Groundwater management challenges: assessment planning and regulatory responsiveness

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Environmental Law Centre

Groundwater Forum NSWA -February 27, 2019

Environmental
Law Centre

About the ELC

- Our vision is a society where laws secure an environment that sustains current and future generations.

- Mission: to educate and champion for strong environmental laws so that all Albertans can enjoy clean water, clean air and a healthy environment.

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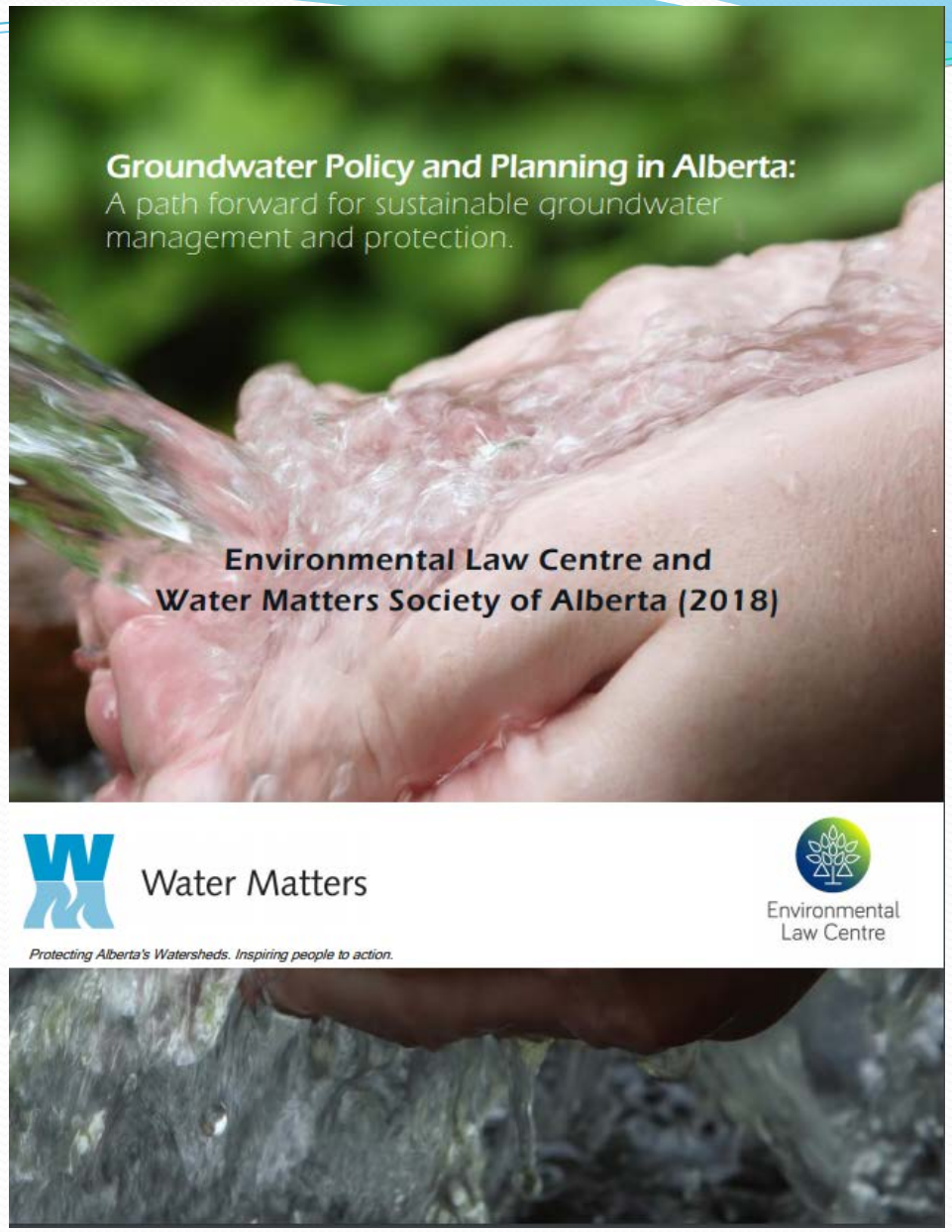

Groundwater Policy and Planning in Alberta:
A path forward for sustainable groundwater management and protection.
Environmental Law Centre and
Water Matters Society of Alberta (2018)
Water Matters
Protecting Alberta's Watersheds. Inspiring people to action.
Environmental Law Centre

Outline

- The issues & challenges
- Current regulation
- Future law and policy focus

Water quantity

- Recharge
- Discharge
- “Sustainable”

Water Quality

- Surface risk
- Subsurface risks

Decision making

- Water use
- Land use
- Pathways of potential impacts

Underlying challenges

- Scaling knowledge to individual decisions
  - Provincial
  - Municipal
- Jurisdictional silos
  - Government
  - Department
- Cumulative effects
- Climate variability
- Complexity of knowledge needs
  - Eco-hydrology
  - Significant pockets of uncertainty (depends on study area)
- Monitoring and Compliance

