

Overview of performance indicators

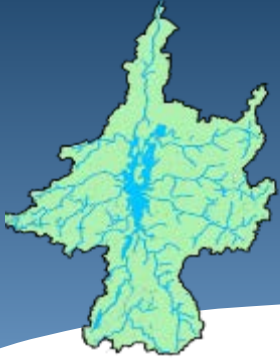


Lake Champlain Richelieu River flood mitigation study

Technical webinar, 12 November 2020
Rose Paul, *The Nature Conservancy*
Mathieu Roy, *Environment and Climate Change Canada*

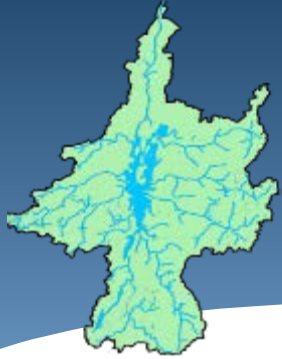


Background



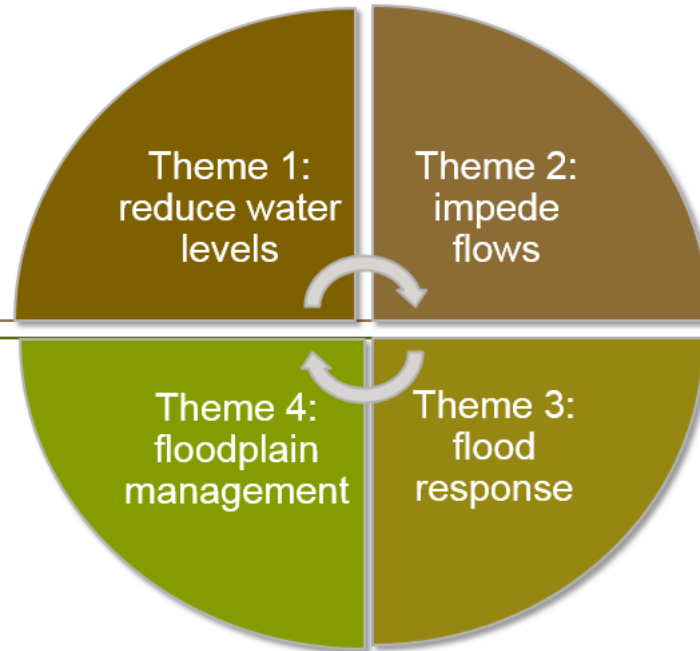
- Study objective
 - Evaluate ways to mitigate flooding impacts in the LCRR basin and provide recommendations.
- How?
 - Using computer models simulating floods and flood impacts.
 - Proposing mitigations solutions, based on scenarios.
 - Gauging the acceptability of those solutions.





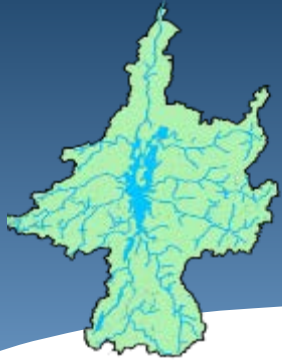
Ways to mitigate flooding

**Goal 1: Reduce High Water Levels and Thereby Flooding Impacts
(Moderate Structural Solutions)**



**Goal 2: Reduce Vulnerability to High Water and Build Flood Resiliency
(Non-Structural Solutions)**





Performance indicators

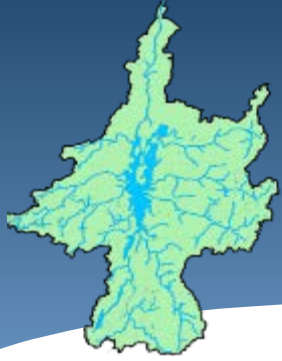
- Performance indicators (PI) are quantitative measures that reflect how society, the economy, and the environment are impacted by floods under different mitigation solution scenarios.

Social

Economic

Environment



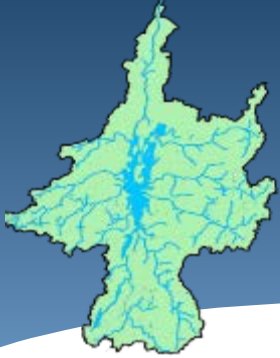


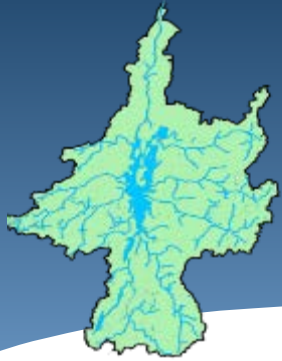
PI Selection criteria

- Consultation with experts, stakeholders and community members
 - Together, encompass the expected impacts of the different types of mitigation measures
- Responds to water level fluctuations
- Representative of sensitive species
- Covers lake, river and floodplain in both countries
- Covers all seasons (low flows, Spring flood, winter)
- Data available for calibration and validation



