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TRIECA March 21, 2019

Scott Cowan, P.Geo
Heather Amirault, P.Eng

Natural Channel Design Methods – Better Together

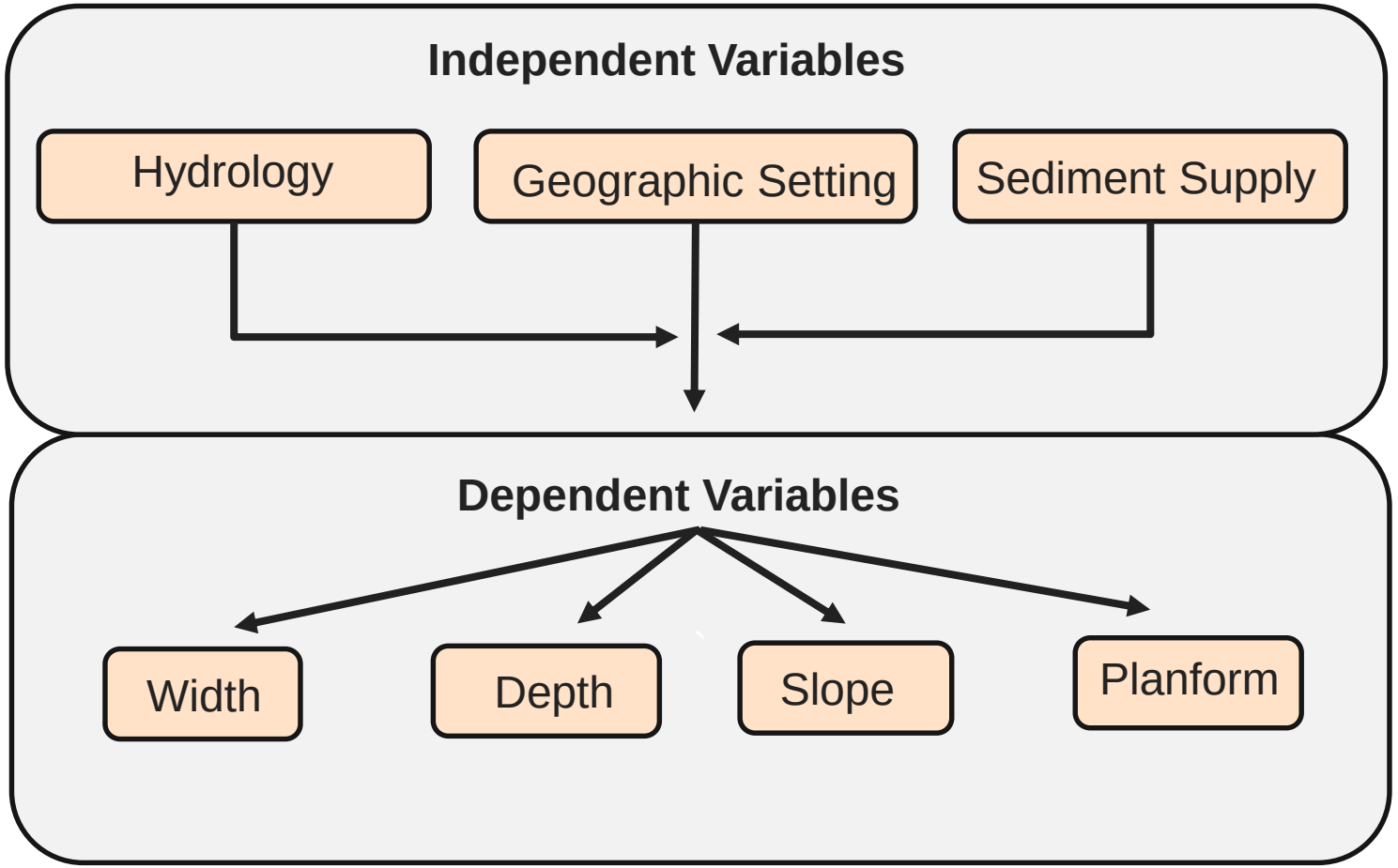
Stantec

Agenda

1. Design Approach Overview
2. Idlewood Take 1
3. Idlewood take 2
4. Take-Aways
5. Questions

Design Approach Overview

Typical Variables in Channel Morphology



Source: Adapted from Knighton, 1998

Typical Design Approaches

Analog

Selection of one or more dependent variables from reference conditions

Typical Design Approaches

Analog

Selection of one or more dependent variables from reference conditions

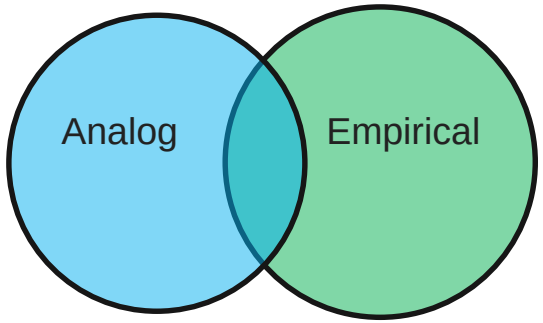
Pros

- Ease of implementation
- Can be applied at reach scale or for individual components

Cons

- Assumed constancy of independent variables

Typical Design Approaches



Empirical

Relates a dependent variable (i.e. width) to an independent variable (i.e. drainage area)