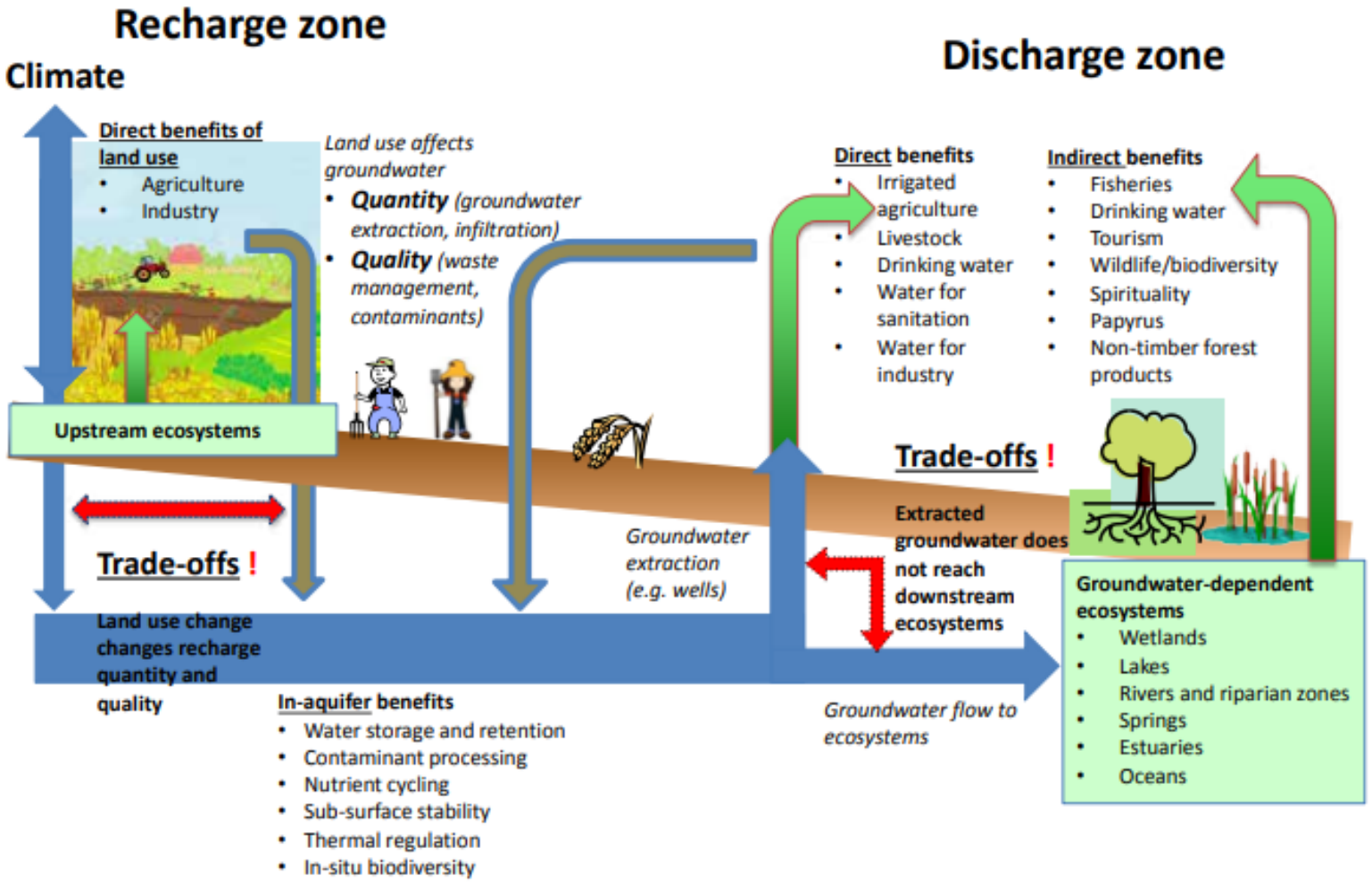


FIGURE 1. Conceptual diagram of the multitude of ecosystem services associated with groundwater over a landscape scale. People benefitting from as well as interacting and influencing ecosystems are implicit throughout

CGIAR Research Program on Water, Land and Ecosystems (WLE). (2015). Groundwater and ecosystem services: a framework for managing smallholder groundwater-dependent agrarian socio-ecologies – applying an ecosystem services and resilience approach. Colombo, Sri Lanka: International Water Management Institute (IWMI). CGIAR Research Program on Water, Land and Ecosystems (WLE). 25 p. doi: 10.5337/2015.208

