North Saskatchewan River Research Information Exchange

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&
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REPORT PREPARED FOR
RESEARCH INFORMATION EXCHANGE
PARTICIPANTS

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WORKSHOP DESCRIPTION

On February 5, 2019 the North Saskatchewan Watershed Alliance (NSWA) and the Modeste Natural Infrastructure Project (MNIP) held a workshop to learn about upcoming and current research projects related to watershed health and ecosystem services in the North Saskatchewan River basin. The purpose of the exchange was to increase awareness between policy makers and researchers on water quality and quantity research being undertaken in the basin, identify synergies between research projects, and identify opportunities to collaborate on current and future initiatives. A summary of the workshop is provided in this report.

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WORKSHOP REPORT

1.1 INTRODUCTION TO THE MODESTE NATURAL INFRASTRUCTURE PROJECT (MNIP)

Natural infrastructure consists of landscape features such as wetlands, riparian buffers and forests that improve water quality and lower the risk of floods and droughts. The presence of natural infrastructure can extend the life of built or "grey" infrastructure (such as floodways, culverts, or water treatment plants) by retaining and filtering water as well as reducing overland flooding and replenishing groundwater supplies.

The Modeste Natural Infrastructure Project (MNIP) will evaluate the financial benefits of conserving and enhancing natural infrastructure on agricultural lands in the Modeste sub watershed. The sub watershed will be modeled to evaluate scenarios where natural infrastructure is restored, enhanced and conserved and will be based on ALUS programs that create natural infrastructure on approximately 650 acres in the Modeste. Based on the modeling, a cost-benefit analysis will be created to compare natural infrastructure with built infrastructure to better understand the value proposition for natural infrastructure investments from the public and private sectors. The MNIP is funded by Alberta Environment and Park's Watershed Resiliency and Restoration Program (WRRP) and the federal government's Climate Change Adaptation Program through Natural Resources Canada, and is also supported by the City of Edmonton, EPCOR, and the McConnell Foundation.

1.2 SESSION 1: RESEARCH PRESENTATIONS

Seven lightening talks covered selected water quality and quantity projects in the basin. Presenters were given 10 minutes and a presentation template for outlining research objectives, partners, methods, time frames and future research ideas. Workshop Participants then contributed to a facilitated roundtable discussion on policy and project linkages. The agenda, the list of workshop participants, and the MNIP project description is provided in the Appendices. Presentations are attached within the document and key messages are summarized in Table 1 below.

An important outcome of the workshop was the identification of Alberta Environment and Parks' Modelling Expert System (MES) as a repository of information about modeling and research projects accessible by researchers and policy analysts (see Figure 1 below).

Figure 1: AEP Modelling Expert System

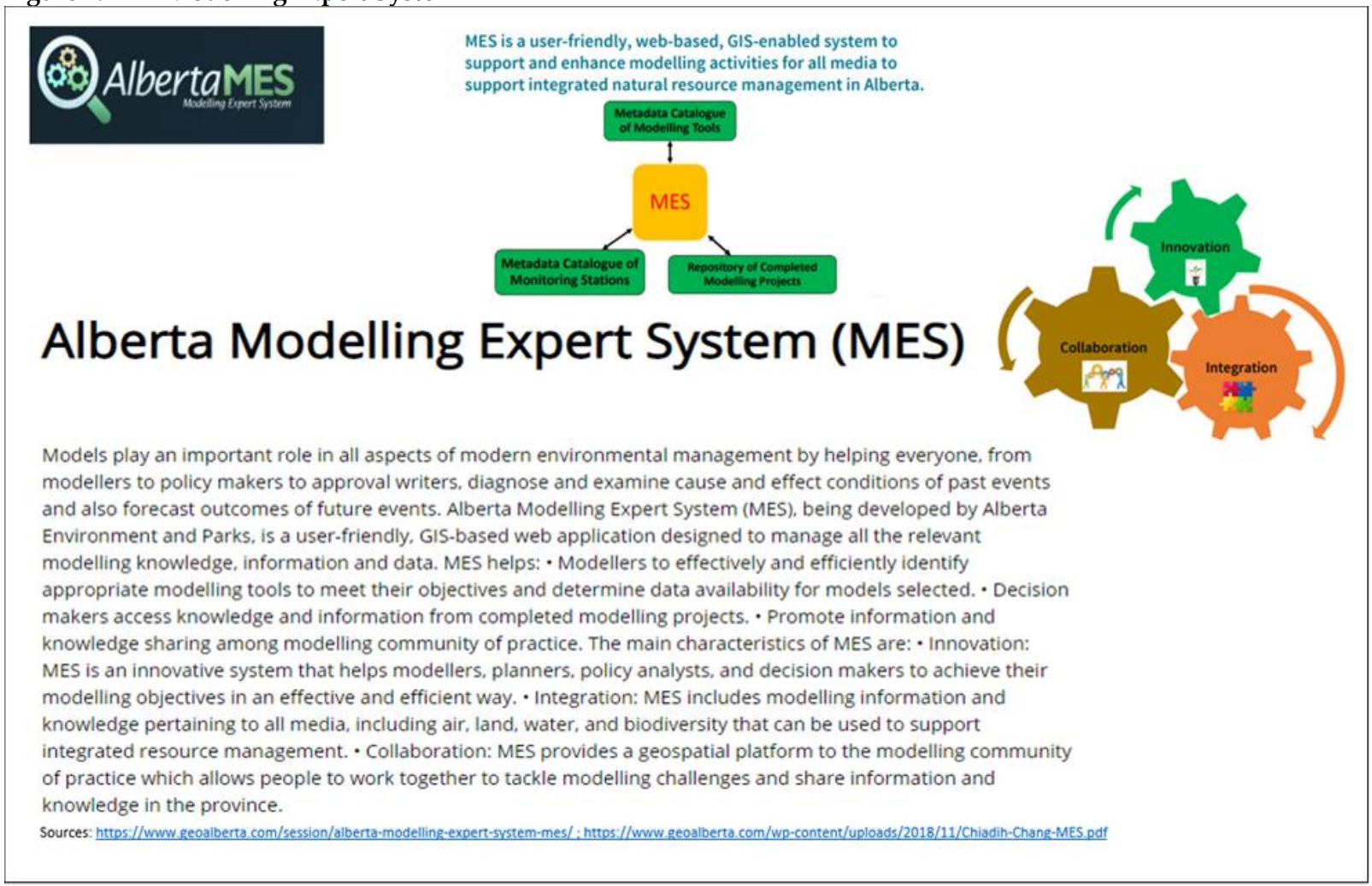


Table 1: North Saskatchewan River Research Exchange Research Presentation Summary

Research Goals/ Objectives	Partners/Funding	Timeline	Geographic Location	Modelling and Data Information	Goal or Key Results	Conclusion
#1 Greg Piorkowski-- Nutrient Objectives for Small Streams in Agricultural Watersheds of Alberta						
• Derive nutrient objectives applicable to agricultural watersheds in Alberta using stressor-response modelling approaches • Evaluate the achievability of nutrient objectives through watershed-scale BMP modelling • Assess the provincial-scale implications of adopting ecologically-based nutrient objectives in agricultural watersheds	Alberta Innovates; University of Alberta; GoA Agriculture and Forestry & Environment and Parks; Agriculture and Agri-Food Canada; North Saskatchewan Watershed Alliance; Intensive Livestock Working Group; Crop Sector Working Group	2016-18 & 2019-21	Alberta: Parkland, Grassland, and Boreal regions. Threehills Creek (Parkland), Indianfarm Creek (Grassland), and Wabash Creek (Boreal).	CEEOT modelling system used to evaluate scenarios (Farm Economic Model, APEX and SWAT). Water quality, flow and aquatic ecosystem data collection in April through September in 86 streams across the province.	Expected: Nutrient management targets applicable to small streams in Alberta's primary agricultural region.	n/a

Research Goals/ Objectives	Partners/Funding	Timeline	Geographic Location	Modelling/Data	Goal or Key Results	Conclusion
#2 Mike Christensen & Cristina Buendia-Fores-- WaterSHED Monitoring Program						
• Historical water quality monitoring has focused on the mainstem of the NSR; with limited tributary sampling • Need for a comprehensive and sustainably funded water quality and aquatic ecosystem health monitoring program	EPCOR Water; EPCOR Drainage; City of Edmonton (Economic and Environmental Sustainability); North Saskatchewan Watershed Alliance; GoA Environment and Parks (Operations and Environmental Monitoring and Science Division) Funding: 1 million dollars per year provided by EPCOR Water from the Edmonton rate payers.	2018-2021 with possible renewal	North Saskatchewan River Basin (in the Long Term River Network (LTRN), and the Tributary Monitoring Network (TMN)	Data collected with spatial variability (e.g. ranges of watershed scales and environmental conditions such as climate, lithology, land use), and temporal variability (e.g. inter-annual variability in with wet and dry years and seasonality). Data collected monthly for most water quality variables on major water rivers at Long Term River Network (LTRN) sites and augmented with new Tributary Monitoring Network (TMN). Site selections based on Hydrological Response Unit (HRU) where landscape is similar in its hydrological response.	Monitoring design based around a "mass balance approach" where water quality data is paired with water quantity	n/a

Research Goals/ Objectives	Partners/Funding	Timeline	Geographic Location	Modelling/Data	Goal or Key Results	Conclusion
#3 Faye Wyatt & Cristina Buendia-Fores--Watershed Integrity and Aquatic Ecosystem Health in the North Saskatchewan River						
• Conduct a multi-metric assessment of aquatic ecosystems health (fish, benthos, algae, microbes, water quality) • Develop stressor-response relationships between aquatic ecosystem health and watershed scale stressors (ag, urban development, industrial activities, wetland loss, climate etc.) • Develop, implement and assess candidate geospatial model of watershed integrity • Quantify watershed integrity for the NSR basin	North Saskatchewan Watershed Alliance; EPCOR; University of Alberta	Alberta Innovates (proposal submitted) April 2019 – March 2022	North Saskatchewan River Basin	Field data for: water quality (from EPCOR); and fish/ microbes/periphyton/benthic invertebrates. Geospatial data such as land-use/land cover; human footprint; climate; wetlands; topography; forest fires; remote sensing etc. Model at HUC10 scale.	Future: provide end users (stakeholders, managers, policy makers) with a model of healthy aquatic ecosystems through geospatial tools/ data/ modeling and statistical analysis	n/a

Research Goals/ Objectives	Partners/Funding	Timeline	Geographic Location	Modelling/Data	Goal or Key Results	Conclusion
#4 Monireh Faramarzi--Adapting to Changing Water in Alberta (Modelling Climate Change Impacts on Water Supply in Alberta)						
• Develop provincial water supply demand model for long-term policy and planning • Assessment of blue (surface and groundwater) and green water storage (soil moisture) and green water flow (actual evapotranspiration) at sub-basin spatial and monthly temporal resolution (historical and future periods) • Assessment of water demand of various water intensive crops and beef industry • Assessment of water needs of environment (e.g. wetlands) • Assessment of water needs of municipal and other industries	Alberta Innovates; GoA Agriculture and Forestry (former ALMA); Alberta Biodiversity Monitoring Institute; NSERC Discovery Grant; Campus Alberta Innovation Program (CAIP) Chair	On-going	Alberta scale: a study area of approximately 700,000 Km^2 (2255 sub basins were delineated using SWAT); Elbow Watershed: a study area of about 13000 Km^2, a supply for about half of Calgary's drinking water; North Saskatchewan River Basin: study area of about 51000 KM2).	Historic data (1983-2015) and projected future data (2010-2040 and 2040-2070). 129 hydrometric stations are used for provincial model calibration and validation. Locally available water quality (e.g. sediment, organic carbon) and quantity data were gathered for calibration of watershed models. Wetland water demand analysis—there is no time series data for the wetland water levels and water quality factors; there is no high-resolution topographic map at large regional scale (e.g. Lidar data) identifying wetlands watershed areas and wetlands storage capacity. These are key information for hydrologic modeling of wetlands and for prediction of wetland water storage and their viability under changing climate and land management conditions. Existing data are scattered and only available for few sites within the province. They don't help develop predictive models for future planning and management of wetlands.	Potential research: high resolution hydrology model for studying SW-GW interactions; improving and integrating glacier melt/ runoff; freezing/ thaw process; snow processes; and simulation of the role of wetlands in regional hydrology by incorporating better input data and related key processes.	Models are developed for different purposes including operational site-specific process simulation vs regional planning and management; models are useful tools but there is no best model; models are subject to uncertainty due input data, conceptual, parameters; The largest source of uncertainty in most of advanced models are input data.

