

# *From the Mountains to the Sea: The State of the Saskatchewan River Basin*

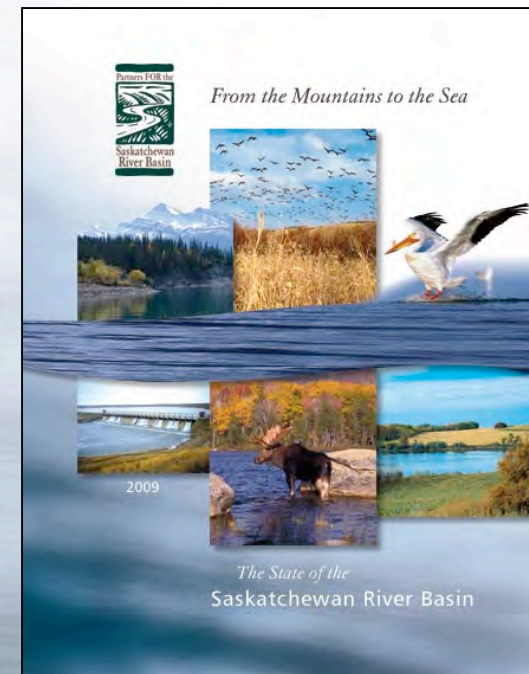
R. A. (Bob) Halliday

for

Northern Saskatchewan  
Watershed Alliance

Rural Municipal Watershed  
Planning Round Table

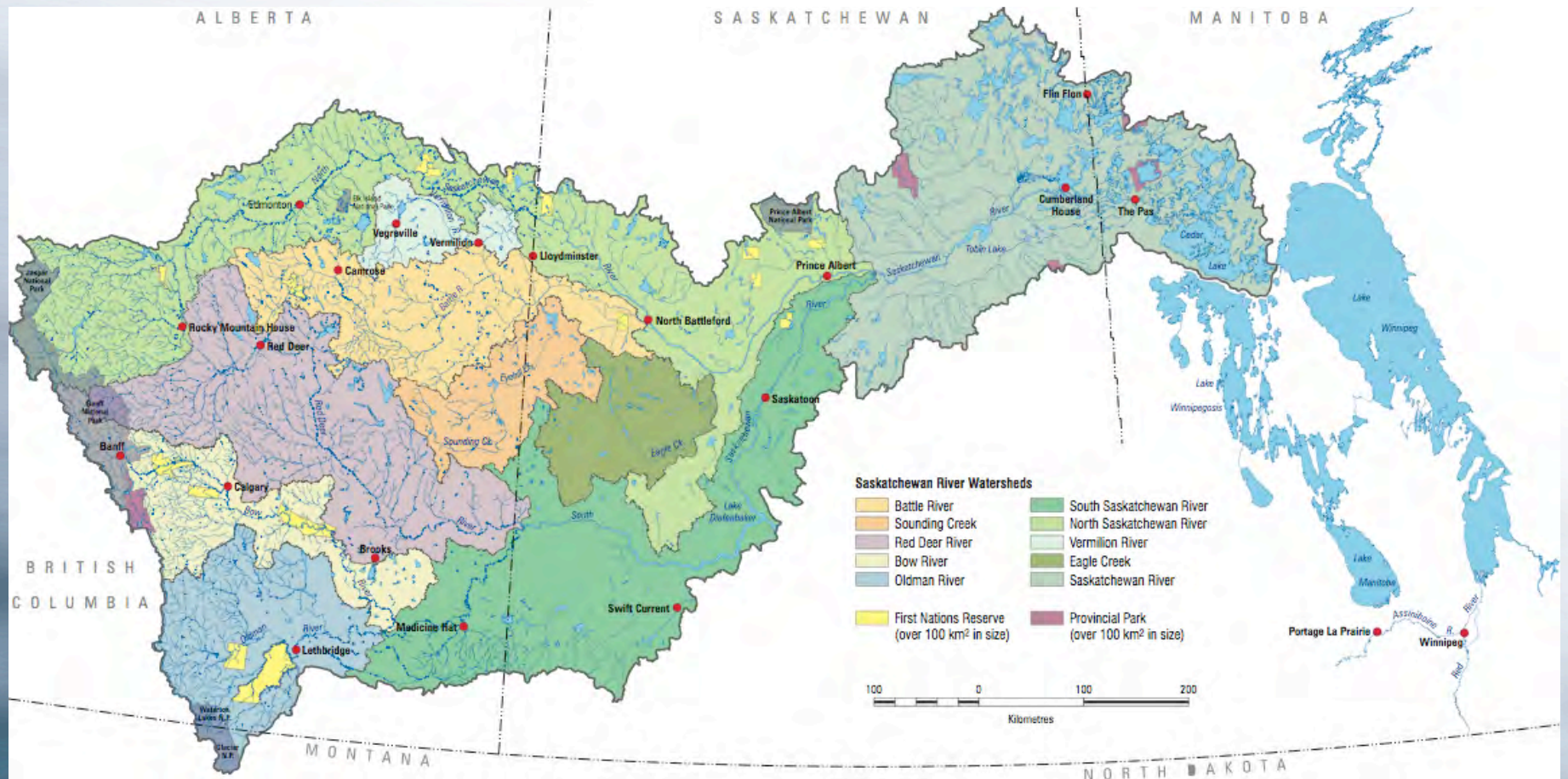
December 10, 2009



# Outline

- Basin Overview
- Vulnerabilities
- Conclusions

# Saskatchewan River Basin



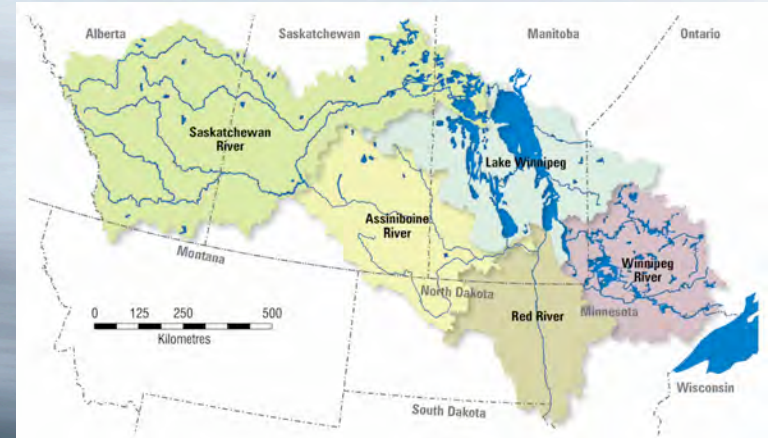
*From the Mountains to the Sea –  
The State of the Saskatchewan River Basin*

