

Groundwater-Wetland Ecosystem Interaction in the Semiarid Glaciated Plains of North America



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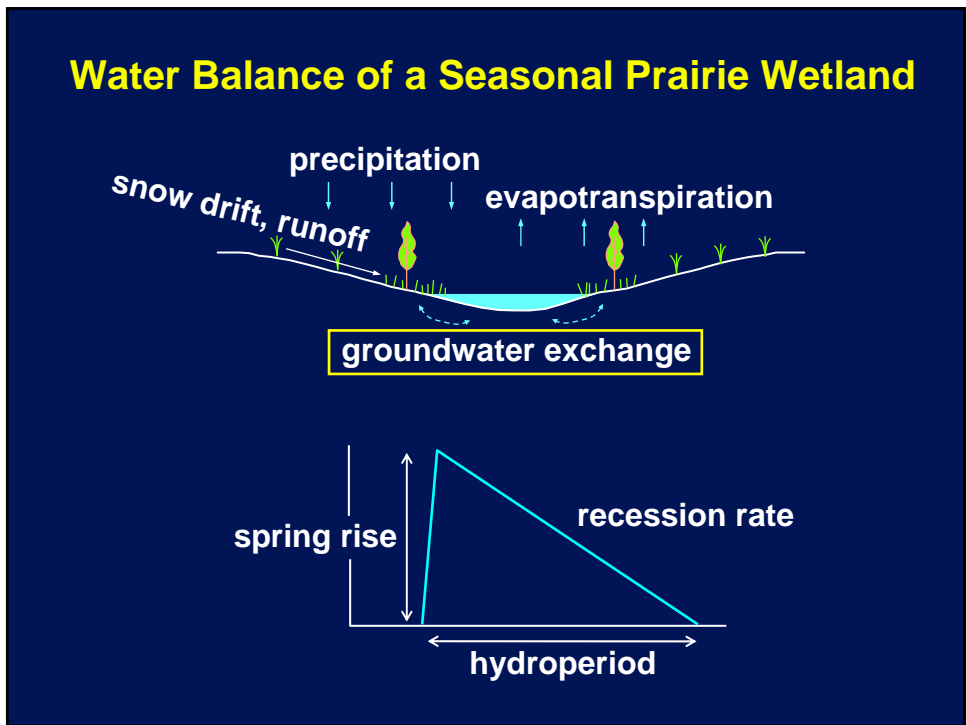
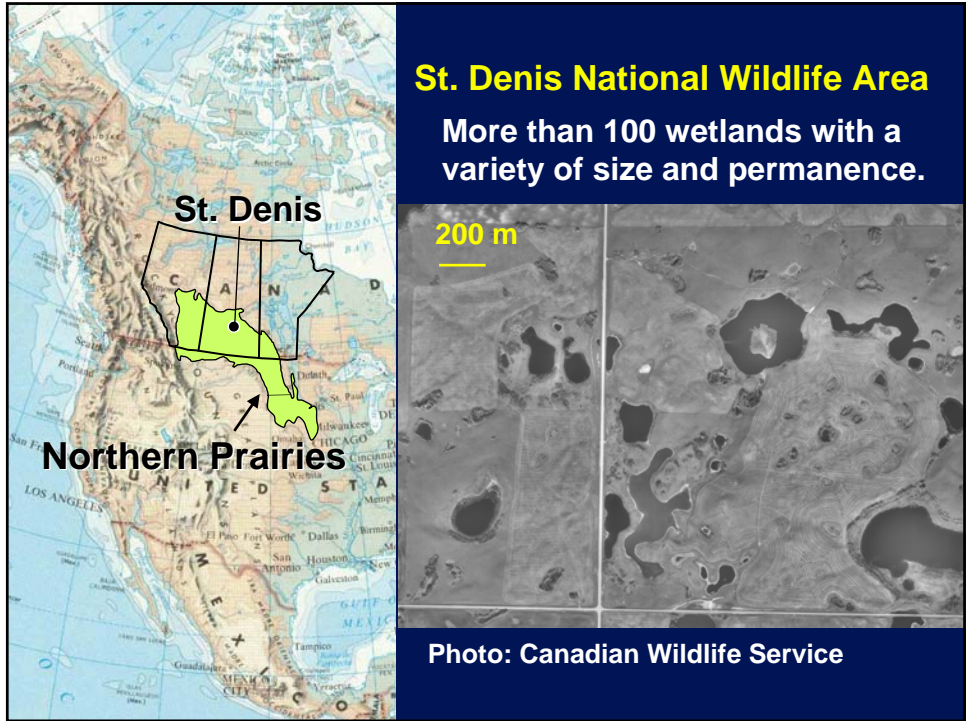


