Revisiting Reach Delineation

Avoiding Misguided Erosion Risk Management and Channel Restoration Initiatives

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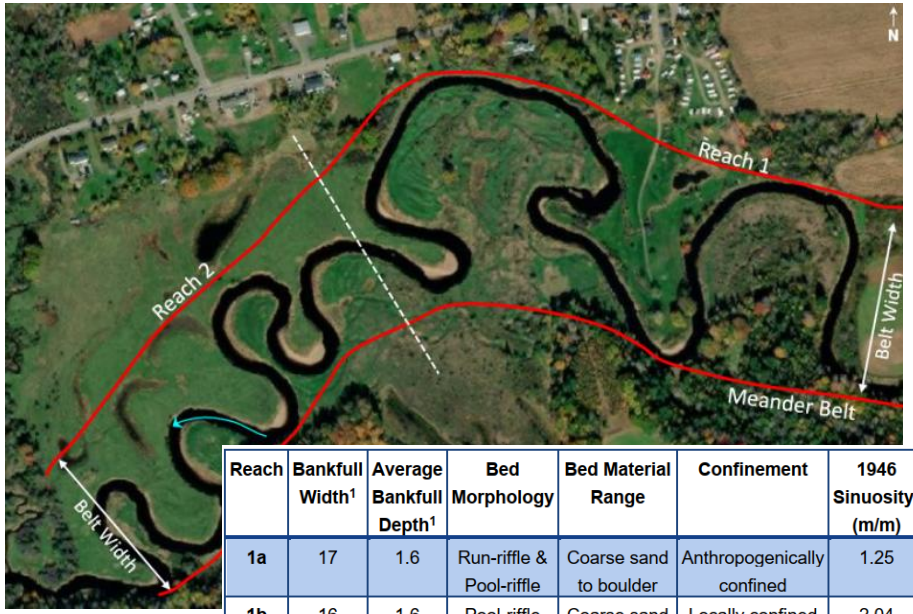
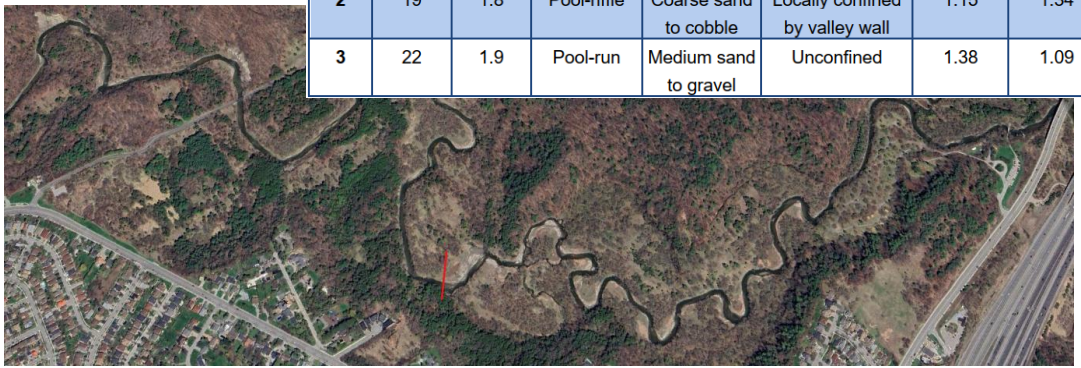
Natural Channel Systems 2026

Why Reaches Matter

- Delineation of continuous river corridor into manageable sections for assessment
- Reach breaks group sections with similar controls and expected behaviour
- Good reach breaks help ensure we are comparing like with like
- Foundation for understanding form and function

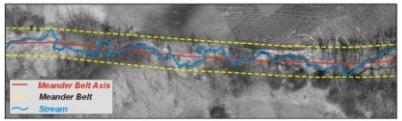


Reach	Bankfull Width[1]	Average Bankfull Depth[1]	Bed Morphology	Bed Material Range	Confinement	1946 Sinuosity[2] (m/m)	2018 Sinuosity[2] (m/m)
1a	17	1.6	Run-riffle & Pool-riffle	Coarse sand to boulder	Anthropogenically confined	1.25	1.16
1b	16	1.6	Pool-riffle	Coarse sand to cobble	Locally confined by valley wall	2.04	1.15
2	19	1.8	Pool-riffle	Coarse sand to cobble	Locally confined by valley wall	1.15	1.34
3	22	1.9	Pool-run	Medium sand to gravel	Unconfined	1.38	1.09



Existing Guidance, Persistent Challenge

Belt Width Delineation Procedures



Given the definition of a reach, it is necessary to identify lengths of channel that display similar physical characteristics and whose setting remains relatively length of the channel. When any of the following variables change al this tends to demarcate the position of a new reach boundary:

