



ALBERTA WATERBOOTCAMP: FOR MUNICIPALITIES





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- Jay is the principal researcher and founder of *AQUALITY* Environmental Consulting Ltd.
- He is a certified Alberta Professional Biologist and Qualified Wetland Aquatic Environment Specialist (QWAES)
- He earned his M.Sc. degree from the University of Alberta. He worked with Ducks Unlimited Canada on Frank Lake, the largest wetland restoration project in Canada
- Jay worked as a research associate at the University of Alberta for three years as the Land-Aquatic Program Administrator for the Sustainable Forest Management Network
- Jay currently sits on the Alberta Water Council representing the Lake Environment Conservation Sector. Jay has been involved with the Provincial Water Strategy (Water for Life) since its creation in 2003
- Jay is involved with several non-profit groups such as the Alberta Lake Management Society, Inside Education, Ducks Unlimited Canada and Trout Unlimited Canada





Wetland Definitions



USA

“Wetlands are areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions” (Cowardin, 1979; adopted by USEPA)



Canada

“A wetland is land where the water table is at, near or above the surface or which is saturated for a long enough period to promote such features as wet-altered soils and water-tolerant vegetation” (Environment Canada, 1996)





Wetland Definitions



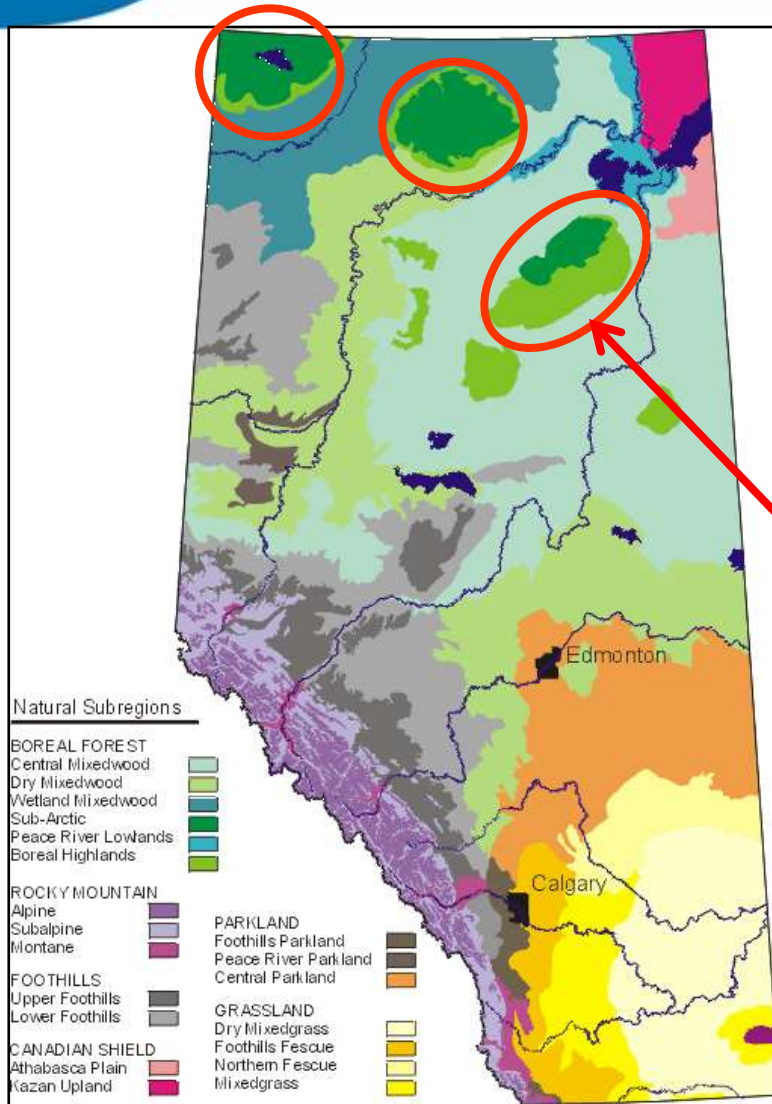
Alberta

“Land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, water-loving vegetation, and various kinds of biological activity which are adapted to a wet environment”
(Wetland Restoration Compensation Guide, 2007)





Wetlands in Alberta



http://www.cd.gov.ab.ca/preserving/parks/anhic/natural_regions_map.asp

Covers 17.3% of Alberta's landscape
(Mostly Peatlands)



Fens = 68%

Bogs = 27%

Marshes & Swamps = 5%

Main Peatland region is in Northern Alberta
(66% of landscape) and encompasses:

- Caribou Mountains
- Birch Mountains
- Cameron Hills

Nearly $\frac{3}{4}$ of all bogs are underlain by permafrost

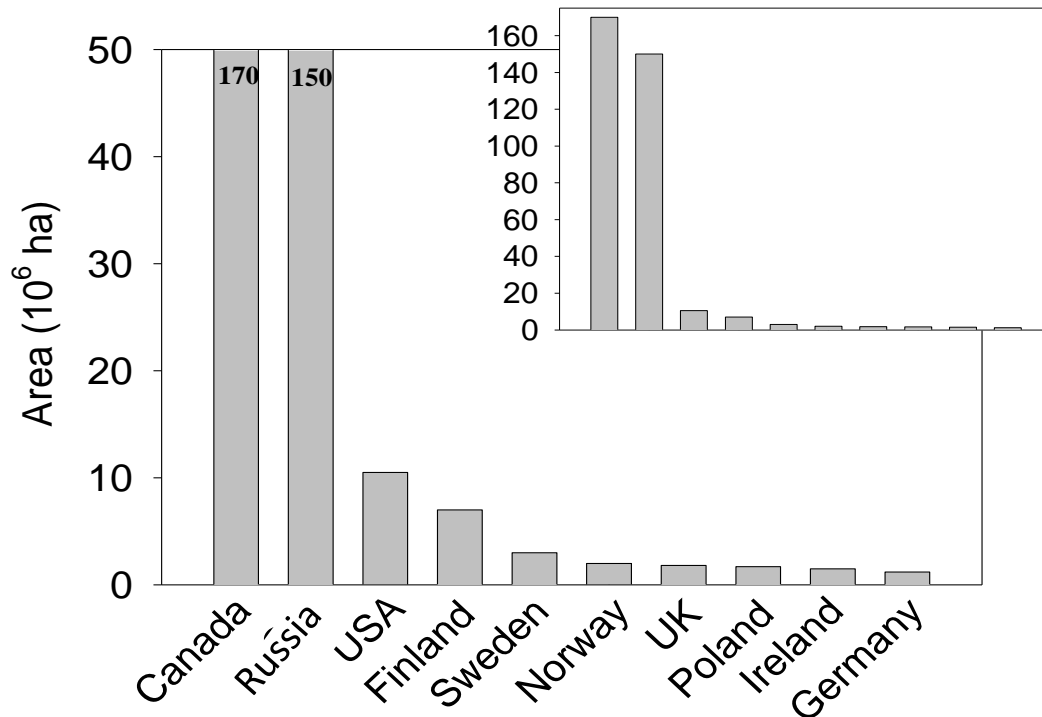




Wetlands in Canada



- Canada has the most wetlands of any country in the world
- 4% of the world's and 14% of Canada's landscape





Prairie Wetland Cycle



- In Western North America, moisture flows come from the Pacific Ocean
- As moist Pacific air reaches the west coast, it is forced upward by the mountains, where most of the moisture cools and falls as rain or snow
- Alberta's distance from the ocean and the presence of the western mountains combine to produce a "rain shadow" (area of low precipitation which causes thunderstorms)
- While limited in quantity, the prairies still depend on this supply of water from the ocean

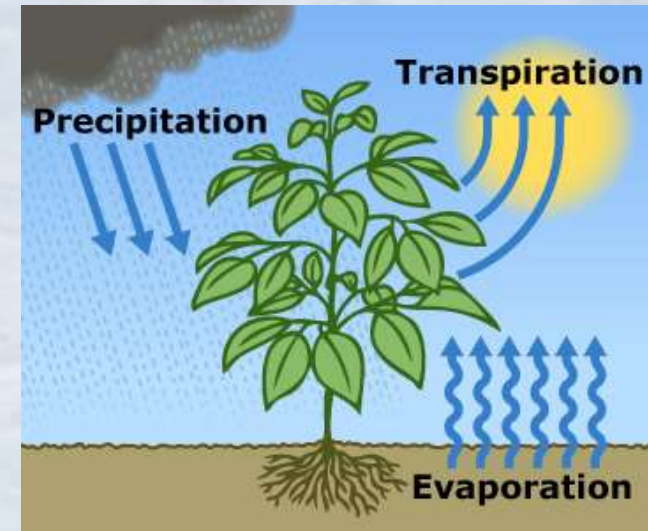




Prairie Wetland Cycle



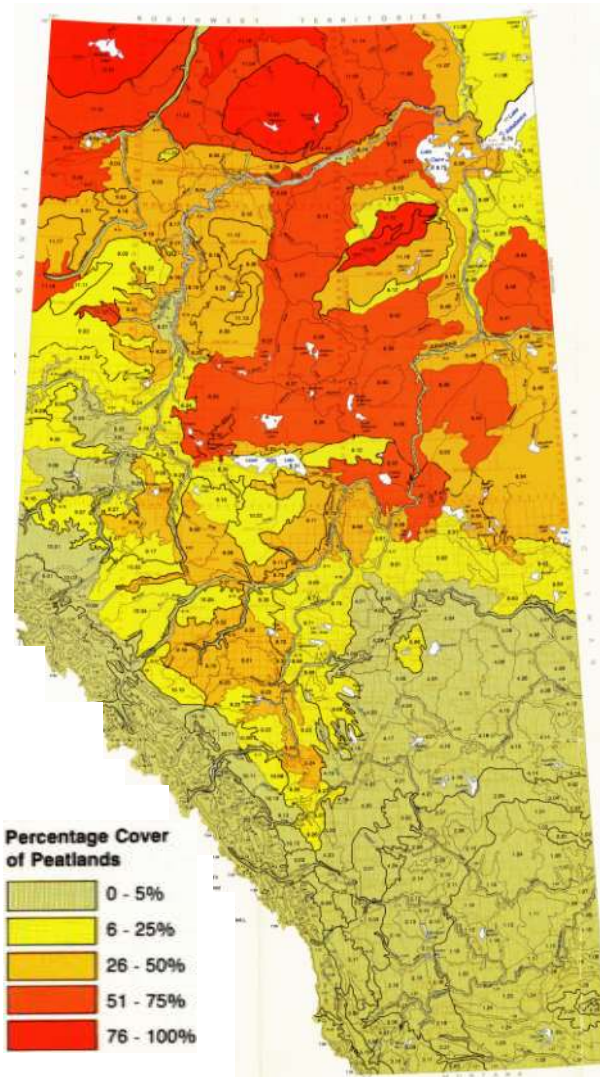
- Wetlands and surrounding plant communities are important links between atmospheric, surface and groundwater movements
- When water is evaporated it is available again as precipitation
- As crops and other plants grow, they remove water and dry out the soil



The effect of individual wetlands on climate is small, the **cumulative** effect of extensive wetland loss and de-watering of the landscape is potentially serious. Large-scale elimination of wetlands has the potential to reduce regional precipitation.



White and Green Zones in Alberta





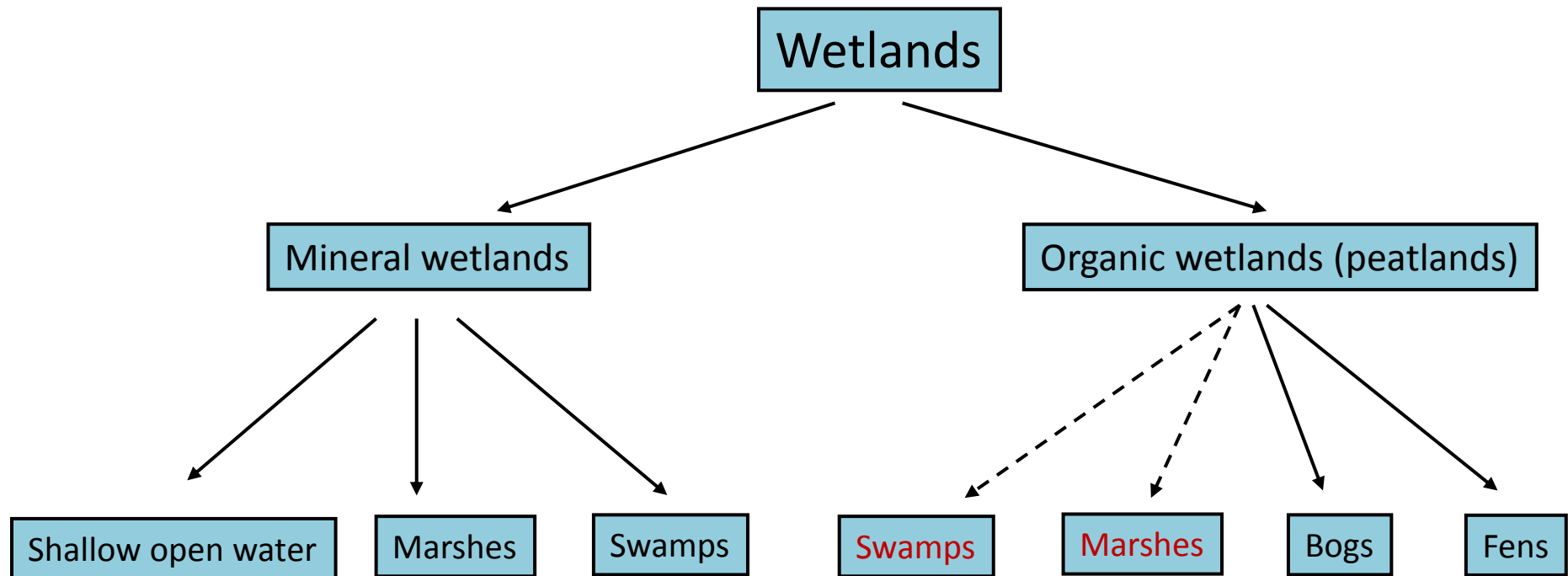
Wetland Classification Systems

2. Canadian Wetland Classification System (1997)





2. Canadian Wetland Classification System (1997)



National Wetlands Working Group. 1997. The Canadian Wetland Classification System, 2nd Edition. Warner, B.G. and C.D.A. Rubec (eds.). Wetlands Research Centre, University of Waterloo, Waterloo, Ontario. 68 pp.



Wetland Definition



“Land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation and various kinds of biological activity which are adapted to a wet environment”

National Wetlands Working Group, 1988

Divided into 2 broad categories:

1. Organic Wetlands (Peatlands)

- More than 40 cm of peat accumulation

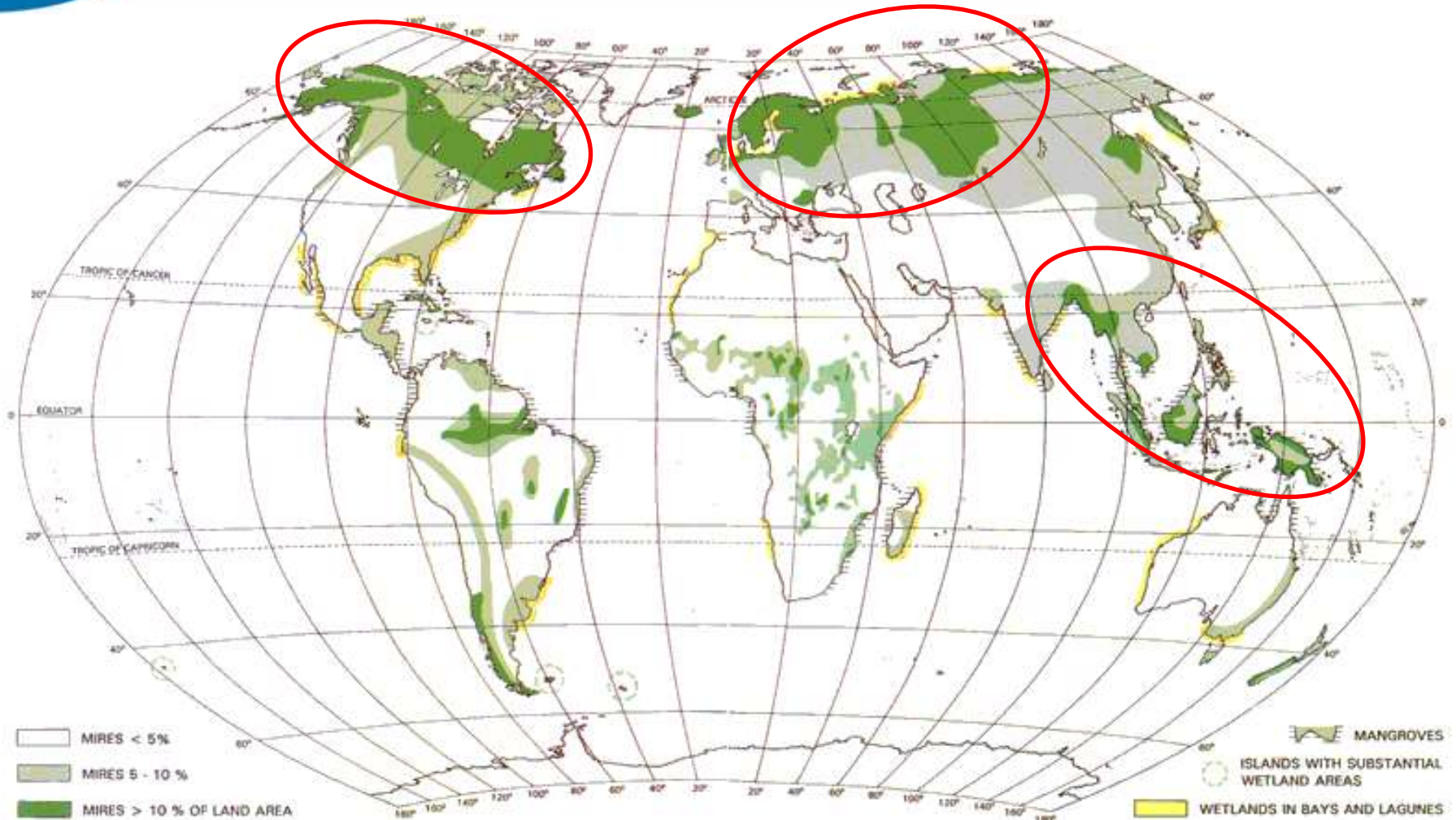
2. Mineral Wetlands

- Excess water collects on the surface
- Produce little or no organic matter or peat





