



# Indices of Aquatic Ecosystem Health in the Beaver River Watershed



*Charette  
Pell  
Poscente*

# Challenge

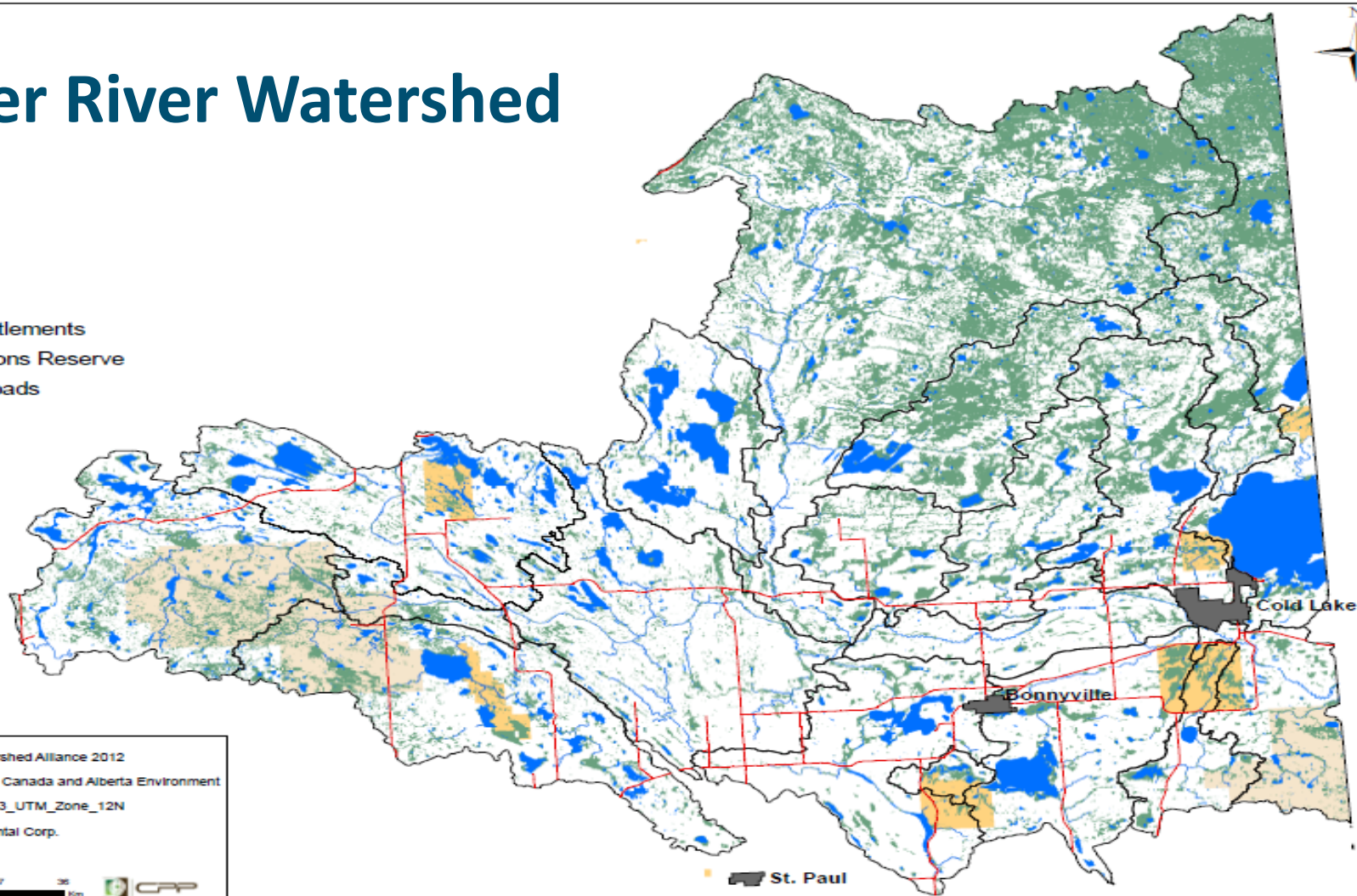
- Obtain a better understanding of what makes aquatic ecosystems in the Beaver River Watershed “tick”
- Develop indicators of aquatic ecosystem health that are repeatable over time and can be used for long-term reporting.
- Inform the upcoming Watershed Management Plan in a meaningful way.



# Beaver River Watershed

## Legend

- Lakes
- Wetlands
- Metis Settlements
- First Nations Reserve
- Paved Roads
- Streams



Copyright: Beaver River Watershed Alliance 2012  
Data Source: Ducks Unlimited Canada and Alberta Environment  
Coordinate System: NAD\_1983\_UTM\_Zone\_12N  
Prepared By: CPP Environmental Corp.  
Prepared On: April 2012

0 4.5 9 18 27 36 Km



# A History of AEH Science in the past 15 years...

- 2003: ALMS Lakewatch – LICA partnership for lake sampling (ALMS)
- 2004: Multiple lake riparian assessments (G. Walker)
- 2006: A water management plan, state of the watershed reports (ESRD)
- 2008: Extensive lake waterbird study (ESRD)
- 2008: Paleolimnological study (ESRD, McGill U, UWaterloo)
- 2011: Extensive river fish survey (ACA)
- 2011: Plan for Healthy Aquatic Systems (CPP Environmental)
- 2013: Lake water quality study (CPP Environmental)
- 2013: River winter oxygen study (CPP Environmental)
- 2014: Aquatic Ecosystem Health Indices project (CPP Environmental)