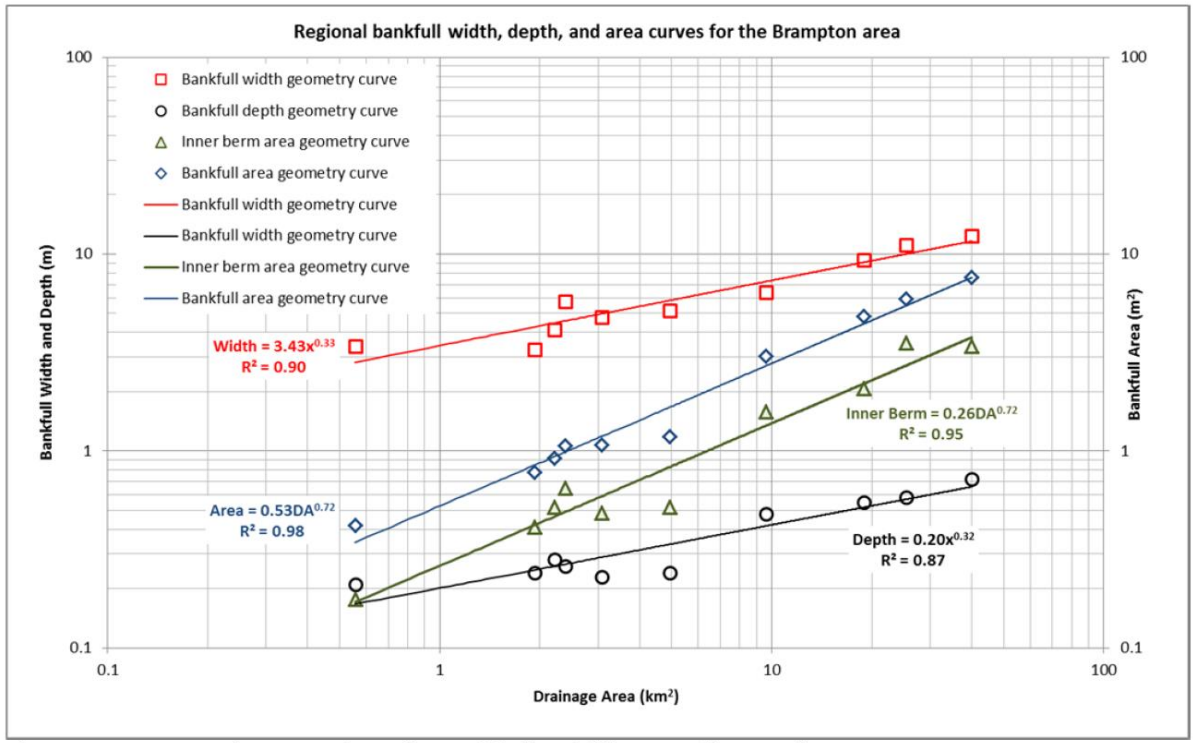
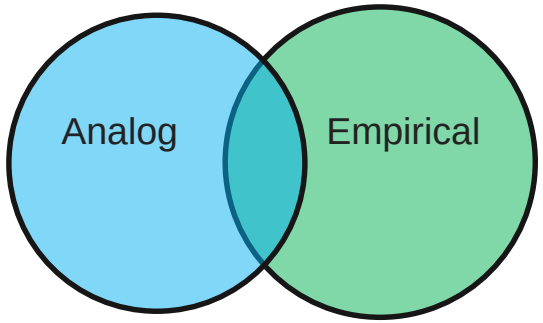


Figure 6. Brampton Regional Bankfull Width, Depth, and Area Curves

Typical Design Approaches



Empirical

Relates a dependent variable (i.e. width) to an independent variable (i.e. drainage area)

Pros

- Ease of implementation
- Larger data set than analog

Cons

- Limited by the data set

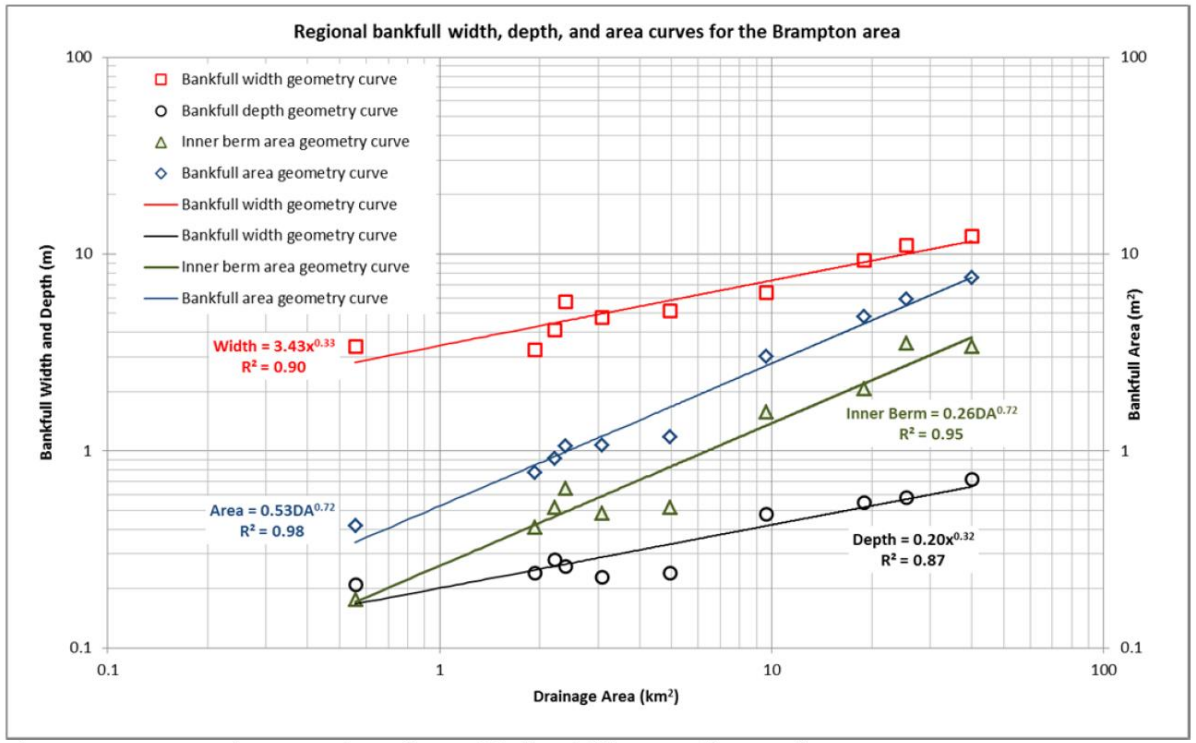
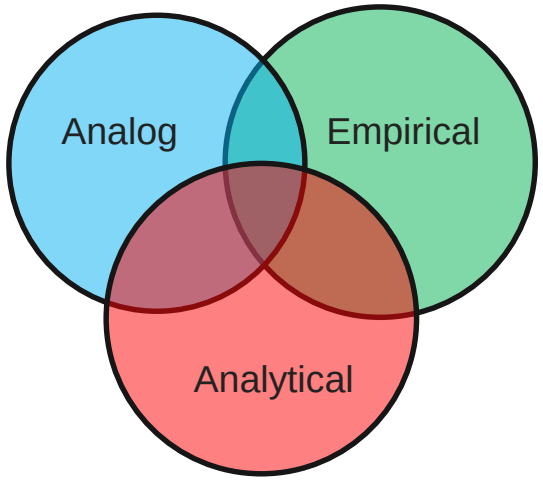