Global Distribution of Peatlands



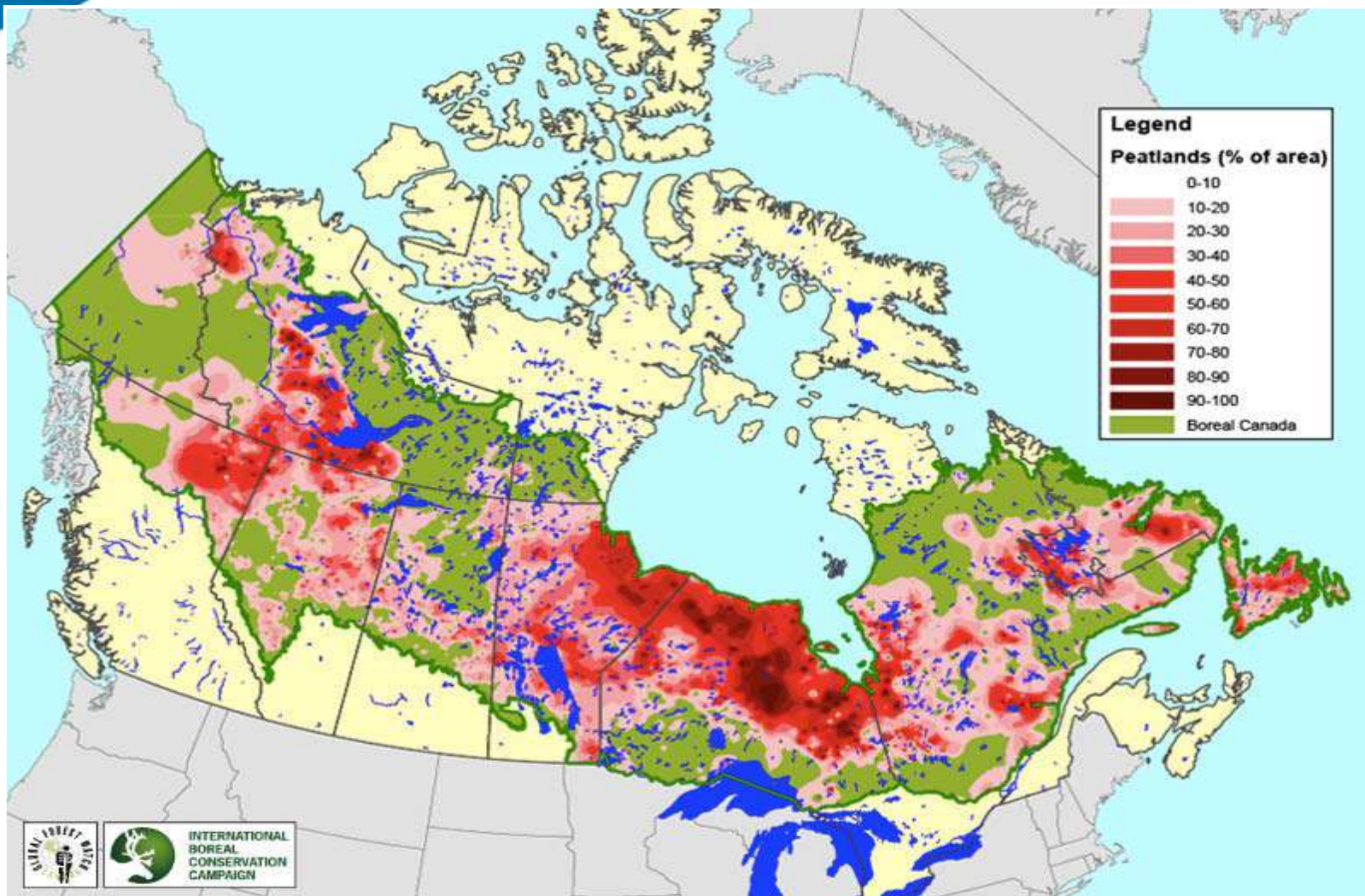
Gore 1983

Mires = swamp, bog, fen or moor (Gore, 1983)

Occur mainly in North America, northern Europe, and northern and southeastern Asia



Peatlands in Canada

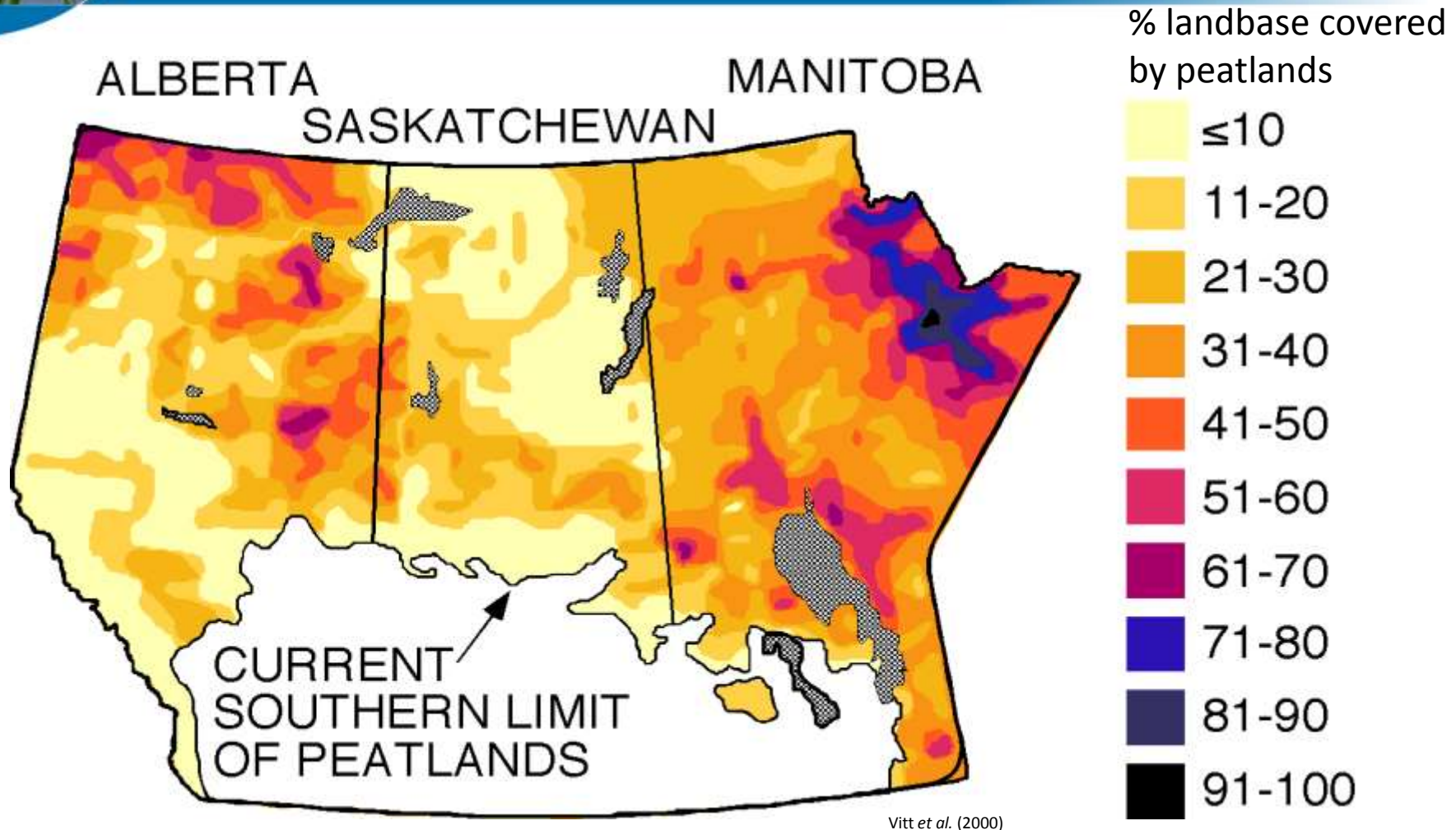


Global Forest Watch (2007)





Peatland Distribution in the Prairie Provinces



Peatlands of continental western Canada (AB, SK and MN) cover ~365 157 km² (½ the size of Saskatchewan)





What is peat?



- Peat refers to an accumulation of **partially decomposed plant material**
- Anoxic and/or acidic conditions cause slow decomposition
- Results in a build-up of partially decomposed plant matter



<http://www.houlecountry.com/wp-content/uploads/2012/07/image011-e1341689769253.jpg>



What is Sphagnum?



- Genus containing between 1510-3500 plant species
- May hold between 16-25 times dry weight in water
- Contains phenolic compounds that slow tissue breakdown
- Acidifies its surroundings
- Provides habitat for a wide array of wetland plants

Commonly known as
“Peat Moss”



<http://www.out-here.co.uk/sphagnum-moss.php>

<http://www.commanster.eu/commanster.html>



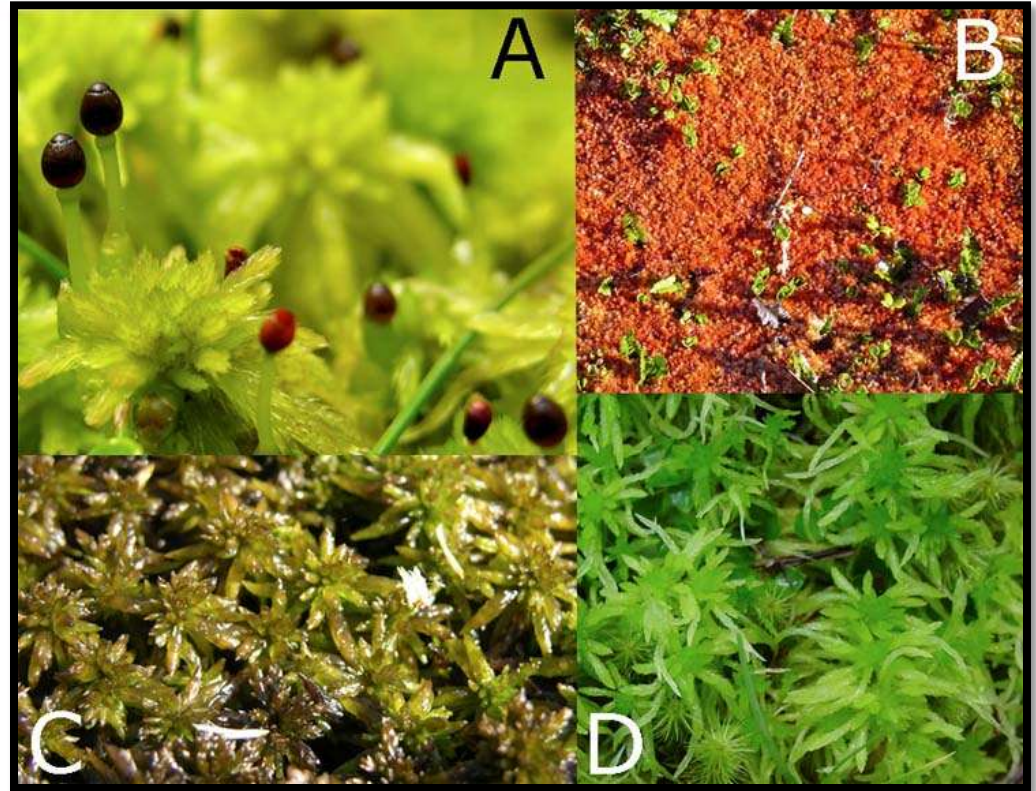
Sphagnum spp. – peat mosses

Sphagnum spp. have the ability to **acidify** their environment

- Cation-Exchange mechanism
- Often labeled as “*ecosystem formers*”

Once established, the pH of the environment decreases up to 10,000-fold

(bog pH is about 3.3 – 3.8)



A – *Sphagnum falcatum*

B – *Sphagnum magellanicum*

C – *Sphagnum subsecundum*

D – *Sphagnum fimbriatum*



1. Bog

Wetland Class



Primary characteristics:

1. Accumulation of **peat**
2. Surface raised or level with surrounding terrain
3. Water table at or slightly **below the surface** and raised above the surrounding terrain
4. **Ombrogenous**: water originates exclusively from precipitation and has a low concentration of dissolved minerals
5. Moderately decomposed ***Sphagnum*** peat with woody remains of shrubs
6. Most frequently dominated by *Sphagnum* mosses with tree, shrub or treeless vegetation cover



Bog Typical Vegetation



Picea mariana
(black spruce)



*Rhododendron
groenlandicum*
(Labrador tea)

- Bogs may be treed or treeless, and they are usually covered with *Sphagnum* spp. and ericaceous shrubs
- The driest bogs, especially in permafrost terrain may be covered in dwarf shrubs and lichens



Vaccinium vitis-idaea
(bog cranberry)



Sphagnum spp.

The soils are mainly Fibrisols, Mesisols and Organic Cryosols (permafrost soils)



2. Fen Wetland Class



Primary characteristics:

1. Accumulation of **peat**
2. Surface is **level with the water table**, with water flow on the surface and through the subsurface
3. **Fluctuating** water table which may be at, or a few centimeters above or below, the surface
4. **Minerogenous**: water originates on the land surface or as groundwater where it comes in contact with mineral soils and bedrock
5. Decomposed sedge or **brown moss** peat
6. Graminoids and shrubs characterize the vegetation cover



Fen Typical Vegetation



Larix laricina (tamarack)



Sarracenia purpurea
(pitcher plant)



Carex rostrata
(beaked sedge)



Drepanocladus sp.



Aulacomnium palustre
(glow moss)

The vegetation on fens is closely related to the depth of the water table and the chemistry of the waters present as well as regional geographic variations



3. Swamp Wetland Class



Primary characteristics:

1. Peatland and mineral wetlands
2. Water table at or below the surface
3. **Minerogenous**: water originates on the land surface or as groundwater where it comes in contact with mineral soils and bedrock
4. Highly decomposed **woody** peat and organic material
5. Coniferous or deciduous trees, or tall shrub vegetation cover

A swamp can be defined as a treed or tall shrub (also called thicket) dominated wetland that is influenced by minerotrophic groundwater, either on mineral or organic soils.

Swamps occur on mineral and organic soils!



Swamp

Typical Vegetation



- **3 general physiognomic types of swamps**
 - Shrub (thicket) swamps
 - Coniferous swamps
 - Deciduous (Hardwood) swamps



Picea spp.
(spruce)



Betula spp. (birch)



Salix spp. (willow)



Ribes spp. (currants and gooseberries)



4. Marsh Wetland Class



Primary characteristics:

1. **Mineral soils**
2. Shallow surface water which **fluctuates** dramatically
3. **Minerogenous**: water originates on the land surface or as groundwater where it comes in contact with mineral soils and bedrock
4. Little accumulation of organic material and peat of aquatic plants
5. **Emergent aquatic macrophytes** largely rushes, reeds, grasses, and sedges and some floating aquatic macrophytes

Three basic marsh zones are usually attributed to water duration and depth (Millar 1976):

- (a) transitional open water,
- (b) emergent deep marsh, and
- (c) shallow marsh

Marsh Typical Vegetation



Sagittaria sp. (arrowheads)



Lemna minor (duckweed)



Carex spp. (sedges)



Typha latifolia (cattail)



Schoenoplectus acutus
(Hardstem bulrush)

Predominantly emergent aquatic macrophytes, graminoids (rushes, reeds, grasses, sedges), shrubs, other herbaceous species such as broad-leaved emergent macrophytes, floating-leaved and submergent species, and non-vascular plants such as brown mosses, liverworts, and macroscopic algae



Marsh Typical Vegetation



- Vegetation is usually arranged in distinct zones of parallel or concentric patterns in response to gradients of water depths, frequency of drawdowns, water chemistry or disturbance

open pools with aquatic plants →	emergent reeds →	sedges, reed grasses →	low rushes, sedges, herb meadows →	tall shrubs, trees (extreme edge)
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Phalaris arundinacea
(reed canary grass)



Calamagrostis canadensis
(marsh reed grass)



Carex aquatilis
(water sedge)



5. Shallow Water Wetland Class



Primary characteristics:

1. **Standing or flowing water** <2 m deep in mid-summer
2. Water levels seasonally stable, permanently flooded, or intermittently exposed during droughts, low flows or intertidal periods
3. Occupies more than **75% of the surface area** of a confined basin or saturated zone
4. May also occupy bays and margins of profundal zones of lakes



5. Shallow Water Wetland Class



5. Large depressions with permanent water may be classified separately from the surrounding wetland, if they are subject to limnic processes or have different hydrological processes such as upwelling groundwater
6. **Excludes artificial water bodies** (reservoirs, impoundments and dugouts)
7. Natural impoundments such as beaver ponds or other open water wetland systems are included where water levels are not regulated

Distinct wetlands transitional between those wetlands that:
are saturated or seasonally wet (i.e. bog, fen, marsh or swamp) and
permanent, deep water bodies (i.e. lakes) usually with a developed profundal zone.



Shallow Water Typical Vegetation



Myriophyllum sibiricum
(Northern Watermilfoil)



Potamogeton spp. (pondweed)



Nuphar lutea (yellow pond-lily)

When present, deposits provide a substrate
for rooted submerged and floating
macrophytes, algae and aquatic mosses



Who Classifies Wetlands?



Qualified Wetlands Aquatic Environmental Specialist (**QWAES**)

- A **QWAES** is an expert with detailed knowledge of the aquatic environment, wetland soils, wetland species, wetland hydrology and wetland margin habitat and their management or assessment
- The term QWAES was adapted by the **Provincial Wetland Restoration/Compensation Guide** from a Guide to the Code of Practice for Pipelines and Telecommunication Lines Crossing A Water Body



Other Designations



Qualified Aquatic Environmental Specialist (QAES):

- A QAES may include a private individual, consultant or employee of a company that owns, plans or constructs pipeline crossings – typically someone with educational background in environmental sciences
- The specifications and recommendations prepared by the QAES may include mitigation and compensation measures related to the harmful alteration, disruption and destruction of fish habitat (HADD)
- Not really the person you need for a wetland assessment unless your wetland is fish bearing
- Defined under the Guide to the **Code of Practice for Pipelines and Telecommunication Lines Crossing A Water Body**



QAES – Code of Practice



CODE OF PRACTICE

WHAT IT MEANS

**What is a “qualified aquatic environment specialist?”
[s. 2 (q)]**

A qualified aquatic environment specialist may include a private individual, consultant or employee of a company. The specifications and recommendations prepared by the qualified aquatic environment specialist under the Code of Practice include, but are not limited to, mitigation and compensation measures related to achieving the “no net loss” objective and the determination of fish passage requirements that must be considered in the design and construction of watercourse crossings.

A qualified aquatic environment specialist would generally be employed when a crossing results in a disruption or alteration of the bed or banks of a fish bearing water body and/or when fish passage requirements must be incorporated into the water course crossing design. The qualified aquatic environment specialist determines what information and assessments are needed to meet the requirement of the Code of Practice.

In the event of enforcement actions resulting from contravention of the Code of Practice, a qualified aquatic environment specialist should be able to defend and rationalize any specifications and recommendations prepared on behalf of the owner. The Director may also request information regarding the experience and qualification of a qualified aquatic environment specialist.

A QAES should be able to **defend & rationalize** any specifications and recommendations....may also request information regarding the **experience** and **qualification** of a qualified aquatic environment specialist.

