Natural Hazards: Flood

R. Halliday[1]

Saskatchewan Flood and Natural Hazard Risk Assessment – Stakeholder Workshop

[1]R. Halliday & Associates

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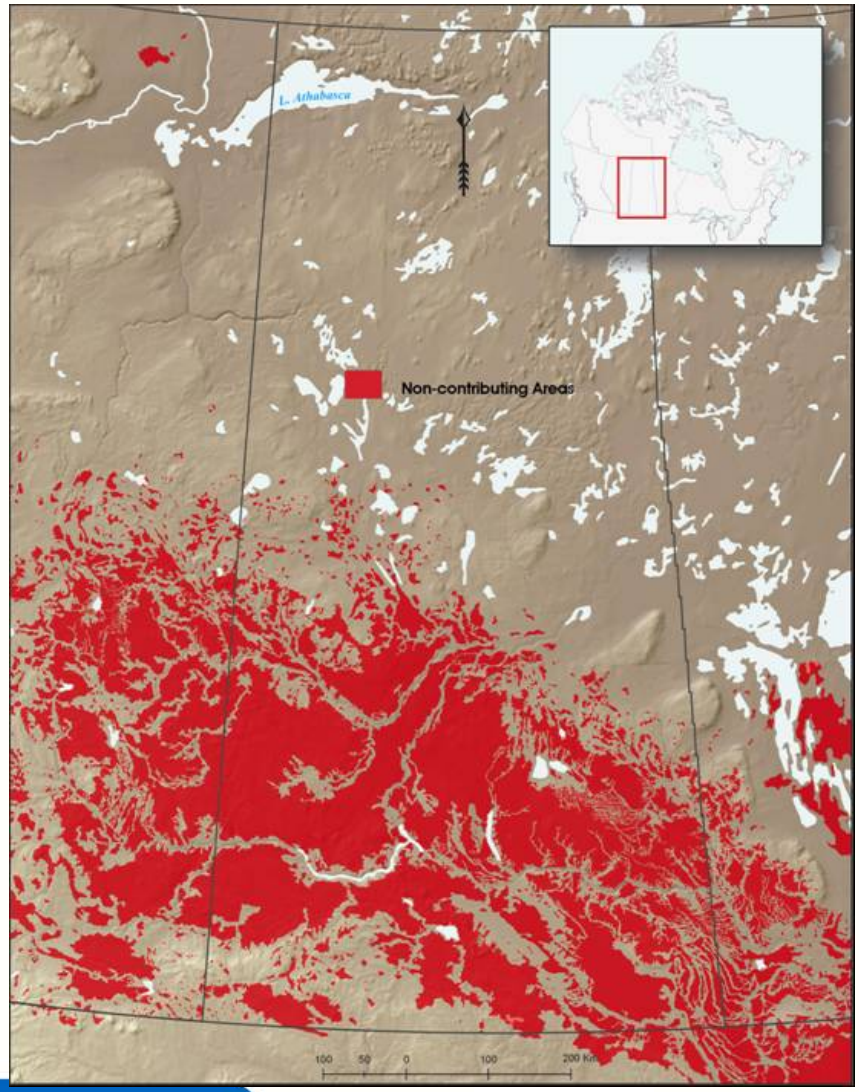
Flooding – SK Hydrology – 1

- Saskatchewan River system is the source of high quality reliable water supply for the southern half of province
- North and South branches are exotic rivers, 80-90% of flow is mountain runoff
- South Saskatchewan River is highly regulated by dams/reservoirs