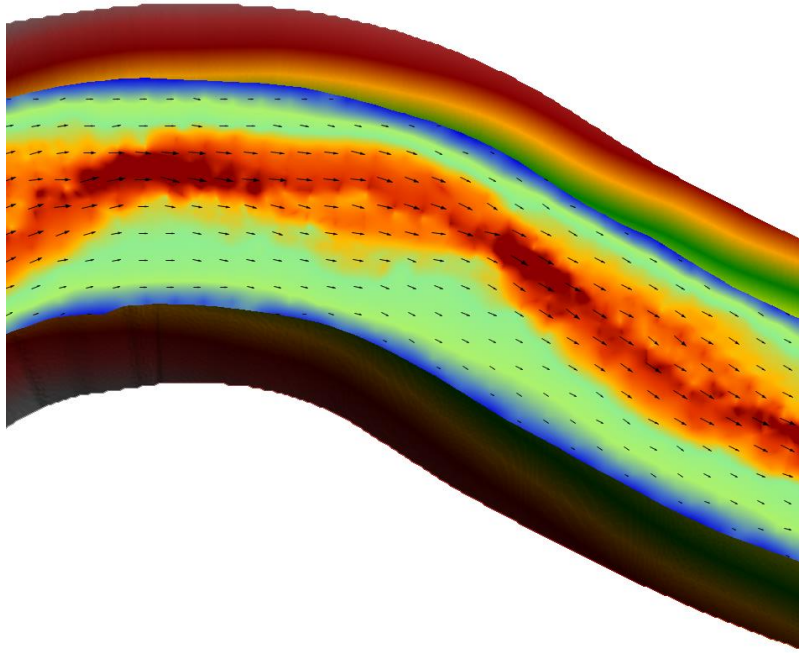
Figure 6. Brampton Regional Bankfull Width, Depth, and Area Curves

Typical Design Approaches

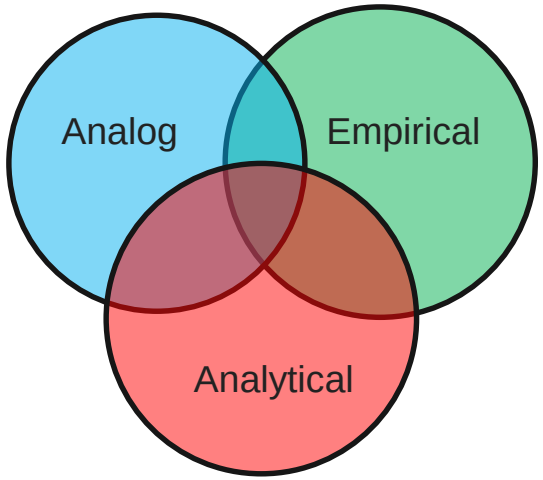


Analytical

Computation to derive any or all dependent variables



Typical Design Approaches



Analytical

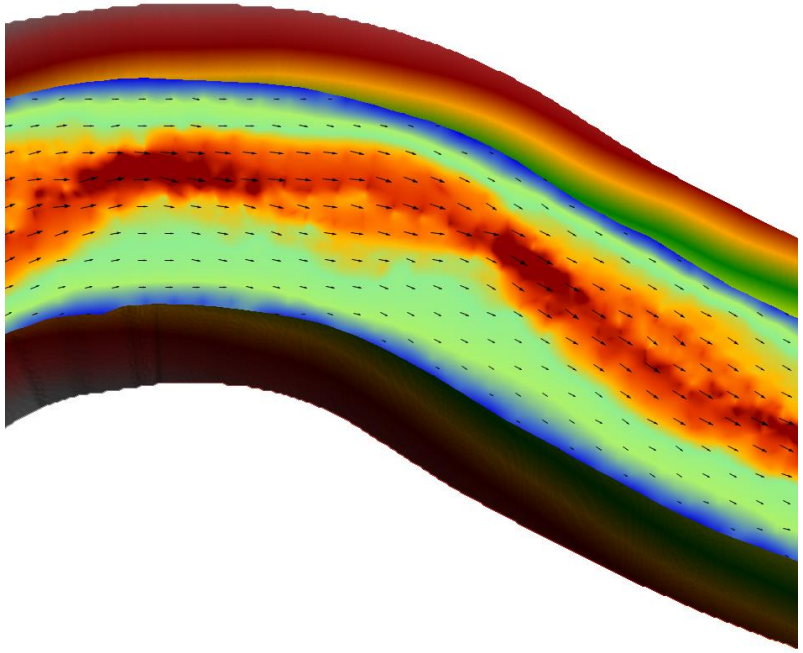
Computation to derive any or all dependent variables

Pros

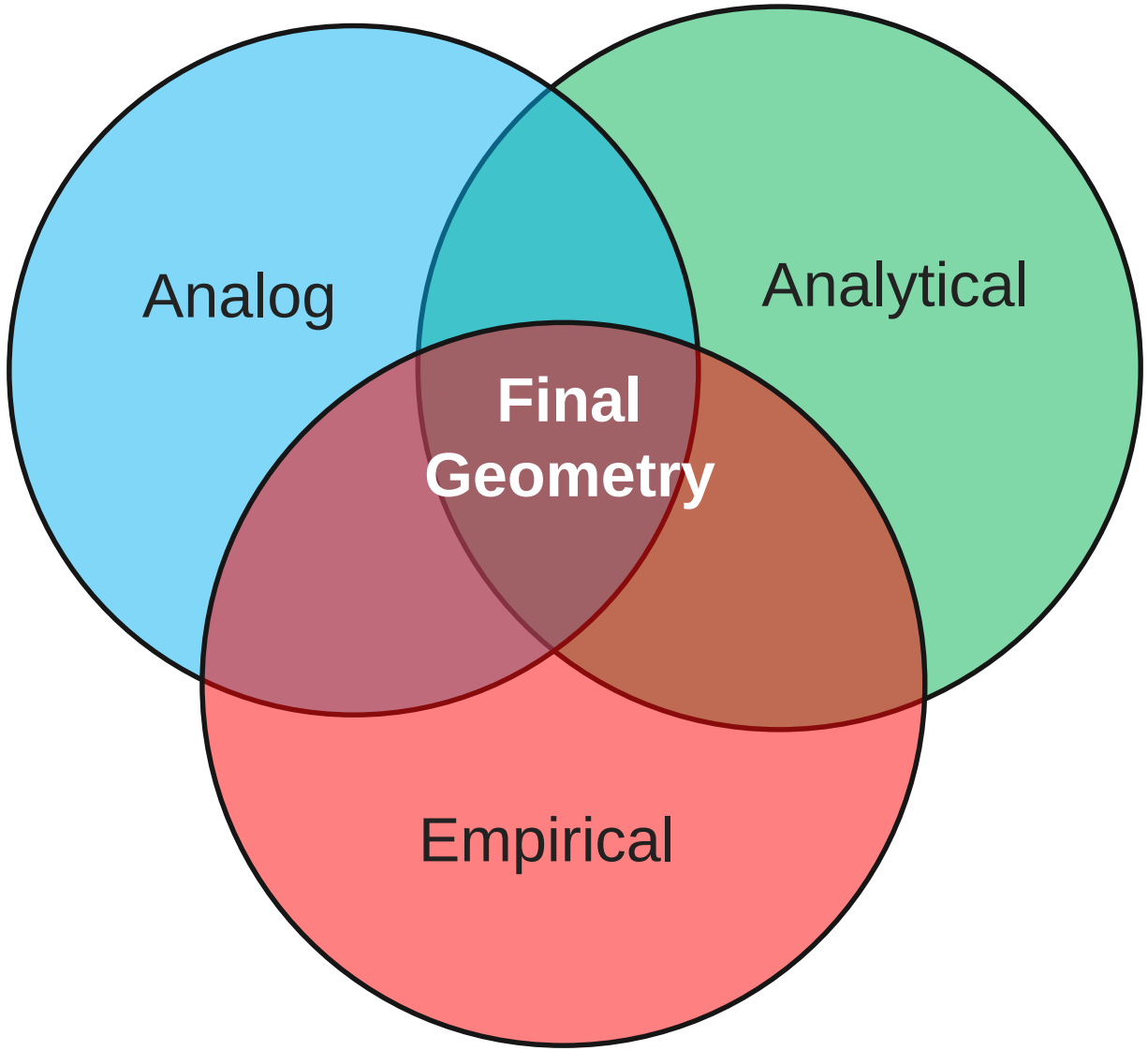
- Useful when reference conditions are not valid
- Quantification of design components (i.e. water surface, shear stress etc.)

