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Bioengineering and Wetlands for Source Water Protection

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Water Coalition North

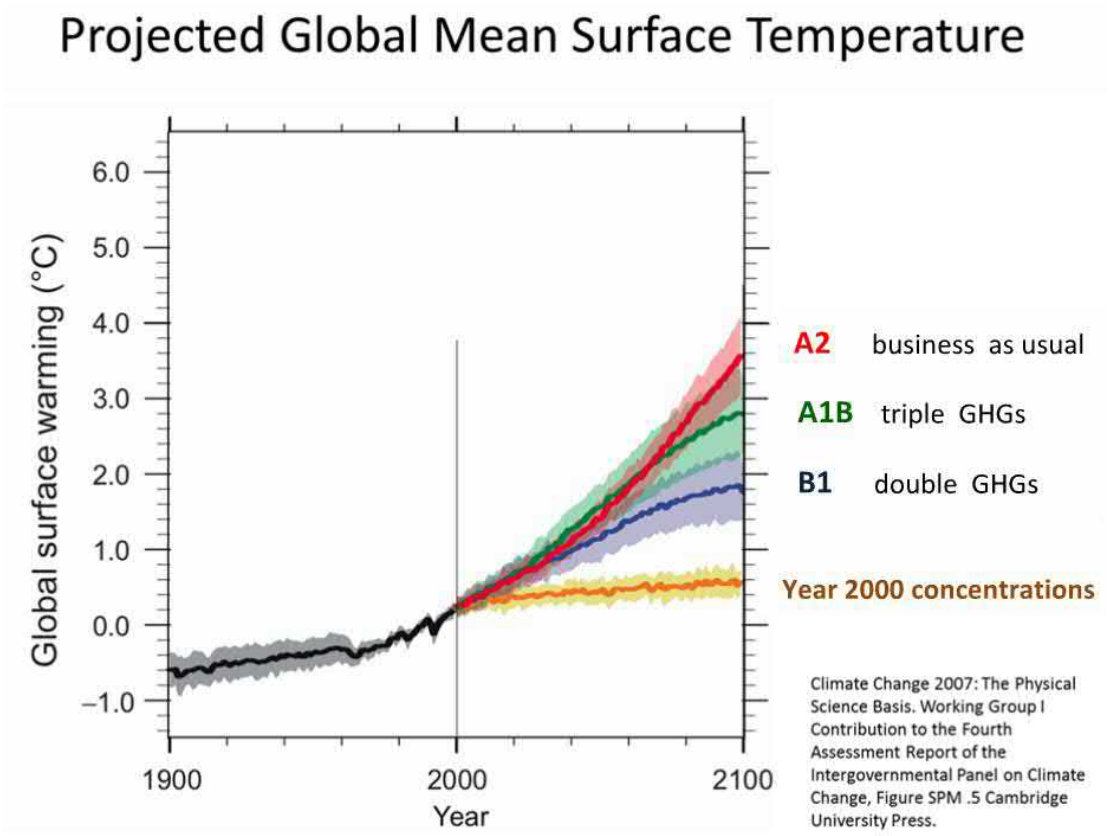
October 3, 2019

Outline

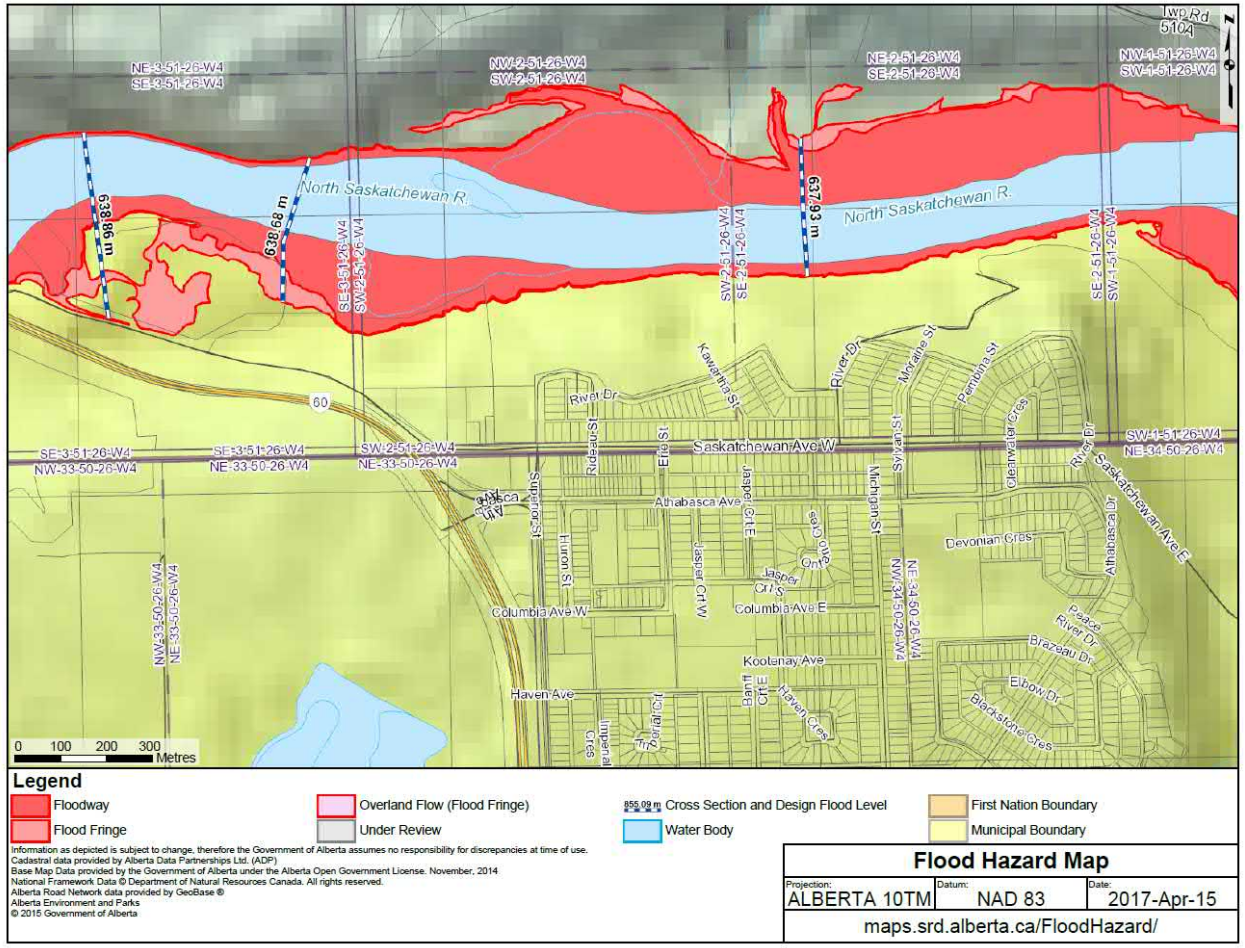