# Saskatchewan River Basin

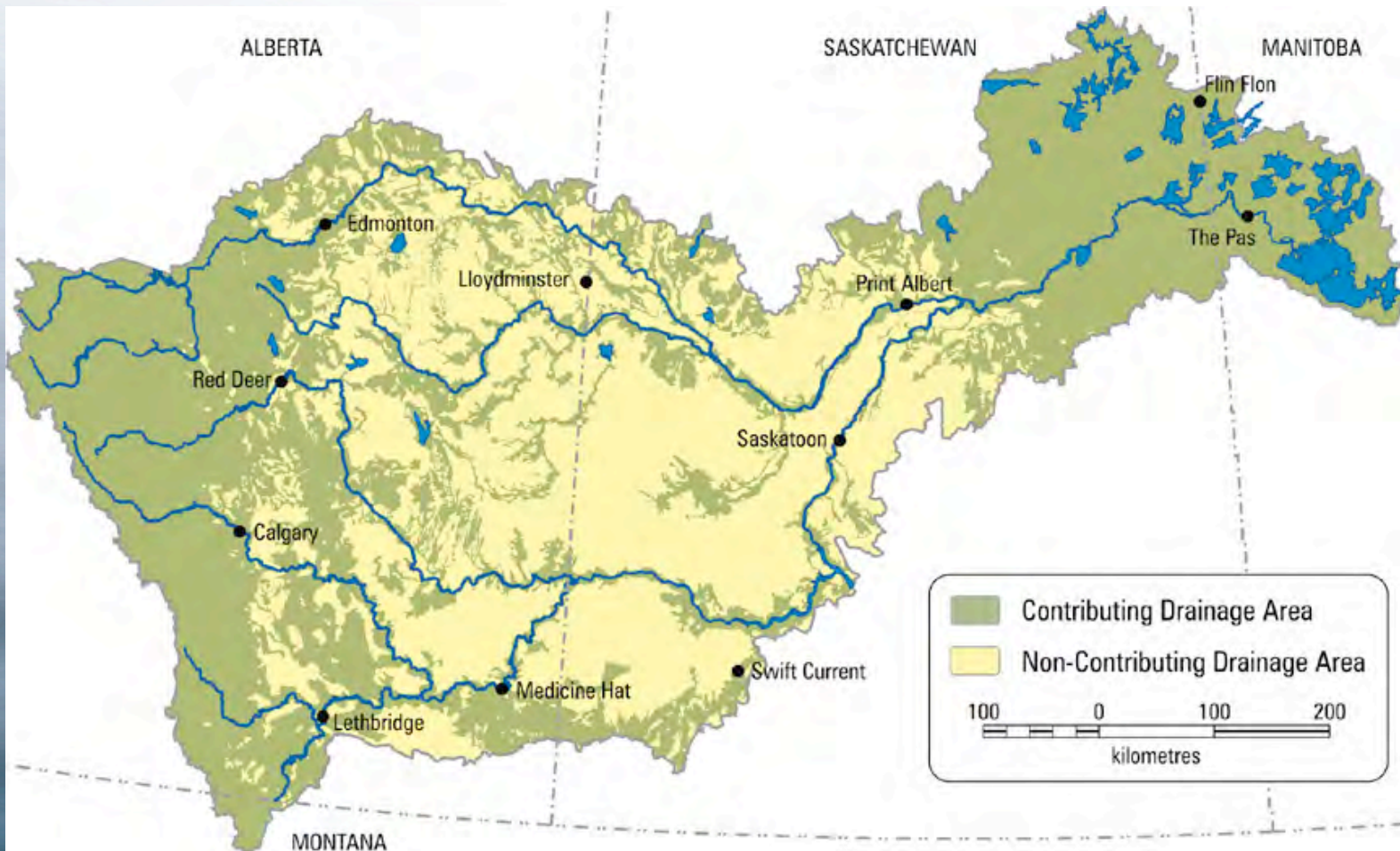
- 1940 km from the continental divide to Lake Winnipeg
- 405,864 km<sup>2</sup> - larger than Germany, smaller than France
- 52% in Alberta, 42% in Saskatchewan and 6% in Manitoba
- Major component of the Saskatchewan-Nelson system flowing into Hudson Bay

# More Basin Facts

- Most of the water that flows in the basin originates in the 'water towers' - the Rocky Mountains and foothills forest
- About half the basin doesn't contribute to flow in a typical year
- Saskatchewan River Delta is the largest inland freshwater delta in North America
- Joins Lake Winnipeg - the world's 11<sup>th</sup> largest lake



# Non-contributing Drainage



# Human Settlement

- Occupied for over 10,000 years
- First European, Henry Kelsey - 1690-92
- Oldest settlement, Cumberland House - 1774
- Now over three million inhabitants - most in Alberta
- Most residents live in cities