Cons

- Limited by data quality/quantity
- Rely on assumptions that can be difficult to calibrate

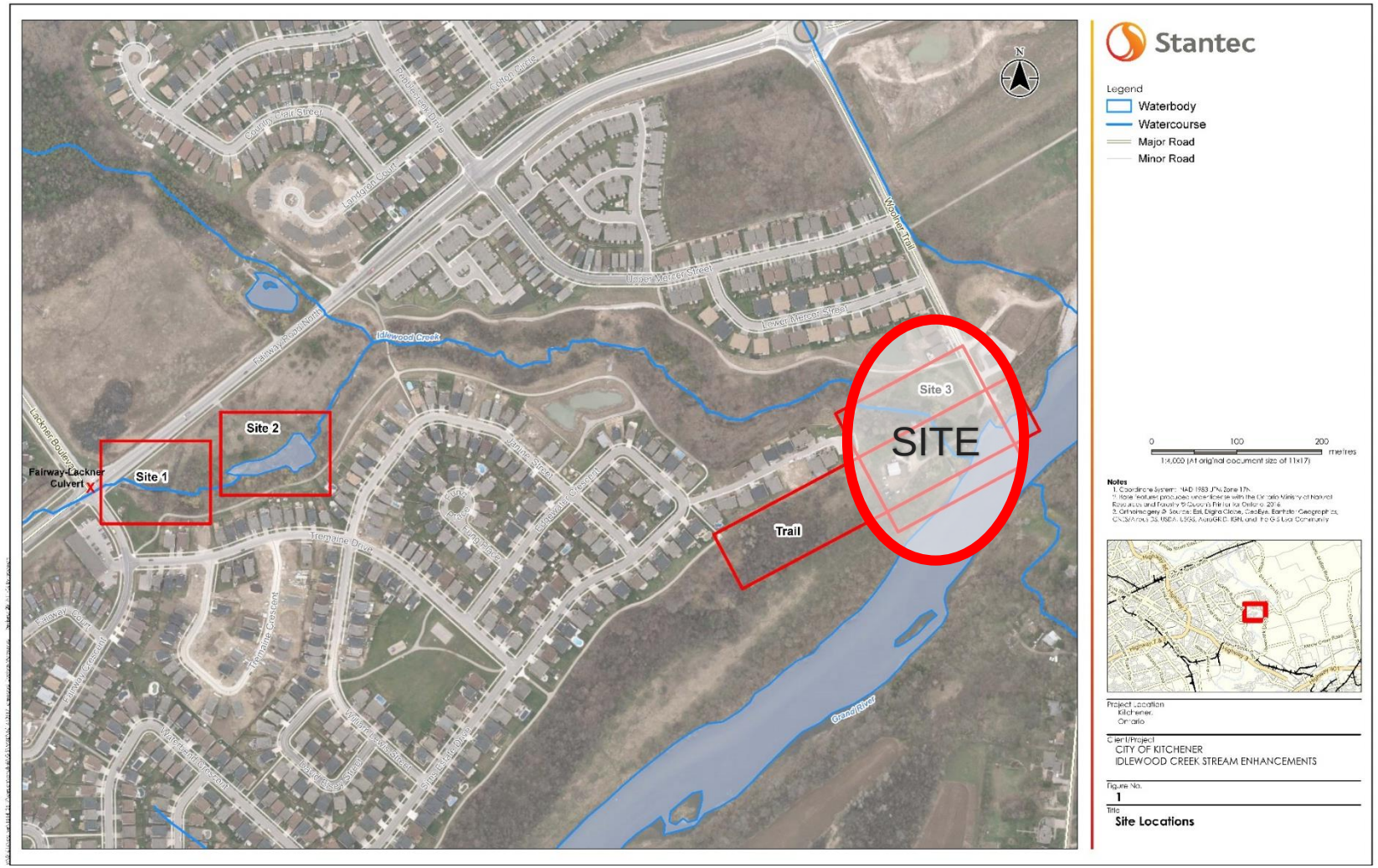


Determination of Final Design Geometry




Idlewood Take 1

Site Context



Take 1

Approach:

Analog

- Reference conditions from neighbouring streams to define BKF

Empirical

- Regional curves and bed mobility relationships

Analytical

- Hydraulic Modelling

Take 1

Used 3 methods to determine bankfull flow area:

Bankfull Discharge Estimate, $Q_{bkf,est.}$ (m^3/s)	Site 3
Analog: Reference Conditions	2.09
Analytical: Return period	2.4
Empirical: Regional Curve	1.64
Design Bankfull Discharge, Q_{bkf} (m^3/s)	**2.04**

