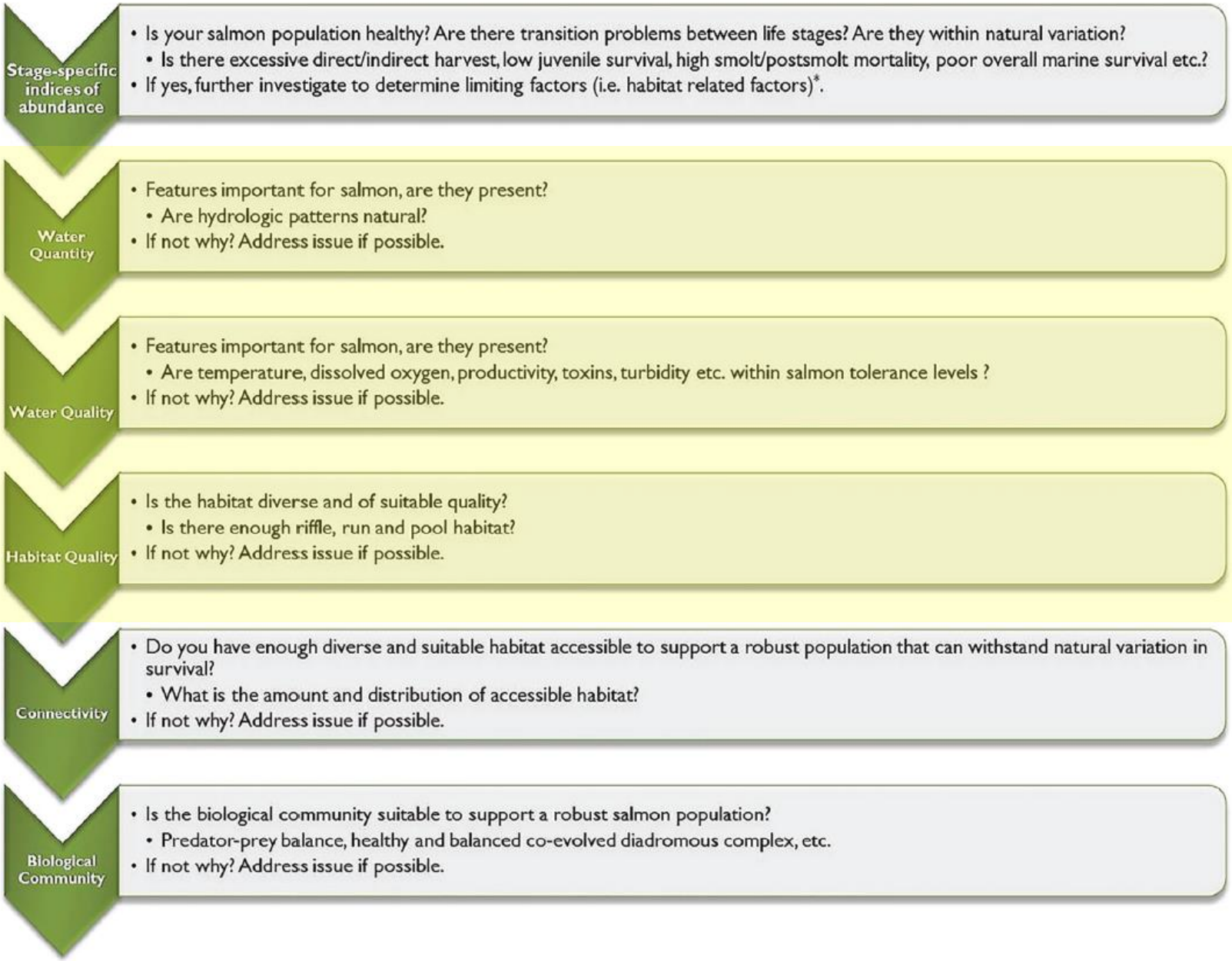
5TH CDN DIV SUPPORT GROUP

GROUPE DE SOUTIEN DE LA 5e DIV CA

Project Prioritization and Restoration of Watershed Processes at 5th Canadian Division Support Base Gagetown

Andy Smith – Aquatic Biologist, 5th Canadian Division Support Group



Carr, J., Trial, J., Sheehan, T., Gibson, J., Giffin, G. Meerburg, D. 2015. Summary of Proceedings of the Symposium: What Works? A Workshop on the Wild Atlantic Salmon Recovery Programs. Atlantic Salmon Federation, St. Andrews, New Brunswick, Canada, 24 pp.

Overview

Part 1
- Watershed planning

Part 2
- Watershed Processes

Part 3
- Watershed Analysis

Part 4
- Case Study – Kerr Brook Watershed

Watershed Management Plans

- **A watershed planning approach** is a flexible framework for managing water resource quality and quantity within a specific drainage area, or watershed.

- **A watershed plan** is a strategy that assesses the state of a watershed and presents detailed management information in terms of analyses, actions, participants and resources required for developing and implementing the plan.

FOCUS ON THE WATER!

Fraser Basin Council
http://www.rethinkingwater.ca/watershed_management.html

Steps in the Watershed Planning and Implementation Process

1. Build Partnerships

2. Characterize the Watershed
   - Gather data, identify causes of habitat degradation and knowledge gaps.

3. Finalize Goals and Identify Solutions
   - Vision statement, overall goals, measurable targets or objectives.
   - Focus on landscape processes that form and sustain high quality habitat.

4. Design an Implementation Program
   - Schedule, technical and financial needs, monitoring program, responsibility

5. Implement Watershed Plan

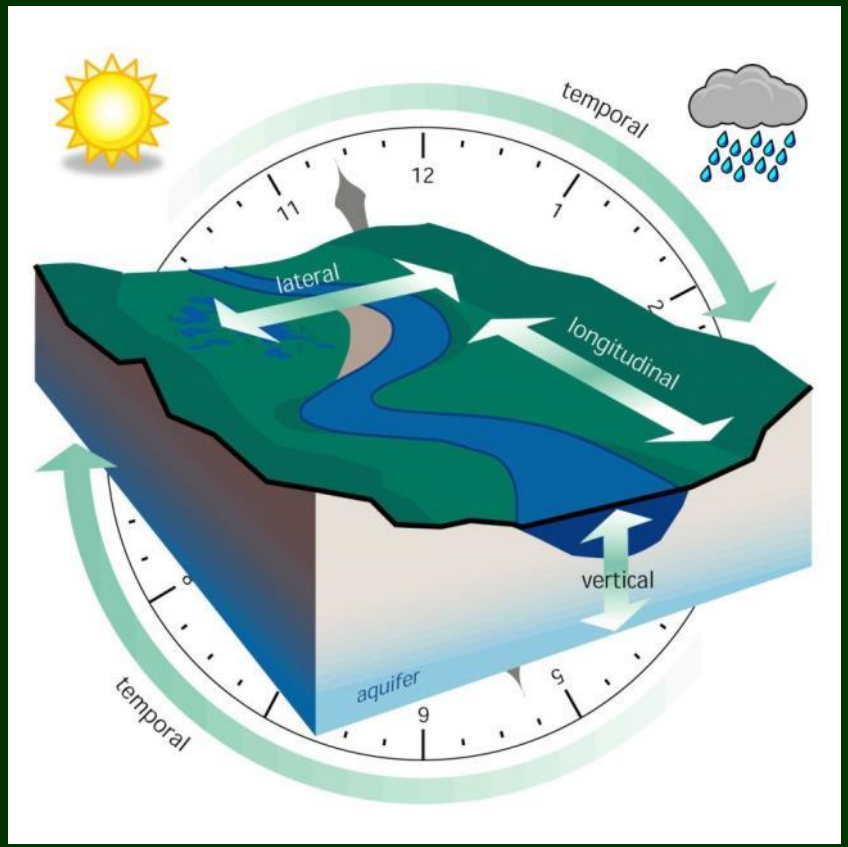
6. Measure Progress and Make Adjustments
   - Analyze monitoring data, report and adjust (adaptive management)

Adapted from EPA Handbook for Developing Watershed Plans to Restore and Protect Our waters (https://www.epa.gov/nps/handbook-developing-watershed-plans-restore-and-protect-our-waters

Watershed Processes

Connectivity

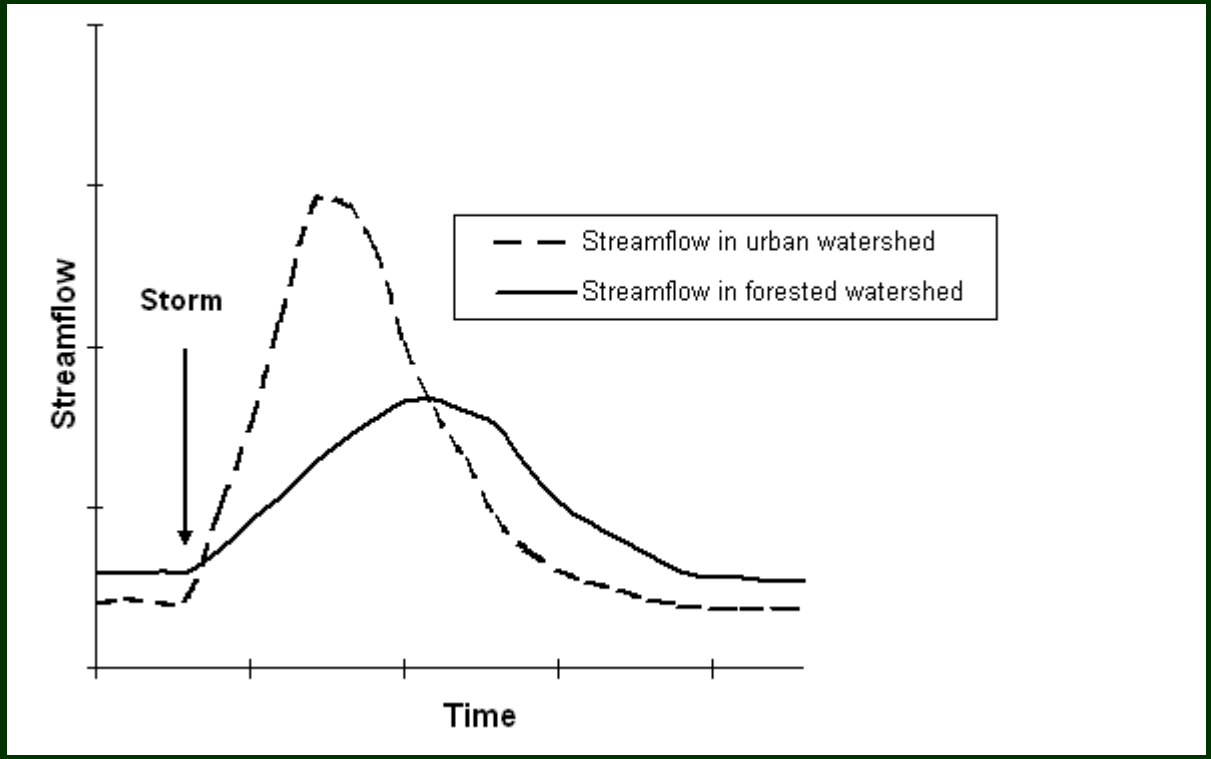
- Longitudinal - Up and downstream
- Lateral – watercourse and its floodplain
- Vertical – surface to groundwater



https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044574.pdf

Watershed Processes

Hydrological



NAIL THE HYDROLOGY!