Code of Practice for Watercourse Crossings - May 2000, Revised April 2001



Riparian Areas





What are Riparian Areas?



Walker Environmental



Riparian Areas Defined



“Riparian areas are plant communities contiguous to and **affected by surface and subsurface hydrologic features** of perennial or intermittent lotic and lentic water bodies (rivers, streams, lakes, or drainage ways). Riparian areas have one or both of the following characteristics:

- (1) distinctly different **vegetative species** than adjacent areas
- (2) species similar to adjacent areas but exhibiting more vigorous or robust growth forms. Riparian areas are usually **transitional** between wetland and upland”

-United States Fish and Wildlife Service (1997)





Riparian Areas Defined



- The **highly productive** land immediately adjacent to a body of water that supports high biodiversity
- **Critical** for reducing the negative effects of various land-uses on adjacent waters
- Characterized by **hydrophytic vegetation, hydric soils**, and are affected by and adapted to fluctuating water levels or otherwise persistent hydrological factors and the complex interactions occurring between these and the biota dependant on them





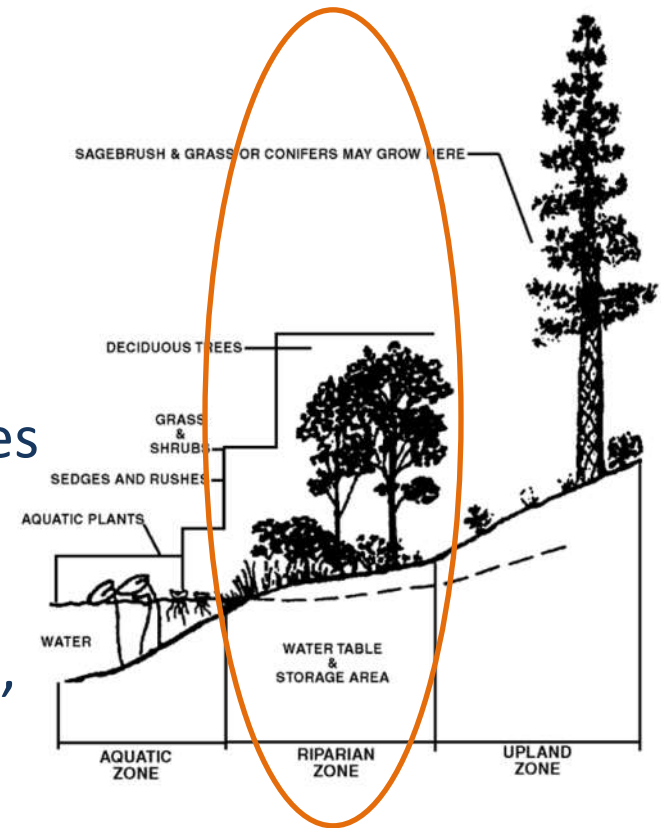
Riparian Areas Defined



Alberta Water Council Definition:

“Riparian lands are:

- **transitional areas** between upland and aquatic ecosystems.
- Have variable width and extend both above and below ground.
- **Influenced by and/or exert an influence** on associated water bodies, which includes alluvial aquifers and floodplains, when present.
- Riparian lands usually have soil, biological, and other physical characteristics that reflect the influence of water and/or hydrological processes.”



Where do you find Riparian Areas?



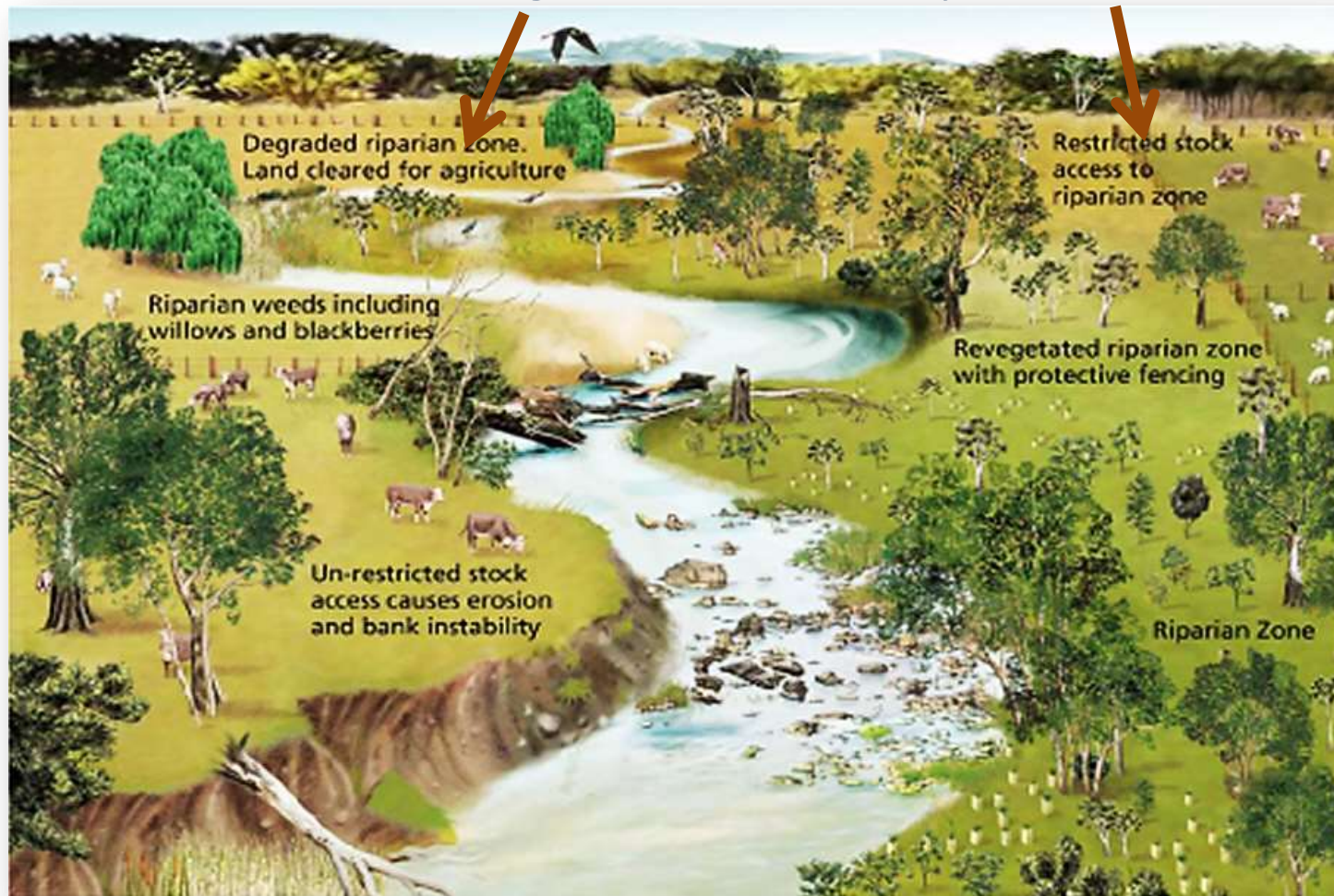
**Lakes, Streams, Rivers, Swamps,
Marshes, Bogs, Fens and Estuaries**



Riparian Areas



Riparian Areas can be Degraded (unhealthy) or Intact (healthy)



Healthy Riparian Areas





Unhealthy Riparian Areas





Unhealthy Riparian Areas





Where is the Riparian Area?





Where is the Riparian Area?



How do you determine the extent of the riparian area?



Riparian zones are characterized by water-loving and upland vegetation. The identification of these plants allows you to delineate riparian zones.



Carex atherodes (Awned Sedge)



Typha latifolia (Cattail)



Sparganium eurycarpum (Giant Burreed)



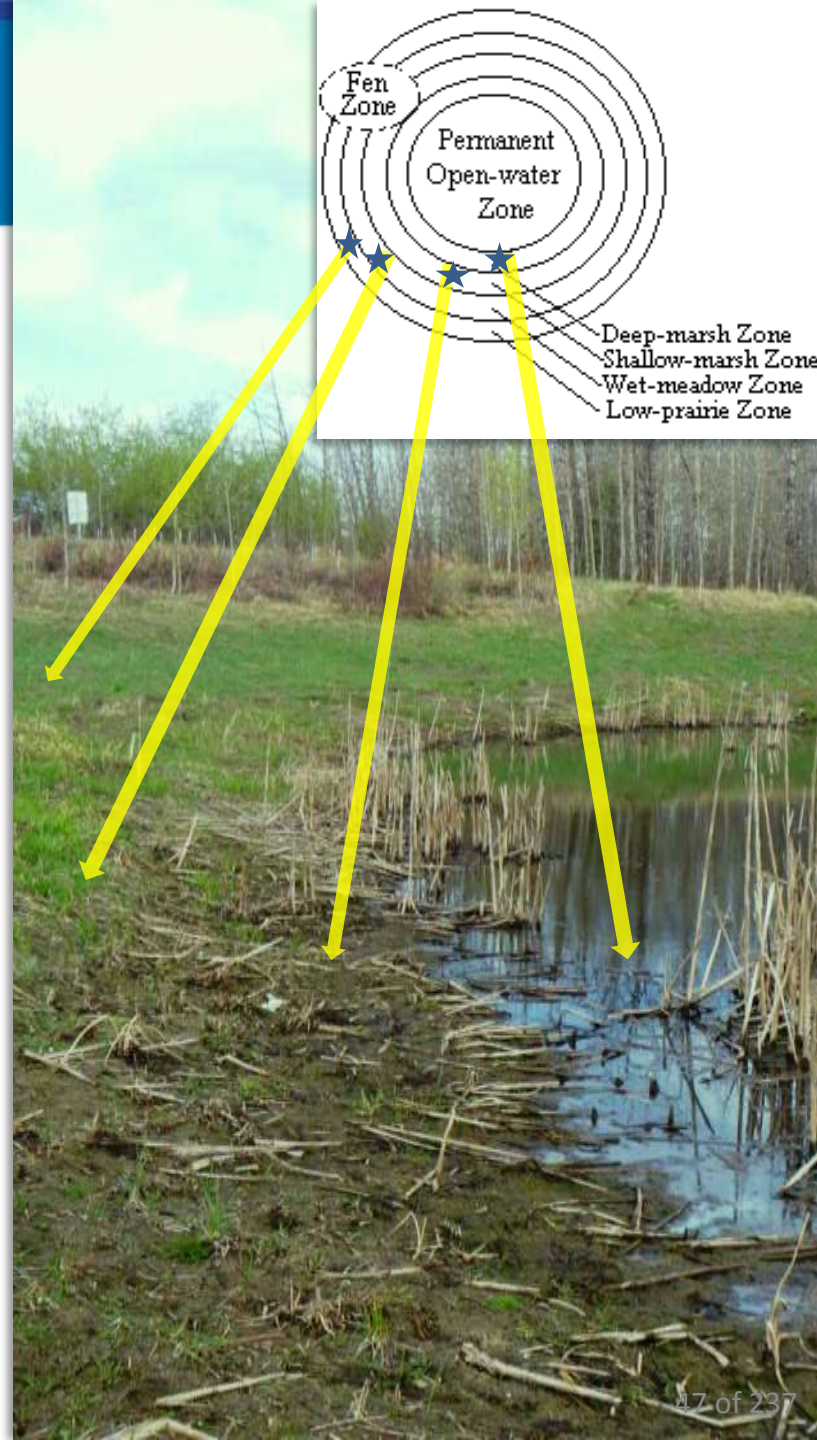
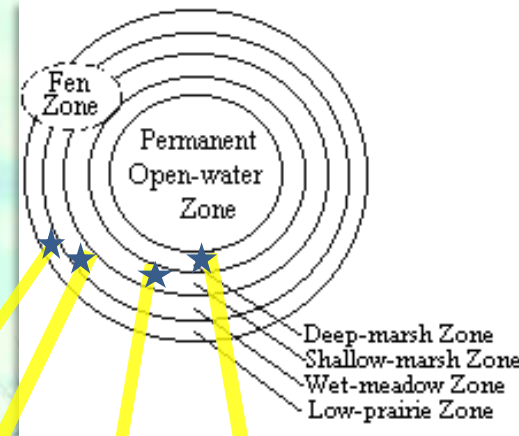
Betula spp. (Birch)



Salix spp. (Willow)

Where does the Riparian Area end?

According to the Stewart and Kantrud Wetland Classification System (1971):
the transition zone is at the end of Zone 2 (wet-meadow) and the start of Zone 1 (low-prairie)





Where does the Riparian Area end?



Upland species that indicate the end of the riparian area:

- Bebb's Willow
- Kentucky Bluegrass
- Buckbrush
- Wheatgrass spp.
- Tall Goldenrod
- Common Wild Rose
- Canada Anemone
- Fleabanes
- Prairie Sage
- Some Aspen and Poplar spp.





Riparian Areas in Decline





Riparian Areas in Decline



- Despite the list of benefits and services provided by wetlands and riparian areas, they continue to be drained and degraded
- Alberta has seen losses of about 64% of the total wetlands in the settled areas (white zone)
 - Some areas as high as 90% lost
- Riparian health continues to degrade:

Health Status	Early 19 th Century	Present (2002)
Healthy	70%	11%
Healthy w/ problems	20%	49%
Unhealthy	10%	40%

Table information courtesy of Cows and Fish Riparian Areas: A User's Guide to Health



Riparian Areas in Decline



- Where riparian areas are compromised, ability to perform some or all key functions is lost
- The watershed may experience:
 - Reduced water quality
 - Increased runoff, erosion and sedimentation
 - Reduced groundwater storage
 - Higher peak flows and lower base flows
 - Increased flood and drought frequency
 - Reduced habitat quality and food supplies
 - Declined recreation and aesthetic value





Legislation Affecting Wetlands in Canada





Fisheries Act (1985)



- Regulates and enforces on harmful alteration, disruption and destruction (**HADD**) of fish habitat
- Applied to all fishing zones, territorial seas and inland waters of Canada and is binding to federal, provincial and territorial governments
- Activities that may have resulted in a HADD include installation of a culvert and removal of riparian vegetation
- So the Federal government regulates fish habitat, while the province regulates the fish!





Fisheries Act (before Bill C-38)

- If a **HADD** occurred with **no authorization**, the proponent may be charged with fines up to **\$1,000,000** and or up to 6 months in jail
- **The Fisheries Act** included regulations on:
 - fish passages,
 - fish screens for water intakes,
 - no unauthorized killing of fish
 - prohibition on the deposit of deleterious substances
- The Alberta Government controls the promotion, processing, and regulation of the marketing of fish within Alberta





Bill C-38



At least 10 pieces of federal environmental legislation were amended or repealed by Bill C-38 including:

- *Canadian Environmental Assessment Act*
- *Fisheries Act*
- Operation of the National Energy Board

Results:

1. **Fewer environmental assessments:** reduced scope, public participation, and less information collected
2. **Reduced habitat protection:** reduced definition of fishery (less about protecting fish and fish habitat – only concerned with certain types of fisheries)
3. **Less environmental consideration:** ignore environmental impacts for exporting electricity





Bill C-38 HADD Provision



Bill C-38 introduces changes to the HADD provisions in a two-step process:

- The HADD provisions still apply – but the **types of activities** that can be permitted without violating HADD can be expanded by regulation (none yet)
- The HADD provisions will be replaced (at a later date) with “**serious harm**” to fish that are part of a commercial, recreational or aboriginal fishery
- The “serious harm” standard offers **less protection**, only against **death** or **permanent alteration** of habitat
 - There are many serious harms to fish that are less than death but threaten survival





Fisheries Act (after Bill C-38)



Bill C-38:

- Weakens the **habitat protection** provisions of the previous *Fisheries Act*
 - Focuses on protecting “**useful**” fish rather than all fish and fish habitat
- Focus is on managing threats to **Recreational, Commercial and Aboriginal (RCA) fisheries**
 - Areas without RCA fisheries will continue to be protected from pollution under the *Fisheries Act* and other relevant laws
 - Shift away from reviewing all projects on all waters to focusing on those that may significantly impact **Canada’s Fisheries**



<http://www.watershed-watch.org/>

Department of Fisheries and Oceans Canada received a \$ 78 million budget cut!



<http://www.canada.com/hook+Canada+jeopardizing+fish+stocks+with+poor+management+report+says/6091501/story.html>





Implications of Bill C-38



- Who decides what a **valuable** fishery is?
- Vital prey species for fisheries fish will not be given protection
- Many endangered species of fish listed by COSEWIC would no longer be given protection under the new *Fisheries Act*

Question: If there are sport fish in a lake but the lake is inaccessible to fishermen is there still a fishery?



Western Silvery Minnow (*Hybognathus argyritis*)
An endangered species in Alberta yet would not be protected



Northern Pike (*Esox lucius*)
Considered a sport fish in Alberta and would be protected





Canadian Environmental Assessment Act (CEAA) (1992)



““water body” includes a **lake**, a **canal**, a **reservoir**, an **ocean**, a **river** and its **tributaries** and a **wetland**, up to the annual high-water mark, but **does not include**

a **sewage or waste treatment lagoon**, a **mine tailings pond**, an **artificial irrigation pond**, a **dugout** or a **ditch** that **does not contain fish habitat** as defined in subsection 34(1) of the *Fisheries Act*.”

Dugout





Navigable Waters Protection Act (1985)



- Prohibited activities that could interfere with the navigability of water including:
 - Approval of works
 - Obstacles and Obstructions
 - Regulation of Ferry Cables and Swing or Draw Bridges

“**navigable water**” included a canal and any other body of water created or altered as a result of the construction of any work



<http://tutkc.org/Projects/BronteCreek/BronteCreekWatershed.htm>





Omnibus Bill C-45



- *Navigable Waters Protection Act* is amended and renamed the *Navigation Protection Act*
- Only pertains to **navigation** and no longer takes into account environmental protection
- New law only applies to the three oceans in Canada and lakes and rivers that have been qualified as important **commercial** and **recreational** water courses
- **Only five rivers and two lakes will be protected in Alberta:**
 - Bow, Peace, Athabasca, North Saskatchewan, South Saskatchewan
 - Lake Athabasca and Slave Lake





Legislation Affecting Wetlands in Alberta





Environmental Protection and Enhancement Act (EPEA) (2000)



- Supports and promotes the protection, enhancement, and **wise use** of the environment
- Covers a wide range of activities relevant to wetlands, including environmental assessment, reclamation, conservation easements, wastewater, storm drainage, and substance release
- Produced water spills occur in wetlands throughout Alberta on a daily basis





Water Act (1999)



- Defines “water” and a “waterbody”
- Regulates and enforces actions that affect water and water use management, the aquatic environment, fish habitat protection practices, and storm water management
- **Does not** distinguish between wetlands in the White Zone and Green Zone
- Prohibits anyone from draining, altering or infilling wetlands on **private or public land** unless authorized to do so by the Province through an approval under the provisions of the *Act*





Water Act (1999)



- Prohibits **export** of water to the United States
- Prohibits **inter-basin transfers** of water between major river basins
- Provision for “**in-stream**” allocations defined by “**Water Conservation Objectives**”
- Water Management Plans to address regional water issues
- Sets the requirement for a provincial water management planning framework
- Provides a wide range of enforcement and water management tools





Fisheries (Alberta) Act (2000)

- Under the British North America Act the responsibility for fish and fisheries was vested in the Federal Government
- Today the provincial governments have the boots on the ground to manage the fish (biologists and technicians) but they still need the Federal Government to pass the actual legislation that sets catch limits and methods along with other restrictions
- The Alberta Fishery Regulations (1998) is made pursuant to the Federal Fisheries Act by the feds and regulates both sport and commercial fisheries in Alberta
- Provinces often pass acts they call Fisheries Acts but they are usually related to the licensing and regulation of fish buyers and processors and aquaculture operations
- Provinces also have the authority to regulate fishing licenses for fresh water

(Pers comm Ben Mitchell-Banks)

<http://laws-lois.justice.gc.ca/eng/regulations/SOR-98-246/page-1.html>

<http://www.qp.alberta.ca/documents/Acts/F16.pdf>





Public Lands Act (updated 2000)



Public Lands Act:

(1) Subject to subsection (2) but notwithstanding any other law, the title to the beds and shores of

(a) all **permanent** and naturally occurring bodies of water

(b) all naturally occurring rivers, streams, watercourses and lakes

is vested in the Crown in right of Alberta and a grant or certificate of title made or issued before, on or after May 31, 1984 does not convey title to those beds or shores.