Flooding – SK Hydrology – 2



Prairie Runoff

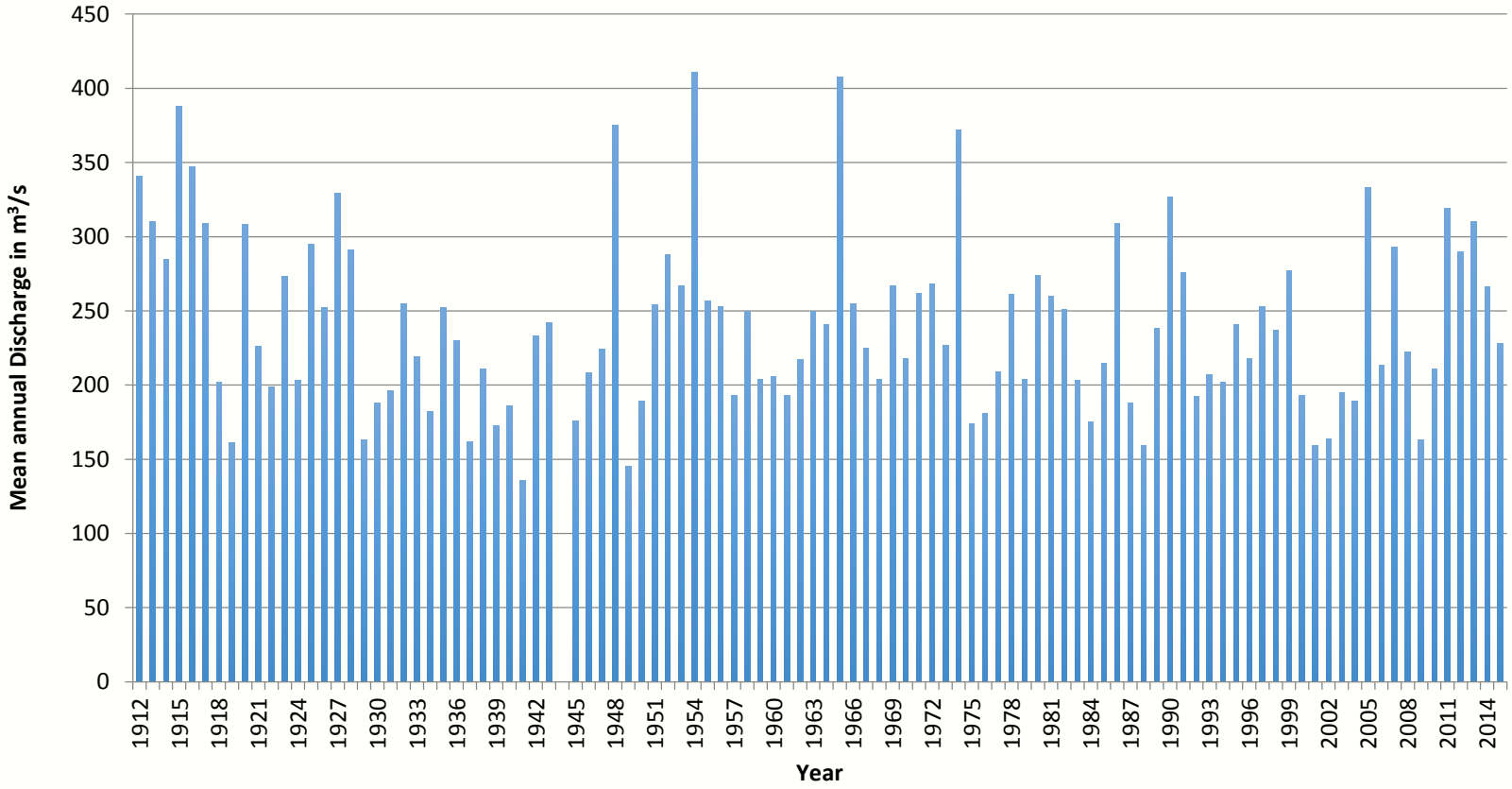
- Typically about ten percent of precipitation
- Driven by antecedant conditions, winter precipitation, and rain during runoff
- Summer rains sustain crops
- Non-contributing drainage

P. Gregoire, PFRA data

The Flood Hazard – 1

- Mountain runoff – June-July
  - Battlefords, Prince Albert, Cumberland House
  - First Nations Reserves
- Plains runoff – April
  - Riverine flows, about 20 communities
- Lake flooding – April through July
  - High water levels, wind set-up, ice shove
  - About 20 communities, including resort villages