- The role of wetlands for water quality, quantity and flood mitigation
- Use of soil bioengineering for bank erosion and slope stability
- Restoration opportunities and challenges

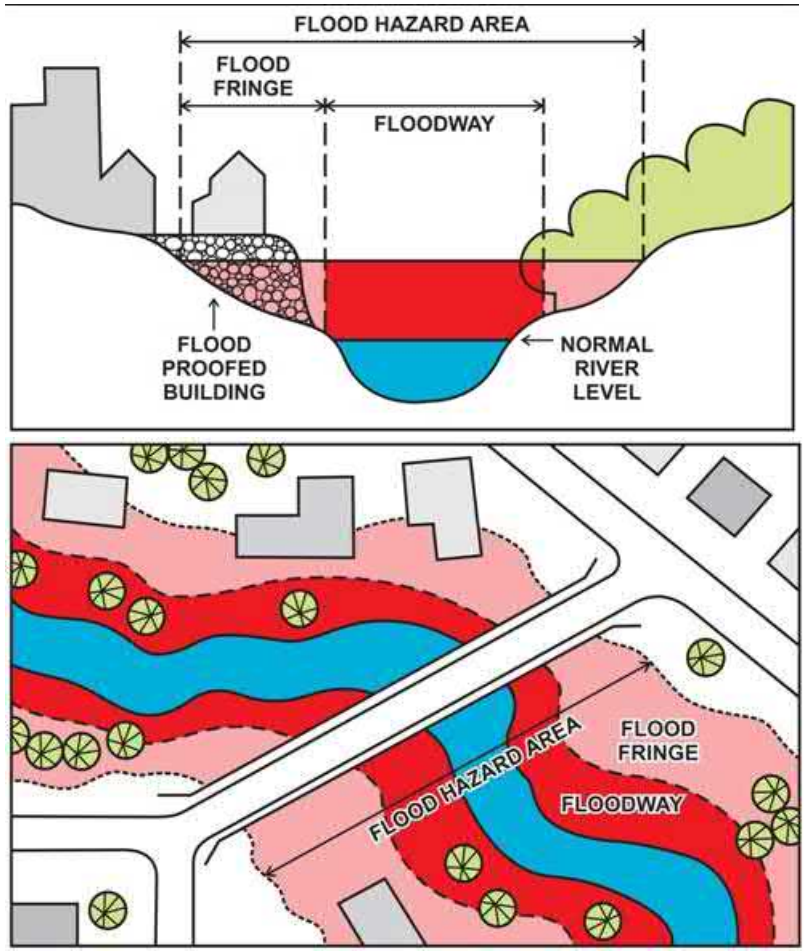
Climate change adaptation and resilience

