

# Perspectives on Connectivity in Canadian Watersheds



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# How it all started

## CAG 2021

- Workshop on watershed connectivity
- Short presentations on recent and ongoing projects across Canada
- Lots of Q and A and discussion following

## Participants

- Genevieve Ali, Faran Ali, Stephen Dery, Masoud Goharrokhi, Sirja Islam, Kristen Kieta, David Lobb, Merrin Macrae, Issac Noyes, Phil Owens, Ellen Petticrew, Kokulan Vivekananthan

# How its going

## Draft paper being written

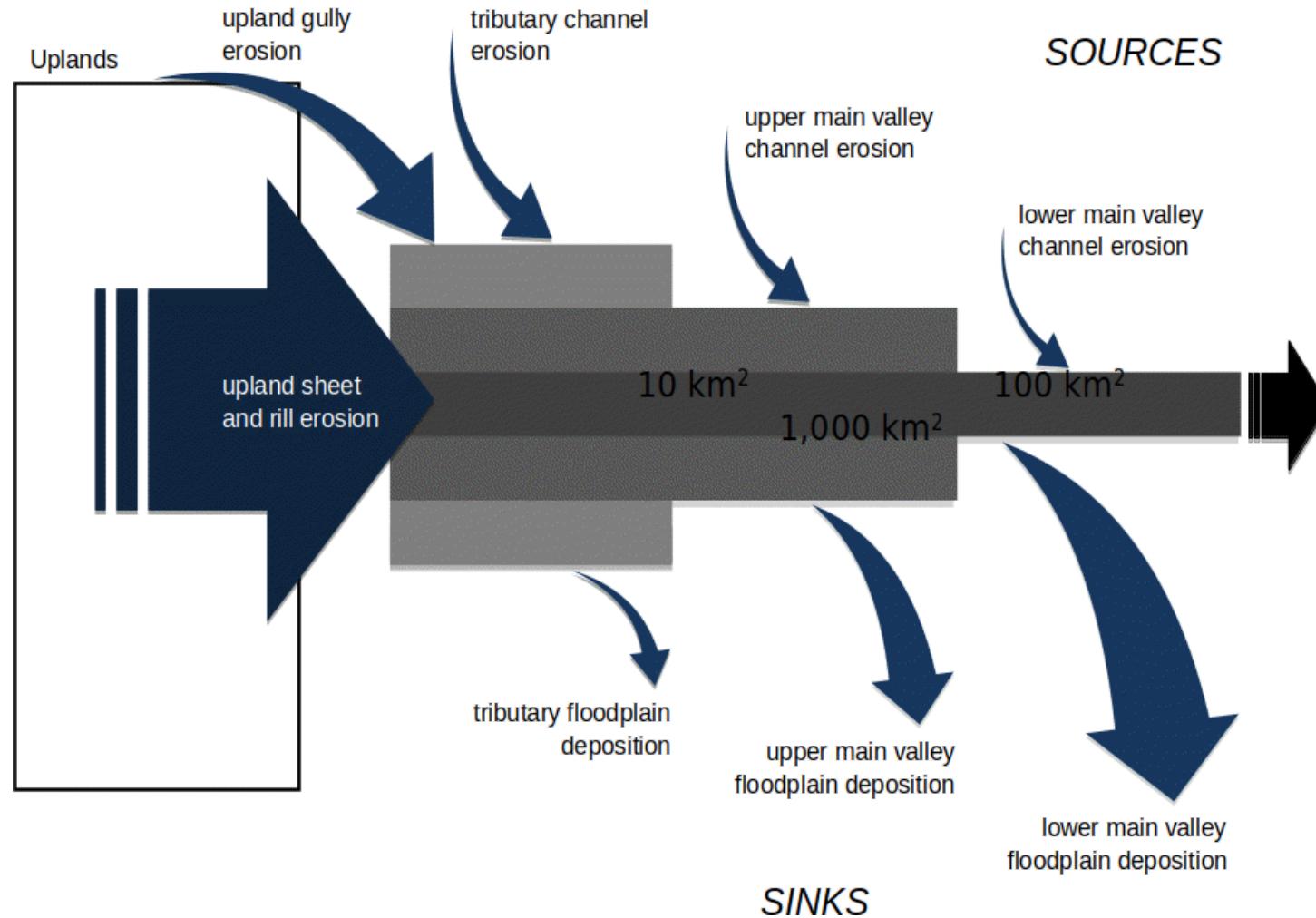
- State of knowledge
- Major themes
- Implications