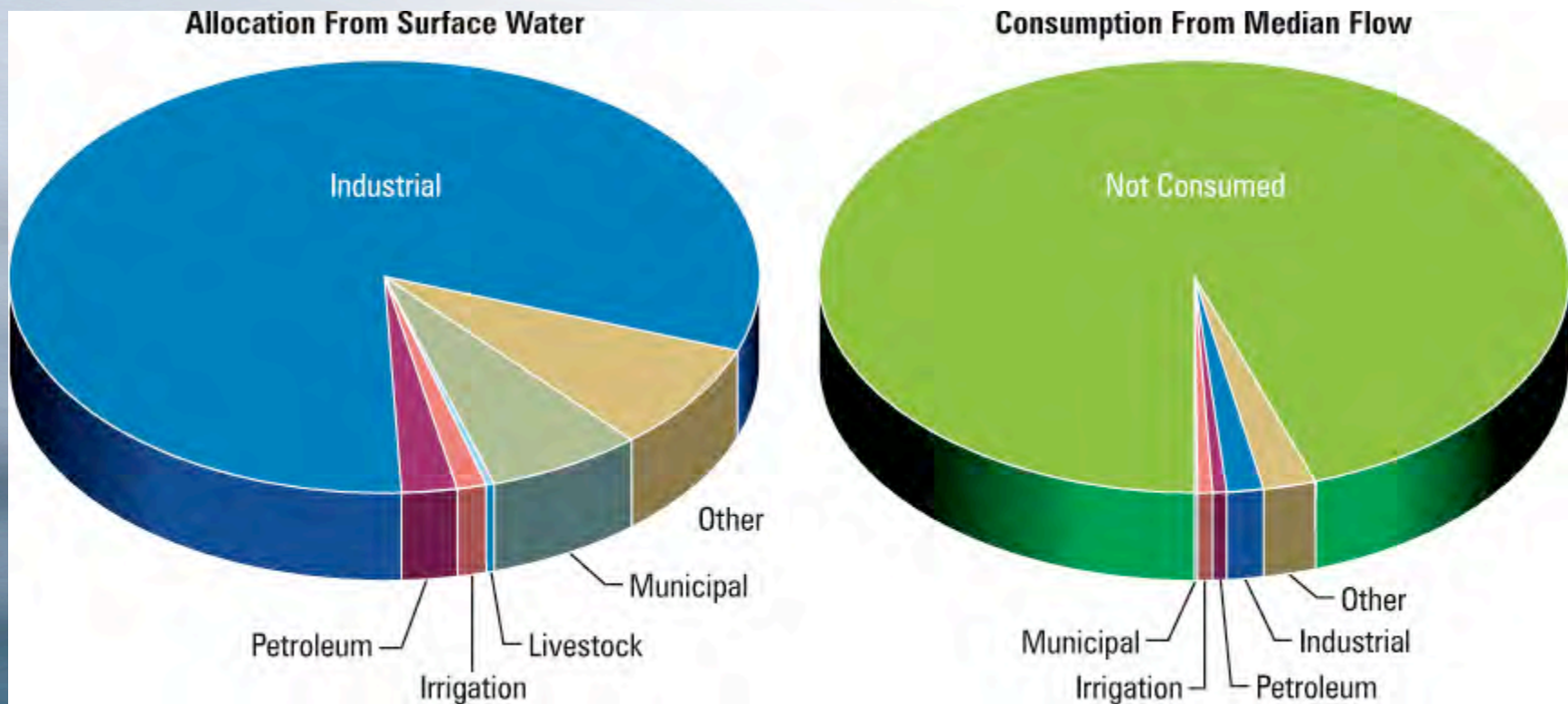
# North Saskatchewan River Basin

- Natural flow is slightly less than that of South Saskatchewan River
- Mainstem flows are regulated
- Licensed water use is primarily for industrial purposes
- Total water consumption is roughly equivalent to evaporation from Lake Diefenbaker



# Allocation and Consumption

## North Saskatchewan River



# South Saskatchewan River Basin

- Almost entirely transformed by human activity
- Highly regulated by dams and diversions
- Headwaters subject to IJC's 1921 Order
- Only 2% of the flow originates in Saskatchewan
- Contains more than 75% of Canada's irrigated agriculture
- Livestock in the basin consume more water than people



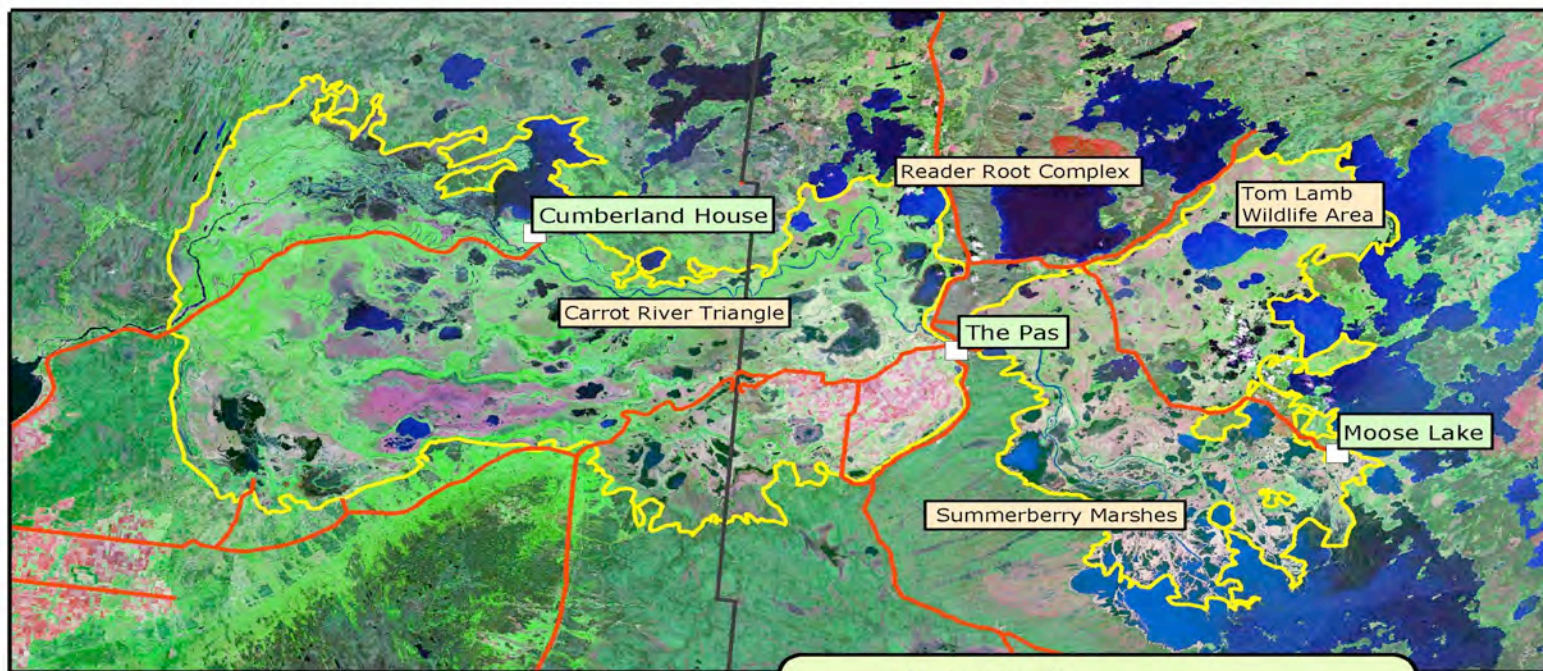
# Saskatchewan River Reach

- From The Forks (near Prince Albert, SK) to Lake Winnipeg
- Regulated for hydropower
- Carrot River flows greater than those of Red Deer River
- Saskatchewan River Delta straddles the interprovincial boundary



