “blue book”;
- 1994 - 1st International Natural Channel Systems Conference;
- 1999 – 2nd International Natural Channel Systems Conference;
- 2003 – Publication of “Adaptive Management of Stream Corridor in Ontario” manual;
- 2004 – 3rd International Natural Channel Systems Conference;
- 2010 – 4th International Natural Channel Systems Conference;
- 2016 – 5th International Natural Channel Systems Conference.



TRCA Natural Channel Design Monitoring Program, 2005 to 2014

Multi-year workplan to:

- ✓ Develop guidance on design of monitoring plans for stream rehabilitation projects (2005 - 2009)
- ✓ Implement plans at 10+ sites around the GTA to evaluate if design objectives are being achieved in the 5 to 15 years post-construction time frame (2005 to 2014);
- ✓ Adapt the 2009 monitoring protocol guidance where warranted based on experiences gained and review of recent literature.


STEP

Evaluating the Effectiveness of 'Natural' Channel Design Projects:
A Protocol for Monitoring New Sites

Prepared by:
The Toronto and Region Conservation Authority
Geomorphic Solutions, Sernas Group Inc.
LGL Limited

Final Report 2009

Available at http://sustainabletechnologies.ca

Natural Channel Systems Post-Construction Monitoring Workshop

Workshop hosted on November 1, 2017:

- Over 60 attendees;
- Representatives from private, public, and academic sectors;
- Focused on habitat restoration projects.

Morning: “table setting” presentations:

- Conservation authority perspectives (TRCA & CVC);
- Fisheries and Oceans Canada perspective;
- Academic perspective (Bill Annable, University of Waterloo);
- Consultant perspectives (Waters Edge, Stantec);
- Contractor perspective (R&M Construction).

Afternoon: “breakout” sessions and wrap-up:

- Geomorphology, vegetation, biology

Outcome: Recommended framework for regulators to consider

Recent publications

Assessing the Effectiveness of Habitat Offset Activities in Canada: Monitoring Design and Metrics.

Karen E. Smokorowski[1], Michael J. Bradford[2], Keith D. Clarke[3], Marie Clément[4], Robert S. Gregory[3], Robert G. Randall[5]

[1]Great Lakes Laboratory for Fisheries and Aquatic Sciences, Fisheries and Oceans Canada, Sault Ste. Marie, ON
[2]Fisheries and Oceans Canada and School of Resource and Environmental Management, Simon Fraser University, Burnaby BC
[3]Northwest Atlantic Fisheries Center, Science Branch, Fisheries and Oceans Canada, St. John's, NL
[4] Gulf Fisheries Centre, Fisheries and Oceans Canada, Moncton, NB. Current address: Fisheries and Marine Institute in partnership with the Labrador Institute, Memorial University of Newfoundland, Happy Valley - Goose Bay, NL
[5]Great Lakes Laboratory for Fisheries and Aquatic Sciences, Fisheries and Oceans Canada, Burlington, ON

2015

Canadian Technical Report of Fisheries and Aquatic Sciences 3132

Fisheries and Oceans Canada   Pêches et Océans Canada   Canada

Smokorowski et al. 2015. Fisheries and Oceans Canada Technical Report

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

ELSEVIER

Time is no healer: increasing restoration age does not lead to improved benthic invertebrate communities in restored river reaches

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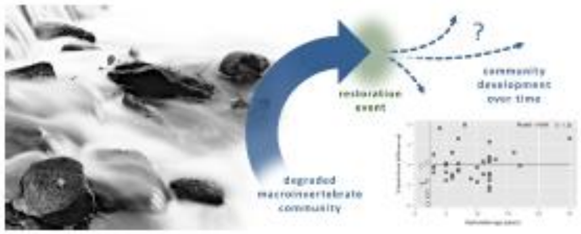
[c] Oregon State University, Department of Integrative Biology, 3029 Cordley Hall, Corvallis, Oregon 97331, USA
[d] University of Duisburg-Essen, Faculty of Biology, Universitätsstrasse 5, 45141 Essen, Germany