Consider this presentation an early test drive of a forthcoming publication



# What goes in must ...

The path from source to sink is rarely straightforward



# Types of connectivity

## Structural

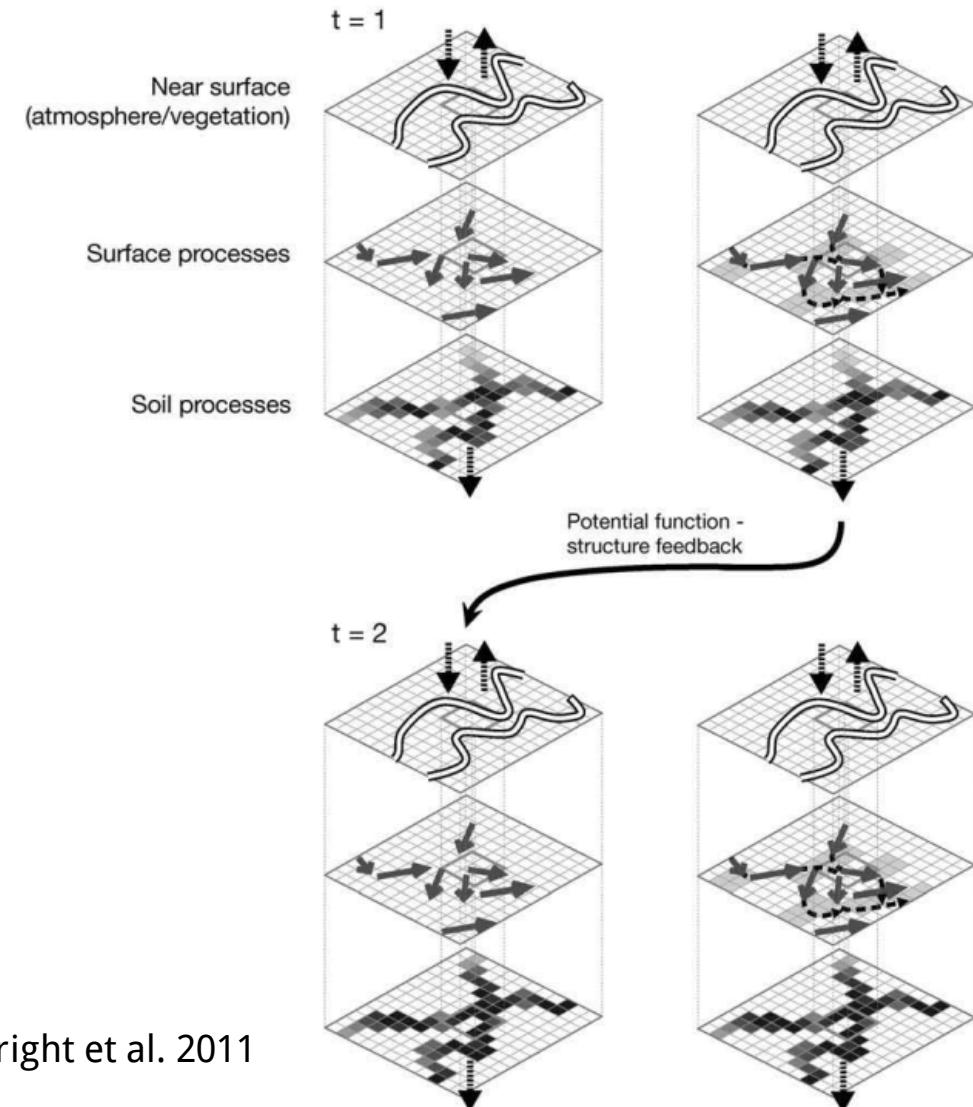
- Configuration of landscape elements
  - Location, size, shape, number

## Functional

- Linkage of landscape elements by a process(es)
  - Flows of energy and materials