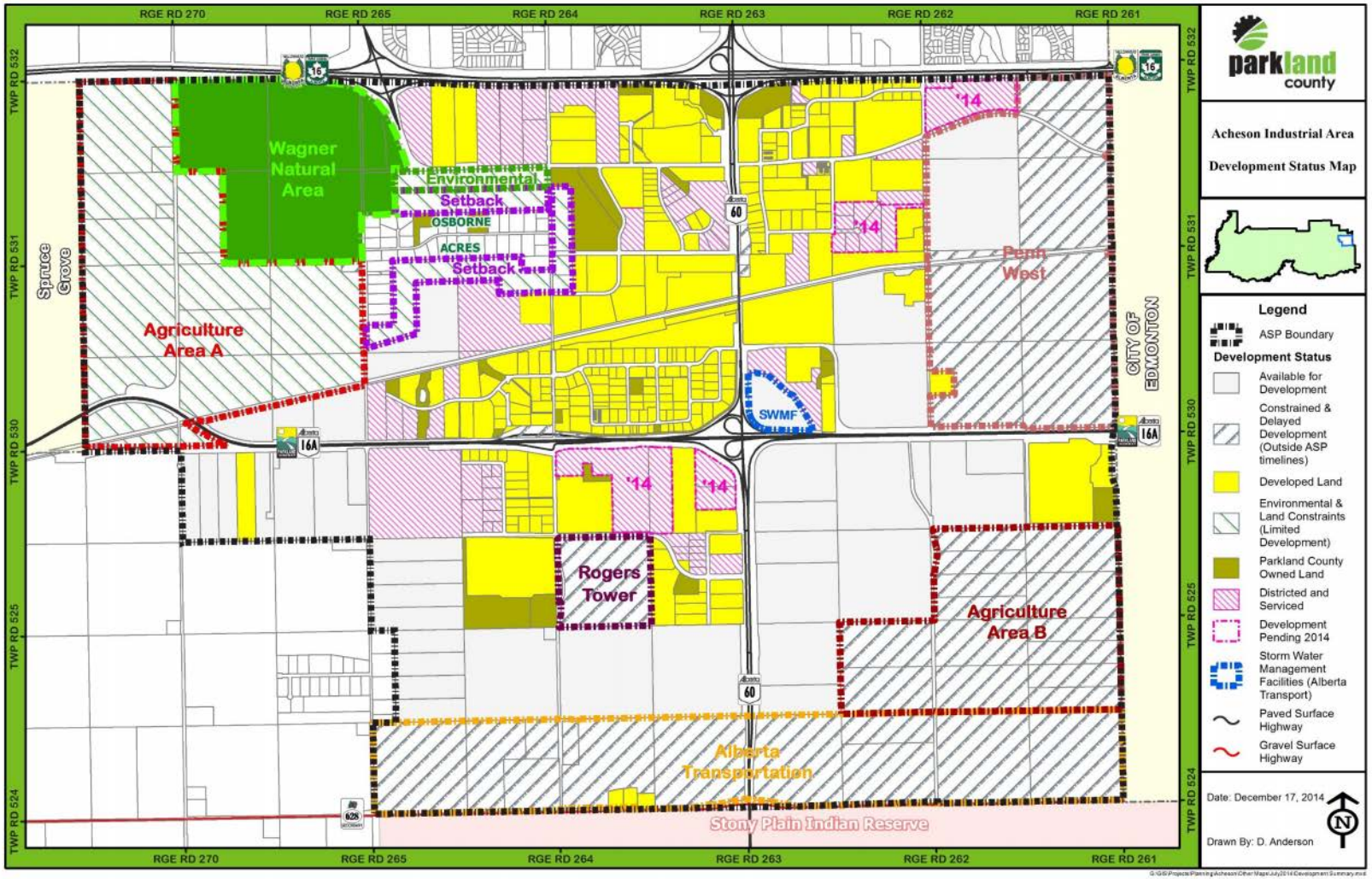
Eco-hydrology

- Groundwater has well-recognized ecological functions including:
  - (1) sustaining stream base flow and moderating water-level fluctuations of groundwater-fed lakes and wetlands,
  - (2) providing stable-temperature habitats,
  - (3) supplying nutrients and inorganic ions, and
  - (4) providing moisture for riparian and other groundwaterdependent vegetation (Hayashi and Rosenberry 2002).
- Hunt, R.J., Hayashi, M. and Batelaan, O. 2016. Ecohydrology and its relation to integrated groundwater management. In: Integrated groundwater management. (Eds. Jakeman, A.J., Hunt, R.J. and Ross, A.). Springer, pp. 297-312.
  - **Also highlights**
    - **Need for adaptive management**
    - **Need for sentinel metrics**
    - **Need for further study to understand thresholds, tipping points, and response curves**
    - **Recognize some uncertainty will never be removed**

- Hayashi, M. and Farrow, C.R. 2014. Watershed-scale response of groundwater recharge to inter-annual and inter-decadal variability in precipitation. Hydrogeology Journal, 22: 1825-1839.
  - *Average baseflow showed a distinct shift from a low value (4 mm y–1) in 1982–1995 to a high value (15 mm y–1) in 2003–2013, indicating the sensitivity of groundwater recharge to a decadal-scale variability of meteorological conditions.*

Parkland County, Acheson Industrial Area Structure Plan -2014
https://www.parklandcounty.com/en/do-business/resources/planning/Acheson-ASP-Bylaw-No-2014-29---Copy.pdf

FIGURE 5 – DEVELOPMENT STATUS MAP (December 2014)



Water Quality

Table 1: Sources of Groundwater Contaminants
(Ritter et al. 2002, adapted from Barcelona et al (1990).

Category 1: Sources designed to discharge substances

1 Sub-surface percolation from septic tanks/ cesspools
2 Injection wells
- Hazardous waste
- Nonhazardous waste (e.g., brine disposal)
- Nonwaste (e.g., solution mining)

3 Land application
- Wastewater (spray irrigation)
- Wastewater by-products (biosolids)
- Hazardous waste
- Nonhazardous waste

Category 2: Sources designed to store, treat, and/ or dispose of substances; discharge through unplanned release

1 Landfills
- Industrial hazardous waste
- Industrial nonhazardous waste
- Municipal sanitary

2 Open dumps, including illegal dumping
3 Residential disposal
4 Surface impoundments
- Hazardous waste
- Nonhazardous waste

5 Materials stockpiles (nonwaste)
6 Graveyards
7 Animal burial
8 Above-ground storage tanks
- Hazardous waste
- Nonhazardous waste
- Nonwaste

9 Underground storage tanks
- Hazardous waste
- Nonhazardous waste
- Nonwaste

10 Containers
- Hazardous waste
- Nonhazardous waste
- Nonwaste

11 Open burning and detonation sites
12 Radioactive disposal sites

Category 3: Sources designed to retain substances during transport or transmission

1 Pipelines
- Hazardous waste
- Nonhazardous waste
- Nonwaste

2 Materials transport and transfer operations
- Hazardous waste
- Nonhazardous waste
- Nonwaste

Category 4: Sources discharging substances as a result of other planned activities