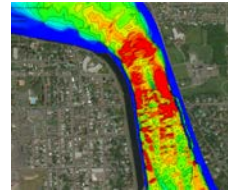
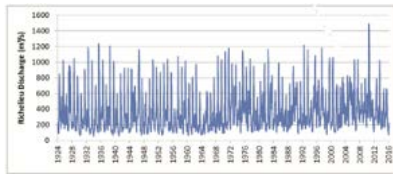
Modelling floods





Indicator modeling workflow

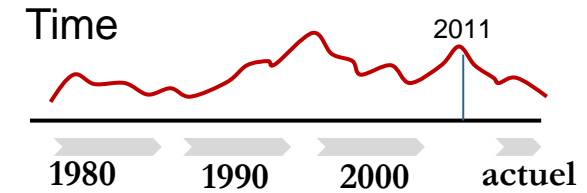
Hydrology
(Historical Water supply)



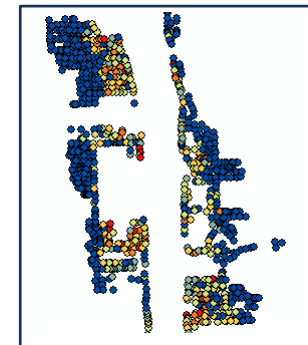
Hydrodynamic model
(Flood maps)

Response
function
(equation)

Performance indicator



Maps (e.g. flood risk)

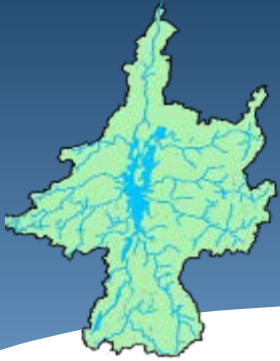


Mitigation measures
Flood forecast



Geospatial
Data





Social indicators

Components include numerous socio-economic variables



Social sensitivity

- Elderly
- Low income
- Single parent
- Etc.



Adaptative capacity

- Couple without children
- Owners
- Long-time residents
- Etc.



Territorial sensitivity

Number of key units

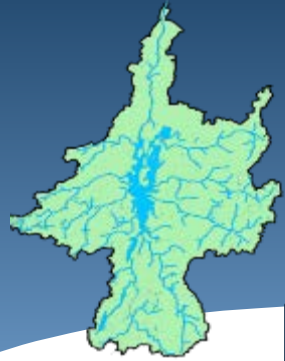
- Housing
- Shops
- Industries
- Farms
- Schools
- Etc.