Northern Pintails
Photo: Bob Clark

Aquatic Invertebrate
Gammarus Lacustris
Photo: Dorothy Lindeman

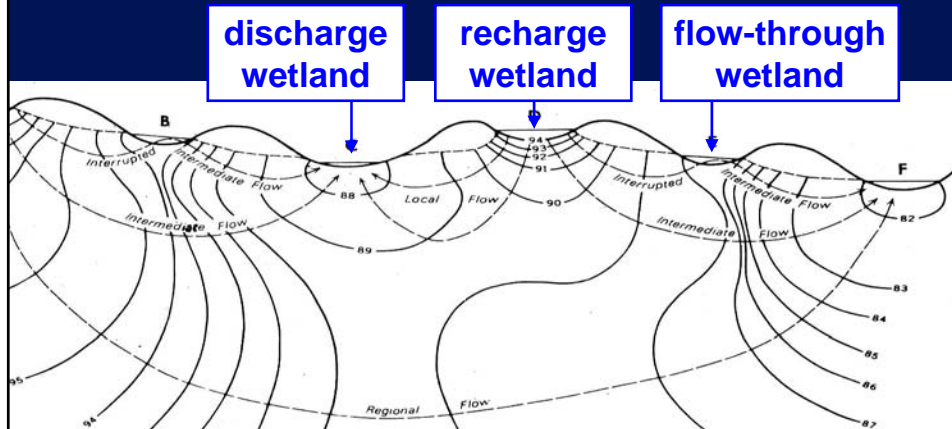






Groundwater Flow and Landscape Setting

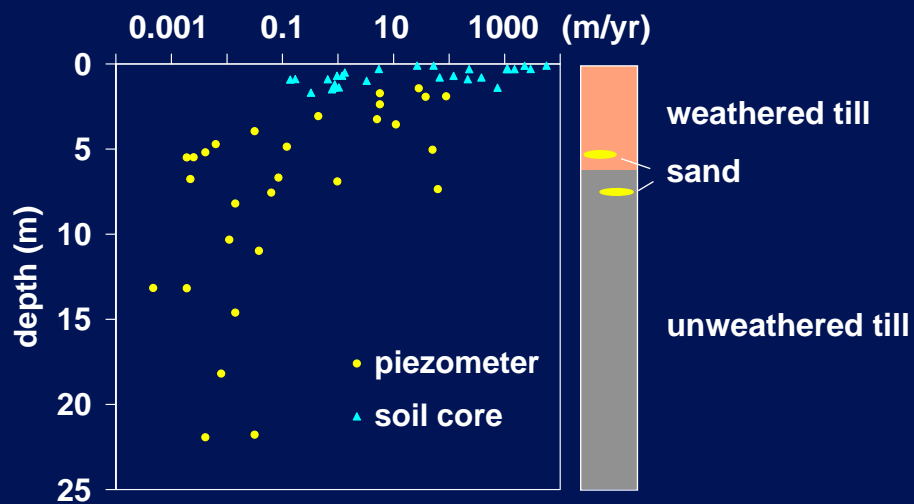
A. Lissey (1971)



This model has misled eco/hydrologists.
It is time to revise the model!

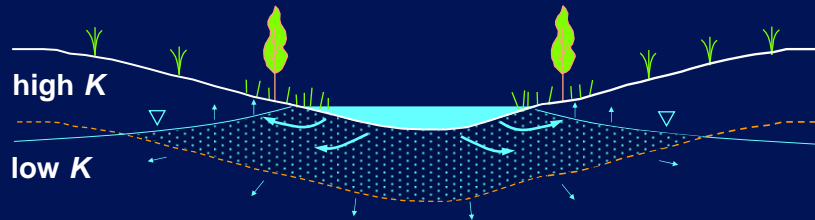
Hydraulic Conductivity (K) of Glacial Till

