



Environment and
Climate Change Canada

Environnement et
Changement climatique Canada

Canada

Climate Change & Freshwater Availability in the Canadian Prairies

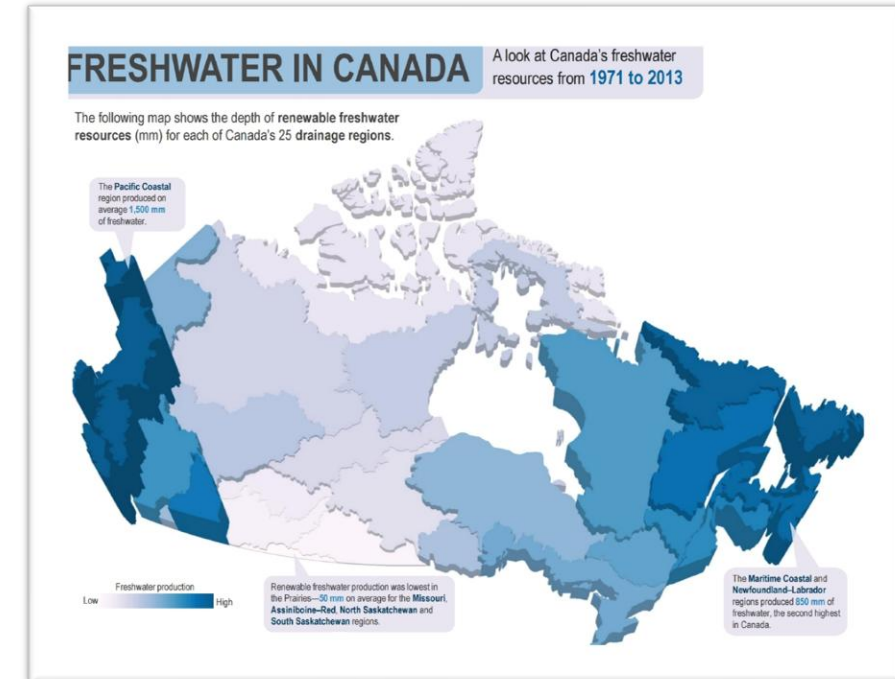


Daniel L. Peters and Barrie R. Bonsal

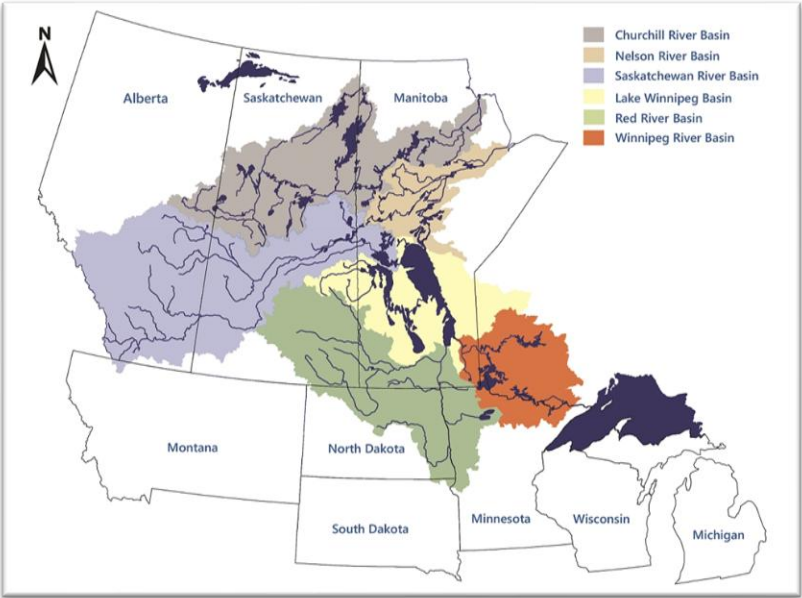
Environment and Climate Change Canada

Introduction

- Freshwater is key to Canadian Prairie prosperity
 - Economic viability
 - Ecological identity
 - Cultural, spiritual pillar for Indigenous People
- Secure and sustainable water supply essential
- Prairie landscape relies on a delicate hydrological balance
 - Support agricultural land, industry, and populated areas
- Freshwater paradox for the Prairies



Canadian Prairies – Major Drainage Basins



Saskatchewan River Basin



Reservoir operation vs climate change

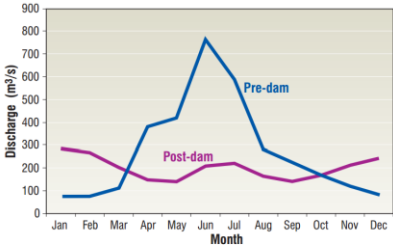


Figure 9.3. Effects of River Regulation Downstream of Gardiner Dam.