North Saskatchewan River at Prince Albert

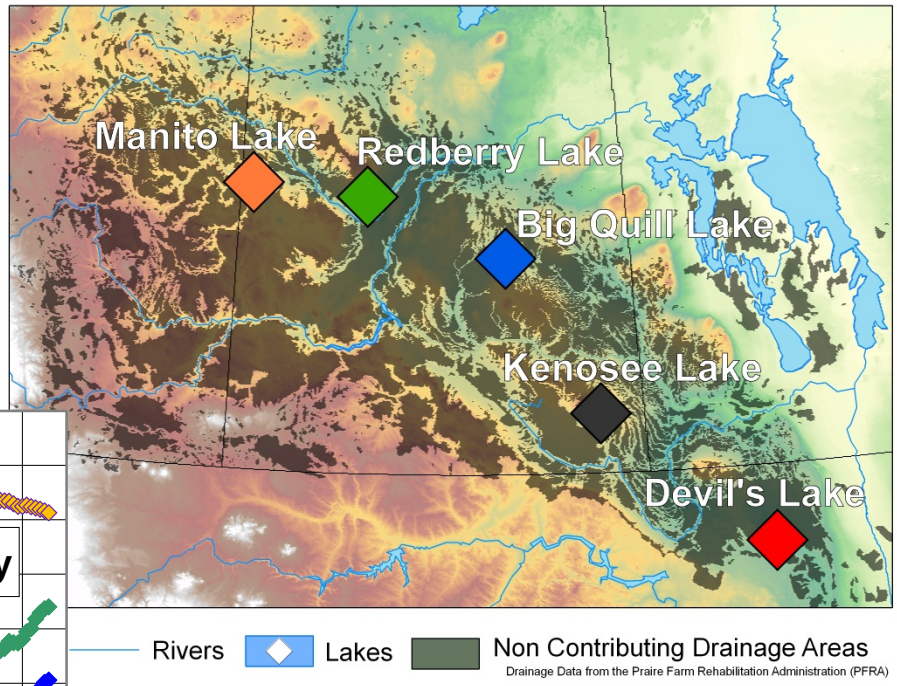


The Flood Hazard – 2

- Overland Flooding – April through October
  - Rain-driven, excessive moisture
  - A volume problem rather than a peak problem
  - Flat lands lacking well-defined watercourses
  - Large spatial extent
  - About 35 communities
- Urban Infrastructure Capacity
  - Limitations of drainage infrastructure

Prairie lakes 1820 – 2016:
Devil's Lake (ND) has been rising since 1940 while nearby Canadian prairie lakes were falling until recently, but are now rising rapidly.

[Adapted from van der Kamp et al., 2008]