Watershed Processes

Erosion and sedimentation (geological)

Watershed Processes

Riparian Zones and Forests

Watershed Processes

Water Quality (including nutrient cycling and temperature)

Watershed Processes

Biological (impacts to habitat)

- Beavers
- Gaspereau, sea lamprey – ocean derived nutrients
- Muskrats – creating openings in wetland vegetation
- Wild ungulates - browsing riparian vegetation

Watershed Analysis

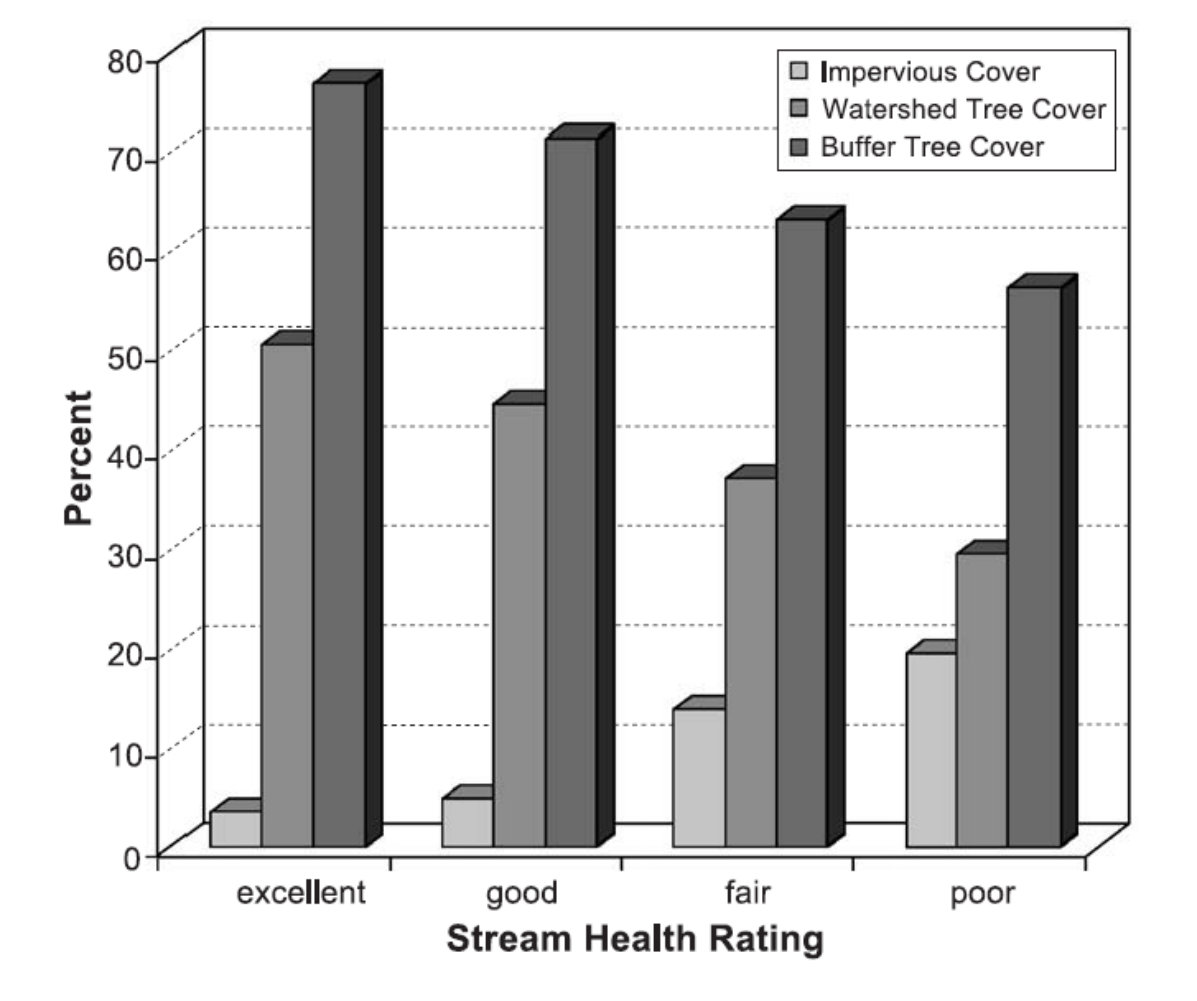
Water-crossings and barriers

- Number, condition and location in watershed.
- Water crossings (ditches and roadbeds) are a principle pathway for excess runoff and sediment laden water to enter watercourses.
- Undersized culverts and dams interfere with the downstream movement of sediment and woody debris .

Identify unmapped headwaters

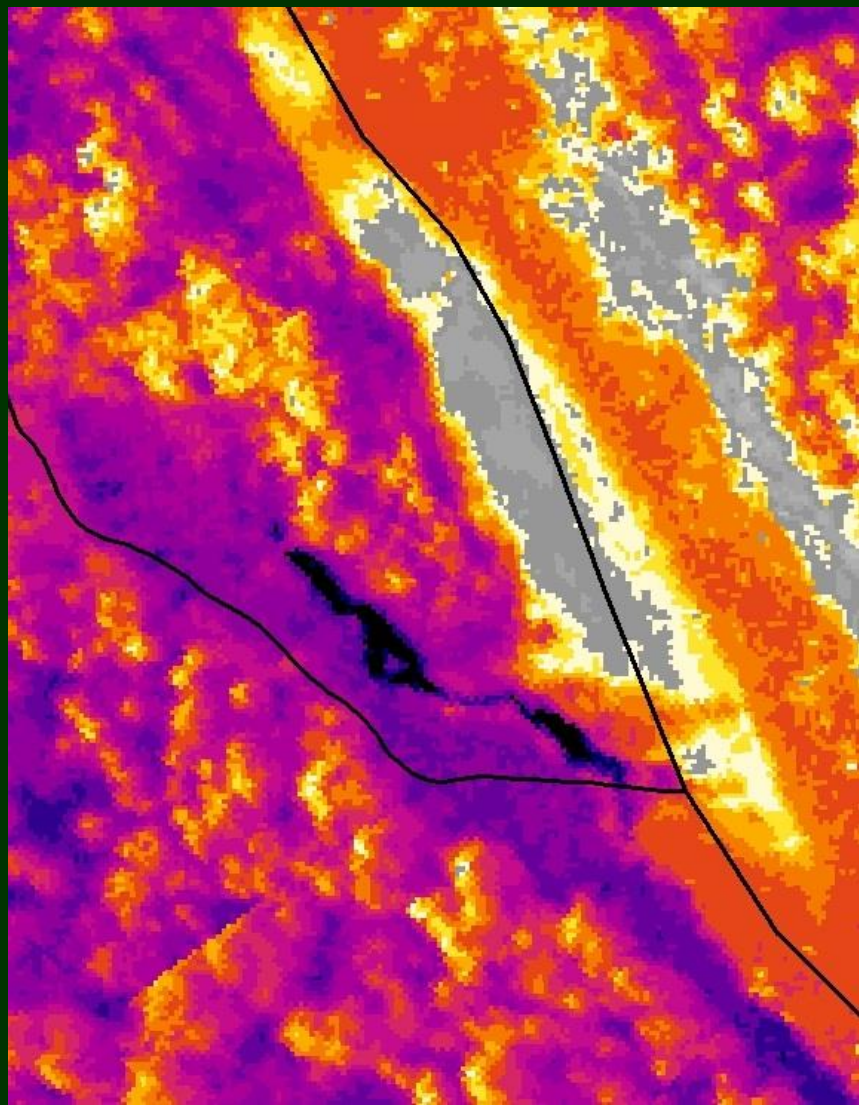
- Less likely to be protected or buffered
- Don’t forget sewersheds, agricultural drains, tile drains
- Source of excess flows, sediment and pollutant laden water

Percent forest cover/ percent imperviousness/ riparian zones



Goetz et al., 2003

Thermal Infrared Remote Sensing



Water quality

- CCME and provincial guidelines; CCME water quality index
- Severity of Ill effects to fish due to turbidity (Newcombe, 2003)

Water quantity

- Indicators of Hydrologic alteration (Richter et al., 1996)

Table 23. Average annual baseflow regime during the late summer or winter low-flow period as a percentage of the average annual daily flow (cubic feet per second - cfs).

Species	Excellent	Good	Poor	Notes
Salmonids	50	30	20	

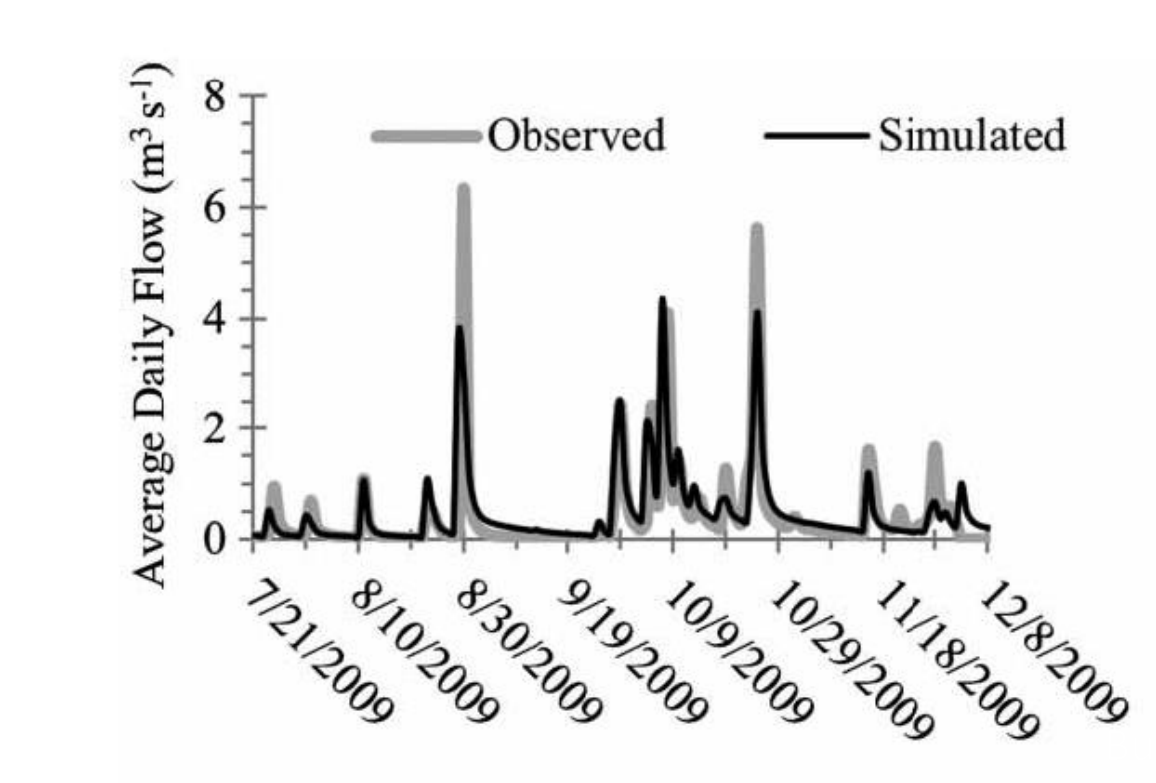
Table 24. Average annual peak flow as a multiple of the average annual daily flow.

