Sand and Gravel Quarries of Western WA

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By

Kelly H.

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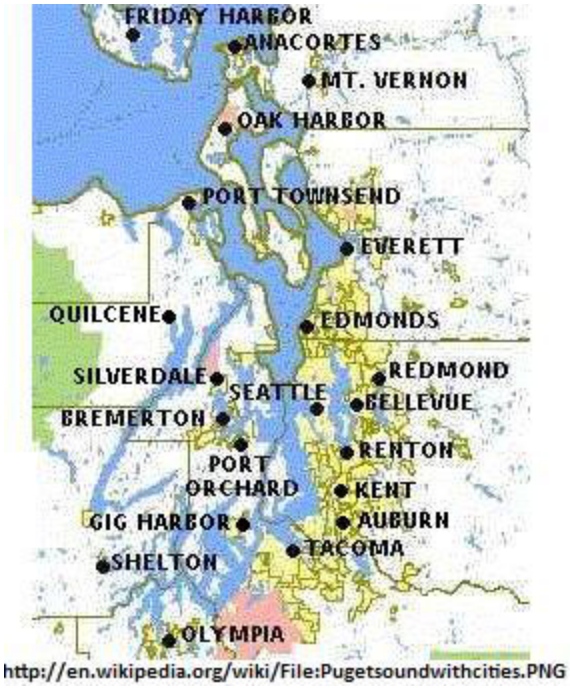
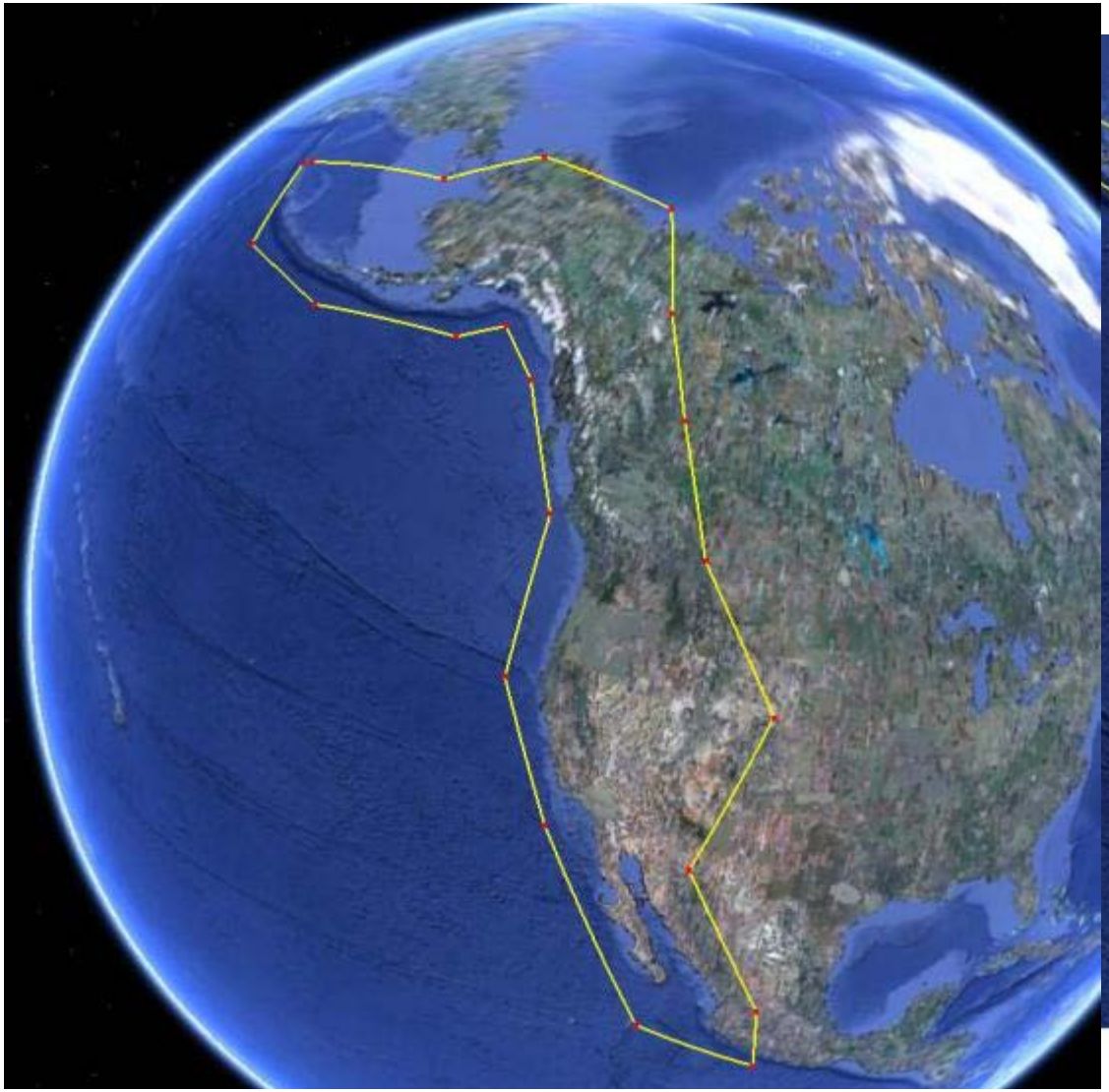
Puget Sound – A little perspective