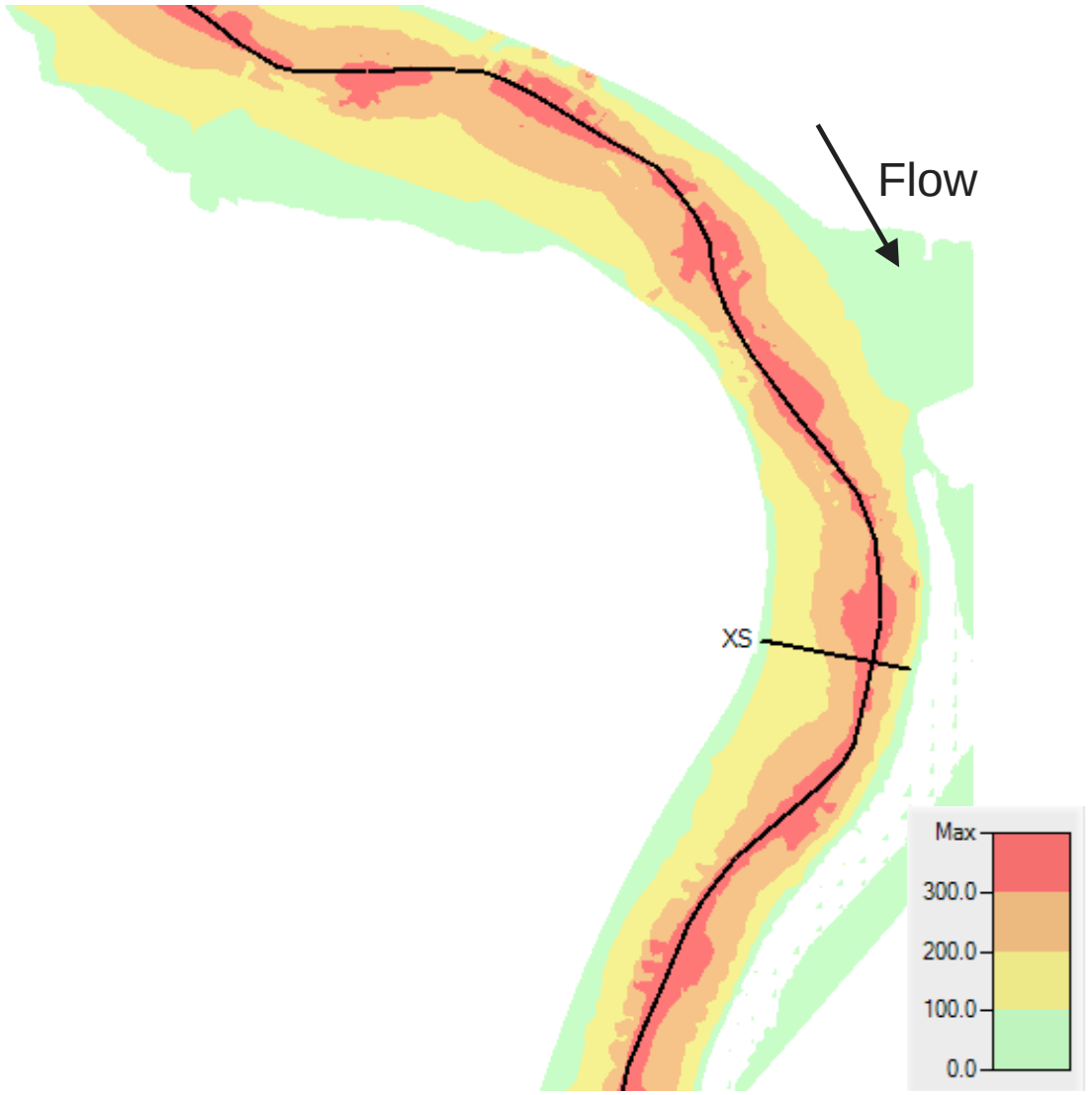
General Plan

Model of First Design Iteration

Created 2D model of Proposed Design

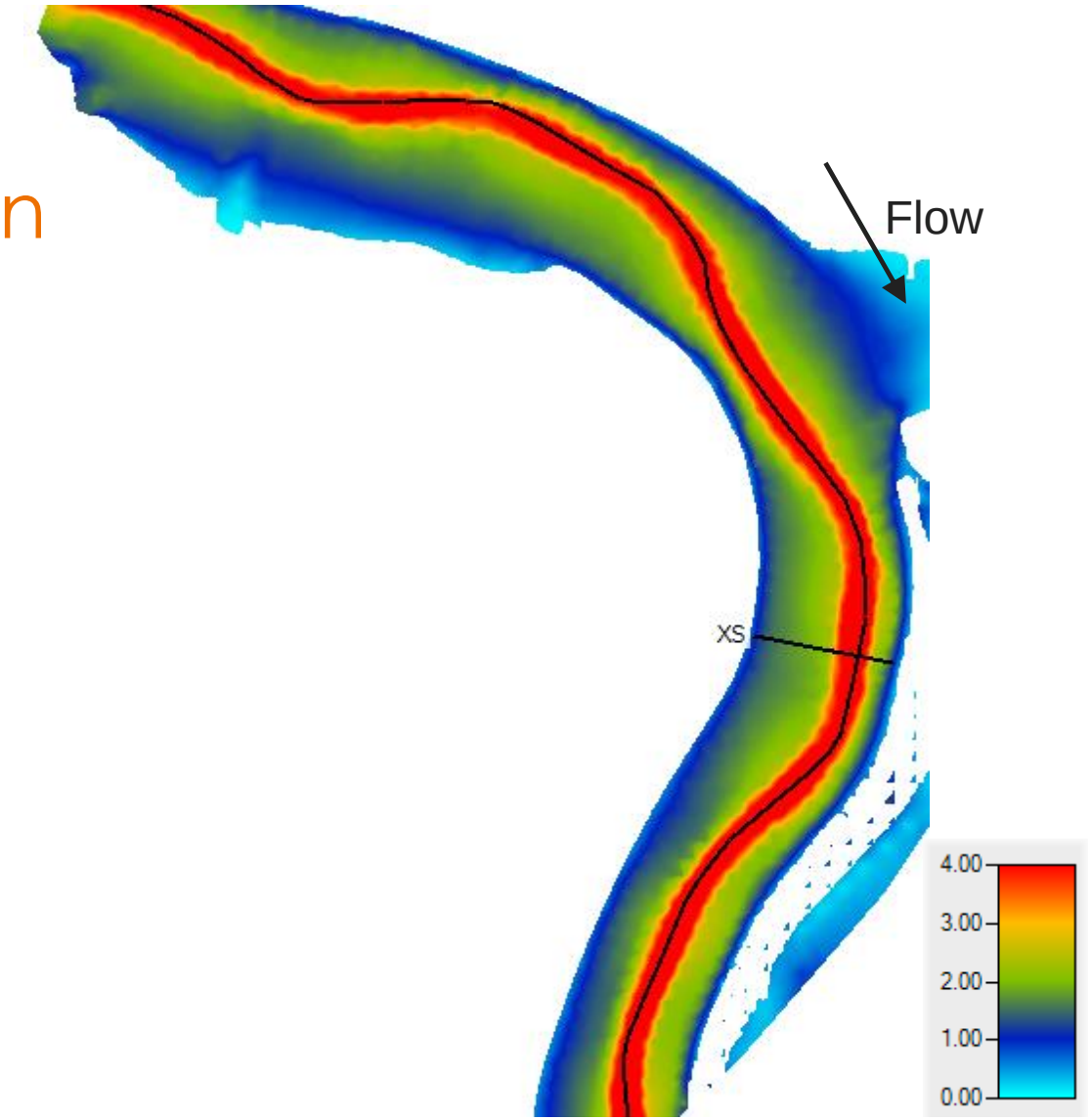
Large floodplain area with
Shear stress >200 N/m^2