1 Irrigation practices
2 Pesticide applications
3 Fertilizer applications
4 Animal feeding applications
5 De-icing salt applications
6 Urban run-off
7 Percolation of atmospheric pollutants
8 Mining and mine drainage
- Surface mine related
- Underground mine related

Category 5: Sources providing conduit or inducing discharge through altered flow patterns

1 Production wells
- Oil and gas wells
- Geothermal and heat recovery wells
- Water supply wells

2 Other wells
- Monitoring wells
- Exploration wells

3 Construction excavation

Category 6: Naturally occurring sources whose discharge is created and/or exacerbated by human activity

1 Groundwater–surface water interactions
2 Natural leaching
3 Salt water intrusion

http://elc.ab.ca/wp-content/uploads/2018/11/Groundwater-Policy-and-Planning-in-Alberta-November-2018.pdf

Potential pathways

- Surface
  - Land applications and discharges (leaching)
  - Overland flow
- Subsurface
  - Induced seismicity (and related impacts of subsurface distrubance)
  - Casing failures
  - Aquifer interconnections

Water quality

- S. M

Table 1. Summary of compounds (n = 105) detected in water samples (n = 436) derived from wells (n = 38) and piezometers (n = 28) in Alberta.

Compound	No. of samples with detections	Year detected	Well or piezometer depth	Concentration	MAC†	GUS‡
			m	ng L^{-1}		
			Southern Alberta			
2,4-D	19 (3.12.4)§	1,2,3¶	3.0–20.0 (11.0, 50%)#	26–154 (60, 68%)#	100,000	1.69

Table 2. Summary of pesticides mixtures detected in Alberta from 2013–2015.

Pesticides	Total concentration	Well or piezometer depth	Season: region
	ng L^{-1}	m	
2,4-D, ethion, simazine	1755	10.0	Fall: southern Alberta
2,4-D, ethion	267	7.0	Fall: southern Alberta
2,4-D, diazinon	249	7.0	Fall: central Alberta
2,4-D, clopyralid	121	5.3	Fall: central Alberta
2,4-D, clopyralid	100	7.5	Fall: central Alberta
2,4-D, MCPA	68	8.0	Fall: southern Alberta
MCPA, clopyralid, propyzamide	7330	2.3	Summer: southern Alberta
MCPA, fluroxypyr	1335	8.3	Summer: southern Alberta
MCPA, fluroxypyr	380	6.8	Summer: central Alberta
MCPA, fluroxypyr, bromoxynil	244	7.0	Summer: central Alberta
MCPA, 2,4-D	172	9.5	Summer: southern Alberta
MCPA, clopyralid	108	7.5	Summer: central Alberta
MCPA, β-HCH	79	2.3	Spring: southern Alberta
MCPA, dicamba	58	7.8	Spring: southern Alberta

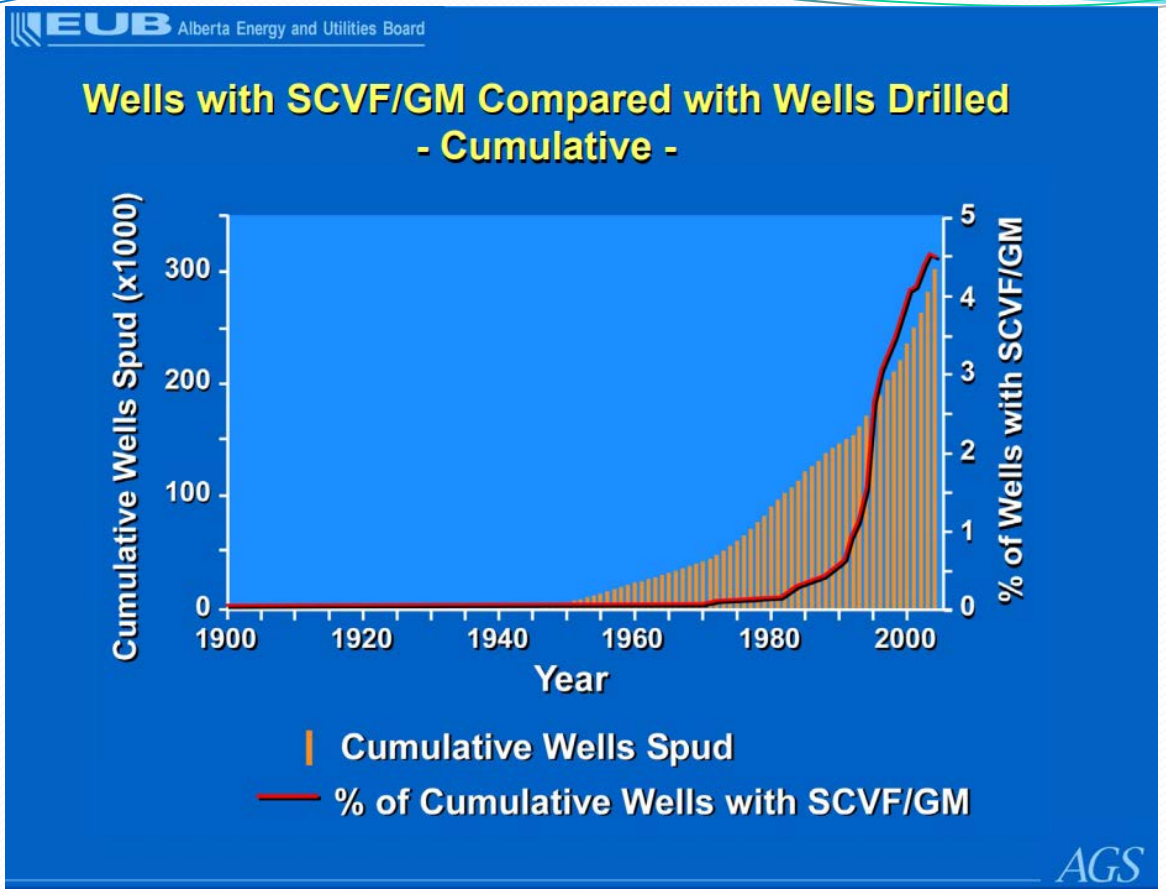
Journal of Environmental Quality

Numbers refer to minimum-maximum (mean, CV).

