Algal Monitoring on the Red River of the North
Assessing the Effects of Eutrophication

Julie Blackburn, Tony Miller and Bruce Wilson (RESPEC)

RESPEC

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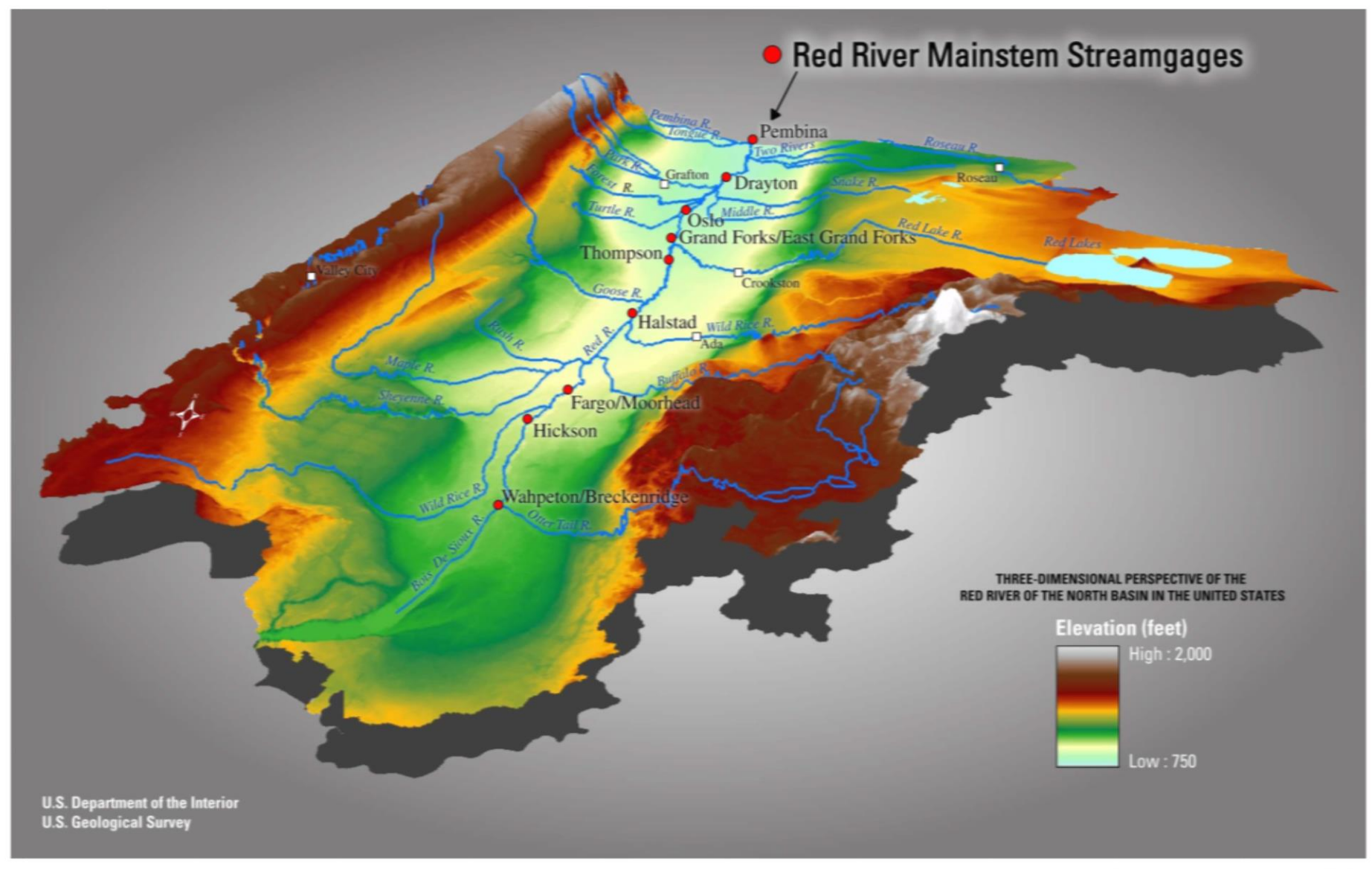# Acknowledgements

