Water Innovation Program

Alberta Innovates Energy and Environment Solutions

Addressing Alberta's Water Challenges & Opportunities
AI-EES Water Innovation Program

Dr. Brett Purdy, Senior Director

Alberta Innovates Corporations

Alberta Innovates Bio Solutions

Alberta Innovates Energy and Environment Solutions

Alberta Innovates Health Solutions

Alberta Innovates Technology Futures

AI-EES History

AI-EES Mandate

"Research, innovation and technology implementation arm of the Alberta Government in energy and environment"

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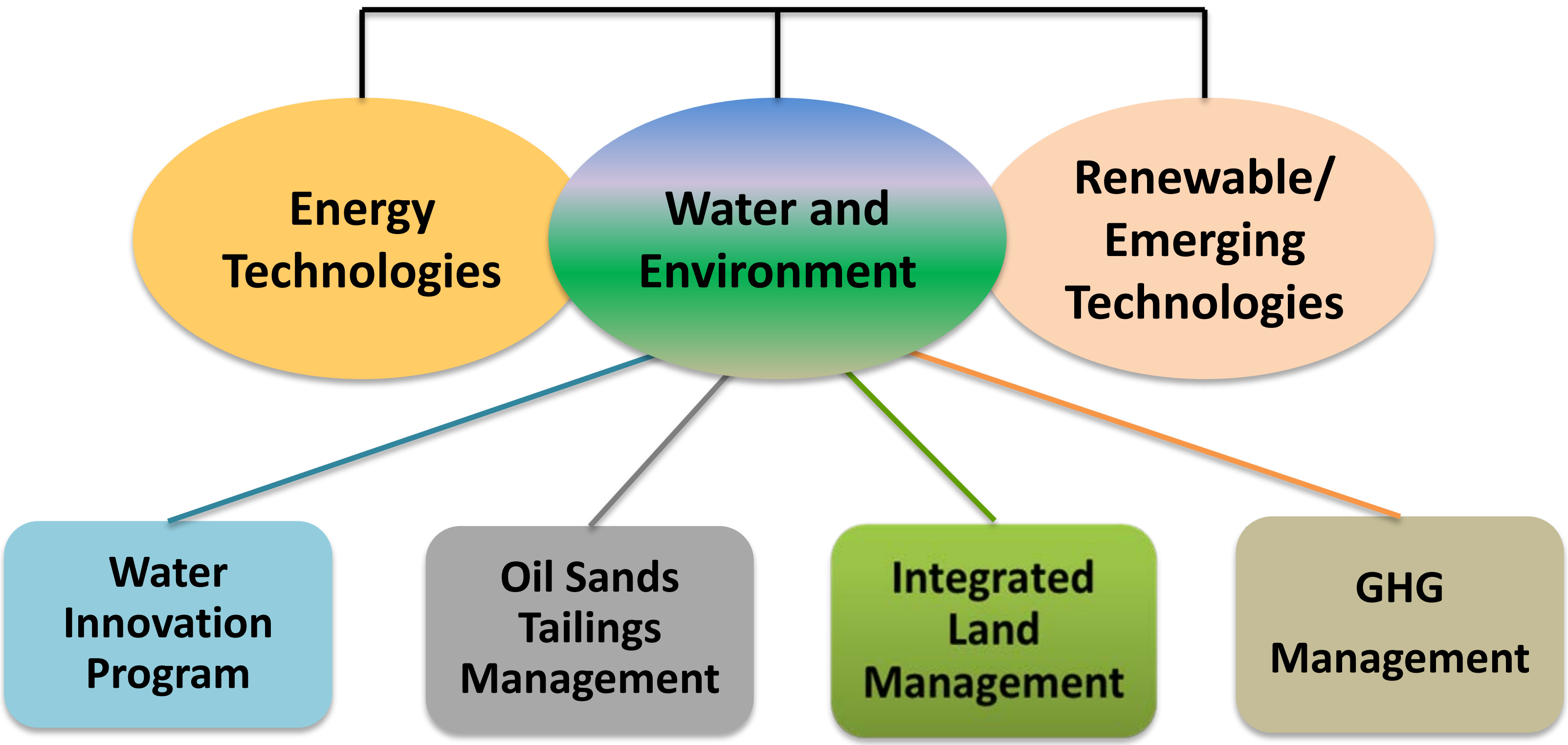
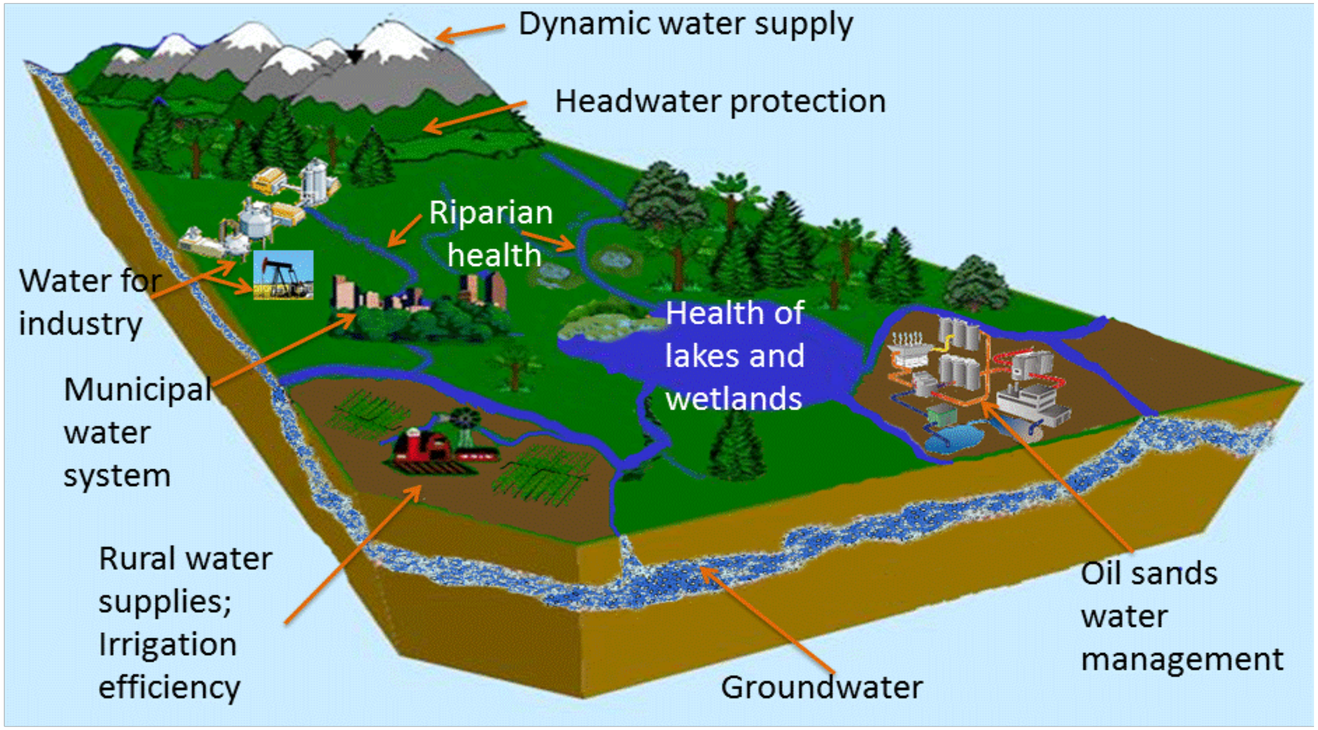