Accessibility to first responders

- Inaccessible houses
- Impracticable roads





Social risk mapping

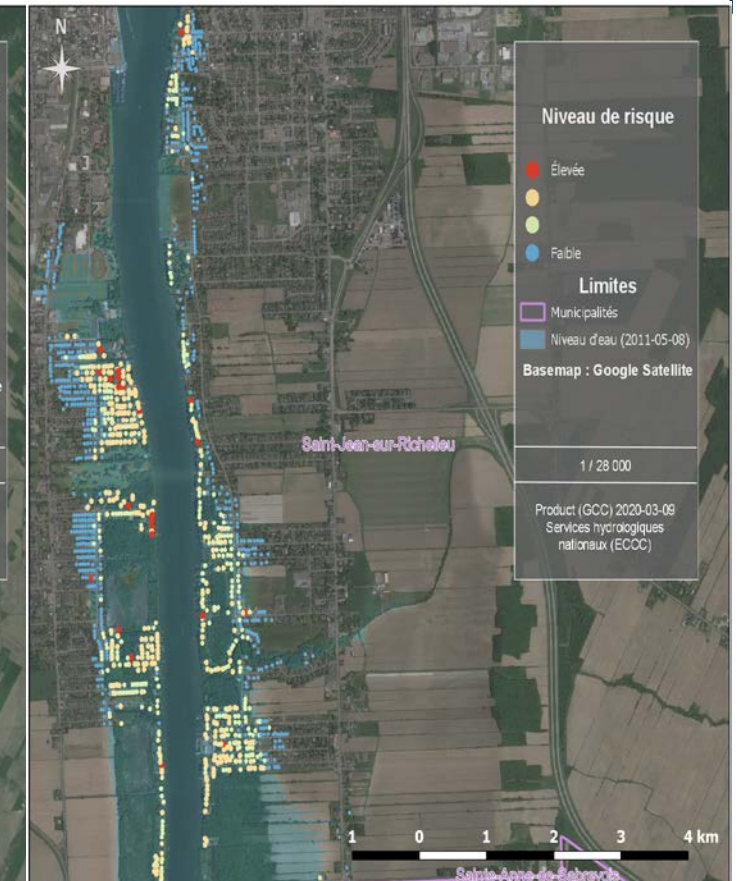
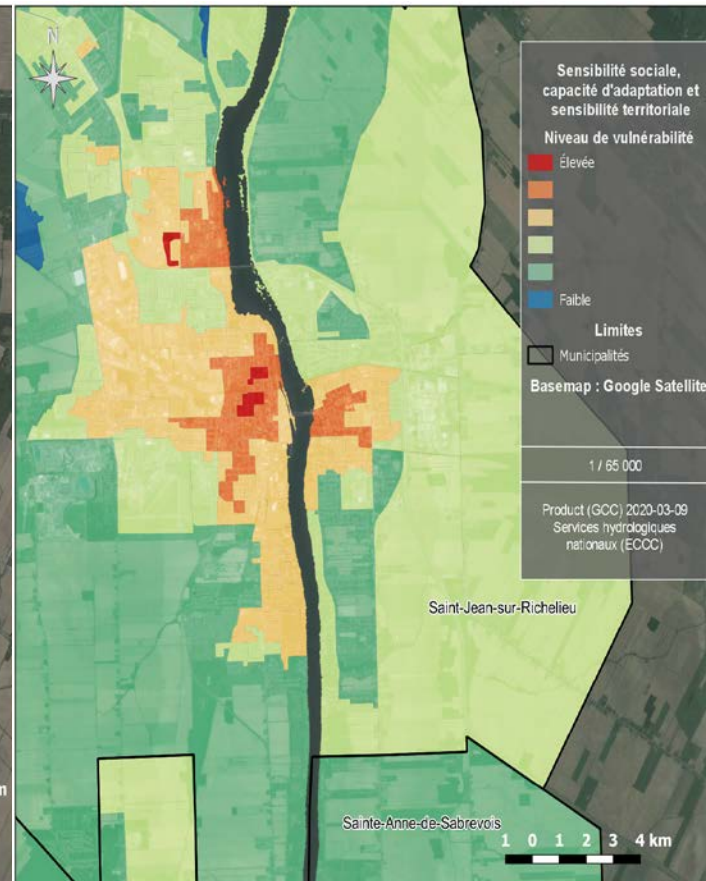
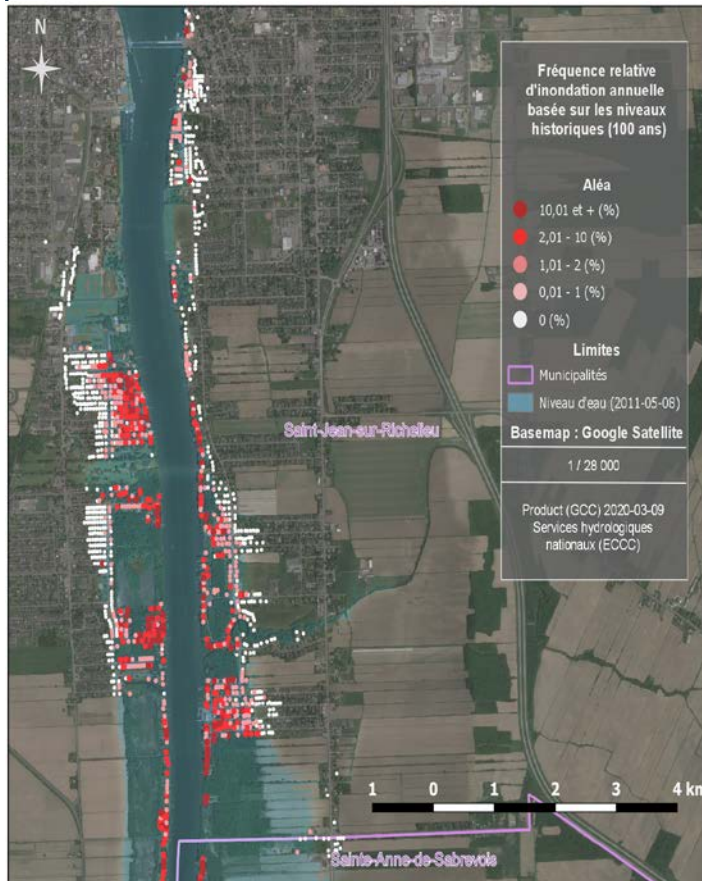
Flood Hazard
Vallée du Richelieu