The extent of the Bed and Shores of a Body of Water is determined by the location of the bank, based on a legal land survey



<http://albertawilderness.ca/issues/wildwater>





Public Lands Act (updated 2010)



- Prohibits “the **disturbance** of any public land in **any manner** that results or is likely to result in injury to the bed or shore of any river, stream, watercourse, lake or other body of water or land in the vicinity of that public land...”
- Regulates and enforces on activities that affect Crown-owned beds and shores of all permanent and naturally occurring bodies of water





Public Lands Act (updated 2010)

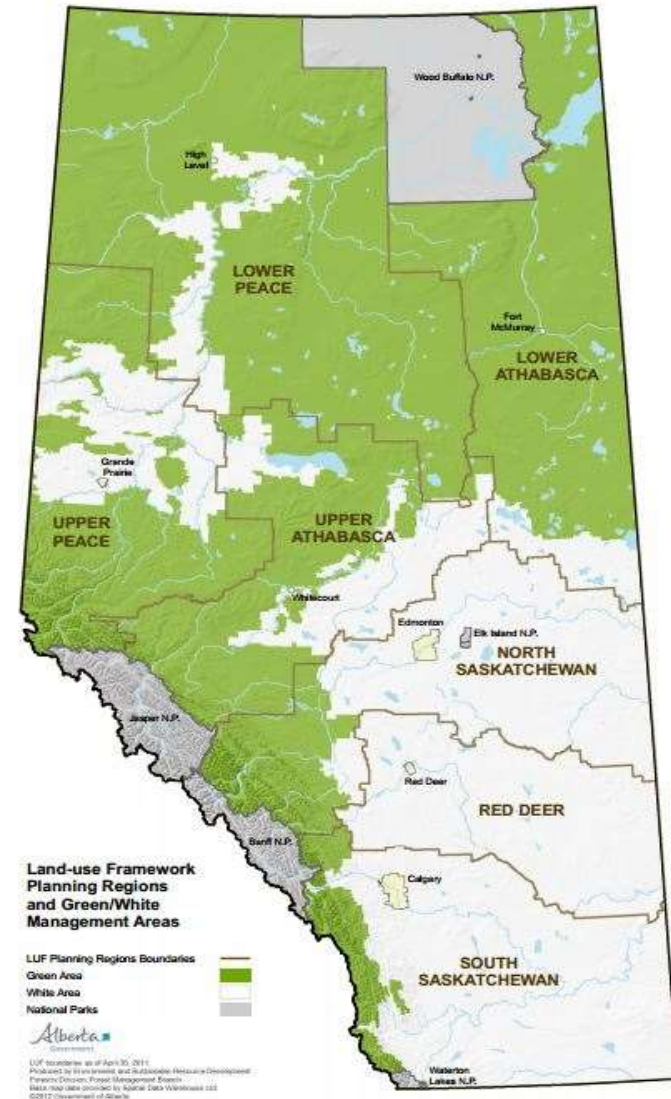


- The Crown owns the **beds and shores** of all permanent and naturally occurring bodies of water including wetlands in the White Area, and ALL the land in the Green Area, including its wetlands
- Differentiates wetlands into **White** (settled) and **Green** (forested) Zone areas





White and Green Zones in Alberta





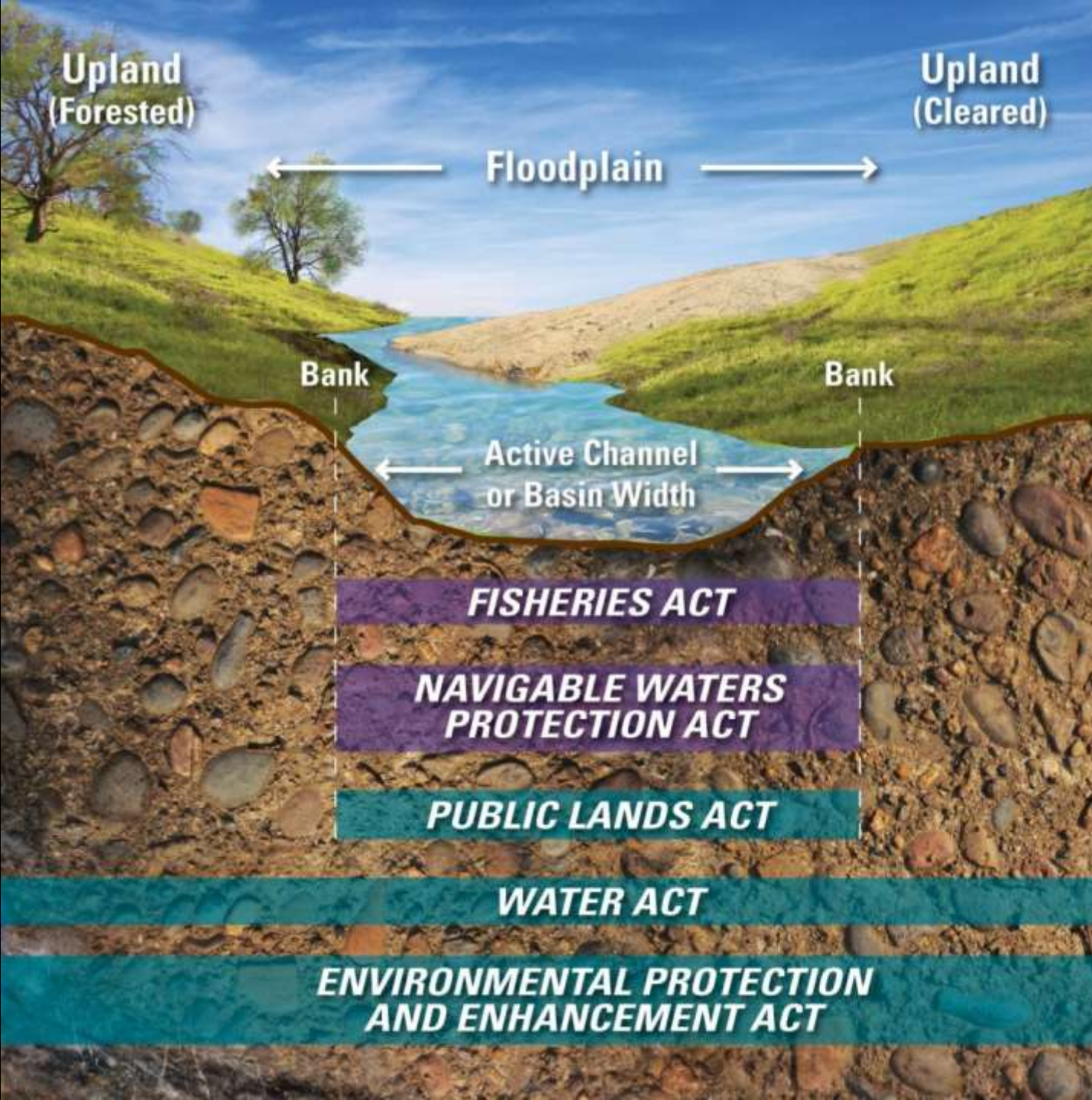
Surveys Act (1990)

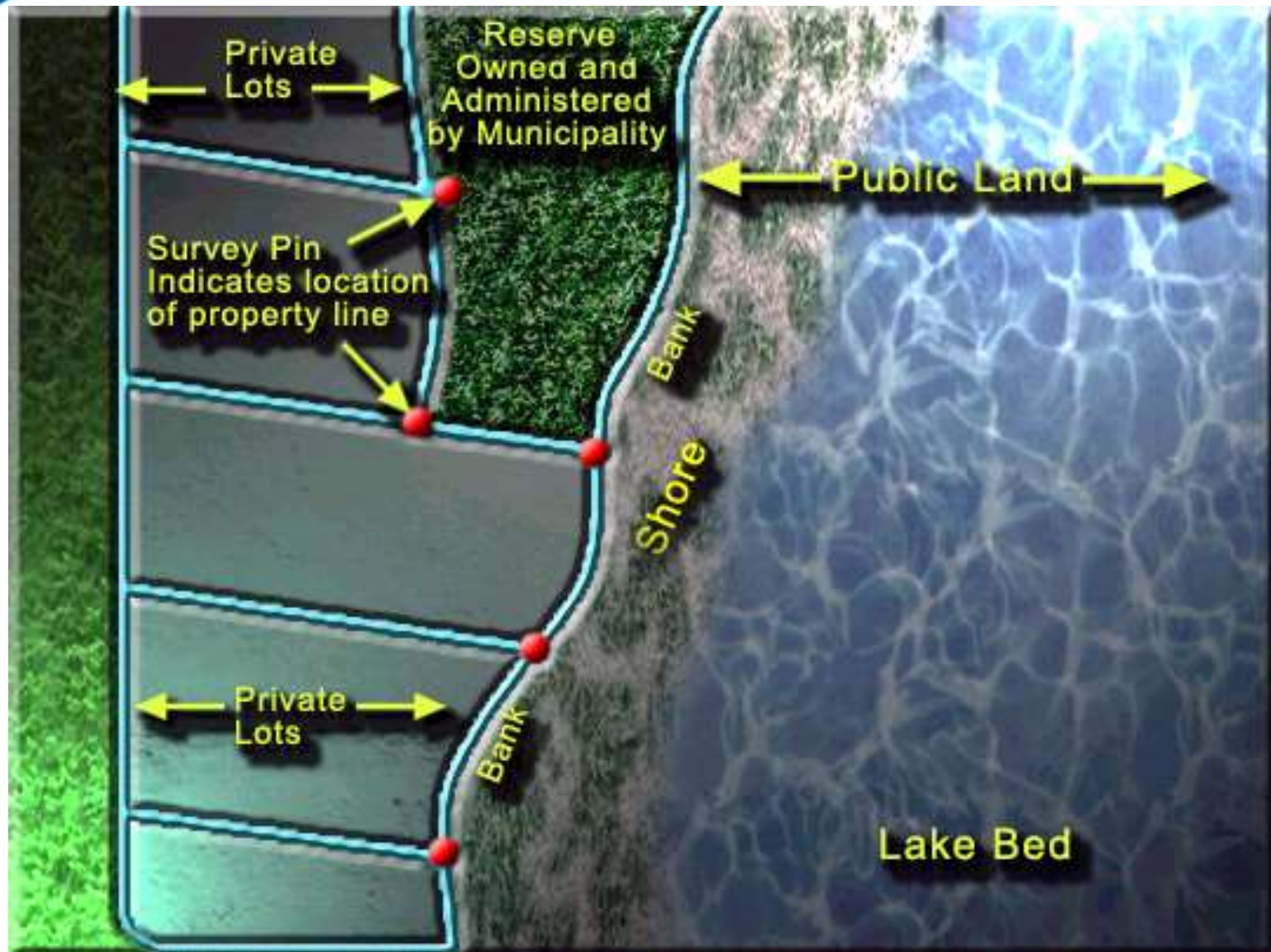


17(2) When surveying a natural boundary that is a body of water, **the surveyor shall determine** the position of the line where the bed and shore of the body of water cease and the line is to be referred to as the **bank of the body of water**

17(3) For the purposes of this section, the bed and shore of a body of water shall be the land **covered so long by water as to wrest it from vegetation** or as to mark a **distinct character on the vegetation** where it extends into the water or on the soil itself

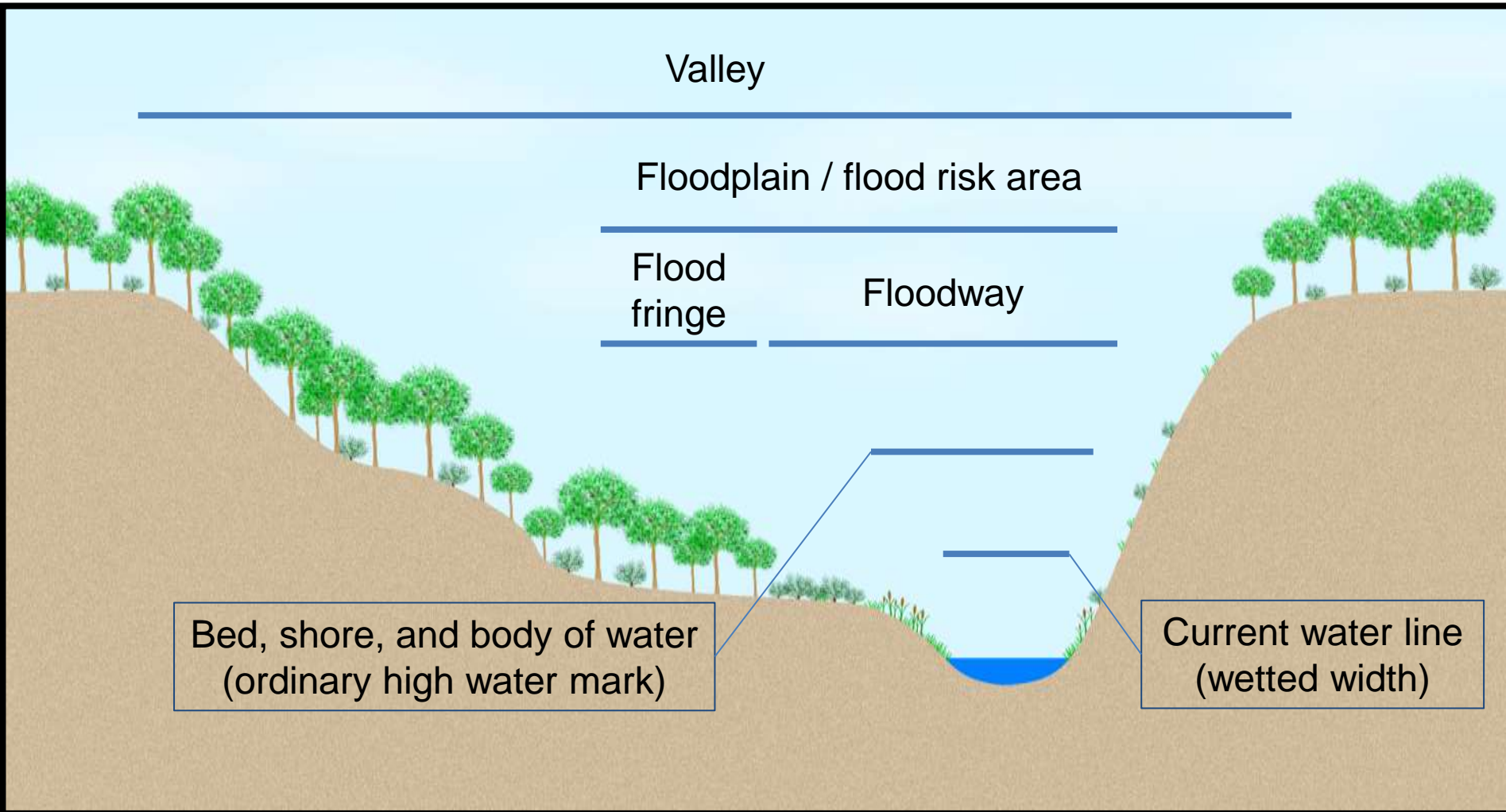








Floodplain/Flood-Risk Area (Water Body – *Water Act*)



Floodplain/Flood-Risk Area (Water Body – *Water Act*)



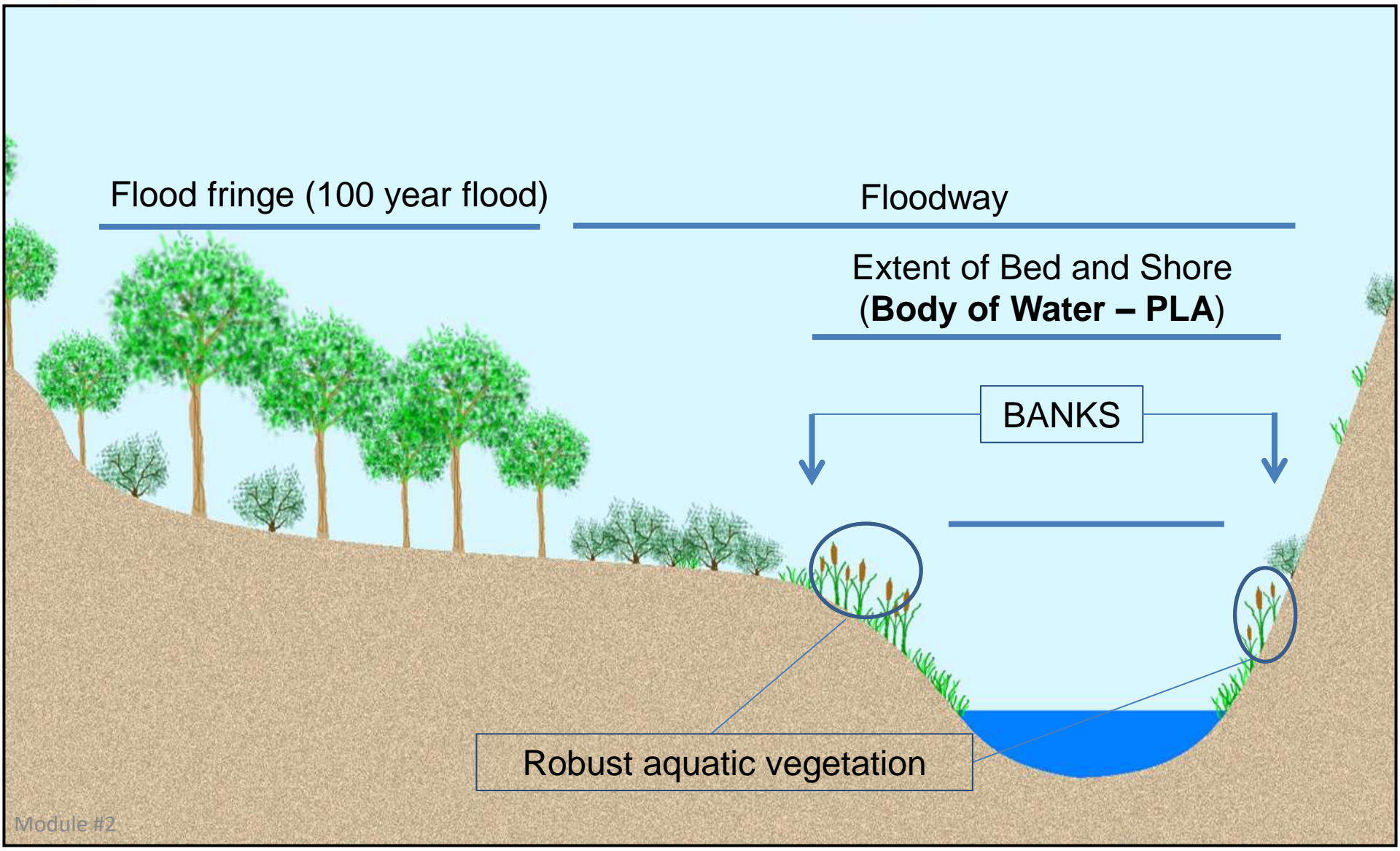
Flood fringe (100 year flood)

Floodway

Extent of Bed and Shore
(Body of Water – PLA)

BANKS

Robust aquatic vegetation



Flood Hazard Map Application



- Flood Hazard Identification Program
- GIS technology is used to display the flood hazard maps
- Areas denoted include floodway zones and flood fringe zones.
- Overland flow areas are considered to be part of a flood fringe zone.