Water Innovation Program (WIP)

Innovation to support Alberta's *Water for Life* strategy

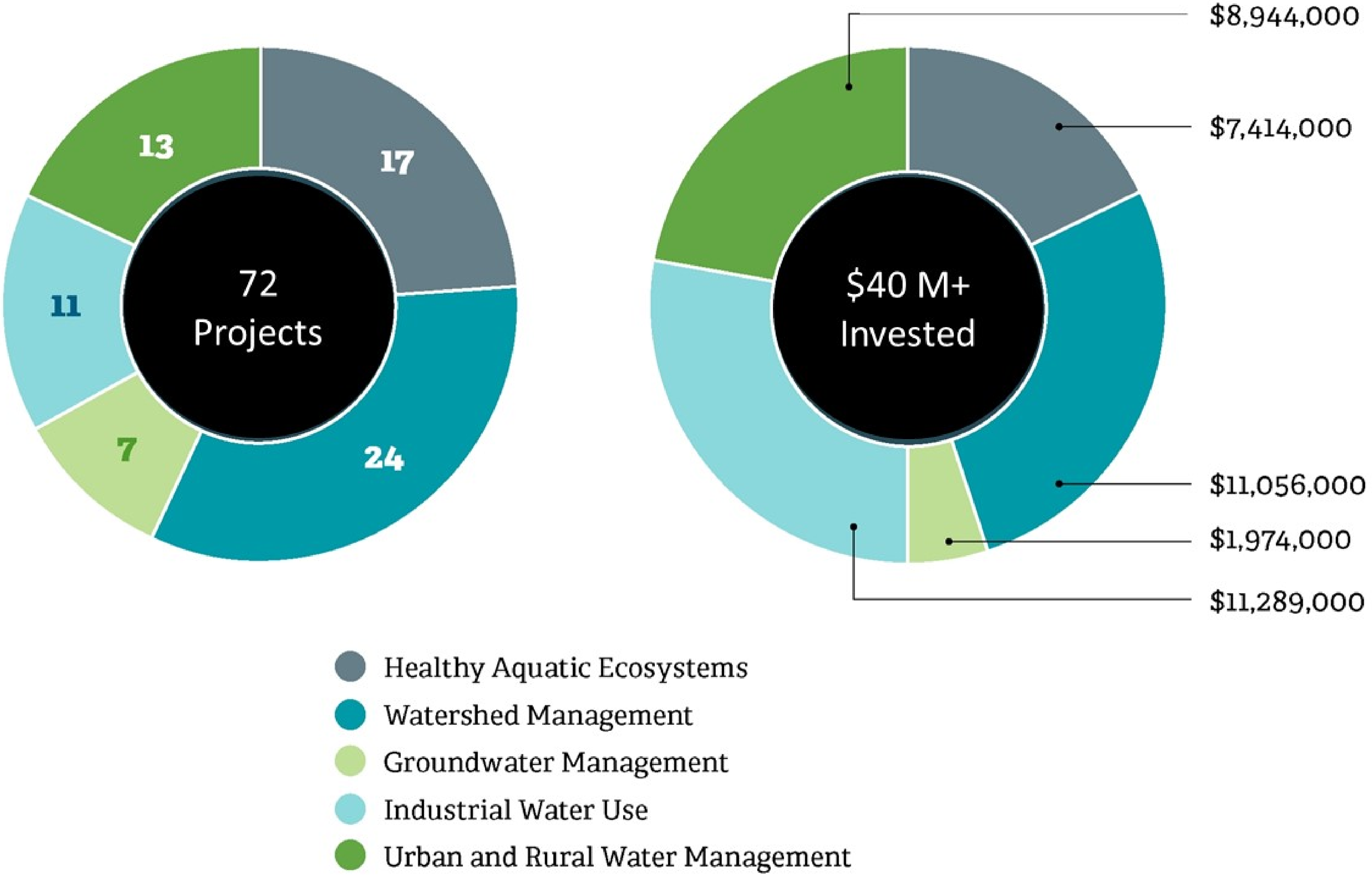
- Safe, secure and reliable water resources for six million people
- Enhance the health of aquatic ecosystems
- Improve the overall efficiency and productivity of water use by 30%



Alberta's water challenges

- Invasive species
- Droughts / floods
- Eutrophication
- Resource extraction
- Food production
- Contaminants
- Reuse
- …..