# Saskatchewan River Delta

Saskatchewan River Delta



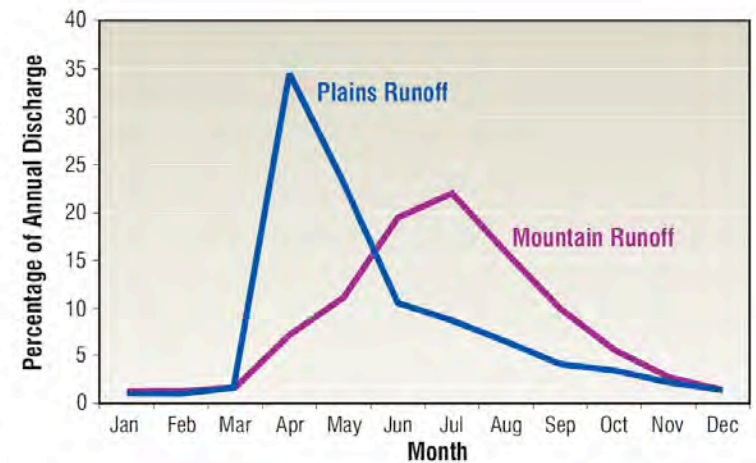
- Major Roads
- Provincial Border
- Saskatchewan River Delta Boundary

# Saskatchewan River Delta

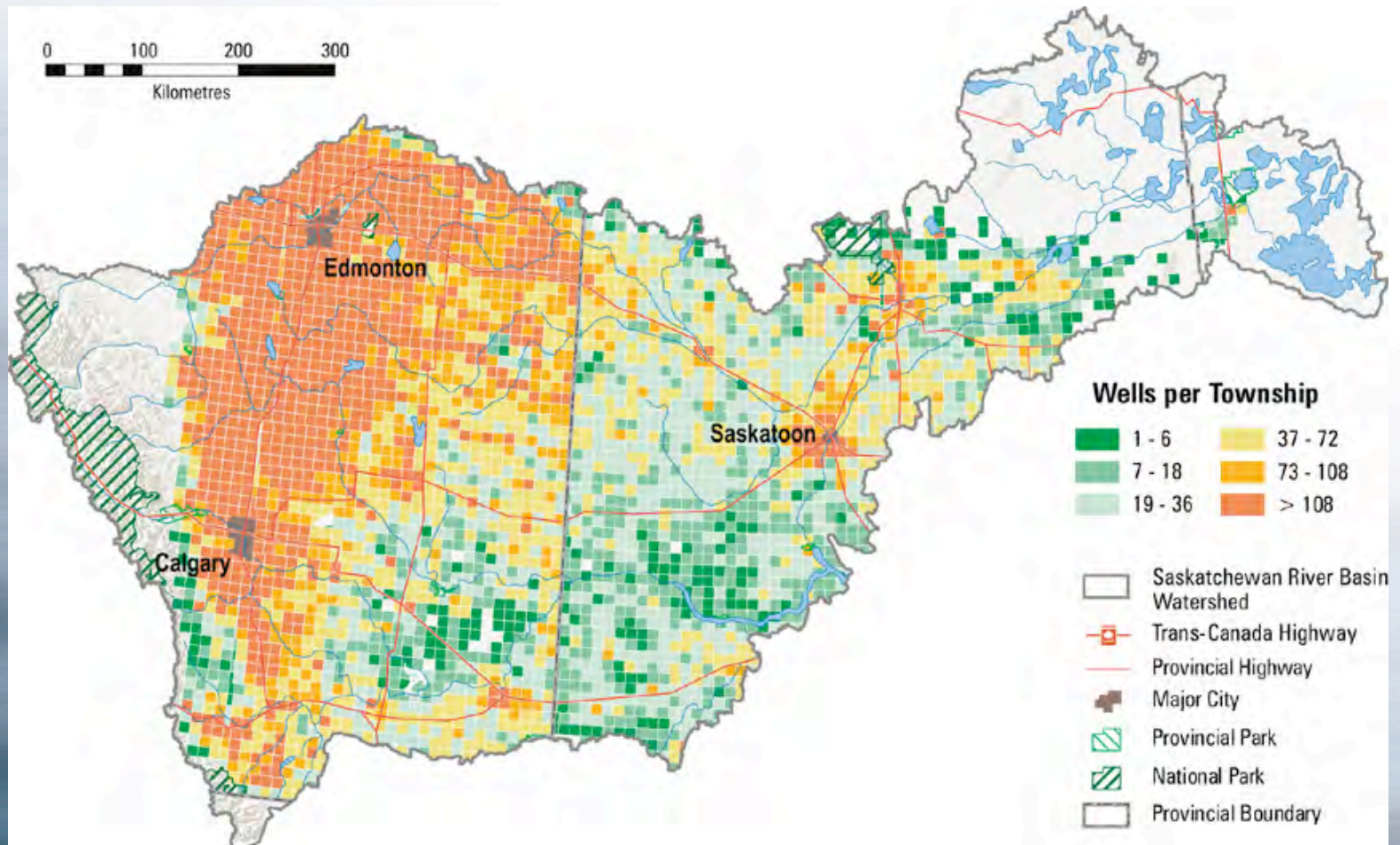
- Ecological change in Saskatchewan River Delta
  - terrestrial, riparian habitat
  - fishery
- River regulation and lake sturgeon
  - 75 m<sup>3</sup>/s minimum flow
- The river continues to stabilize following 1870s channel change