# Methods

## Drafted Drivers and Indicators of Ecosystem Health

### Ecosystem Drivers:

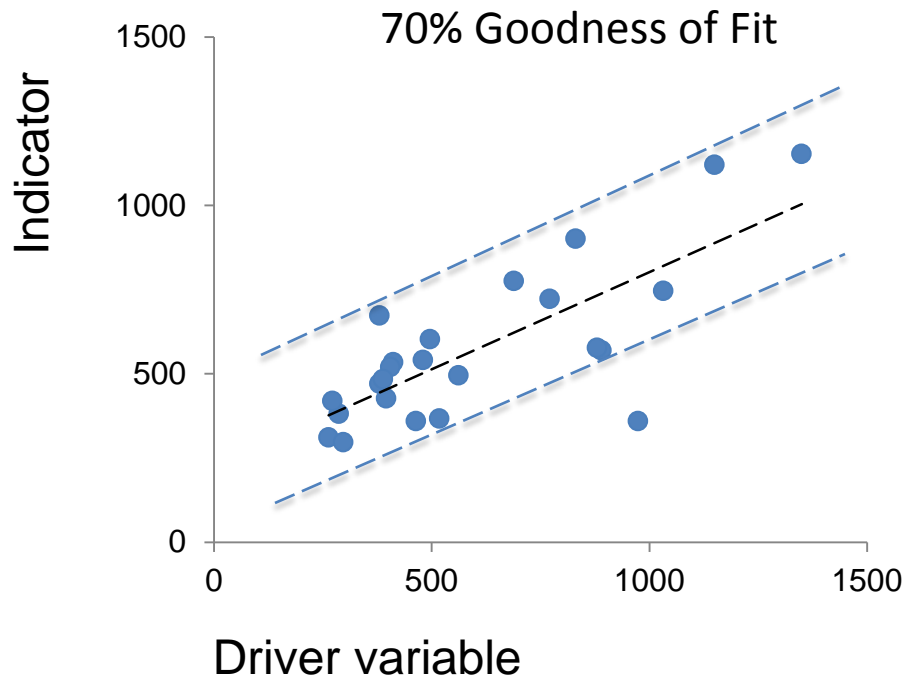
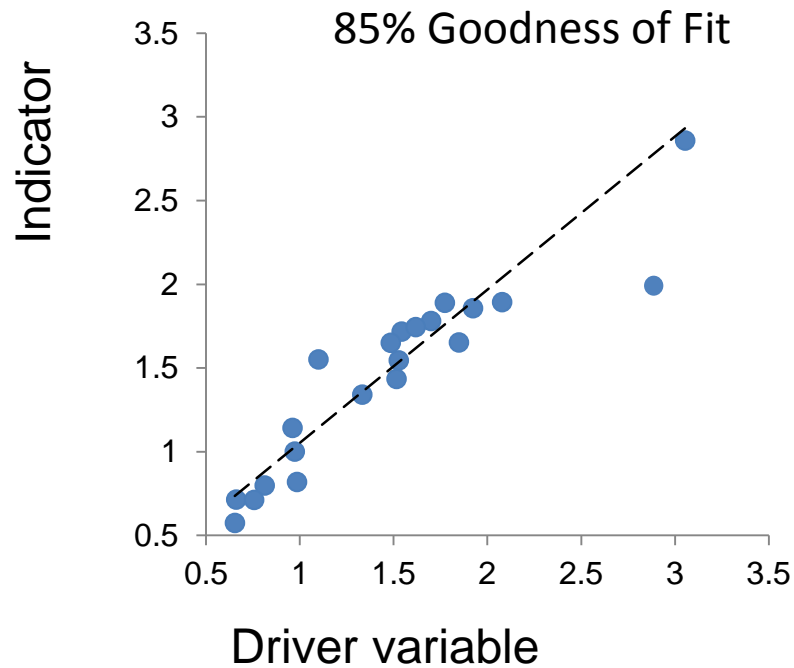
- Human footprint in watershed
- Change in human footprint
- Forest in 500 m water body buffer
- Water body surface area
- Water body depth
- Water body type



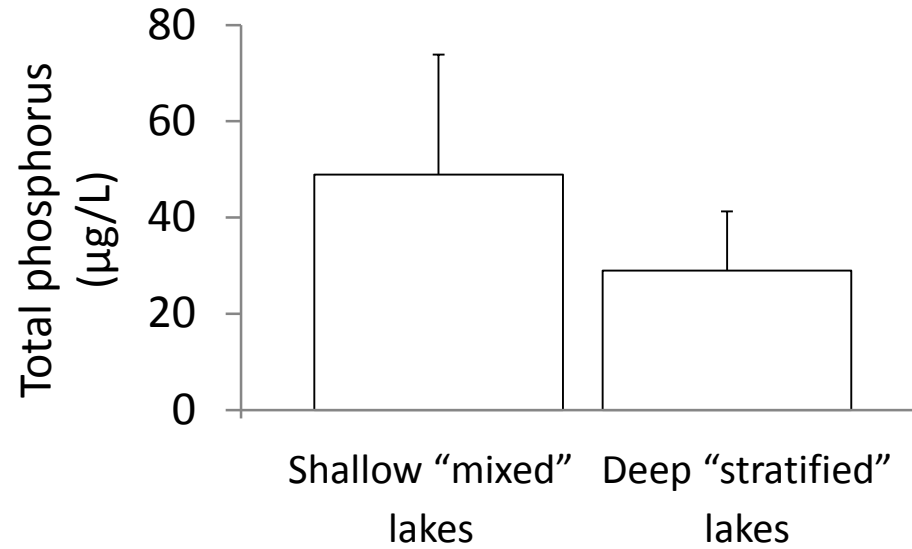
### Indicators:

- Common Loon
- Great Blue Heron
- Western Grebe
- Lake nutrients
- Lake salinity
- River/stream oxygen
- River/stream fish community
- Wetland nutrients

# Model fit



## Methods: Shallow vs deep lakes



# Methods

Created aquatic ecosystem landscape models:

1. Delineated watersheds for 60 lakes.
2. Used ABMI land cover layer to derive drivers.
3. Created a database, including lake surface area, maximum depth, watershed area, total disturbances in the watershed.
4. Computer programming to create interactive models.





