

Deteriorating Beaches: Are People or is Nature to Blame?

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Environment
Canada

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Canada



Dry Beaches & Wet Beaches



- dry sand at surface
- sand dunes present
- no water on surface
- little/no vegetation
(only beach grass)



- wet sand at surface
- flat beach; no dunes
- often water on surface
- lots of vegetation
(invasive plants)

Objectives

- (1) Are there hydrogeological or physical differences between dry and wet beaches?
- (2) Are the deteriorating physical and water quality conditions caused by natural events or human actions?
- (3) Can deteriorated/wet beaches be restored?

Location



Methods: Field



Results

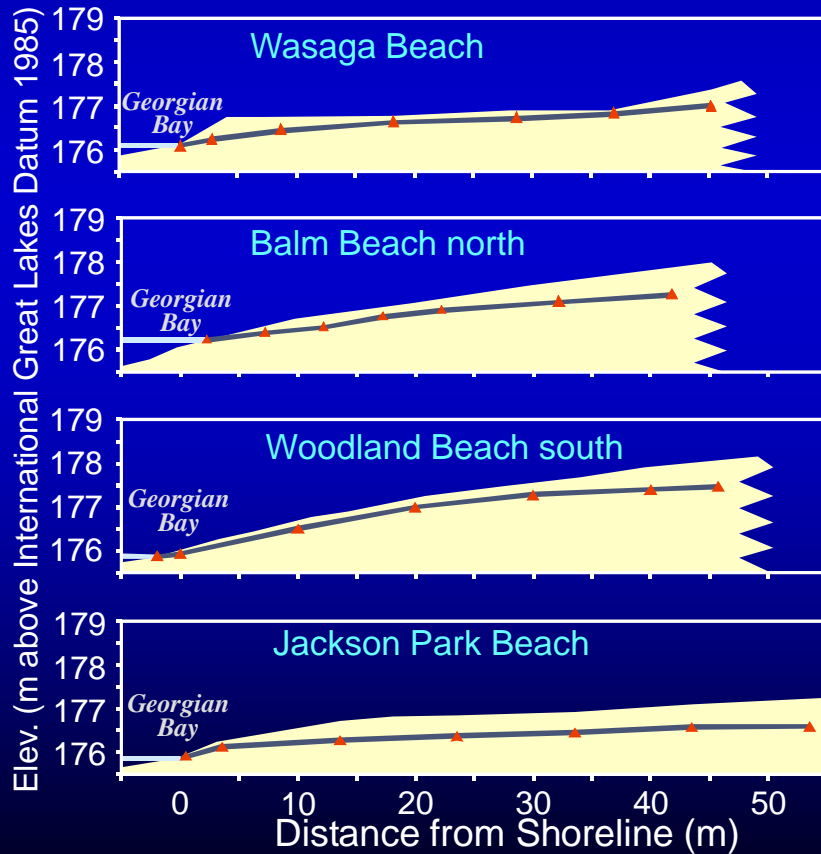
Two main physical/hydrogeological factors controlling dry vs. wet beaches:

(1) depth to the water

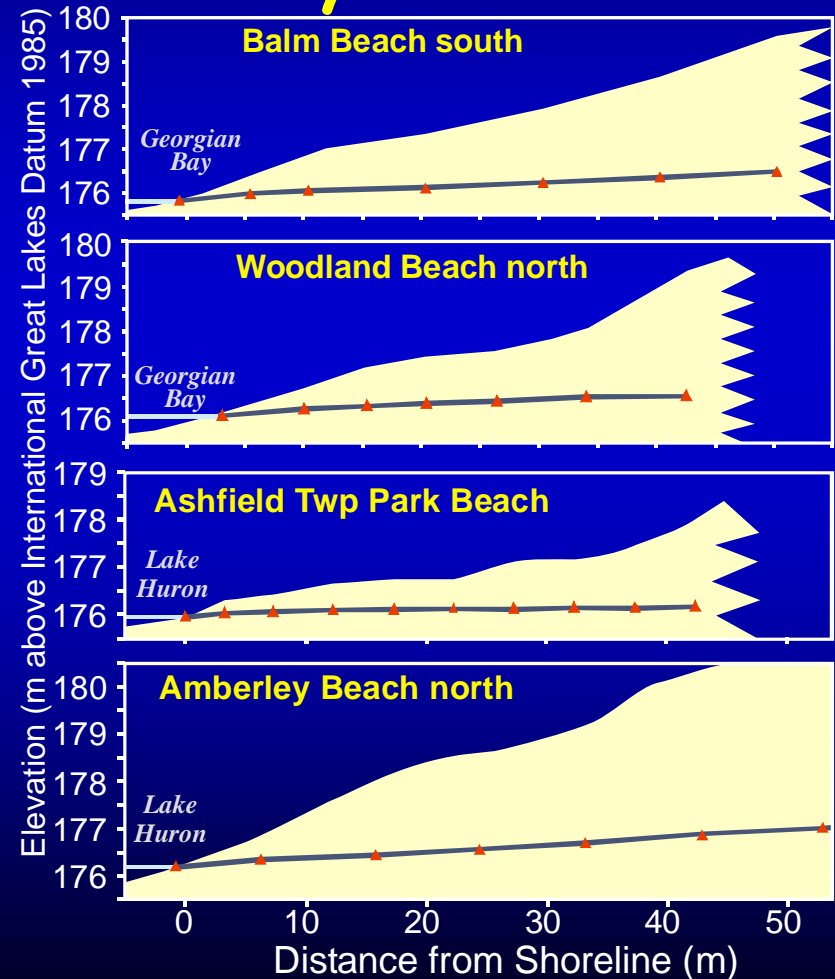
(2) grain size of beach sand

Results: Depth to the Water Table

Wet Beaches



Dry Beaches



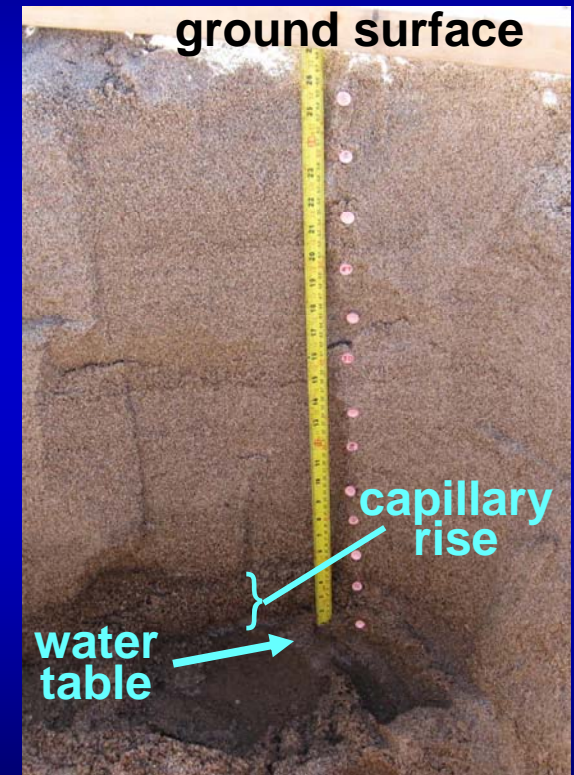
Results: Depth to the Water Table

deep water table:

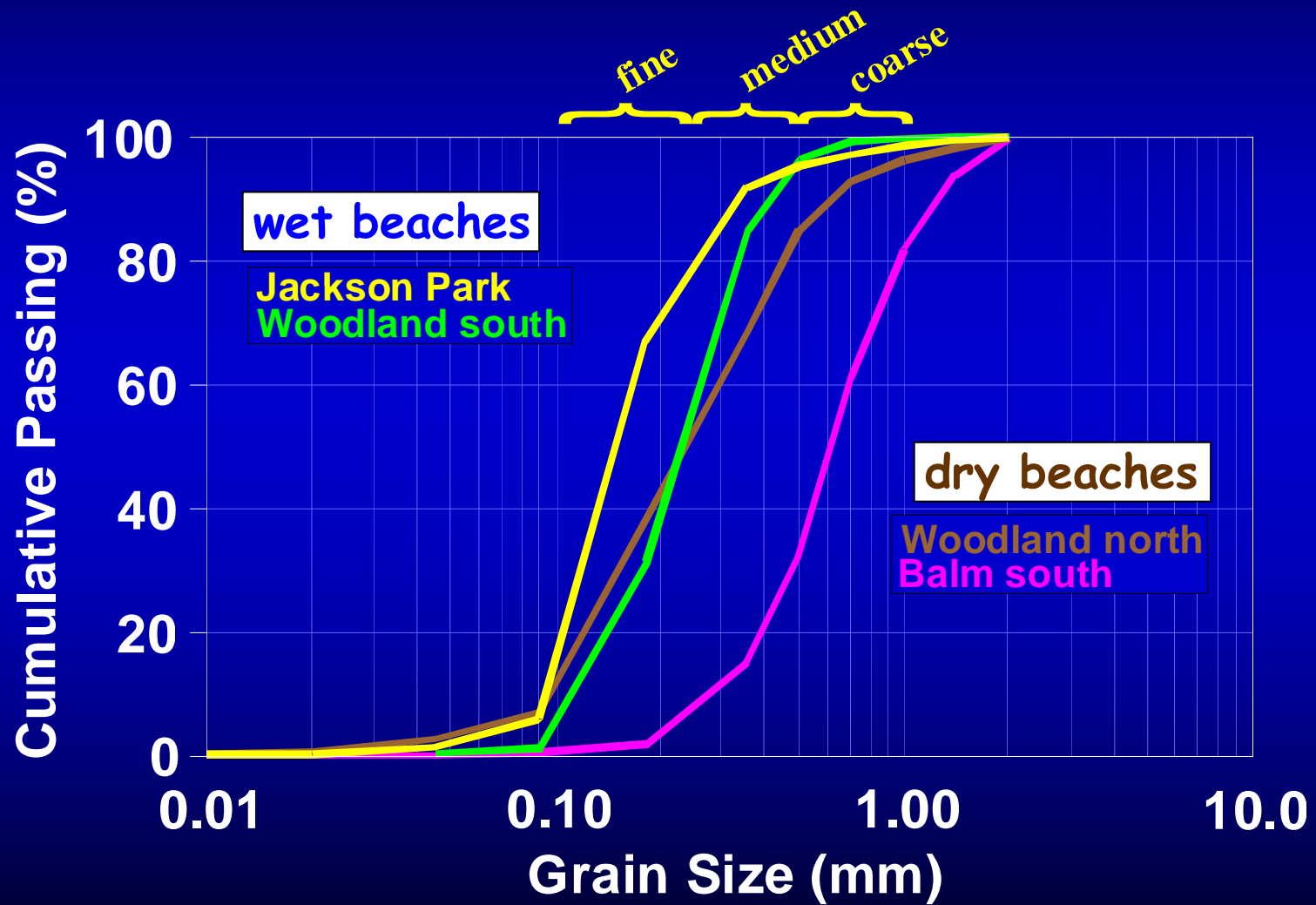
- saturated sand below w.t. and in capillary rise is well below surface
- i.e., wet sand not close to surface

shallow water table:

- saturated sand below w.t. and in capillary rise is close to surface
- i.e., wet sand close to surface



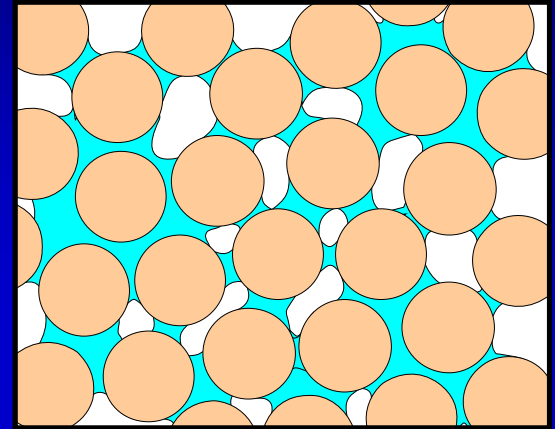
Results: Grain Size



Results: Grain Size

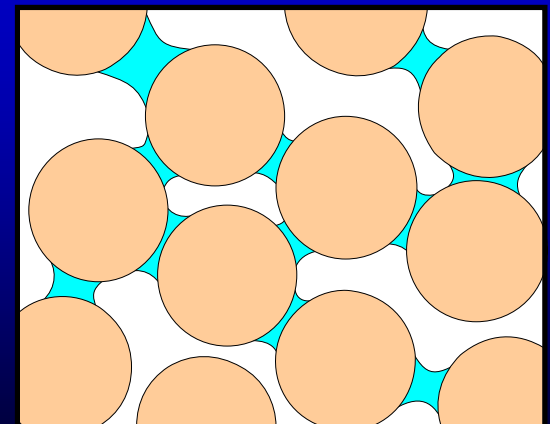
fine sand has small pores:

- retains water by capillary forces
- lots of water at residual saturation
- larger capillary rise above w.t.