Many areas of channel / overbank with
Shear Stress > 300 N/m^2

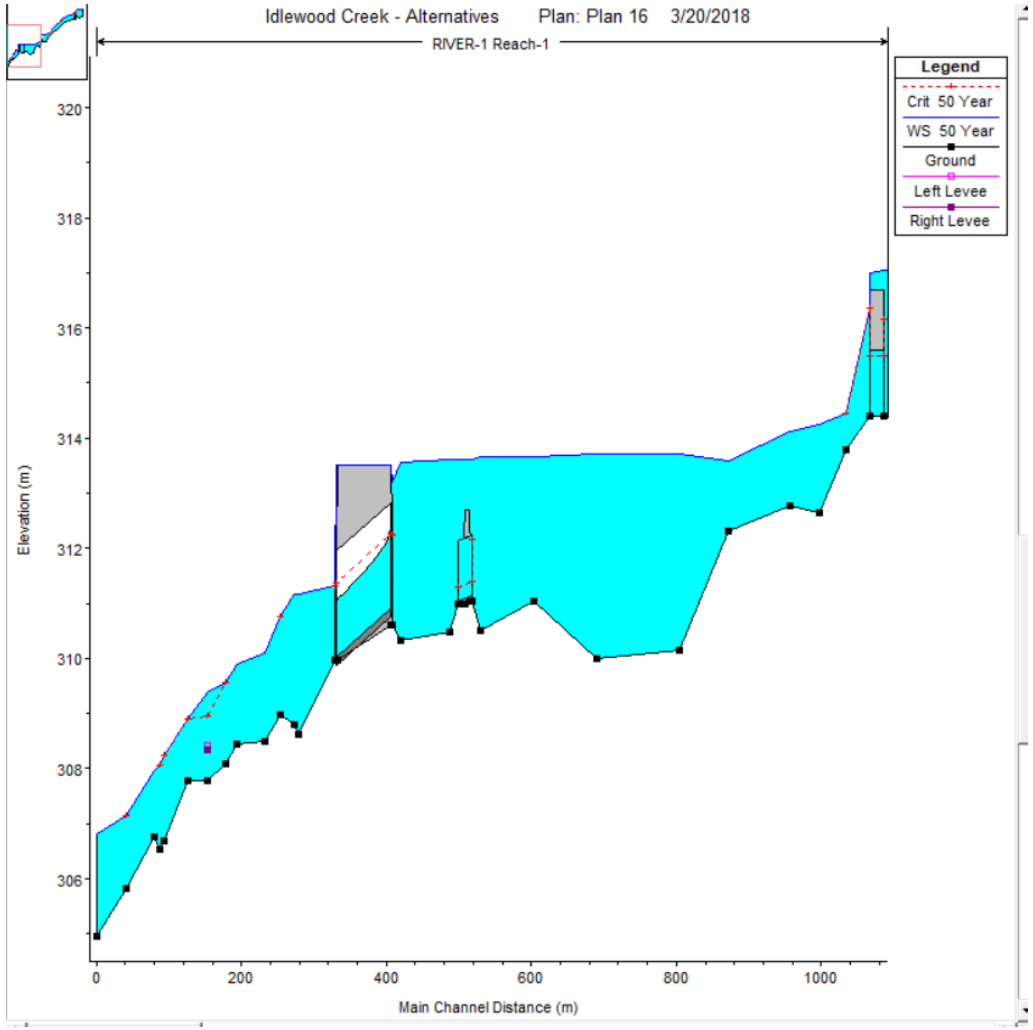


Model of First Design Iteration

Velocities not well distributed on floodplain




Idlewood Take 2