Droughts and Deluges



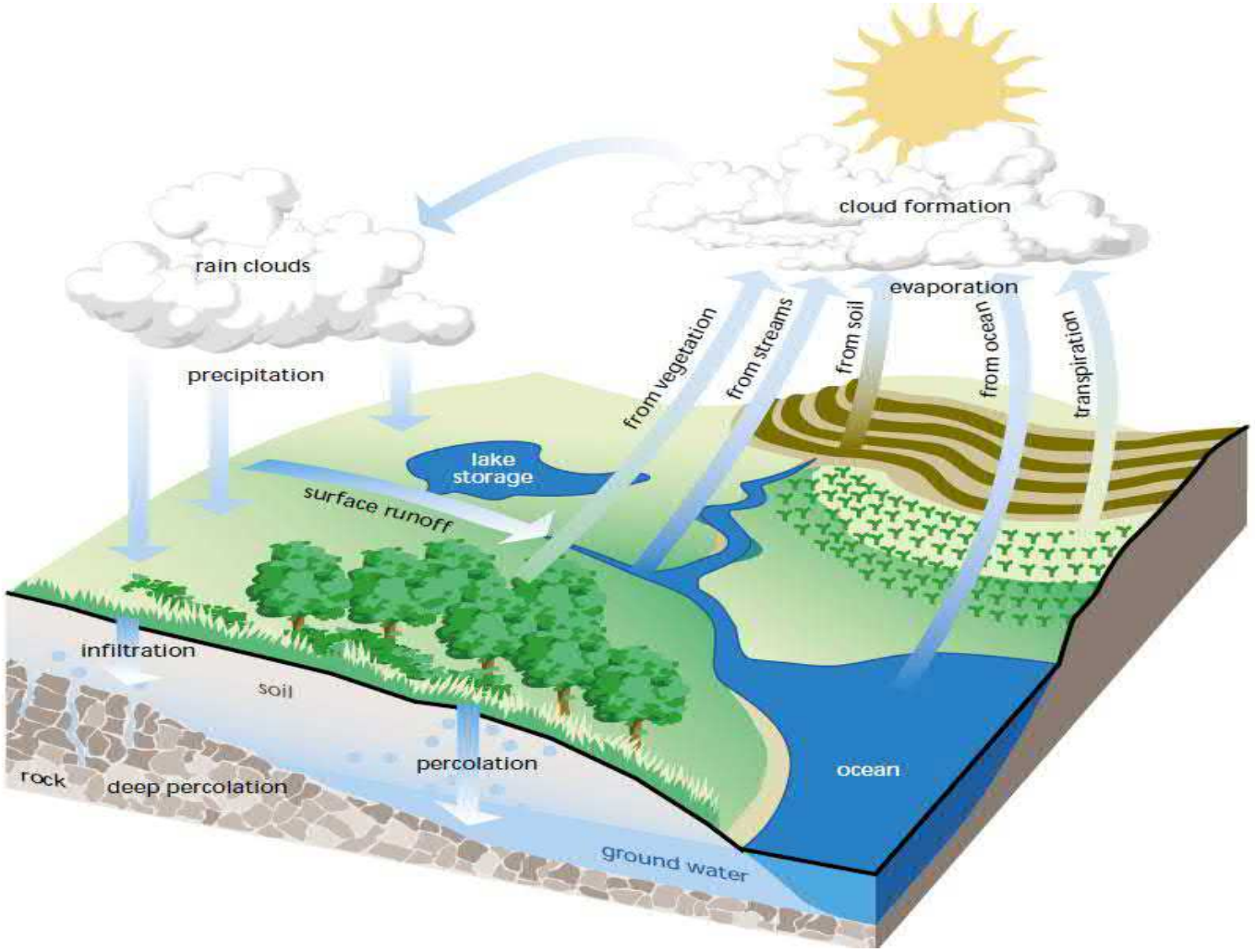
Flood Hazard Areas





http://aep.alberta.ca/water/programs-and-services/flood-hazard-identification-program/flood-hazard-mapping.aspx