# Results - Waterbirds

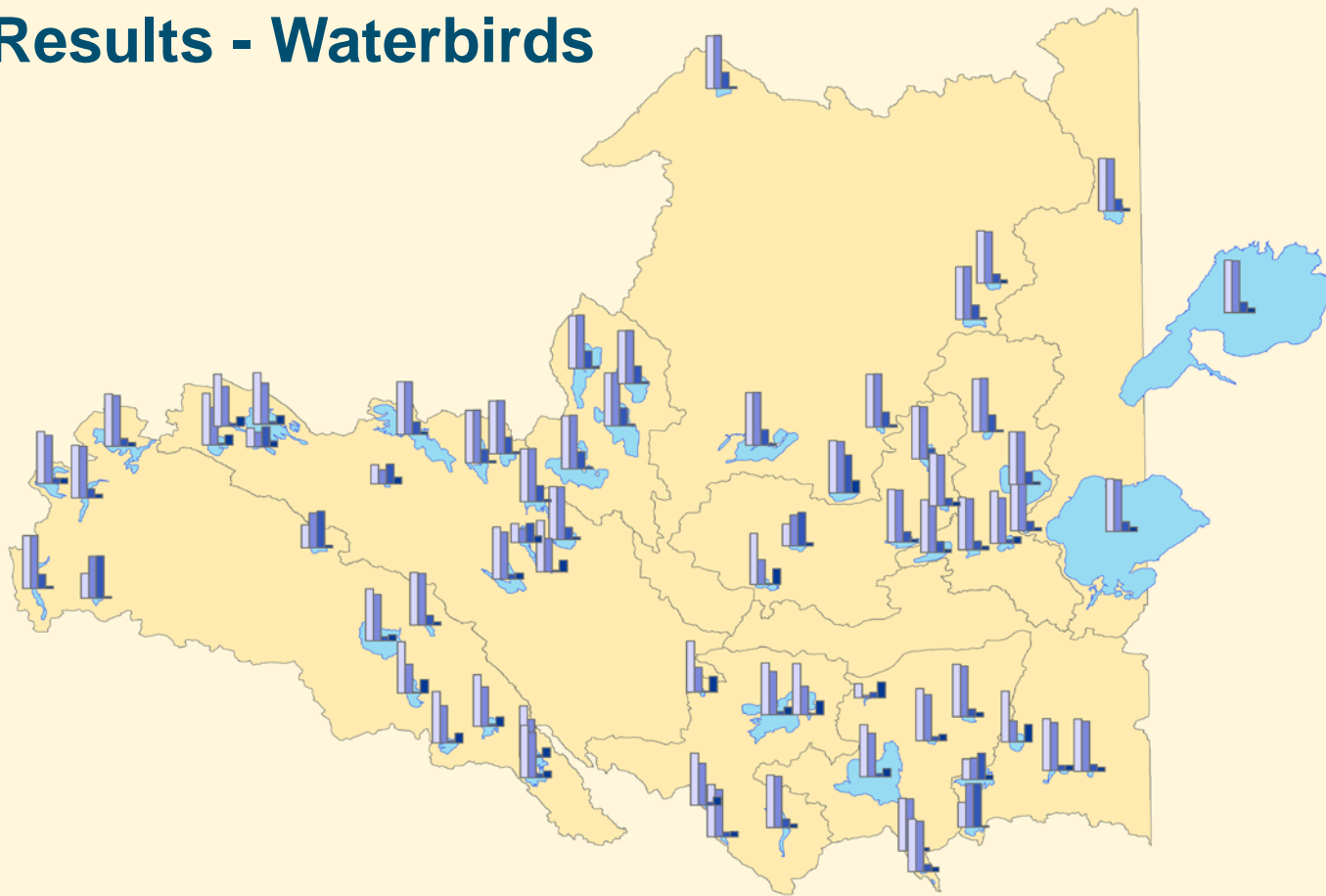


Figure 2:  
Modelled waterbird occurrence  
in Beaver River Watershed lakes.

Probability  
of Occurrence

96.4

Waterbirds

Common Loon  
Great Blue Heron  
Common Merganser  
Western Grebe

Lakes

Subwatershed

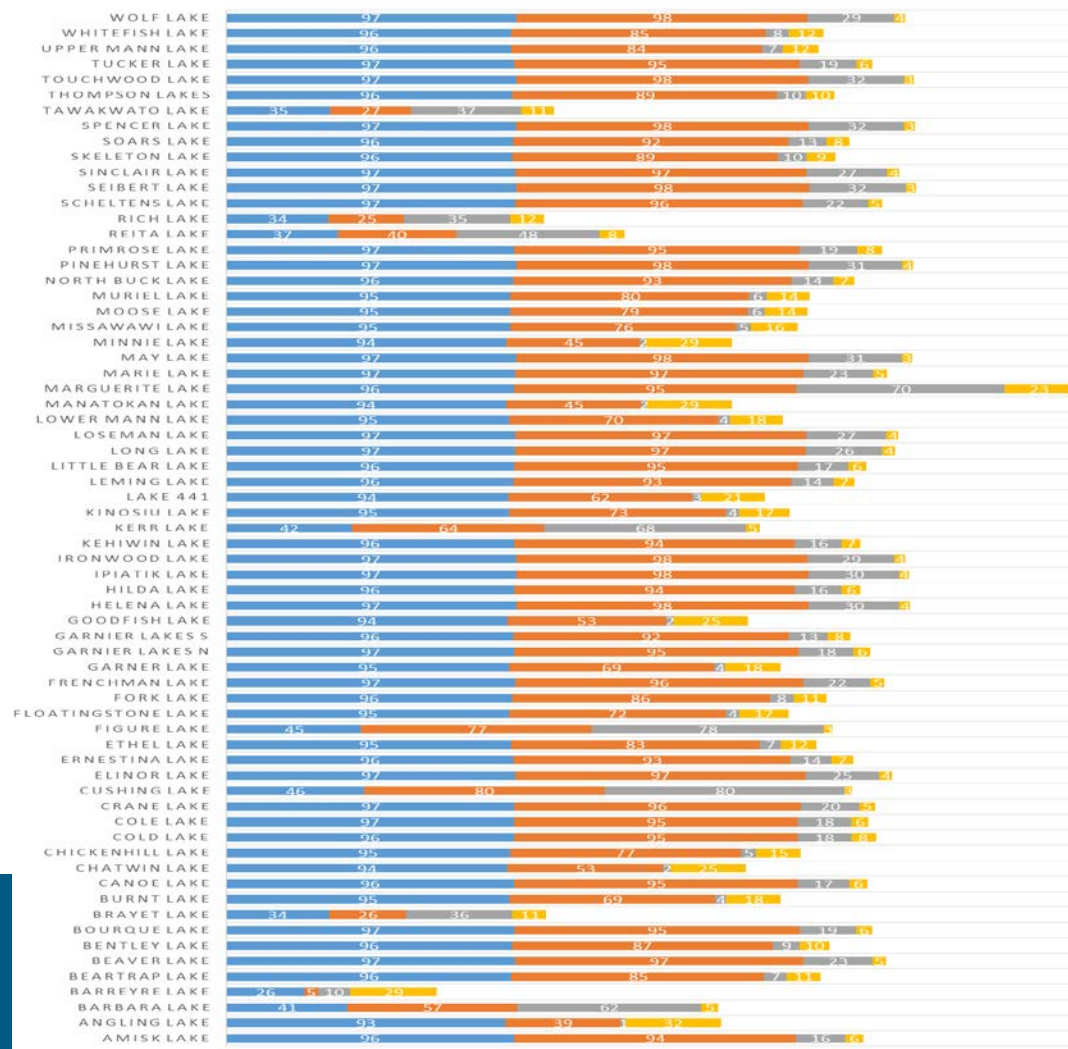
Source: ABMI, ESRO, BRWA, CPP Environmental

0 10 20 40  
km

Coordinates system:  
NAD 1983 UTM Zone 12N  
Date:  
March 23, 2015

Prepared by:

**CPP**  
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# Results: Conductivity

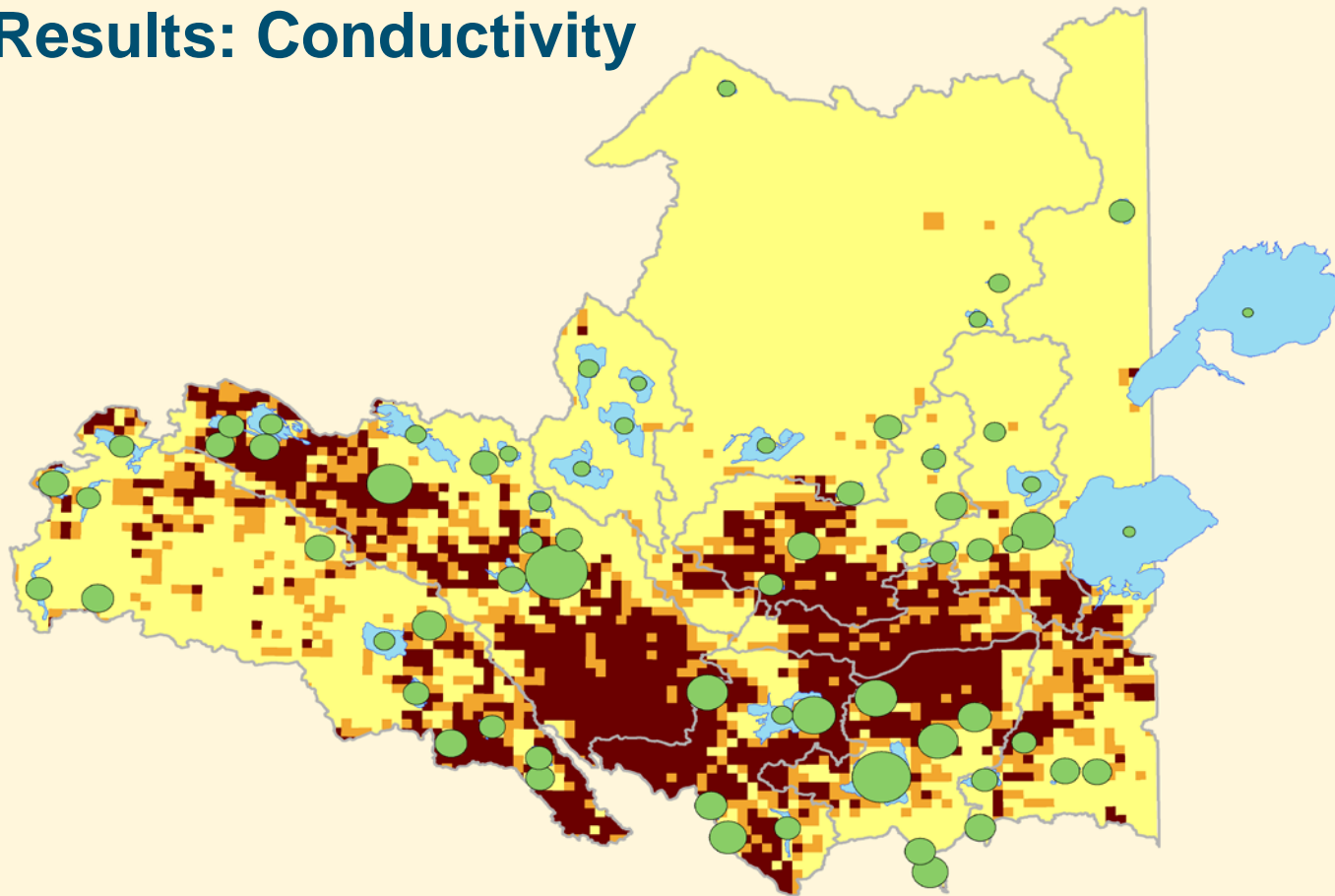
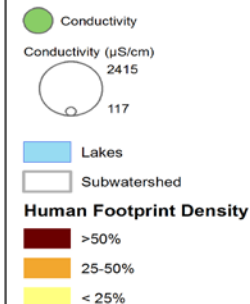


Figure 4:  
Modelled conductivity  
in Beaver River Watershed lakes.



Note: Conductivity displayed for Muriel Lake  
is measured, not modelled.

Source: ABMI, AESRD, BRWA, CPP Environmental

0 10 20 40 km

Coordinates system:  
NAD 1983 UTM Zone 12N

Date:  
March 23, 2015

Prepared by:

**CPP**  
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# Results – Total Nitrogen

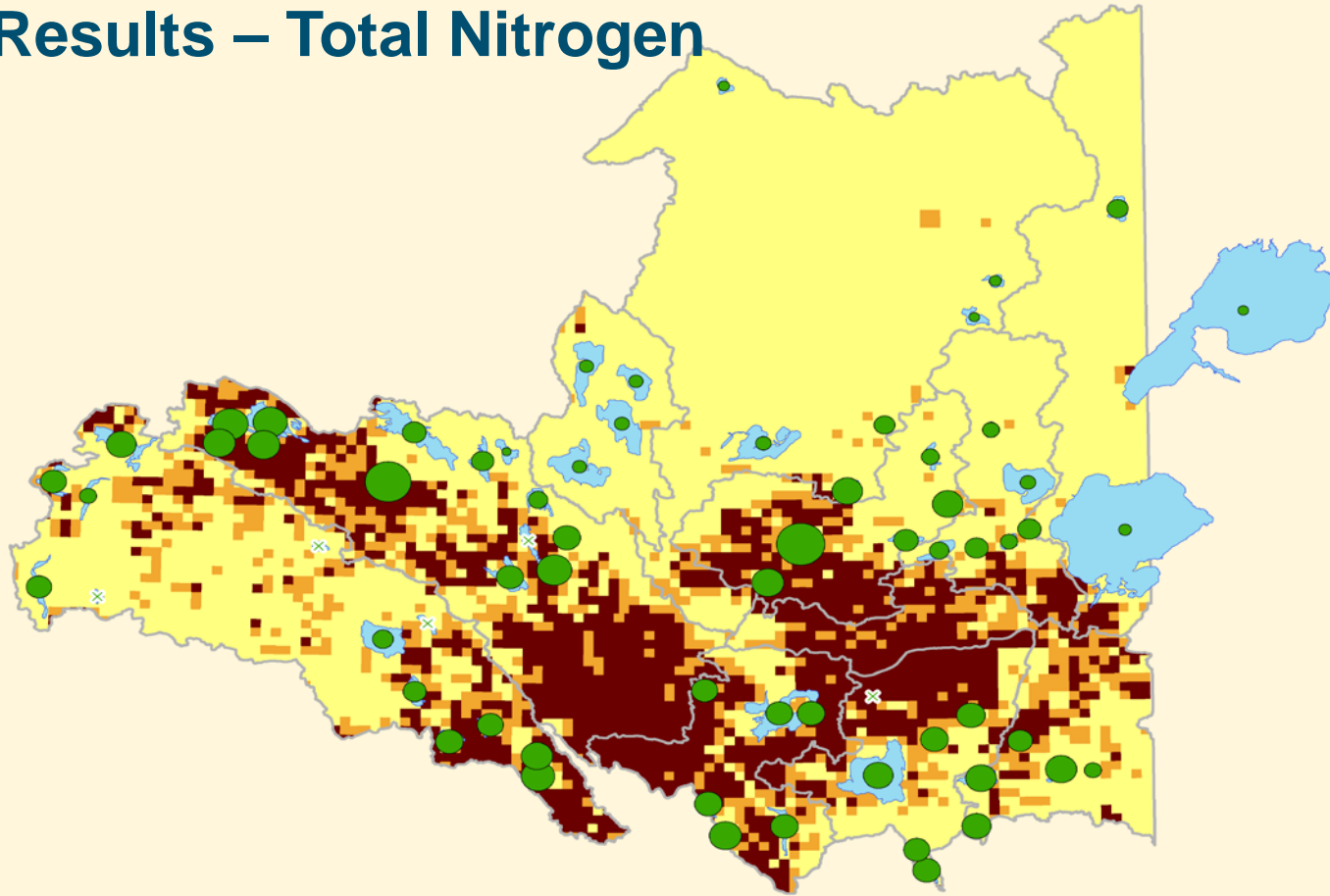
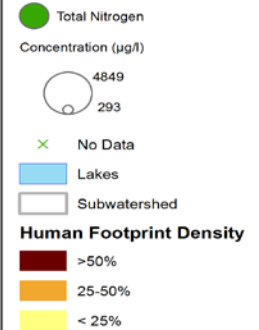