Species	Excellent	Good	Poor	Notes
Salmonids	2 to 3	> 1 and < 4.5	1 and > 5	

DFO and Thaumas Environmental Consultants, 2006

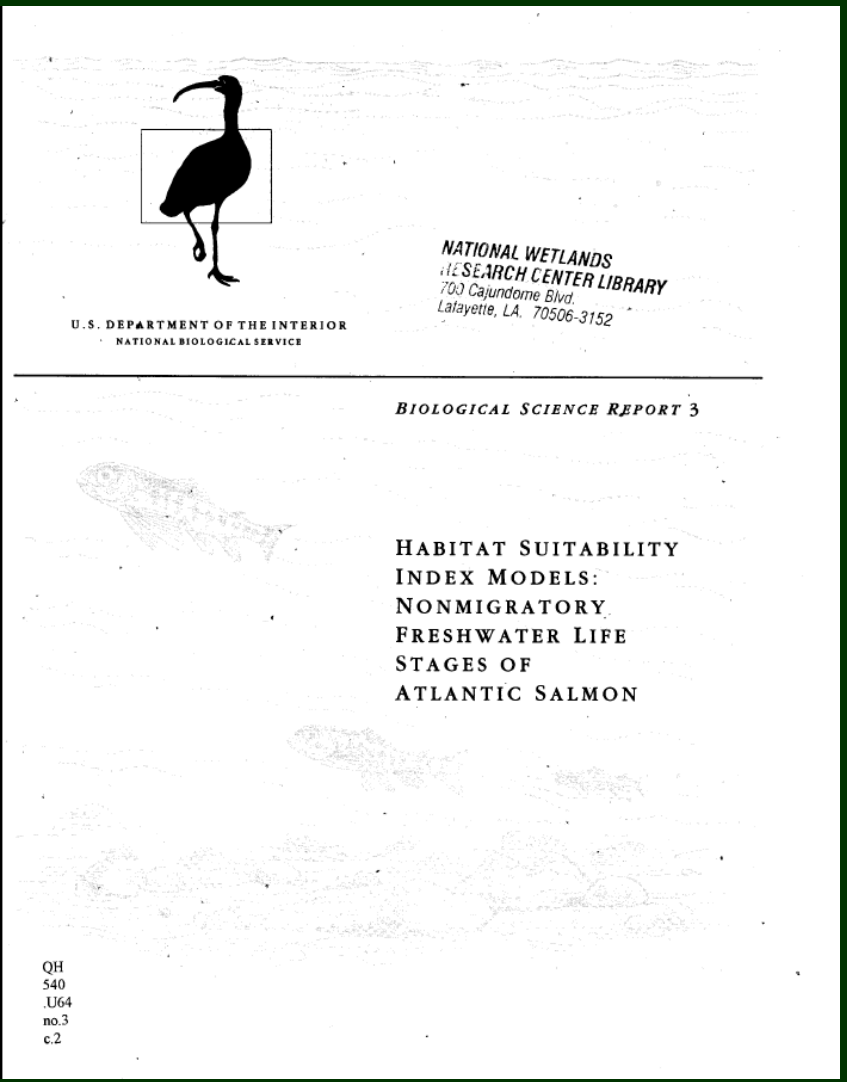
Hydrological Models

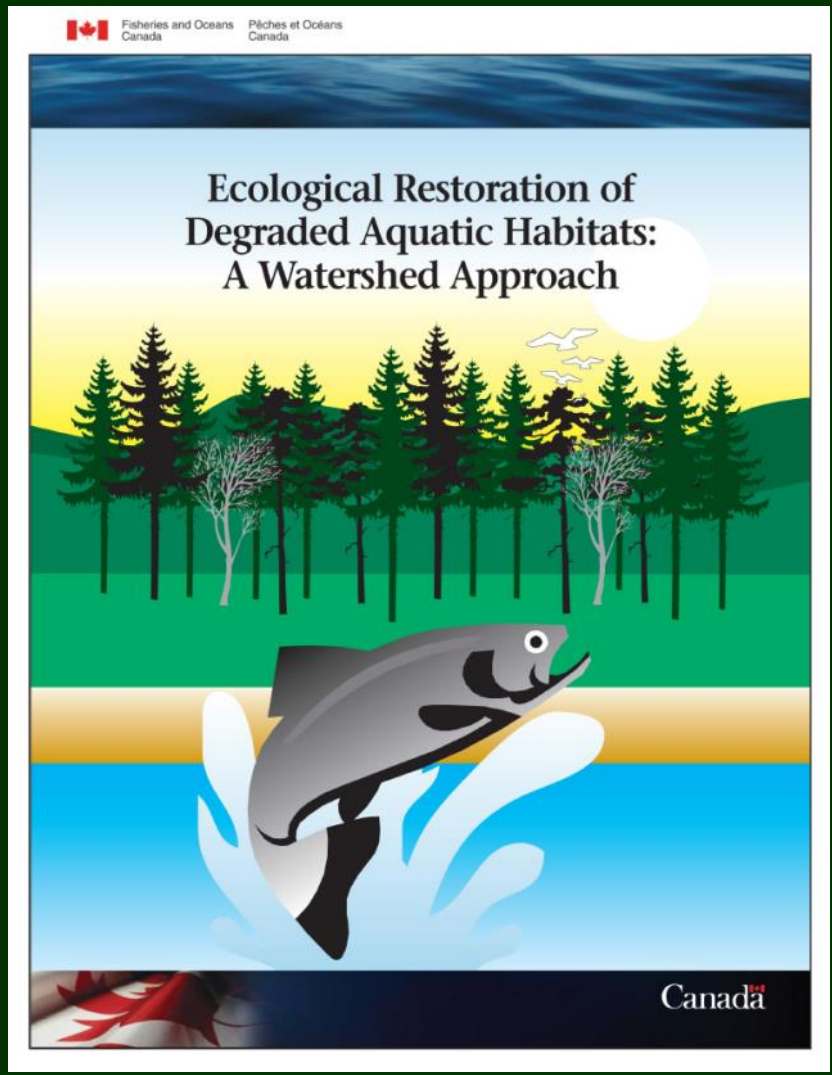
- Soil Water Assessment Tool
  - Predict the effect of management decisions on water, sediment, nutrient and pesticide yields with reasonable accuracy on large, ungaged river basins.



rdett et al. 2014

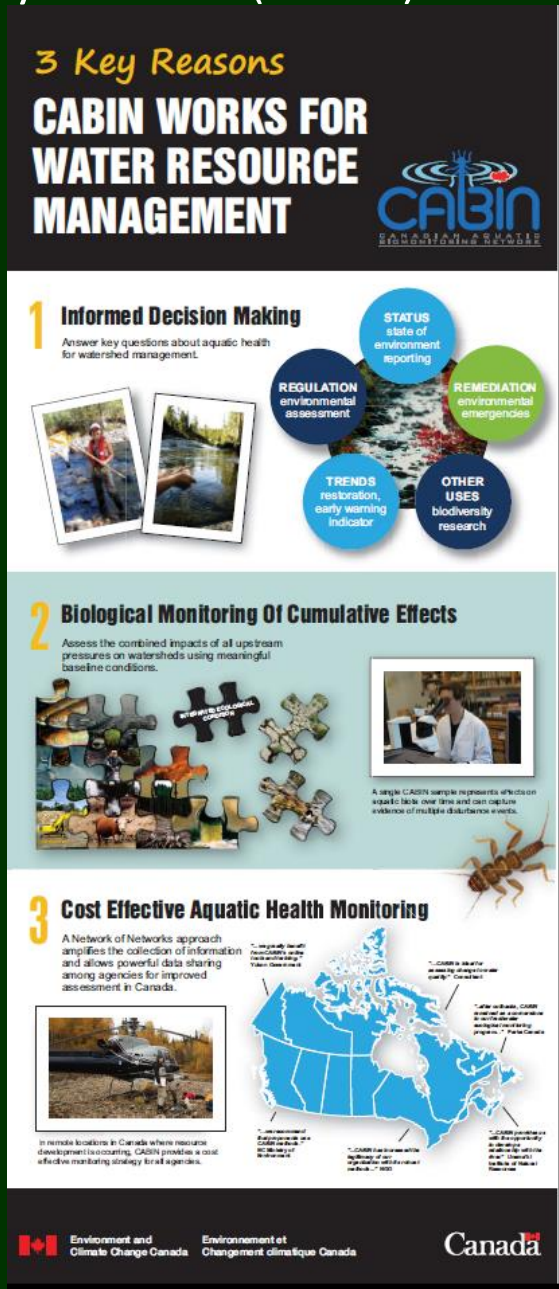
Habitat Suitability



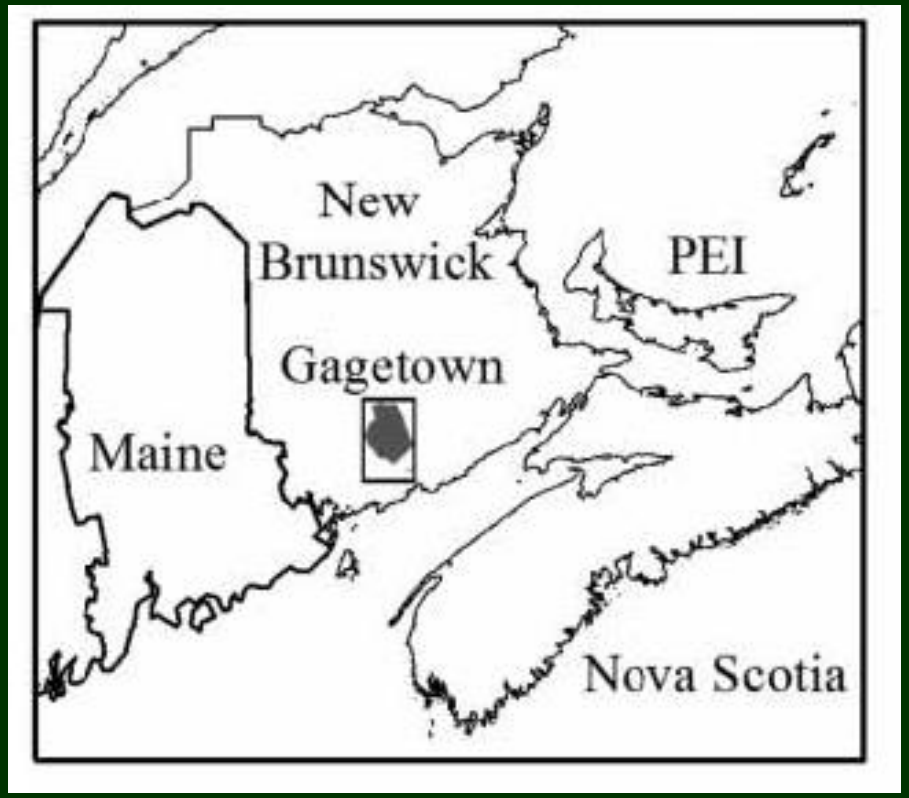


Benthic Invertebrates - Canadian Aquatic Bio-inventory Network (CABIN)

- ECCC program uses benthic macro invertebrates to assess freshwater ecosystem health.
- Uses the reference condition approach.
- Ability to compare test sites to a model of reference sites with minimal anthropogenic impacts.



5th Canadian Division Support Base Gagetown



- Located in south central N.B the base was established in the mid 1950's and is home to the Army's Combat Training Centre, CFSME and several military units.
- 1100 Km^2 including 21 000 ha of manoeuvre area, and 30 000 ha of impact areas.,
- Approximately 4600 military and 800 civilian personnel.

Base Gagetown Training Activities

Canadian Army Mission

- The Canadian Army will generate combat effective, multi-purpose land forces to meet Canada's defence objectives

Canadian Army Environmental Policy

- Demonstrate due diligence;
- Manage operations and activities in an environmentally sustainable way;
- Comply with applicable environmental legislation and DND stewardship policies;
- Continually improve environmental performance.