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RED RIVER CONUNDRUM

Typical river - growing season nutrient-algal responses (phosphorus/chlorophyll-a, diel DO, CBOD5
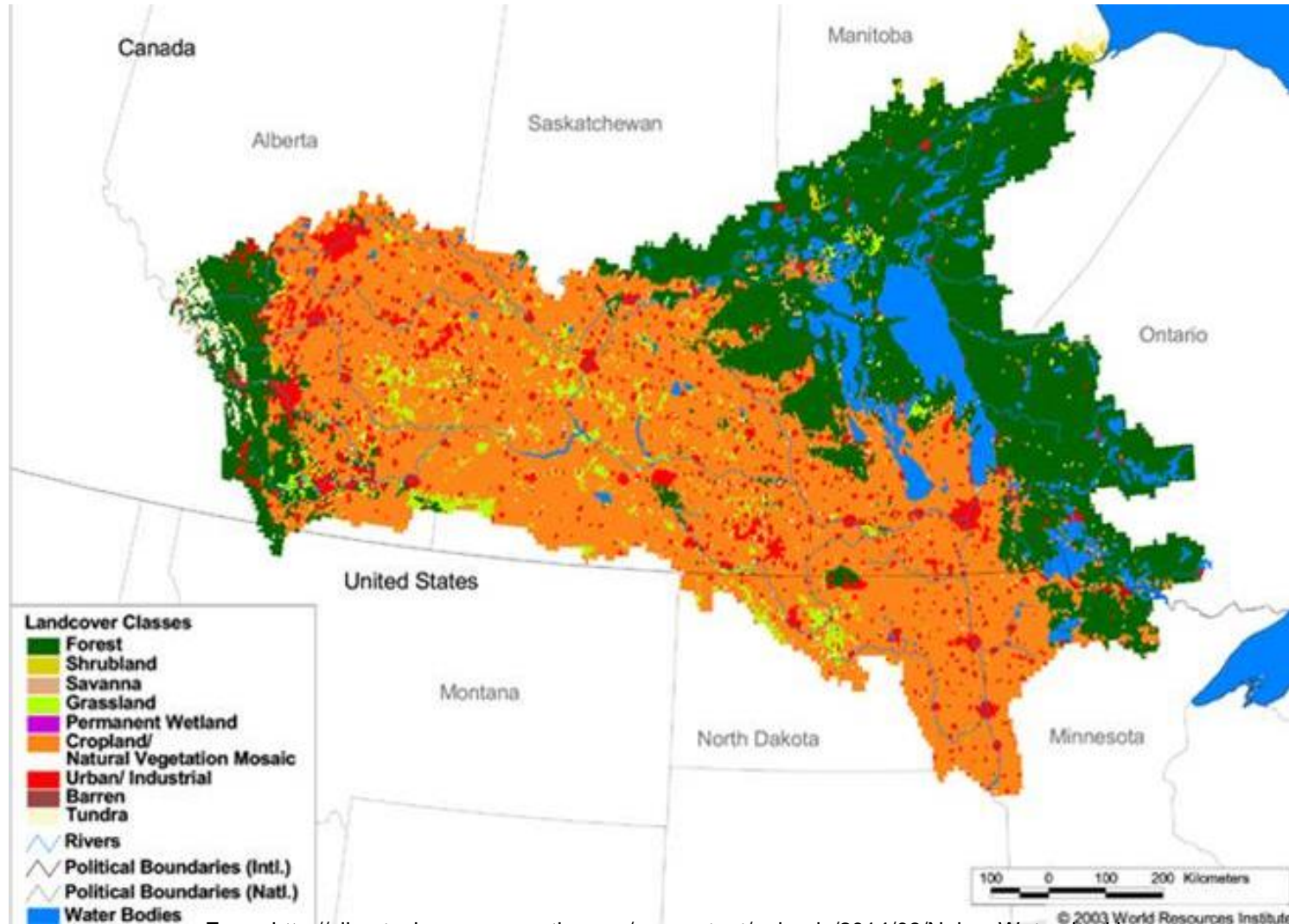
…not noted

Suspect: turbidity/light limitation

Red River Elevation Shifts

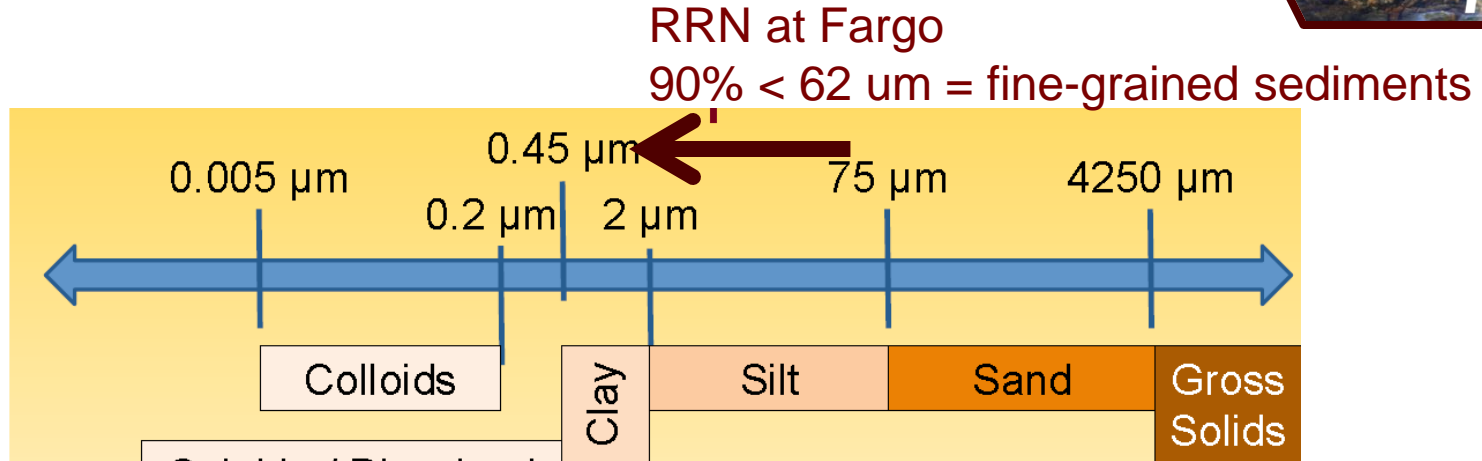# LAND COVER

From: http://climatechangeconnection.org/wp-content/uploads/2014/08/NelsonWatershed.jpg