Figure 3:  
Modelled total nitrogen  
concentration in Beaver River  
Watershed lakes.



Source: ABMI, AESRD, BRWA, CPP Environmental

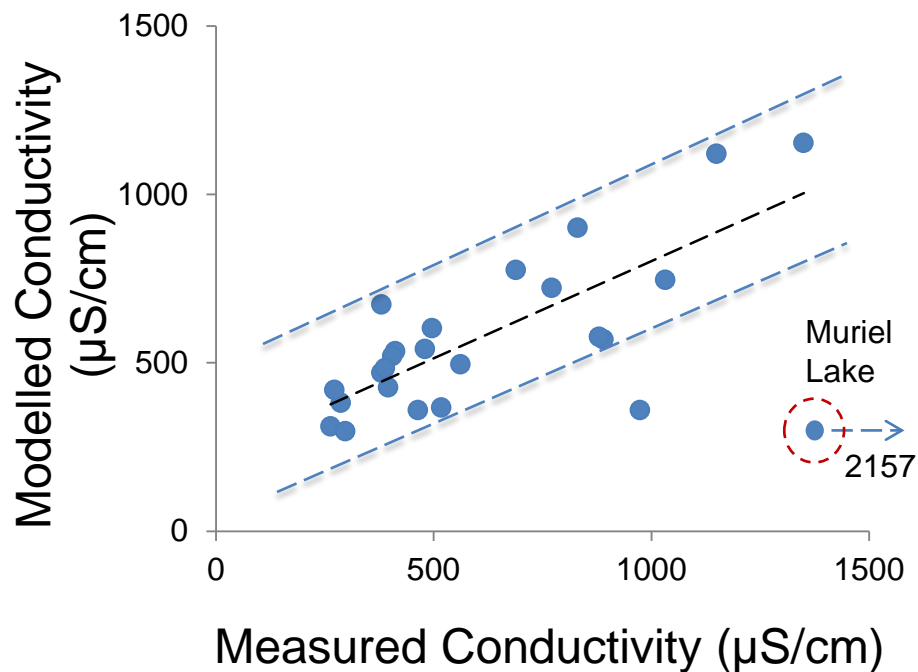
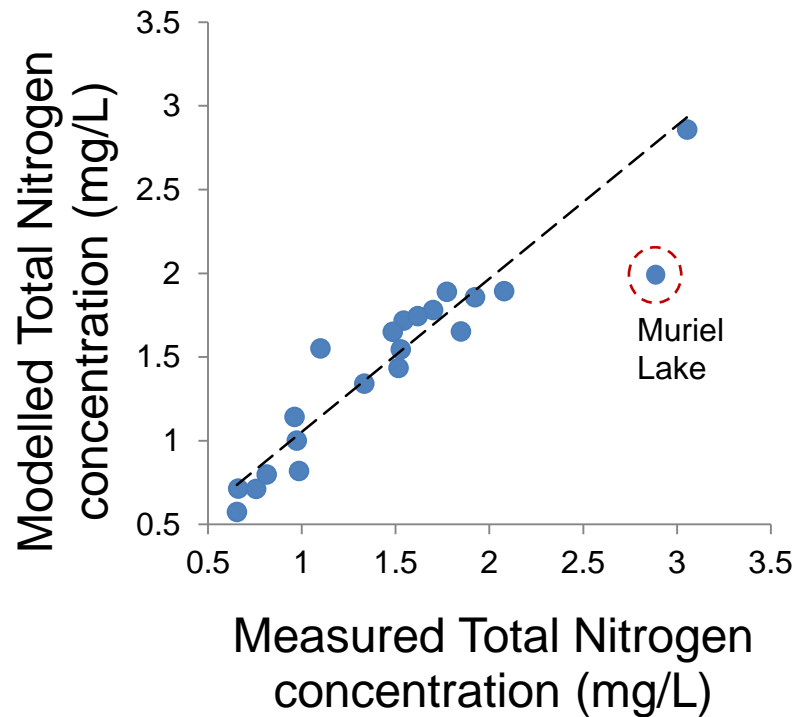
0 10 20 40  
km

Coordinates system:  
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Date:  
March 23, 2015

Prepared by:

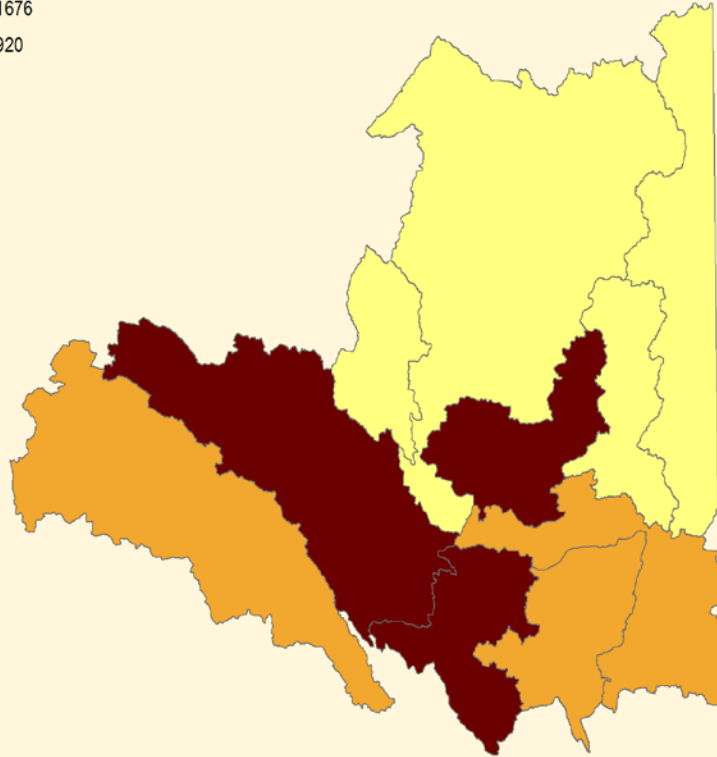
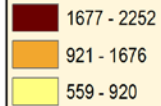
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# Results – Model fit