St. Denis National Wildlife Area



Original data: J. Hydrol. 207:42; Hydrol. Process. 18:2011

Effective Transmission Zone

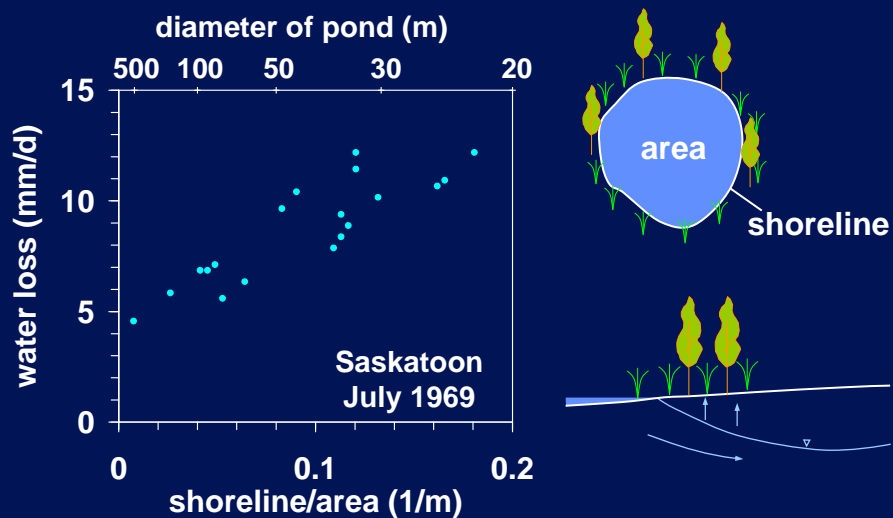


Shallow groundwater exchange is a major component of water balance.

Groundwater flow in low-K till is very slow, very minor component of water balance.

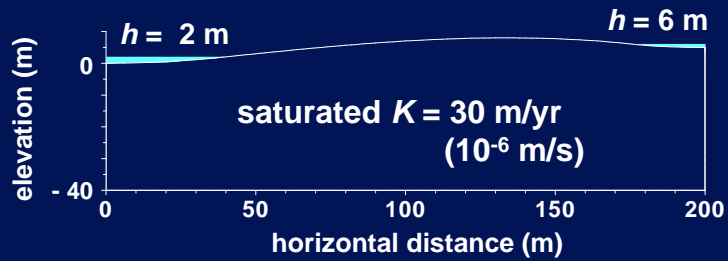
Rate of Water Loss Increases with Shoreline

Analysis of 35 wetlands by Millar (1971, J. Hydrol.)

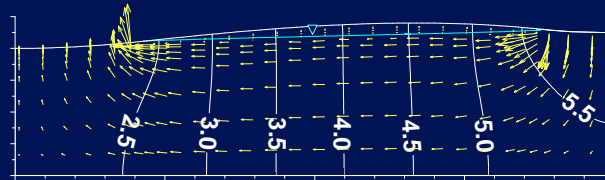


Steady-state flow simulation

Variably saturated 2-D finite-element flow model
van Genuchten eqn. for unsaturated parameters

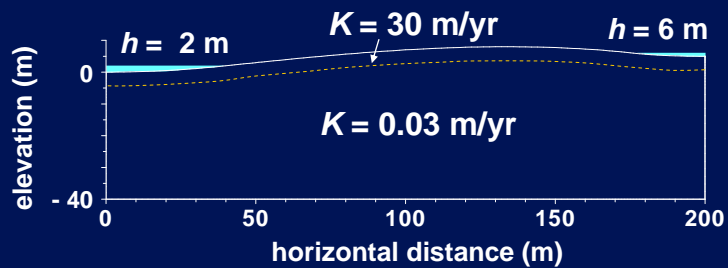


Avg. $q = 800$ mm/yr

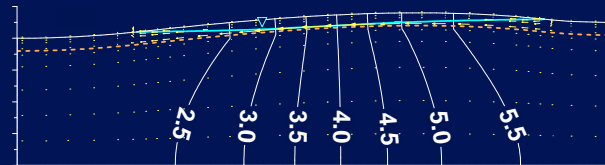


Steady-state flow simulation

Saturated K decreases with depth

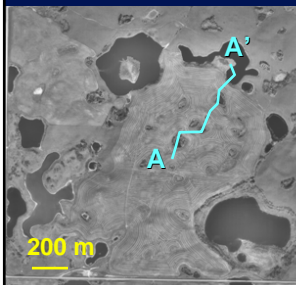
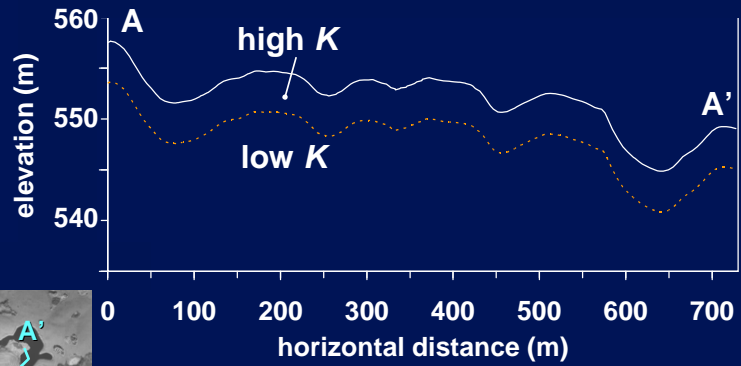