†† Numbers refer to minimum–maximum.

Other issues

- Coliforms
- Nutrients
- Chemicals



- EUB/AGS Factors Affecting or Indicating Potential Wellbore Leakage --Dr. Stefan Bachu Alberta Energy and Utilities Board Theresa Watson T.L. Watson and Associates Inc. https://ieaghg.org/docs/WBI3Presentations/SBachuTWatson.pdf

- CNRL Primrose site theglobea

ordered-to-drain-a-lake-in-alberta-stop-oil-spill/article1450950

ENVIRONMENT

CNRL ordered to drain a lake in

An Apache Corp. pipeline spill in June in northwestern Alberta, 20 kilometres north of Zama City a separate leak in the oil sands, Canadian Natural Resources Ltd. said faulty engineering on old w its Primrose project is responsible for bitumen leaking to the surface of an oil-sands project, and company did some of the work itself. CNRL believes steam-softened bitumen reached the surfac vertical wells, escaping when it hit defective spots in the casing or cement. Under pressure, the b squirted into natural cracks in the rock layers and moved upward.

DENE THA FIRST NATION

KELLY CRYDERMAN
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Cadillac

Landowners dealing with orphan wells can't prematurely celebrate court ruling, says consultant

CLARE CLANCY Updated: February 1, 2019

A decommissioned pumpjack near Cremona, Alta. JEFF MCINTOSH / THE CANADIAN PRESS, FILE

Enforcement challenges and regulatory responsiveness

- Monitoring capacity
- Causation
- Delay
- Natural vs. anthropogenic
- Grandfathered sites
- Minimal ability to require meeting of new standards

Groundwater governance

- Water Act
- Environmental Protection and Enhancement Act
- Agricultural Operations Practices Act
- Broad suite of regulations/directives/policies of resource regulators
  - Alberta Energy Regulator
  - Natural Resources Conservation Board
- Municipal planning/regulation

Regulation continued

Quantity

- Water Act
  - Ministerial regulation
  - Groundwater authorization guideline
    - Aquifer delineation
    - Sustainable drawdown

Quality

- Preventative
  - Water well siting (setbacks)
  - Standards
- General pollution prohibitions (releases)
- Remediation guidelines
- Sector specific regulations
  - Directives/setbacks/standard
  - Waste management

Municipal roles in Groundwater management

- Land use decisions have broad implications for water
  - Hydrological impacts
  - Water quality impacts

- Planning
  - Statutory plans
- Bylaws
  - Districting/zoning
  - Development permits
- Subdivision