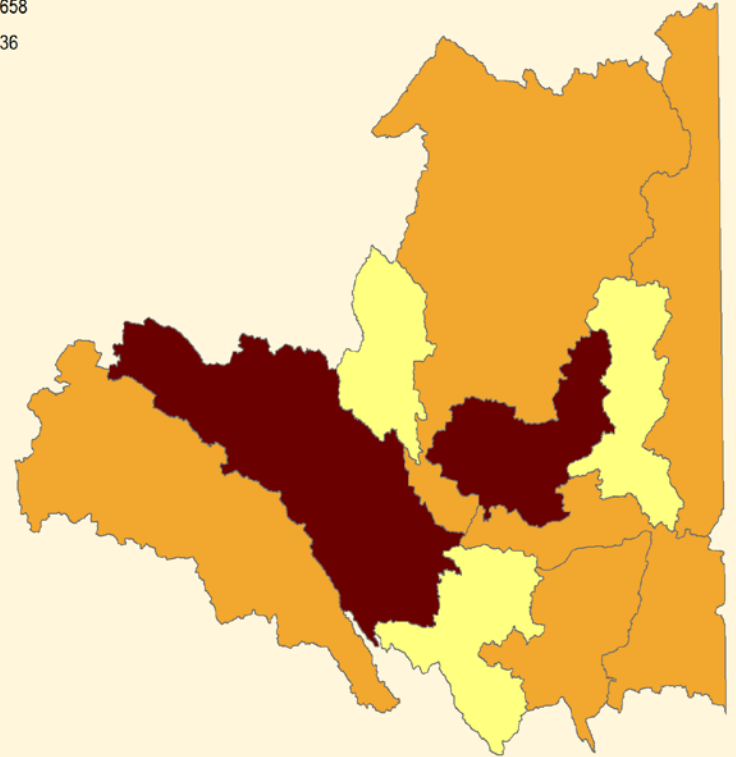
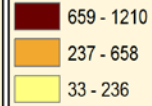