# Water Quantity

- Mountain-fed streams have much more reliable flow than plains-fed streams
- Runoff is largely the result of spring snowmelt
- Runoff is influenced by land use change
- Groundwater use is small,
- Groundwater is spatially important



# Groundwater Wells



# Water Quality

- Natural characteristics, agricultural and municipal effects
- Mountain-fed streams naturally hard, but good quality
- Prairie streams highly mineralized and considerable nutrient content
- Need to consider cumulative effects on Lake Winnipeg, especially for nutrients

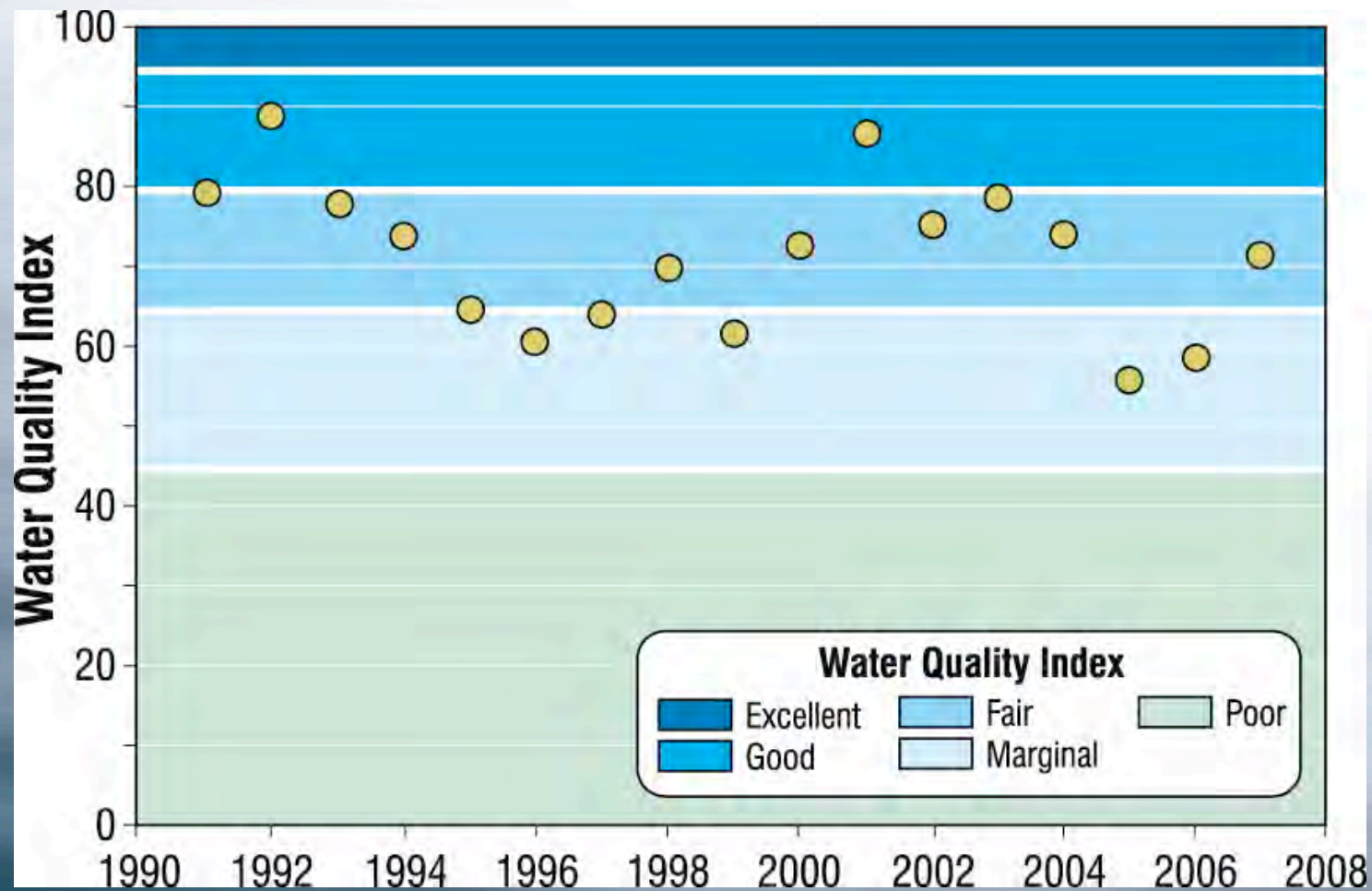


# Water Quality Monitoring

- Dissolved solids and major ions
- Nutrients
  - natural, agricultural, municipal sources
- Heavy metals
- Pesticides
- Microbiological
  - agricultural and urban sources

# Water Quality Index

North Saskatchewan River at Interprovincial Boundary



# Water Management

- Federal roles
  - transboundary waters
  - fish habitat and pollution harmful to fish
  - regulation of toxic substances
  - navigation and shipping
  - Federal lands, eg. National Parks
  - First Nations lands

# Water Management

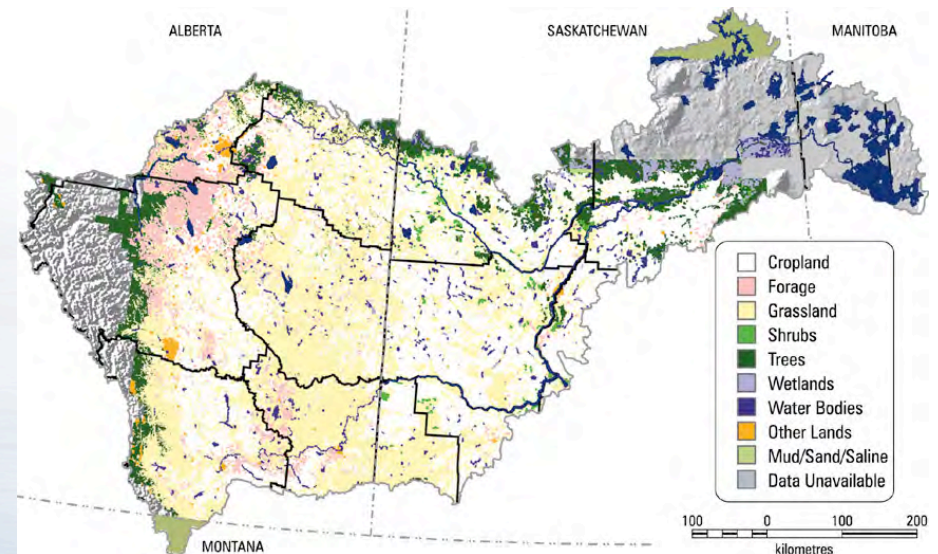
- Provincial roles
  - water infrastructure
  - flood forecasting
  - drinking water and water quality
  - protection of source water
  - licensing water use
  - regulating fisheries