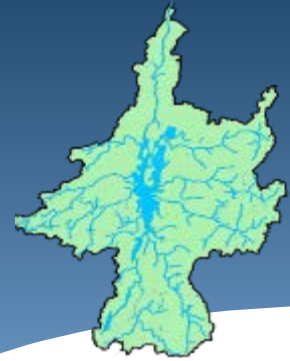
X

Total vulnerability
(aggregated)

=

Flood risk
Vallée du Richelieu





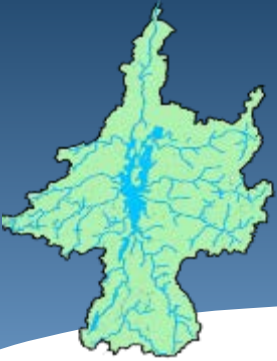
Accessibility (example)

Homes at risk of inaccessibility
in a flooded area

Emergency stages (MSP)
(WL at Rouses Point (m, NAVD88))

- Moderate flooding (31.02m, 101.77ft)
- Major flooding (31.18m, 102.29)
- Similar to 2011 (31.3m, 102.69)

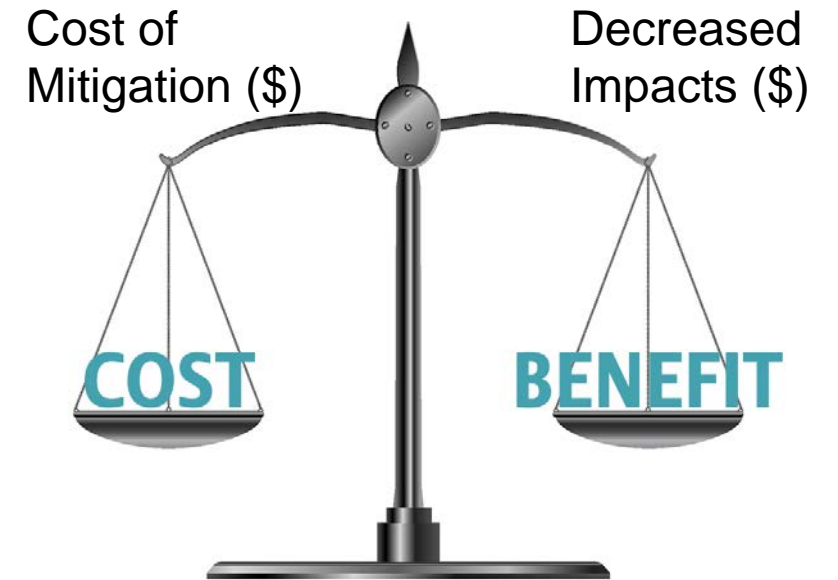