# Results – Total Nitrogen Variability

Total Nitrogen ( $\mu\text{g/l}$ ) - Mean Value

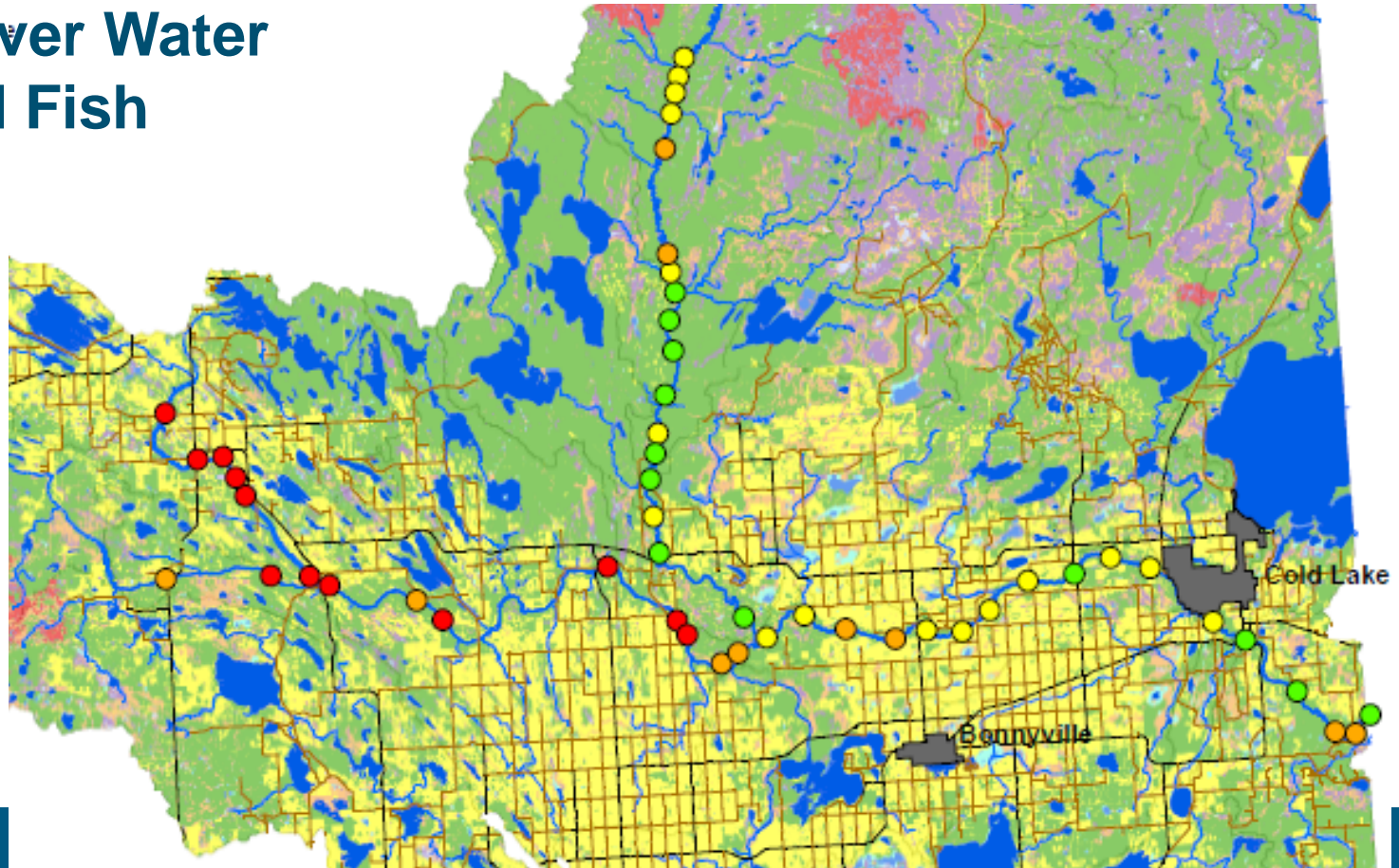


Total Nitrogen ( $\mu\text{g/l}$ ) - Standard Deviation

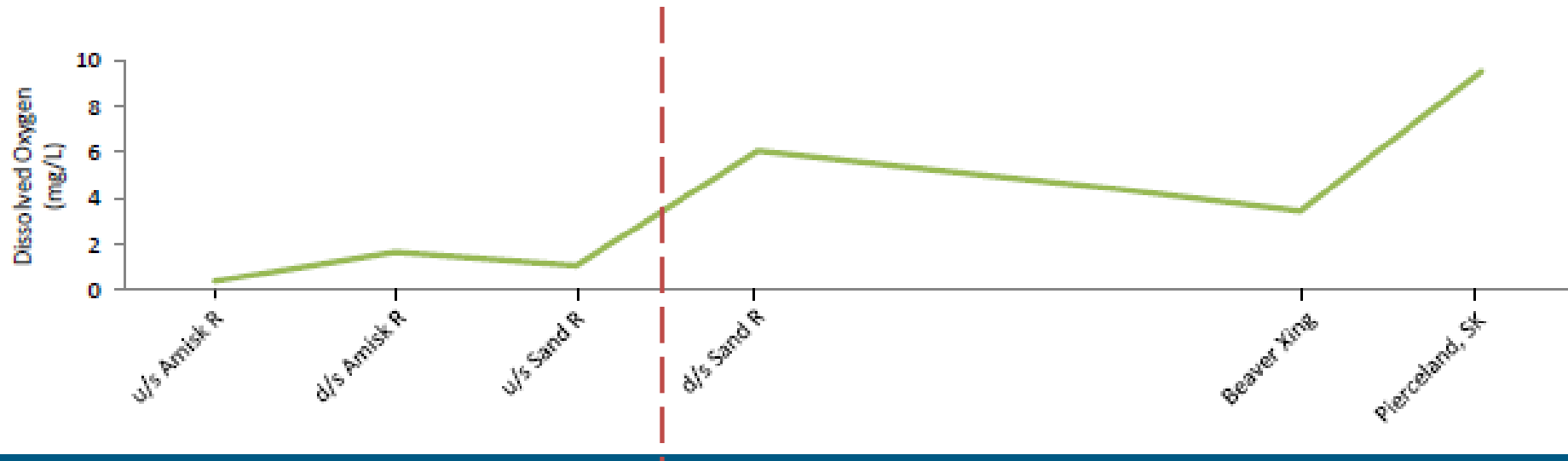




# Results: River Water Quality and Fish



# Results: Winter oxygen





# Results: River Water Quality and Fish

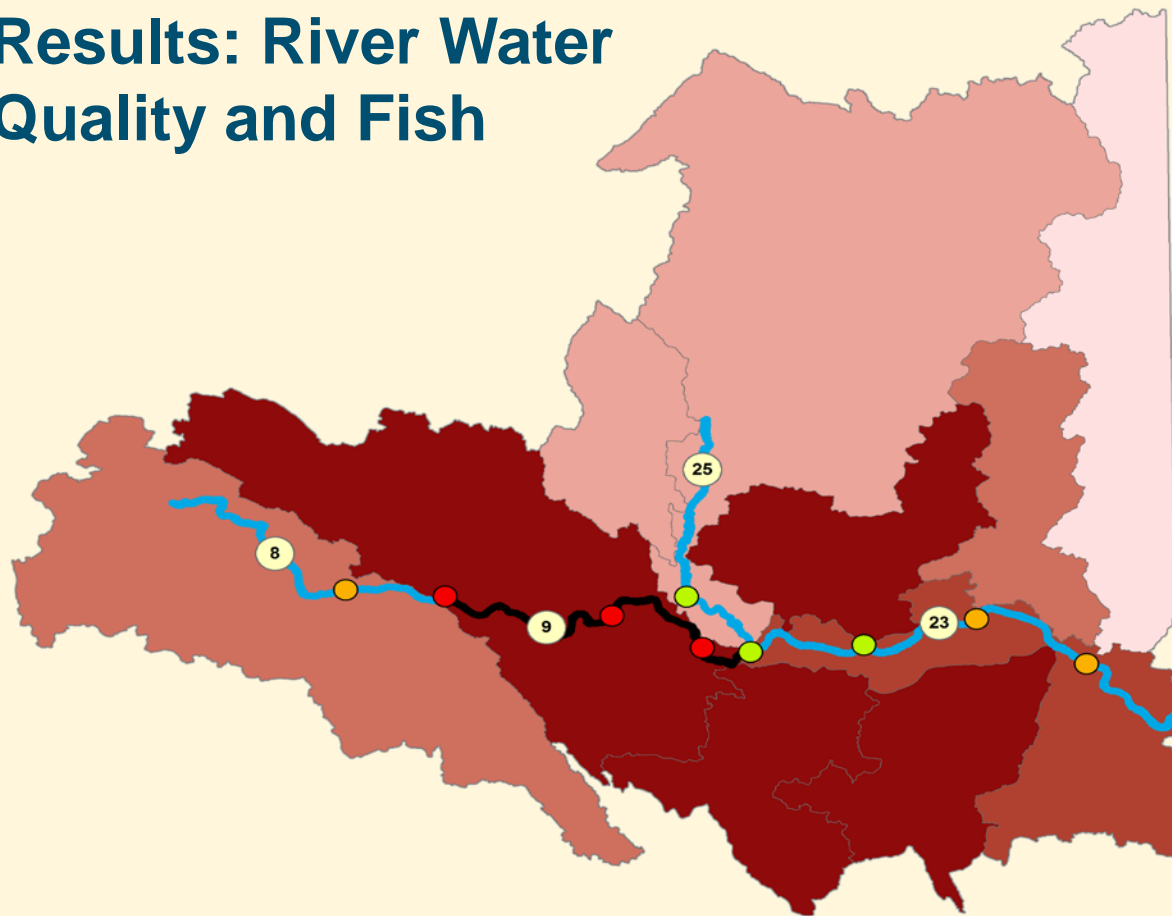
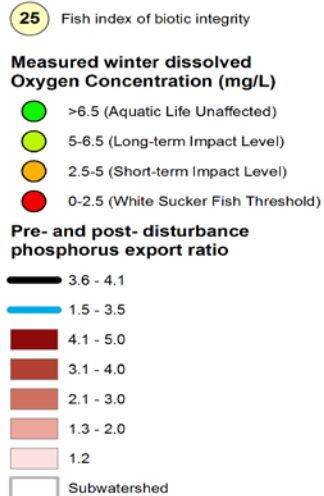


Figure 8:  
Stream water quality  
and fish community suitability  
in the Beaver River Watershed.