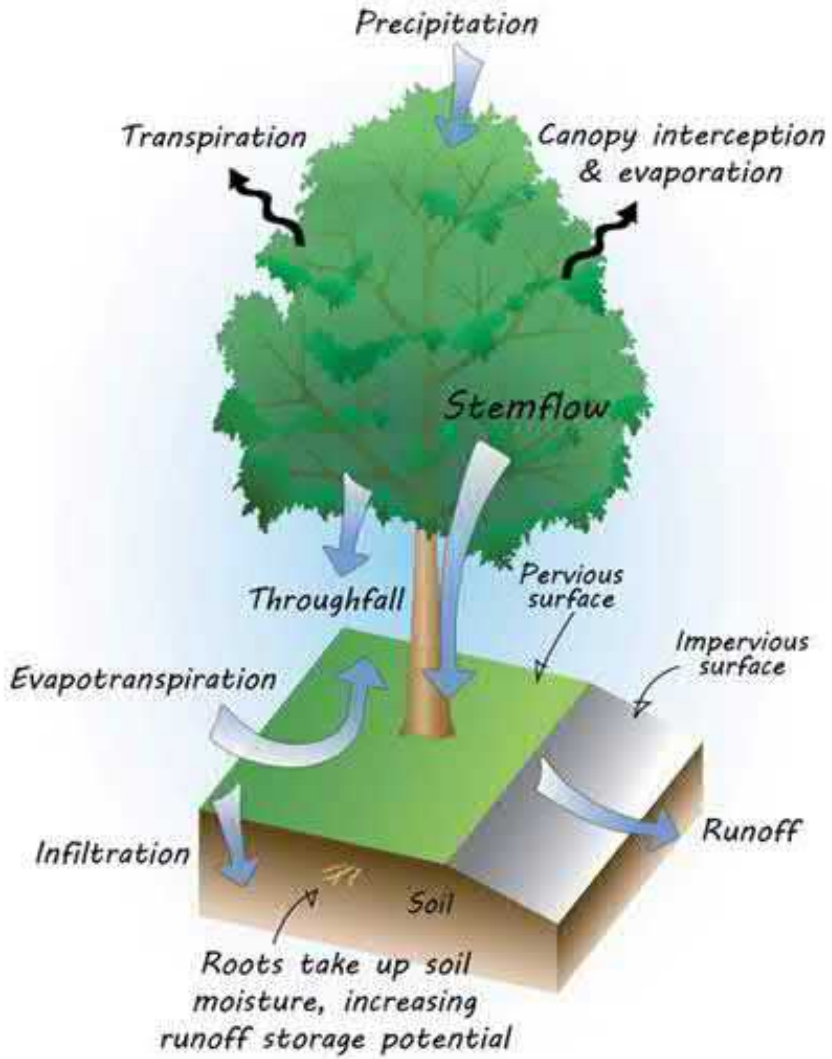
Hydrologic Cycle



NRCS Stream Restoration: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044574.pdf

Trees and Stormwater

- Infiltration
- Interception
- Evapotranspiration



https://www.epa.gov/soakuptherain/soak-rain-trees-help-reduce-runoff

Watershed Health

https://www.mightypeacewatershedalliance.org/about-1/the-watershed/

Adaptation Key Components

- Adaptive Capacity
  - Flexibility in the face of unexpected and predicted hazards
- Mitigation
  - An adaptive act to reduce root causes
- Resilience
  - A kind of adaptation that secures desired function in the face of change

Wetland Definition

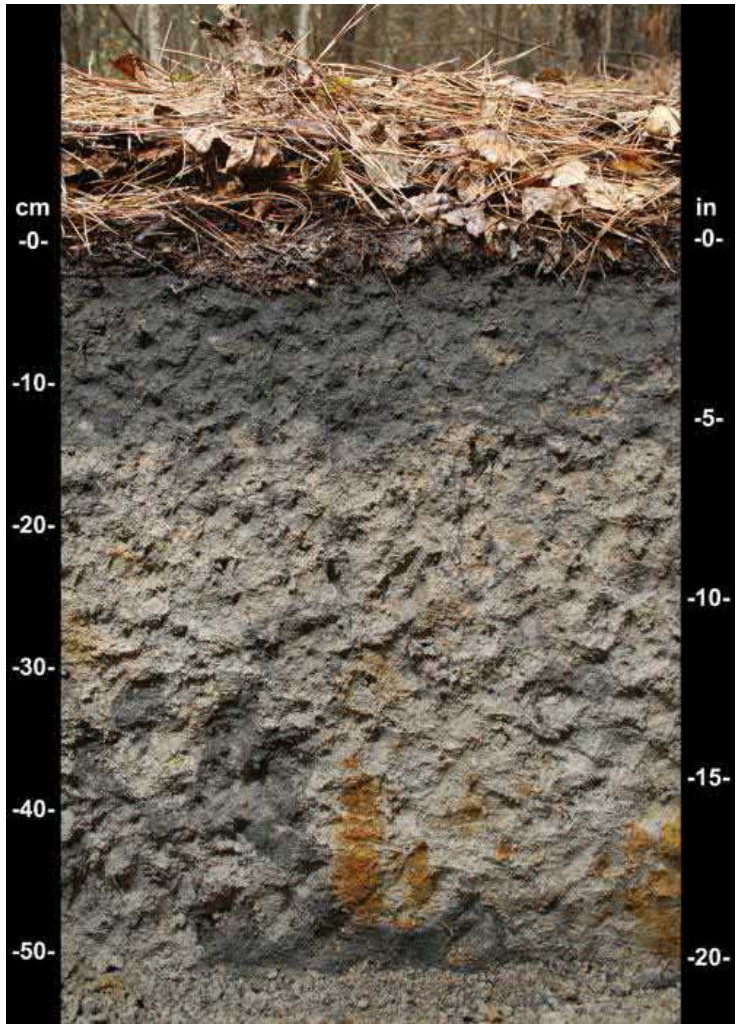
Land saturated with water long enough to promote formation of water altered soils, growth of water tolerant vegetation, and various kinds of biological activity that are adapted to the wet environment