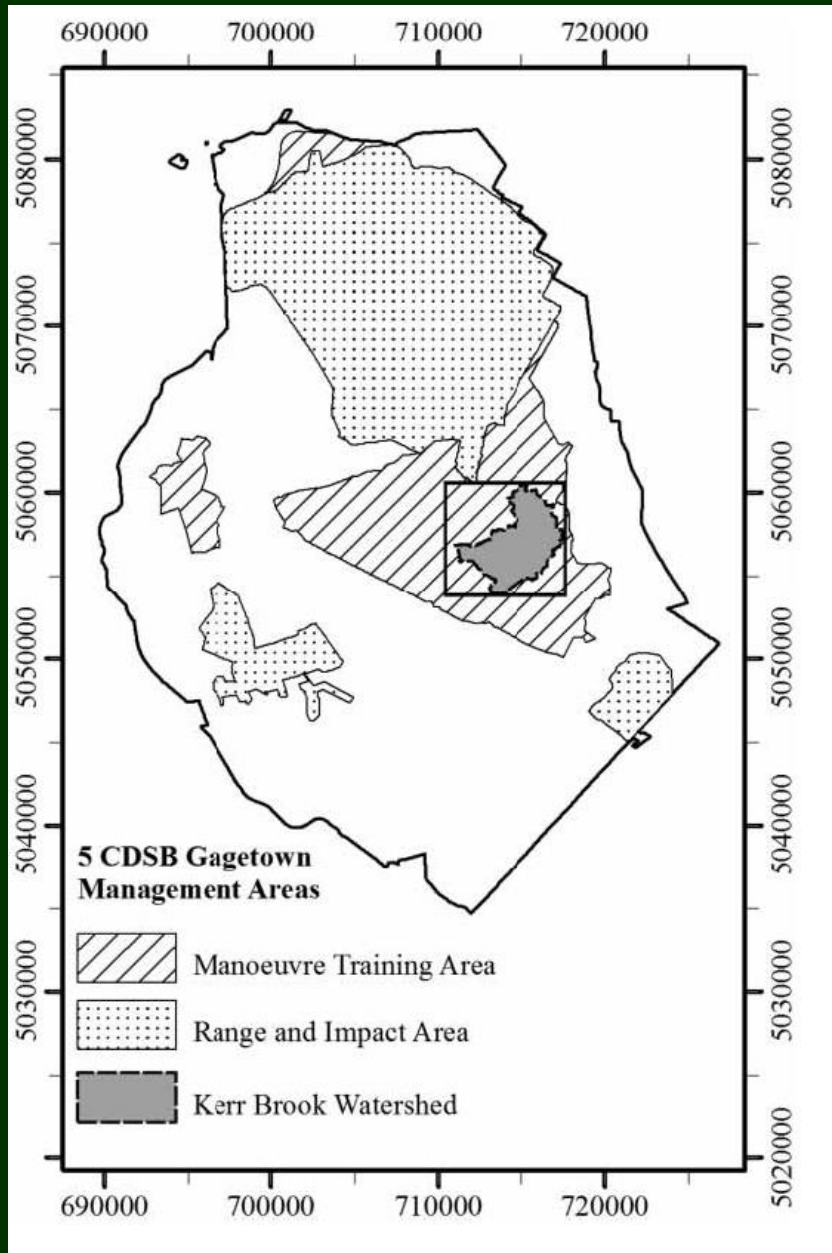
Auditor General's Report, 2003

- "National Defence has not always shown due regard to protecting fish and fish habitat on its training and test areas as required by the *Fisheries Act."*

- "Erosion at CFB Gagetown shows lack of due diligence."

Case Study Kerr Brook Watershed

- Watershed area = 20 km^2
- Located in the Mounted Manoeuvre Area
- Up to 2000 training events /year
- Average of 38 military vehicles/ day in the watershed.

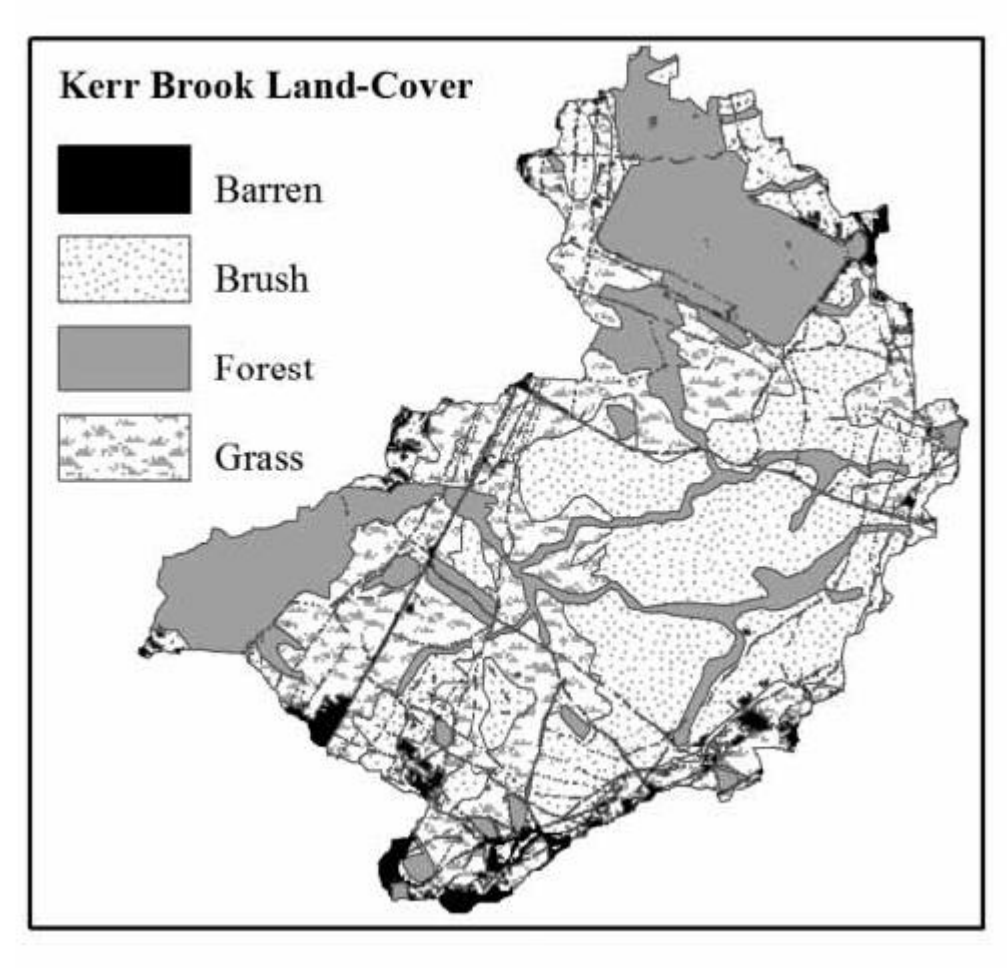


Case Study Kerr Brook Watershed

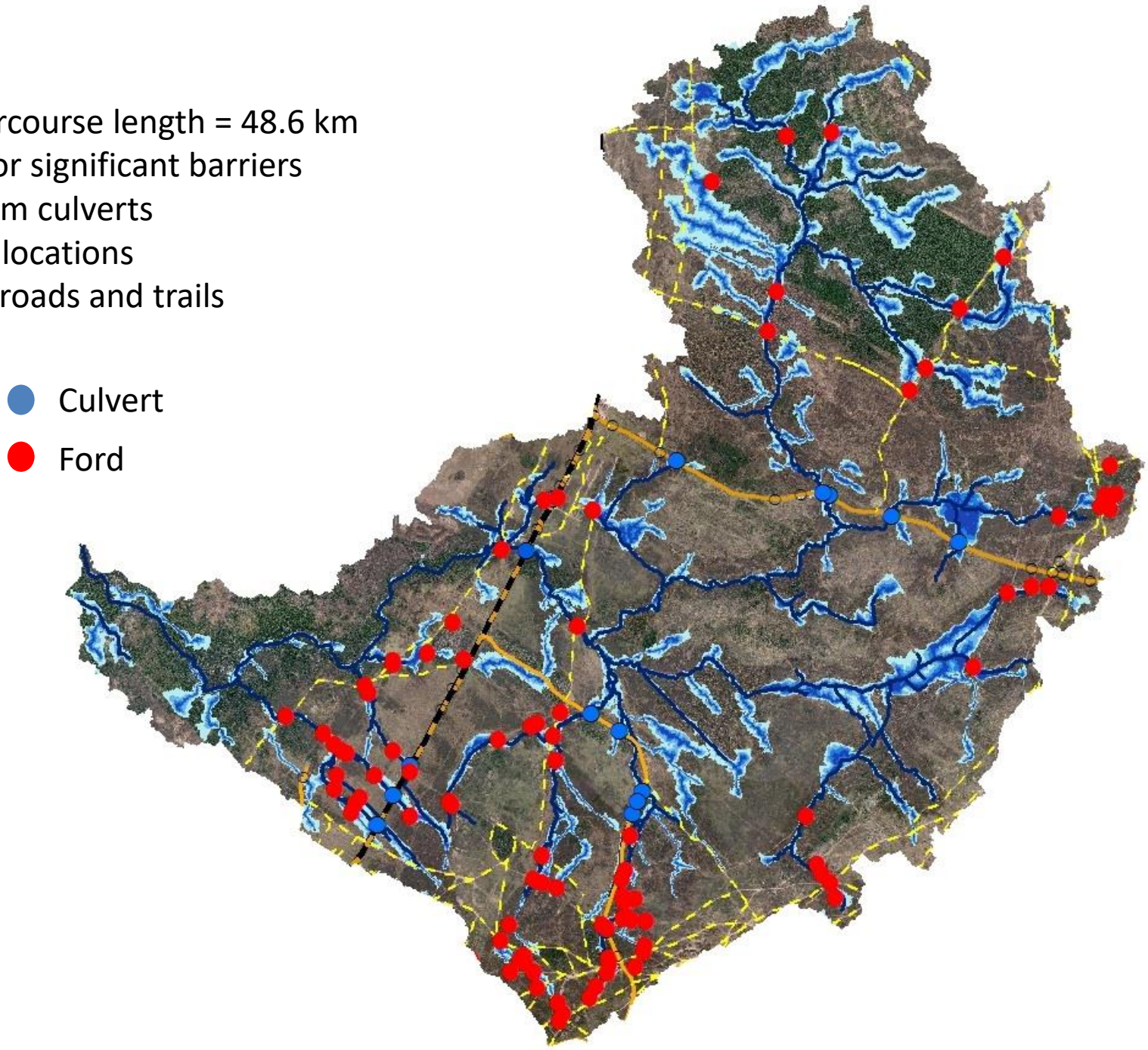
Watershed land cover

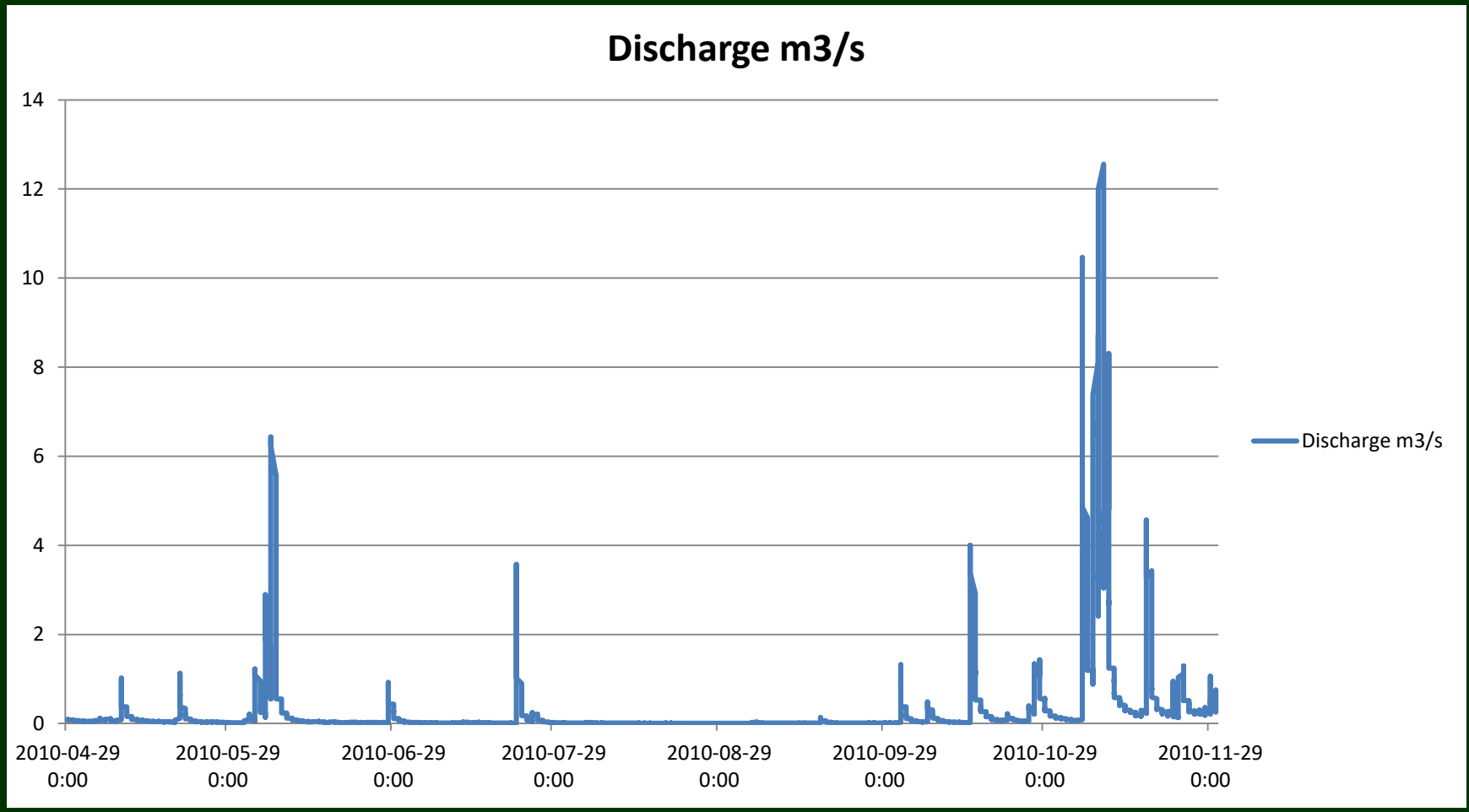
- 26 % forested;
- 36 % shrubs/ young trees;
- 32 % grasslands;
- 4% exposed soils;
- 2 % wetlands