HIGHLIGHTS

- Restored rivers were analyzed for benthic invertebrate community change over time
- Restoration age was a poor predictor of community composition and community change
- Non-linear community shifts revealed post-restoration disturbance effects
- Catchment-scale characteristics override the effectiveness of river restoration
- Hydromorphological restoration alone was not sufficient to repair communities

GRAPHICAL ABSTRACT



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ABSTRACT

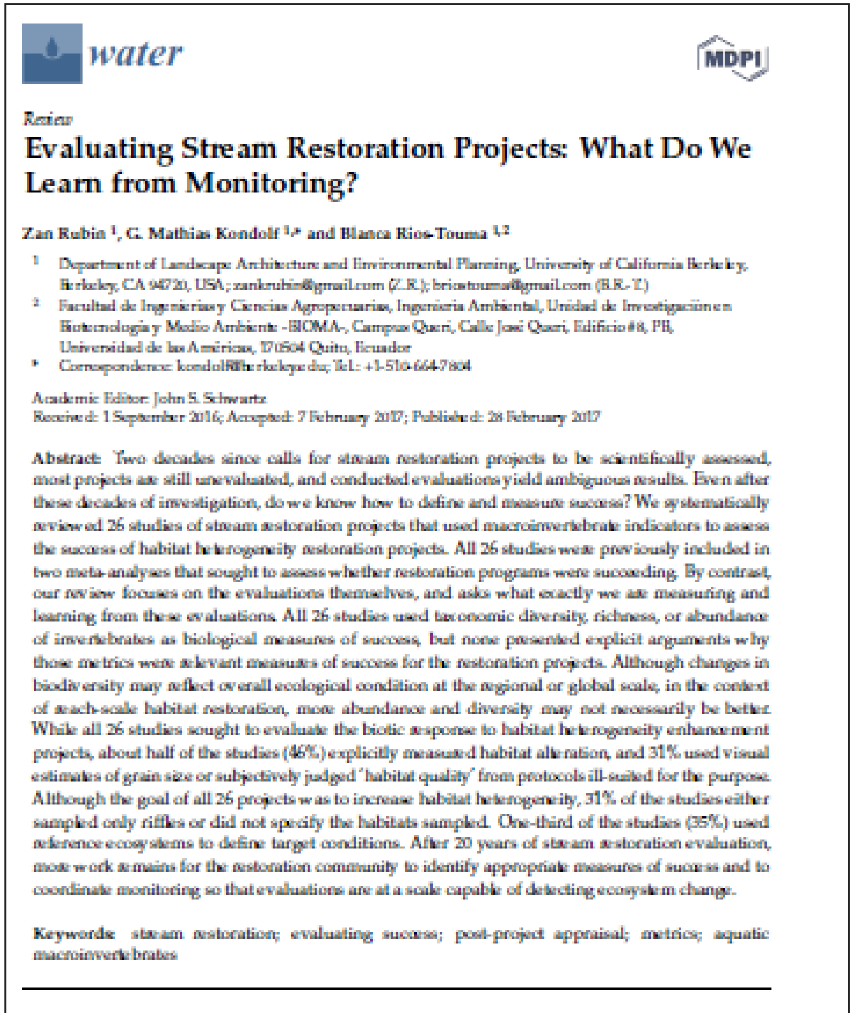
Evidence for successful restoration of riverine communities is scarce, particularly for benthic invertebrates. Among the multitude of reasons discussed so far for the lack of observed effects is too short of a time span between implementation and monitoring. Yet, studies that explicitly focus on the importance of restoration age are rare.