• Assessment of water quality (at watershed scale) due to natural and anthropogenic factors (e.g. sediment and organic carbon)						
Research Goals/ Objectives	**Partners/Funding**	**Timeline**	**Geographic Location**	**Modelling/Data**	**Goal or Key Results**	**Conclusion**
#5 Kyle Swystun--Drinking Water Infrastructure Risk and Vulnerability Study						
• Determine current and future flood and drought risk to drinking water infrastructure • stress test system with high/low flow • see what is at risk (intake, treatment plant etc.) and provide facility level reports to communities	Alberta Innovates (Water Innovation Program); GoA Environment and Parks (WAR Branch); Associated Engineering	Complete by summer 2019	All Alberta (48 facilities)	Working with Monireh Faramarzi at the University of Alberta and using SWAT model	Goal is to determine how vulnerable the components (source, treatment, and distribution) of the drinking water system are to flood and drought currently and into the future utilizing Monireh's SWAT modelling.	n/a

Research Goals/ Objectives	Partners/Funding	Timeline	Geographic Location	Modelling/Data	Goal or Key Results	Conclusion
#6 Wanhong Yang--Overview of IMBWEBs model for evaluating ecosystem services from watershed restoration						
• Determine the IMWEBs-based ES assessment tool setup, calibrate and validate the ES assessment tool • Develop the user interface for the ES assessment tool. Apply the ES assessment tool and interface to simulate water quantity, quality and carbon sequestration benefits of natural infrastructure projects for Modeste subwatershed • Communicate the modelling results to project partners	WRRP (and others)	2020-2022	Modeste subwatershed	Integrated Modelling for Watershed Evaluation of BMPs (IMWEBs) (cell-based)—evaluated water quantity and quality of agricultural beneficial management practice at four scale: site, field, farm, and watershed scales. General BMPS include: crop management; tillage management; fertilizer management; grazing management; isolated wetland restoration; manure and nutrient management; livestock Livestock BMPS include: Riparian and surface water management; wintering site management; pasture management; marginal crop land management	IMWEBs model is the only model in Canada that is designed for evaluating agricultural BMPs at site, field, farm, and watershed scales (results not available yet)	n/a

Research Goals/ Objectives	Partners/Funding	Timeline	Geographic Location	Modelling/Data	Goal or Key Results	Conclusion
#7—Marian Weber & Diana Staley--Evaluation of natural infrastructure benefits and costs						
• To understand the business case for natural infrastructure through wetland and riparian restoration (from a watershed perspective) • Conduct a cost-benefit analysis of the interaction between natural infrastructure and built infrastructure • Create guidance documents for evaluating natural infrastructure options	Natural Resource Canada (NRCan)	2018-2020	Modeste subwatershed	Integrated Modelling for Watershed Evaluation of BMPs (IMWEBs) (cell-based)—evaluated water quantity and quality of agricultural beneficial management practice at four scale: site, field, farm, and watershed scales.	n/a	n/a

1.3 SESSION 2: ROUNDTABLE DISCUSSION

After the series of presentations, the workshop attendees participated in small group discussions on a variety of water quality and quantity issues. The discussion centered on 3 major topics: major policy issues that intersect with natural infrastructure in Alberta and the North Saskatchewan Watershed in particular; information about related research and research gaps; other researchers and decision makers to engage in future natural infrastructure projects. The responses are categorized and summarized below for each discussion point.

1.3.1 Major Policy Issues/Applications for Water Quality and Quantity Research

Wetlands as Natural Infrastructure

- Workshop attendees discussed the role of wetlands for natural infrastructure.
    - Participants explained that there are questions around generally understanding key processes and factors of wetlands as well as the Alberta Wetland Rapid Evaluation Tool (ABWRET)[1] and the affordability and applicability of it.
- Others mentioned how watersheds contribute to the needs of wetlands as well as how the cumulative effects and solutions could change over time, making wetland impacts more difficult to measure in the future.

Watershed Planning

- Workshop participants highlighted that policies related to watershed planning and approach are important as well as specific policy frameworks such as the Water Management Frameworks[2] and the Land-use Framework regional plans.[3]
- Others highlighted that every watershed is different due to multiple factors and that needs to also be taken into account when considering natural infrastructure.
- The impacts of natural infrastructure should go beyond water quality and quantity and include other ecosystem services such as biodiversity and habitat.

Nutrient Load Management

- The City of Edmonton has a Total Loadings Plan (TLP) [4] that could utilize water quality and quantity research and modeling for the management of rivers and lakes in terms of estimated nutrient and sediment loads and how much load can be handled as well as provide information on allocations.

Cumulative Effects and Watershed Planning

- Managing for cumulative effects management is important buts not always done at a basin scale.

[1] https://open.alberta.ca/publications/9781460123652
[2] https://www.alberta.ca/water-management-plans.aspx?utm_source=redirector
[3] https://www.landuse.alberta.ca/RegionalPlans/NorthSaskatchewanRegion/Pages/default.aspx
[4] https://www.edmonton.ca/city_government/documents/PDF/TotalLoadingPlan.pdf

- Cumulative effects from wetland drainage and restoration can change over time and this is important to account for in an analysis.
- While resources are put toward improving water quality there is not always an understood clear objective or end-goal.

Spatial and Temporal Considerations

- Several participants mentioned the need to develop seasonal models that capture fluctuations in water quantity throughout the year rather than average annual measurements; flood events also need to be considered.
- Spatial issues are important for drinking water systems since urban areas typically draw from the mainstem, while rural areas are more heavily dependent on groundwater. It was noted that the ground water levels fluctuate which needs to be considered in natural infrastructure projects.
- Some participants mentioned the need to understand how to spatially prioritize restoration of the landscape, as it is not always clear where the benefits would be highest.
- Participants also discussed the need for a better understanding of connectivity between different spatial and temporal elements on the landscape.

Water Allocations/ Trading/ Offsets/ Payments for ES

- Water Allocation policies[5] and Directives and the Surface Water Quality Guidelines[6] and Objectives are important for management of natural infrastructure.
- Water quality trading and offsets would allow point sources to pay non-point sources for natural infrastructure to reduce the nutrient loads.

Private and Public Land

- Land ownership (public versus private lands) can affect the feasibility and cost of natural infrastructure projects.

Municipal Accounting & Policy

- The Public Sector Accounting Board (PSAB) to be involved in the accounting of natural infrastructure projects within a municipal budget.
- Compliance of natural infrastructure under the Water Act versus the Municipal Government Act needs to be clarified.

Data

- Need high resolution digital elevation data
- Need to understand site specific benefits for agriculture in terms of BMPs.

[5] https://www.alberta.ca/water-allocations-and-transfers.aspx?utm_source=redirector
[6] https://www.alberta.ca/water-quality-guidelines.aspx?utm_source=redirector

1.3.2 *Other research related to natural infrastructure and knowledge gaps*

Projects/Topics

- Alberta Narratives https://albertanarrativesproject.ca
    - a community-based initiative to approach public engagement that aims to improvement communications on topic such as energy and climate.
      Report I: "*Communicating Climate Change and Energy in Alberta*" http://albertanarrativesproject.ca/wp-content/uploads/2019/02/ANP-Report-I-Final-Online.pdf
      Report II: "Communicating Climate Change and Energy with Different Audiences in Alberta" http://albertanarrativesproject.ca/wp-content/uploads/2019/02/ANP-Report-II-final-online.pdf
- Wetland Inventory Guidelines
    - Alberta Environment and Parks: Wetland Policy, Guidelines, and Directives https://www.alberta.ca/alberta-wetland-policy-implementation.aspx
- LiDAR data collection
    - Free and open LiDAR data sources in Canada https://canadiangis.com/free-canada-lidar-data.php
    - LiDAR data for a fee Altalis https://www.altalis.com/

Organizations/Researchers

- North Saskatchewan Watershed Alliance (NSWA)
    - Riparian intactness study. *"Modeste Watershed Riparian Area Assessment."* https://www.nswa.ab.ca/wp-content/uploads/2018/04/Modeste-Riparian-Assessment-2018_-Fiera.pdf
- Irene Creed, Executive Director and Professor, School of Environment and Sustainability from University of Saskatchewan
    - Research on hydrology, wetlands, and ecosystem services https://sens.usask.ca/people/faculty/core-faculty/creed-irena.php#AcademicCredentials
- Intact Centre on Climate Adaptation (Intact Centre), in partnership with University of Waterloo
    - Helps to identify and reduce risks associated with climate change and extreme weather events https://www.intactcentreclimateadaptation.ca
- Insurance Bureau of Canada
    - Flood Costs and Natural Infrastructure. *"Combatting Canada's Rising Flood Costs."* http://www.ibc.ca/ns/resources/studies/natural-infrastructure-is-an-underutilized-option
- Alberta Real Estate Foundation http://aref.ab.ca
    - Links water quality to the housing market
- Municipal Natural Asset Initiative (MNAI)
    - Work on municipal accounting for natural infrastructure. https://mnai.ca/about/
    - Report: "*Advancing Municipal Natural Asset Management: The Town of Gibsons experience in financial planning and reporting*" https://mnai.ca/media/2018/01/GibsonsFinancialPlanningReport-WEB.pdf
- Alberta WaterSMART https://watersmartsolutions.ca/our-team/
    - Team of engineers, environmental scientists and policy advisors for water management

3. Research Gaps and Needs

- How natural infrastructure changes over time
- Education about the value of natural infrastructure
- Understand natural infrastructure at project and watershed scale for Land-use planning under the Land Use Framework
- Identify ground water and recharge/discharge zones
- Climate factors and risks for wetland policy and lake management and protection strategies
- Socio-economic questions related to landowner participation
- Seasonality of water quality/quantity
- Spatial prioritization and cost effectiveness of wetland restoration
- Cumulative effects and local impacts
- Biodiversity Framework—what are the incentives that could work regionally; what kind of management response is needed that could inspire change
- Benefits of infrastructure built within floodplains of small tributaries particularly for fish-bearing tributaries
- Inclusion of permaculture as a BMP
- Impact of summer villages
- Need to understand impact of different restoration/enhancement activities (i.e. beyond ditch plugs)

Data and Modelling Gaps

- Standardize provincial "open database"
- Ready-to-use models to predict ecosystem services (i.e. drained wetlands; surface and groundwater interactions)
- Wetland inventory and land cover data gaps
- Map of projects/ models and a summary plus data management and availability (see AEP Expert System portal in first section)
- Policy implications through new development codes
- A repository of models and data sets – create efficiencies
- Bathymetry data for lakes (for strategy and compliance)

1.3.3 Suggested Groups and Researchers to Engage in Future Research

Government/ Public Sector

- Alberta Environment and Parks—Water Policy Group
- Alberta Energy Regulators (water licenses)
- Agriculture and Agri-food Canada (AAFC)
- Municipal decision-makers / leaders particularly large urban centers as well as summer villages and hamlets (e.g. villages surrounding Lake Wabamun)
- Utilities and Alberta Infrastructure
- Ag. extension specialists (provincial and municipal)