RED RIVER PARTICLE SIZES AND SEDIMENTATION

RRN at Fargo
90% < 62 um = fine-grained sediments

0.45 μm

0.005 μm   75 μm   4250 μm

0.2 μm   2 μm

| Colloids | Clay | Silt | Sand | Gross Solids |

- Red River has very small particle sizes (< silts & clays)
- Sedimentation of clays can take days with no flow.
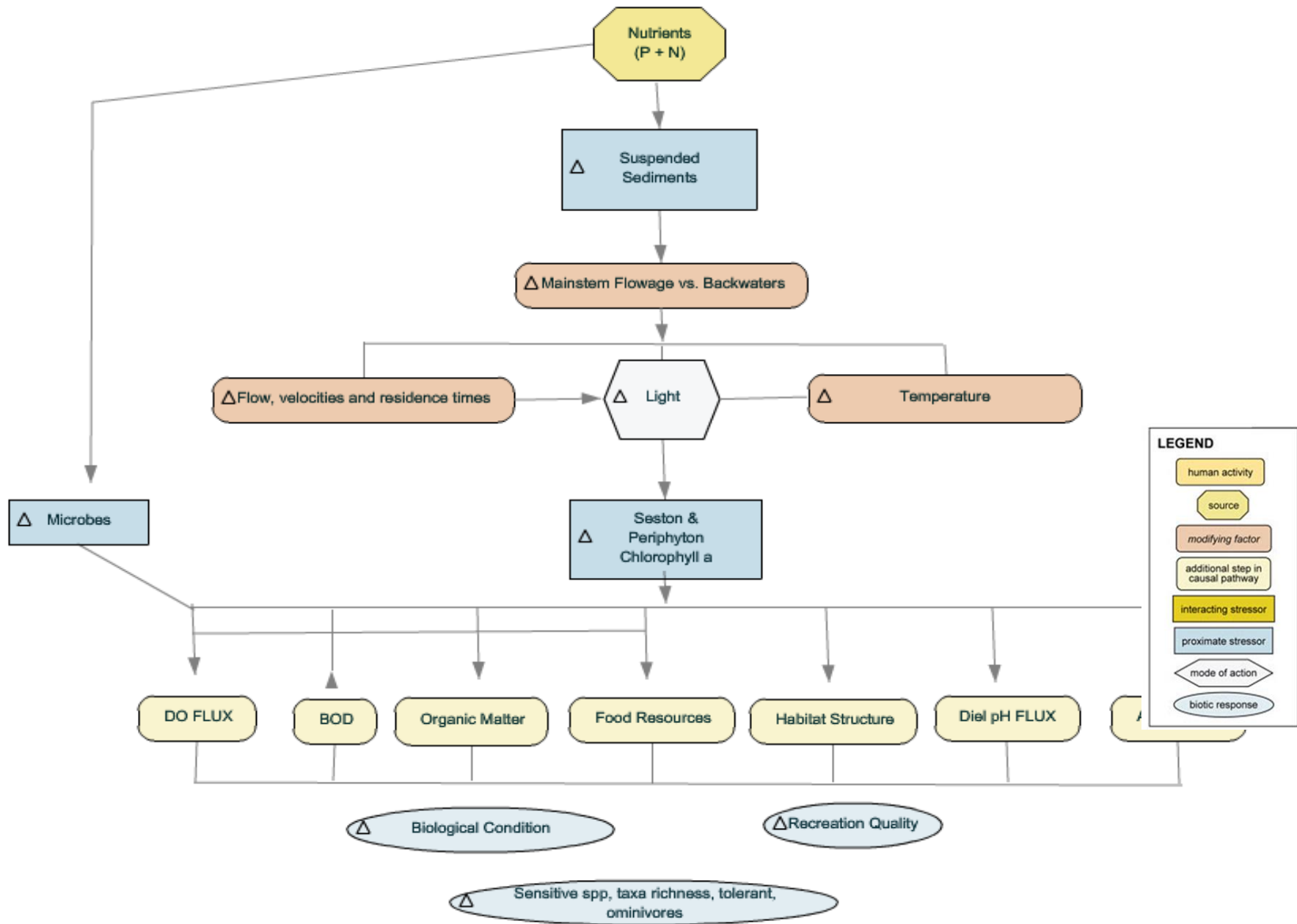- Sedimentation is reduced by low temperatures

Above Graphic from Prof. John Gulliver, UM/SAFL.