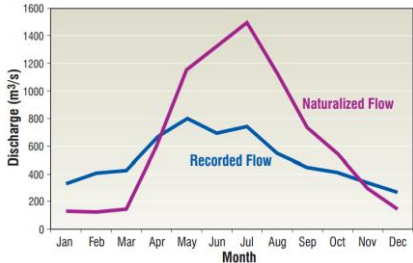


Figure 10.3. Median Monthly Naturalized Flow for Saskatchewan River at The Pas.

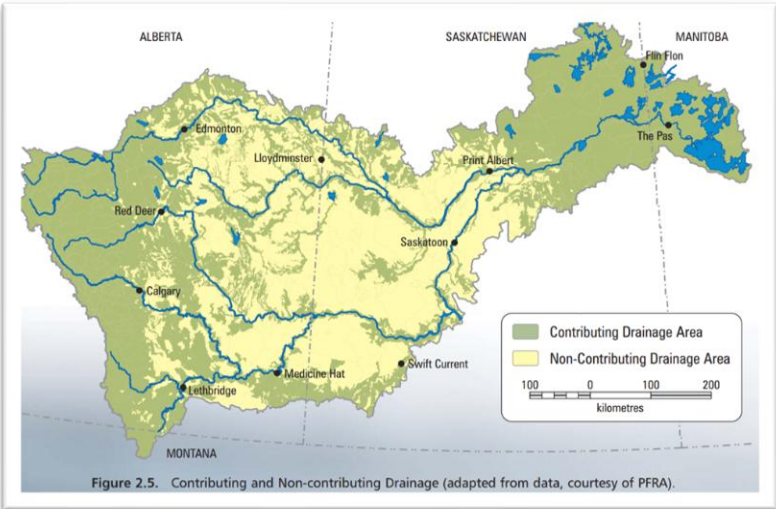
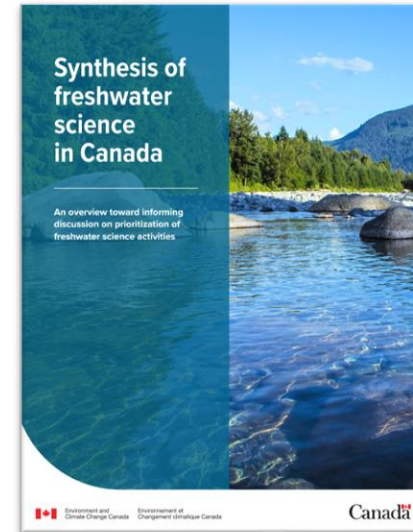
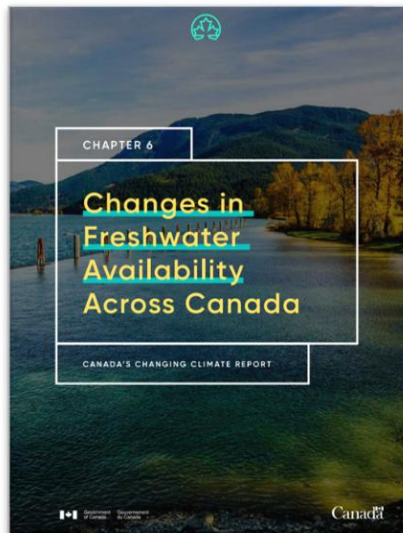


Figure 2.5. Contributing and Non-contributing Drainage (adapted from data, courtesy of PFRA).