- Riparian zones
- 21 % forested;
- 47 % shrubs;
- 27% grass;
- 5 % bare soil or water



- Total watercourse length = 48.6 km
- No dams or significant barriers
- 16 in-stream culverts
- 93 fording locations
- 174 km of roads and trails




Discharge m3/s
14
12
10
8
6
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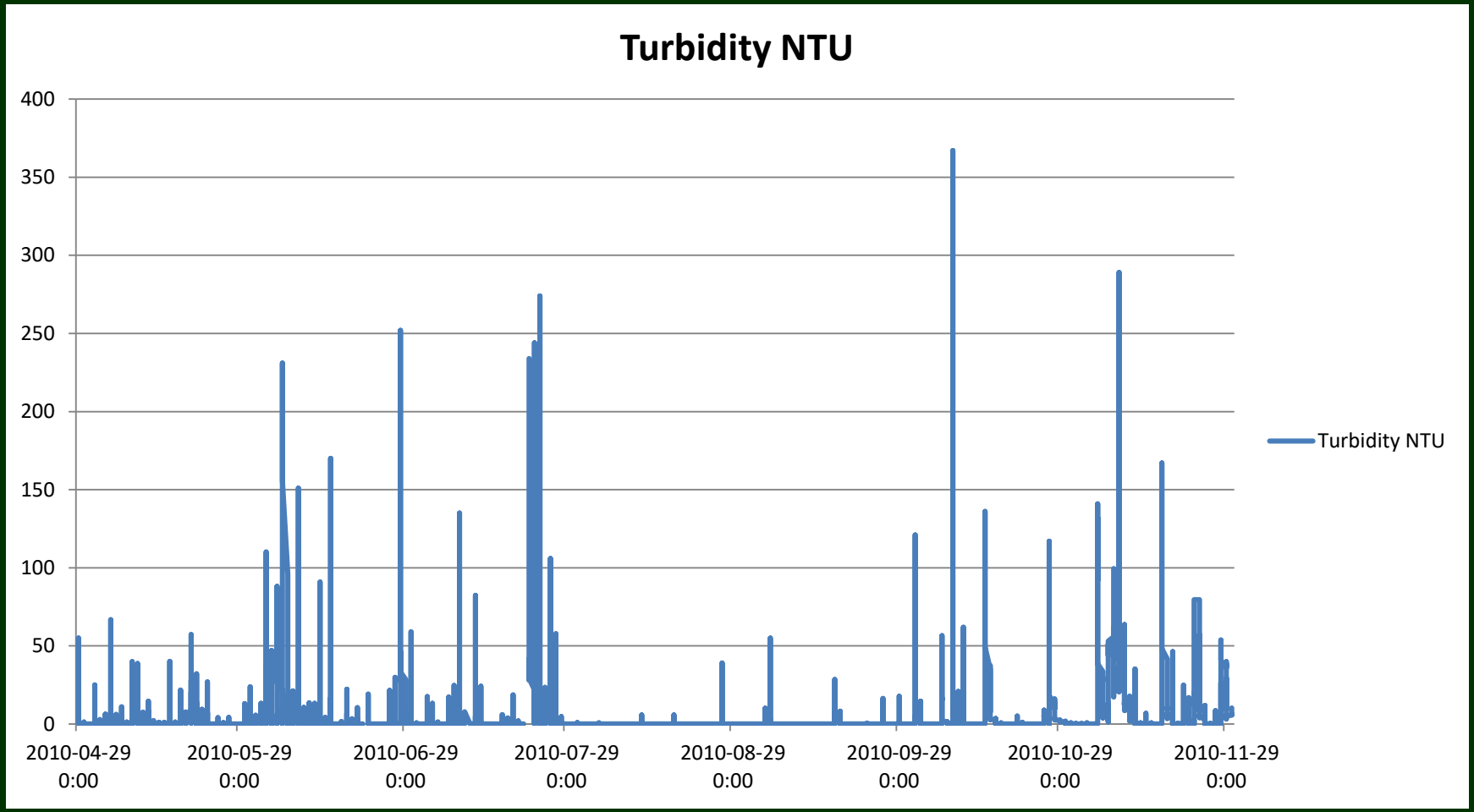


- TSS recordings up to 185 mg/l.
- No other significant or ongoing exceedances of CCME water quality guidelines.

Fish Species

- American eel;
- Atlantic salmon (old record);
- Brown bullhead;
- Brook trout;
- Sea lamprey;
- Smallmouth bass;
- Various baitfish

- HSI score (1996) = 0.3.

Kerr Brook Watershed Management Plan…

…does not exist!

Do as I say not as I do!

In the Kerr Brook Watershed we have:

- One land owner
- One land use
- Minimal development
- One source of funds
- Internal environmental compliance/conformance team
- No specific significant interest in this watershed from external stakeholders.

Other base wide plans are applicable the Kerr Brook watershed:

Case Study Kerr Brook Watershed

Strategies for the Management of Fisheries and Aquatic Habitat at 5 CDSB Gagetown.

Vision - *A sustainable and realistic military training environment where healthy aquatic habitats support diverse, self sustaining aquatic communities, including species at risk, capable of contributing to recreational, commercial and Aboriginal fisheries.*

Case Study Kerr Brook Watershed

5 CDSB Gagetown Sedimentation and Erosion Control Plan

Goals

- Environmental Stewardship and Compliance
- Sustainable Range and Training Areas

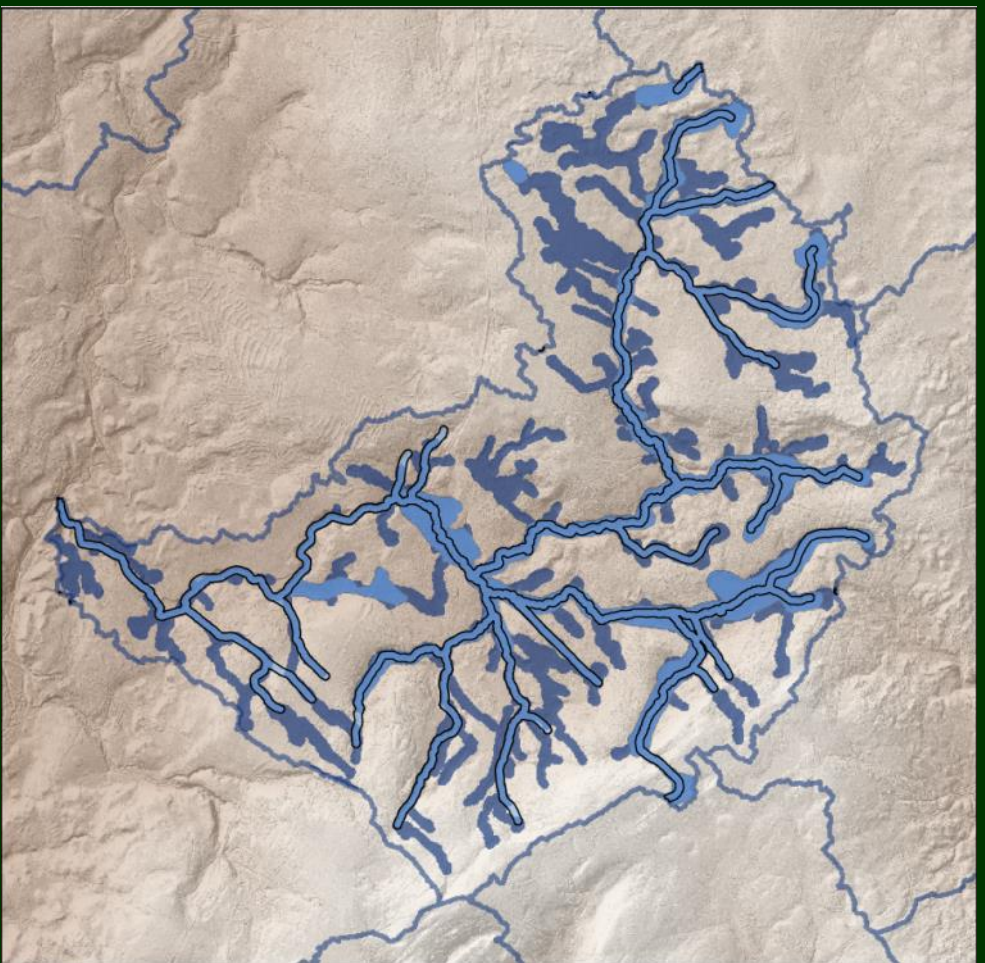
Objectives

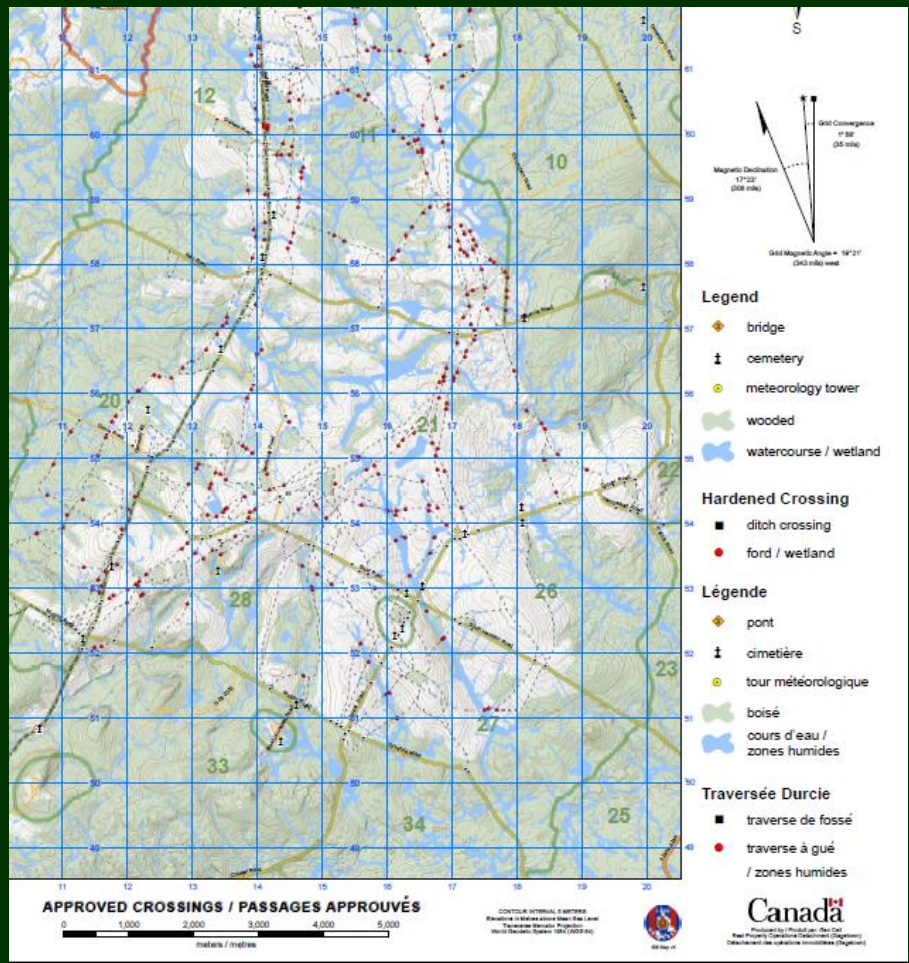
- Minimize and mitigate erosion and sedimentation by implementing high priority projects.
- Ensure applicable regulations, policies and compliance issues are met by minimizing and mitigating sedimentation effects.
- A realistic training environment where activities are conducted in a compliant and sustainable manner.