# Water Planning

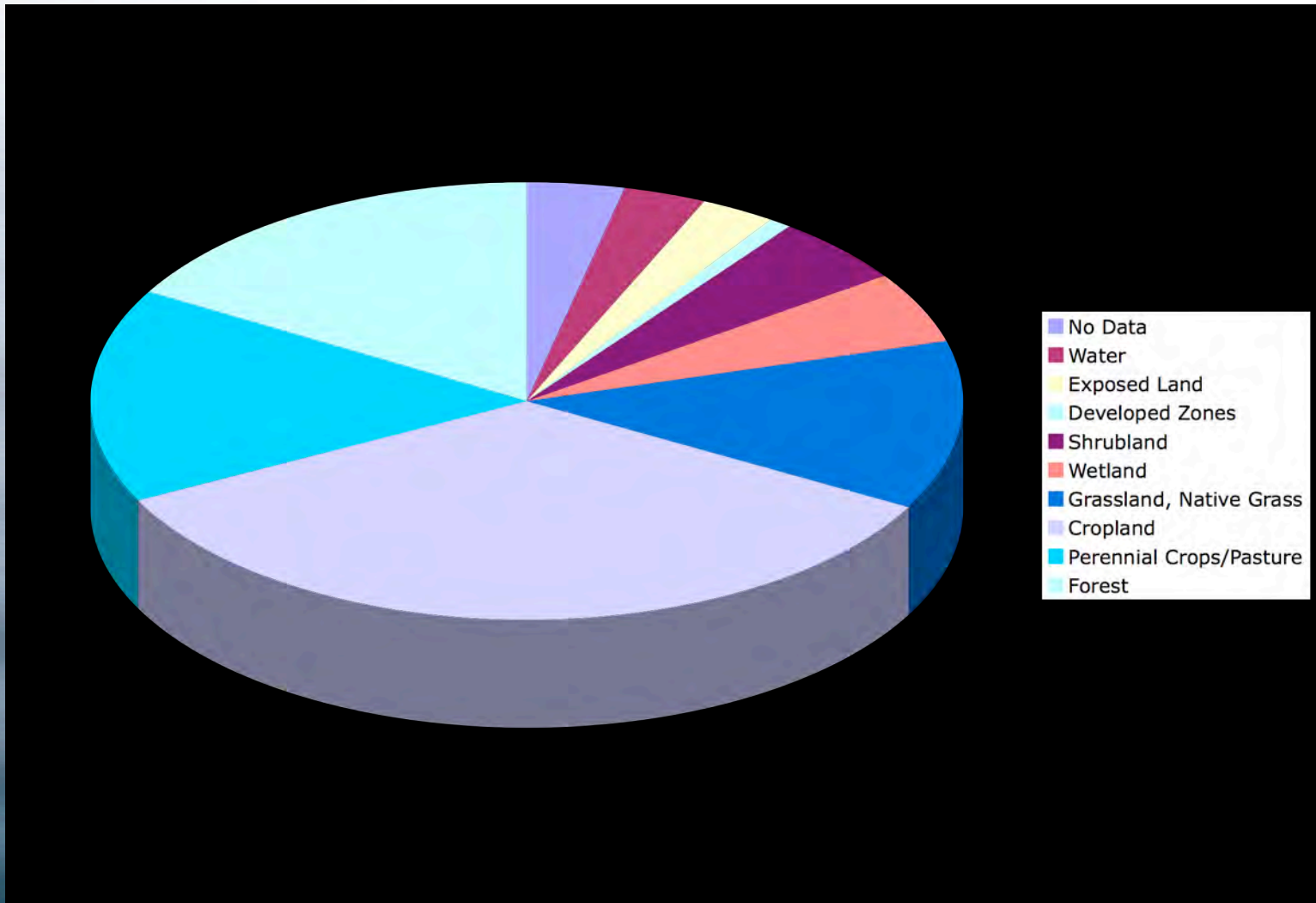
- Alberta - Water for Life Strategy
  - WPACs
- Saskatchewan - Long-term Safe Drinking Water Strategy
  - WACs
- Manitoba - Manitoba Water Strategy
  - Conservation Districts

# Key Vulnerabilities

- Landscape modification
- Water supply
- Dams and diversions
- Municipal water and wastewater
- Climate change
- Natural hazards - flood, drought
- Invasive species
- Institutional development