PROJECT GOAL

Develop stressor-response model to investigate the relationships among nutrients, suspended sediment and the biological response in the Red River of the North.
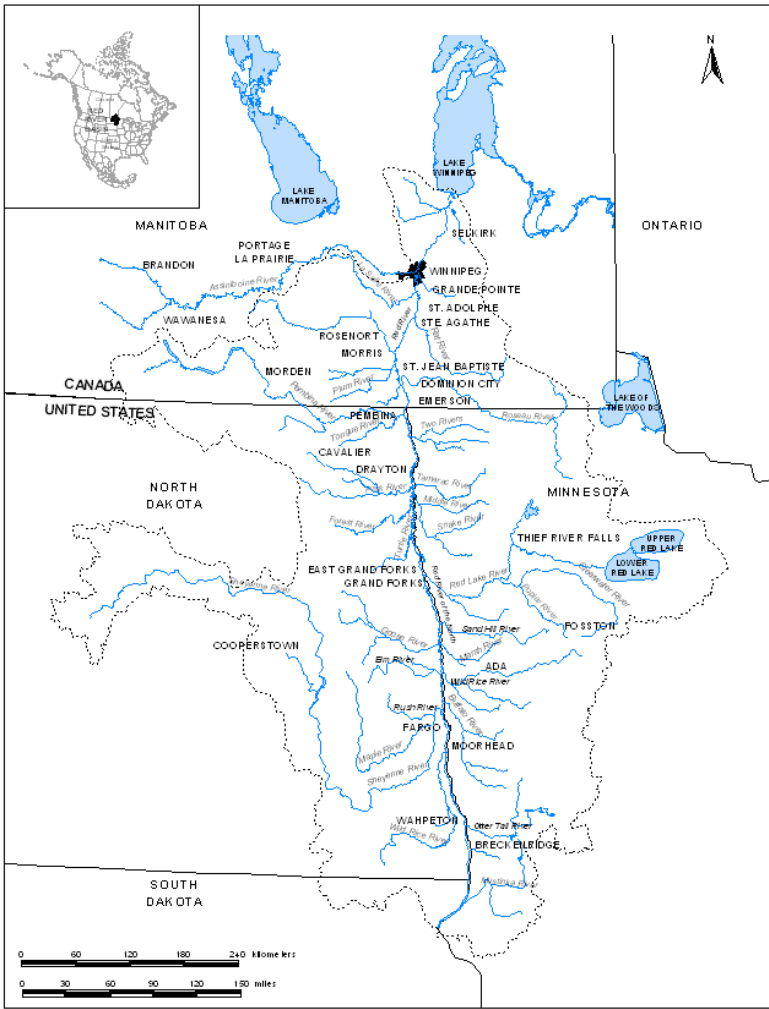
Modified Heiskary et al. Conceptual Model

IDENTIFYING OTHER BIOLOGICAL RESPONSES

- **Fisheries data limited.**
  - Further complicated by ~ 500 dams in basin

- **Macroinvertebrate data limited**
  - Assessments difficult in large rivers

- **Algal data limited (seston, periphyton)**

- **PLAN B**
  - Summer monitoring of phytoplankton, physical-chemical and periphyton by Partnering Agencies over summer 2015. Experts Panel reiterated need. Project managers:
    - Mike Ell (NDDH)
    - Nicole Armstrong (Manitoba CWS)
    - Jim Ziegler (MPCA)