AI-EES commitment to water research

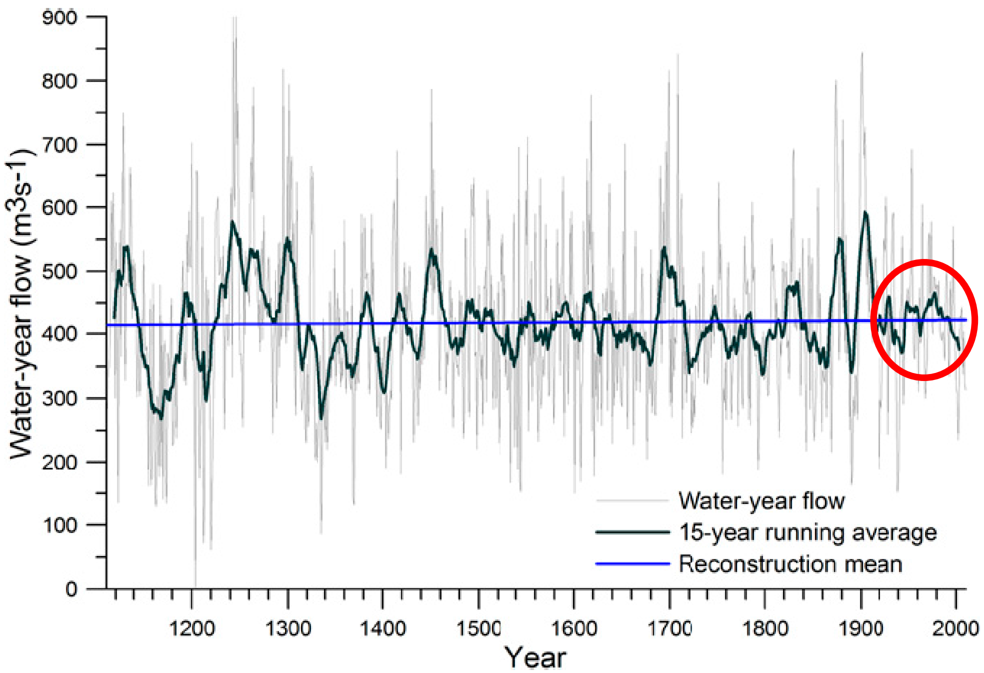


AI-EES Water Innovation Program: Key Research Themes

- Future Water Supply and Watershed Management
- Healthy Aquatic Ecosystems
- Water Use Conservation, Efficiency, & Productivity
- Water Quality Protection

Sustainable urban water management - climate variability and change

Collaborators –EPCOR, City of Calgary, PARC, Uregina (for work on SSRB and NSRB)



PNAS (2014) Vol 112:12621–12626 – note the above graph is from the Athabasca River Basin, although the interpretation of results in the SSRB and NSRB are similar

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Southern Rockies Watershed Project

Disturbance – hydrology – water quantity – water quality – sediments - drinking water treatment

University of Alberta, Waterloo, City of Calgary, Government of Alberta

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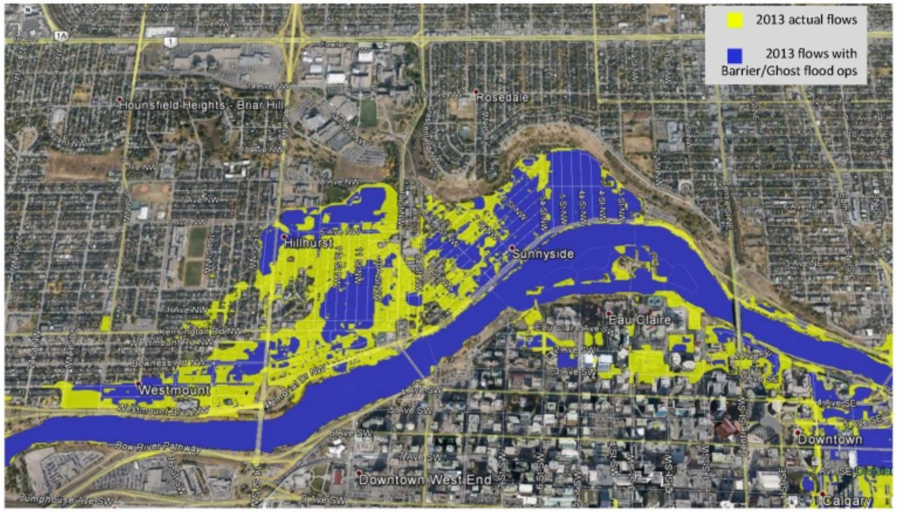
Watershed Management:
South Saskatchewan River Basin (SSRB)

- stakeholder engagement
- impact on issues
    - current (basin management & allocation)
    - emerging (flooding)
    - long-term (climate change)

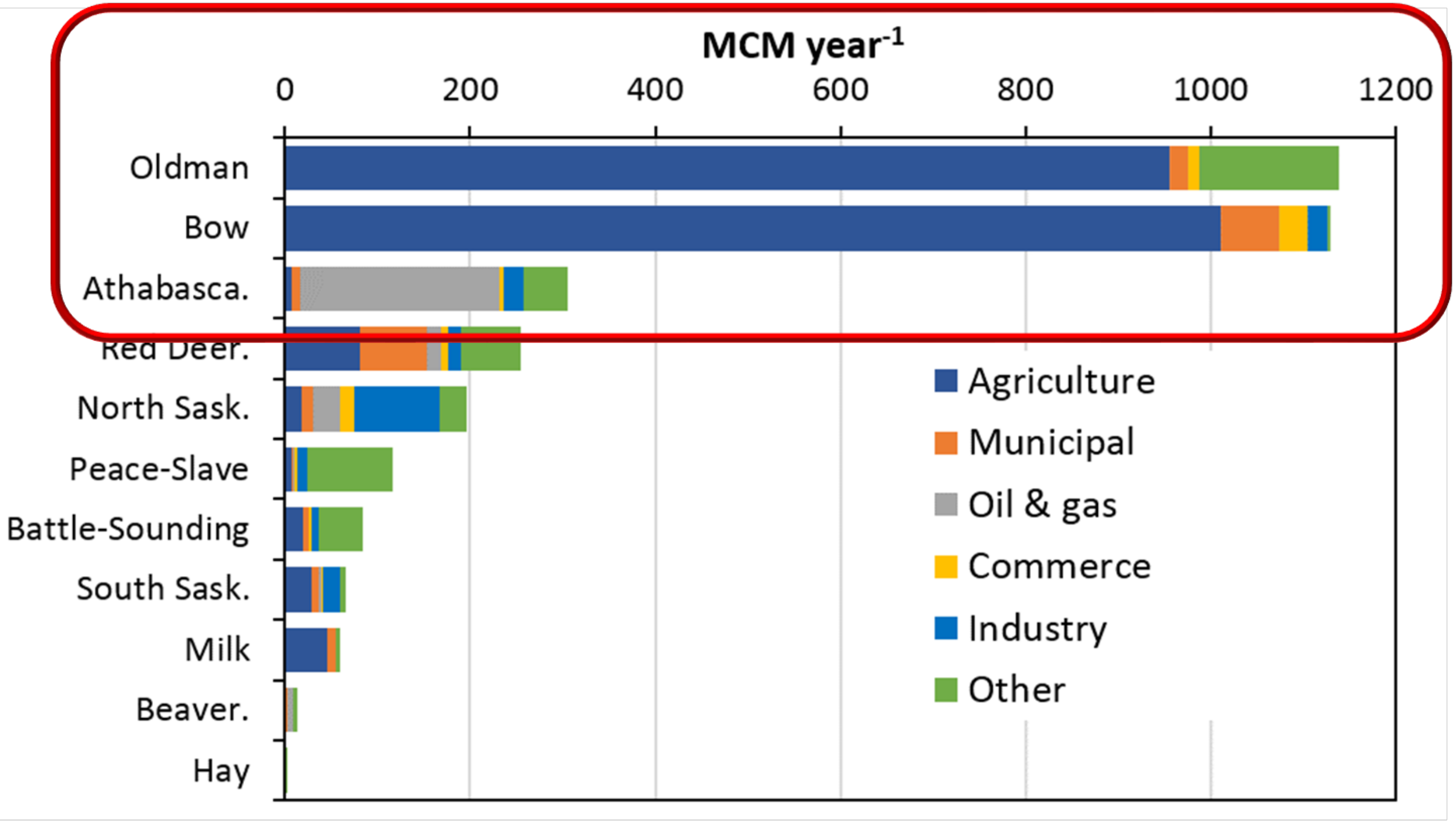
Watershed Management:
South Saskatchewan River Basin (SSRB)