# Current Land Use



# Landscape Modification

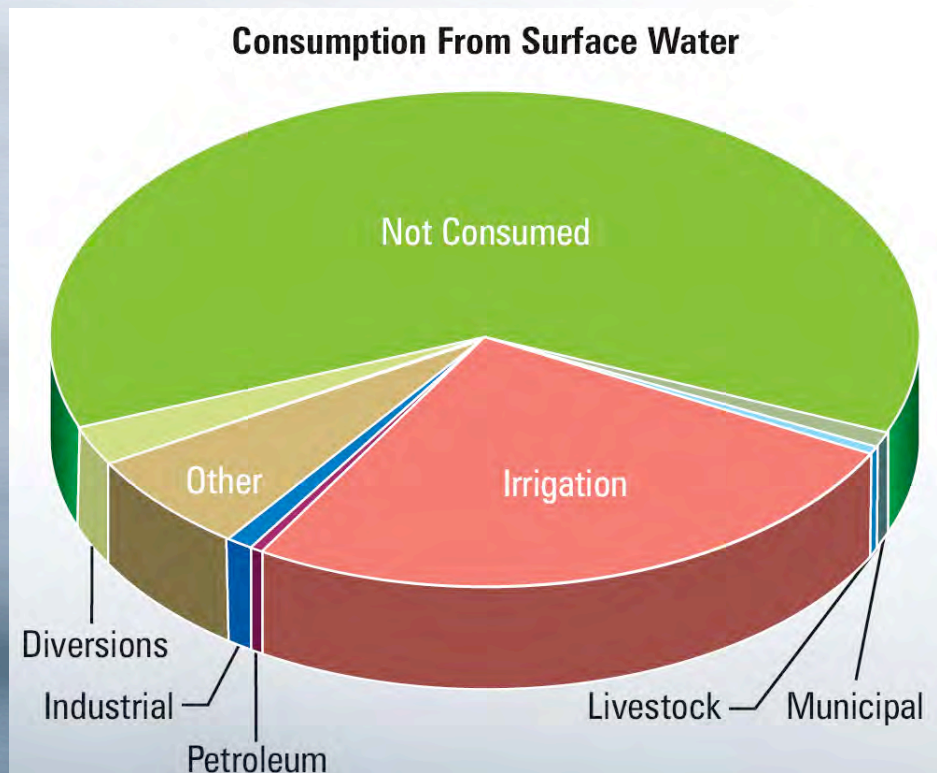
- Habitat loss, particularly wetlands loss
- Forests
  - harvesting increases runoff/erosion
  - linear features fragment habitat
- Agriculture
  - minimum till reduces runoff
  - land drainage increases local runoff and erosion
- Urban development
  - increases runoff, erosion



# Water Supply

- Mountain sources much more reliable than plains sources
- Supplies affected by land use change and climate change
- Currently sufficient supply to meet reasonable demands
- South Saskatchewan basin

# Water Consumption in South Saskatchewan Basin



- Based on median flow
- Current Alberta consumption is less than entitlement
- Drought

# Water Use Trends

- Existing projections - business as usual
- Data problems:
  - licence data - good
  - withdrawal, consumption data - poor
- Conservation opportunities
  - urban, industrial, agricultural
- Business as expected

# Instream Flow Needs

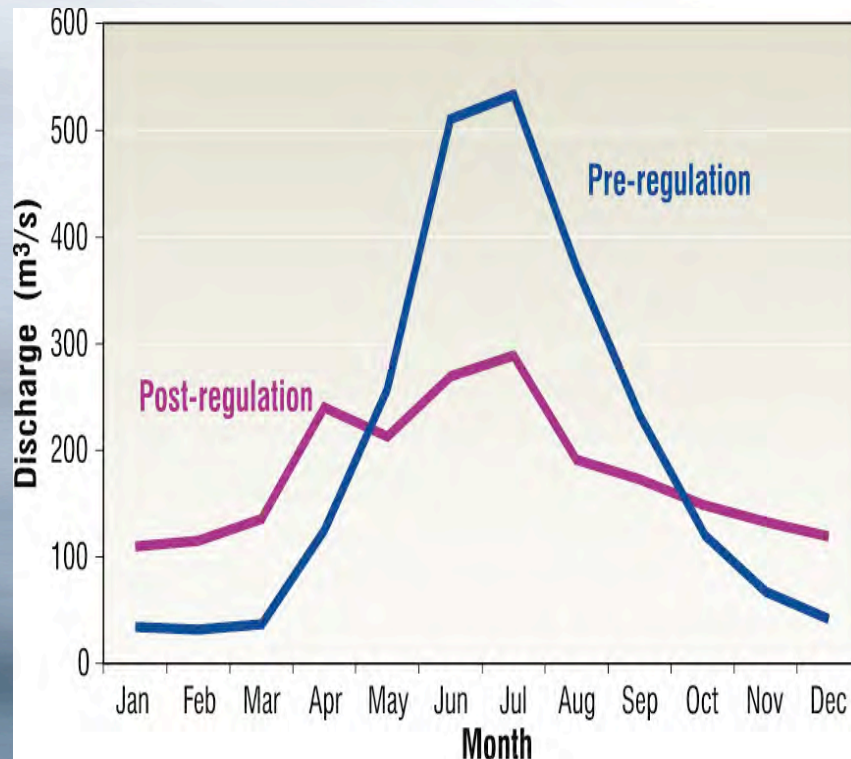
- Maintain aquatic and riparian ecosystems
- Water licences regulate diversions and withdrawals not environmental uses
- Considerable work on instream flow needs in Alberta
- Conservation flows on South Saskatchewan River mainstem and Alberta tributaries
- Releases of 42.5 m<sup>3</sup>/s from Lake Diefenbaker and 75 m<sup>3</sup>/s from Tobin Lake

# Dams and Diversions

- Modify timing and volume of flow
- Enable increased water demands
- River channel converted to lake environment
- Affect sediment and thermal regime
- Fragment habitat
- Affect riparian habitat



# River Regulation



- Hydro operation modifies the hydrograph
- Spring flushing flows reduced
- Increased winter flows assist waste assimilation

# Municipal Water

- Significant withdrawal, but insignificant consumption
- Major urban centres are net contributors to surface water if stormwater runoff is considered
- Water conservation reduces costs for operation and expansion of WWT facilities