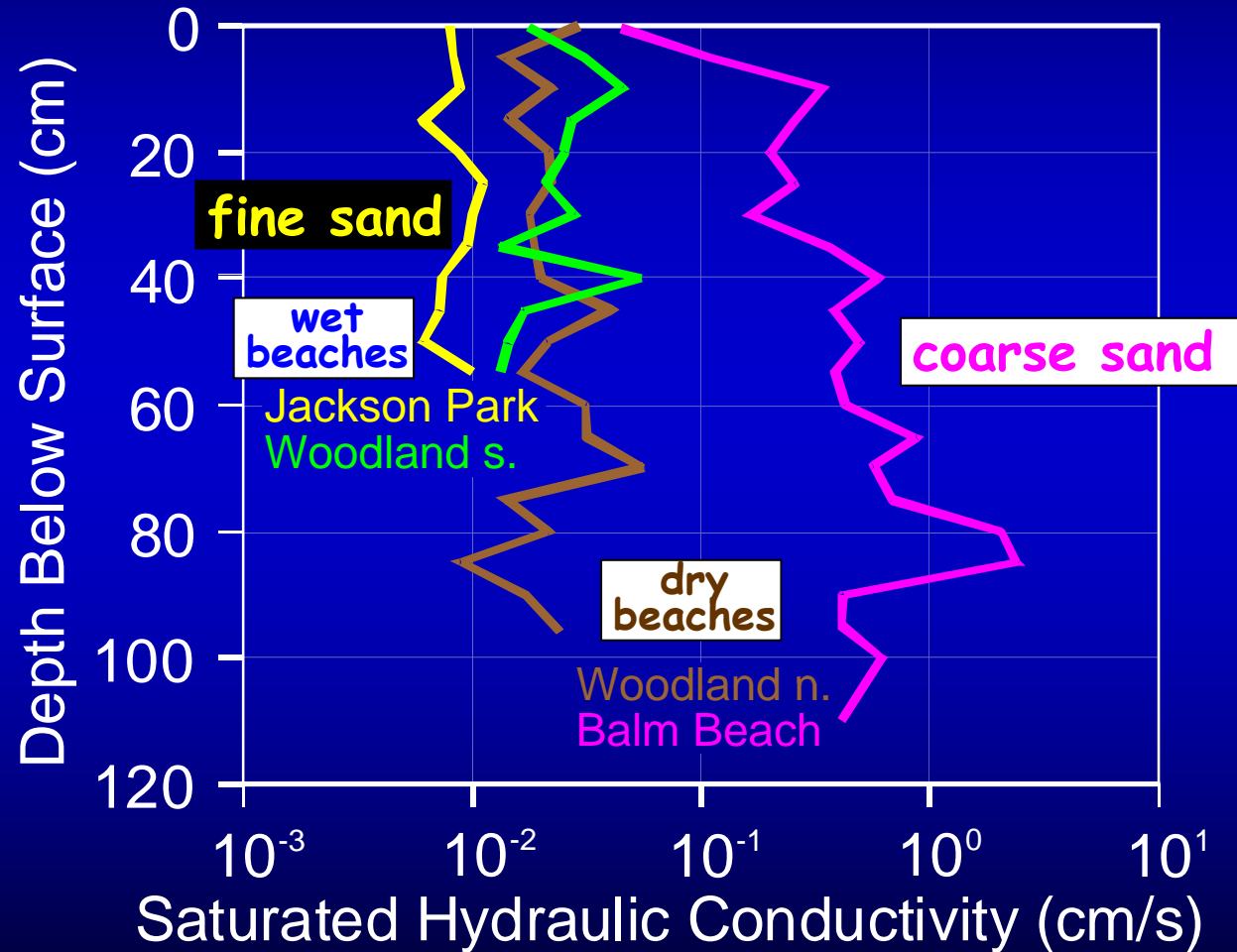


medium-coarse has large pores:

- low capacity to retain moisture
- little water at residual saturation
- smaller capillary rise above w.t.