Economic Pls

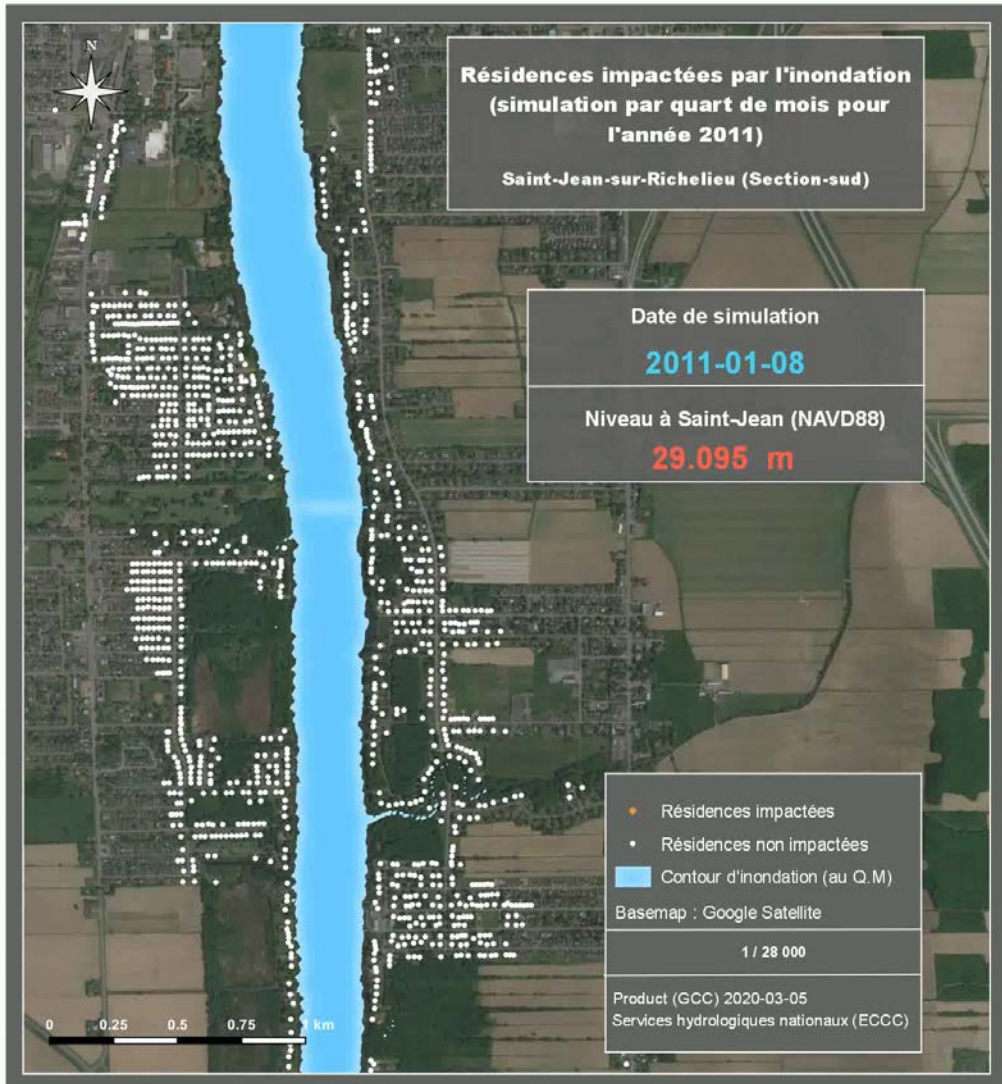
Economic indicators

- Structural damage to buildings**
- Income loss (commercial, industries, farms)**
- Damages to public infrastructures**
- Impacts on recreational sector**
- Cost of emergency response**
- Cost of health impacts**
- Cost of mitigation measures**



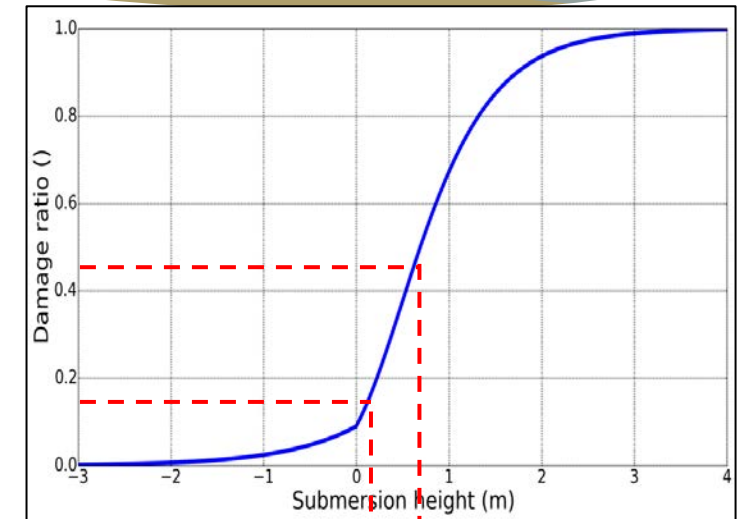
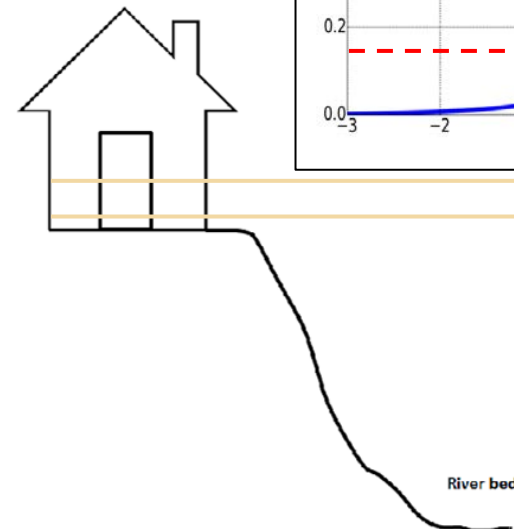