We present a comprehensive study based on 44 river restoration projects in Germany, focusing on standardized benthic invertebrate sampling. A broad gradient ranging from 1 to 25 years in restoration age was available. In contrast to clear improvements in habitat heterogeneity, benthic community responses to restoration were inconsistent when compared to control sections. Taxon richness increased in response to restoration, but abundance, diversity and various assessment metrics did not respond clearly. Restoration age was a poor predictor of community composition and community change, as no significant linear responses could be detected using 34 metrics. Moreover, only 5 out of 34 tested metrics showed non-linear shifts at restoration ages of 2 to 3 years. This might be interpreted as an indication of a post-restoration disturbance followed by a re-establishment of pre-restoration conditions. BIO-ENV analysis and fourth-corner modeling underlined the low importance of restoration age, but revealed high importance of catchment-scale characteristics (e.g., ecoregion, catchment size and land use) in controlling community composition and community change.

Overall, a lack of time for community development did not appear to be the ultimate reason for impaired benthic invertebrate communities. Instead, catchment-scale characteristics override the effectiveness of restoration. To

Leps et al. 2016. *Science of the Total Environment*, April 2016.

Recent publications



water

MDPI

Review

Evaluating Stream Restoration Projects: What Do We Learn from Monitoring?

Zan Rubin [1], G. Mathias Kondolf [1,*] and Blanca Rios-Touma [1,2]

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2. Facultad de Ingenierías y Ciencias Agropecuarias, Ingeniería Ambiental, Unidad de Investigación en Biotecnología y Medio Ambiente -BIOMA-, Campus Queri, Calle José Queri, Edificio #8, PB, Universidad de las Américas, 170504 Quito, Ecuador

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Academic Editor: John S. Schwartz
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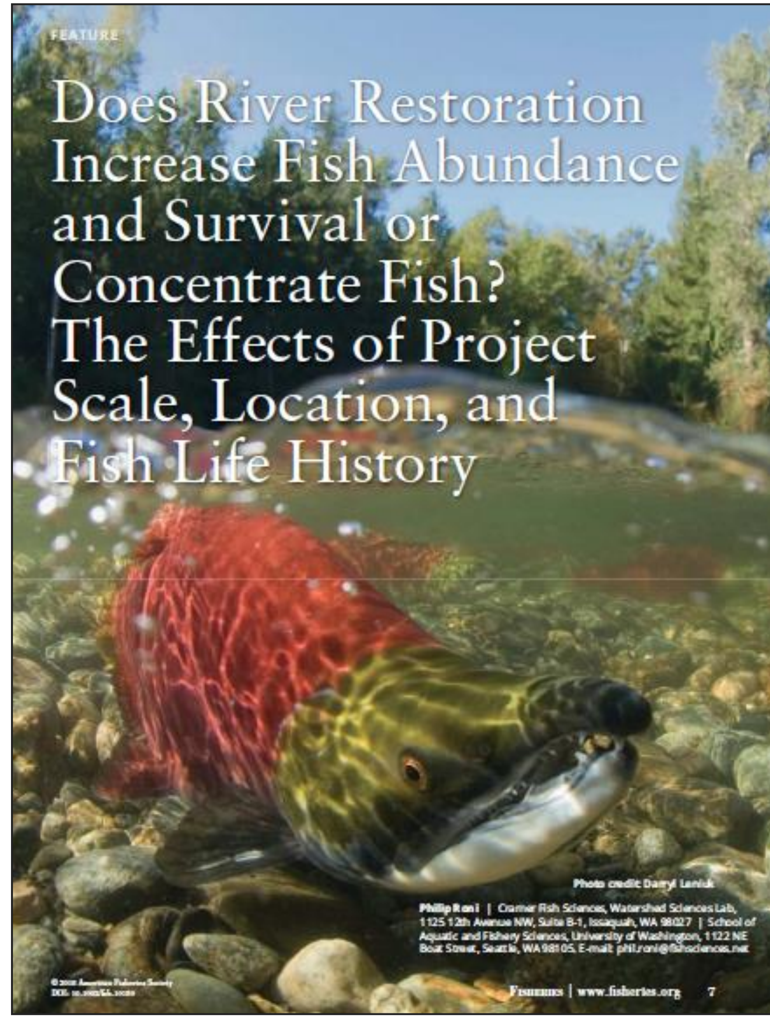
Abstract: Two decades since calls for stream restoration projects to be scientifically assessed, most projects are still unevaluated, and conducted evaluations yield ambiguous results. Even after these decades of investigation, do we know how to define and measure success? We systematically reviewed 26 studies of stream restoration projects that used macroinvertebrate indicators to assess the success of habitat heterogeneity restoration projects. All 26 studies were previously included in two meta-analyses that sought to assess whether restoration programs were succeeding. By contrast, our review focuses on the evaluations themselves, and asks what exactly we are measuring and learning from these evaluations. All 26 studies used taxonomic diversity, richness, or abundance of invertebrates as biological measures of success, but none presented explicit arguments why those metrics were relevant measures of success for the restoration projects. Although changes in biodiversity may reflect overall ecological condition at the regional or global scale, in the context of reach-scale habitat restoration, more abundance and diversity may not necessarily be better. While all 26 studies sought to evaluate the biotic response to habitat heterogeneity enhancement projects, about half of the studies (46%) explicitly measured habitat alteration, and 31% used visual estimates of grain size or subjectively judged 'habitat quality' from protocols ill-suited for the purpose. Although the goal of all 26 projects was to increase habitat heterogeneity, 31% of the studies either sampled only riffles or did not specify the habitats sampled. One-third of the studies (35%) used reference ecosystems to define target conditions. After 20 years of stream restoration evaluation, more work remains for the restoration community to identify appropriate measures of success and to coordinate monitoring so that evaluations are at a scale capable of detecting ecosystem change.