Flood Hazard Identification Program



- **Flood Hazard Area**

- Area affected by the design flood under encroachment conditions,
- The flood hazard area divided into floodway and flood fringe zones, and
- May also include areas of overland flow.

- **Floodway**

- Portion of flood hazard area where flows are deepest, fastest & most destructive,
- Includes the main channel of a stream and a portion of the adjacent overbank area,
- The floodway is required to convey the design flood,
- New development is discouraged in the floodway and may not be permitted in some communities.

- **Flood Fringe**

- The portion of the flood hazard area outside of the floodway,
- Water is generally shallower and flows more slowly than in the floodway,
- New development in the flood fringe may be permitted in some communities and should be floodproofed.



Flood Hazard Identification Program



- **Overland Flow**
 - Part of the flood hazard area outside of the floodway, and
 - Typically considered special areas of the flood fringe.
- **Design Flood**
 - The current design standard in Alberta is the 100-year flood, determined when a flood hazard study is undertaken,
 - A 100-year flood is defined as a flood whose magnitude has a one percent chance of being equalled or exceeded in any year,
 - The design flood can also reflect a computed 100-year water level resulting from an ice jam or be based on a historical flood event.
- **Design Flood Levels**
 - Flood hazard area water elevations computed to result from a design flood under encroachment conditions,
 - Design flood levels do not change as a result of development or obstruction of flows within the flood fringe.
- **Encroachment Conditions**
 - The flood hazard design case that assumes a scenario where the flood fringe is fully developed and flood flows are conveyed.



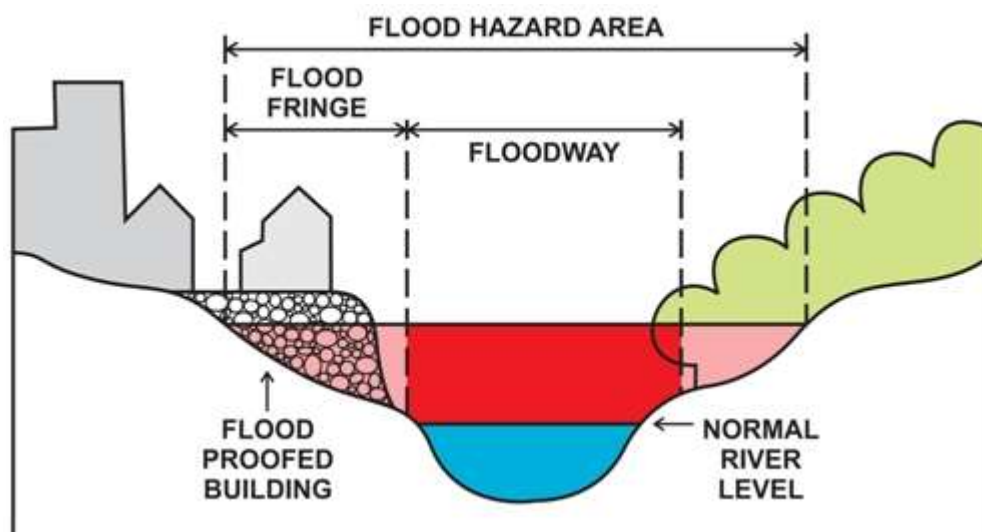
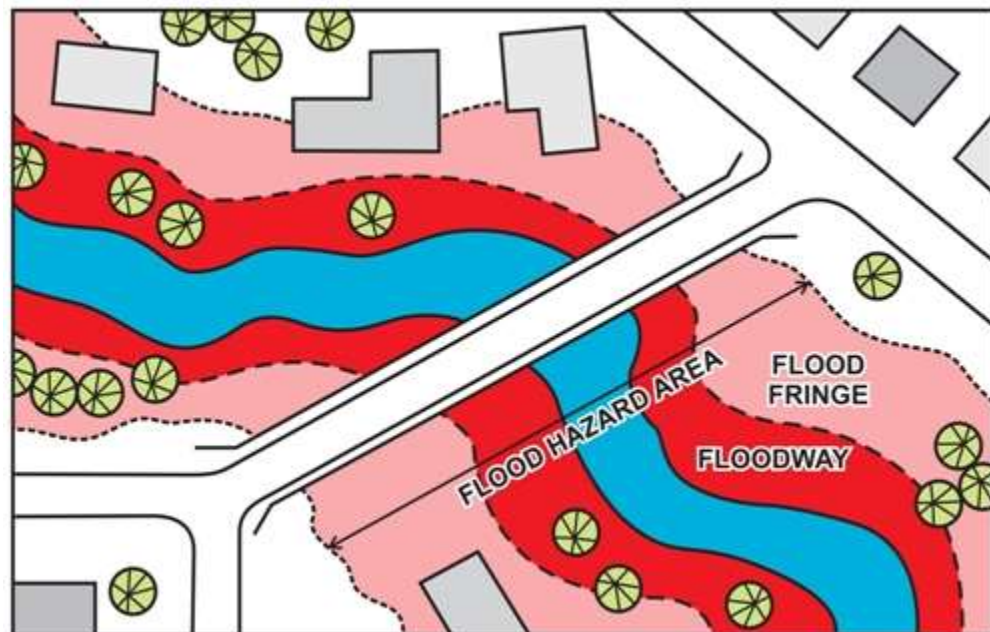
Flood Hazard Identification Program



Designed according to 1:100 year flood events

[http://environment.alberta.ca/documents/Flood Hazard ID Prg Fact Sheet 2013.pdf](http://environment.alberta.ca/documents/Flood_Hazard_ID_Prg_Fact_Sheet_2013.pdf)

[http://environment.alberta.ca/documents/Use of Flood Hazard Study Fact Sheet 2013.pdf](http://environment.alberta.ca/documents/Use_of_Flood_Hazard_Study_Fact_Sheet_2013.pdf)





Programs for Riparian Areas



Provincial Champions of Riparian Management



Cows and Fish

Alberta Riparian Habitat Management Society



[home](#) | [contact us](#) | [search](#)

[About](#)

[Riparian Areas & Management](#)

[Publications](#)

[What's New?](#)

[Youth Education](#)

[Photos & Videos](#)



[What is Riparian?](#)

[Ecology & Function](#)

[Riparian Health](#)

[Management](#)

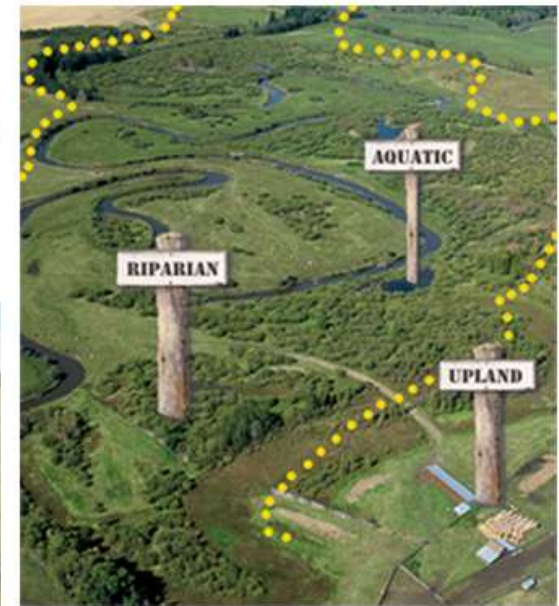
[Caring for the Green Zone](#)

[Riparian Area's a User's Guide to Health](#)

What is Riparian?

Riparian areas are the lands adjacent to streams, rivers, lakes and wetlands, where the vegetation and soils are strongly influenced by the presence of water. Although they make up only a small fraction of the land, they are among the most productive and valuable of all landscape types and have been the focus of conflicts between resource users.

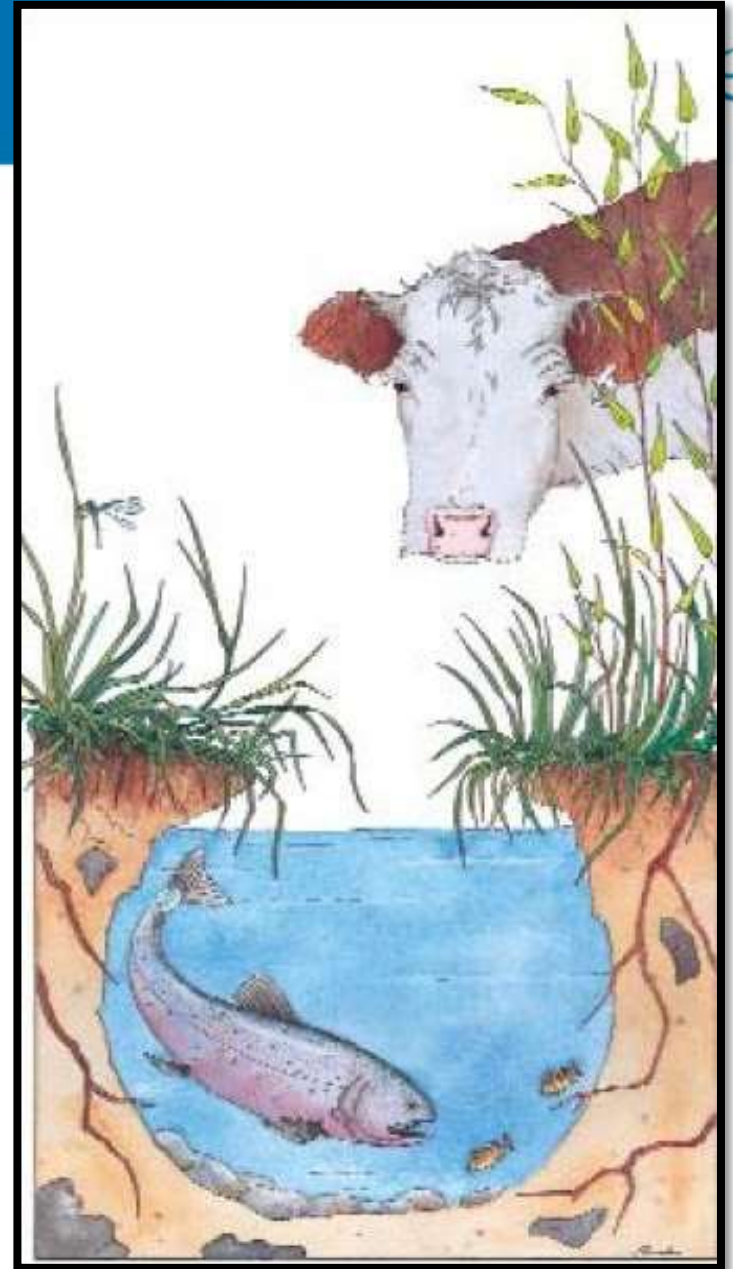
Riparian areas come in all shapes and sizes:





Cows and Fish

- Established in 1992
- Develops and delivers awareness and education programs to the public, producers, and land managers about:
 - managing, maintaining, and protecting riparian areas to increase productivity and retain value





Living by Water Program



- National initiative established in 1997, brought to Alberta by Nature Alberta in 1999.
- Host environmental education programs, workshops, and produce educational resources for homeowners living next to urban and recreational lakes.
- Focus is on riparian health.





Living by Water Program



- Homesite consultation program – free riparian assessments of home owners properties to provide information to shoreline residents about the basics of shoreline living and how to be lake friendly.
- Similar to Cows & Fish with a more specific audience.





Functions of Riparian Areas and Wetlands





Importance and Function



1. **Water Quality:** Filters and absorbs excess nutrients, sediments and pollutants from surface runoff and subsurface flow.
2. **Water Storage and Flood Control:** Recharges aquifers through slow release during dry periods. Stores flood water and energy to attenuate flood waters.
3. **Bank Stabilization:** Roots of plants stabilize the soils and protect shorelines from erosion caused by waves and boat wakes by reducing and dissipating wave energy.
4. **Aquatic and Terrestrial Habitat:** Provides vital wetland habitat and biodiversity. Feeding, spawning and rearing habitat for fish (emergent riparian vegetation).
5. **Peatland Carbon Storage and Use:** Peatlands are natural carbon sinks and globally store at least 550 Gigatonnes of carbon in their organic soils (x2 the world's forests).

1. Water Quality



- Trap and store sediment
 - Builds soil on banks and shores
 - Traps contaminants and excess nutrients attached to soil particles
 - Reduces turbidity
 - Increases habitat quality

The effect of wetlands on water quality is so dramatic that artificial wetlands are sometimes created specifically to treat domestic, municipal, and industrial wastewater where no wetlands were originally present.



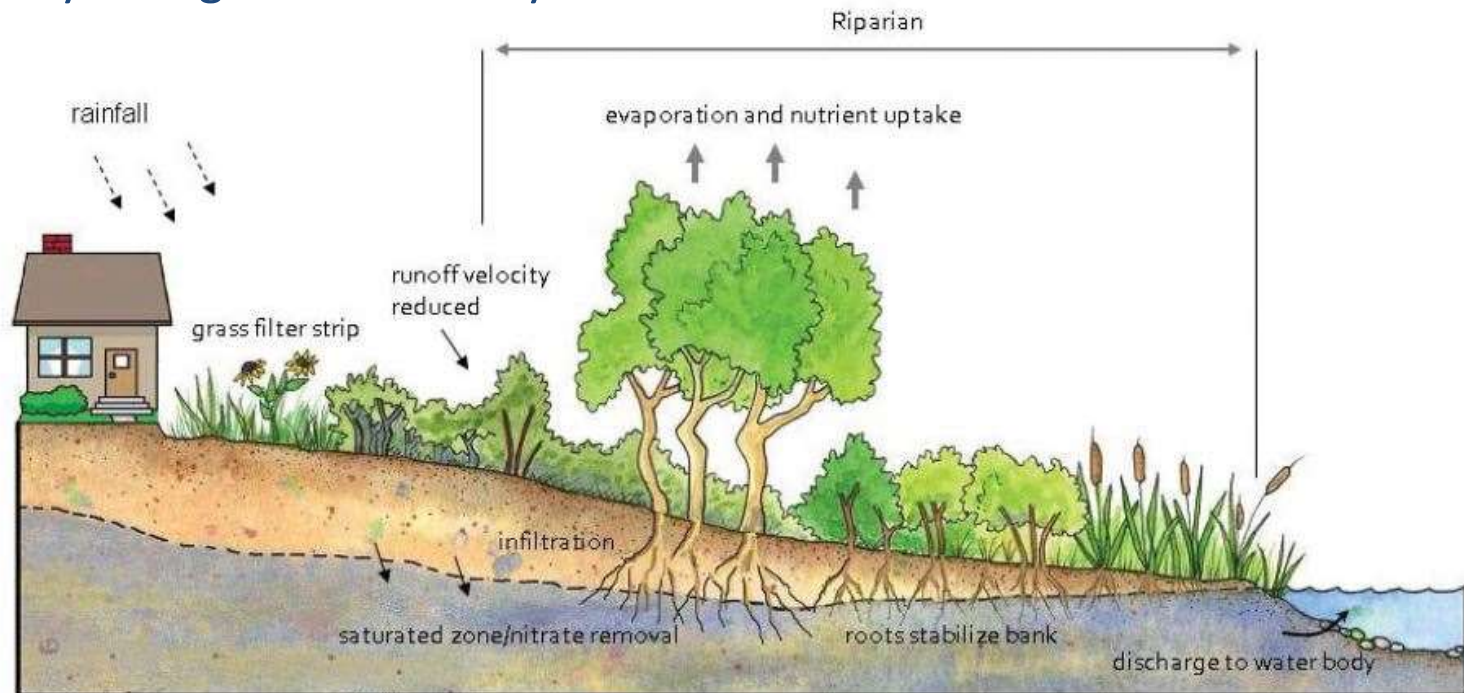
Cottonwoods on a floodplain

Water Quality



- Filter and buffer water

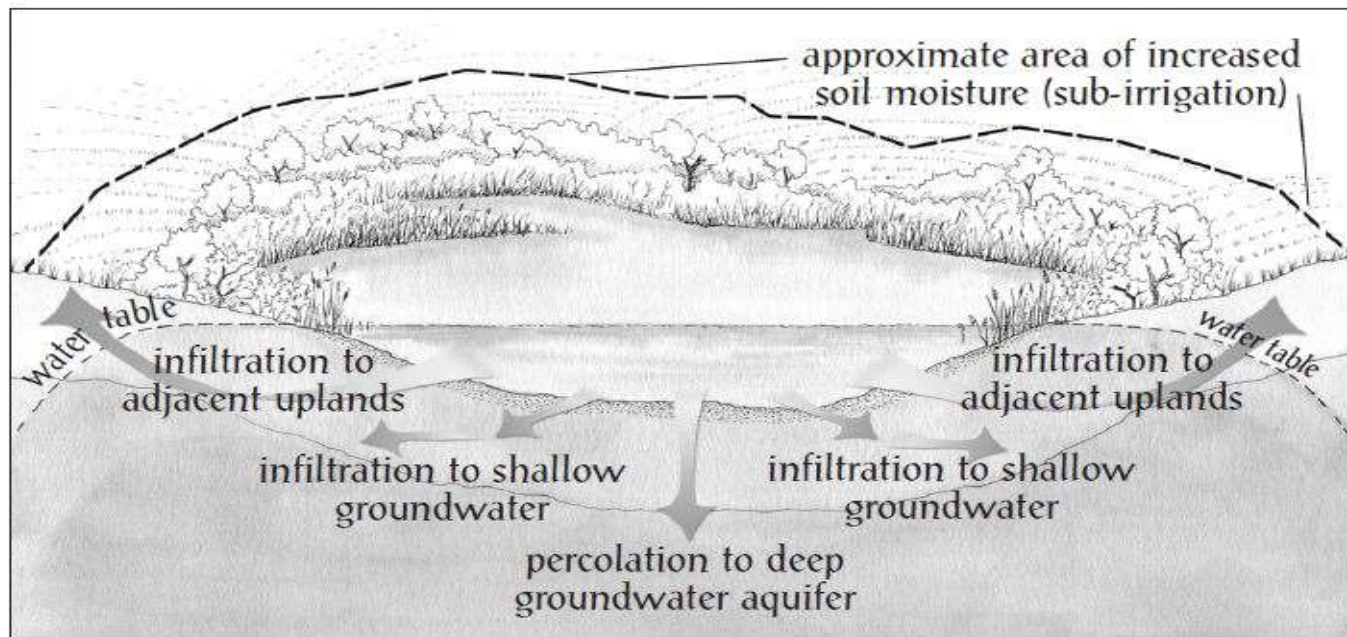
- Plant roots take up nutrients and contaminants in the water
- Broken down in the plant to less harmful forms
- More vegetation will increase the water bodies ability to react to and buffer any changes in chemistry