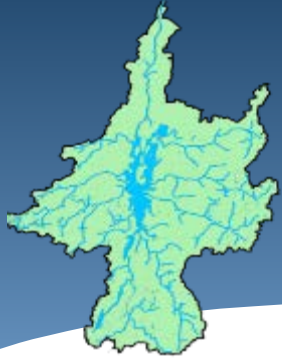
Structural damage modelling



Data on buildings

- Property value
- Precise elevation
- Basement and finish
- Number of stories





Flood damage estimation for mitigation scenario (e.g. Chambly Diversion)

Scenario 10 with diversion

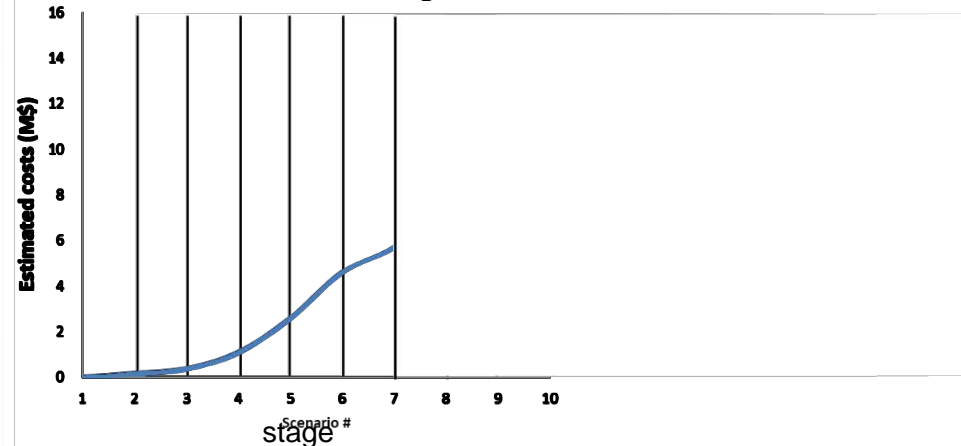


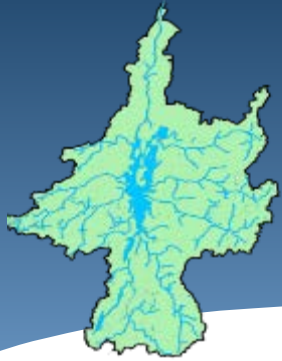
Scenario 10 with diversion

Flooded houses: 209
Total damage costs: \$12,000,000

- Damage mitigation and cost-benefit can be estimated for each mitigation measure.