Keywords: stream restoration; evaluating success; post-project appraisal; metrics; aquatic macroinvertebrates

Rubin et al. 2017. *Water*, Vol. 9. No. 174



Roni, P. 2019. *Fisheries*, Vol. 44. No. 1

What is Effectiveness Monitoring?

Systematic assessment and evaluation of a project site, pre- and post-construction to determine if objectives have been met, inform follow-up actions, learn from successes and shortcomings and improve future design and implementation.

<u>Plan components</u>:

- Fluvial geomorphology
- Aquatic system
- Terrestrial system

<u>Duration</u>:

- From 2 years pre-construction to 10 years post-construction, depending on project objectives and scale;
- Year 0 = "as built and planted" surveys;
- 1, 2 and 3 years post-construction to detect and address deficiencies over warranty period and as a condition of assumption by owner;
- 5 and 10 years post-construction surveys to verify channel form and function remains acceptable and habitat objectives are still being achieved.

Benefits of Effectiveness Monitoring?

<u>Designers and contractors</u>:

✓ Learn from successes and shortcomings to improve future design and implementation.

<u>Regulators and plan reviewers</u>:

✓ Provides process for verifying environmental compliance.

<u>Proponents and owners</u>:

✓ Clarity on success criteria, scope, timeframe and responsibilities;

✓ Provide process for addressing deficiencies prior to assumption

Setting SMART objectives and success criteria

Specific (concrete, detailed, well-defined)

Measurable (quantifiable, comparable)

Achievable (feasible, actionable)

Realistic (considering resources)