2. Water Storage and Flood Control



- Store water and energy
 - Slows water for increased infiltration into soil and groundwater sources
 - Stores excess water and releases slowly into surrounding area as needed
 - Utilizes floodplain in times of flood events
 - Reduces peak flows and maintains base flows

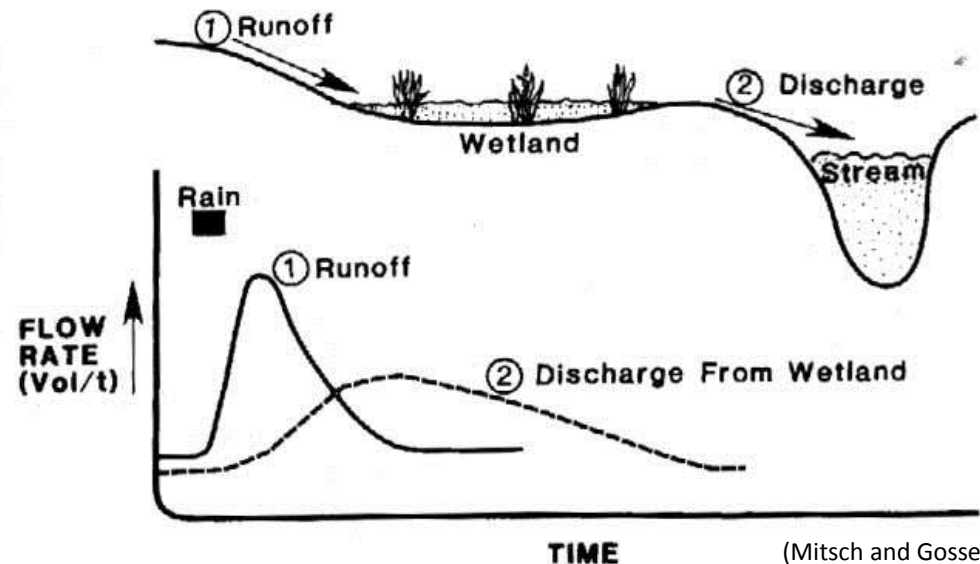
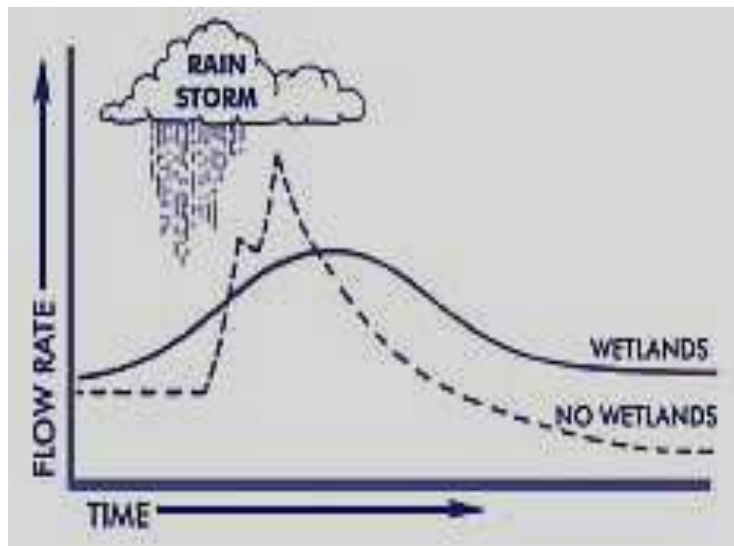




Flood Mitigation



- Wetlands act as “**natural sponges**” store water during periods of drought and help to buffer floods during high precipitation events
- Wetlands are nature’s major flood-control agents
- In “giant floods”, they may only reduce flood height
- With river alterations and development in floodplains, the bottom line is that you will pay sooner or later

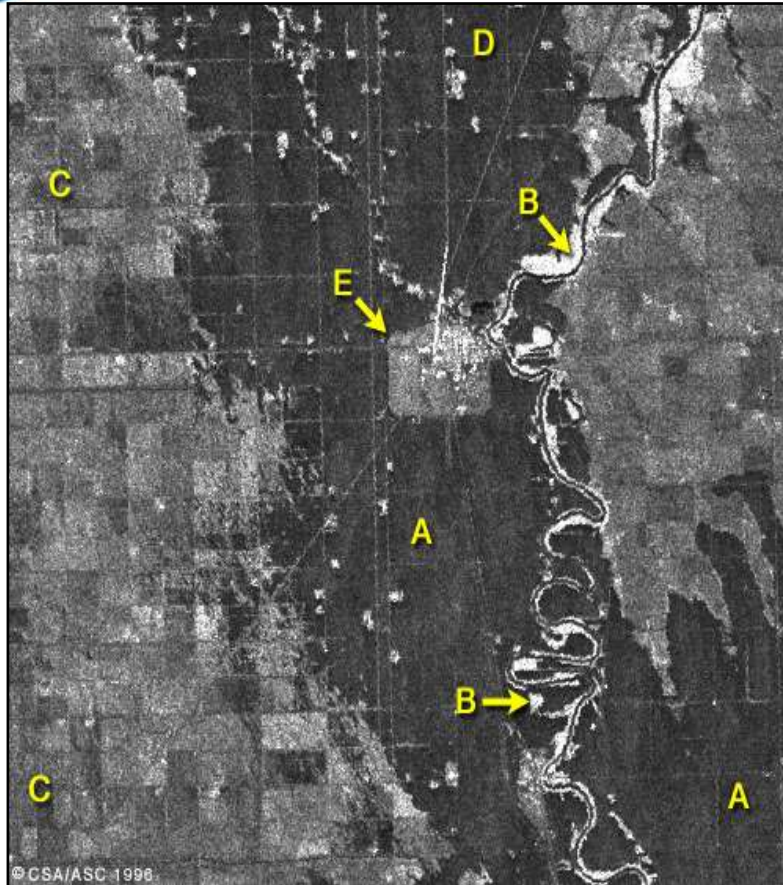


(Mitsch and Gosselink, 1993)

Figure 15-7 The general effect of wetlands on streamflow.



Case Study: Red River Flood, Manitoba major events in 1950, 1997, 2009, 2011



- A – flooded area
- B – non-flooded, near the Red River
- C – non-flooded, agricultural fields
- D – flooded area
- E – town of Morris, levee-protected



Grand Forks, MN



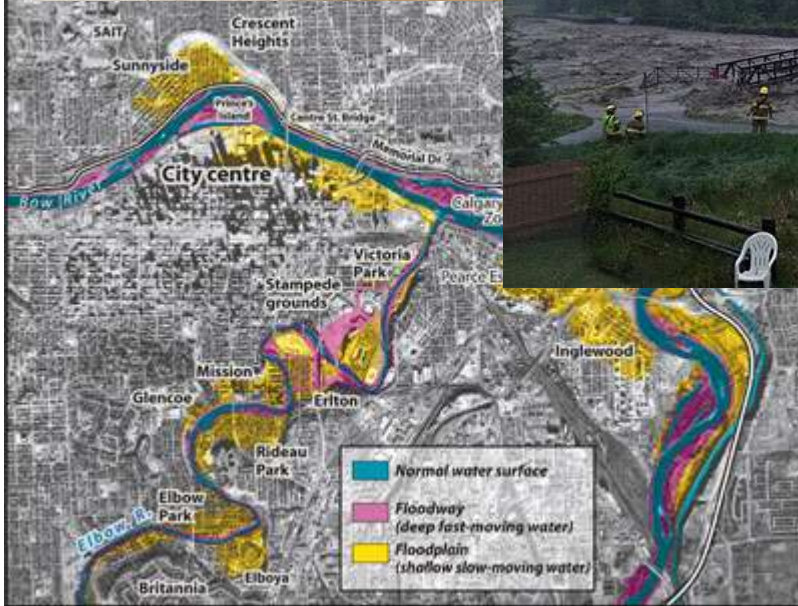
City of Calgary and Area – June 2013



High River



Canmore

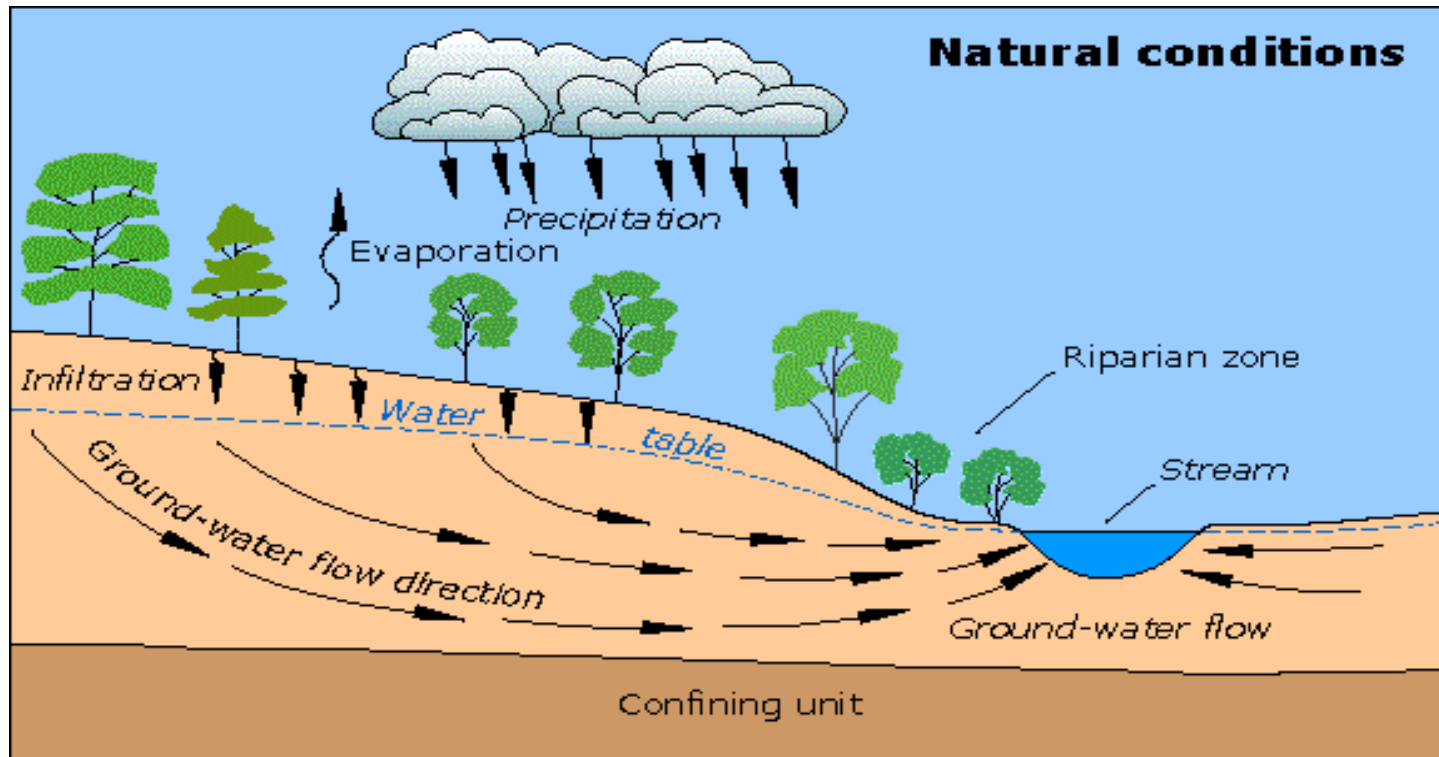




Water Storage



- Recharge aquifers
 - Reduced velocity of water allows time to percolate to below ground storage
 - Maintains surface flows and drinking water availability

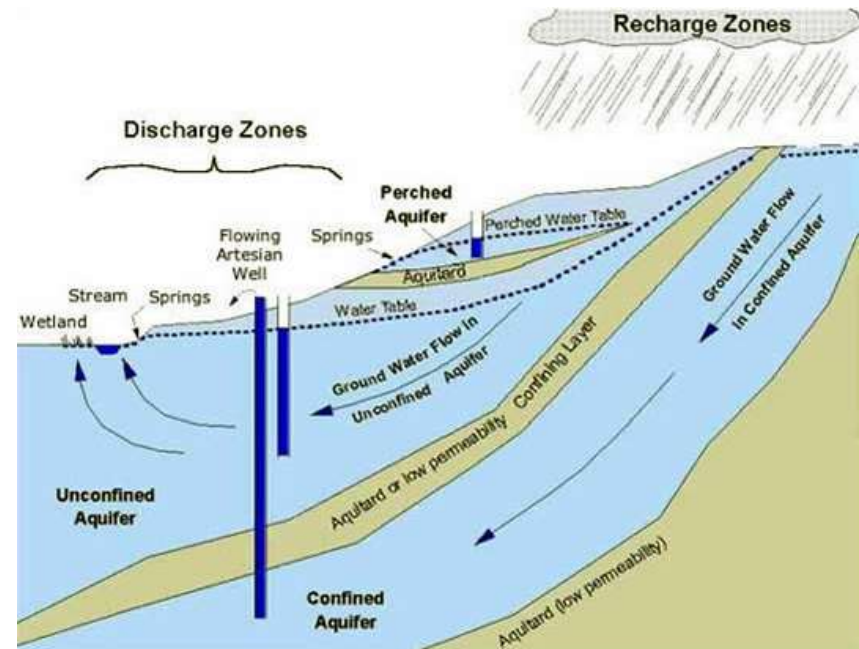




Groundwater Recharge



- The process by which water is added to underground aquifers
- Aquifers are bodies of rock or sediment that are water-saturated
- Without recharge, aquifers can become depleted



<http://environment.alberta.ca/images/SOE-Water-groundwater-main-a-full.jpg>



Groundwater Recharge



- Wetlands promote recharge by holding water
- Allows water time to percolate down
- Groundwater depletion causes wells to dry up
- Subsistence of land (sinkholes)



http://www.waterlink-international.com/wosimages/782_255.jpg



Reduce Contaminants



- Wetlands slow the spread of contaminants
- Contaminants are taken up by plants, degraded by microbes (fungi and bacteria), or are incorporated into the sediment



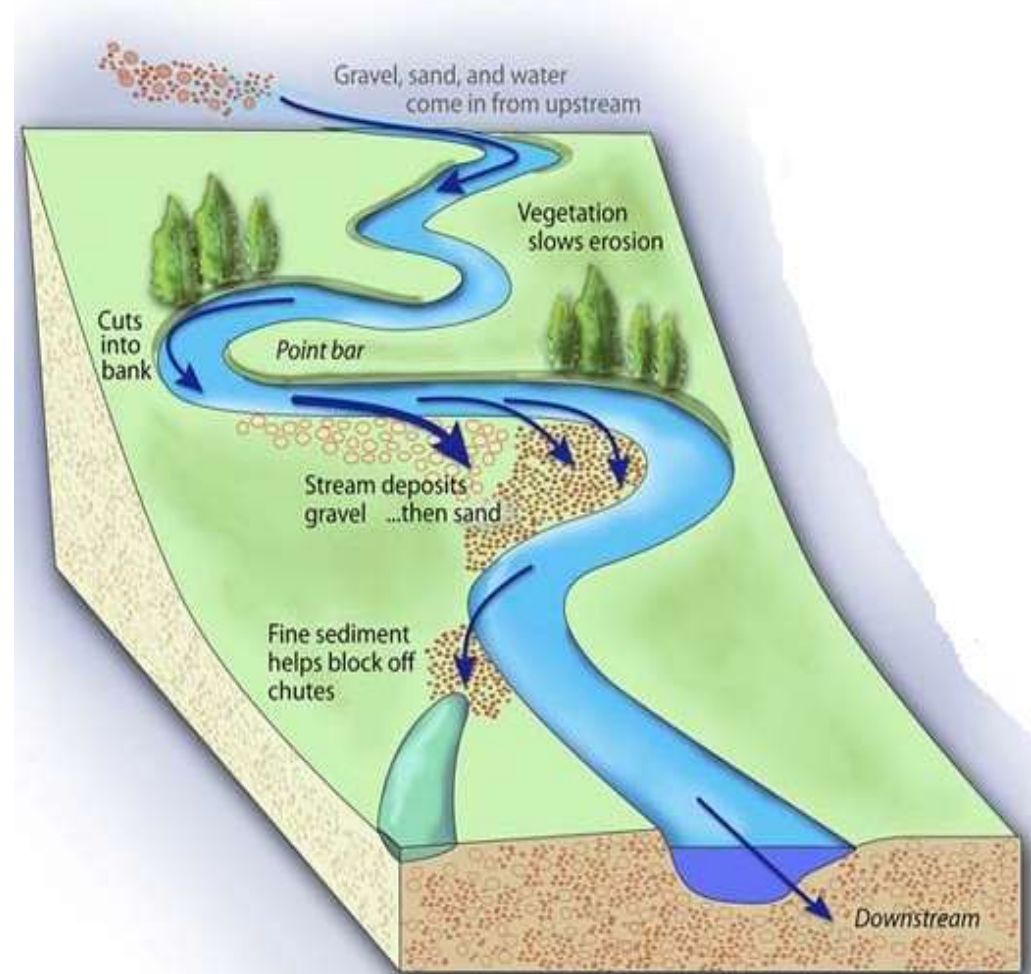
Wabamun Lake



3. Bank Stabilization



- Build and maintain banks and shores
 - Streams tend to erode on outside edges of bends and meanders and deposit on the inside edges
 - Stream channel will continuously change over time; the slower the better
 - In flood events sediment is deposited on floodplain, leading to nutrient rich soil development
 - Preferred vegetation binds soil and reduces erosion

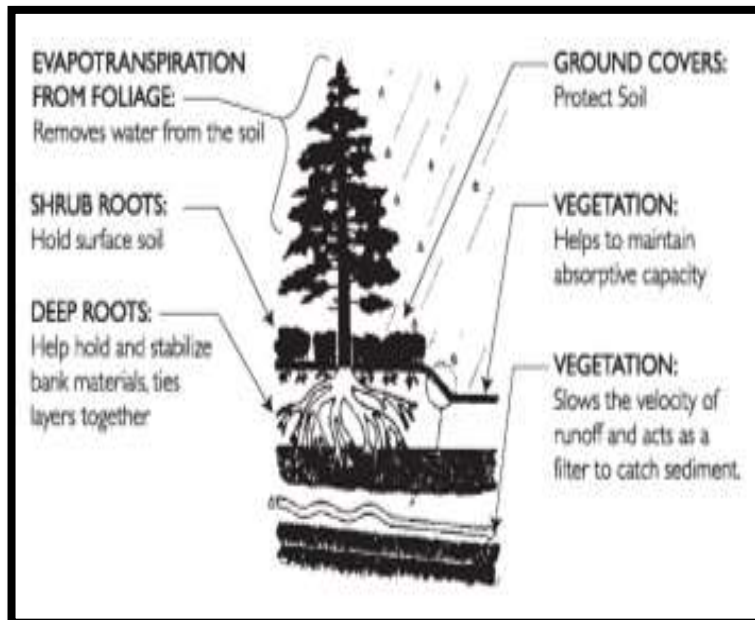




Bank Stabilization



- Reduce and dissipate energy
 - Reduced velocity means reduced energy potential of the water
 - Less energy expended will result in lower rates of erosion





4. Aquatic and Terrestrial Habitat

- Provides vital wildlife habitat and biodiversity
 - Provides shelter for fish species for feeding, spawning, and rearing of young
 - Protection from predators



Photo Credit: Julie Robinson





Aquatic and Terrestrial Habitat

- Depending on the size of the wetland, different riparian species/growth forms may be more desirable

Legend:

E=Excellent - these species have all the necessary properties of deep, binding and large root mass appropriate to riparian type or size.