## Changes

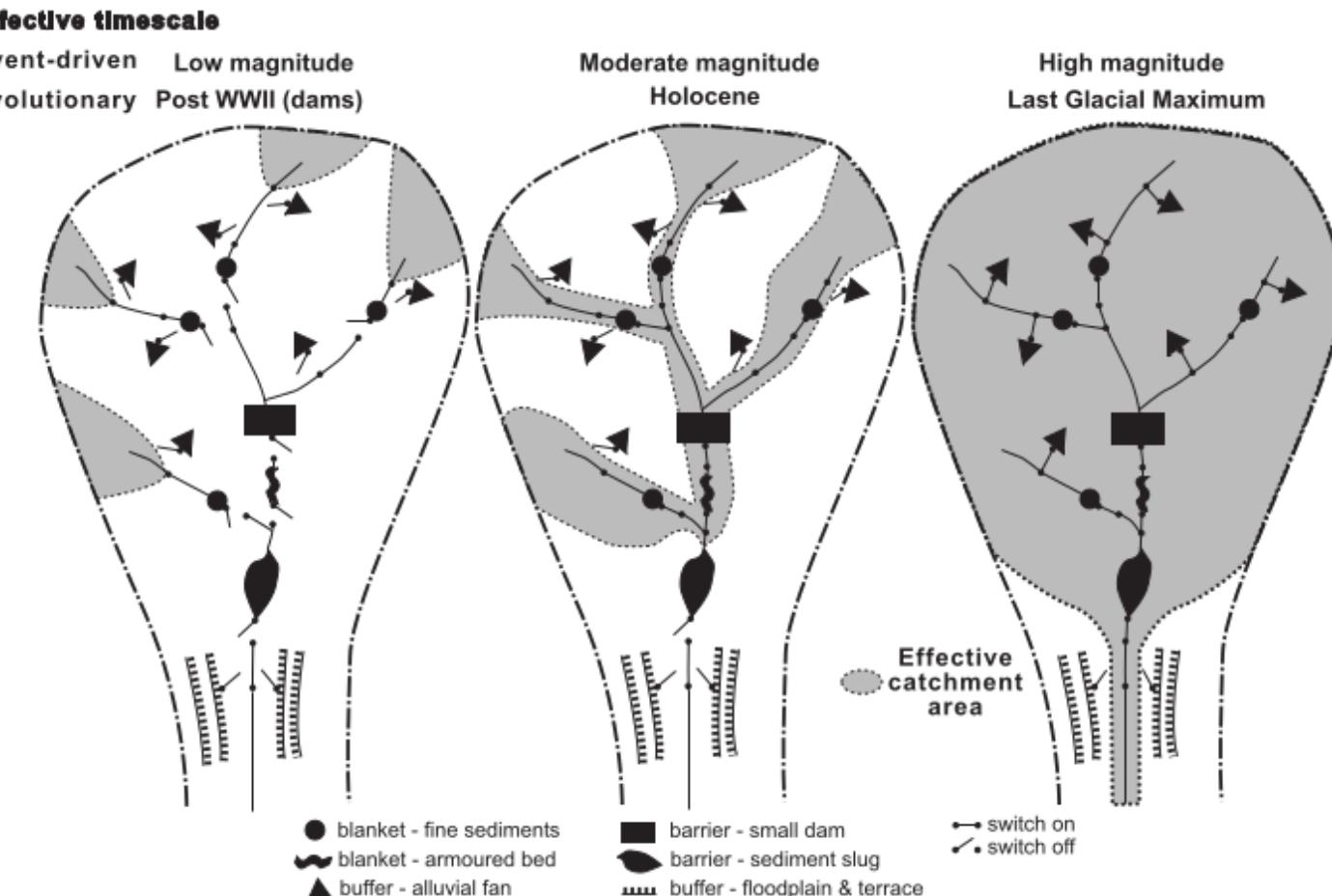
- Alteration of the structure and function over time
  - Function-structure feedback