- Hydrology (e.g., addition of a tributary)
- Sinuosity
- Valley setting (e.g., confined, partially confined, unconfined)
- Gradient (e.g., steep, gradual)
- Geology (*only for Procedures 2 - 4*)

Submitted by:

PARISH geomorphic

Vermont Stream Geomorphic Assessment
Phase 2 Handbook

RAPID
STREAM ASSESSMENT

Reach: A section of stream having relatively uniform physical attributes, such as confinement, valley slope, sinuosity, dominant bed material, sediment regime and bed form. Reach determinations do not take into account human disturbances, but rather are based on variables related to valley setting, stream morphology, and their inherent fluvial processes. Provisional reference

anagement Planning and
Design Manual

March 2003

satisfy the scope of the investigations defined in Steps 1 through 3. A 'like' reach approach has been proposed wherein the channel is divided into reaches of 'like' morphology. This approach assumes that the sensitivity of the channel and its mode of adjustment to a disturbance are similar within reaches having similar morphology. A number of representative cross-sections are selected within distinct reaches to characterize the parameters describing the channel system.

Ontario Ministry of the Environment

Colorado **FLUVIAL HAZARD ZONE** Delineation Protocol

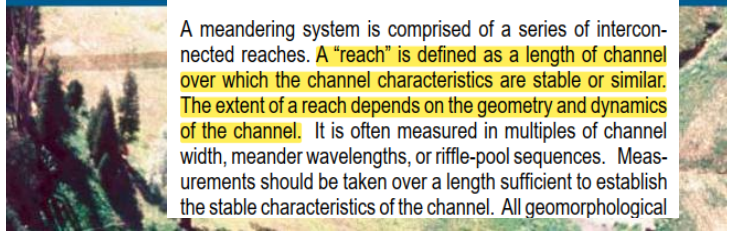
REACH BREAKS

A geomorphic stream reach is defined as having consistent geomorphic characteristics related to valley and channel geometry as influenced by local geology, valley slope, sediment and water supply, vegetation, and anthropogenic factors. For Fluvial Hazard Zone mapping purposes it is important to delineate stream reaches with similar migration potential, stream planform patterns, and valley characteristics such as valley margin composition and channel-valley confinement. Reaches may be

Ontario

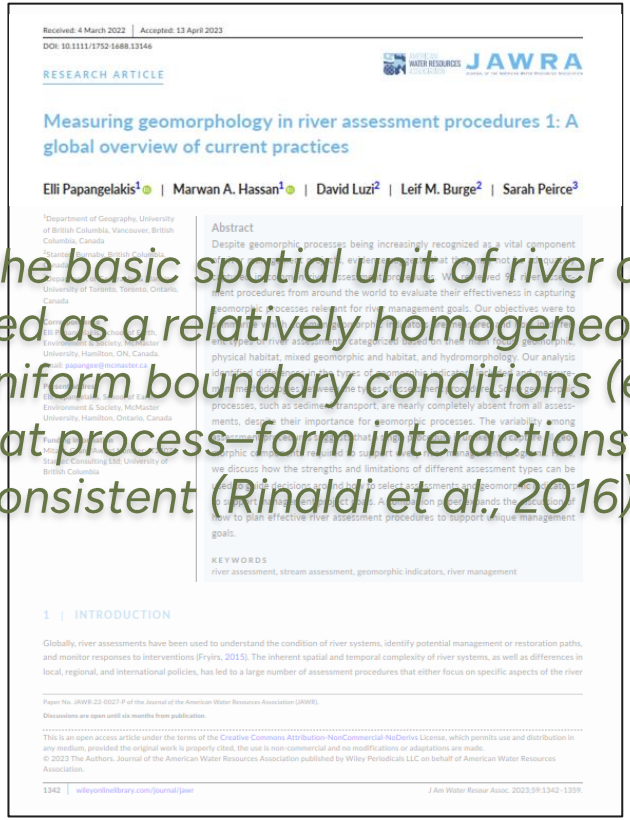
Technical Guide

2.4.2 Reach



A meandering system is comprised of a series of interconnected reaches. A "reach" is defined as a length of channel over which the channel characteristics are stable or similar. The extent of a reach depends on the geometry and dynamics of the channel. It is often measured in multiples of channel width, meander wavelengths, or riffle-pool sequences. Measurements should be taken over a length sufficient to establish the stable characteristics of the channel. All geomorphological

Papangelakis et al. 2023 Definition



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RESEARCH ARTICLE

JAWRA

Measuring geomorphology in river assessment procedures 1: A global overview of current practices

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Abstract

Despite geomorphic processes being increasingly recognized as a vital component

physical habitat, mixed geomorphic and habitat, and hydromorphology. Our analysis

processes, such as sediment transport, are nearly completely absent from all assess-

ments, despite their importance for geomorphic processes. The variability among

we discuss how the strengths and limitations of different assessment types can be

goals.