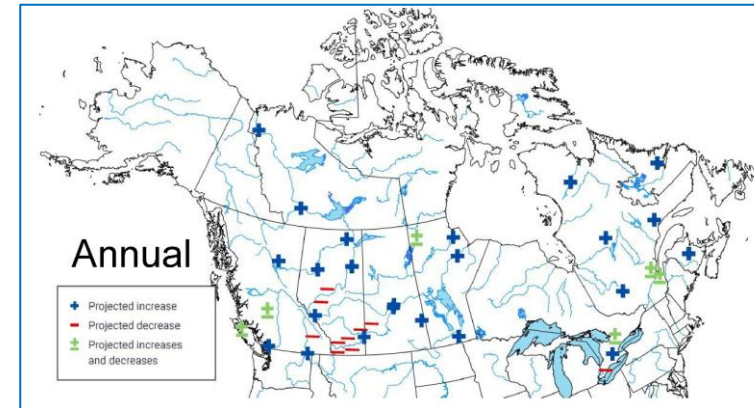
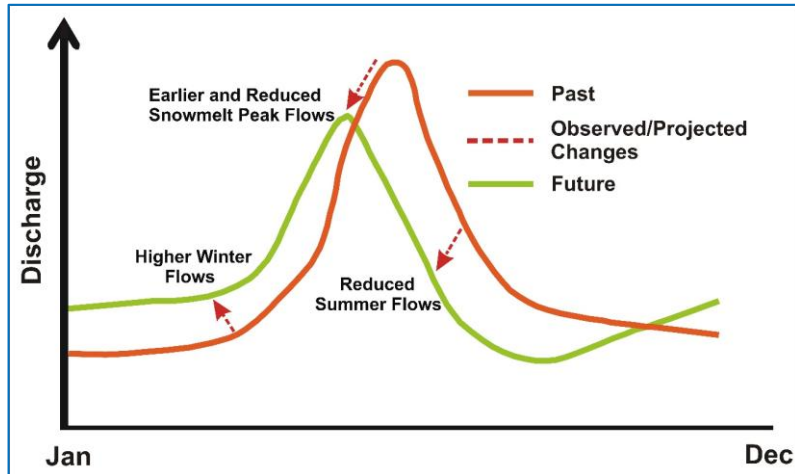
Freshwater Availability & Climate Change Indicators

1. Surface Runoff: Streamflow
2. Surface Water Levels: Lakes and Wetlands
3. Soil Moisture and Drought
4. Groundwater



Surface Runoff: Streamflow

- Earlier spring flows and peaks, with higher winter flows (**high confidence**)
- Reduced summer flows observed in some areas (**medium confidence**)



- Seasonal changes projected to continue, with shifts from more snowmelt-dominated regimes toward rainfall-dominated regimes (**high confidence**)
- Shift in the timing away from when water demands are high – eg summer
- Saskatchewan River: potential challenge for infrastructure & water-sharing agreements

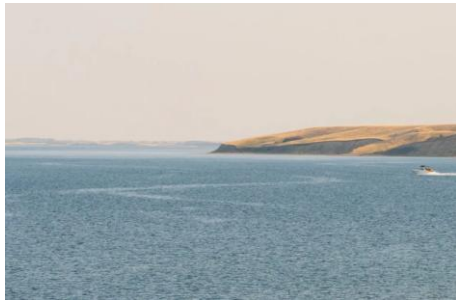
Streamflow Related Flooding

- Streamflow-related floods result from many factors
 - excess precipitation, snowmelt, ice jams, rain-on-snow, or combo
- Historically - no spatially consistent trends in these flood-causing factors or in flooding events across the country
- Projected increases in **extreme precipitation** - expected to increase the potential for future urban flooding (*high confidence*)
- Projected **higher temperatures** – earlier floods associated with snowmelt, ice jams, and rain-on-snow events (*medium confidence*)
- Uncertain how projected higher temperatures and reductions in snow cover will combine to affect the frequency and magnitude of future snowmelt-related flooding