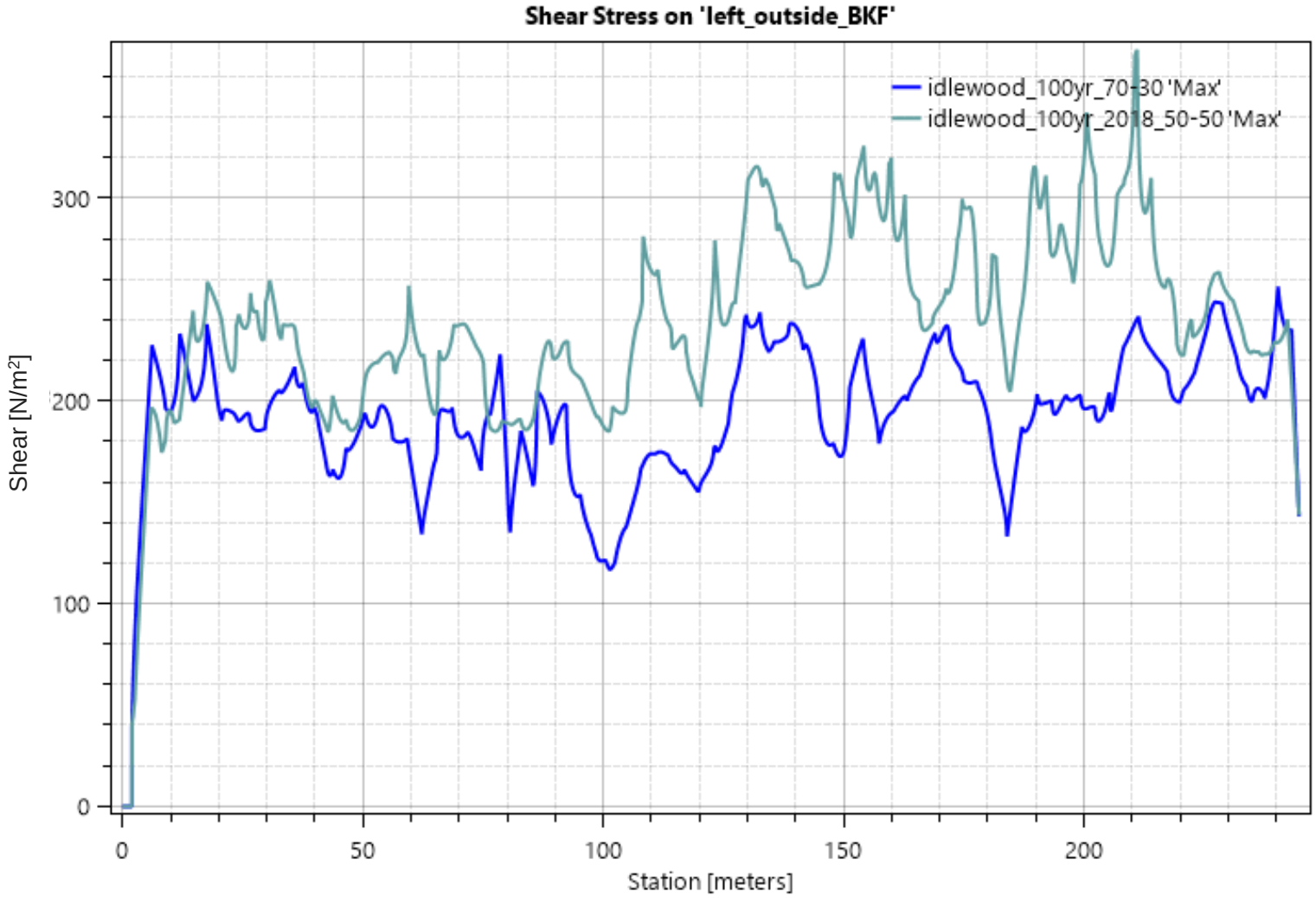


Take 2

Analytical approach allowed us to refine the design:

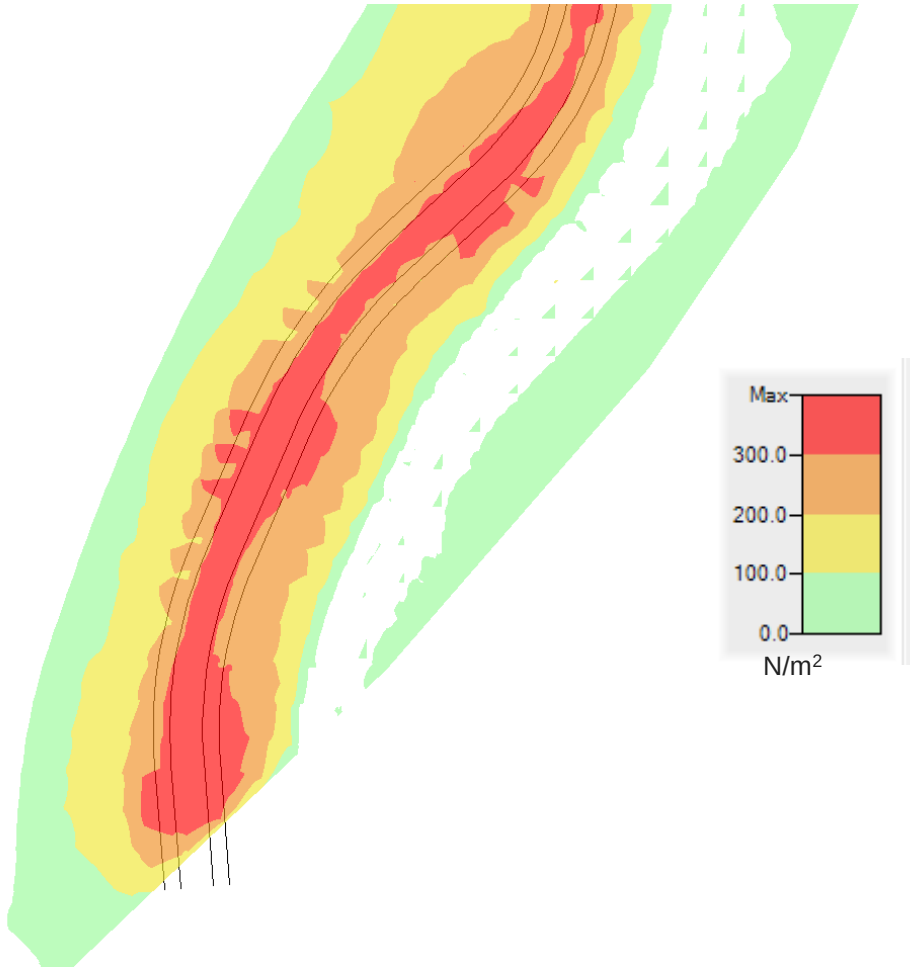
- Spacing between pools
- Slope/Sinuosity
- Floodplain grading