KEYWORDS

river assessment, stream assessment, geomorphic indicators, river management

1 | INTRODUCTION

Globally, river assessments have been used to understand the condition of river systems, identify potential management or restoration paths, and monitor responses to interventions (Fryirs, 2015). The inherent spatial and temporal complexity of river systems, as well as differences in local, regional, and international policies, has led to a large number of assessment procedures that either focus on specific aspects of the river

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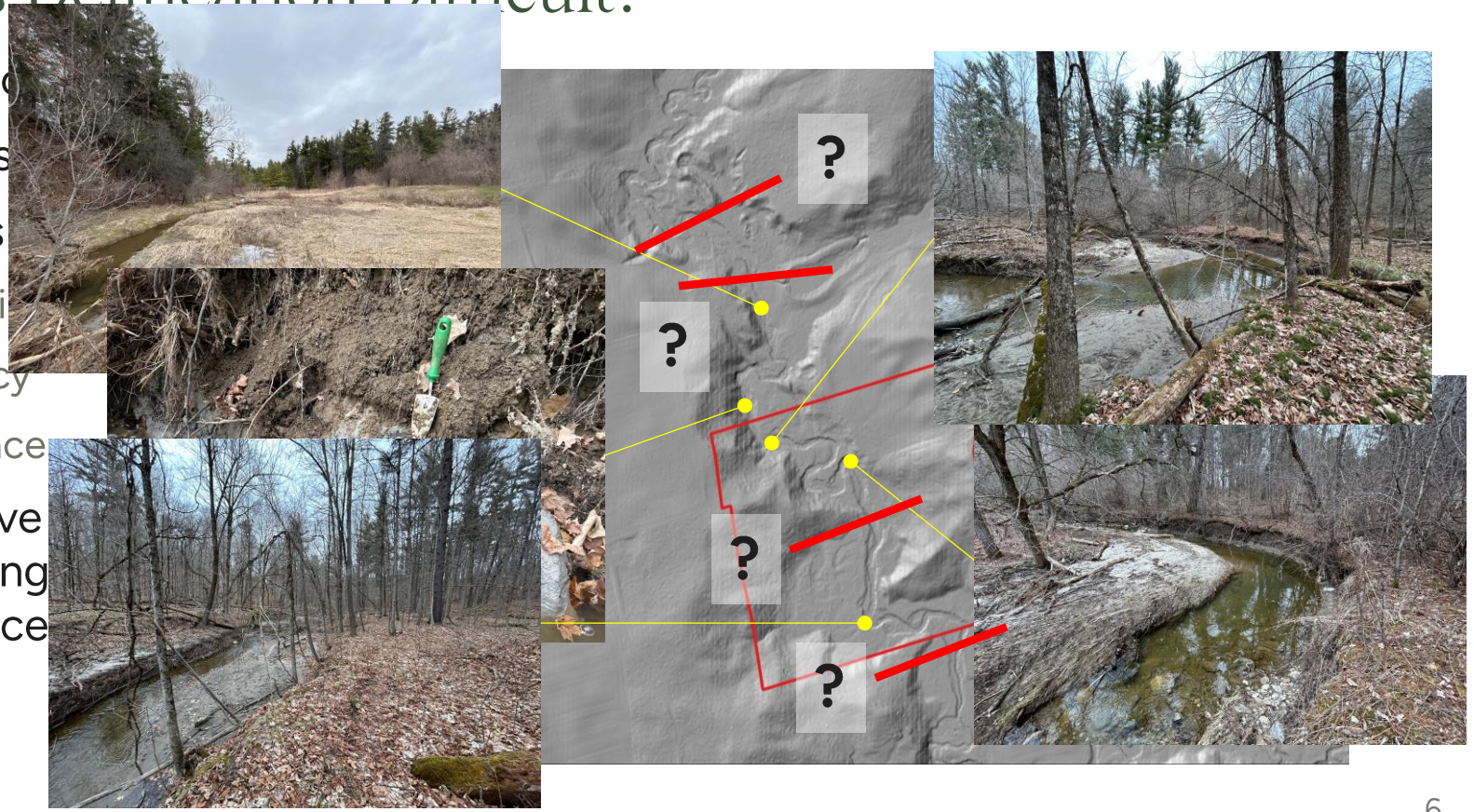
"The study reach is the basic spatial unit of river assessments (Belletti et al., 2015), defined as a relatively homogeneous segment of the channel that has uniform boundary conditions (e.g., slope, geology, confinement) so that process–form interactions are assumed to be consistent (Rinaldi et al., 2016)."