Non-Profit / NGOs

- Watershed Planning and Advisory Councils (WPACs) https://www.alberta.ca/watershed-planning-and-advisory-councils.aspx
- Alberta Biodiversity Monitoring Institute (ABMI) https://www.abmi.ca/home/about-us/governance-funding.html#
- Prairie Conservation Forum http://www.albertapcf.org/
- Alberta Conservation Association (ACA) https://www.ab-conservation.com/about/roles-and-responsibilities/
- Forest Research Improvement Association (FRIA) https://friaa.ab.ca/
- Foothills Institute https://friresearch.ca/content/who-we-are
- Alberta Real Estate Association https://www.albertarealtor.ca/
- First National Technical Services Advisory Group (TSAG) (train First Nations in Alberta Asset Management such as water and waste water management, environmental management etc. and can be on steering committee) http://www.tsag.net/
- Traditional Ecological Knowledge Policy (TEK) (these can be on a steering committee)
- Cows and Fish (and other who advise on BMPs) http://cowsandfish.org/about/about.html
- Alberta crop sector working groups

Private Sector

- Associated Engineering (has worked with outflows and water treatment plans on municipal and indigenous lands (note some indigenous lands have their own water treatment/wastewater treatment plants) https://www.ae.ca/
- Tetra Tech (engineering firm) work on the NSR http://www.tetratech.com/en/about
- Landowners

Other

- Regional limnologist and hydrologist
- Forest industry (research on riparian areas)
- Forestry and agroforestry research groups

APPENDIX A – LIST OF ATTENDEES

List of Attendees

Attendees	Organization
Introduction	
Lara Ellis	(MNIP) ALUS Canada, Vice President, Policy and Partnerships
Christine Campbell	(MNIP) ALUS Canada, Hub Manager (West)
Mary Ellen Shain	(MNIP) NSWA, Watershed Planning and Management Coordinator
Krista Quesnel	(MNIP) Parkland Co., Manager, Community Sustainability
Presenters	
Marian Weber	(MNIP) InnoTech Alberta & NAIT, Principal Researcher
Diana Staley	(MNIP) InnoTech Alberta, Economic Researcher
Wanhong Yang	(MNIP) University of Guelph, Professor and Chair
Greg Piorkowski	GoA (AF), Watershed Research Scientist
Mike Christensen	EPCOR, Environmental Technologist
Cristina Buendia-Fores	GoA (EP), Aquatic Scientist
Faye Wyatt	GoA (EP), Geospatial Scientist
Monireh Faramarzi	University of Alberta, Assistant Professor
Kyle Swystun	GoA (EP), Resilience Planner
Other Attendees	
Andy Jedrych	GoA (AAF), Watershed Management Engineer, Water Quality Section
Arin McFarlane Dyer	GoA (EP), NSRP Integrated Resource Planner
Brendan Hemens	GoA (EP), Director, Biodiversity, Ecosystems Services and Environment
Brian Ilnicki	Land Stewardship Centre, Executive Director
Carol Bettac	Alberta Innovates, Executive Director
Chris Mallon	GoA (EP), Land and Biodiversity Modeller
Craig Emmerton	GoA (EP), Watershed Scientist
David Trew	NSWA, Water Specialist Advisor
Janet Dietrich	GoA (AF), Water Working Group for Agri-Environmental Partnership of AB
Javed Iqbal	GoA (AF), Geomatic Specialist
John Thompson	NSWA board member ecological economist; Watrecon Consulting
Juliana Tang	Associated Engineering, Sustainable Design Specialist
Karen Raven	GoA (AF), Land Use Unit Lead
Majid Zaremehrjardy	University of Alberta, PhD student
Matt Wilson	GoA (EP), Provincial Wetlands Mitigation Specialist
Monique Dietrich	GoA (EP), WRRP Grant Coordinator
Sarah Stuebing	Alberta Real Estate Foundation, Communications/Investment Manager
Susan Carlisle	Interim Director, Water Innovation at AB Innovates
Vanessa Swarbrick	GoA (EP), Limnologist for NSR

APPENDIX B – WORKSHOP AGENDA

Workshop Agenda

Invitation to Participate in North Saskatchewan River Research Information Exchange
February 5, 2019
13:00-16:30
Alberta Innovates, Boardroom
250 Karl Clark Road, Edmonton AB

The North Saskatchewan Watershed Alliance and the *Modeste Natural Infrastructure Project* (MNIP) team invite you to participate in a **small gathering to learn about upcoming and current research projects** related to watershed health and ecosystem services in the North Saskatchewan River basin.

The objectives of the meeting are to increase awareness between researchers and policy makers of complementary research initiatives in the basin; understand the linkages to relevant policy initiatives; and identify potential opportunities to share information and/or collaborate on current or future initiatives. We hope that this small informal meeting will foster future opportunities to learn about and engage with a broader set of research initiatives in the North Saskatchewan watershed.

Agenda

1:00-1:05	**Introduction to Workshop** Marian Weber
1:05-1:15	**Welcome and Round Table Introductions** Lara Ellis, ALUS and Mary Ellen Shain NSWA
1:15-1:30	**Background to the Municipal Natural Infrastructure Project** Mary Ellen Shain, Krista Quesnel, Lara Ellis
1:30-2:30	**RESEARCH INITIATIVE LIGHTENING TALKS** This session will involve brief 10-minute research overviews
2:30-2:45	**BREAK**
2:45-3:00	**RESEARCH INITIATIVE LIGHTENING TALKS** (*con't*) This session will involve brief 10-minute research overviews
3:00-4:00	**Policy Maker Round Table & Discussion** Government, municipalities, ENGOs identify relevant policy linkages
4:00-4:30	**Next steps** Future communication and collaboration opportunities

FINAL LIST of WORKSHOP LIGHTENING TALKS
(presentations in this order)

Greg Piorkowski *Alberta Agriculture and Forestry*	*Nutrient Objectives for Small Streams in Agricultural Watersheds of Alberta*
Mike Christensen *EPCOR* **Cristina Buendia** *Alberta Environment and Parks*	*New Water Quality Monitoring Network for Select Tributaries of the North Saskatchewan River Watershed* (EPCOR and/or EMSD)
Faye Wyatt; Cristina Buendia *Alberta Environment and Parks*	*Modelling Watershed Integrity in the North Saskatchewan River Basin*
Monireh Faramarzi *University of Alberta*	*Modelling Climate Change Impacts on Water Supply in Alberta*
Kyle Swystun *Alberta Environment and Parks*	*Drinking Water Infrastructure Risk and Vulnerability Study*
Wanhong Yang *University of Guelph*	*Overview of IMBWEBs model for evaluating ecosystem services from watershed restoration*
Marian Weber and Diana Staley *InnoTech Alberta*	*Evaluation of natural infrastructure benefits and costs*

THE MODESTE NATURAL INFRASTRUCTURE PROJECT

What is Natural Infrastructure?

Sometimes referred to as "green infrastructure" or "natural assets," natural infrastructure consists of landscape features—such as wetlands, riparian buffers and forests —that improve water quality and lower the risk of flooding and drought.

The benefits of natural infrastructure include carbon sequestration, wildlife habitat, recreation and protection from severe weather events. By retaining and filtering water, wetlands reduce overland flooding and replenish groundwater supplies.

Natural infrastructure also extends the life of built, "grey" infrastructure, such as floodways, culverts, bridges, and water-treatment plants.

Researchers have begun to financially quantify these many benefits to society, and to understand the costs when natural infrastructure is lost.

The Modeste Natural Infrastructure Project

The Modeste Natural Infrastructure Project will evaluate the financial benefits of conserving and enhancing natural infrastructure on agricultural lands in the Modeste Creek watershed in Alberta, Canada.

Experts from the University of Guelph, InnoTech Alberta, and ALUS will work with local communities to understand how restoring natural infrastructure will improve water quality and reduce the impact of flood and drought.

Using modelling, they will evaluate scenarios where natural infrastructure is restored, enhanced and conserved to meet the needs of local and downstream communities.

A cost-benefit analysis comparing different combinations of natural infrastructure with built infrastructure will help create a knowledge base and value proposition for natural infrastructure investment from the public and private sector.

The Modeste Natural Infrastructure Project will also contribute to the creation of natural infrastructure. Through the ALUS program, 263 hectares (650 acres) of wetland and riparian areas will be restored or enhanced in the Modeste watershed.

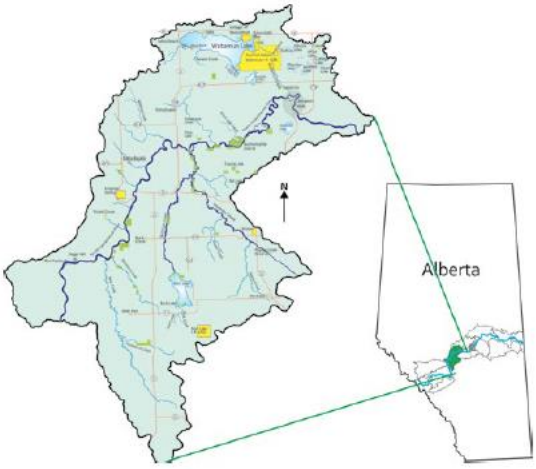
About the Project Area

The Modeste watershed is a sub-basin of the North Saskatchewan River basin, and is located upstream of Alberta's Capital Region.

The Government of Alberta has identified the Modeste watershed as a priority for flood and drought mitigation, as well as an important area affecting water quality in the province.

The Modeste was chosen for this project because of the support provided by the North Saskatchewan Watershed Alliance's Headwaters Alliance—a water-focused intermunicipal collaboration group established in 2014. Each of the five counties in the Alliance has a program to engage farmers and ranchers in the enhancement and protection of natural infrastructure: Parkland, Brazeau, Leduc and Wetaskiwin Counties administer the ALUS program, while Clearwater County administers the LandCare Program.

THE MODESTE CREEK WATERSHED



THE MODESTE NATURAL INFRASTRUCTURE PROJECT

Project Partners

ALUS Canada

ALUS Canada is a federally-registered charity that partners with communities and farmers to restore and enhance natural ecosystems on agricultural lands. ALUS communities in the Modeste watershed—ALUS Wetaskiwin-Leduc, ALUS Parkland and ALUS Brazeau—will restore and enhance wetlands and riparian areas as a part of this project.

Contact: Lara Ellis, Vice-President, Policy and Partnerships: lellis@alus.ca

ALUS.CA

Department of Geography, Environment and Geomatics, University of Guelph

Dr. Wanhong Yang's research program integrates economic, hydrologic, and GIS modelling to examine the cost effectiveness of agricultural conservation programs, with a mission to develop modelling tools for agricultural BMP assessment at both field and watershed scales. Modelling projects using his IMWEBs tool have taken place in Canada and the U.S.

Contact: Dr. Wanhong Yang, Professor and Chair, Department of Geography, Environment and Geomatics: wayang@uoguelph.ca

UOGUELPH.CA

InnoTech Alberta

InnoTech Alberta's primary focus is to facilitate the conversion of applied research to economic, social and environmental benefits. InnoTech links basic research and commercial outcomes, in accordance with strategic directions set out by the Government of Alberta, by delivering specialized services for its government and industry clients.

Contact: Dr. Marian Weber, Principal Researcher: Marian.Weber@innotechalberta.ca

INNOTECHALBERTA.CA

North Saskatchewan Watershed Alliance

As a Watershed Planning and Advisory Council, the NSWA is a multi-stakeholder organization that seeks to improve the management of water quality, water quantity and the health of aquatic ecosystems by developing and sharing knowledge and facilitating partnerships and collaborative planning processes. The NSWA will contribute watershed data and advice toward this project.

Contact: Mary Ellen Shain, Watershed Planning and Management Coordinator: Maryellen.shain@nswa.ab.ca

NSWA.AB.CA

Parkland County

Parkland County, located just west of the City of Edmonton, is a vibrant and robust community that is proud of its leadership toward sustainability and its long-time support of stewardship on both public and private lands.