Avg. $q = 30$ mm/yr



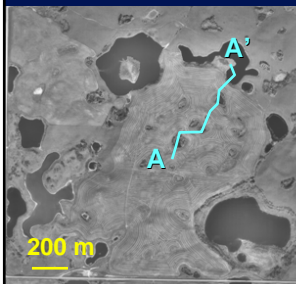
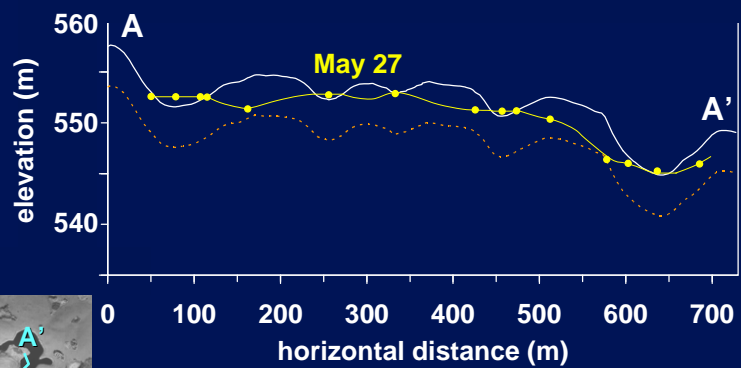
St. Denis Wetland Complex

Water table configuration in 1994



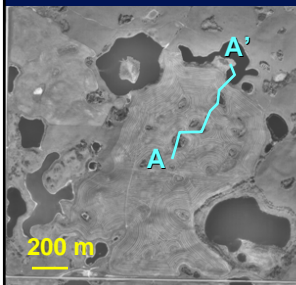
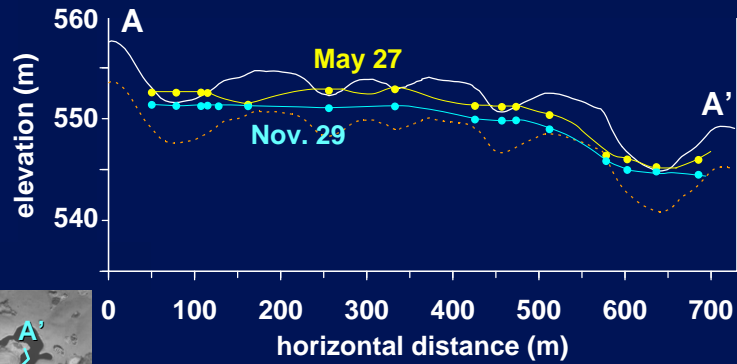
St. Denis Wetland Complex

Water table configuration in 1994



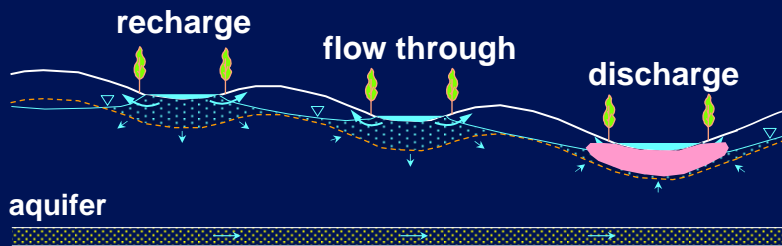
St. Denis Wetland Complex

Water table configuration in 1994



Effective transmission zones are continuous only in spring.

Revised Model of Wetland Complex



- Shallow groundwater exchange with riparian zone.
- Upward/downward gradient – landscape setting.
- Flow in low-permeability till is very small.
- Inter-till aquifer may provide connection.
- Salts accumulate under discharge wetland.

Management Implication

Discharge wetlands have more permanent ponds because they have:

- larger drainage basin, larger runoff inputs
- lower shoreline/area ratio, lower infiltration loss

These need to be considered in wetland management.

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