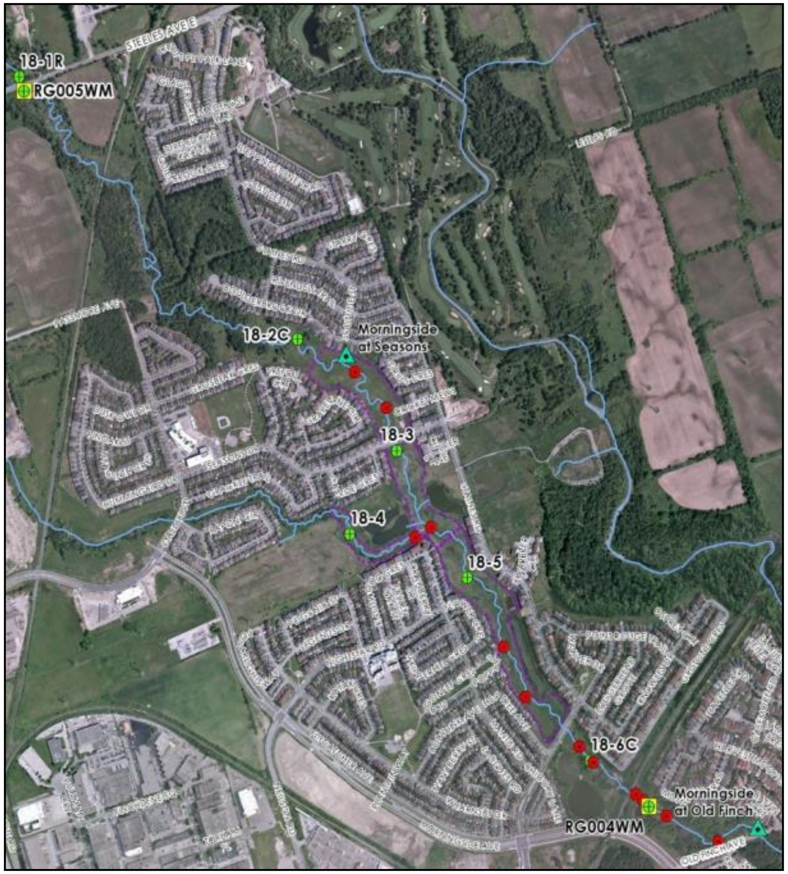
Time-Bound (defined timeframe).

e.g., *"Create a self-sustaining natural channel that exhibits migration and cross-sectional adjustments within 10% of a reference site within five years post-construction".*