(Alberta Wetland Policy 2013)

http://www.waterforlife.alberta.ca/documents/Alberta_Wetland_Policy.pdf

Hydrophytic Vegetation

Hydric Soil



United States Department of Agriculture, Natural Resources Conservation Service. 2010. Field Indicators of Hydric Soils in the United States, Version 7.0. L.M. Vasilas, G.W. Hurt, and C.V. Noble (eds.). (Fair Dealing)

Hydrology Indicators

U.S. Army Corps of Engineers. 2010. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Great Plains Region (Version 2.0), ed. J. S. Wakeley, R. W. Lichvar, and C. V. Noble. ERDC/EL TR-10-1. Vicksburg, MS: U.S. Army Engineer Research and Development Center. (Fair Dealing)

Classification and Relative Value

Wetland Functions and Values

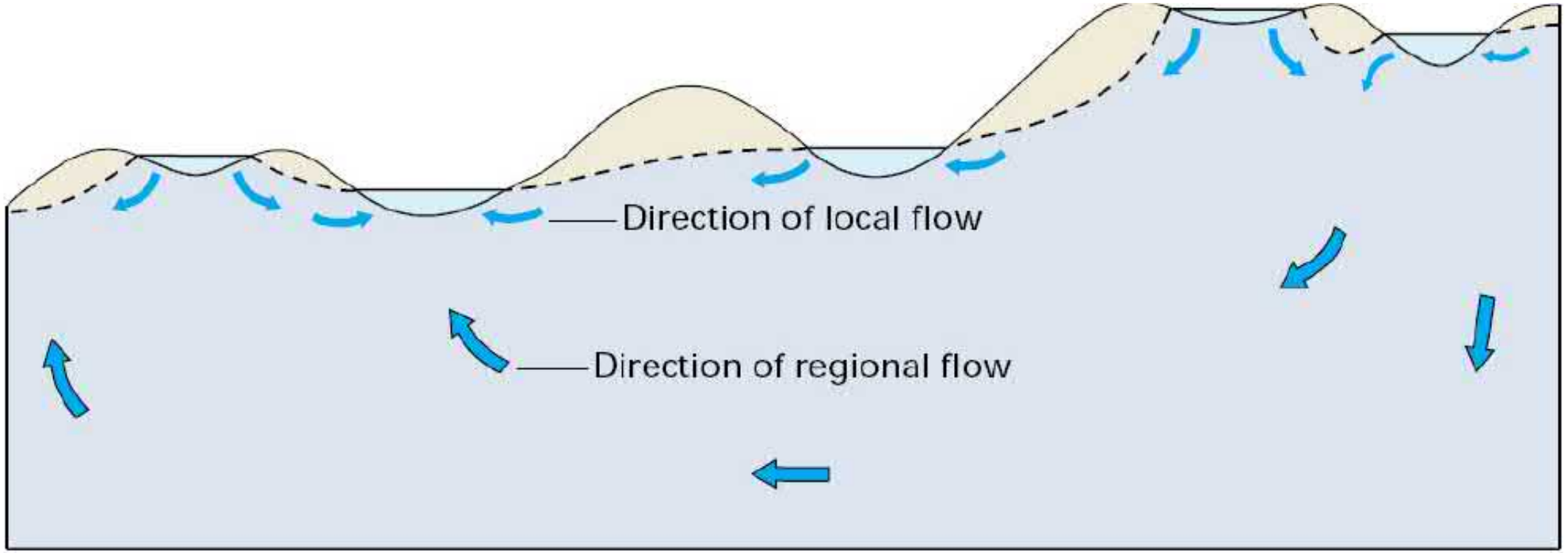
- Water quality improvement
- Flood mitigation
- Groundwater replenishment
- Carbon Sequestration
- Biodiversity and critical habitat
- Shoreline protection
- Human use (cultural, education, recreation)