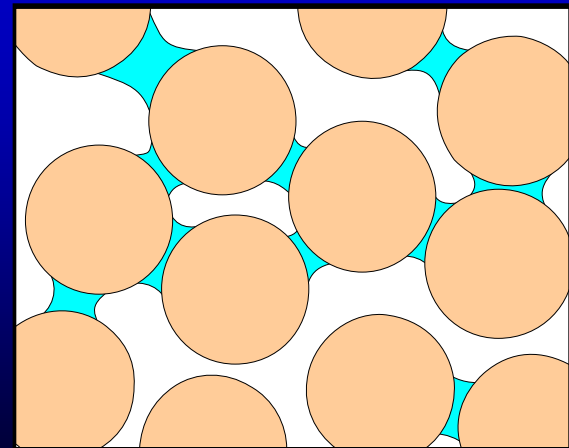
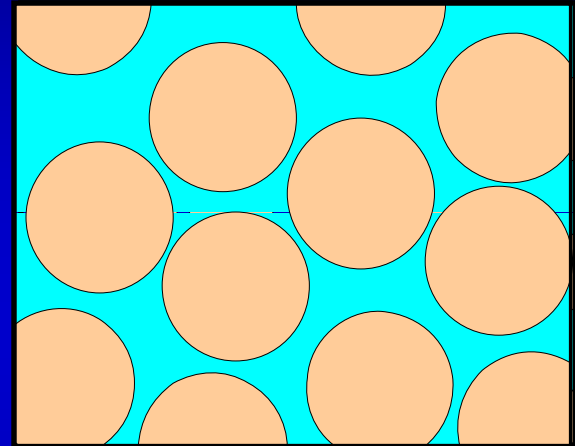
Results: Grain Size



Results: Grain Size

but hydraulic conductivity is a function of both:

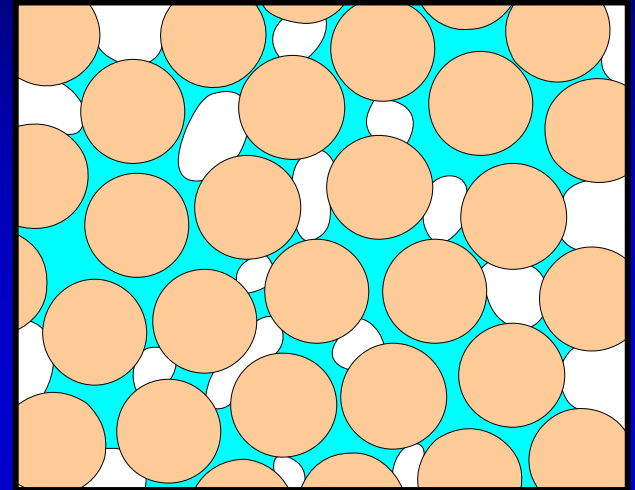
- grain size
- % saturation of pores and connectivity of sat. pores (less water content = lower K)



Results: Grain Size

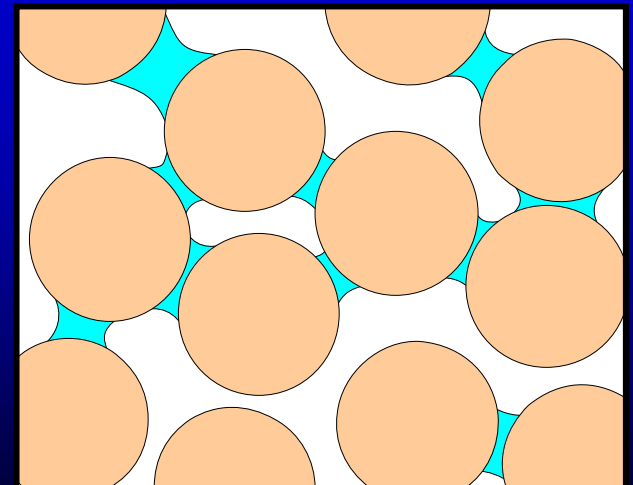
fine sand has small pores:

- lower hydraulic conductivity
- lots of water in sand
- therefore more infiltration

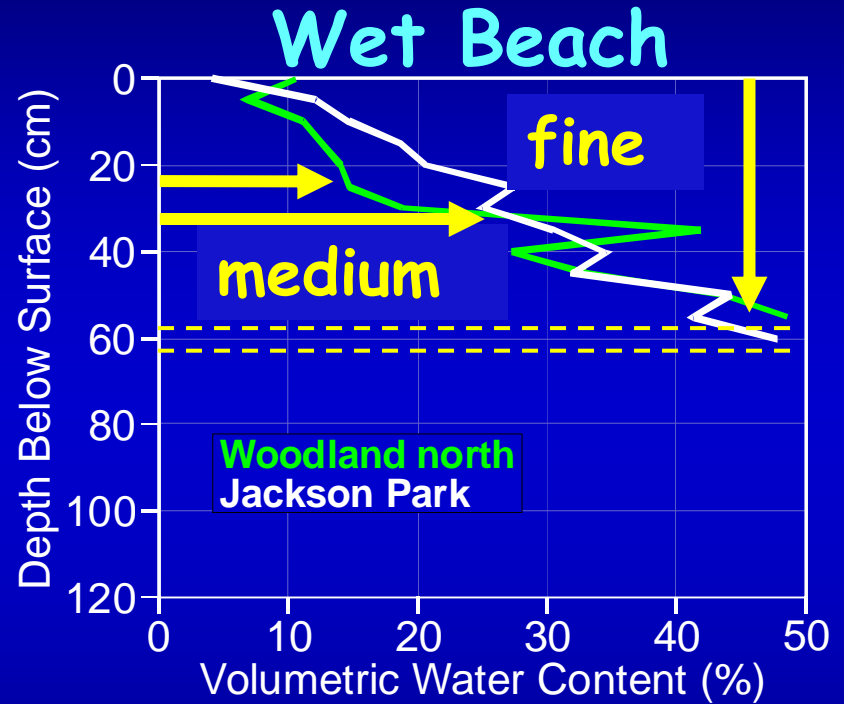
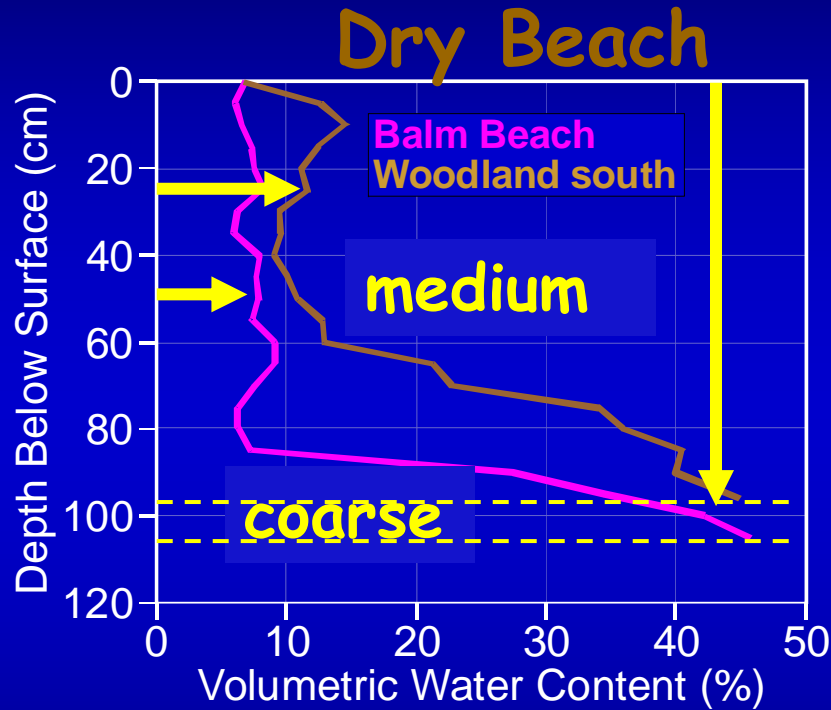


coarse has large pores:

- higher hydraulic conductivity
- little water in sand
- therefore less infiltration



Results: Water Table + Grain Size



$$\text{Volumetric water content} = \frac{\text{vol. water}}{(\text{vol. water} + \text{vol. sand} + \text{vol. air})}$$

water table
grain size



% moisture content

Physical & Hydrological Characteristics of Dry & Wet Beaches

Dry Beach: coarse sand or deep w.t.