From standards →assessment and planning - Integrated groundwater management

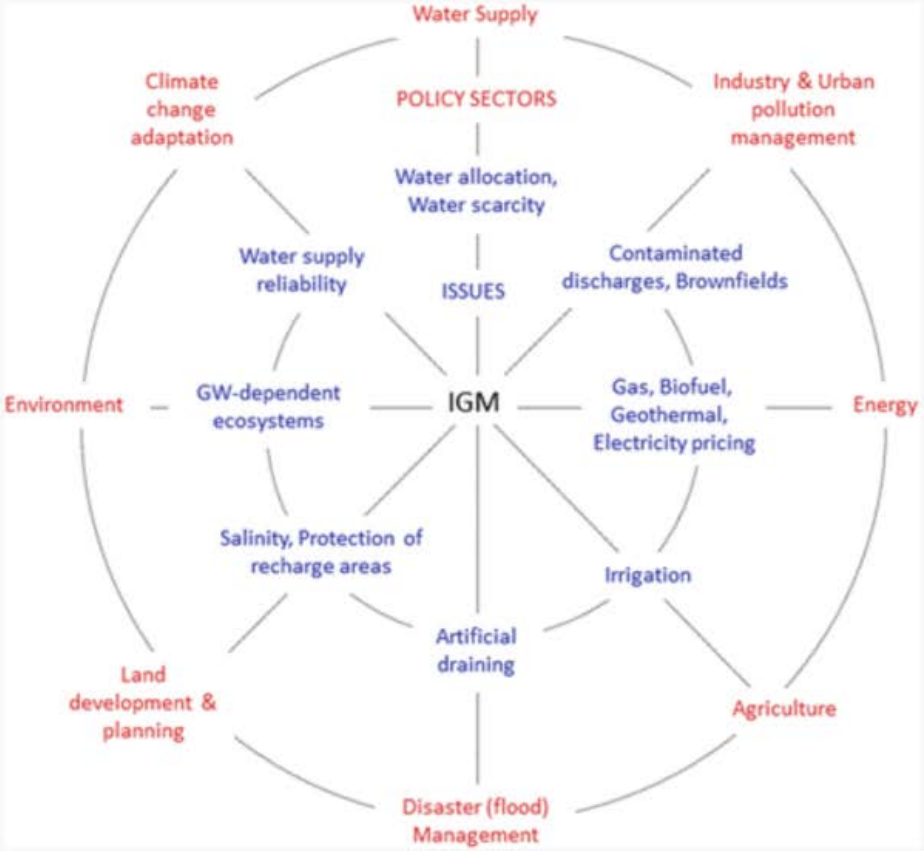
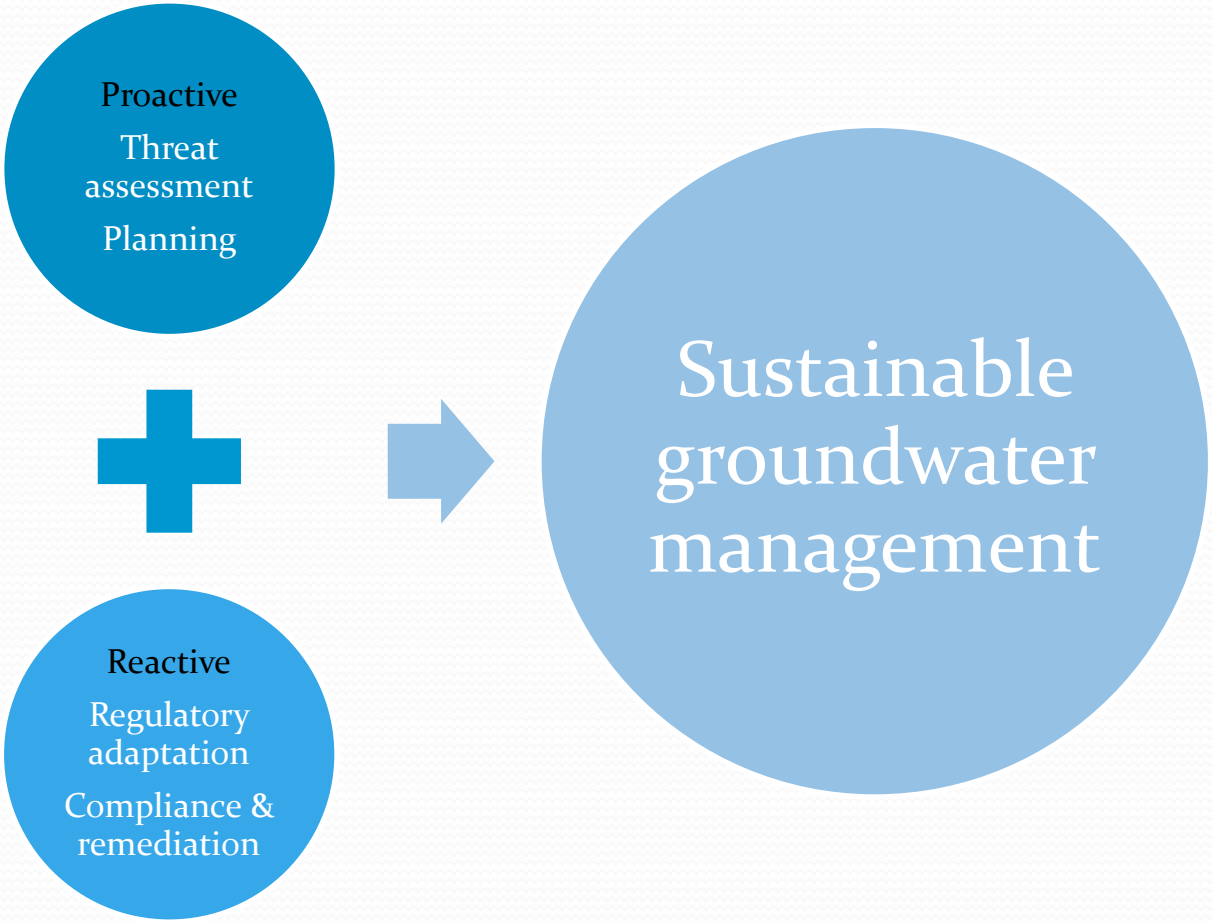


Fig. 1.1
Examples of diverse issues related to groundwater and their relevant policy sectors

- Jakeman A.J. et al. (2016) Integrated Groundwater Management: An Overview of Concepts and Challenges. In: Jakeman A.J., Barreteau O., Hunt R.J., Rinaudo JD., Ross A. (eds) Integrated Groundwater Management. Springer, Cham