Water Quality

- Sediment Trapping
- Nutrient Removal
- Chemical Detoxification

Photo courtesy Dr. Lee Foote

Flood Mitigation and Groundwater Recharge



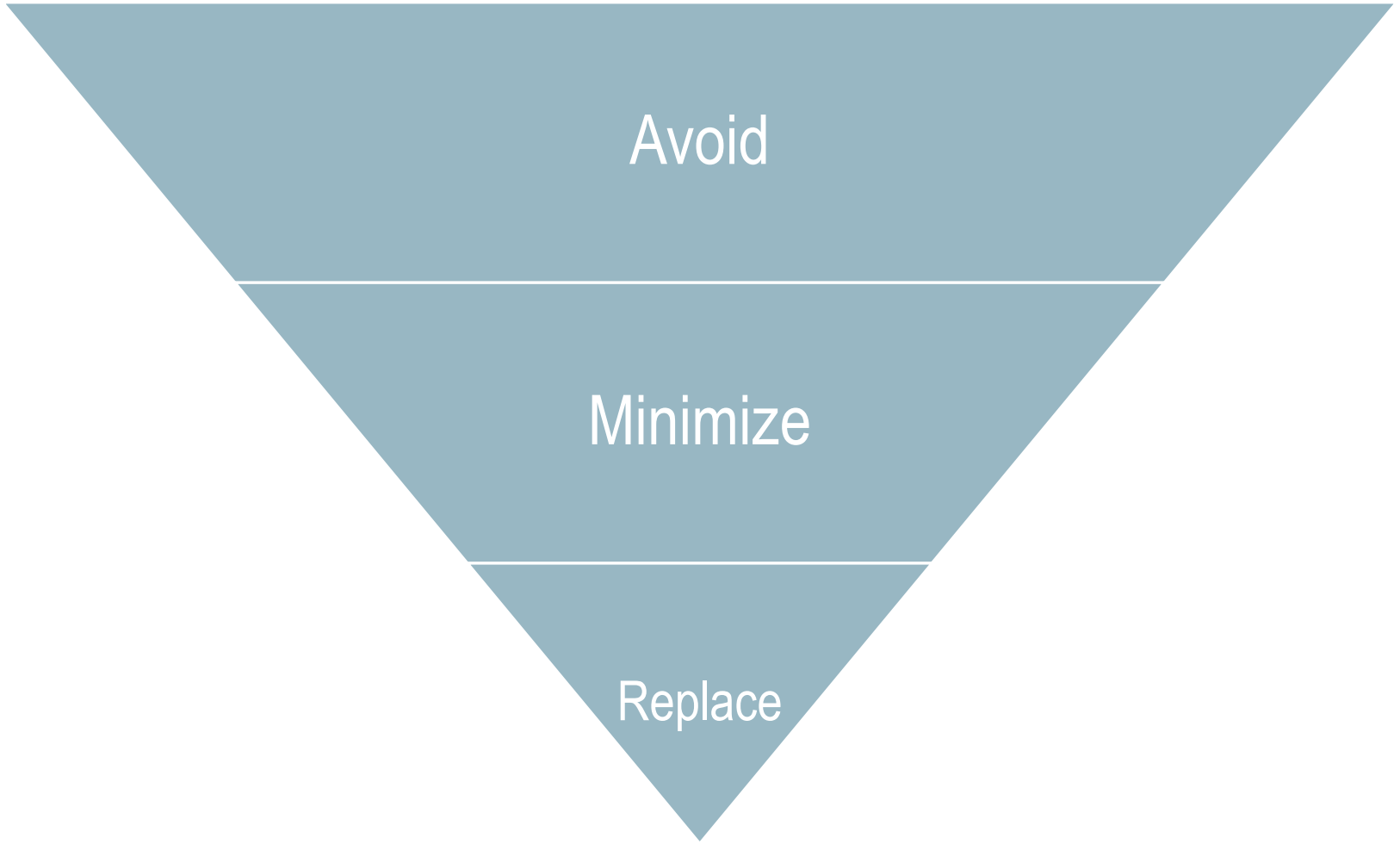
(Winter et al., USGS, 1998)

Ecosystem Goods and Services

Goods and services provided by natural functions that contribute to human well-being

(Constanza et al., 2011)

Wetland Mitigation Hierarchy



Wetland Replacement Concepts

- Watershed perspective
- In-kind mitigation (replace what is lost)
- Replacement ratios

Value of Lost Wetland	Value of Replacement Wetland: D	C	B	A
A	8:1	4:1	2:1	1:1
B	4:1	2:1	1:1	0.5:1
C	2:1	1:1	0.5:1	0.25:1
D	1:1	0.5:1	0.25:1	0.125:1

*Ratios are expressed as hectares of wetland

(Alberta Wetland Policy 2013)

Wetland Replacement Options

- Restoration
- Construction / Creation
- Non-restorative (research, monitoring, education, securement, etc.)