Solving emerging issues



Management strategies

Water consumption *(Adamowicz, Goss, Faramarzi)*



Remediation Outcomes …

Remove the parts that expose risk to the local environment?

Contain the remaining risk that remains on site?

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Restoration / Reclamation Outcomes …

Put the pieces back?

Make sure they are working?

Ensure the land provides the desired values?

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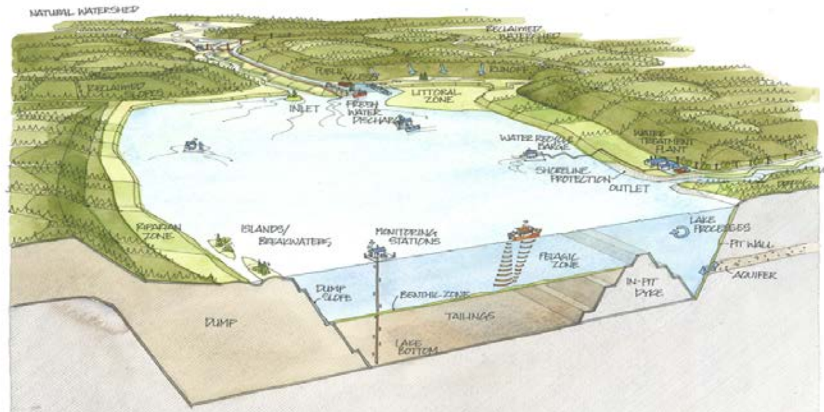
Knowledge gaps to assist operations and policy

Reclaiming novel materials

Wetland reclamation

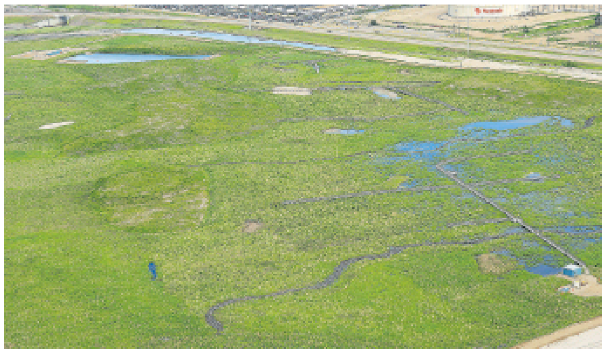
Soil water and nutrients

Aquatic reclamation



Making science meaningful – choosing your reference.

A6 FRIDAY, JULY 10, 2015 CITY & REGION



Syncrude's Sandhill Fen reclamation project covers 57 hectares of sand-capped soft tailings at its former
Mine. A new book by Alberta ecologist Kevin Timoney says wetland reclamation efforts have not worked.

Rebuilding wetlands isn't working: ecologist

.. successful reclamation has not been accomplished and may not be attainable within the foreseeable future … responsible for reclamation failure on a grand scale.

… wetland sites from throughout the world show that even a 100 years … biological structure & biogeochemical functioning have not recovered

Structural and Functional Loss in Restored Wetland Ecosystems

David Moreno-Mateos[1,2]*, Mary E. Power[1], Francisco A. Comín[3], Roxana Yockteng[4]

1 Integrative Biology Department, University of California at Berkeley, Berkeley, California, United States of America, 2 Jasper Ridge Biological Preserve, Stanford University, Woodside, California, United States of America, 3 Department of Conservation of Biodiversity and Ecosystem Restoration, Pyrenean Institute of Ecology – CSIC, Zaragoza, Spain, 4 UMR CNRS 7205, Muséum National d'Histoire Naturelle, Paris, France

Abstract

Wetlands are among the most productive and economically valuable ecosystems in the world. However, because of human activities, over half of the wetland ecosystems existing in North America, Europe, Australia, and China in the early 20th century have been lost. Ecological restoration to recover critical ecosystem services has been widely attempted, but the degree of actual recovery of ecosystem functioning and structure from these efforts remains uncertain. Our results from a meta-analysis of 621 wetland sites from throughout the world show that even a century after restoration efforts, biological structure (driven mostly by plant assemblages), and biogeochemical functioning (driven primarily by the storage of carbon in wetland soils), remained on average 26% and 23% lower, respectively, than in reference sites. Either recovery has been very slow, or postdisturbance systems have moved towards alternative states that differ from reference conditions. We also found significant effects of environmental settings on the rate and degree of recovery. Large wetland areas (>100 ha) and wetlands restored in warm (temperate and tropical) climates recovered more rapidly than smaller wetlands and wetlands restored in cold climates. Also, wetlands experiencing more (riverine and tidal) hydrologic exchange recovered more rapidly than depressional wetlands. Restoration performance is limited: current restoration practice fails to recover original levels of wetland ecosystem functions, even after many decades. If restoration as currently practiced is used to justify further degradation, global loss of wetland ecosystem function and structure will spread.