Management Actions

Range Standing Orders:

- No fording of watercourses or wetlands except at engineered hardened fords.
- 30 m buffer zones with no manoeuvring or vegetation management includes: wetlands, watercourses and now 50 cm wet areas mapping.





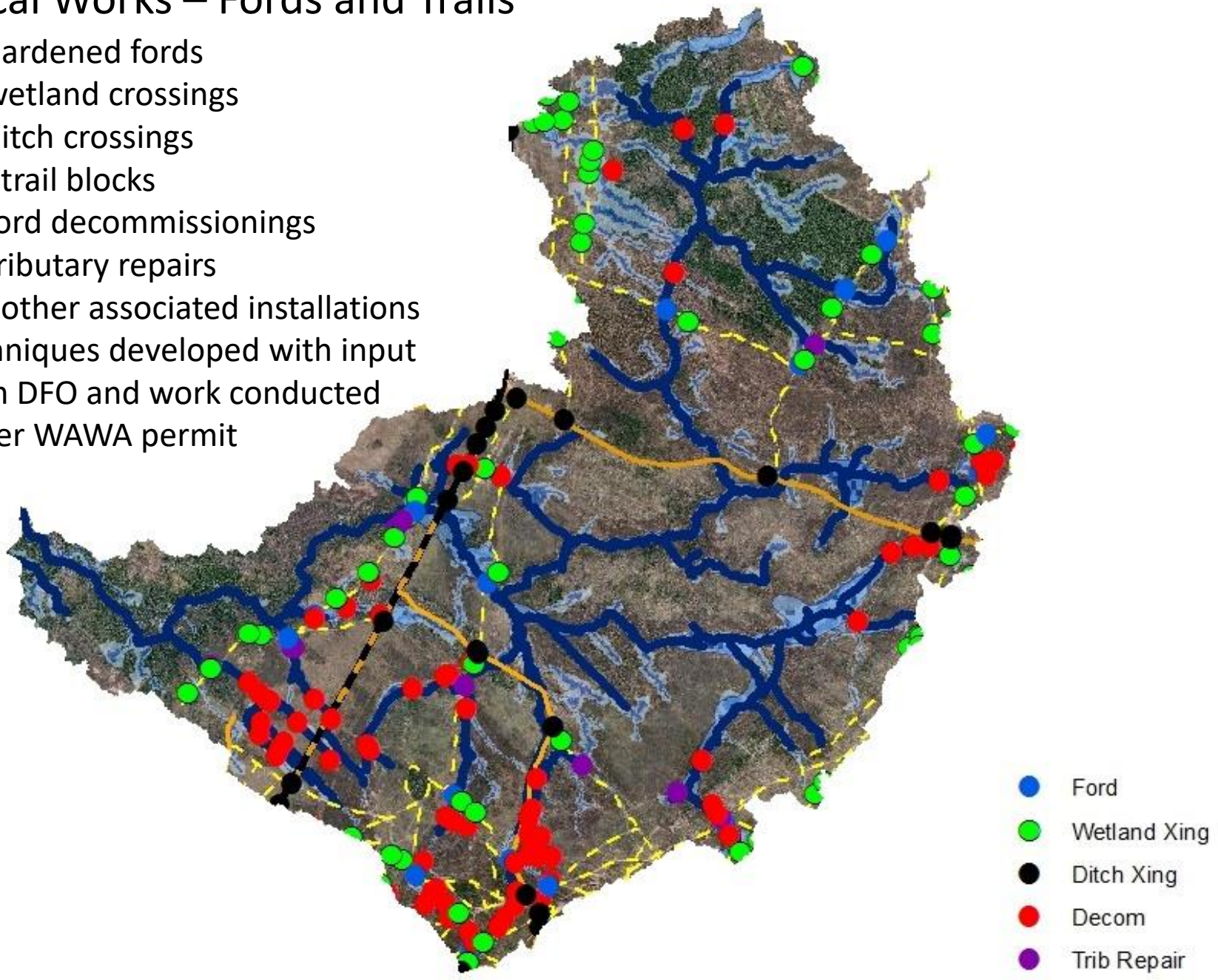
Physical Works – Road Improvement

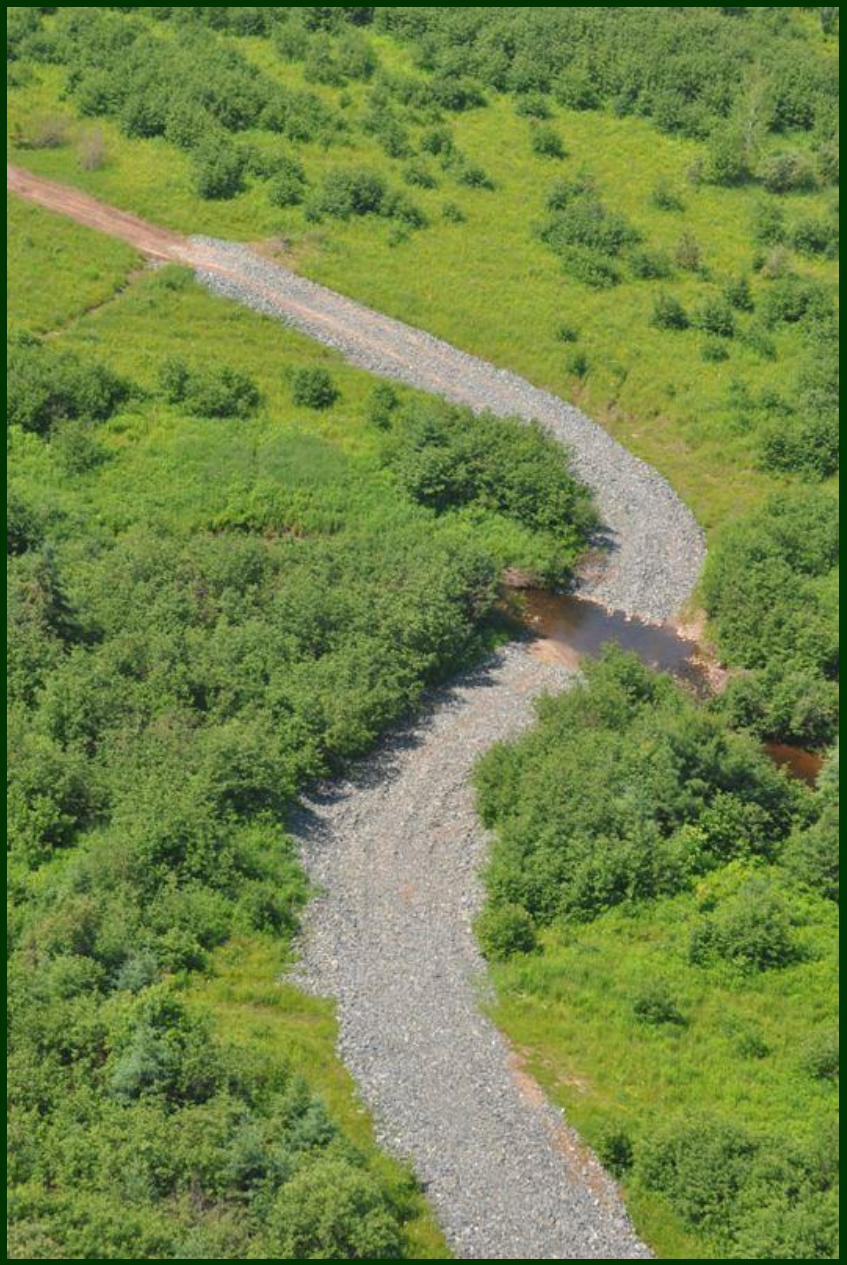
- 8 of 16 instream culverts replaced so far.
- Capping roads, ditching, cross culverts and off-take construction 6.7 of 9.6 km completed.
- Designs based on NB Watercourse and Wetland (WAWA) Certification training guidelines and/or had a WAWA permit.

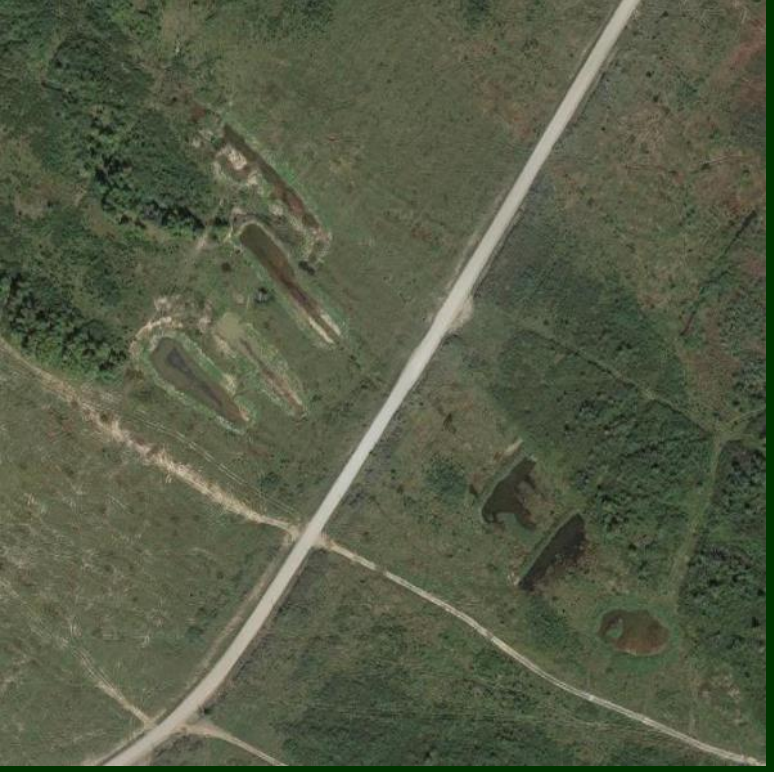
- BREAK THE HYDRAULIC PATHWAY!

Physical Works – Fords and Trails

- 20 hardened fords
- 44 wetland crossings
- 21 ditch crossings
- 207 trail blocks
- 73 ford decommissionings
- 10 tributary repairs
- 491 other associated installations
- Techniques developed with input from DFO and work conducted under WAWA permit







Constructed Wetlands

- Approximately 7 ha constructed.
- Sediment removal and wildlife habitat.
- Headwater areas, typically off-line, no fish.

Tree Planting

- Small projects (100’s of trees)
- Gullies, decommissioned fords and infill planting

Instream Sediment Collector

- Captures bedload sand and fines and allows larger sediment to pass.
- Over $50 000 for unit and installation.
- Requires maintenance (grates clog) and annual pumping.

Measuring Progress

Modeling of Ford Improvements in Kerr Brook Watershed

Application of the RUSLE model to Kerr Brook

- 41 hardened ford approaches were assessed.
- Model estimated that:
  - Hardening ford approaches reduced erosion by 98%;
  - there is an annual reduction of 32.4 tonnes of eroded soil entering the watercourse; and
  - A 9% reduction in the total watershed sediment yield

Study did not assess impact of ford decommissioning, wetland crossings and other treatments.