Source: ABMI, AESRD, BRWA, CPP Environmental

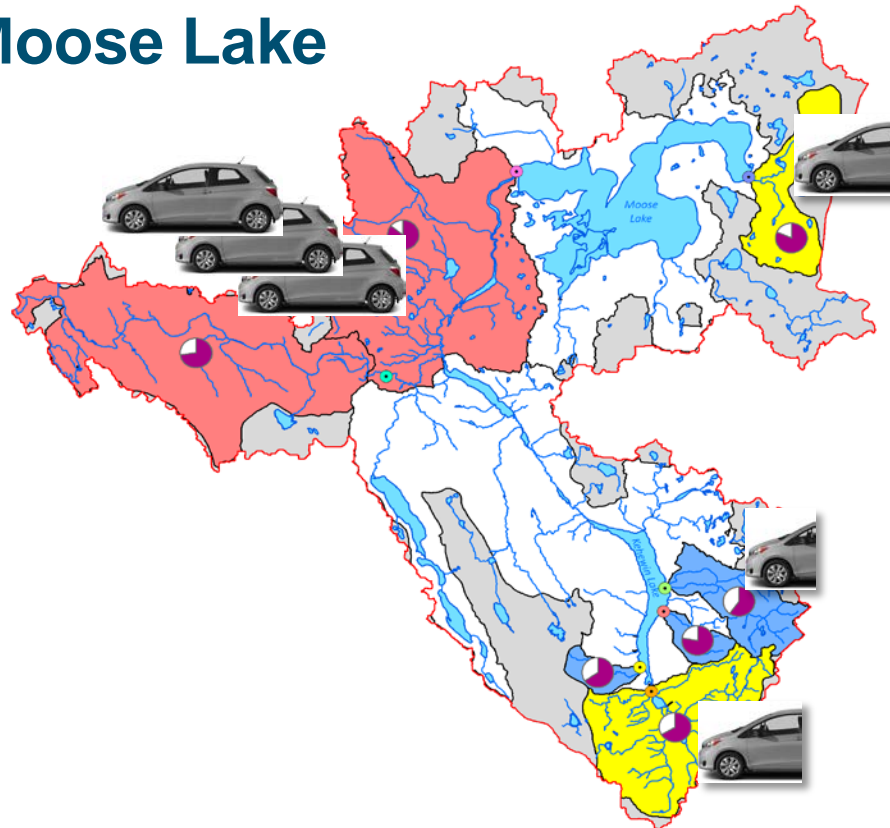
0 10 20 40 km

Coordinates system:  
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Date:  
March 13, 2015

Prepared by:

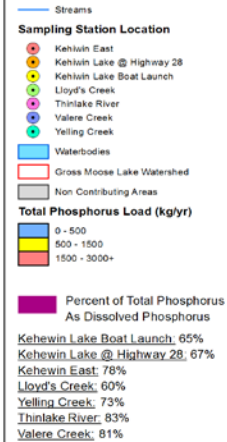
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# Results: Moose Lake



## Moose Lake Watershed: Nutrient Export Study

Total Phosphorus Loading in  
Sampled Sub-Watersheds



Source: Aftis



Coordinates system:  
NAD 1983 UTM Zone 12N

Date:  
April 8, 2015

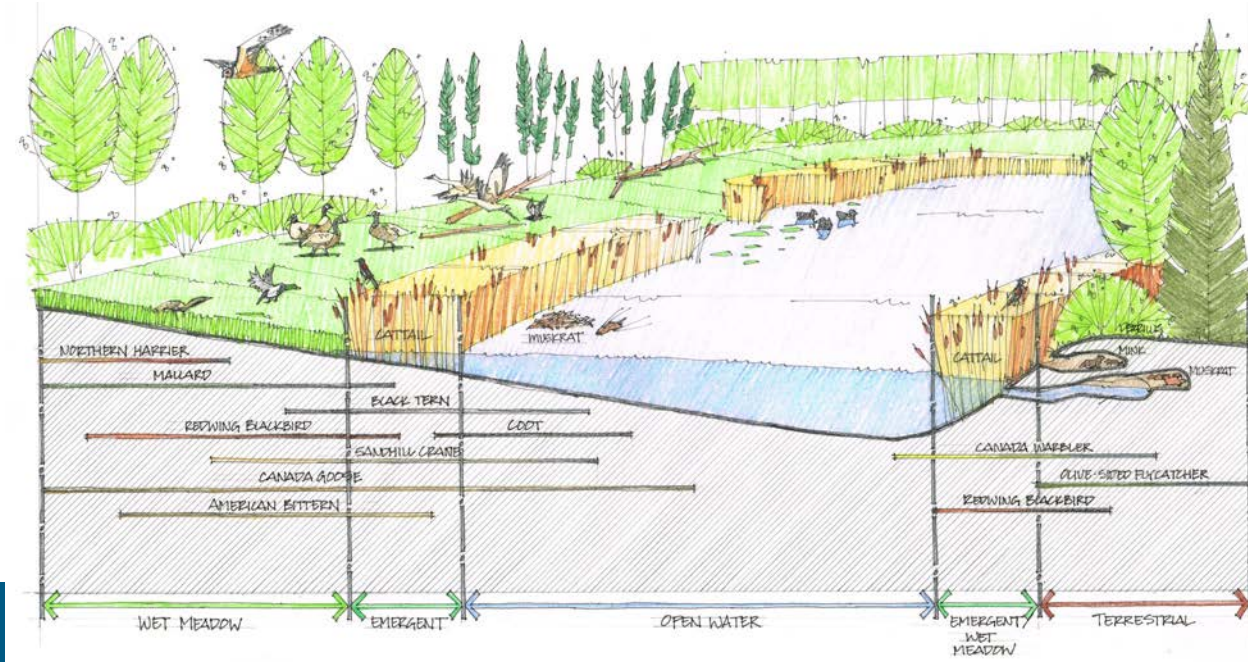
Prepared by:  
**CPP**  
ENVIRONMENTAL

## Outcomes...

- The state of the Sand River sub-watershed is critical to the health of the Beaver River
- Areas in the watershed that require attention have been identified.
- Lake water quality should be managed according to lake physical properties (deep vs shallow) and watershed land use change, not by sub-watershed
- Muriel Lake requires further study: it can't be managed in the same way as other lakes

# Outcomes...

- Buffers around lakes and wetlands are very important for water quality and wildlife in the Beaver River watershed.



# Acknowledgements

- **Beaver River Watershed Alliance**
- **Lakeland Industry and Community Association**
- **Jordan Walker**
- **Harry Keys**

# Questions?