Trials and Outcomes – Modifications to Channel Slope

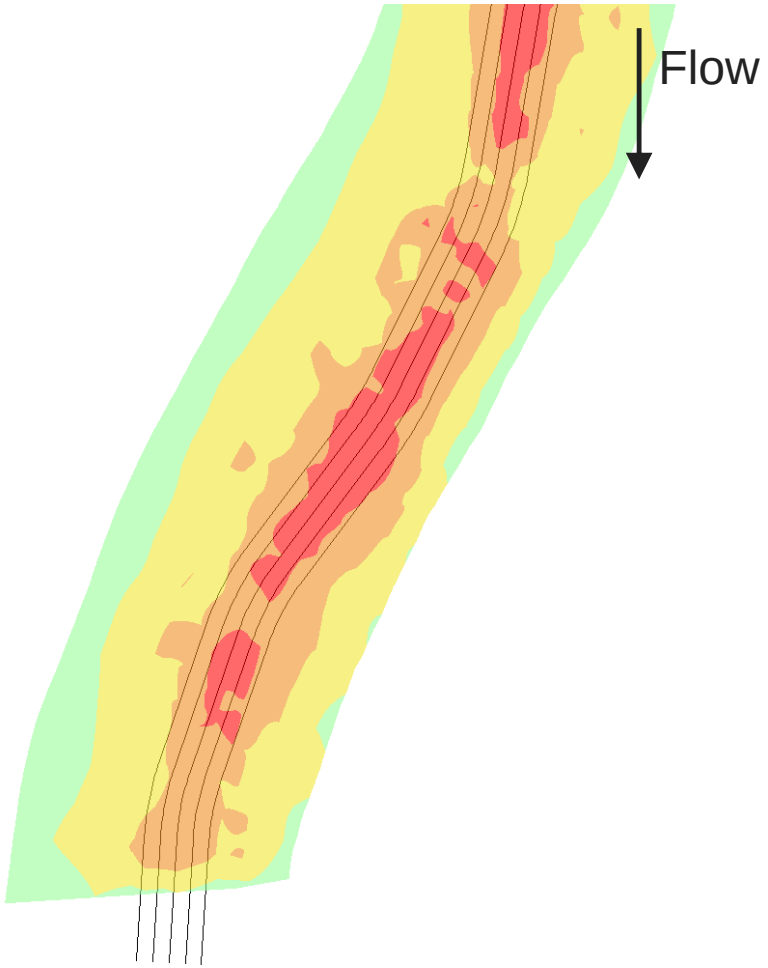


Outcomes

Original Design

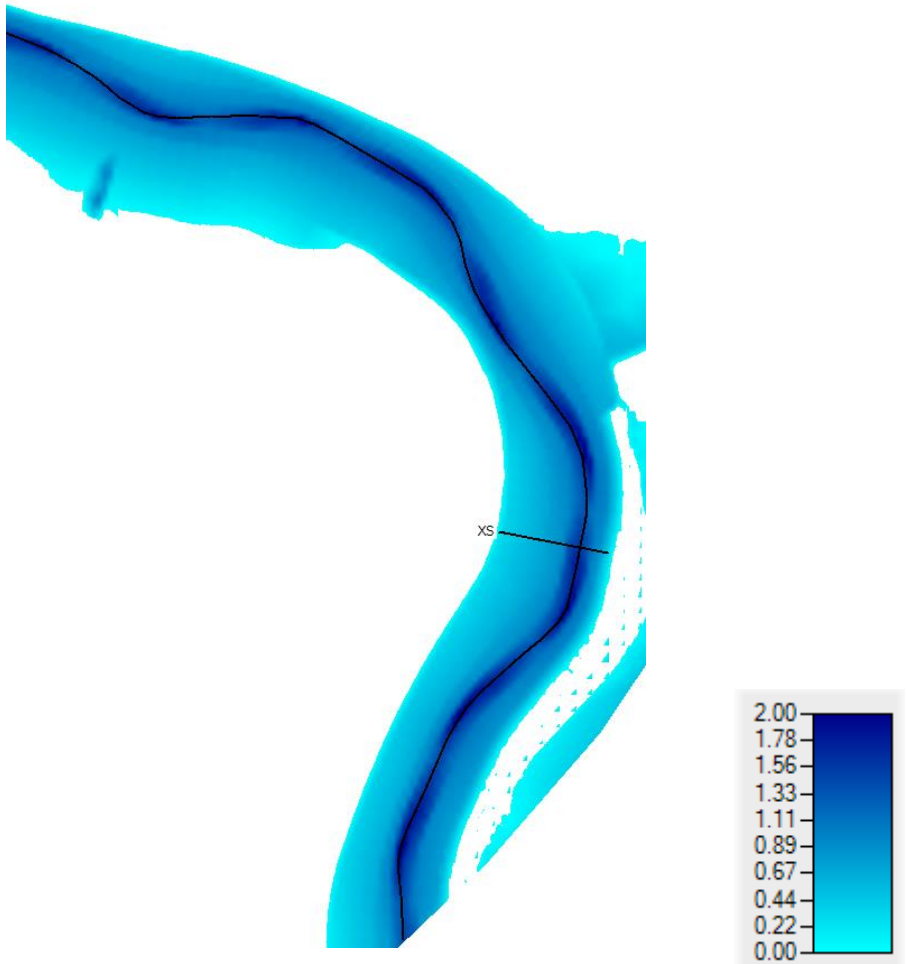


Revised Design

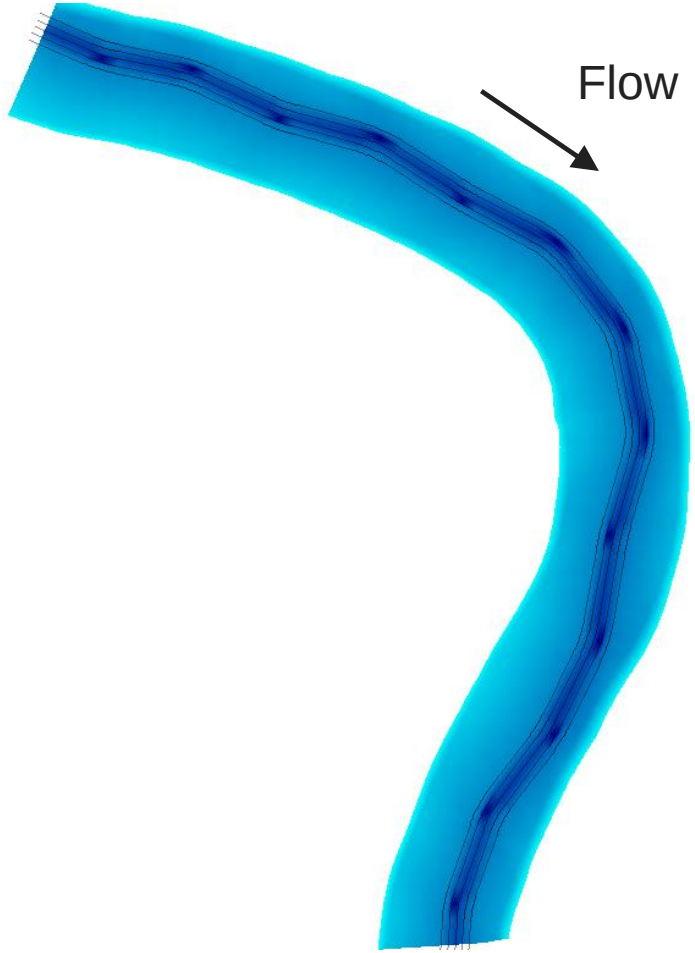


Outcomes

Original Design



Revised Design



Takeaways

- Stream rehabilitation is complicated - there is no master manual
- Site conditions may dictate which design approaches are most appropriate
- Every method has limitations – combine methods to minimize individual limitations
- 2D modelling can add valuable perspective to high risk projects

List of References

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