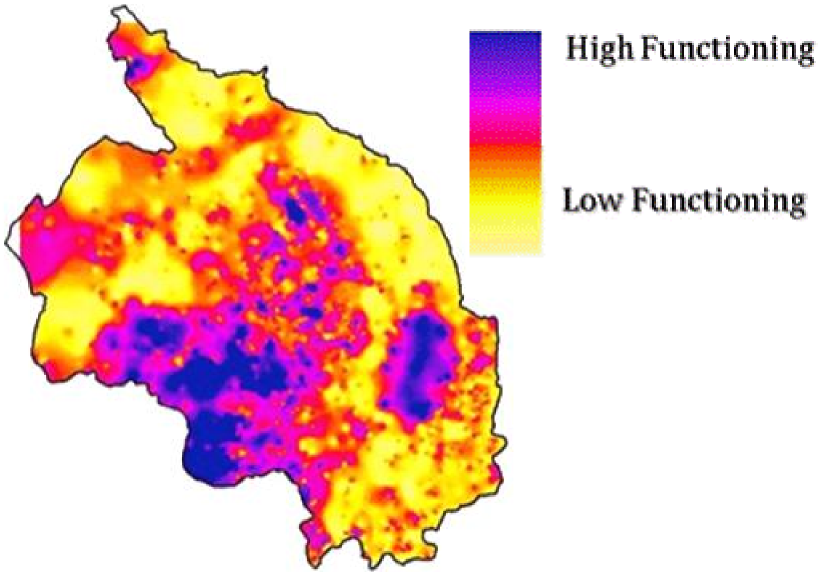
PLoS Biol 10(1): e1001247

Impaired Wetlands in a Damaged Landscape: The Legacy of Bitumen Exploitation in Canada. Timoney 2015.

Wetlands

Support for policy & best management practices

- Peer reviewed science
- Focus on technology transfer
- Inform policy
- Support BMPs



Assessment Methods for Oil Sands Reclamation Marshes

Pete's Pond – Syncrude Canada

Restoration of Linear Corridors

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OSLI Oil Sands Leadership Initiative www.osli.ca

University of Alberta Quaecumque Vera

nexen

Government of Alberta

Biodiversity Conservation

Alberta Innovates Energy and Environment Solutions

Alberta Innovates Bio Solutions

cosia

Government of Alberta

University of Alberta — Quaecumque Vera


Suncor Pond 1 - 2005

Fluid tailings reduction, reclamation and closure


Suncor Pond 1 - 2009

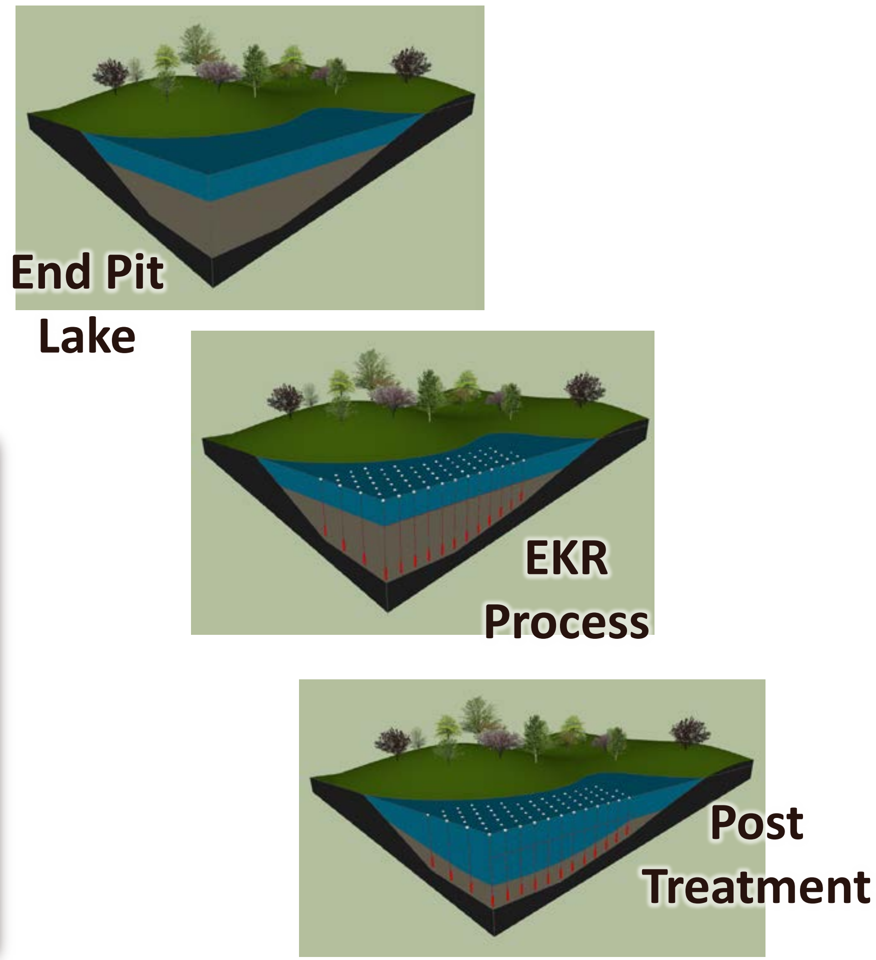
- Remediation
- Landform design
- Soil placement
- Revegetation
- Monitoring