Wainwright et al. 2011

# Scale

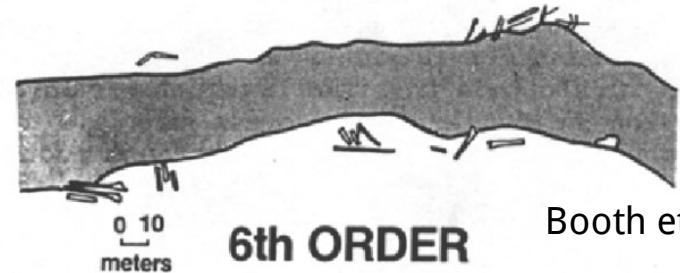
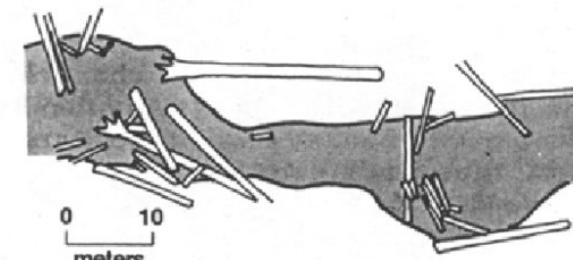
Degree of connectivity depends on the temporal and spatial scale of observation/interest



# Land use change

## Forestry

- Reduced evapotranspiration → Increased connectivity
- Increased LWD → Decreased connectivity
- Increased landslides → ??



Booth et al. 1997

# Land use change

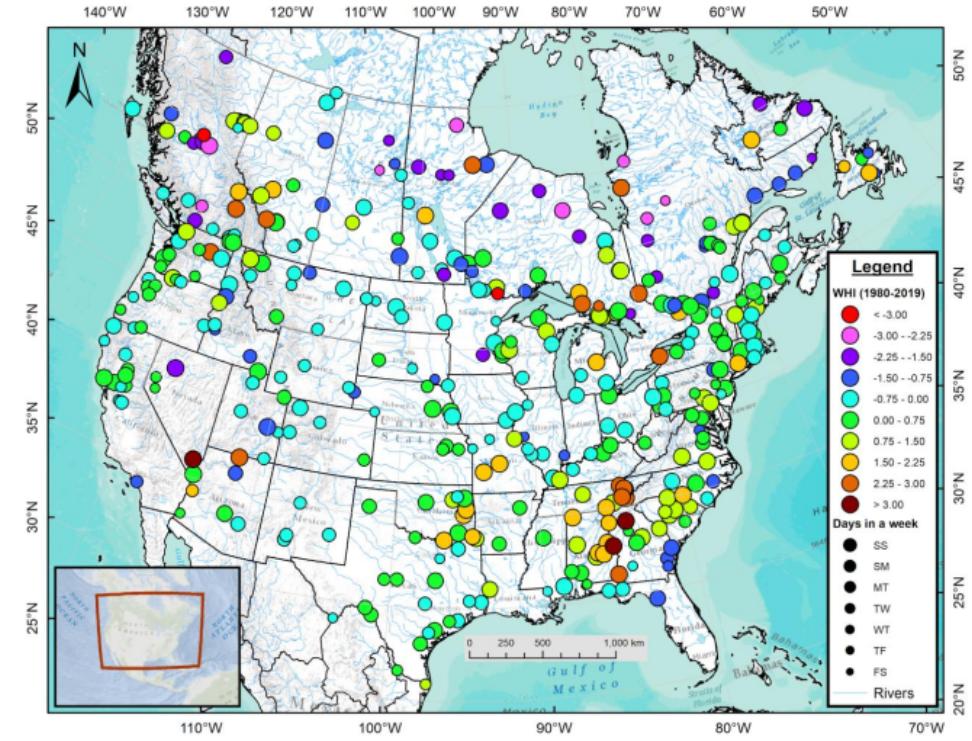
## Agriculture

- Creation of surface and subsurface drains → Increased connectivity
- Drainage of wetlands → Increased connectivity
- Tillage ridges → Decreased connectivity