Wetland Replacement Options

- Undertaken by Permittee
- In-Lieu Fee Program
- Wetland Mitigation Bank

Updates in December 2018

- Directive for Permittee-Responsible Wetland Construction
- Alberta Guide to Wetland Construction in Stormwater Management Facilities
- Wetland Replacement Fees to GoA

Wetland Replacement Concepts

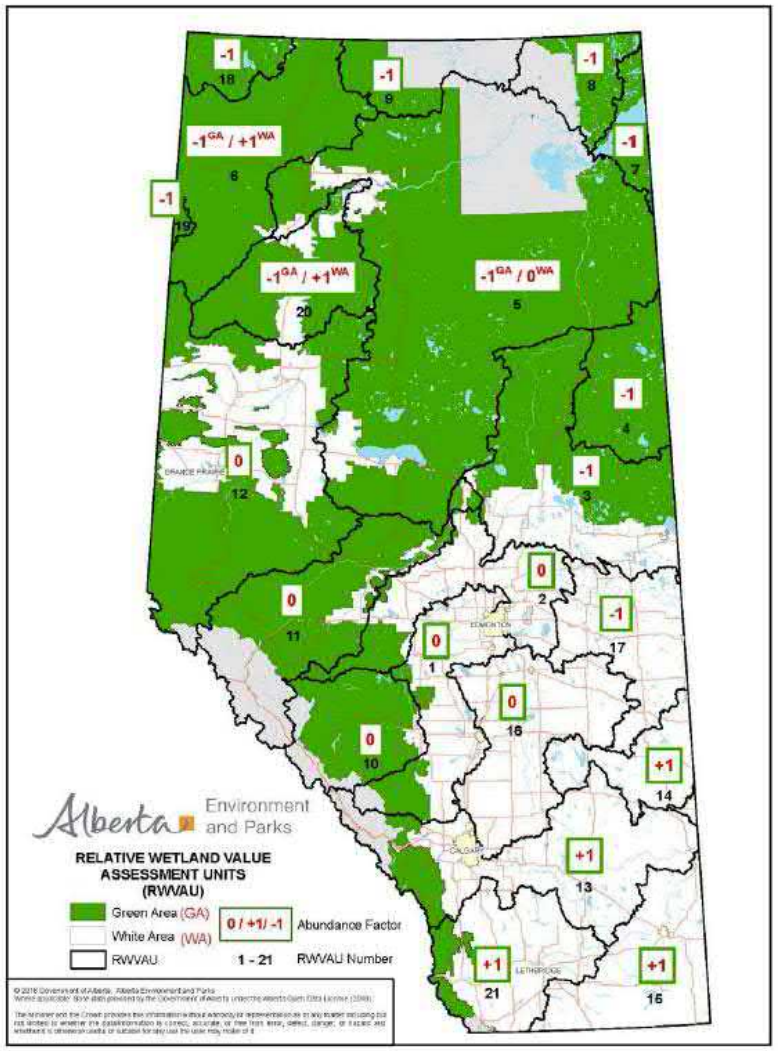
- The relative value of a constructed wetland is adjusted on the basis of two factors:

- The creation of an upland buffer
- Regional wetland abundance and historical loss

Abundance Modifier	Buffer	Relative Value of Constructed Wetland	Replacement Credit
-1	No	D	1
-1	Yes	C	2
0	No	C	2
0	Yes	C+	3
+1	No	C+	3
+1	Yes	B	4

Directive for Permittee-Responsible Wetland Construction in Alberta (AEP 2018)

Calculating Replacement Area



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Past and Future

Aerial Photo from by AESRD Photo Distribution Library
Project 11-ERJOI 83H / G1105004-16-134

Building resilience into watersheds

Erosion Processes

Over-Steepened Slopes

Soil Compaction

Rill and Gully Erosion

Lack of woody vegetation, undercutting and excess moisture

Soil Bioengineering

- Use of plants to perform an engineering function
- Live cuttings of willows, poplars and dogwood
- Root systems provide root strength and root zone diversity to stabilize soil
- Woody vegetation removes excess soil moisture
- Self healing and self sustaining
- Other benefits include biodiversity, carbon sequestration, habitat and aesthetics