Suncor Pond 1 - 2011

Tailings Technology projects

Inline dewatering

Electro-kinetic dewatering



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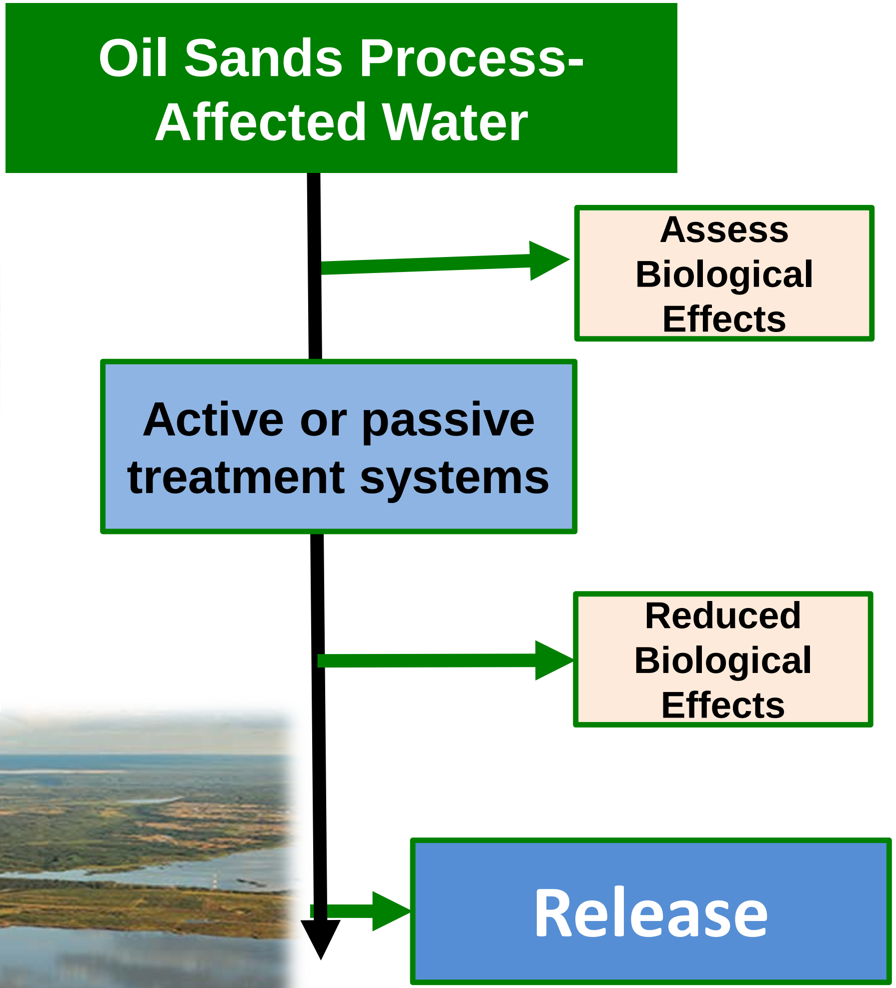
cosia

Healthy Aquatic Ecosystems

- **end pit lakes**



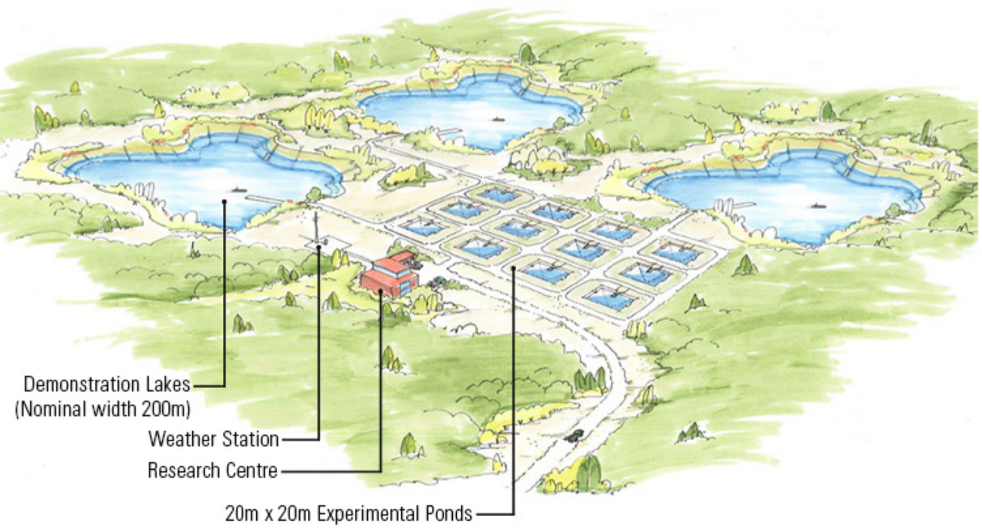
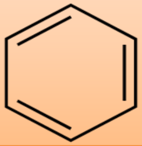