G=Good - species meet most of the requirements for holding bank and shore materials together.

F=Fair - plants have marginal ability to perform stabilizing function.

P=Poor - vegetation unable to hold banks or shore together under normal circumstances.

		<i>Vegetation Type</i>						
		Trees	Preferred Shrubs	Other Shrubs	Native Grasses Forbs	Introduced Grass	Disturbance Species	Weeds
<i>Riparian System</i>	Large River	E	G	P	P	P	P	P
	Small River	E	E/G	F/P	F/P	P	P	P
	Large Stream	E	E	F	F	P	P	P
	Small Stream	E	E	G	G	P	P	P
	Intermittent Stream	E	E	E	E	G/F	P	P
	Lake	E	E	G	G/F	P	P	P
	Wetlands	E	E	E	E	F/P	P	P



Maintain Biodiversity



- Water provides a more stable thermal environment than typical terrestrial ecosystems
- Aquatic and riparian vegetation acts as habitat and food source for a wide variety of organisms
- Vegetation provides shade and cover for organisms, particularly important for fish and invertebrates
- Act as movement corridors and breeding grounds, extremely important for migrating birds
- Many species at risk reside in wetlands
- Over 80% of wildlife depend on wetlands and riparian areas for food, cover, nesting and breeding sites, movement corridors, or resting sites at least once during their life cycle





Biodiversity



“Wetlands are home to over 600 species of plants and animals and are 2nd only to rainforests in the level of biodiversity that they harbour”

www.ducks.ca

- Prairie province wetlands provide habitat for approximately 50% of North American waterfowl
- Over 200 bird species (including 45 species of waterfowl) and over 50 species of mammals depend on wetlands for food and habitat
- 1/3 of Species at Risk listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) live in or near wetlands

http://atlas.nrcan.gc.ca/site/francais/english/learningresources/theme_modules/wetlands/index.html



Avian Biodiversity

Planet Earth
Fresh water –
46:12 - 48:18

- Wetlands provide water, food, cover and nesting habitat for a variety of prairie wildlife
- Small, shallow wetlands are accessible earlier in the spring, which provides early food sources for migrating waterfowl when large wetlands remain frozen
- Permanent wetlands are required for the rearing of young by most species of shorebirds, waterfowl and other waterbirds
- Saline wetlands are especially important to shorebirds



American Avocet



Piping Plover

In general, a mix of temporary, seasonal, and permanent wetlands, along with permanent upland habitat, provide the most productive wildlife and waterfowl habitats



Species at Risk



There are a number of species at risk that are dependent on wetlands:

- Western toad (*Bufo boreas*)
- Piping plover (*Charadrius melodus*)
- Western Silvery Minnow (*Hybognathus argyritis*)
- Northern Leopard Frog (*Rana pipiens*)





Species at Risk



Migratory bird species listed as at risk that are dependent on wetlands:

- Yellow Rail (*Coturnicops noveboracensis*)
- Whooping Crane (*Grus americana*)
- Horned Grebe (*Podiceps auritus*)
- Canada Warbler (*Wilsonia canadensis*)
- Rusty blackbird (*Euphagus carolinus*)
- Short-eared Owl (*Asio flammeus*)



http://fog.ccsf.cc.ca.us/jmorlan/yeraIMG_24261.jpg



<http://www.wilddelaware.com/wp-content/canada-warbler-13689.jpg>



Photo by: Timmy Hopwood



Fisheries Biodiversity



Freshwater marshes:

- Non-tidal marshes typically are dominated by floating plants, such as water lilies and duckweed, or soft-stemmed plants, such as cattails, arrowheads, reeds, and sedges
- As a general rule, the deeper the water in the marsh and the more of its hydrology is connected with lakes and rivers, the more likely the marsh is to support fish
- Freshwater marshes that fringe large water bodies, (i.e. Lac La Biche); provides spawning areas and a food source for other fish, such as Walleye, Northern Pike, and Yellow Perch



Plant Biodiversity



- Of Alberta's 1,775 vascular plants, about 250 grow in wetlands ($\approx 14\%$)
- Some rare vascular plants grow in wetlands (48)
- Many non-vascular plants (mosses, liverworts, hornworts) only grow in wetlands
e.g., *Sphagnum compactum*



Lycopodiella inundata
(Bog Club-moss)



Cypripedium acaule
(Stemless Lady's-slipper)



Pinguicula villosa
(Small Butterwort)



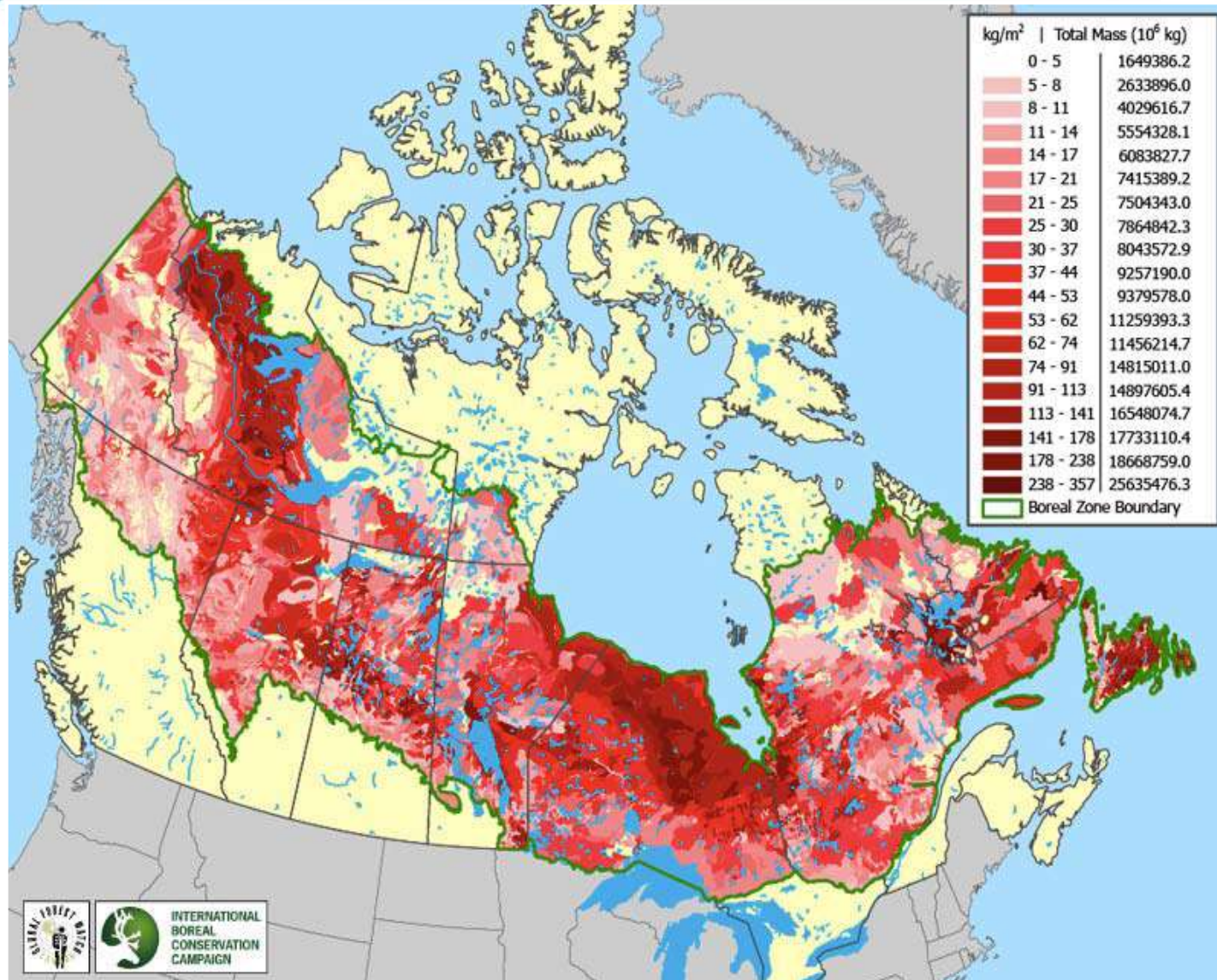
Malaxis paludosa
(bog adder's-mouth)



Drosera linearis
(slender-leaved sundew)



Carbon Storage in Peatlands (kg/m²)





“Ecosystem Services” - RAMSAR



Provisioning Services

Products obtained from wetland ecosystems:

- Food
- Fresh Water
- Fibre & Fuel
- Genetic resources
- Biochemical Products

Regulating Services

Benefits obtained from regulation of wetland ecosystem processes:

- Climate regulation
- Hydrological regimes
- Erosion Protection
- Reduction of Natural Hazard risk
- Pollution Control & Detoxification processes

Cultural Services

Material and non-material benefits obtained from wetland ecosystems:¹

- Spiritual & Inspirational
- Recreational
- Aesthetic
- Educational
- Historical Artifacts
- Traditional Livelihoods & Knowledge

Supporting Services

Services necessary for the protection of all other ecosystem services:

- Soil formation
- Nutrient cycling
- Primary production

¹. Note that “Cultural Services” includes material and non-material cultural values, benefits and functions (as identified in COPS DOC.15. *Cultural aspects of wetlands*).



The Future of Wetlands





Wetland Loss



- The world has lost half of its wetlands
- 25 million km² of wetlands in 1900
- Only 12.8 million km² left
- Wetlands provide billions of dollars worth of Environmental Services
 - \$12-47 billion in hurricane and flood protection by the Mississippi delta alone



<http://www.ducks.ca/assets/2012/07/post-120727-Need-to-Arrest-Wetland-Loss-is-Urgent-slider1.jpg>



Wetland Loss



- Rate of loss (0.5%/yr) is *higher than rate of loss of the Amazon rainforest* (0.4%/yr)
- The cost to restore ~350,000 hectares in SW Saskatchewan and Manitoba would be ~\$250 million
 - Amount of wetlands lost in last 40-60 years
- For every 10ha of wetlands destroyed in Manitoba, only 1ha was restored
- If wetlands are restored at a slower rate than they're destroyed, there is still a net loss

Wetland Modification and Losses

Activities encroaching on wetlands in Alberta:

- **Agriculture (85%)**
- Urban expansion (6%)
- Hydroelectric reservoirs (5%)
- Ports/harbors (3%)
- Forestry practices (0.02%)
- Peat harvesting (0.02%)
- Other (0.96%)



Photo Credit: Julie Robinson

<http://www.spillsorb.com/Oil%20Spill%20Absorbent%20%209%20Pea%20Moss%20Harvesting.htm>

Agricultural Impacts



Loss of wetlands since colonial settlement:

- 65% of Atlantic tidal and salt marshes
- 70% of the lower Great Lakes - St. Lawrence River shoreline marshes and swamps
- up to **71% of prairie potholes and sloughs**
- 80% of Pacific coast estuarine wetlands



Photo Credit: Julie Robinson



Photo Credit: Julie Robinson



City Encroachment



- Loss of wetlands in and around Calgary > 90%
- Integration of stormwater into natural or built wetlands
- Creation or protection of existing wetlands?
 - Current City of Calgary Wetland Conservation Plan emphasizes avoidance first
 - Calgary's urban expansion could impact 8,000 wetlands

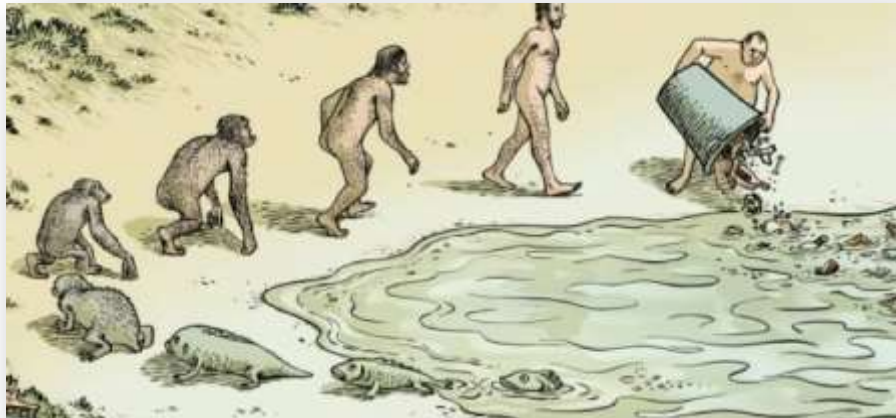




Result of Encroachment



- Wetland loss
- Habitat loss (biodiversity)
- Decreased flood mitigation
- Altered climatic regimes
- Impacted fisheries (coastal wetlands)
- Decreased water quality
- Loss of recreational areas





Effects on Wildlife



- During the late 1980's, the combined effects of years of drought, agricultural drainage, and loss of upland nesting habitat reduced populations of some waterfowl to less than half their historical average
- However, since the mid-nineties, above average precipitation and run-off have raised water levels and increased the number of wetlands



(U.S. Fish and Wildlife Service)



Common Goldeneye

Combined with on-going habitat conservation, the result is increasing populations of waterfowl and wetland wildlife.