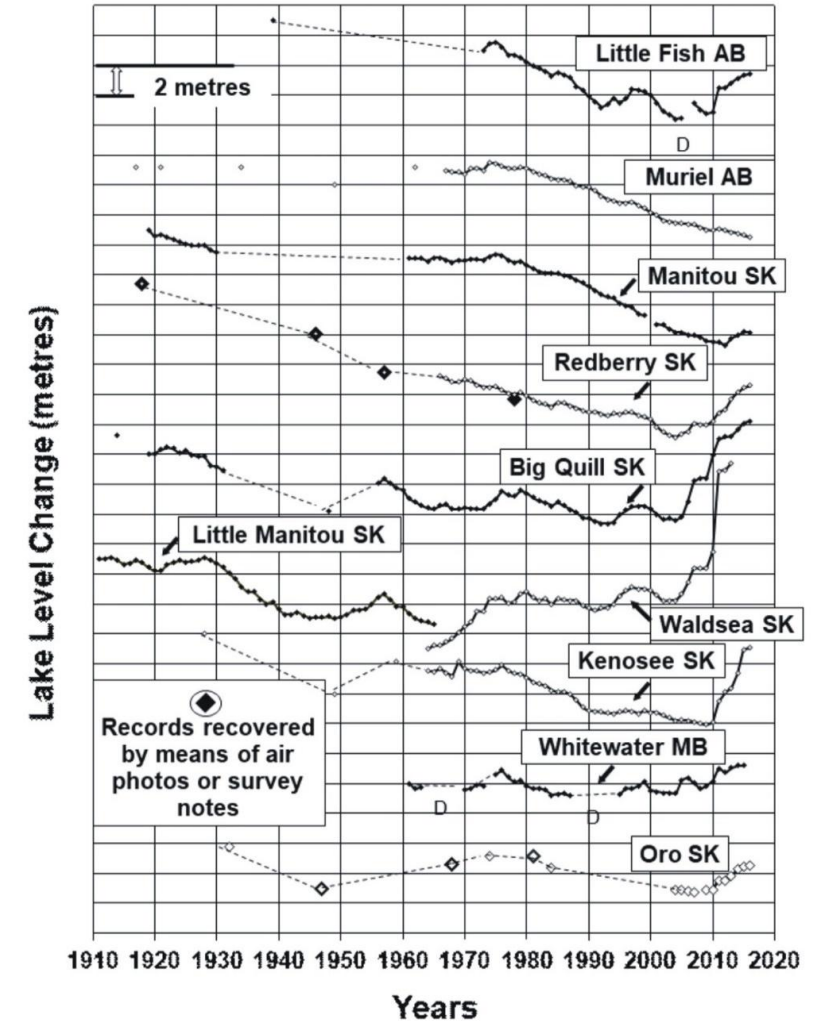


Surface Water Levels

- Across Canada, where there are sufficient data, there is no indication of long-term changes to lake and wetland levels
 - Regional and temporal variability apparent eg Prairies.
- Complex interactions - ice cover, evaporation, precipitation.
- Future levels may decline where **increased evaporation** may exceed increased precipitation (*low confidence*).



Water Levels Across the Southern Prairies

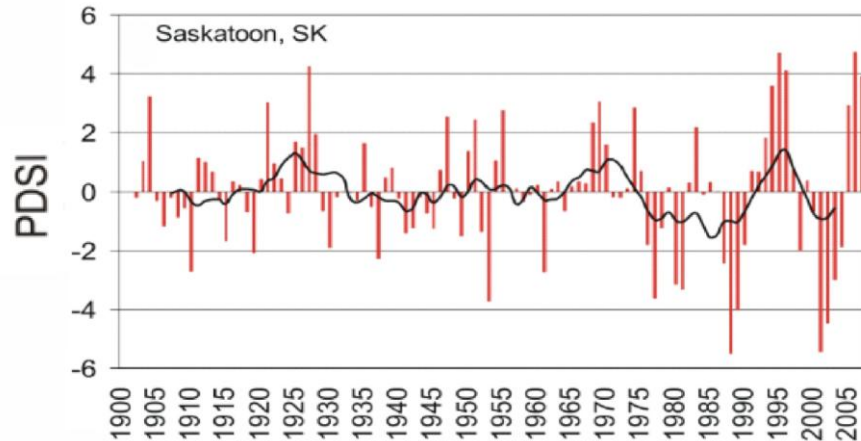


Soil Moisture and Drought

- Periodic droughts have occurred across much of Canada, but no long-term changes are evident

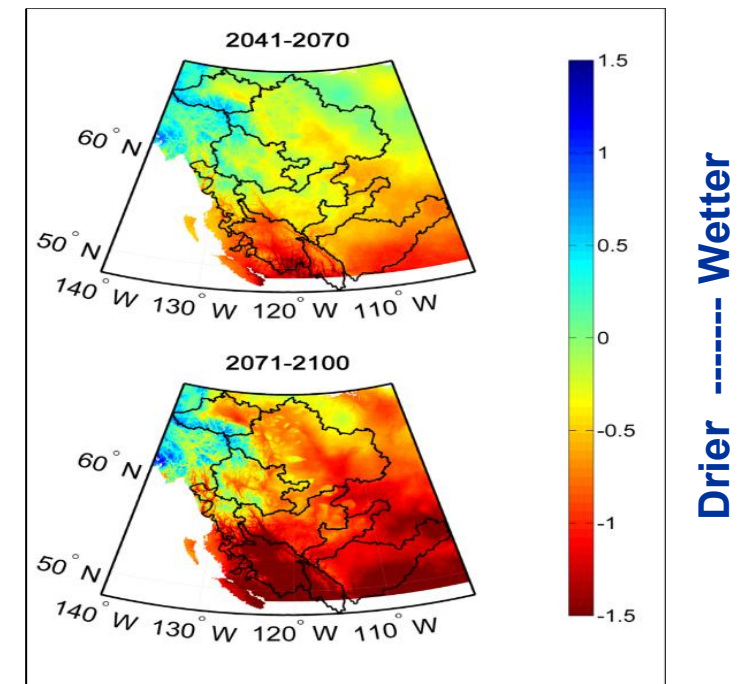


Palmer Drought Severity Index (PDSI)