# River channel changes

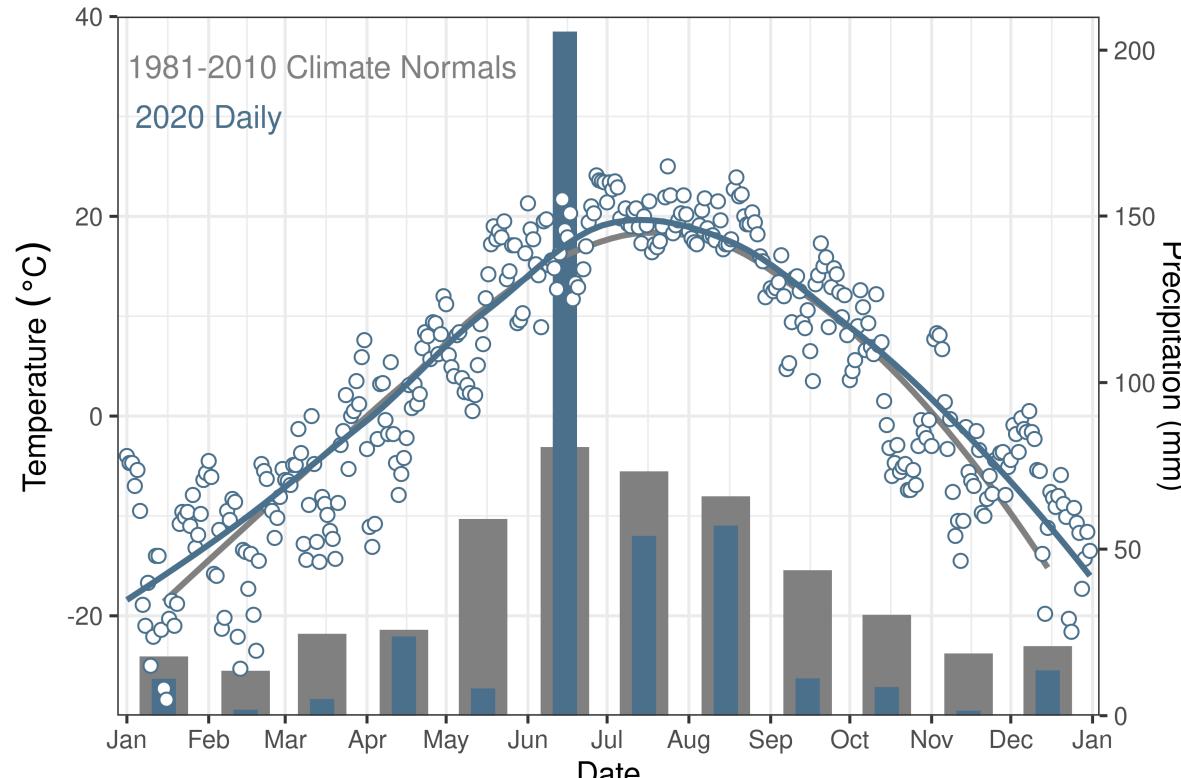
- Dams and reservoirs → Decreased connectivity
- Channelization in urban areas → Increased connectivity
- Culverts → Depends on design and purpose



# Climate change

## Changes in precipitation and temperature

- Change in precipitation types, frequency & intensities (magnitude and duration) → Complicated
- Increased droughts resulting in the loss of the "fill and spill" of potholes → Decreased connectivity