Periphyton Sampling

- Periphyton and phytoplankton collected at 30 sites along the Red (23 US/7 Manitoba)
  - Periphytometers deployed ~ 1 month (~mid-July-mid-August)
- Water sample collected for nutrient analysis
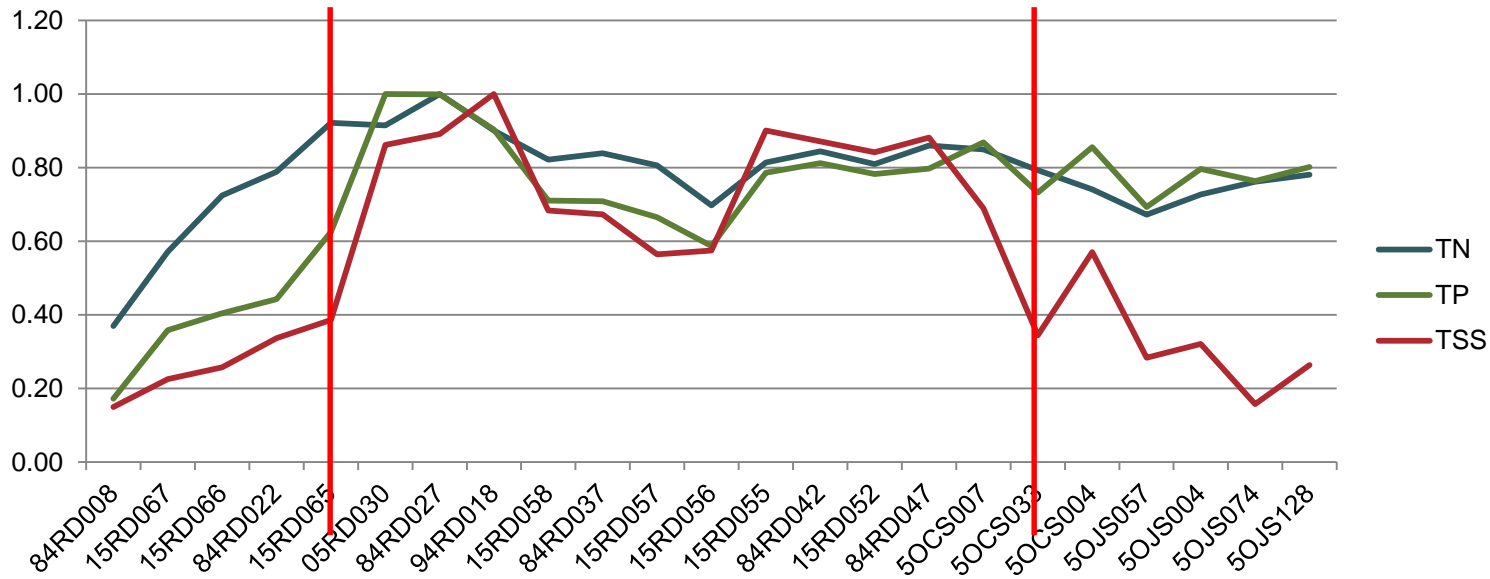- Samples analyzed (seston and periphyton)
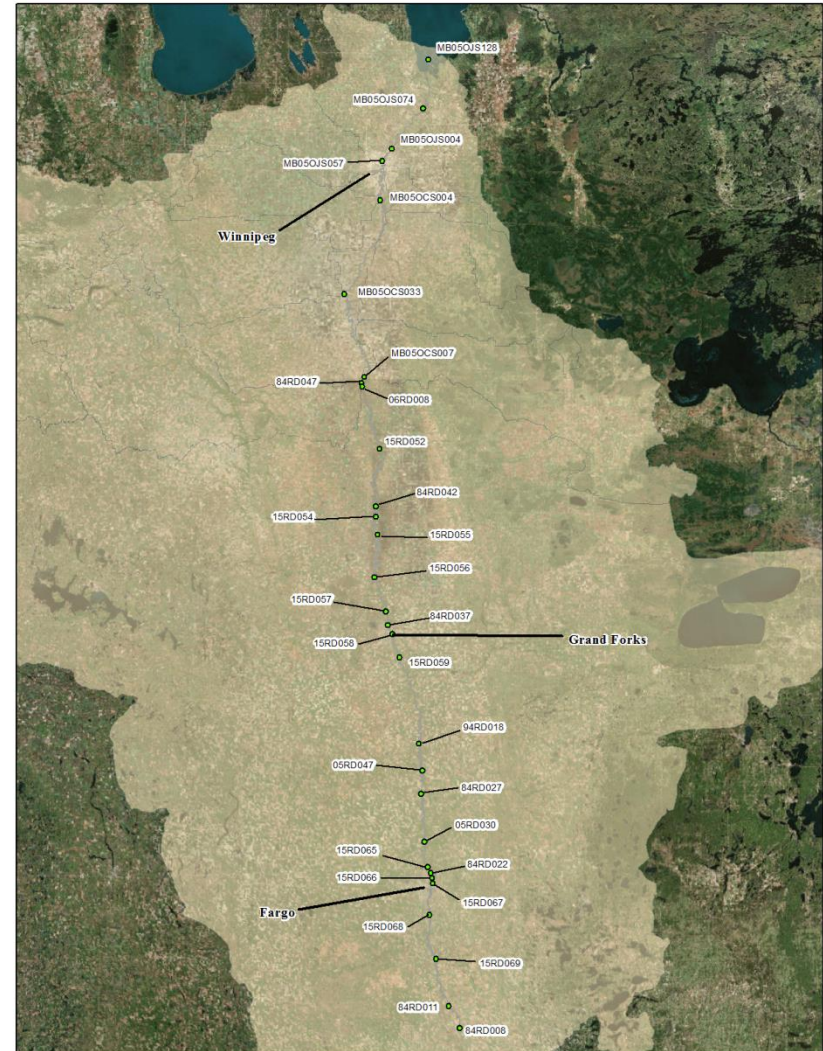
WATER QUALITY SNAPSHOT