- Future droughts and soil moisture deficits:
 - Projected **more frequent and intense** across the southern Canadian Prairies during summer
 - More prominent at the end of the century under a high emission scenario (*medium confidence*)

Projected Changes in Summer Drought across Western Canada vs 1971-200 baseline RCP8.5

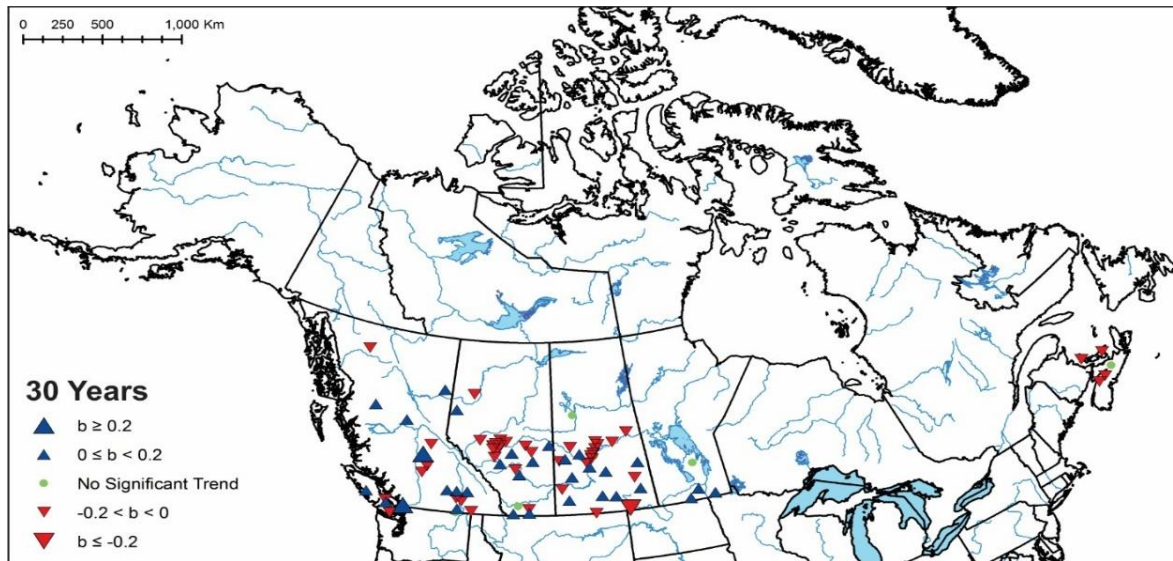


Groundwater

- Complexity of groundwater systems and a lack of information make it difficult to assess groundwater level changes since records began
- Do have some information for the Prairies



Past Annual Groundwater Level Trends in Canada



- Projected changes to temperature and precipitation expected to influence future groundwater levels - magnitude and even direction of change is not clear.
- Spring recharge of groundwater aquifers over most of the country is anticipated to occur earlier in the future, as a result of **earlier snowmelt** (*medium confidence*)

Strategies to minimize risk associated with climate change

- **Adaptation:** Reactive or proactive adjustment to manage the “supply-demand” gap
 - eg - modify water management practices and infrastructure to minimize the harm (or exploit the benefits) of climate changes
- **Mitigation:** Actions taken to reduce the severity or intensity of climate change
 - eg - nature based solutions, such as restore wetlands
 - eg – human solution, such as add a weir to raise river level
- **Resilience** - Increase the hydrological buffer or flexibility of the system
 - eg - water storage expansion to capture earlier snowmelt, ensuring water is available later in the season

Take Away Messages

- Anticipated changes from climate warming will directly affect the timing and amount of future freshwater supplies, and these may be exacerbated by human management alterations to freshwater systems
- The impacts are expected to be more prominent toward the end of this century under higher emission scenarios, given the larger associated climate changes
- Of particular concern are impacts in regions that currently rely on snow and ice melt as freshwater sources, particularly the prairies where increased evapotranspiration from warmer temperatures could reduce future water supplies
- It is also anticipated that water-related extremes, such as droughts and floods, will intensify these impacts
- Canadian Water Agency – play a role in multi-knowledge system building, water management, and integrated freshwater assessments

THANK YOU!