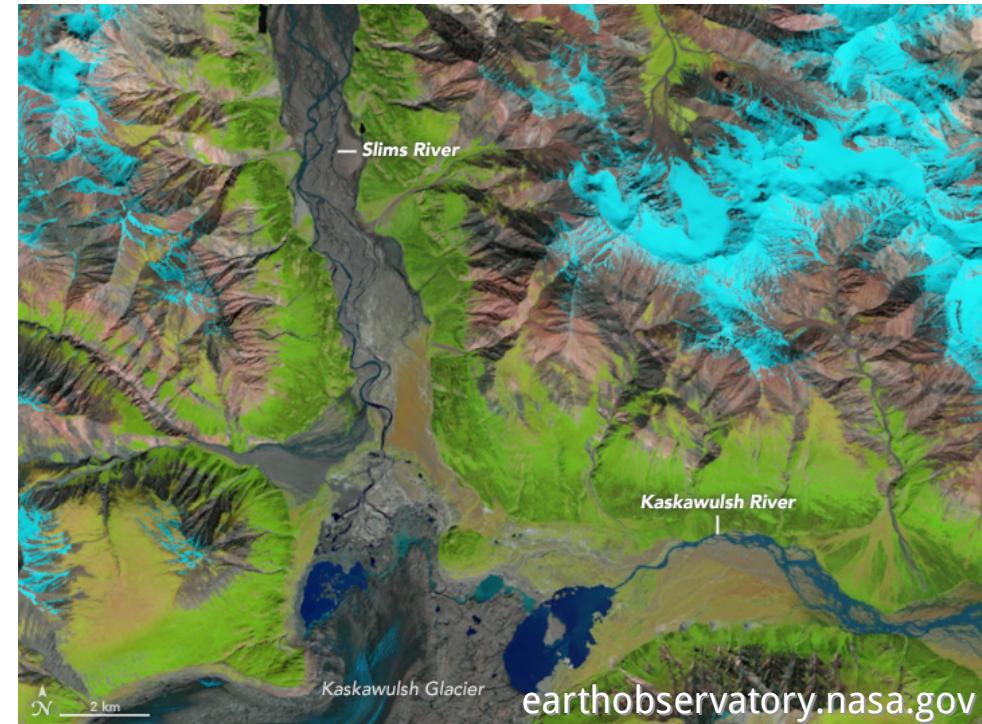
# Climate change

## Wildfire

- Decreases in evapotranspiration and infiltration, and increase in soil hydrophobicity → Changes in the amount and timing of runoff and sediment and chemical fluxes

## Cryosphere

- Receding glaciers → Complicated
  - River piracy → Reconfiguration in connectivity
  - Faster rates of melting → Increased connectivity
  - Smaller/disappearing glaciers → Decreased connectivity
- Permafrost degradation → Shift from overland to subsurface flows



# Regional challenges

## Geography matters

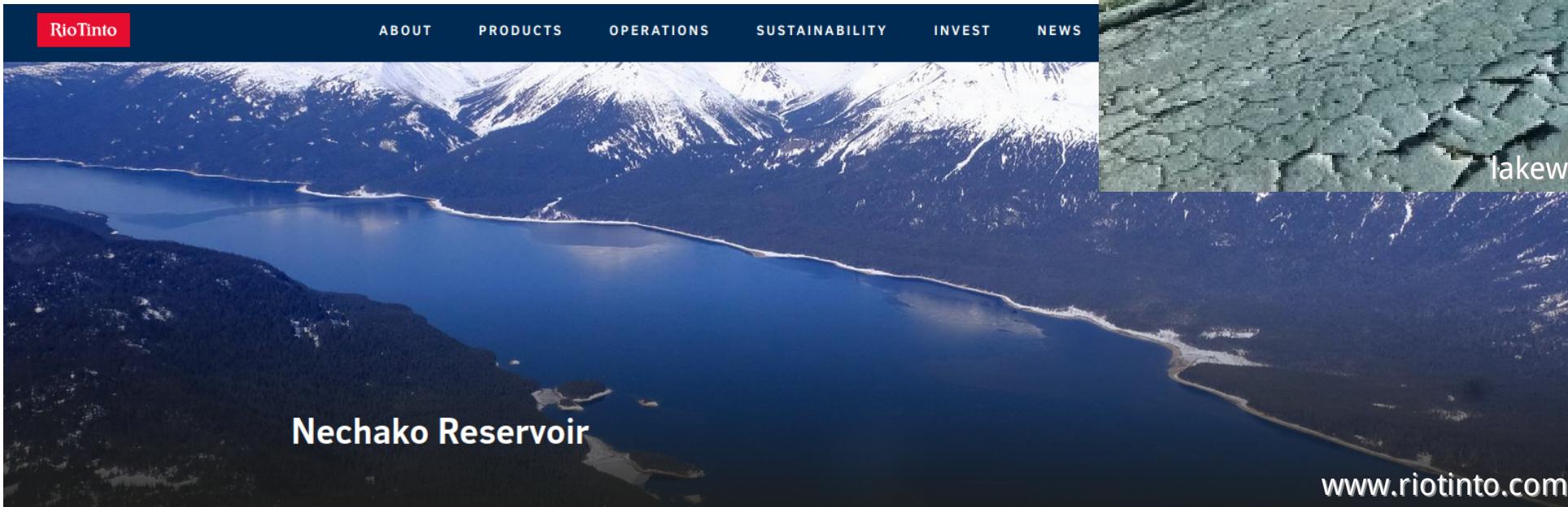
- Urban vs rural
- Forested vs prairies
- North vs south
- Resource development
- Climate change