Contact: Krista Quesnel, Community Sustainability Manager: krista.quesnel@parklandcounty.com

PARKLANDCOUNTY.COM

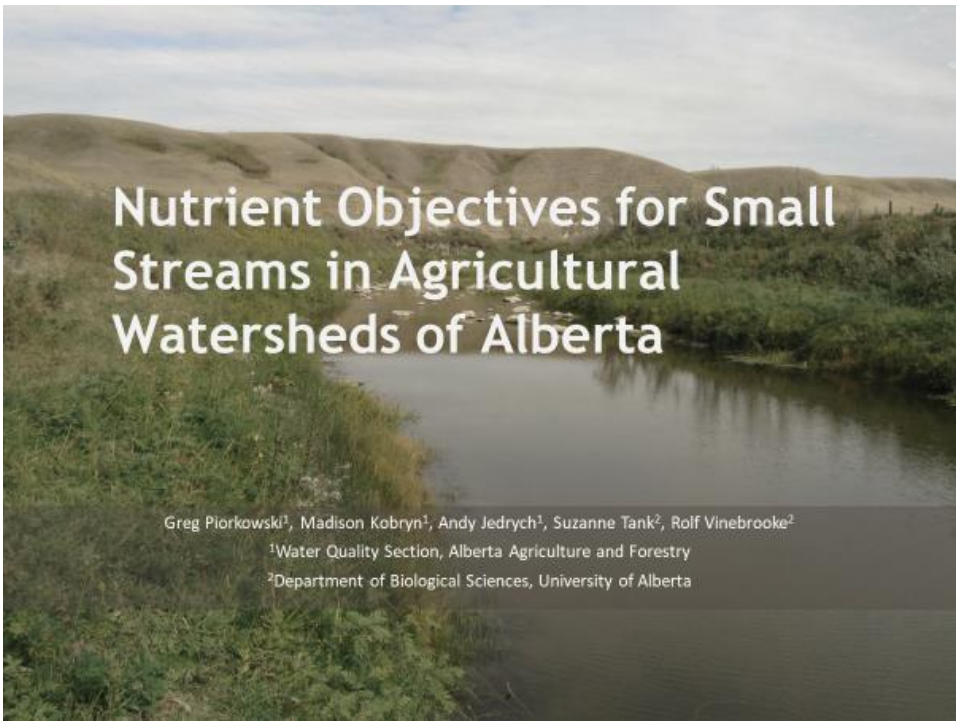
Funding Partners

The primary funder of the project is Alberta Environment and Parks' Watershed Resiliency and Restoration Program (WRRP). This project is funded in part through Natural Resources Canada's Climate Change Adaptation Program. Additional funding is supplied by the City of Edmonton, EPCOR and the McConnell Foundation.

ALUS participants will restore and enhance wetlands and riparian areas in the Modeste Creek watershed.

APPENDIX D – POWERPOINT PRESENTATIONS

1.1 PRESENTATION #1, BY DR. GREG PIORKOWSKI



Funding and Partners

ALBERTA INNOVATES

Alberta Agriculture and Forestry

UNIVERSITY OF ALBERTA

Alberta Environment and Parks

Agriculture and Agri-Food Canada

CROP SECTOR WORKING GROUP

North Saskatchewan Watershed Alliance

ILWG Intensive Livestock Working Group

Project Objectives

1. Derive nutrient objectives applicable to agricultural watersheds in Alberta using stressor-response modelling approaches.

2. Evaluate the achievability of nutrient objectives through watershed-scale BMP modelling

3. Assess the provincial-scale implications of adopting ecologically-based nutrient objectives in agricultural watersheds

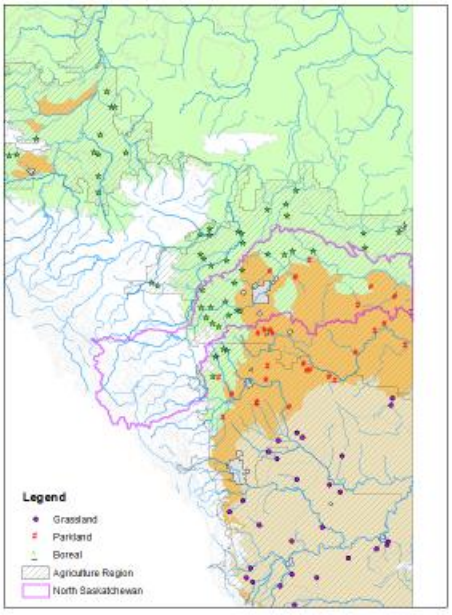
Project Scope:

1. Natural region focus
   - Parkland (26 sites) [2016-2018]
   - Grassland (30 sites) [2016-2018]
   - Boreal (30 sites) [2019-2021]

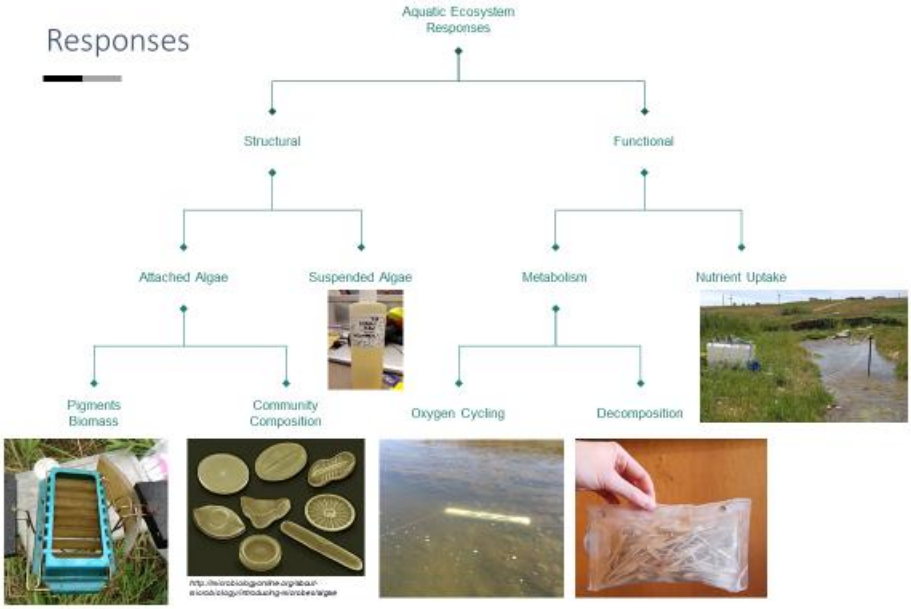
2. Streams/Tributaries

3rd Strahler Order

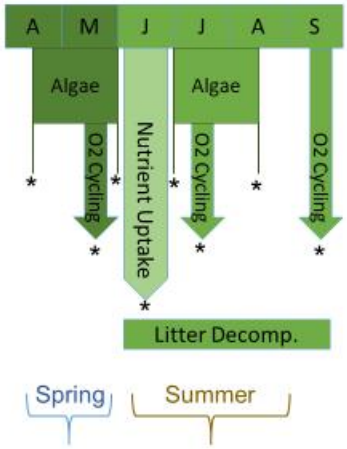
4th Strahler Order



Responses



Sample Schedule and Analysis



* Water sample

Nutrient Objectives: Proposed Approach

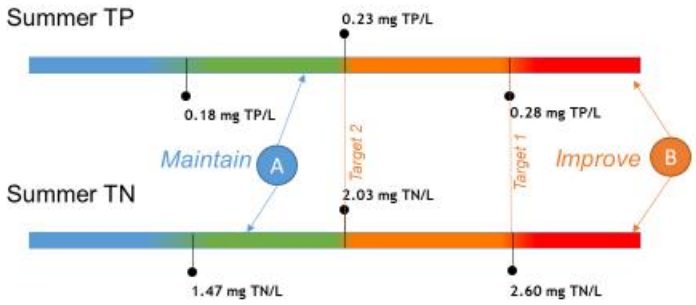
Unlikely to be Impaired
All ecosystem components are likely be performing well

Low Risk of Impairment
Aquatic ecosystem is in good condition, but some ecosystem components may be stressed

Moderate Risk of Impairment
Some ecosystem components may be operational, but most are likely to be altered

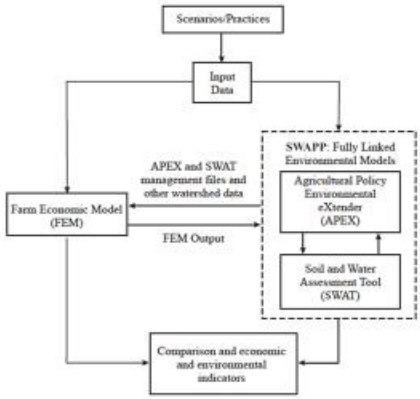
High Risk of Impairment
High degree of alteration in most ecosystem components

Example: Preliminary Parkland Objectives



Objectives = Mean ± Standard Error; Derived from 7x Ecosystem Response Metrics

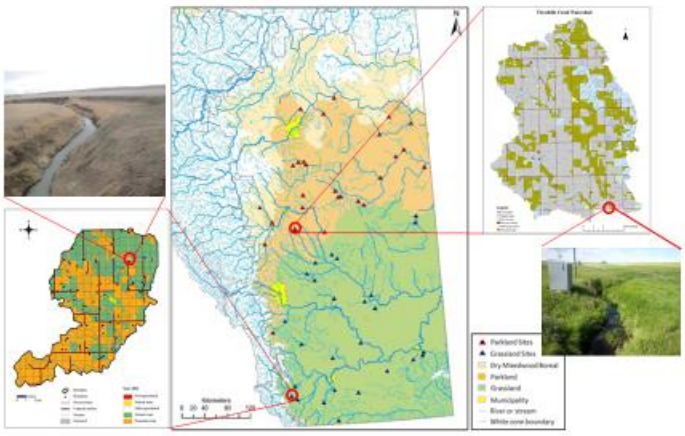
Achievability of Nutrient Objectives: Watershed-Scale BMP Modelling



Schematic of the CEEOT modelling system.

Watershed-Scale BMP Modeling: Study Sites

Parkland – Threehills Creek

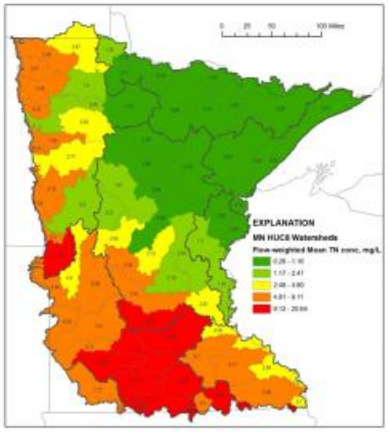


Grassland – Indianfarm Creek

Implications of Derived Nutrient Objectives

1. Estimate the nutrient concentrations in unmonitored watersheds?

- SPAtially Referenced Regressions On Watershed attributes (SPARROW) Model
  - USGS model for estimating water quality in unmonitored basins
- Watershed attributes include:
  - Physiography (topography, geology, soil, climate)
  - Land-use (land cover, linear disturbance, population density, # point sources, etc.)

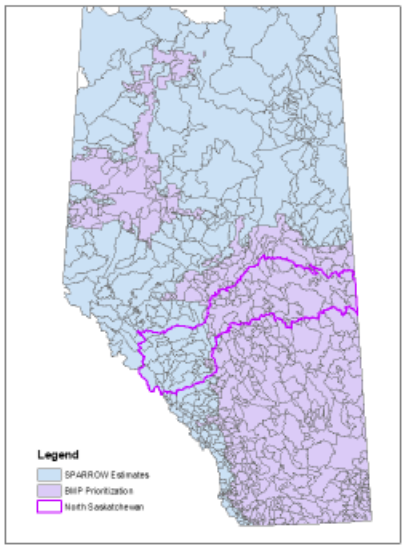


e.g., Wall and Gervino (2013). Nitrogen in Minnesota Surface Waters, Minnesota Pollution Control Agency

Implications of Derived Nutrient Objectives

2. Compare nutrient concentration estimates to risk-based nutrient objectives:

- What is the nutrient status of small streams across the province?
- Can we identify priority watersheds for implementing beneficial management practices?
  - i.e., identify risk zone by comparing nutrient estimates to objectives



1.2 PRESENTATION #2, BY MIKE CHRISTENSEN AND DR. CRISTINA BUENDIA-FORES

WaterSHED Monitoring Program

Mike Christensen – EPCOR-

Cristina Buendia – AEP-EMSD-

Alberta Environment and Parks

PROVIDING MORE EPCOR

Alberta Environment and Parks

Research Goals and Objectives

- Historical water quality monitoring has focused on the mainstem of the NSR; with limited tributary sampling.
- Need for a comprehensive and sustainably funded water quality and aquatic ecosystem health monitoring program.