- Balm Beach: coarse sand, deep w.t.
- Woodland north: medium sand, deep w.t.
- Ashfield Twp: coarse sand-gravel, ~shallow w.t.

Wet Beach: fine-medium sand and/or shallow w.t.

- Jackson Park: fine sand, shallow w.t.
- Woodland south: medium sand, shallow w.t.
- Wasaga Beach: fine sand, shallow w.t.

Deteriorating Beaches

type of vegetation relates to type of beach



Dry Beach:

- lots of moisture in sand above w.t.
- plants adapted to dry conditions



Wet Beach:

- little moisture in sand above w.t.
- just about any plant will grow

Impact of Nature: Low Lake Levels?

expose more of lake bed = a wider beach

but impact depends on:

- dunes vs. flat beach
- if beach grass is present



Impact of Low Lake Levels

no dunes + no beach grass = problem

- loss of sand - no beach grass to hold sand
- maintain shallow water table and **WET BEACH**



Impact of Low Lake Levels

dunes + beach grass = less problem

- beach grass holds sand
- dunes and beach grass migrate towards lake with receding shoreline
- maintain deep water table and **DRY BEACH**



Impact of People? Beach Alteration

remove sand dunes
and beach grass

lower ground surface

promote shallow w.t.

leads to wet beaches

wet conditions for plants



Impact of People? Lawns

removed dunes/sand

plant lawns next to beach



grass will get on to beach

Impact of People

turf
will a

gee
sou



leads to *E. coli* in
lake water & sand

Can Beaches be Restored?

if "wet" is the natural state of the beach . . .

DO NOT try to alter it



wet cobble beach



wet sand beach

Can Beaches be Restored?

if beach is a "degraded" beach" . . .

In some case . . . **NO**

- may need to remove all vegetation and sand
- decaying organic matter reduces size of pores



Can Beaches be Restored?

restoring former dunes **YES** and beach surface will form a dry beach (increase w.t. depth)



small elev. change

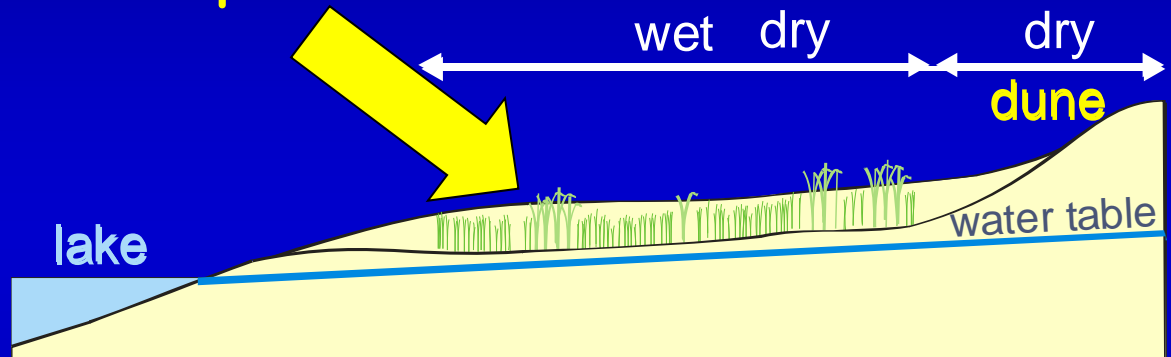
beach grass dry sand

other plants damp sand

Increase Depth to Water Table



shallow water table



restore former ground surface (e.g., add about 30 cm of coarse sand)

Summary

Physical - hydrogeological characteristics control whether a beach is "Wet" or "Dry".

Low lake levels have limited impact on deterioration of beaches; most problems caused by inappropriate actions by people.

Deteriorated beaches (formerly dry, now wet) can be restored.

QUESTIONS?