Estimated costs of damage

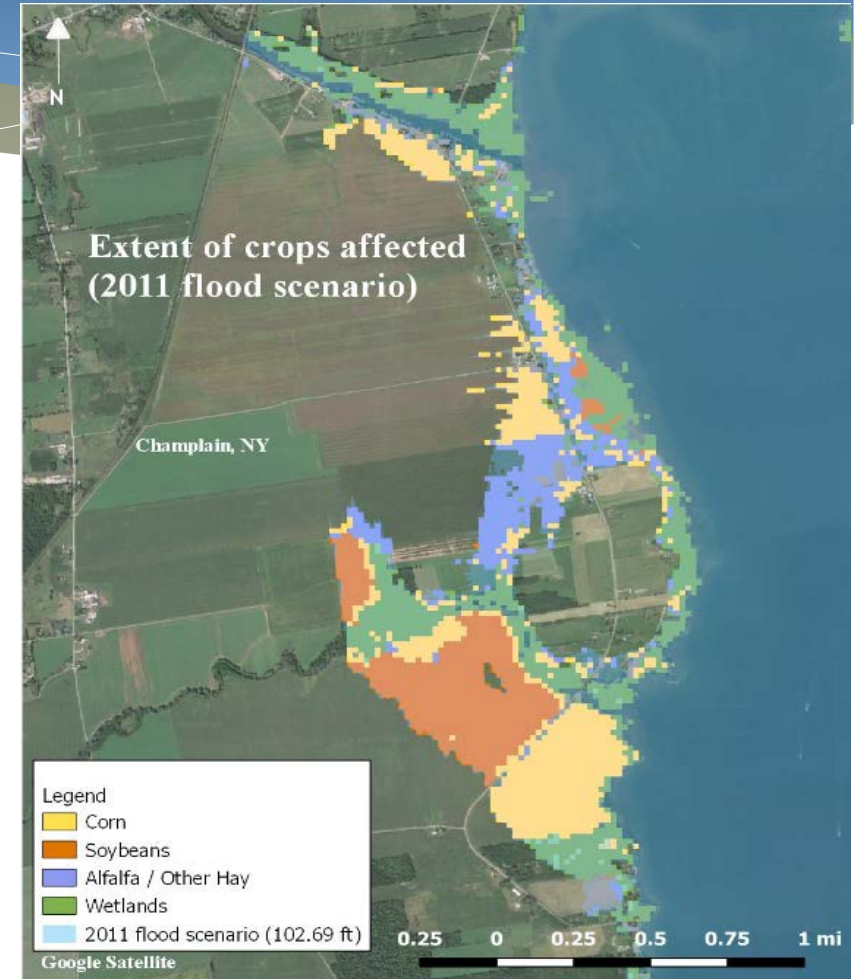


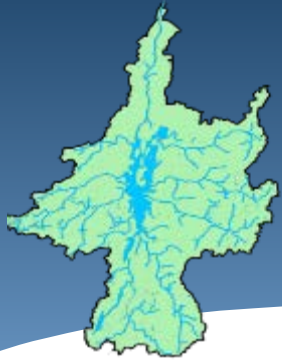


Agriculture yield loss (\$)

- Delineation of flooded land by crop types
- Modelling inputs
 - Flooded area
 - Product value (\$/ton)
 - Annual yield (ton/ha)
 - Day of the year, relative to sowing and harvesting dates

Crop rotation





Environmental performance indicators

Environmental indicators

Wetland succession

Northern pike spawning area and probability of survival of eggs and larvae

Copper redhorse spawning area

St-Ours migratory fishway operation

Spiny softshell turtle egg survival

Muskrat winter lodge viability

Waterfowl migratory habitat area

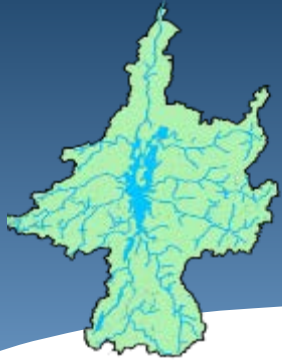
Habitat and reproduction success of least bittern

Wild Rice survival (important to indigenous people)

Sweet grass (important to indigenous people)

Black ash (important to indigenous people)





Copper Redhorse

Spawning habitat area

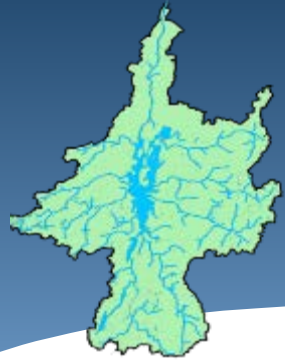
Importance

- Endemic species in Quebec, indicator of the impact of human activities on aquatic ecosystems
- Threatened in Quebec, endangered in Canada
- Richelieu River: Only known spawning grounds.
- Umbrella species (multi-species spawning in running waters)

Model

- Spawning habitat suitability based on
 - Substrate, current velocity, water depth



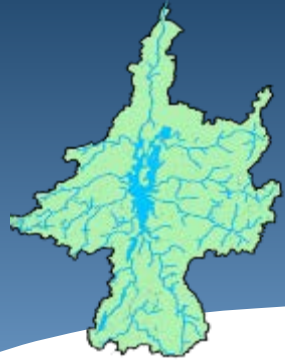


Wetland succession

- Wetland vegetation sampling throughout the Richelieu River and Lake Champlain
- Statistical analyses and artificial intelligence tools to predict how temporal changes in water level have an impact on the area and composition of wetlands.