2

PROVIDING MORE EPCOR

Alberta Environment and Parks

Program Funding

$1 Million per year funding from EPCOR City of Edmonton water rate payers

Special watershed monitoring rate surcharge

< 15 cents per monthly residential bill

Four years funding (2018 -2021) with possible renewal

Additional in-kind resources provided by AEP Monitoring and Science Division

PROVIDING MORE EPCOR

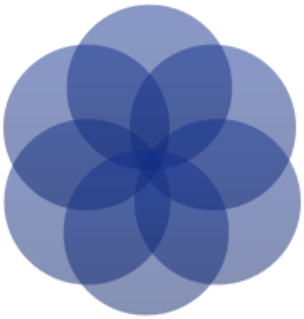
Alberta Environment and Parks

Steering Committee

EPCOR Water

City of Edmonton – Economic and Environmental Sustainability

EPCOR Drainage



North Saskatchewan Watershed Alliance

AEP – Environmental Monitoring and Science Division

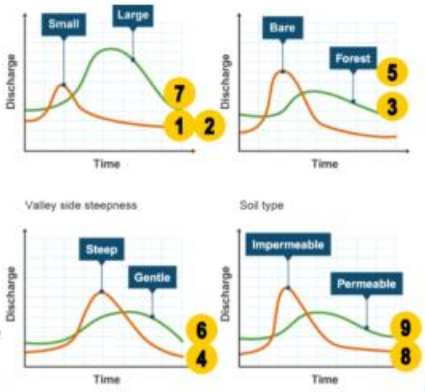
AEP - Operations

PROVIDING MORE EPCOR

Alberta Environment and Parks

Project aim

Evaluate changes in water quality and the causes of any identified change in the North Saskatchewan



PROVIDING MORE EPCOR

Alberta Environment and Parks

Project aim

Evaluate changes in water quality and the causes of any identified change in the North Saskatchewan River

Monitoring stations must:

- Capture the variability of the hydrological regime
- Be representative of:

Spatial variability

- Range of watershed scales
- Environmental conditions (climate, lithology, land use)

Temporal variability

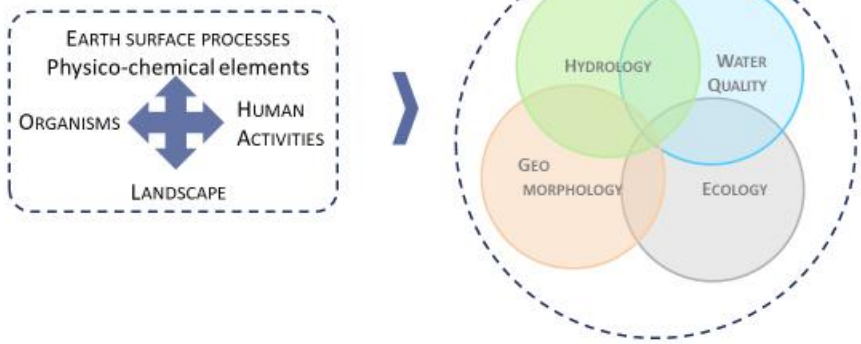
- Inter-annual variability (wet vs dry years)
- Intra-annual variability (seasonality)

PROVIDING MORE EPCOR

Alberta Environment and Parks

Project aim

Multidisciplinary approach



Alberta Environment and Parks

Monitoring design

- Enhance water quality monitoring at current **Long Term River Network** (LTRN) sites
  - Sites across major rivers in Alberta
  - Includes monthly samples of water for most water quality variables

Alberta Environment and Parks

Monitoring design

- Enhance water quality monitoring at current **Long Term River Network** (LTRN) sites
  - Sites across major rivers in Alberta
  - Includes monthly samples of water for most water quality variables
- Add a **Tributary Monitoring Network** (TMN)
  - Augment data generated from LTRN
  - Increase monitoring on tributaries to major river systems

Alberta Environment and Parks

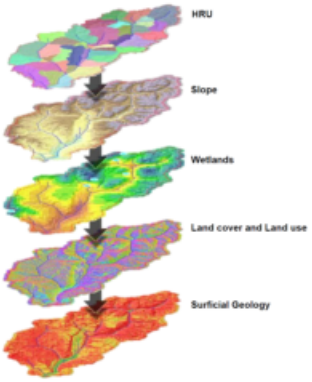
Monitoring design

- Enhance water quality monitoring at current **Long Term River Network** (LTRN) sites
  - Sites across major rivers in Alberta
  - Includes monthly samples of water for most water quality variables
- Add a **Tributary Monitoring Network** (TMN)
  - Augment data generated from LTRN
  - Increase monitoring on tributaries to major river systems
- Monitoring design based around a **mass balance approach**
  - Water quality data paired with water quantity data
    - Budgets for the substance of interest
    - Understand substance fluxes

Alberta Environment and Parks

Monitoring design

Site selection based on a **Hydrological Response Unit** (HRU) approach
HRU – Landscape Units with similar hydrological response



Combination of slope, surficial geology, land cover and land use

Cluster Analysis to group watersheds into groups of watersheds that are similar to each other

Determine magnitude and timing of the hydrological response of the watershed to a rainfall or snowfall event

Credit: John Orwin

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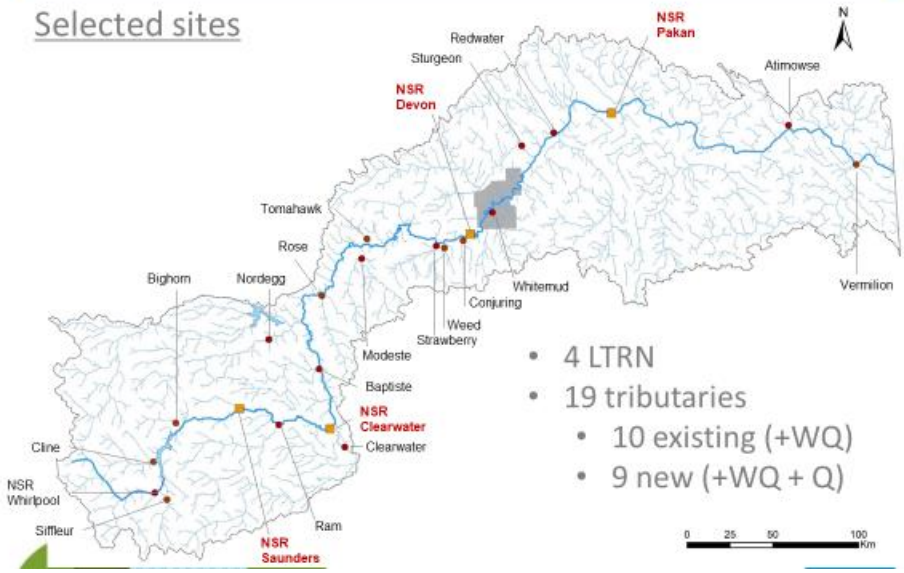
Alberta Environment and Parks

Monitoring design

Selected sites



- 4 LTRN
- 19 tributaries
  - 10 existing (+WQ)
  - 9 new (+WQ + Q)

Alberta Environment and Parks

2019 -Work plan-

Core monitoring program

- Complete installation of hydrometric stations and sonde deployment
- Spring freshet water quality sampling

Focused studies

- DOC dynamics – Implications for water treatment
  - Deployment of fDOM sensors in contrasting tributaries
- Benthic invertebrate communities along the gradient of watershed conditions

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Questions?

Alberta Environment and Parks

PROVIDING MORE EPCOR

1.3 PRESENTATION #3, BY DR. FAYE WYATT AND DR. CRISTINA BUENDIA-FORES

Watershed Integrity and Aquatic Ecosystem Health in the NSR

Faye Wyatt PhD., Cristina Buendia-Fores PhD.,

Environmental Monitoring and Science Division (EMSD), Alberta Environment and Parks.

Aquatic Ecosystem Health assessments

Ecosystems that sustain their ecological structures, processes, functions and resilience within their range of natural variability (AWC, 2008)

Traditionally inferred using local-scale field assessments

- In-stream chemical quality
- Physical habitat conditions
- Biological communities (periphyton, invertebrates, fish)

Aquatic Ecosystem Health assessments

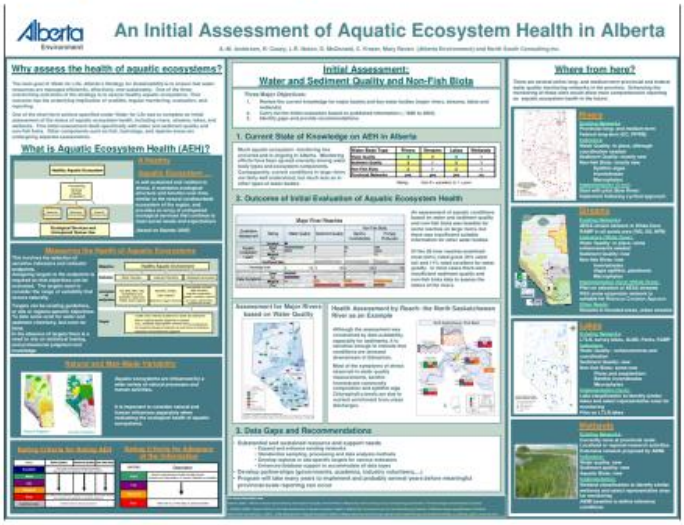
Ecosystems that sustain their ecological structures, processes, functions and resilience within their range of natural variability (AWC, 2008)

Traditionally inferred using local-scale field assessments

- In-stream chemical quality
- Physical habitat conditions
- Biological communities (perophyton, invertebrates, fish)

- Require frequent, costly and time-consuming collections of field data
- Are not practical across large regions
- Extended gaps in time may occur between assessments

Aquatic Ecosystem Health assessments

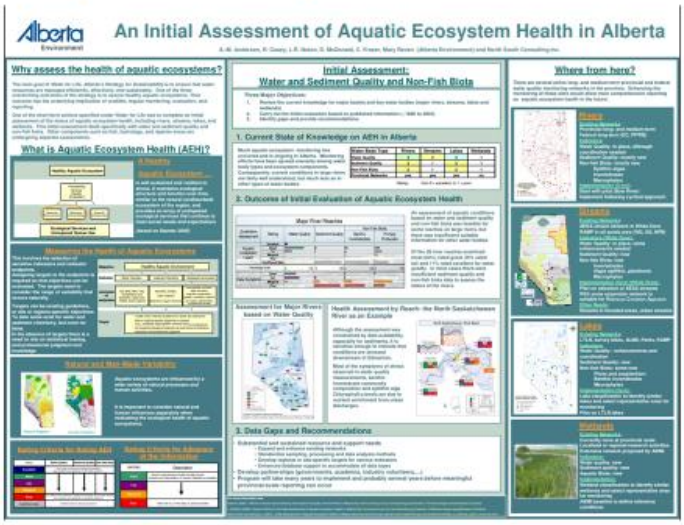


Alberta Environment -2007-

AEH based on:

- Water quality
- Sediment quality
- Primary producers
- Benthic invertebrates

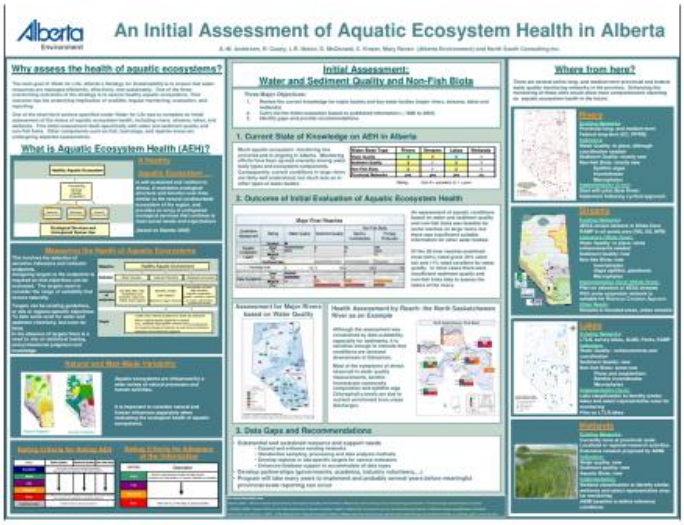
Aquatic Ecosystem Health assessments



Alberta Environment -2007-

- Data limitations, mainly in small tributaries
- Influence of surrounding landscapes not considered

Aquatic Ecosystem Health assessments



Alberta Environment -2007-

- Data limitations, mainly in small tributaries
- **Influence of surrounding landscapes** not considered

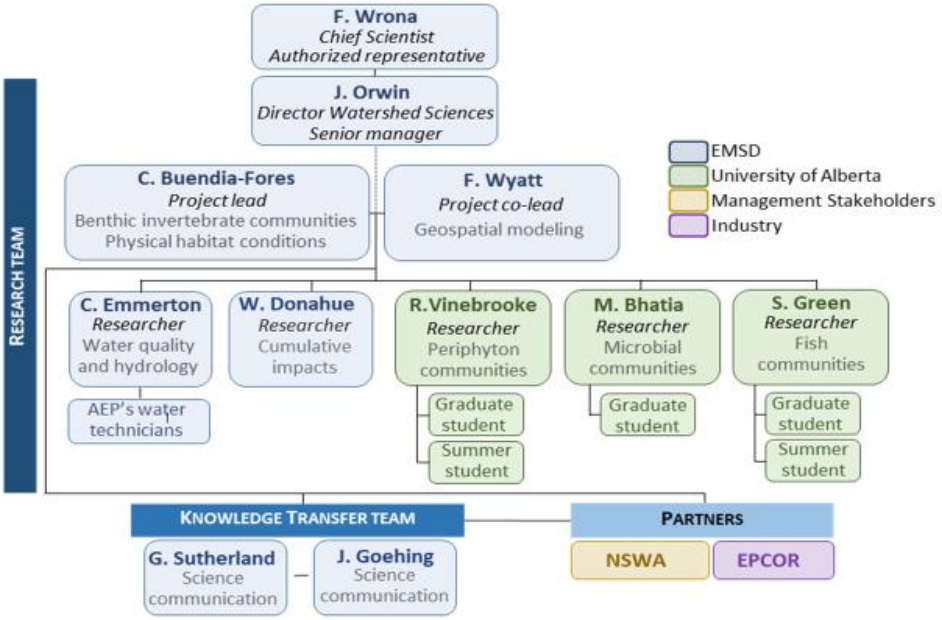
Geospastial models are tools that link site-specific assessments with metrics describing stressors occurring in broader watershed scales

Watershed Integrity

"The capacity of a watershed to support and maintain the full range of ecological processes and functions essential to the sustainability of biodiversity and of the watershed resources and services provided to society" (Flotemersch et al. 2018 pp.1656).

Research Goals and Objectives

- Objectives
  1) Conduct a multi-metric assessment of aquatic ecosystem health (fish, benthos, algae, microbes, water quality)
  2) Develop stressor-response relationships between aquatic ecosystem health and watershed scale stressors (e.g. agriculture, urban development, industrial activities, wetland loss, climate etc.)
  3) Develop, implement and assess candidate geospatial model of watershed integrity
  4) Quantify watershed integrity for the NSR basin



Funding and Timeline

- This project is at the Full Proposal stage with Alberta Innovates, a funding decision is expected XXX.

- ***If*** funded, work for this project will run April 2019 – March 2022.

Field-Data

- Water Quality (EPCOR)
- Fish
- Benthic Invertebrates
- Periphyton
- Microbes

Measure of Aquatic Ecosystem Health

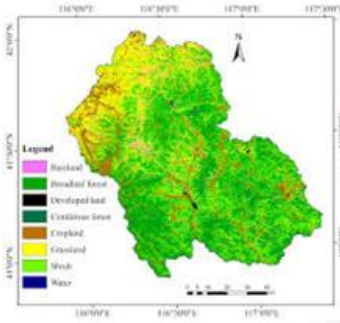


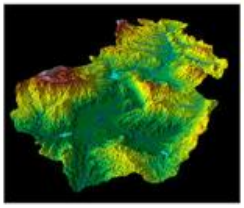
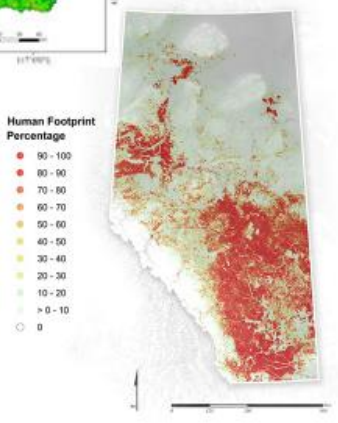


Geospatial-Data

- Land-use/Land cover
- Human Footprint
- Climate
- Wetlands
- Topography
- Forest Fires
- Remote sensing metrics
- Other…

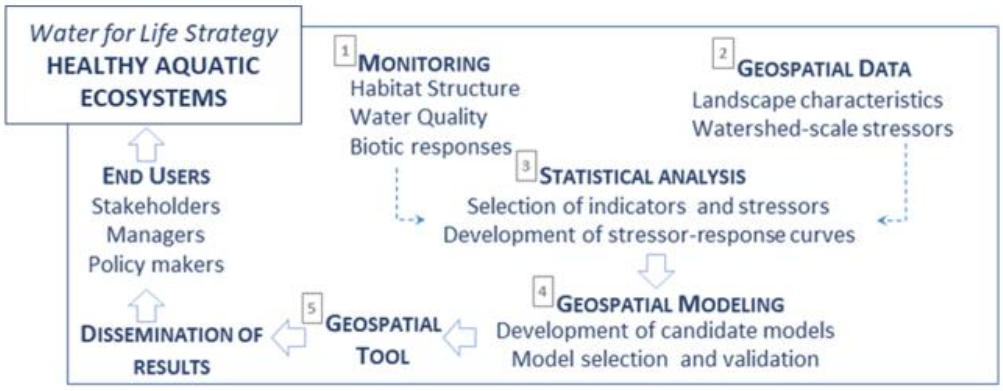
Model of Watershed Integrity



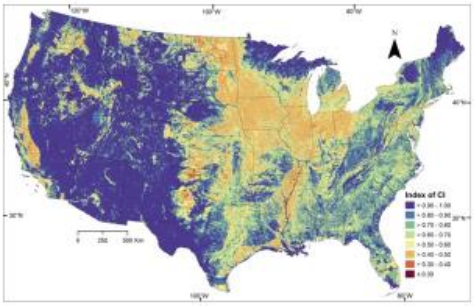
Modeling

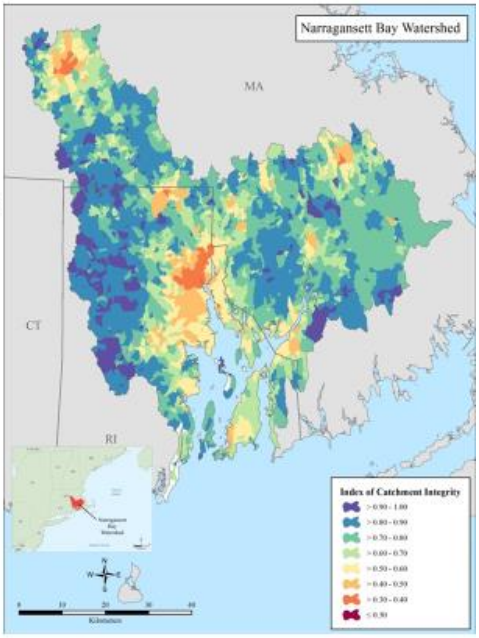
Modeling



Modeling

- Model results at HUC10 scale
- Evaluation of geospatial (e.g. Thornburgh et al, 2018) and statistical (e.g. Goddard et al, 2008) models





Conclusions

- Project is in its infancy
- Dependent on funding for work
- Collaborators welcome!

References

- Flotemersch, J. E., Leibowitz, S. G., Hill, R. A., Stoddard, J. L., Thoms, M. C., & Tharme, R. E. (2016). A Watershed Integrity Definition and Assessment Approach to Support Strategic Management of Watersheds. River Research and Applications, 32(7), 1654–1671.
- Goddard, M. A., Post, C. J., English, W. R., & Pike, J. W. (2008). Examining the impacts of changing land use on biological integrity in streams using Geographical Information Systems and statistical modeling. Aquatic Ecosystem Health & Management, 11(2), 230–242.
- Thornbrugh, D. J., Leibowitz, S. G., Hill, R. A., Weber, M. H., Johnson, Z. C., Olsen, A. R., … Peck, D. V. (2018). Mapping watershed integrity for the conterminous United States. Ecological Indicators, 85, 1133–1148.

Questions ?

1.4 PRESENTATION #4, BY DR. MONIREH FARAMARZI

Adapting to Changing Water in Alberta

Monireh Faramarzi, Assistant Professor, Campus Alberta Innovation Program(CAIP) Chair in Watershed Science
University of Alberta

Feb 05, 2019

Research Goals and Objectives

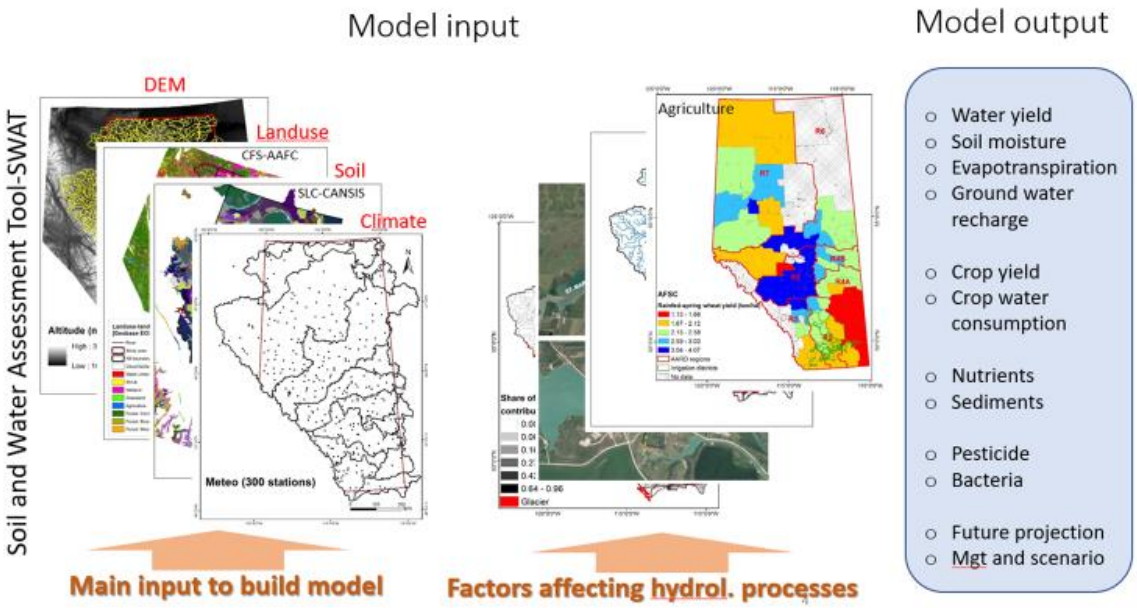
Main goal:

- Develop provincial water supply demand model for long-term policy and planning

Objectives:

- Assessment of blue and green water supply at sub-basin spatial and monthly temporal resolution (historical and future periods)
- Assessment of water demand of various water intensive crops and beef industry
- Assessment of water needs of environment (e.g., wetlands)
- Assessment of water needs of municipal and other industries

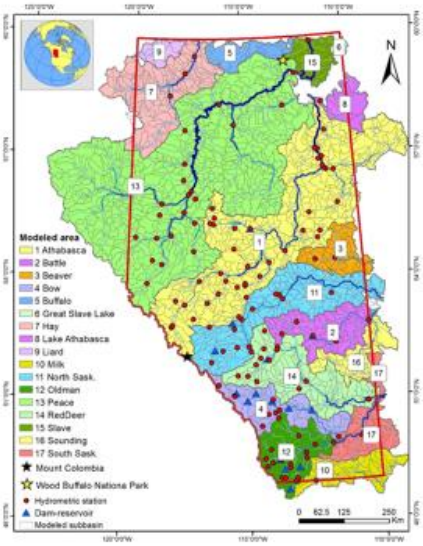
ALBERTA INNOVATES · Alberta Agriculture and Forestry · NSERC CRSNG Discovery Grant Program · Caip Chair Funding



3

Model Resolution

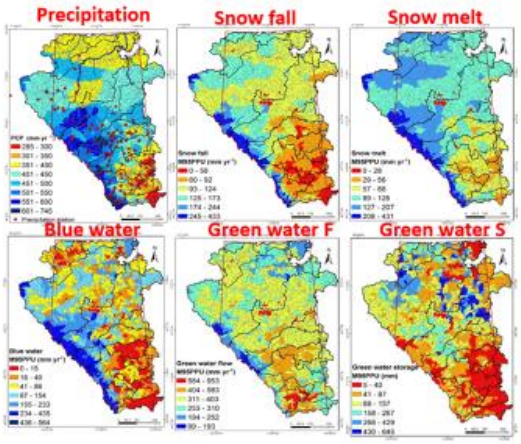
- **Study area: ~ 700, 000 Km²;** 2255 subbasins were delineated using SWAT with a 200 km² drainage area
- **Model calibration-validation (1983-2007):** at 129 hydrometric stations



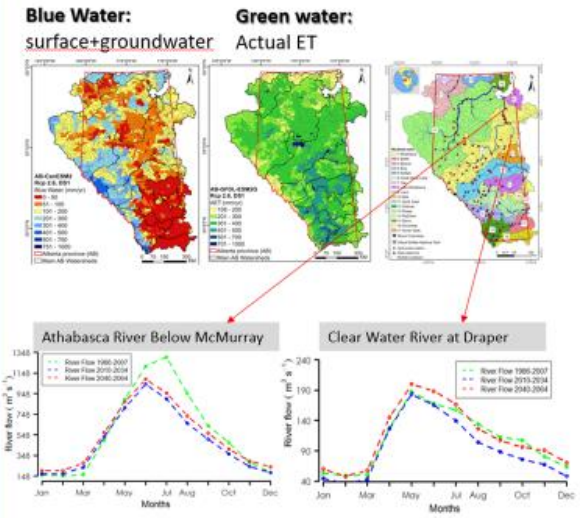
Reference:

Faramarzi et al., Setting up a hydrological model of Alberta: Data discrimination analyses prior to calibration, *Environmental Modelling & Software, 2015.*

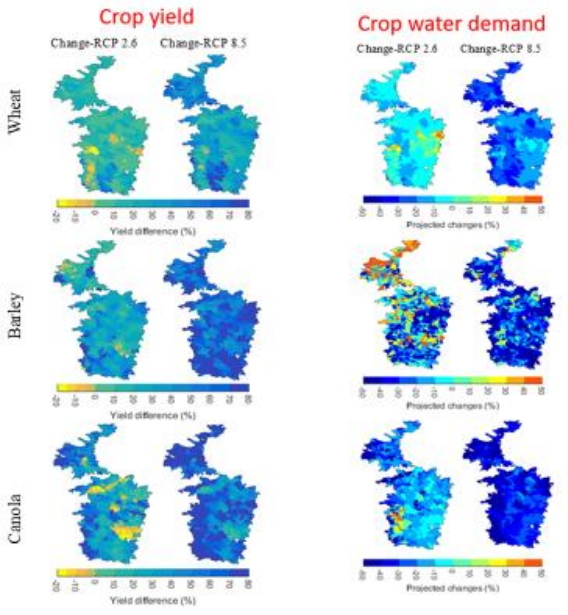
Results

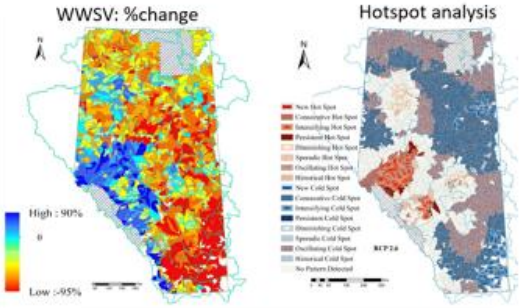


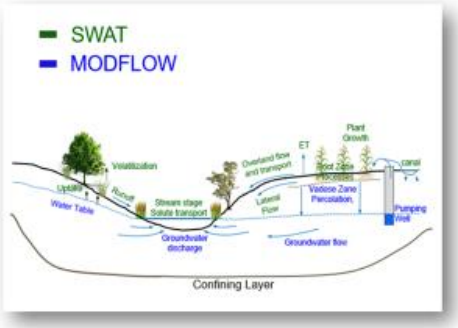
Historic (1983-2007)



Future (2010-2040)
(2040-2070)







Reference: *Masud et al., 2018, 2019. Science of the Total Environment.*
https://cms.eas.ualberta.ca/faramarzilab/key-publications/

Conclusions

Models are developed for different purposes (operational site specific process simulation vs regional planning and management)

Models are useful tool but there is no best model

Models are subject to uncertainty: input data, conceptual, parameters

In our wetland water demand analysis:

- no time series data for the wetlands water level
- no high resolution topographic map identifying wetlands watershed areas (Vmax)

Conclusions

Potential research:

High resolution hydrology model for studying SW-GW interactions in NSW

Improving and integrating glacier melt/runoff; freezing/thaw process; Snow processes;

Simulation of the role of wetlands in regional hydrology by incorporating better input data and related key processes

1.5 PRESENTATION #5, BY KYLE SWYSTUN

Drinking Water Infrastructure Risk and Vulnerability Study

North Saskatchewan River Research Information Exchange

Kyle Swystun, Resilience Planner
Alberta Environment and Parks
Watershed Adaptation and Resilience Branch
February 5, 2019

Alberta

AEP – WAR Branch

- Flood Recovery Task Force (2013 Flood)
- Improve flood and drought resilience
- Flood hazard mapping and forecasting
- Transboundary water management

2

Alberta

Project Summary

- Determine current and future flood and drought risk to drinking water infrastructure
  - Stress test system (high/low flow)
  - What is at risk? (e.g. intake, treatment plant, etc.)
  - Provide facility level reports to communities

Water for Life Strategy

- Healthy aquatic ecosystems
- Reliable, quality water supplies for a sustainable economy
- Safe, secure drinking water

Funding Partnership

- Alberta Innovates Water Innovation Program
- AEP, WAR Branch

Associated Engineering

- Canadian consulting company
- Edmonton HQ
- Familiar with AB drinking water systems

Facility Questionnaire

- Gauge level of facility preparedness related to flood and drought

Watershed Science and Modelling Lab

- University of Alberta
- Monireh Faramarzi
- Soil & Water Assessment Tool (SWAT)
- RCP 2.6 & RCP 8.5


Questions?
Thank you!
Kyle.Swystun@gov.ab.ca
Alberta

1.6 PRESENTATION #6, BY DR. WANHONG YANG

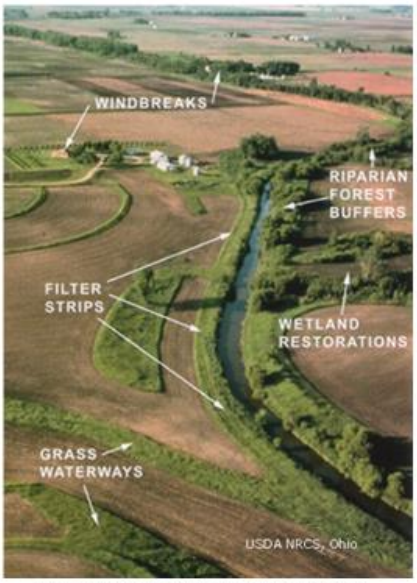
An overview of the IMWEBs model for evaluating ecosystem services from watershed restoration

Wanhong Yang, Professor; Yongbo Liu, Research Scientist; Shawn Shao, Postdoc; John Lindsay, Associate Professor

University of Guelph

MNIP Research Goals and Objectives - IMWEBs

- Develop the IMWEBs-based ES assessment tool. Setup, calibrate and validate the ES assessment tool – March 2020
- Develop the user interface for the ES assessment tool. Apply the ES assessment tool and interface to simulate water quantity, quality and carbon sequestration benefits of natural infrastructure projects for the Modeste subwatershed – March 2021
- Communicate the modelling results to project partners – March 2022



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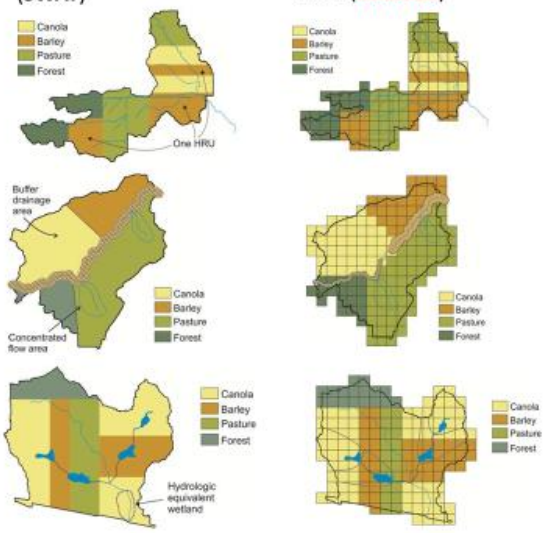
Soil and Water Assessment Tool (**SWAT**)

Integrated Modelling for Watershed Evaluation of BMPs (**IMWEBs**)



IMWEBs Supported BMP List - 1

General BMPs

- Crop management
- Tillage management
- Fertilizer management
- Grazing management

Wetland restore BMPs

- Isolated wetland restoration

Livestock BMPs

Manure and nutrient management

- Manure incorporation
- Manure setback
- No application on snow
- Fall application
- Apply based on soil N level
- Apply based on soil P level
- Feedlot management
- Manure storage design
- Catch basin management
- Dugout

IMWEBs Supported BMP List - 2

Livestock BMPs

Riparian and surface water management

- Manage access including fencing
- Riparian buffer strip
- Grassed waterway

Wintering site management

- Changing location and area of wintering site
- Alternating wintering site annually
- Vegetation adjacent to wintering site