Delineating the Problem

- Reach breaks are sometimes placed at locations that are easy to identify, but not geomorphicologically meaningful
- These may reflect convenience, easily identified differences, or data limitations rather than controlling processes
- The result can be a reach framework that does not match how the channel actually behaves

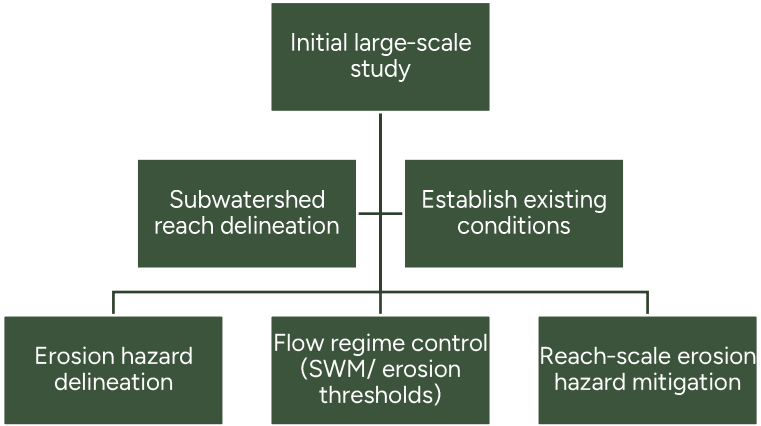
Why is Delineation Difficult?

- Multiple c
- Varying s
- Datasets
  - Resoluti
  - Accuracy
  - Relevance
- Subjective
  with a rang
  experience



Cascading Effects of Poor Delineation

- Reach breaks established early in a project can shape all subsequent assessments
- Poor delineation can cascade from subwatershed or planning-level mapping into reach-scale studies
- Once embedded in municipal datasets, reach breaks may be reused across future assessments, monitoring, and risk screening
- This can affect the interpretation of:
  - Rapid Geomorphic Assessment (RGA) / stability results
  - Erosion threshold estimates
  - Erosion hazard limits (meander belt vs. long-term stable slope)
  - Restoration or management priorities
- Defensible reach boundaries are therefore important for both technical assessment and long-term watercourse management

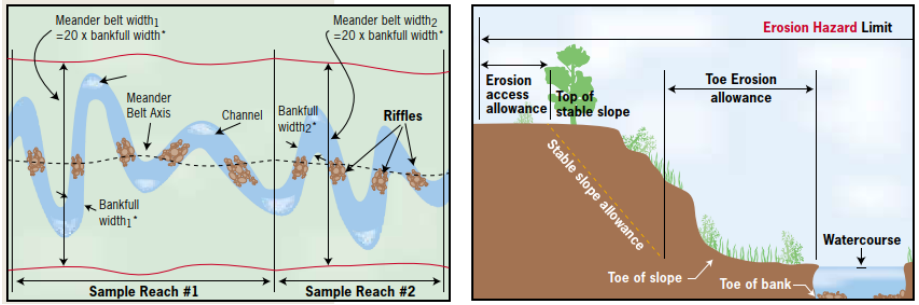


Process, Not Convenience

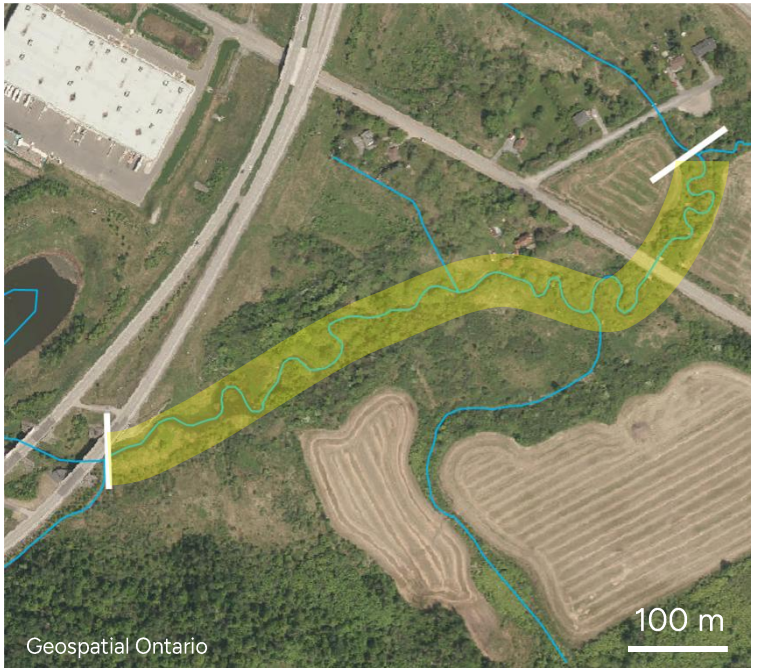
- Reach breaks should reflect meaningful changes in controlling boundary conditions
- Primary controls include confinement, gradient, geology, and flow/sediment regime
- Planform and bed morphology can help confirm whether channel response to primary controls changes along the corridor
- Easily identified differences should be interpreted as lines of evidence (among many), not used in isolation (including vegetation changes!)
  - Does vegetation correspond to a change in dominant geomorphic process?
  - Vegetation by itself is usually an indicator, not the defining control (e.g., temporal instability creates a moving reach break)
- The key question is: **would this segment be expected to behave differently?**