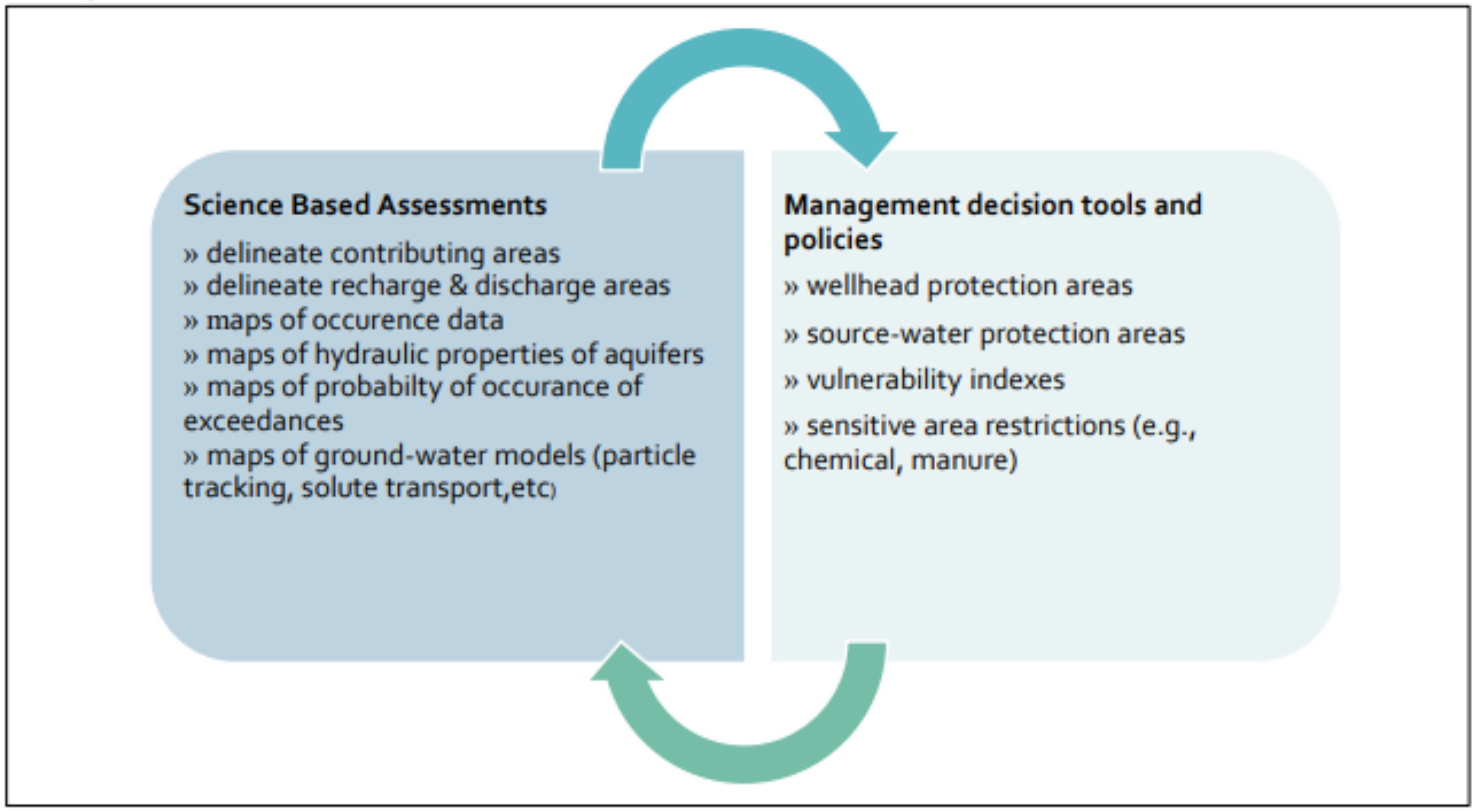

Proactive
Threat assessment
Planning
Reactive
Regulatory adaptation
Compliance & remediation
Sustainable groundwater management

Quantity assessments

- Accuracy
  - Assumptions?
  - Current and future variability – i.e. integrating precaution
- Integrate eco-hydrology or GDE

Quality Assessment

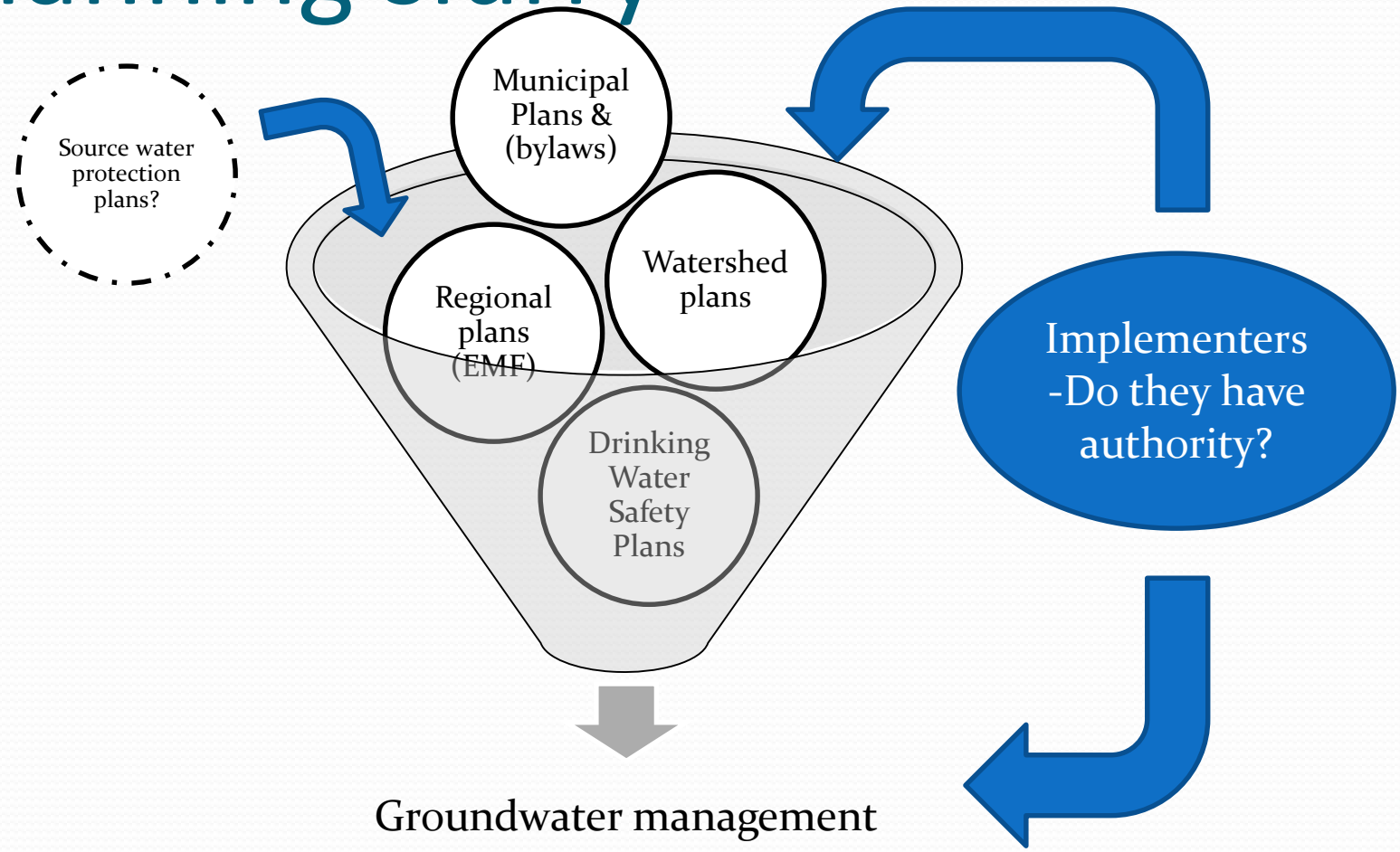
Figure 1: Groundwater assessment and decision making (adapted from Facazio et al., 2012)[77]