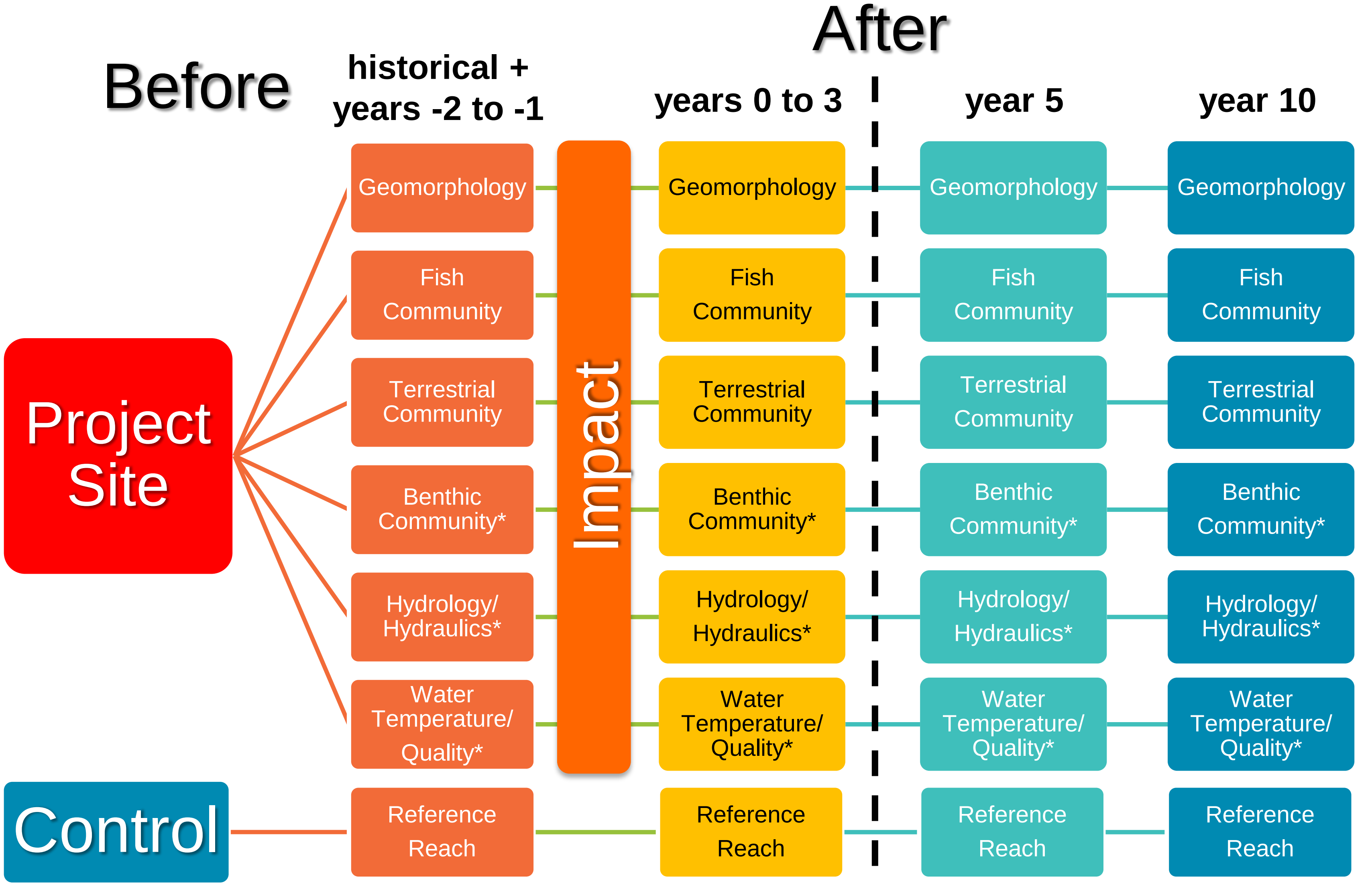
Monitoring plan design

Comparing rehabilitated reach(es) (“impacted”) post-construction condition (“after) to pre-construction condition (“before”) and, where available, upstream or downstream untreated (“control”) reach(es) or other reference site(s);

- ➢Before-After-Control-Impacted (BACI) study design is optimal;
- ➢Control/reference reach not always available;
- ➢Historical fish records may help characterize pre-construction conditions (e.g., species richness; catch per unit effort)



BACI (before–after–control–impacted) monitoring plan



Stream rehabilitation effectiveness monitoring components and indicators

Component	**Indicators** (* = supplemental, depends on project objectives)
Geomorphic System	Qualitative geomorphic assessment
	Geomorphic survey
	Substrate
	Water level/Event-based monitoring*
	Project specific (e.g., engineered structures)*
Aquatic System	Qualitative aquatic habitat
	Fish community
	Instream fish barriers survey
	Water temperature and level*
	Benthic macroinvertebrate community*
	Water quality*
Terrestrial System	Qualitative vegetation communities assessment
	Quantitative vegetation communities assessment*
	Breeding bird survey*

Geomorphology component

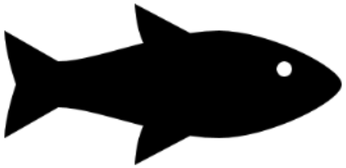
Interpretation/analysis should address:

- Degradation/aggradation
- Cross-section adjustments
- Substrate fining/coarsening
- Overall stability and recovery trajectory

Aquatic system component

Interpretation/analysis should address:

- Species at risk
- Fish community diversity and abundance
- Habitat connectivity/Barriers to fish access/movement
- Benthic community diversity, sensitivity indices
- Physical and functional habitat



Terrestrial system component

Interpretation/analysis should address:

- Invasive exotic species
- Species at risk
- Vegetation cover establishment
- Survival of plantings
- Vegetation communities (Ecological Land Classification)

Next steps

- Complete draft effectiveness monitoring protocols and post to partner websites for stakeholder and peer review (2019);
- Finalize Effectiveness Monitoring Protocols and post to partner websites (2020);
- Develop training resources (e.g., in-person class or on-line course or webinar);
- Promote at conferences and workshops;
- Ideas…incorporation as Ontario Stream Assessment Protocol module?...seed document for a Canadian standard development process?

Thank you!

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