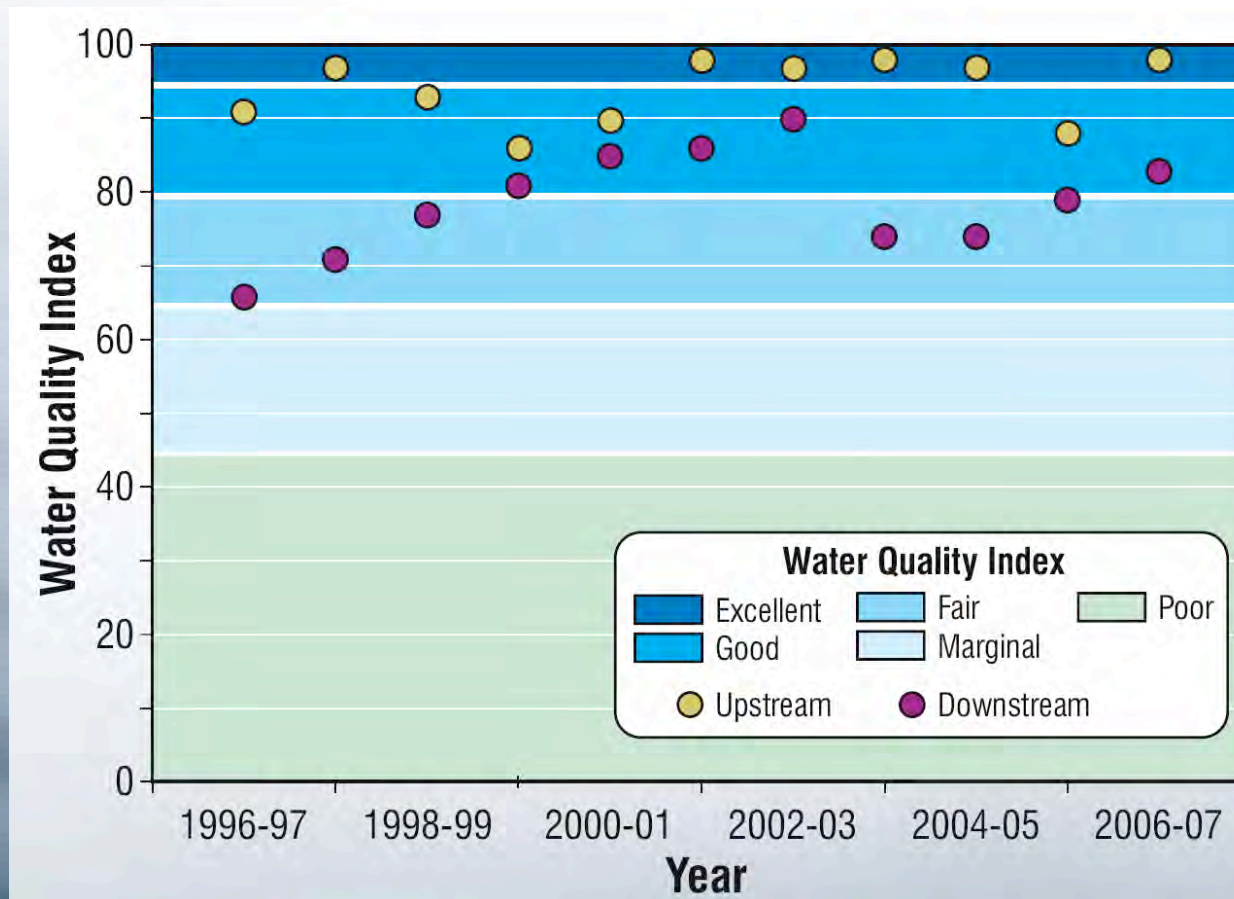
# Municipal Wastewater

- Municipal effluents are a major threat to aquatic ecosystems and downstream source waters
- Wastewater treatment is better than most other parts of Canada, but room for improvement
- Require higher standards of nutrient removal
- Threats: pathogens, endocrine disruptors, personal care and pharmaceutical products (PCPPs)

# Municipal Stormwater

- Combined sewers the norm prior to the 1940s
- Early stormwater systems aimed at reducing property damages and enabling traffic movement
- Stormwater detention ponds in 1970s
- Erosion and water quality problems
- Need to reduce and treat stormwater

# Water Quality Index - Edmonton



# Climate Change

- Temperature increase almost certain
- Precipitation increase in mountains; increase or decrease for the plains
- Effects on streamflow uncertain
- Possibility of more extreme events, both floods and droughts



# Natural Hazards - Floods

- Basin communities are on rivers and streams
- More than 50 communities have some flood hazard
- Degree of risk has been defined for most

# Natural Hazards - Drought

- Slow onset phenomenon
- 20th century relatively benign
  - 1796 - no water in the river at Edmonton
- Design drought - 1930s, 2001-2002?
- Drought contingency plans,
  - monitor, respond



# Invasive Species


- Animals, plants or micro-organisms originating from ecosystems outside the basin
- Threaten environment, economy and social values
- Recent examples: mountain pine beetle in Alberta and purple loosestrife
  - whirling disease, zebra mussel, salt cedar nearing the basin

# Institutional Development

- Policy and legislation
- Nurturing regional planning
- Integrated water resources management
  - science, monitoring, data
- Basin-wide considerations

# Conclusions

- One of several interjurisdictional basins in the Lake Winnipeg watershed
- Physically larger and more varied topography than others
- Highly urbanized
- Significant water use in South Saskatchewan
- Water quality degradation in North Saskatchewan
- Several vulnerabilities and threats
- Cumulative effect on Lake Winnipeg



**This Partners FOR the Saskatchewan River Basin project has been made possible through the financial support of:**

**Alberta Environment**

**Saskatchewan Watershed Authority**

**Manitoba Water Stewardship**

**Alberta Ecotrust**

**Calgary Foundation**

**Ducks Unlimited Canada**

**Environment Canada**

# Low Flow Years

Rank	South Saskatchewan*	North Saskatchewan*	Battle River*	Battle Creek*	Souris River*	Red River
1	2001	1942	1930	1949	1988	1934
2	1941	1941	1961	1931	1937	1931
3	1931	1975	2004	2001	1931	1935
4	1977	2001	1931	1984	1940	1939
5	1984	1988	1977	2000	1932	1933
6	1988	2002	1929	1977	1961	1937
7	1944	1929	1945	1961	1945	1977
8	2000	1984	1942	1992	1935	1936
9	1949	1919	1941	1989	1977	1940
10	1936	1937	2001	1988	1973	1961

- Mountain runoff and plains runoff
- Only three recurring years: 1931, 1977, 1988

# Water Quantity at Boundaries

- Monitored by Prairie Provinces Water Board
- Alberta is required to release one-half of the natural flow
  - prior right provision on South Saskatchewan River
- Minimum flow 42.5 m<sup>3</sup>/s except when natural flow is lower (South Saskatchewan River)
- Saskatchewan is required to release one-half of the natural flow received from Alberta plus one half of the flow arising in Saskatchewan