Control 1: Channel Confinement

- Influences freedom for lateral adjustment, potential sediment sources, and floodplain interaction
- Affects erosion hazard expression and thus hazard limit delineation



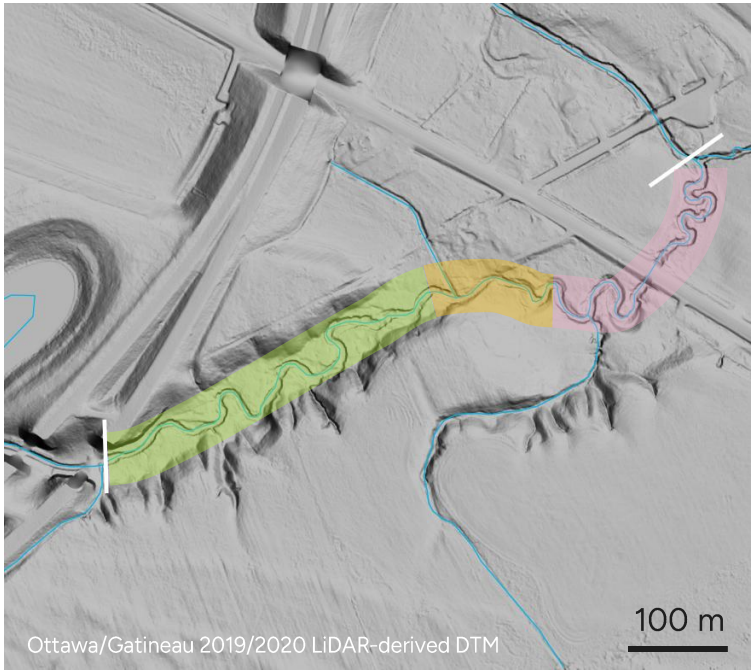
MNR, 2001



Example: existing overlong reach and a decision pathway to updated delineation

Control 1: Channel Confinement

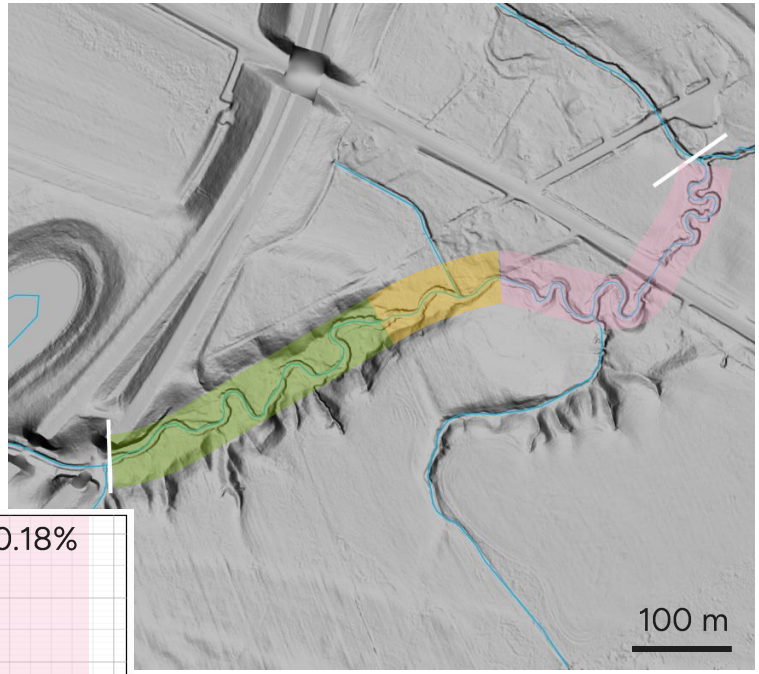
- LiDAR hillshade and terrain models help identify valley-wall, terrace, and floodplain relationships
- Transitions between **confined**, **partly confined**, and **unconfined** settings may justify reach breaks
- Reach breaks should reflect meaningful changes in valley setting, not simply obvious map breaks