Map data ©2021 Google, INEGI, TerraMetrics

# Impacts on water resources

- Water security (access, quantity, quality)
- Indigenous traditional territories
- Power production and industrial development
- Aquatic ecosystems



RioTinto

ABOUT PRODUCTS OPERATIONS SUSTAINABILITY INVEST NEWS

Nechako Reservoir

[www.riotinto.com](http://www.riotinto.com)

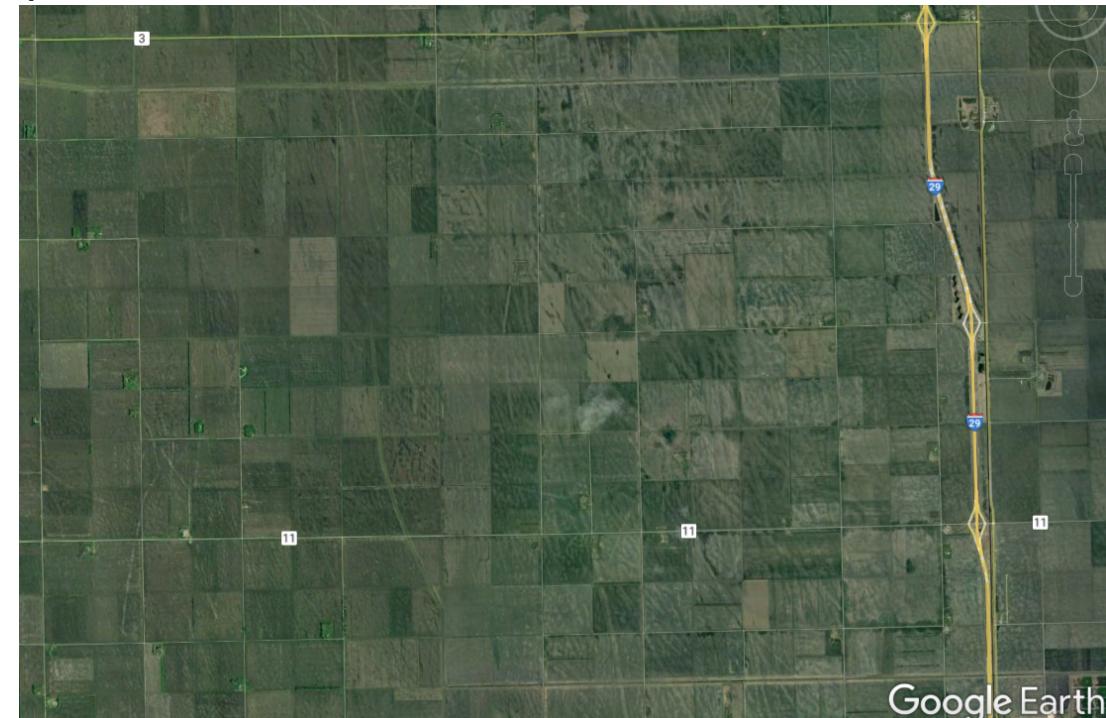
A large aerial photograph showing a deep blue reservoir nestled between towering, snow-covered mountain peaks. The water has a distinct greenish tint. In the foreground, a dark, forested shoreline is visible. A red rectangular button in the top left corner contains the word "RioTinto". Above the main menu, there are six categories: ABOUT, PRODUCTS, OPERATIONS, SUSTAINABILITY, INVEST, and NEWS. At the bottom left, the text "Nechako Reservoir" is overlaid. At the bottom right, the website address "www.riotinto.com" is displayed.

[www.lakewinnipegfoundation.org](http://lakewinnipegfoundation.org)

# Addressing issues of connectivity

## Mitigation

- Limit fragmentation of landscapes and watersheds (roads, pipelines)
- Limit the number of dams and structures and/or better design
- Land management (cover cropping, riparian buffers)
- Multiple stressors → cumulative impacts



# Addressing issues of connectivity

Need to consider measures that are relevant to the specific landscape/region

- Sometimes **increasing** connectivity is a good thing
- Sometimes **decreasing** connectivity is a good thing
- Sometimes increasing connectivity in some areas **and** decreasing it in others is a good thing
- Sometimes changing connectivity is both a **good and bad** thing



# Thank You

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Thank You!