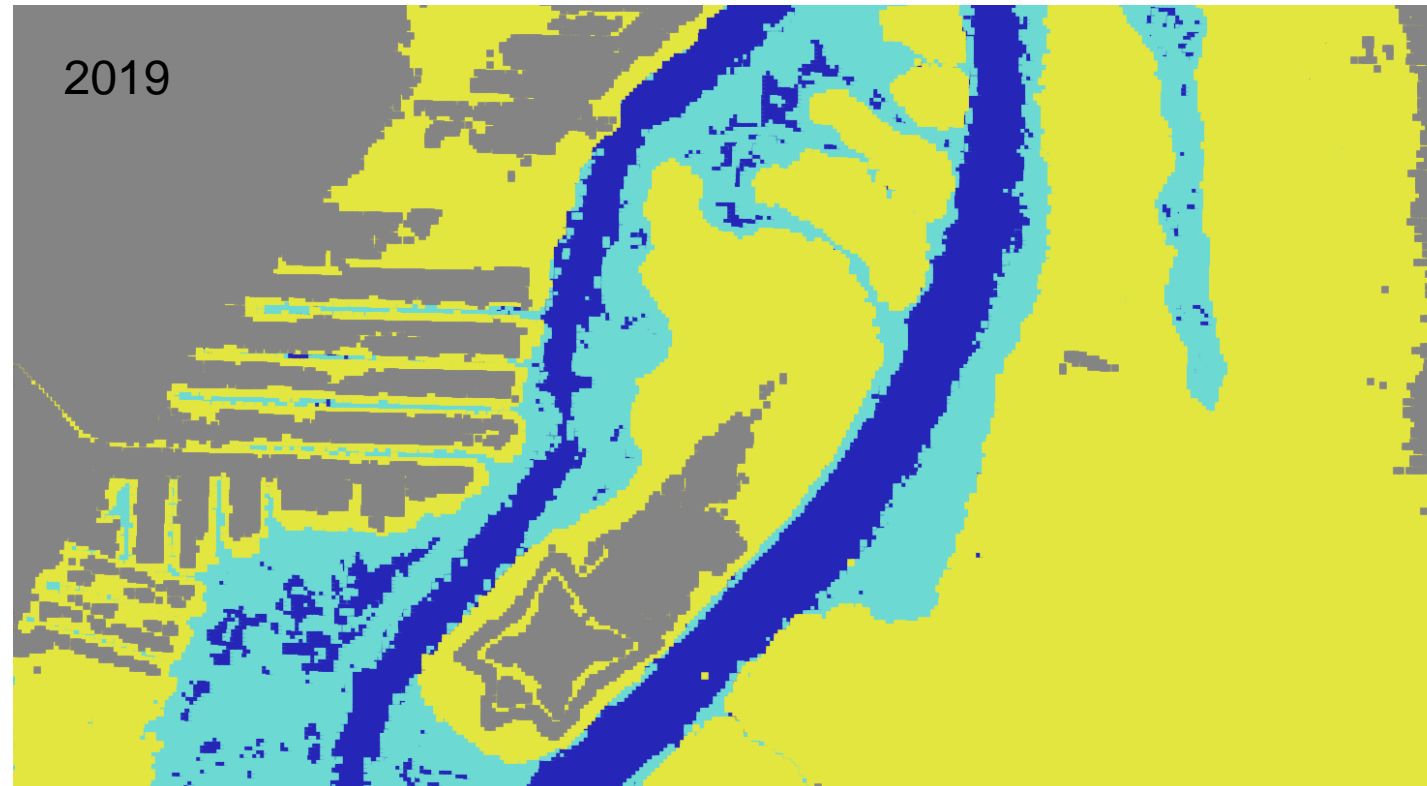


Wetland vegetation survey transects, VFWD, Chittenden county, VT



Wetland succession

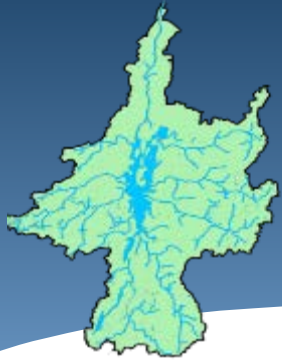
Example of model output



Legend

-  Open water
-  Submerged vegetation
-  Wetlands (marsh + swamp)
-  Upland



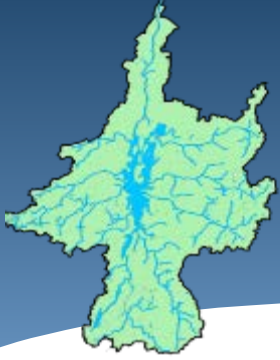


Tradeoffs

- What if one alternative is best measured by economic PIs but not best on social or environmental PIs? How will the Board compare PIs that can't be expressed using a common metric?
- The Board will NOT attempt to:
 - Monetize environmental and social PIs and pick the alternative with the highest dollar benefit
 - Assign weights to different PIs to automate the tradeoff process
- Where necessary, the Board will hold practice decisions when Board members publicly discuss why they are trading benefits in different categories, and their choices will be documented in the final report.

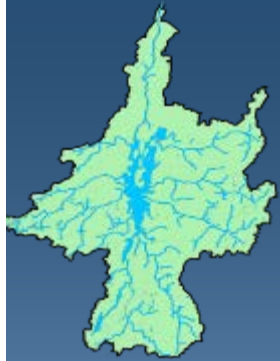


Key messages



- The study evaluates ways to mitigate flooding impacts in the LCRR basin and will provide recommendations.
- Performance indicators are quantitative measures calculated using computer models that reflect flood impacts on the society, the economy, and the environment.
- Impacts can be presented by sector, and/or for specific region (upstream, downstream), for a specific event or over a time series.
- Performance indicators are key components of a powerful decision support tool revealing the benefits and drawbacks of potential flood mitigation measures.





Thank You!

Questions?



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