Water Quality

- **Headwaters rapidly increasing gradient of nutrients and TSS**
- **Middle Reach: consistently high nutrients and high TSS**
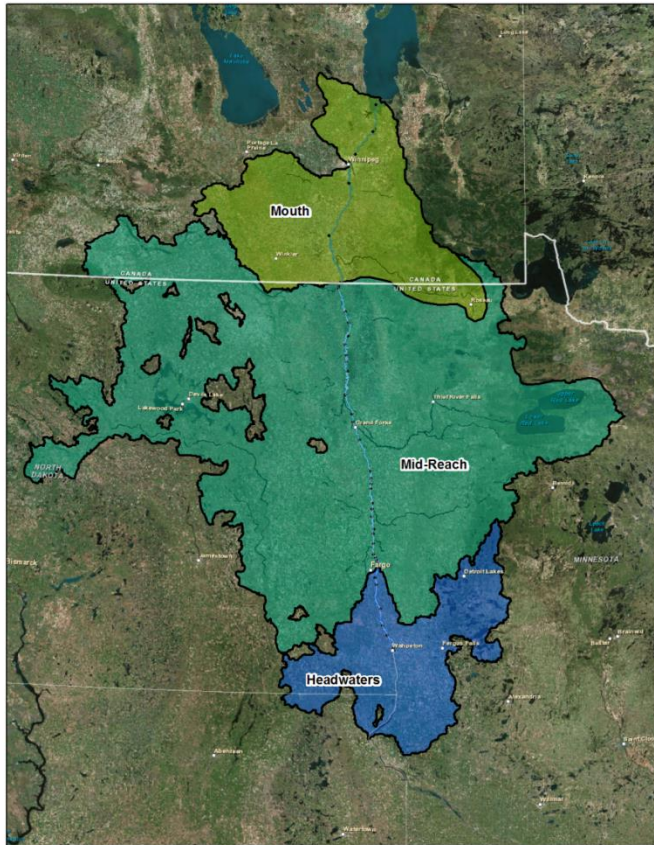- **Mouth: High nutrients but low TSS**
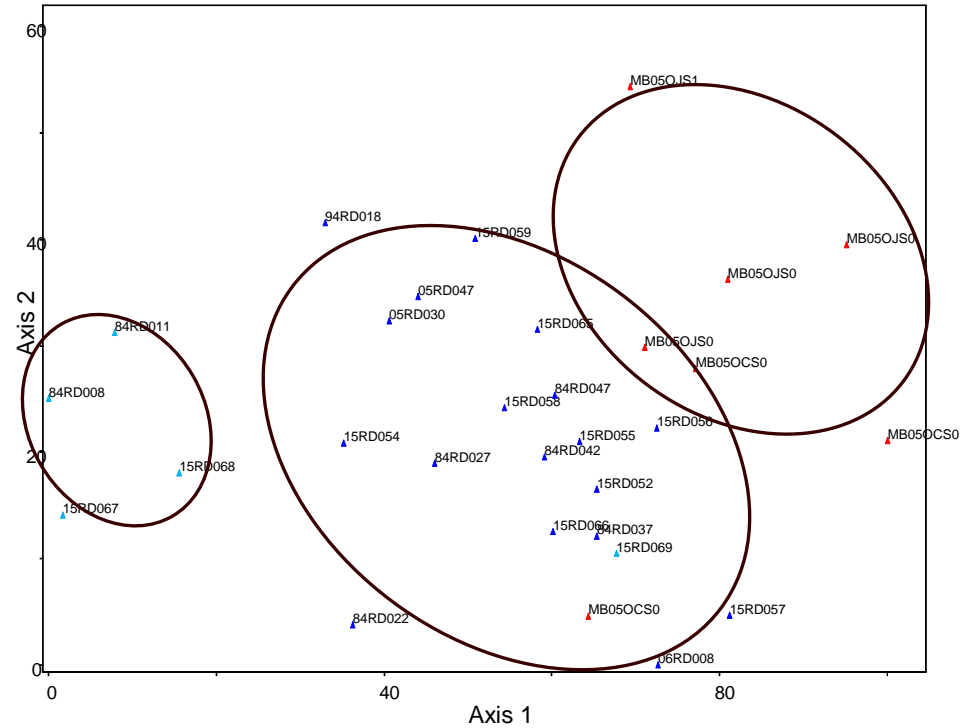- **3 Red River "zones" identified**

Periphyton

- **NMS (Non-metric Multidimensional Ordination) ordination of site level community metrics also delineate river into 3**