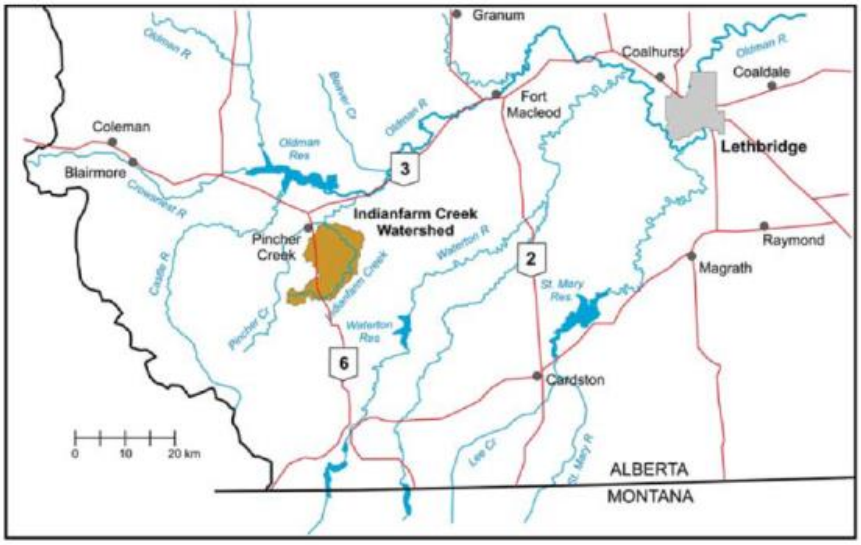
Pasture management

- Rotational grazing
- Timing and density of stocking
- Plant species in tame pasture
- Conservation and sustainable use of natural areas

Marginal crop land management

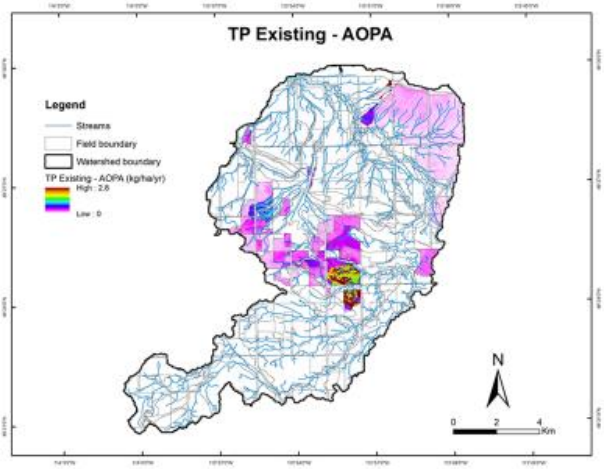
- Conversion to tame perennials
- Conversion to native perennials

The Indianfarm Creek Watershed



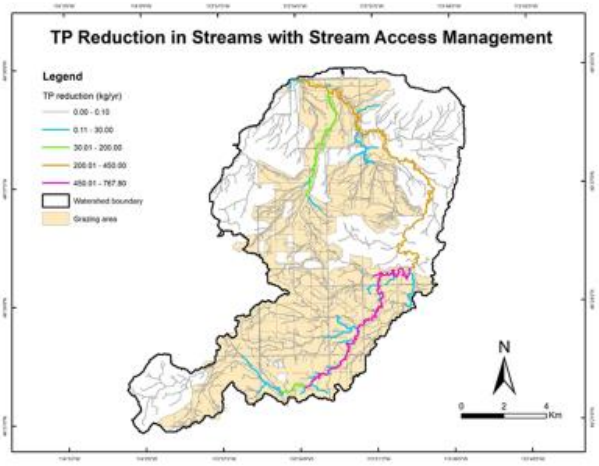
Agricultural Operation Practices Act (AOPA) Effect Analysis (2001-2012)

- AOPA application area 1,951.5 ha
- Total TP reduction compare to existing condition 2,026 kg/year

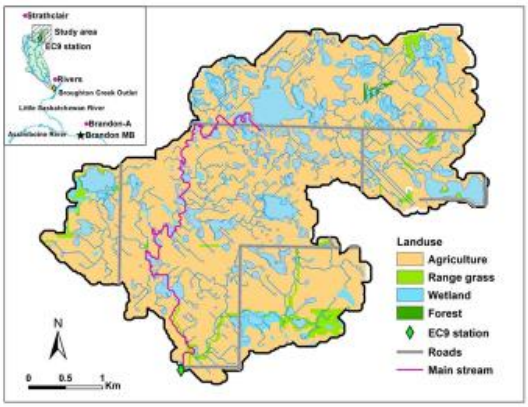


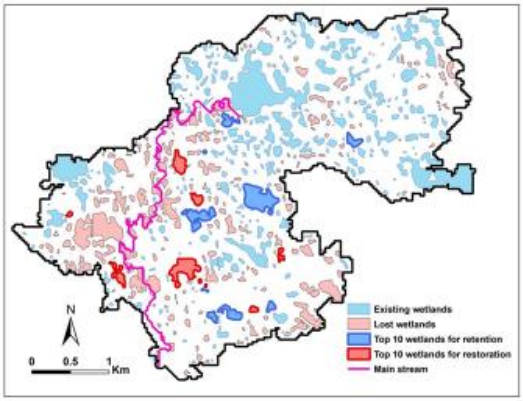
Stream Access Management Effect Analysis (2001-2012)

- Stream access management reduced TP loading at the outlet by 418.1 kg/year, which is 1.71% of total loading
- The average per kilometer stream access TP reduction effect is 5.04 kg TP reduction/km/year



Wetland Loss and Restoration Effect Analysis (2009-2013)





Top 10 for retention – 6.7 kg/ha/yr

Top 10 for restoration – 7.9 kg/ha/yr

Data for IMWEBs Modelling

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- Climate (Daily temperature and precipitation including snow)
- Topography (LiDAR DEM is preferred), landuse/landcover (including crop inventory), soil layer and attributes
- Flow and water quality data
- Land management (such as seeding, harvesting, tillage, manure and fertilizer application, livestock)
- BMPs (such as wetland creation, enhancement, and restoration; Riparian area protection or enhancement, exclusion fencing, native prairie/pollinator habitats, nesting structures, reforestation, shelterbelts)

Conclusions

- The IMWEBs is a cell-based model which evaluates water quantity and quality of agricultural beneficial management practices (BMPs) at four scales: site, field, farm, and watershed scales
- The IMWEBs model evaluates ecosystem services (ES) for a suite of agricultural BMPs including conservation tillage, nutrient management, manure catch basin, grazing management, riparian buffer management, wetland restoration, and marginal land conversion
- The IMWEBs is the only model in Canada that is designed for evaluating agricultural BMPs at site, field, farm, and watershed scales

1.7 PRESENTATION #7, BY DIANA STALEY & DR. MARIAN WEBER

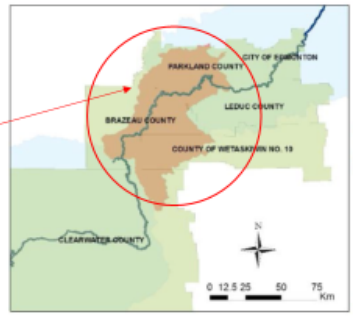
Municipal Natural Infrastructure Project (MNIP)

Dr. Marian Weber,
Principal Researcher
InnoTech Alberta and NAIT

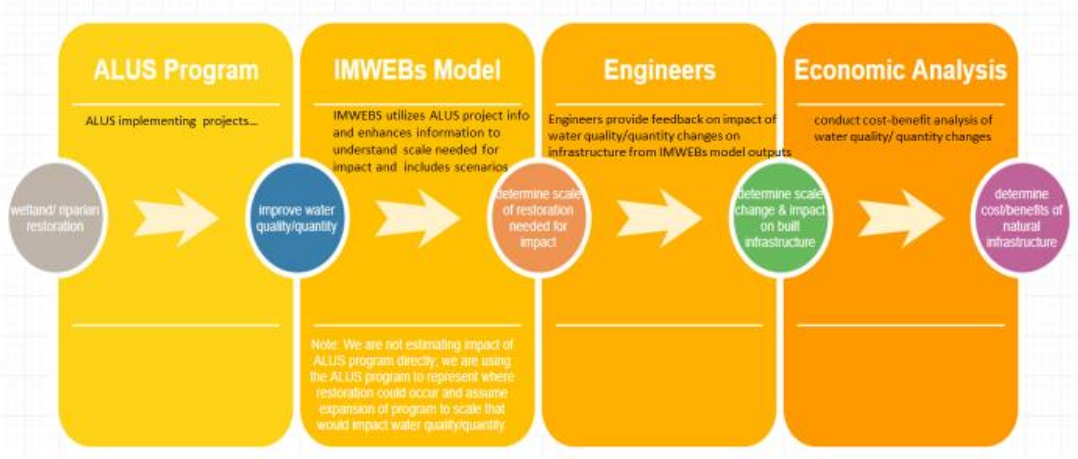
Diana Staley,
Economic Researcher
InnoTech Alberta

Research Goals and Objectives

- **Goals and Objectives:**
  - **GOAL:** To understand the business case for natural infrastructure through wetland and riparian restoration (from a watershed perspective)
  - **OBJECTIVE #1:** Conduct cost-benefit analysis of the interaction between natural infrastructure and built infrastructure (measured through various changes in water quality/quantity and its impact built infrastructure)
  - **OBJECTIVE #2:** Create guidance documents for evaluating natural infrastructure options
- **Partners/Funder**
  - Natural Resources Canada (NRCan)
- **Time line**
  - November 2018 - November 2020
- **Geographic Location (study site)**
  - Modeste subwatershed (upstream from Edmonton)



Modeling



Modeling

We are considering <u>4 scenarios</u>.

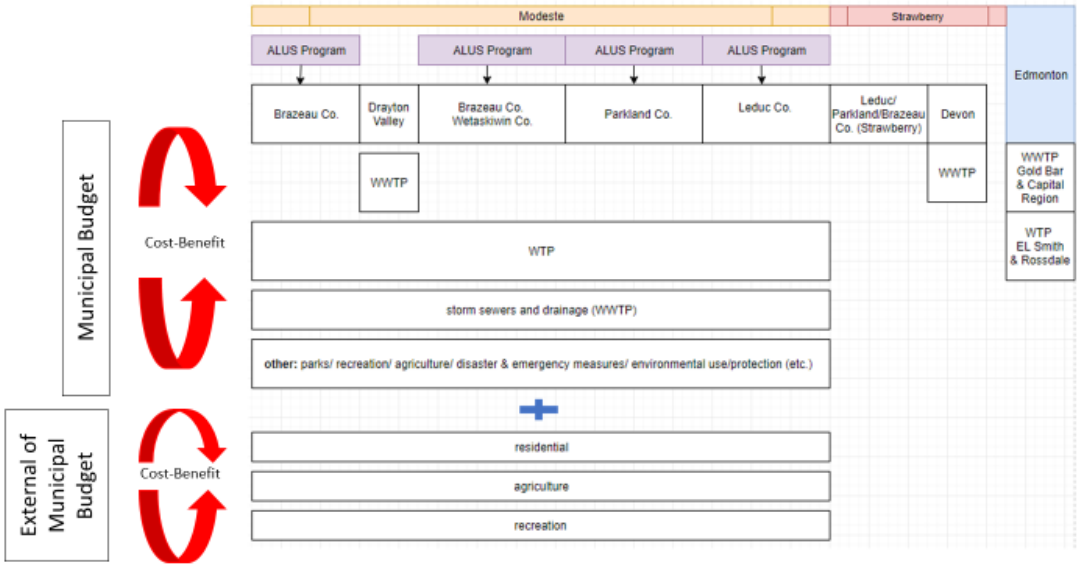
Municipalities:
-Parkland Co.
-Leduc Co.
-Wetaskiwin Co.
-Brazeau Co.

Infrastructure (built)	Infrastructure (natural)
No upgrade	**Loss** (status quo) (Scenario #1)
	Restoration (Scenario #2)
Upgrade	**No Restoration** (Scenario #3)
	Restoration (Scenario #4)

IMWEBs will provide changes in:
1) water quantity
2) water quality

...for each scenario

Data



Conclusions

- We are beginning to define the scope/boundaries project:
  - what infrastructure to include/exclude
  - what specific costs and benefits are most important to consider
- We will work with engineers to better understand:
  - what water infrastructure exists in Modeste
  - how water quality/quantity can impact different types of water infrastructure
- We plan to work with municipalities/engineers to understand:
  - how they cost infrastructure