Photo by Louis Helbig

Effect of Diluted Bitumen on Freshwater Environment: Approach

1.Compositional Comparison



2. Lab Testing: Chemi-physical

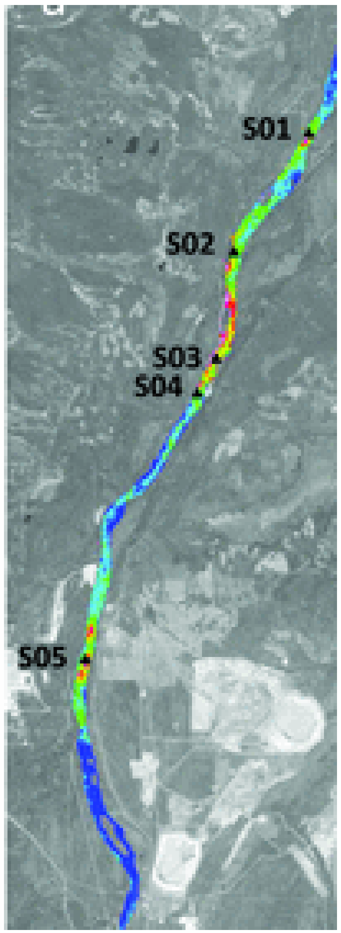
Insight and Understanding

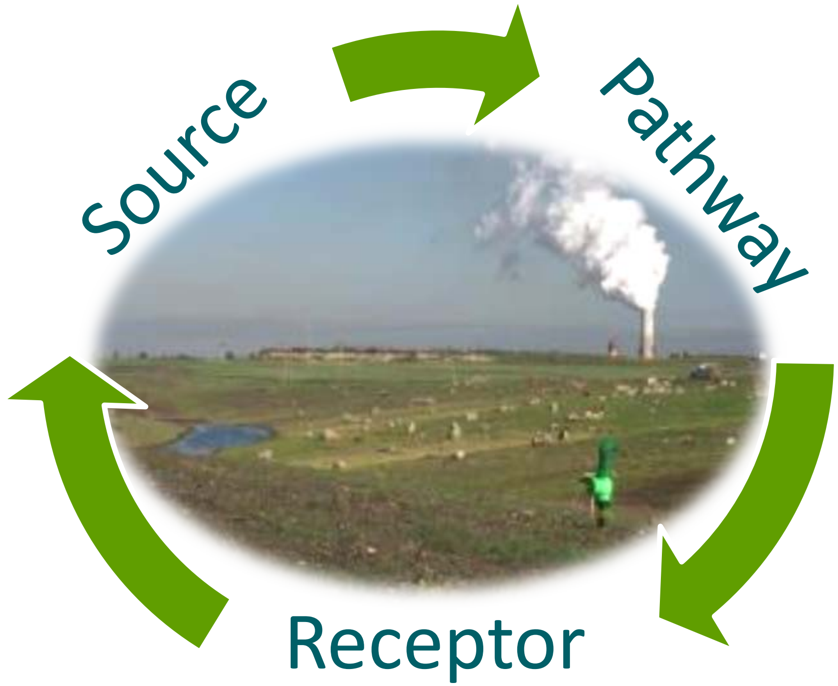
3. Lab Testing: Biological

4. Spill Case Comparisons

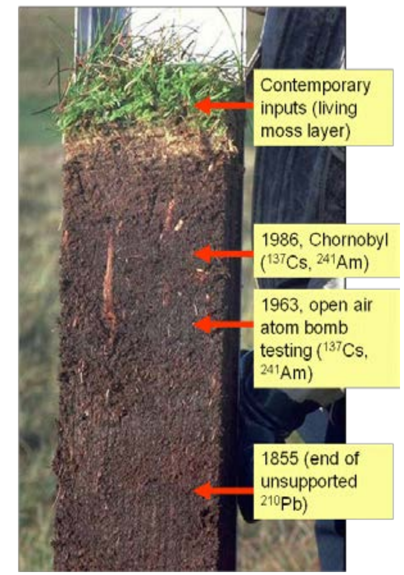
Environmental Monitoring

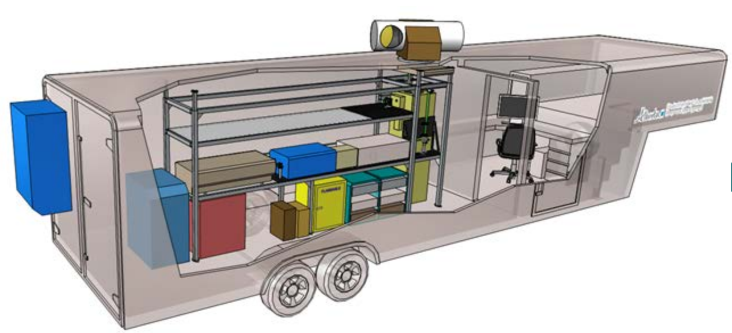
Contaminants in the Lower Athabasca





Historic and current deposition of metals / organics





Emission monitoring using DiAL (LIDAR)

Water Quality Protection

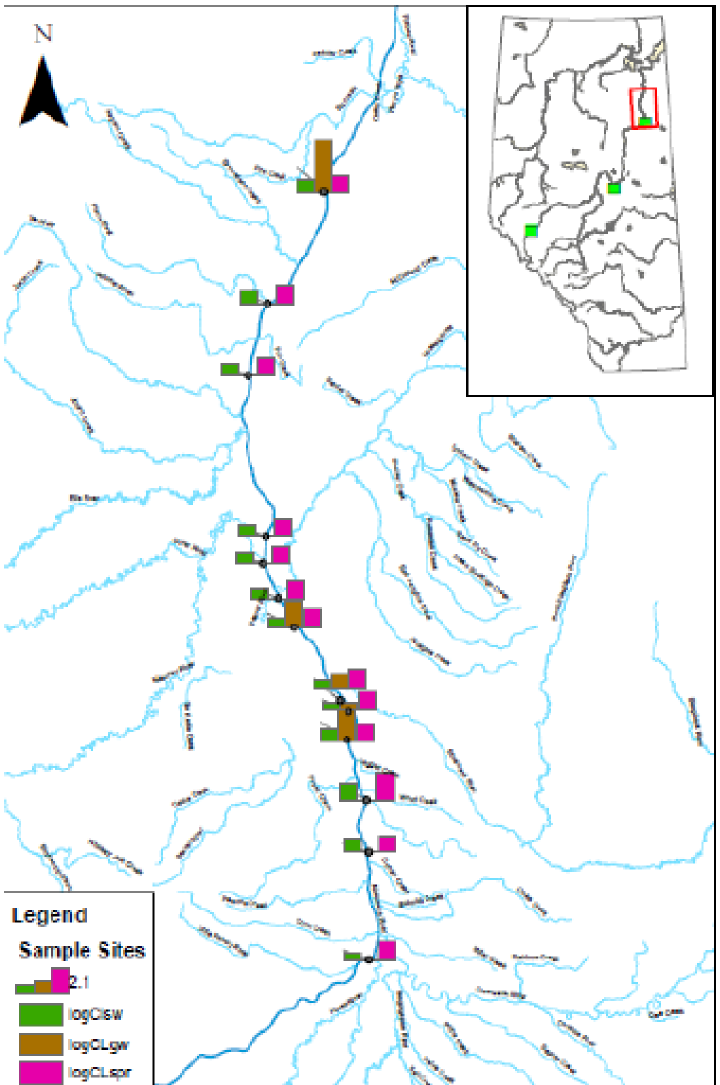
- **water quality variation & sources of contamination in the Lower Athabasca**

U of A profs duel over lead study

By Vincent McDermott
Sunday, December 14, 2014 6:00:26 MST PM

The Athabasca River

Water quality variation & sources of contamination in the Lower Athabasca



125 km

Dr. Bill Shotyk
Heavy metals

Dr. Jon Fennell:
Geology, hydrology

Dr. Jonathan Martin:
Organic contaminants

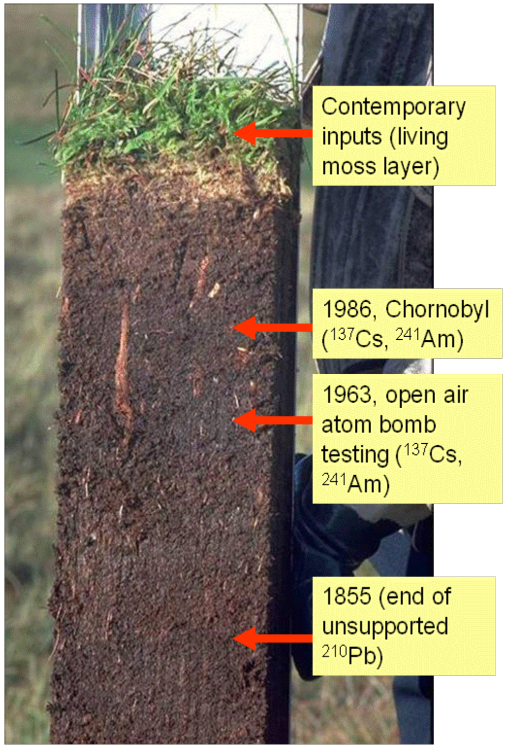
Dr. Tariq Siddique:
Arsenic and selenium