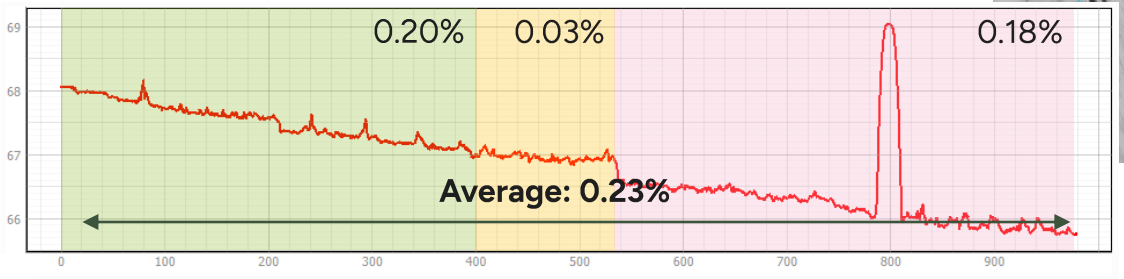
Confined, **partly confined**, and **unconfined** sections within the same reach

Control 2: Channel Gradient

- Influences stream power, sediment transport, and adjustment potential
- Slope breaks may indicate transitions between process domains
- Avoid averaging unless the reach is otherwise process-consistent