Industrial Impacts



Photo Credit: Julie Robinson

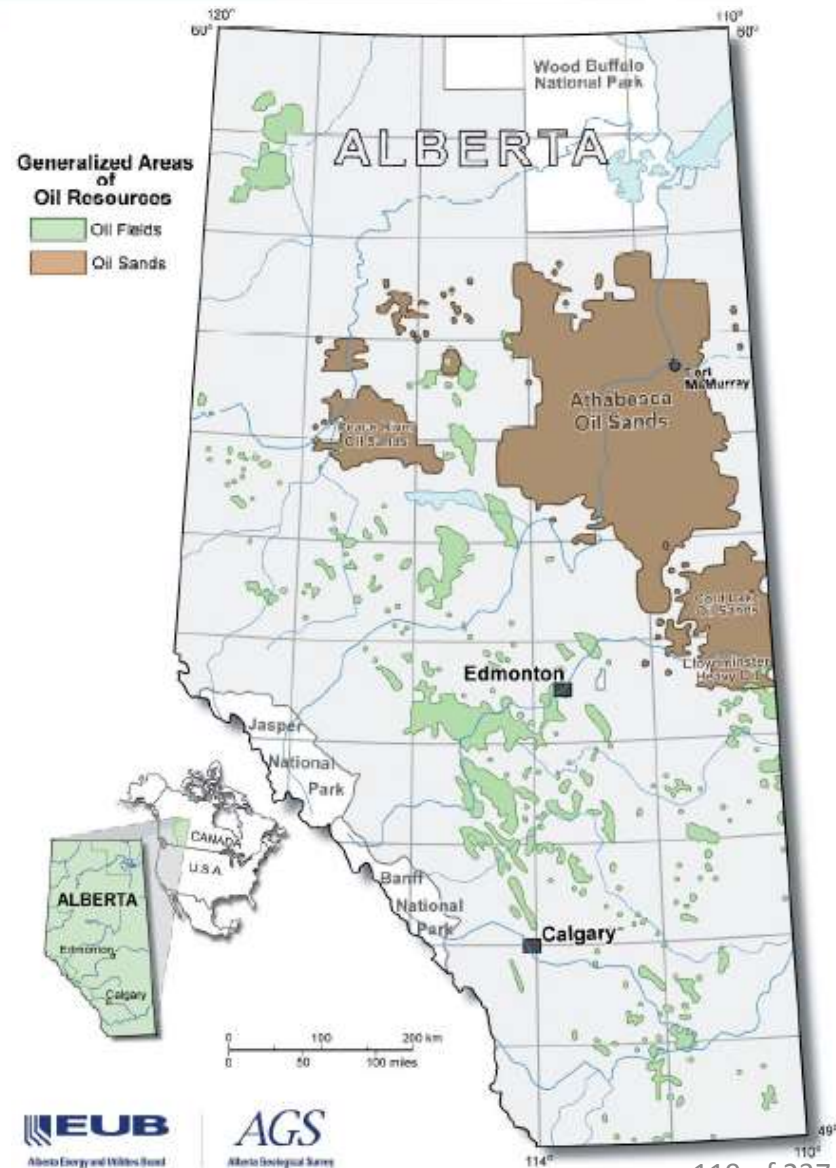


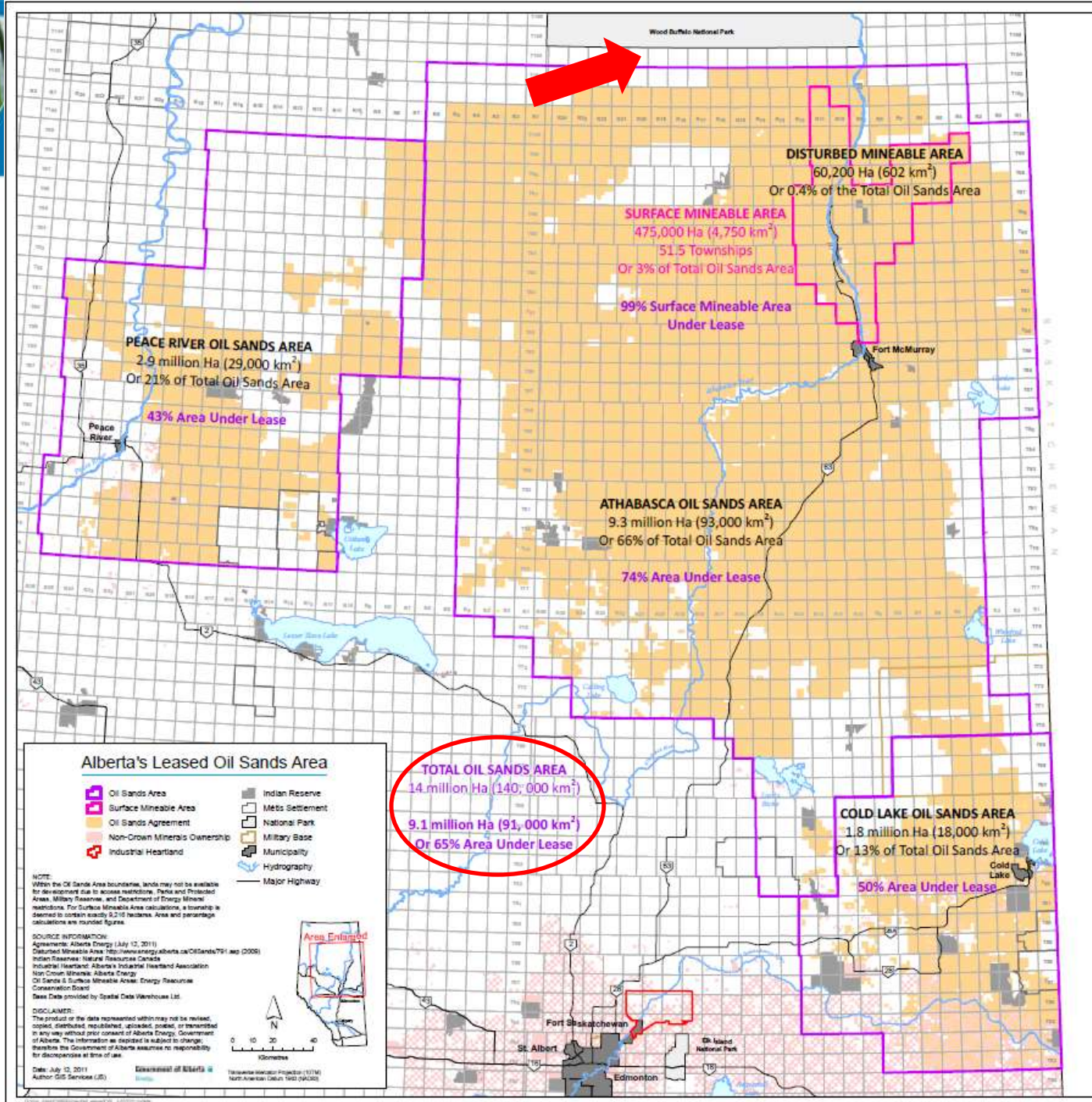


Example: Alberta Oil Sands



- The province's total oil production in 2013 was 974 million bbl.
- Since 1967, Alberta has produced about 9.63 billion bbl of raw crude bitumen from oil sands.
- Conventional oil from fracking produces 556,000 barrels per day
- Employment between 2000-2020 is approximately 174,000 full-time positions earning an estimated \$187 billion dollars
- Oil sands production generates 1.5-3X the amount of global warming pollution as conventional oil production





July 12, 2011



Alberta Oil Sands



- Open pit mines convert Boreal forest to polluted land with mining wastes, tailings ponds and destroy peatlands
- Industrial oilsands development is causing habitat fragmentation and affecting peatland-dependent species
- In 40 years, only 104 hectares have been certified as reclaimed by AESRD¹
- Reclamation concerns are based on the fact that highly complex forest and wetland ecosystems are unlikely to regenerate in areas filled with mine waste

1. March 19, 2008 Syncrude Canada



<http://priceofoil.org/2010/09/15/utah-approves-americas-first-tar-sands-mine/>

Reclamation professionals are faced with **challenges** including:

- Isolating damaging chemicals
- Elevating of soil layers
- Installing under-drains to evacuate salty water
- Finding a tolerant subset of plants that can persist in these conditions

Compaction



- Compaction of wetland soils is also a result of industrial activity



Photo Credit: Dave Noseworthy AESRD

Compaction



Photo Credit : Dave Noseworthy AESRD

What could have been done here to minimize impact?



Impacts of Climate Change on Wetlands



- Expansion of undesirable plant species
- Growth of harmful bacteria, e.g., *botulism* bacterium
- Loss of flora and fauna dependent on wetlands, e.g., some orchids, waterfowl, salamanders, etc.
- Positive feedback to climate change due to loss of peat from peatlands
- Increased fire frequency
- Disappearance of wetlands altogether, etc...



Lythrum salicaria (purple loosestrife)

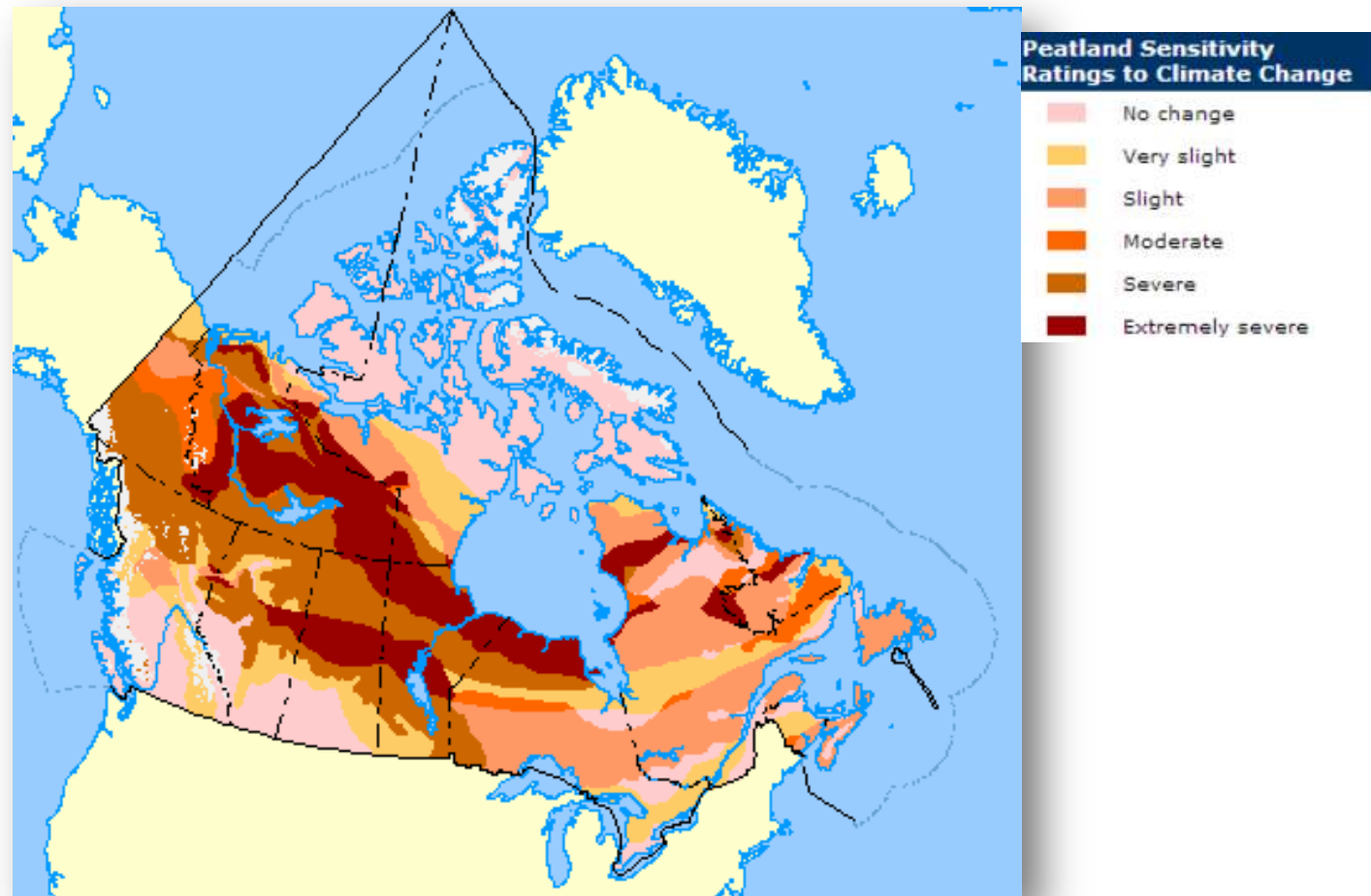




Peatland Sensitivity Ratings to Climate Change



About **60% of peatlands** in Canada are hypothesized to be severely affected by climate change (mostly in permafrost regions)





Enforcement Examples and Penalties

2010 - 2013



Enforcement Example



December 18, 2012

- John Fehr and Kevin Locke fined **\$1,800** each
- Charged for damaging fish habitat
 - Were caught driving their jeeps *in* Carbondale River, which is fish spawning habitat
- Creative sentencing:
 - Most of the money will be paid to Trout Unlimited Canada to fund conservation efforts



<http://media.cmgdigital.com/shared/img/photos/2013/04/17/f8/e8/JeeplnWater.jpg>



Enforcement Example



January 29, 2013

- McColman & Sons Demolition Ltd. fined **\$20,000**, and ordered to pay costs of remediation, an estimated **\$1.85 million**
- Charged under *EPEA* for knowingly operating a landfill without registration, **and**
- Charged under the *Water Act* for conducting an activity related to the destruction of a wetland
- Creative Sentencing:
 - Ordered to remove all waste from the site
 - Address adverse environmental consequences
 - Stop order prevents using the site as a landfill for 3 years



Enforcement Example



June 1, 2010

- Quartz Land and Developments Ltd. fined **\$38,000** plus **\$42,000** to Ducks Unlimited Canada
 - Mark MacNaughton, director, also fined \$3,000
- Charged under the *Water Act* for commencing and continuing an activity without proper approval
 - Three wetlands (1.4 ha total) were impacted
- Ducks Unlimited Canada funds used towards a wetland restoration project near Stettler, AB



Enforcement Example



May 16, 2011

- JOVNIC Ltd. fined **\$200,000**
- Charged under the *Water Act* for removing vegetation from a water body, placing fill on site, and realigning a water body without proper approval in the City of Edmonton
- Creative Sentencing: \$180,000 paid to the University of Alberta
 - to fund research on Lake Sturgeon populations in the North Saskatchewan River

Enforcement Example

January 26, 2012

- Shadow Creek Resort Inc, c/o R.J. Williscroft Contracting Ltd. fined **\$91,000**
- Pleaded guilty to one count of a violation of subsection 35(1) of the *Fisheries Act* for the harmful alteration, disruption or destruction of fish habitat.
- Conducted work prior to receiving approval and damaged Northern Pike habitat
- Payments to the Environmental Damages Fund will be used to hire an environmental consultant to find ways to enhance fish habitat near the inland marina and conduct a monitoring project.

Enforcement Example



October 11, 2012

- Enforcement order issued against Daniel and Katherina Fehr
- Issued under the *Water Act* for unauthorized alteration of a watercourse
 - They were using a backhoe to alter watercourses on their property multiple times
- Investigation was in response to a public complaint; damage assessment is ongoing





Enforcement Example



March 12, 2013

- Dale Andrew Mather fined **\$20,000**
- Charged under the *Water Act* for willfully altering the shoreline of Gull Lake
 - Removed aquatic vegetation to “improve the view” from his property
- Creative sentencing:
 - \$ 15,000 paid to the Gull Lake Water Quality Management Society to fund their Streambed Improvement Project

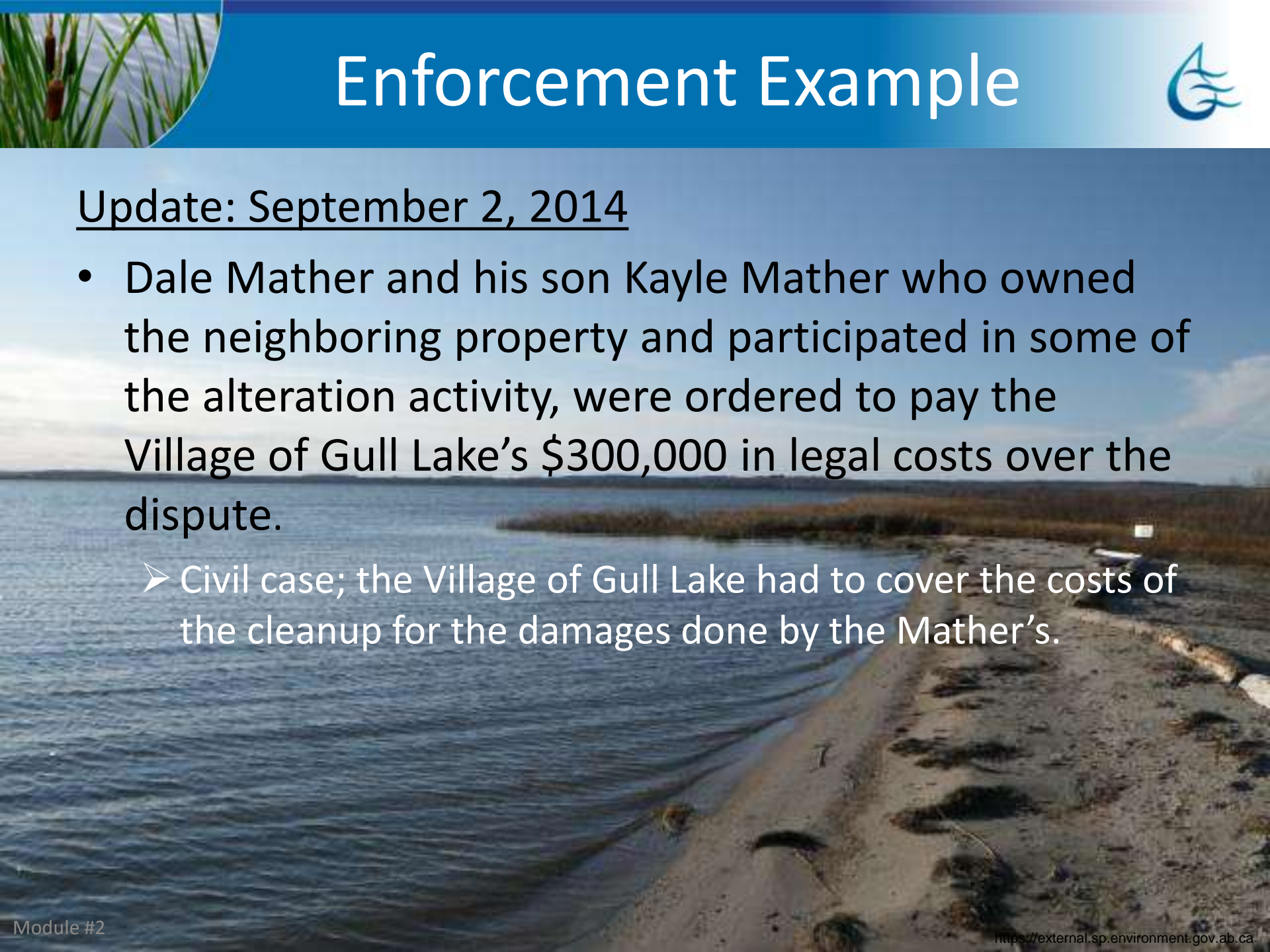


Enforcement Example



Update: September 2, 2014

- Dale Mather and his son Kayle Mather who owned the neighboring property and participated in some of the alteration activity, were ordered to pay the Village of Gull Lake's \$300,000 in legal costs over the dispute.
 - Civil case; the Village of Gull Lake had to cover the costs of the cleanup for the damages done by the Mather's.





Enforcement Example



July 10, 2013

- Stephen Brown of Brownstone Environmental Services Ltd. fined **\$10,000**
- Charged under the *Water Act* for creating a FALSE Temporary Diversion Water Licence
- Creative Sentencing:
 - \$9,000 will be paid to the RiverWatch Institute of Alberta to fund the purchase of a new raft used for education purposes



Enforcement Example



December 23, 2013

- SemCAMS ULC pled guilty and was sentenced to a fine of **\$200,000**
- \$125,000 to be paid into the Environmental Damages Fund, \$60,000 to go toward the LakeWatch Program (ALMS) and a fine.
- On or between August 7, 2010 and August 9, 2010, at or near the Town of Fox Creek they:
 - did deposit or permit the deposit of a deleterious substance of any type in water frequented by fish or in any place under any conditions where the deleterious substance or any other deleterious substance that results from the deposit of the deleterious substance may enter any such water in violation of subsection 36(3) of the Fisheries Act, R.S.C., 1985, c. F-14, as amended, and thereby did commit an offence under subsection 40(2) of the said Act.



Enforcement Example



December 5, 2013

- Cenovus Energy Inc. fined **\$252,385**
- Charged under the *Water Act* for diverting water from ten (10) unlicensed water bodies/sources between December 1, 2010 and February 1, 2011.
- Sections 142(1)(n) and 49(1) of the *Water Act*



Summary



- Wetlands are primarily located in the northern hemisphere, with Canada and Russia having the largest areal wetland expanses
- 17% of Alberta's landbase is covered by wetlands; most wetlands are fens
- There are numerous classes of wetlands in Canada, depending on which classification system you are using
- Wetlands differ based on biogeochemical characteristics, which are heavily influenced by hydrology
- Wetlands perform a myriad of functions, ranging from improving water quality, mitigating floods, storing carbon, influencing local and regional climate, providing wildlife habitat and recreational opportunities, treating wastewater, providing food and shelter, etc.
- Wetlands have been and continue to be undervalued and are under constant threat from human and natural disturbances, including drainage, resource exploration and extraction, wildfire, and climate change associated impacts

Other Resources



Aquality's Wetland Policy Website:

<http://wetlandpolicy.ca/>

<http://albertawetlands.ca>

Aquality's Riparian Policy Website:

<http://riparianpolicy.com/>



<http://www.facebook.com/AqualityEnv>



<https://twitter.com/AqualityEnv>



Thank you!

Questions?



http://www.ramsar.org/pictures_2011/wwd2012/humedales_3_ingles.jpg