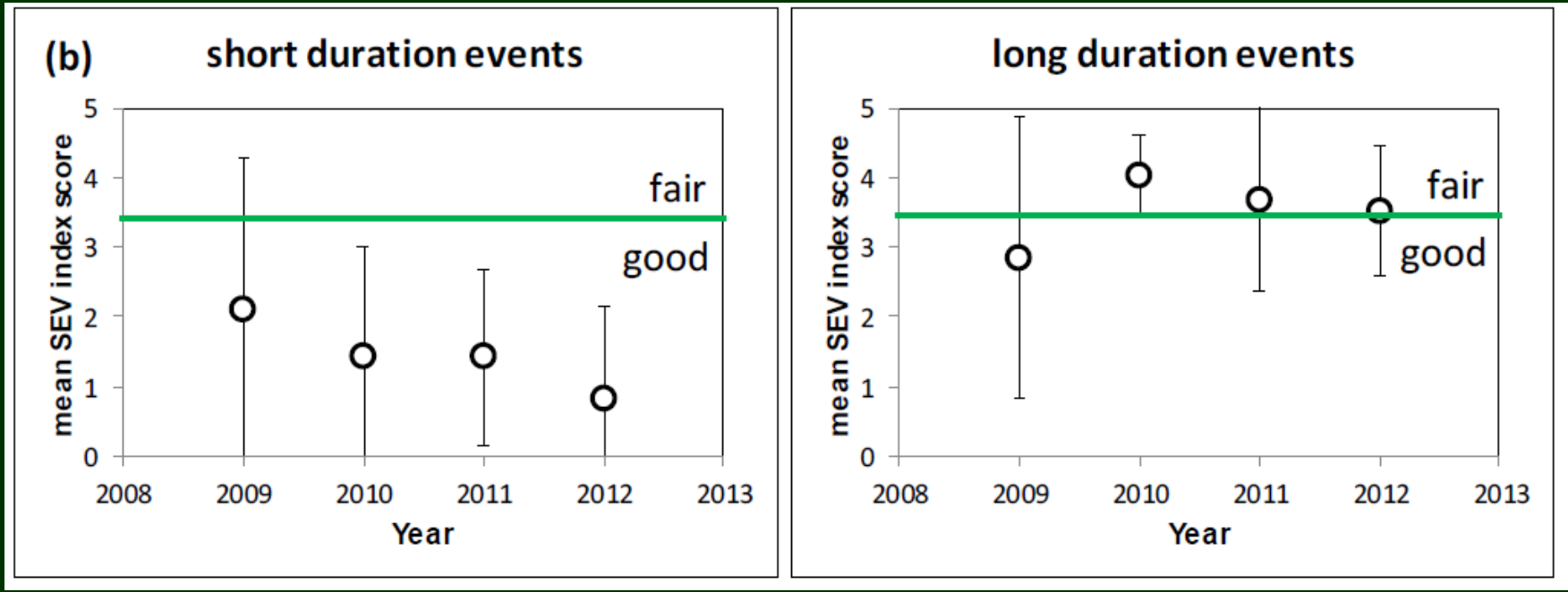
Impacts of Ford Improvement on Turbidity

Automated continuous sampling of turbidity every 15 minutes of the ford in the first slide pre and post-construction.

	Pre-construction	Post-construction
Sample dates	June 10 -23	Aug. 29 – Sept. 26
# of Events*	3	8
Average duration	2.16 hours	0.9 hours
Average Peak NTU	942	31
Peak NTU	1382	93

- Non-precipitation turbidity events

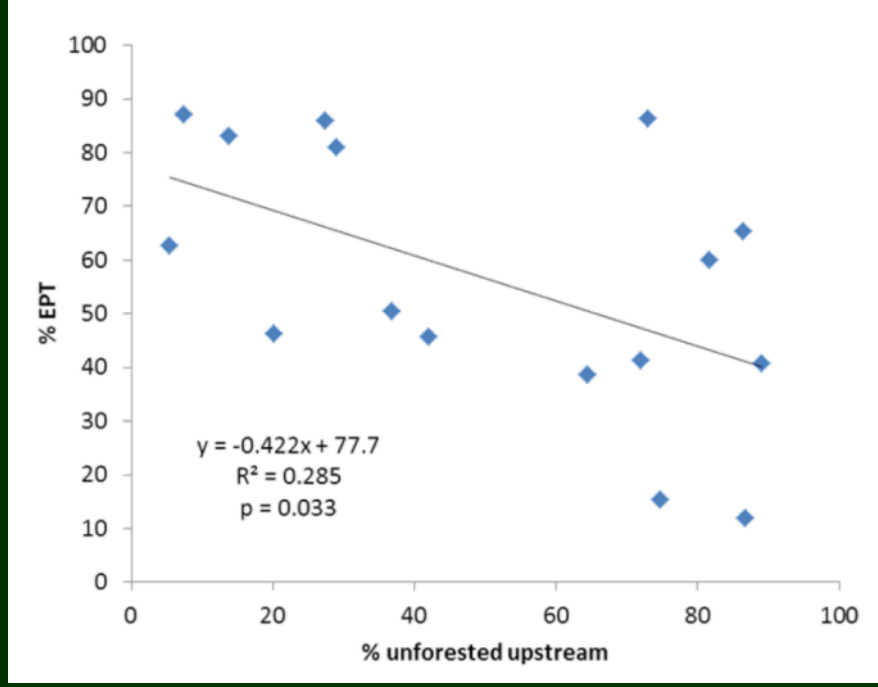
Newcombe's Severity of Ill Effects Model Applied to Kerr Brook Turbidity Data

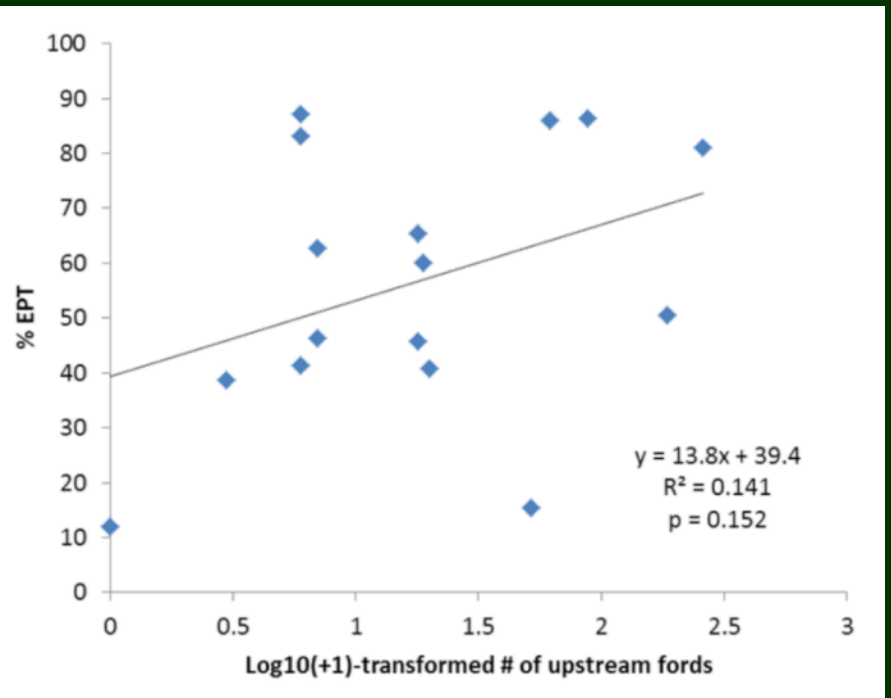


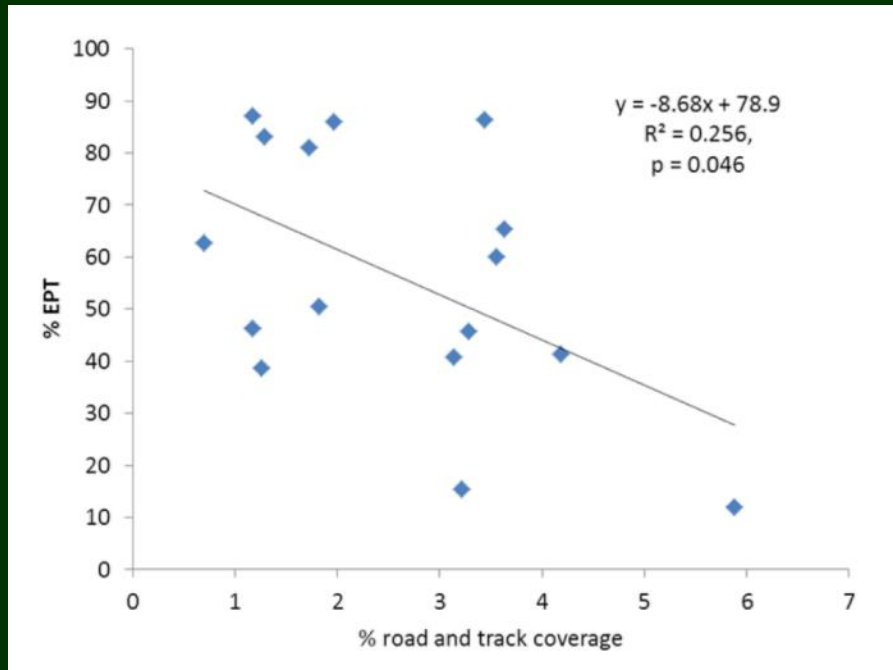
< 24 hours, NTU > 10

1-30 days, NTU> 6

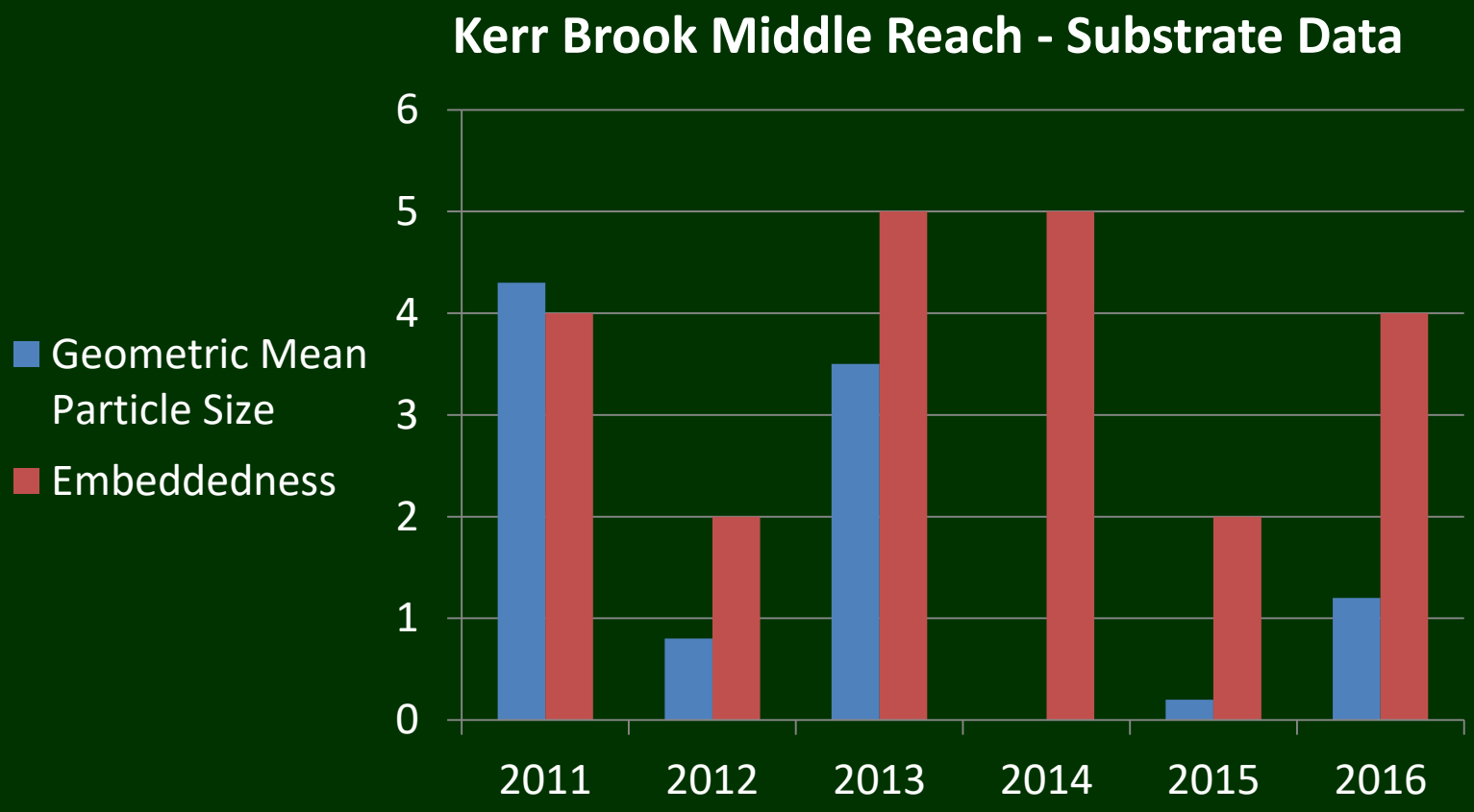
2016 Benthic invertebrates data , base wide