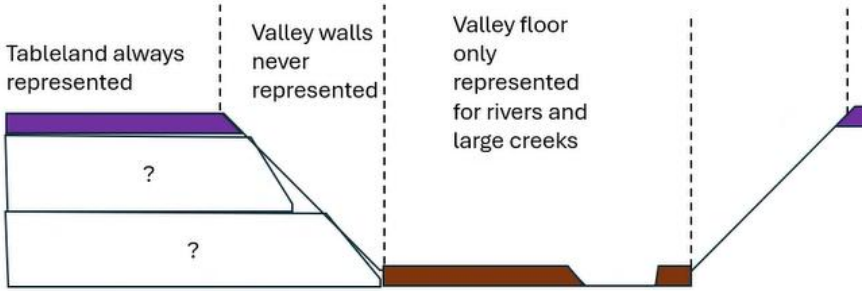


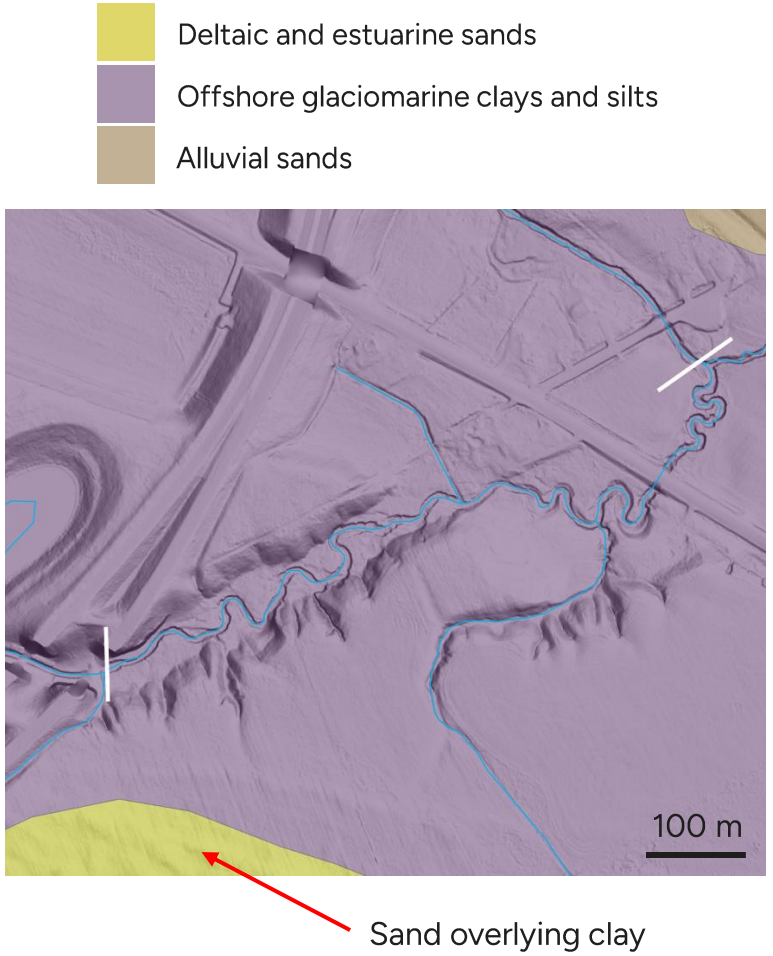
Approximate long profile



Control 3: Geology

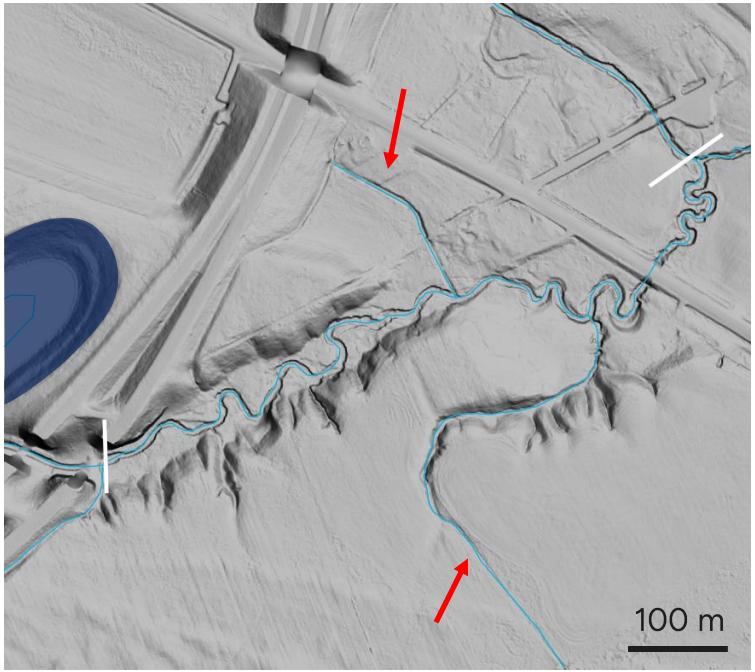
- Influences erodibility, sediment supply, and channel response
- Regional mapping is useful for context but is generally too coarse for reach-scale decisions
- Site-specific information should be used where available





Control 4: Flow

- Changes in contributing drainage area can alter discharge, sediment supply, and channel response
- Major confluences may justify reach breaks where they create meaningful hydrologic or sediment regime changes
  - Example: CVC SWM planning guidance suggests 10% total drainage area is where downstream impacts are observed from a subcatchment

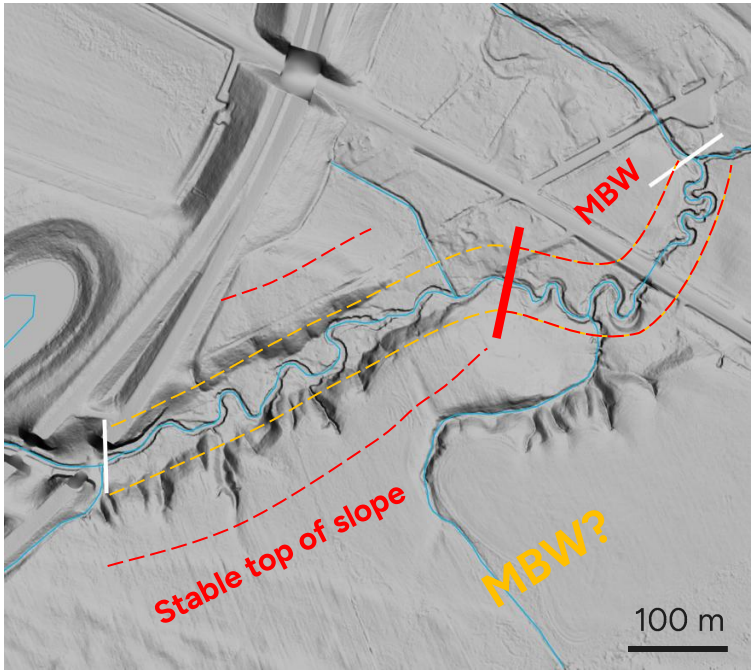


Other Considerations

- Additional considerations:
  - Vegetation
  - Disturbances
  - Human impacts
  - Changes in planform
- These features should be considered where they affect expected channel behaviour or indicate a change in response to primary controls
- The test is not whether a feature is human-made, but whether it changes the process domain
- There is currently overrepresentation of these features as reach breaks
- We want to encourage increase in reach breaks based on primary controls we've highlighted