M.J. Focazio, T.E. Reilly, M.G. Rupert and D.R. Helsel. Assessing Ground-Water Vulnerability to Contamination: Providing Scientifically Defensible Information for Decision Makers (U.S. Geological Survey Circular 1224, 2002),

https://pubs.usgs.gov/circ/2002/circ1224/pdf/circ1224_ver1.01.pdf

A planning slurry



Work underway

- Alberta Water Council Source water protection planning best practices
- Ongoing work on groundwater assessment
- Vulnerability/threats have been assessed in certain areas

- Integration into decisions is key

Quantity reform (ELC)

- Move forward from Q_{20}
- Identify and maintain priority recharge areas
- Policy and regulatory development focusing on assessment of extraction impacts on eco-hydrology or GDE
- Adaptation
  - Licence renewals (adjust/amend)
  - Assess options for deemed licences (seek regulatory or voluntary diversions as required)
- Inform land use decisions with relevant/priority information (municipal/regional planning)

Quality reform

- Risk and vulnerability mapping.
- Create a public risk database for application by decision makers
- Ensure broad integration of risk assessments
- Enable adaptive management as a regulatory approach (i.e. address grandfathered sites)

Compliance responses

- Set out a groundwater specific compliance and enforcement policy
- Clarify roles and responsibilities for source water protection and ensure broad enforcement tools are available to regulators
- Monitoring and audit systems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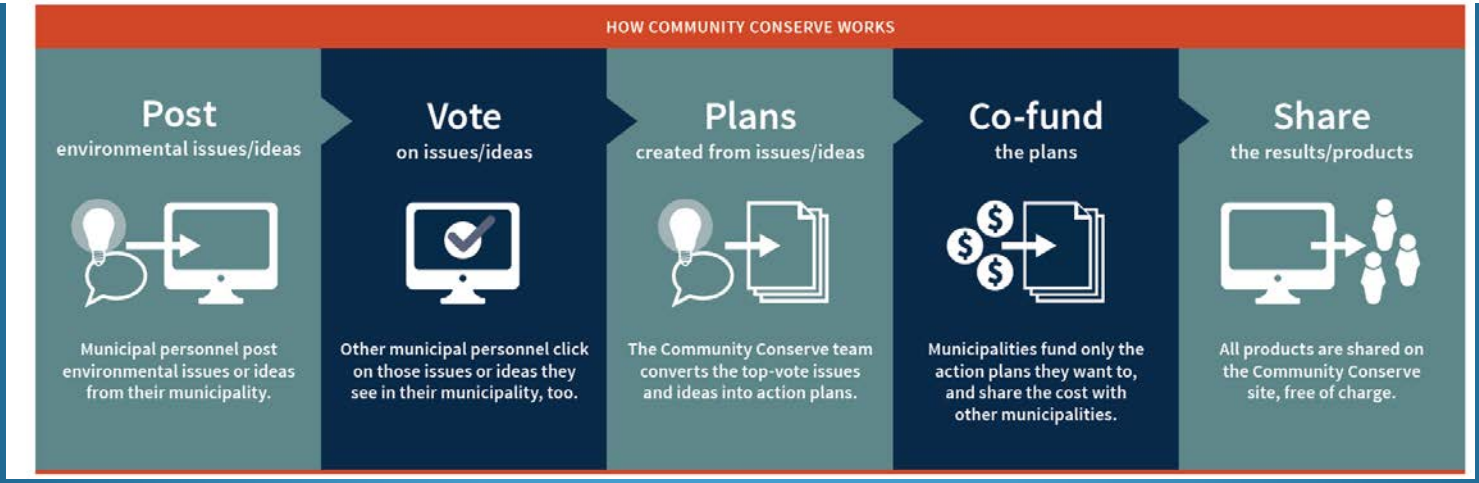
HOW COMMUNITY CONSERVE WORKS
Post
environmental issues/ideas
Municipal personnel post environmental issues or ideas from their municipality.
Vote
on issues/ideas
Other municipal personnel click on those issues or ideas they see in their municipality, too.
Plans
created from issues/ideas
The Community Conserve team converts the top-vote issues and ideas into action plans.
Co-fund
the plans
Municipalities fund only the action plans they want to, and share the cost with other municipalities.
Share
the results/products
All products are shared on the Community Conserve site, free of charge.

Questions?

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