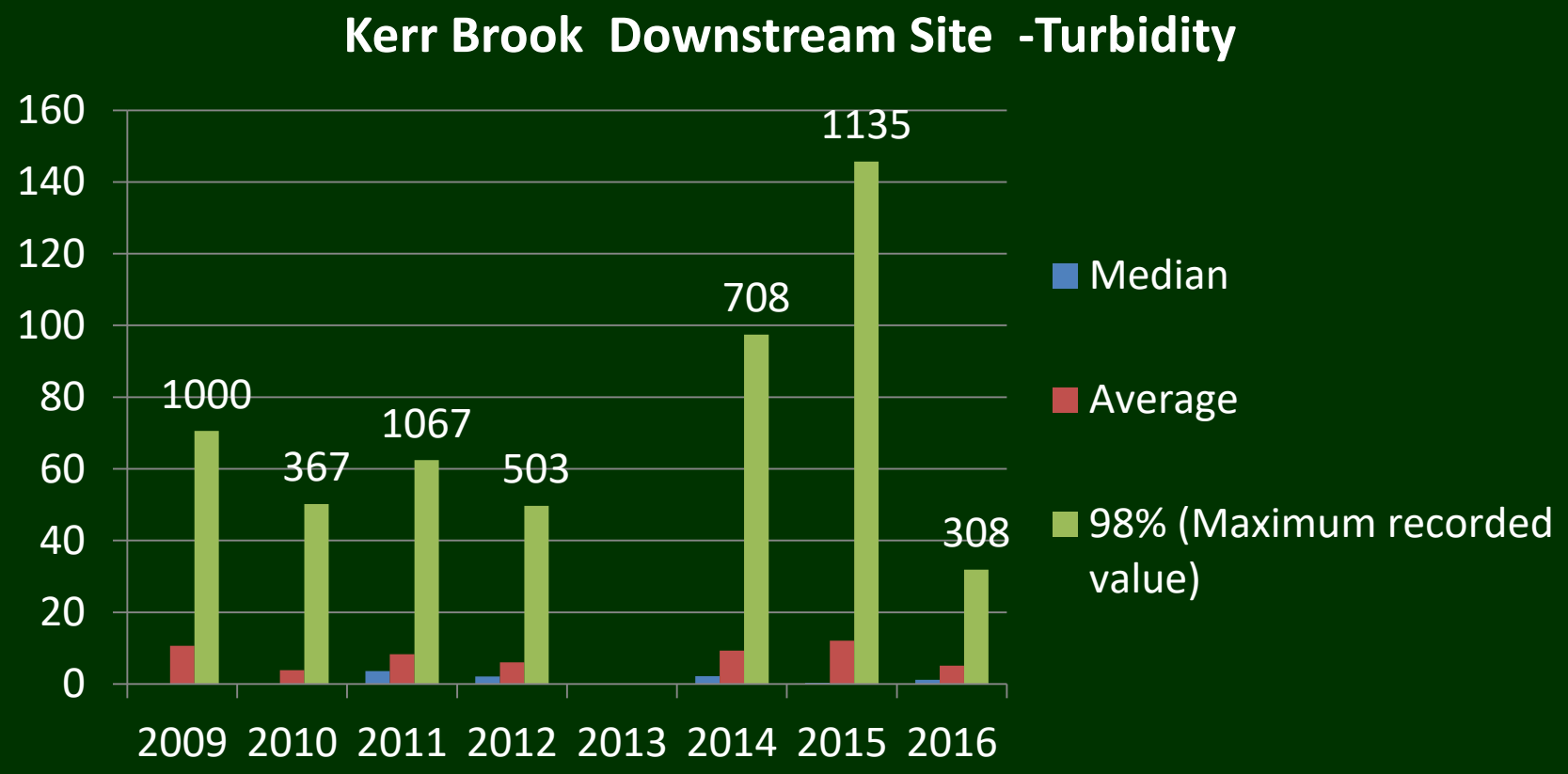


Habitat Monitoring

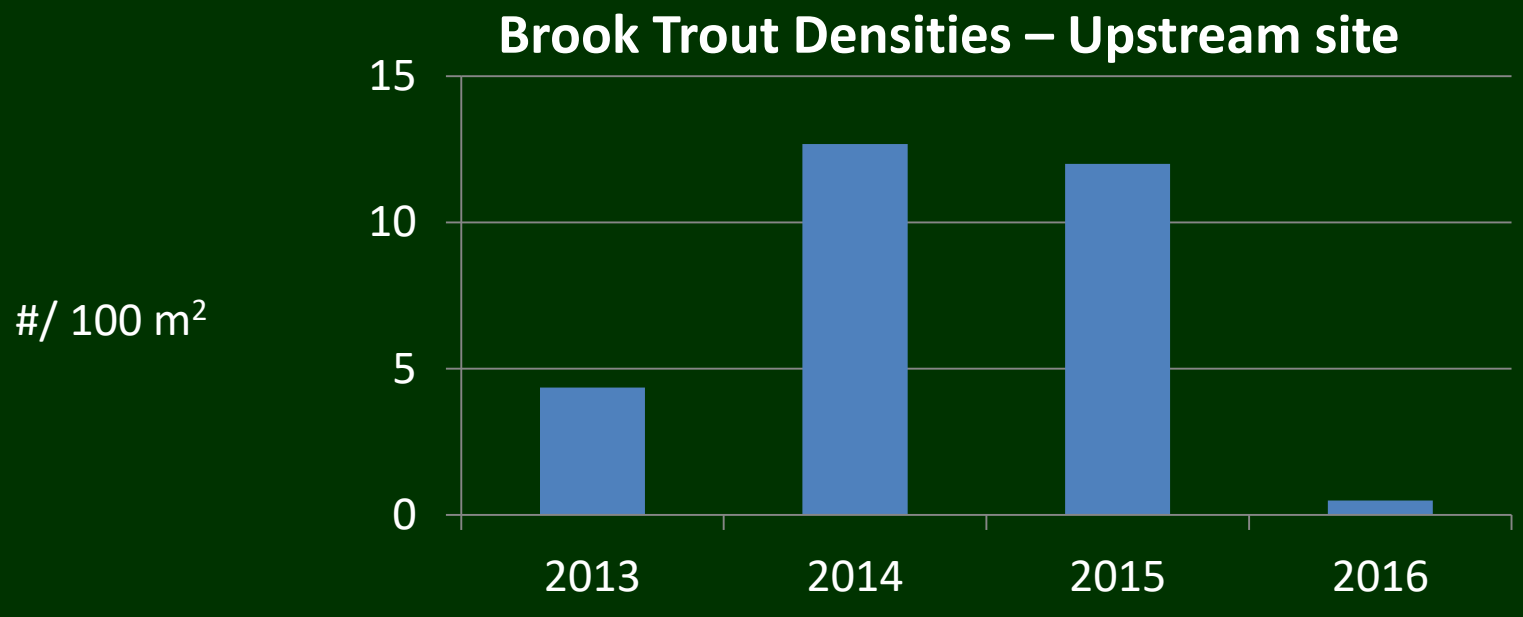


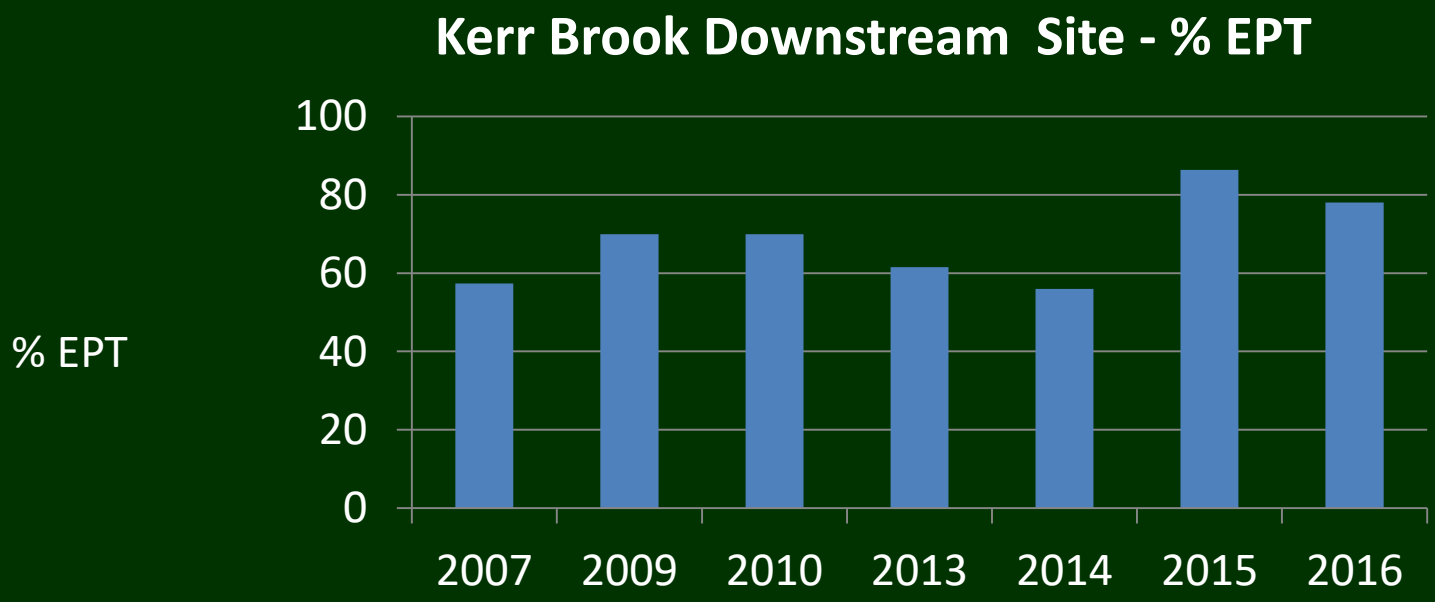
In 2014 an upstream beaver dam blew out.

Habitat Monitoring



Biological Monitoring





Case Study Kerr Brook Watershed - Conclusions

- Measures were implemented that improve compliance and show due diligence.
- Literature and modeling suggest the measures should enhance watershed processes.
- No conclusive evidence from physical or biological indicators of improvement.

Summary (Courtesy of Roni et al. 2002)

1. Protect areas with intact processes and high quality habitat.
2. Reconnect isolated high quality habitat.
3. Restore hydrologic and geologic (sediment delivery) processes.
4. Restore riparian processes.
5. Conduct instream habitat enhancement where short term improvements are needed.

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