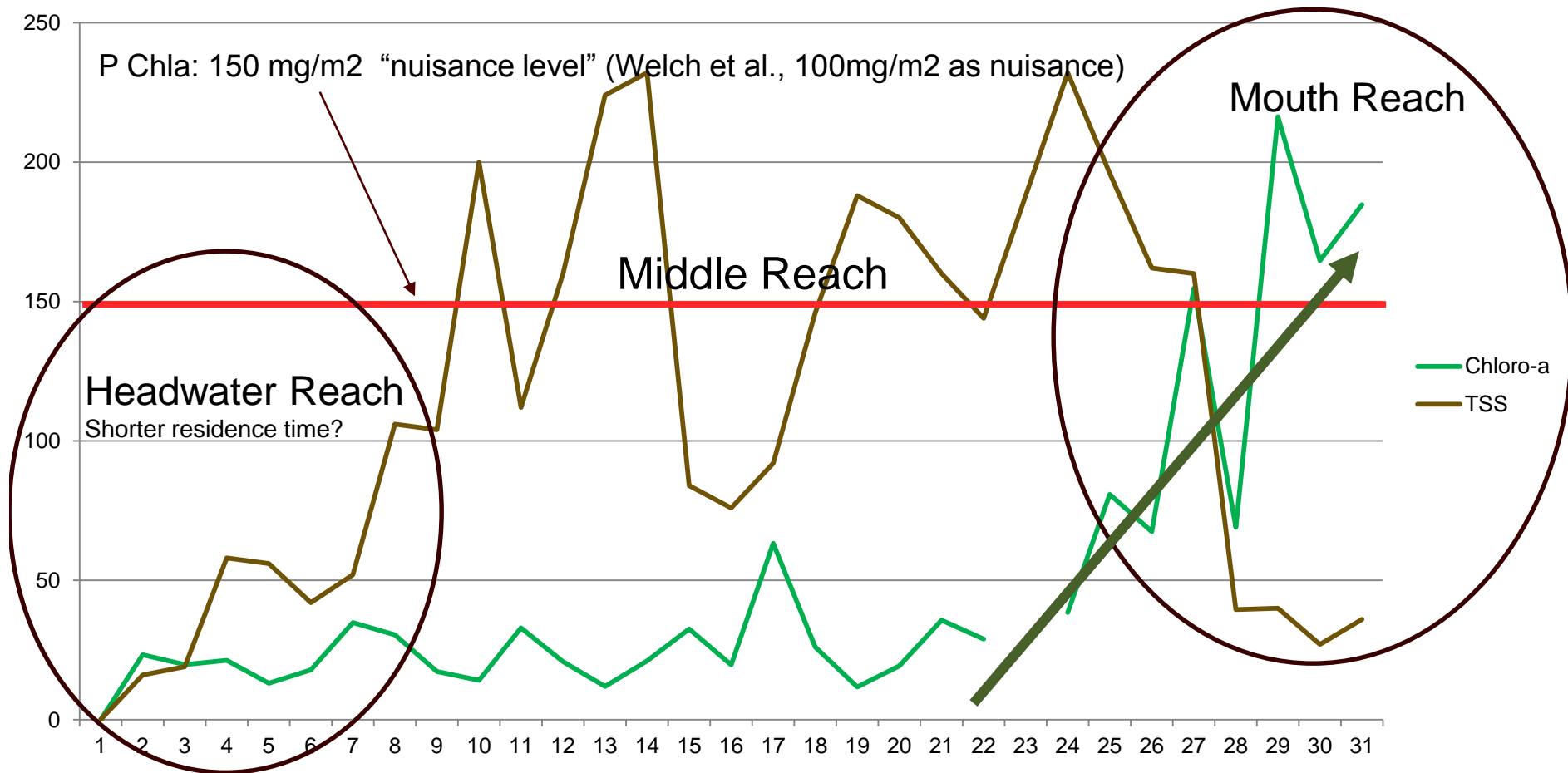NMS of Nutrient and Saprobity Metrics
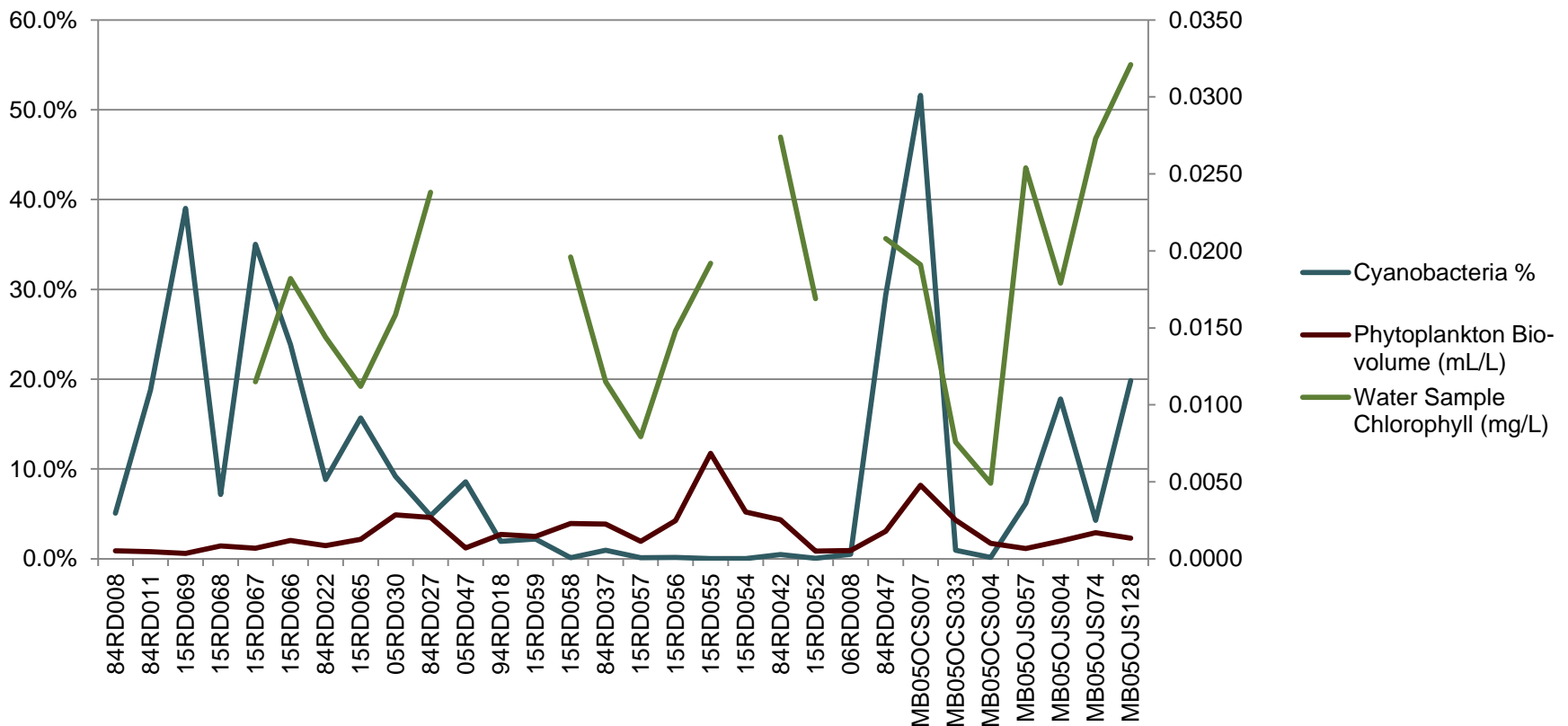
Periphyton

PHYTOPLANKTON

Phytoplankton

- 52% of stations ~ or > 20μg/L chlorophyll-a (nuisance level for lakes in MN)
- One station > 30 μg/L (severe nuisance for lakes in MN)
- Blue-green algae can be a dominant component of these algal communities