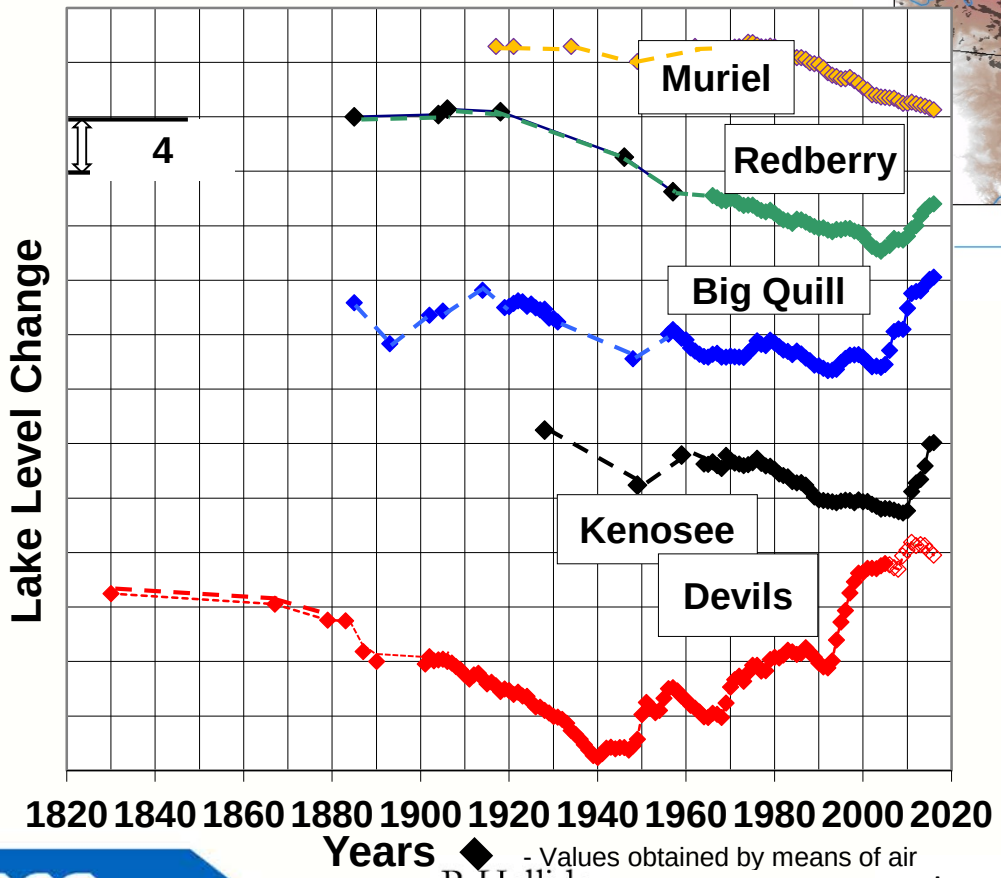


Figure provided by Garth van der Kamp

Lake Flooding

Photo: Google Earth, Ian Stewart, Walker Projects Case Study

Urban Flooding

Photo: Government of Saskatchewan Yorkton 2011

Flood Risk – 1

- Risk = Hazard X Exposure/Consequence

- Riverine flooding
  - Statistical procedures leading to a “return period”
  - Expressed as 1:25, 1:100, 1:500, etc.
- Lake flooding
  - Statistical procedures using joint probabilities
  - Also expressed as a return period

BUT

The times, they are a-changing!

Flood Risk – 2

- Overland Flooding
  - No standardized statistical approach
  - Saskatchewan topographic data gap
  - Treat as an excess moisture problem
  - Express as a vulnerability rather than probability

AND

The times they are a-changing!

Flood Damages

- Riverine flooding – communities and First Nations
- Lake Flooding – communities, First Nations lands, resorts/parks
- Overland Flooding – communities, FN lands, agricultural lands
- Dam break – high hazard communities

Photo: Gov't of Saskatchewan

Vulnerable Infrastructure

Photo: Government of Saskatchewan

Flood Impacts Examples

- Economic
  - Flood-fighting costs
  - Urban damage, including infrastructure
  - Business losses
  - Agricultural losses
- Social
  - Community resilience, anxiety, stress
- Environmental
  - Contaminant mobilization, slumping, erosion, avulsions

Standard Mitigation Measures Non- Structural

- Flood-risk mapping
- Don’t build in flood plains
  - Requires hydrological analysis
  - Requires zoning
- Siting of critical infrastructure
- Safe building elevation, freeboard
- Restoration of natural systems, net-zero ΔQ
- Land acquisition
- Flood forecasting
- Building codes
- Insurance

Standard Mitigation Measures Structural

- Upstream storage, dry dams
- Dykes, berms, floodwalls
- Floodways and spillways
- Dry and wet flood-proofing
- Controlled notches and breeches

Structural Measures

Photo: Walker Projects, Ian Stewart's Quill Lakes Case Study

Risk Assessment

- Well defined flood risk at about 40 riverine and lake communities
- BUT analysis is sometimes outdated
- Summer rains of last decade have flooded many more communities
- BUT hazard is known, risk is not well understood
- SK does not have dam safety legislation
- SK does not include flood-proofing in building code
- Overland flow at small communities, RMs

Conclusions

- Most of Saskatchewan's large communities are at considerable risk from riverine flooding
- Many smaller communities are at risk from riverine, lake or overland flooding
- Application of non-structural measures to mitigate flood risks is uneven
- Application of structural measures is also uneven

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