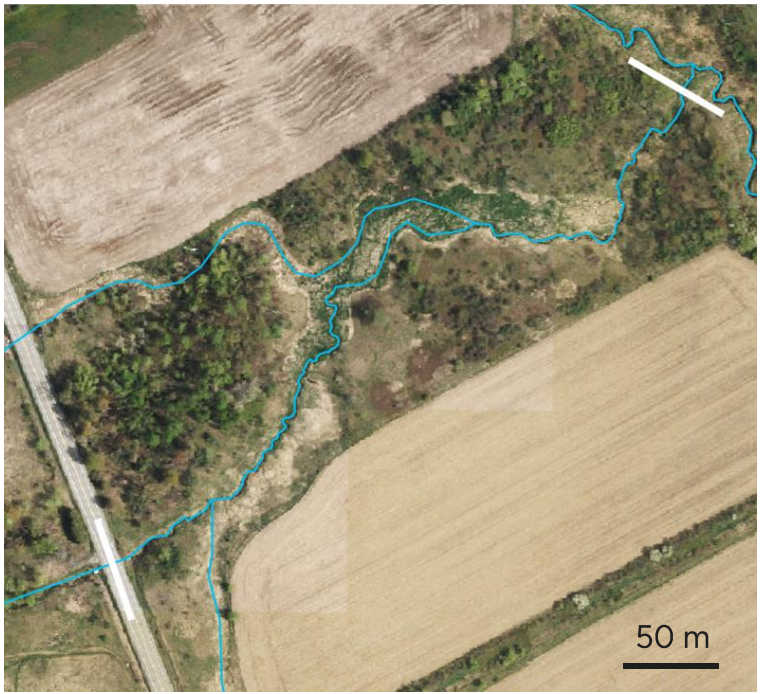
Reach Breaks Revised

- Revised reach breaks placed where multiple lines of evidence indicate change in expected channel behaviour
  - Impacts erosion hazard limit interpretation
  - Existing – MBW?
  - Revised – Stable top of slope + MBW
- Subdivision of the existing reach will also allow for assessment metrics (e.g., RGA, ET) to better reflect local processes



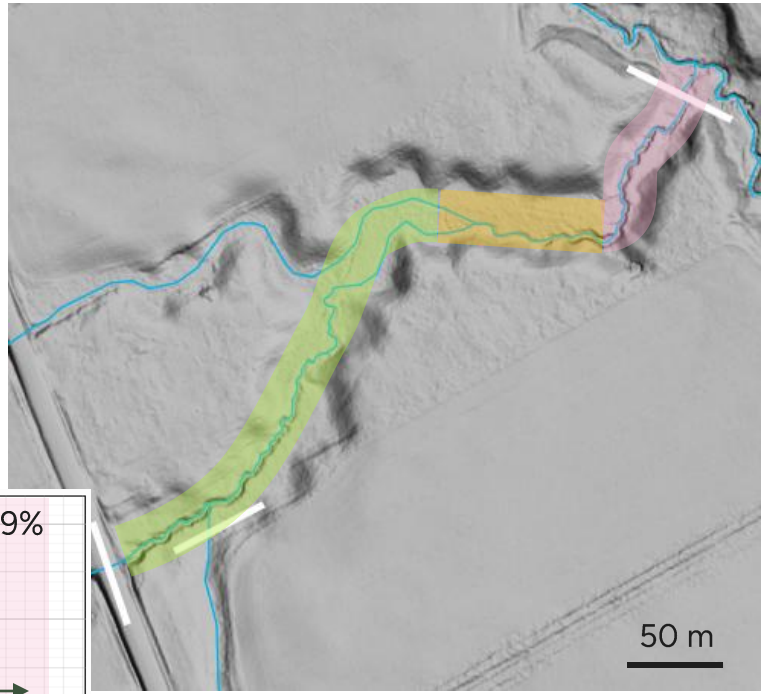
Case Study: Implications for Future Assessment

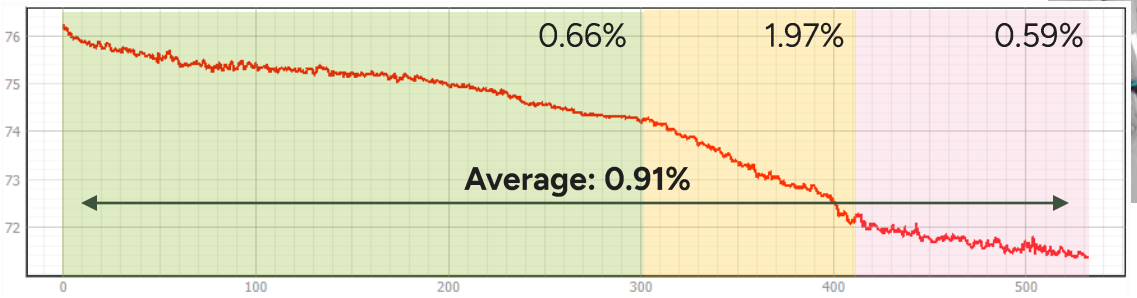
- Ottawa asset inventory application
  - City to use database for ongoing assessment, management, and restoration
  - Overlong reach with convenient breaks from existing study incorporated into database
- Possible impacts to future assessment



Case Study: Implications for Future Assessment

- Overlong reach masks segments with distinct slopes
- Representative slope values especially important where erosion threshold analyses are completed
- Also impacts how City queries, screens, and prioritizes reach stability





Toward a More Defensible Delineation Protocol

- Treat reach delineation as critical part of geomorphic assessment
- Take your time prior to field assessment and re-evaluate during and following field investigations
- Start with terrain-based interpretation where available
- Prioritize primary geomorphic controls
- Use secondary checks to refine interpretation
- Treat access limits and property boundaries as field logistics, not default reach breaks
- Subjectivity is unavoidable – but reach breaks only at road crossings are not!

Thank you

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