SUMMARY OF RESULTS

- **Headwater and mouth reaches show strong dichotomy**
    - Headwater has low TSS, moderate nutrients, and "balanced" periphytic algal community
    - Mouth has low TSS, high nutrients, with algae dominated by tolerant periphytic groups
   - Results provide a framework for determining nutrient thresholds
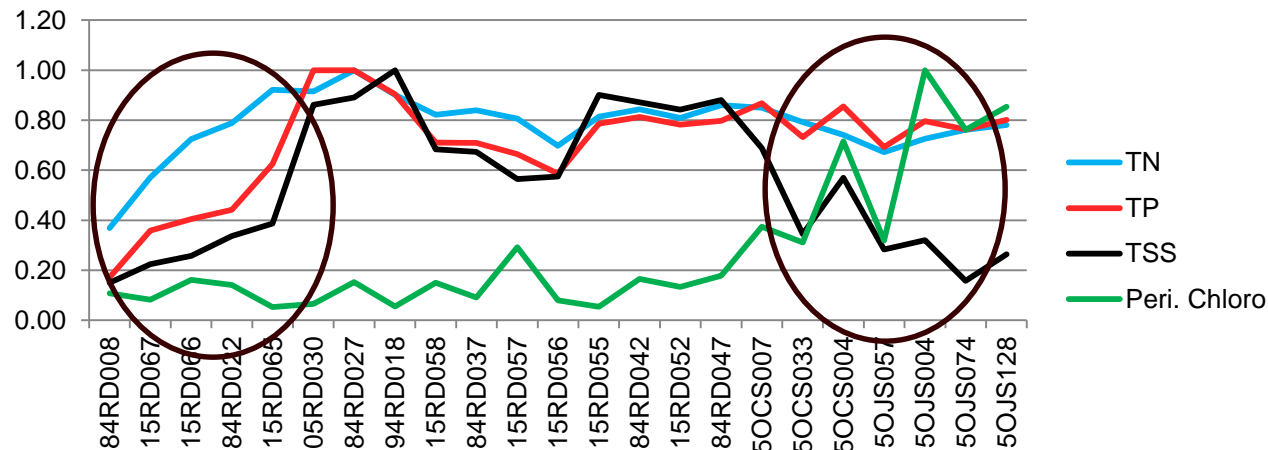
- **River zones**
    – TSS lower Headwaters & Mouth.
        - Mouth peak Pchla > 150 mg/m2
    – High TSS along Mid Zone sites

- **Effects of organic loading are apparent through saprobity metrics**
    – Diatom metrics for saprobity
        - Dominance shift downstream from a group that prefers DO at 70-85% saturation at the headwater to one that thrives in 10-25% after Fargo

- **Low Dissolved Oxygen data availability to evaluate?**
    – Potential for high oxygen depletion rates (>0.25 mg/m3/day)?

DIATOM NUTRIENT TOLERANCE

% Nutrient Tolerance
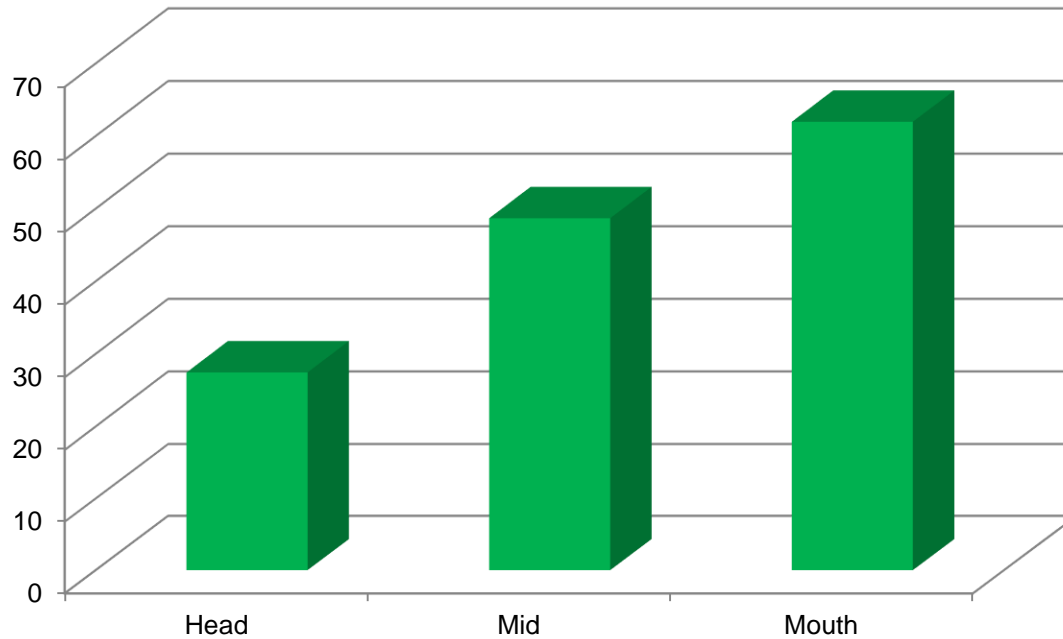
STATISTICAL ANALYSES BEING COMPLETED

Statistical Approaches

- **Non-metric Multidimensional Scaling (NMS)**

- **Redundancy Analysis (RDA)**

- **Non-parametric Multiplicative Regression (NPMR)**

- **Linear regression**

- **Final report being prepared**

Thank You!

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