Dense Live Toe Staking

Dense Live Toe Staking

Dense Live Toe Staking

Dense Live Staking

Wattle Fencing

Grants and Community Workshops

Wattle Fence

May 14, 2019

August 7, 2019

Juniper Place Landslide

Polster Environmental

February 22, 2016

Polster Environmental

March 5, 2017

Polster Environmental

March 25, 2017

Polster Environmental

May 13, 2017

Polster Environmental

July 6, 2016

Polster Environmental

August 24, 2016

Polster Environmental

Brush Layers on a Fill Slope

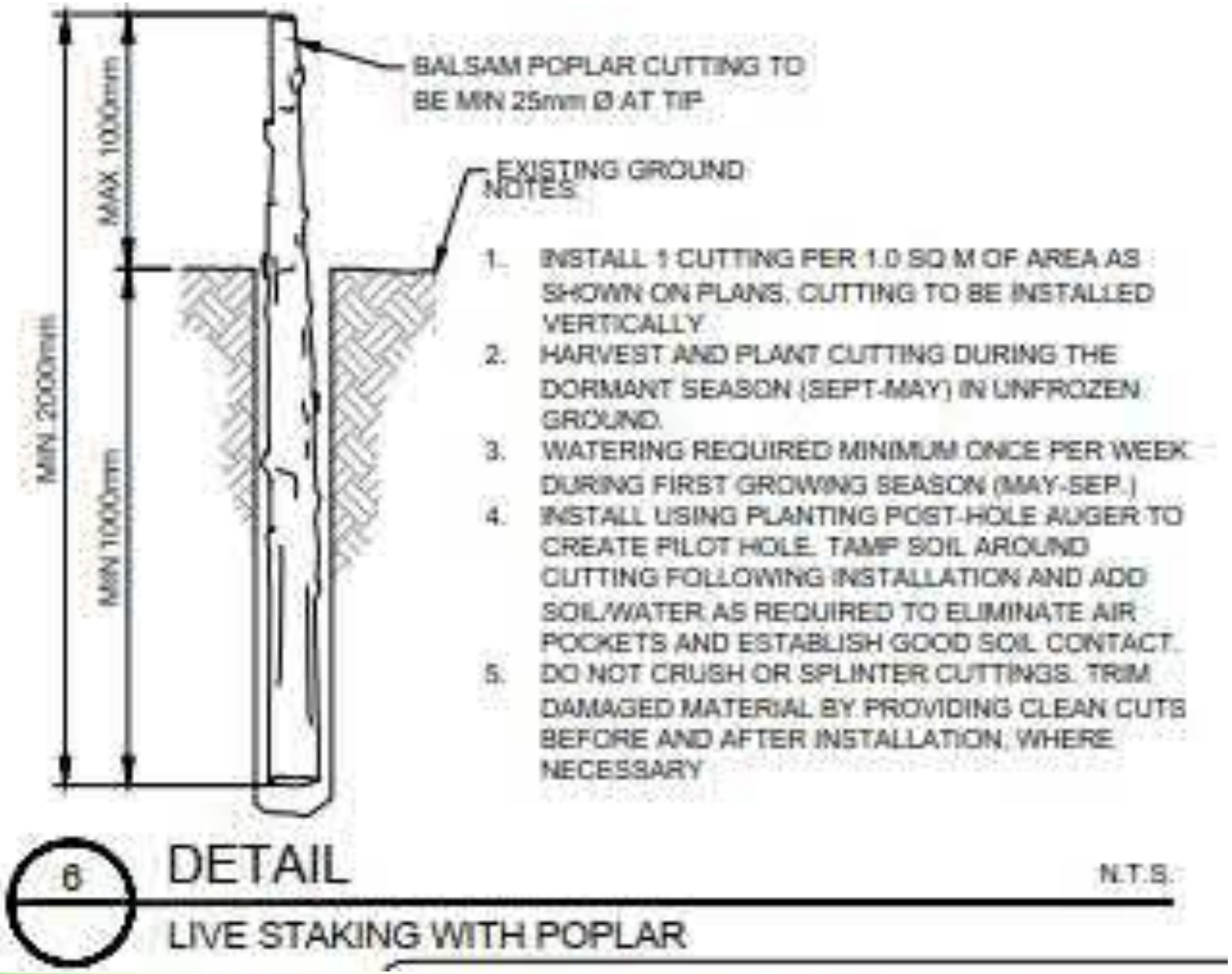
Transportation Research Board National Cooperative Highway Program Project 24-19; CRP-CD-58: Environmentally Sensitive Channel & Bank Protection

Slope at Reservoir– May 15, 2018

Slope at Reservoir– April 24, 2018

Live Staking with Poplar or Cottonwood

Live Staking with Poplar



Rooting along entire length of the cutting

Transportation Research Board National Cooperative Highway Program Project 24-19; CRP-CD-58: Environmentally Sensitive Channel & Bank Protection

Slope at Reservoir– July 16, 2018

Slope at Reservoir– July 16, 2019

Slope at Reservoir– July 19, 2019

Failing Slope – Using Plants for Stability Functions

Polster Environmental

Rough and Loose

Polster Environmental

November 2014

Polster Environmental

August 2015

August 2017

This site is sequestering 20 to 25 tonnes/ha of CO2 annually

Polster Environmental

RMWB Post Wildfire Erosion/Drainage Control

RMWB Post Wildfire Erosion/Drainage Control

RMWB Post Wildfire Erosion/Drainage Control

RMWB Post Wildfire Erosion/Drainage Control

Design Considerations

- Live cuttings collected and installed when dormant
- Soaked for at least 24 hours before installation
- Uses locally collected material
- Typically installed by hand
- Low cost compared to hard engineering
- Works upon installation
- Grant funding availability

Questions?