Dr. Mark Poesch:
Fish and invertebrates

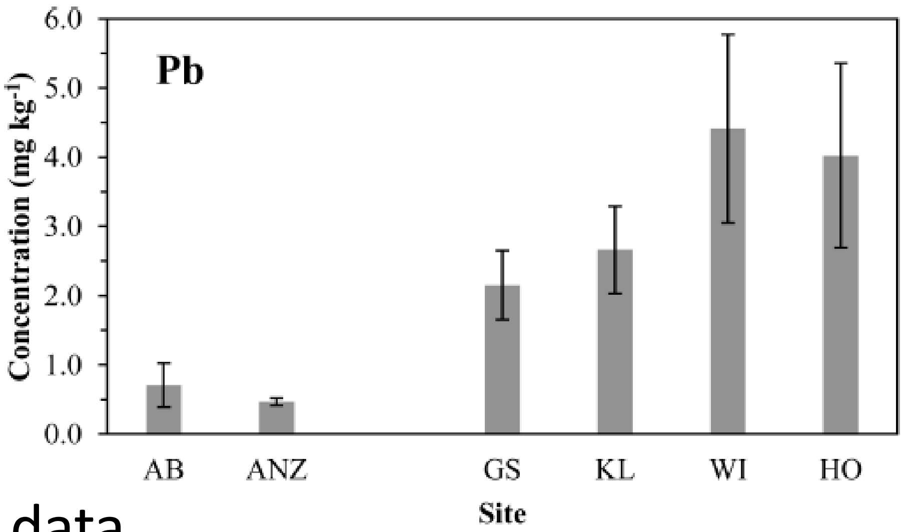
Fort McMurray

Water Quality Protection

- **Metal / organic contamination in the Lower Athabasca region**



Environ. Sci. Technol. 2014, 48, 12603−12611



Recent data

- Peat cores suggest heavy metal precipitation peaked in the past
- Added more sites including near urban centres, background reference, other areas in Canada

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Land Reclamation:
Learning from International Experiences

Appalachian mountain top coal mining
> 8X mineable oil sands disturbance

Australian bauxite mines
Similar footprint to an oil sands mine

What can we learn from nature - Bitumount Provincial Historic Site

Facility operated from the '20s to '50s

Upland forest vegetation with shallow soils over bitumen

Wetland on exposed bitumen

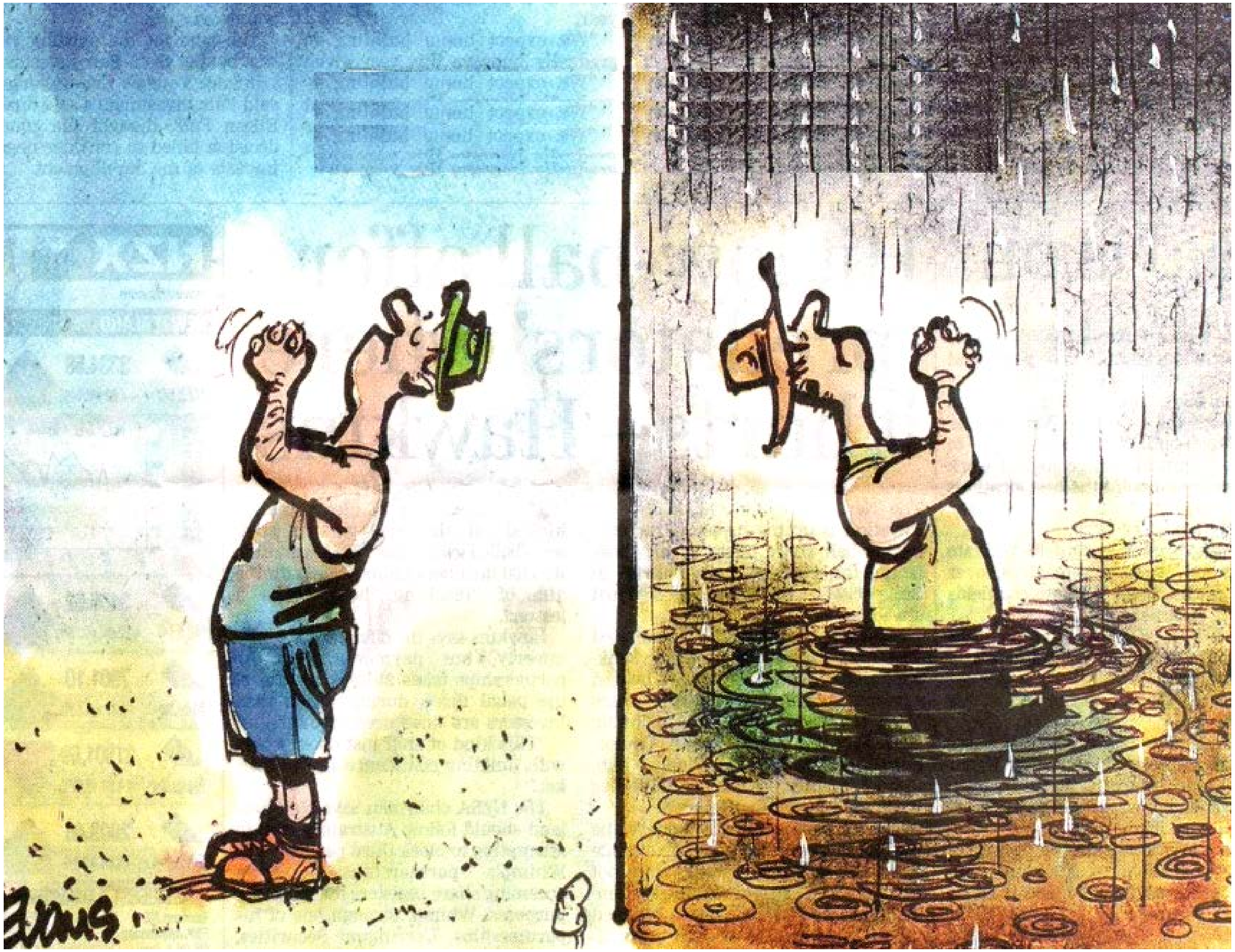
Wetland and terrestrial vegetation rooted into bitumen

So what do we bring

innovatribe.com

theottaviogroup.com

2015 Call For Proposals



www.cosia.ca/events/water-conference

The two-day conference
March 22 to 23 2016
Calgary, AB