- Stretches from Anacortes to Olympia (more or less)
- Is a fjord (fee-YOURD). Meaning a long, narrow inlet with steep sides, created in a valley carved by glacial activity.
- Part of a larger physiographical structure termed the Puget Trough



http://en.wikipedia.org/wiki/File:Pugetsoundwithcities.PNG

Larger Features

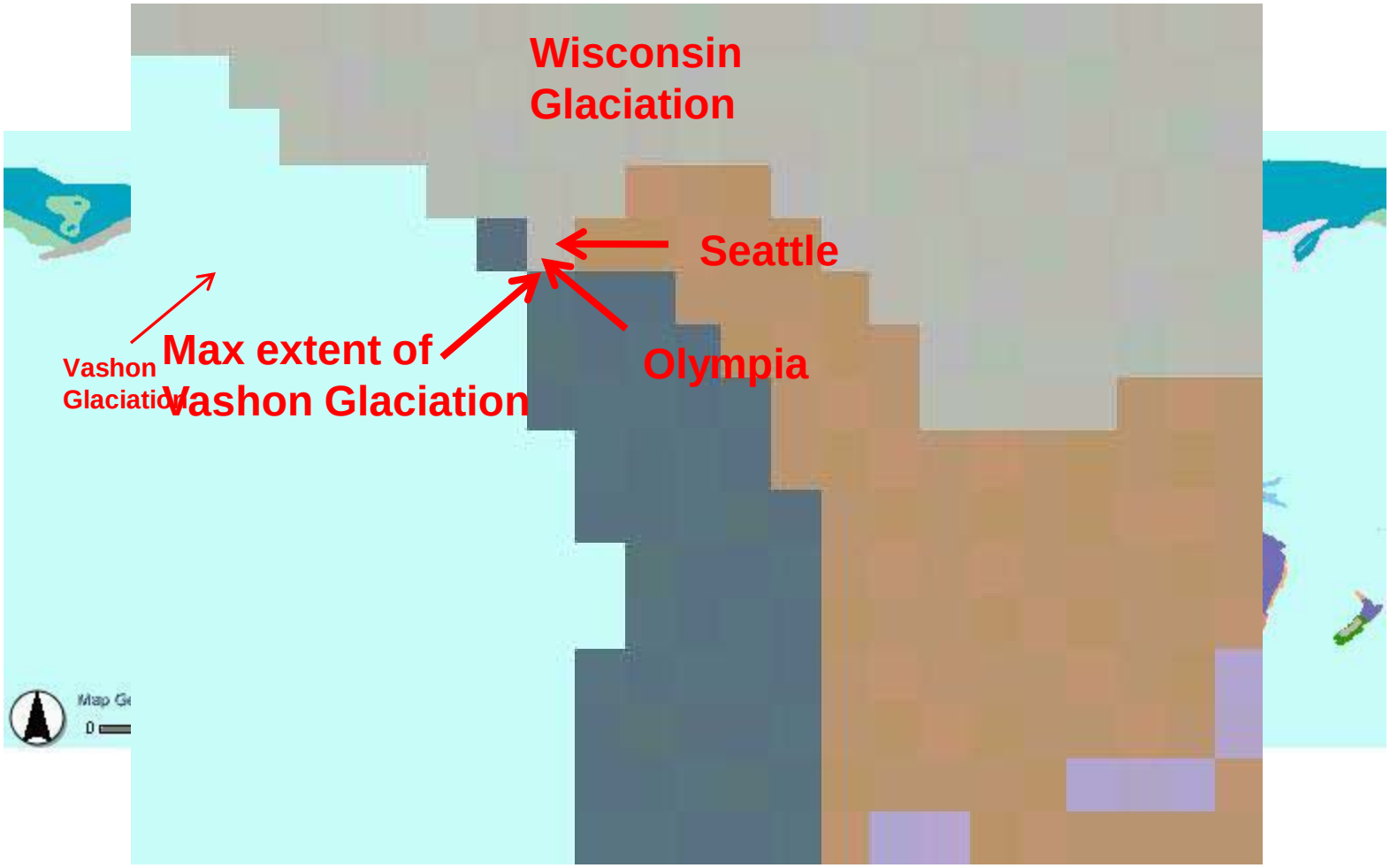


Wisconsin Glaciation

- Last Glacial Period: began about 110,000 years ago (ybp = years before present), ended 10,000 to 15,000 ybp.
- Maximum extent occurred about 18,000 ybp

- Vashon Glaciation
  - Advanced into Washington about 18,000 years ago
  - Receded 10 – 12,000 years ago

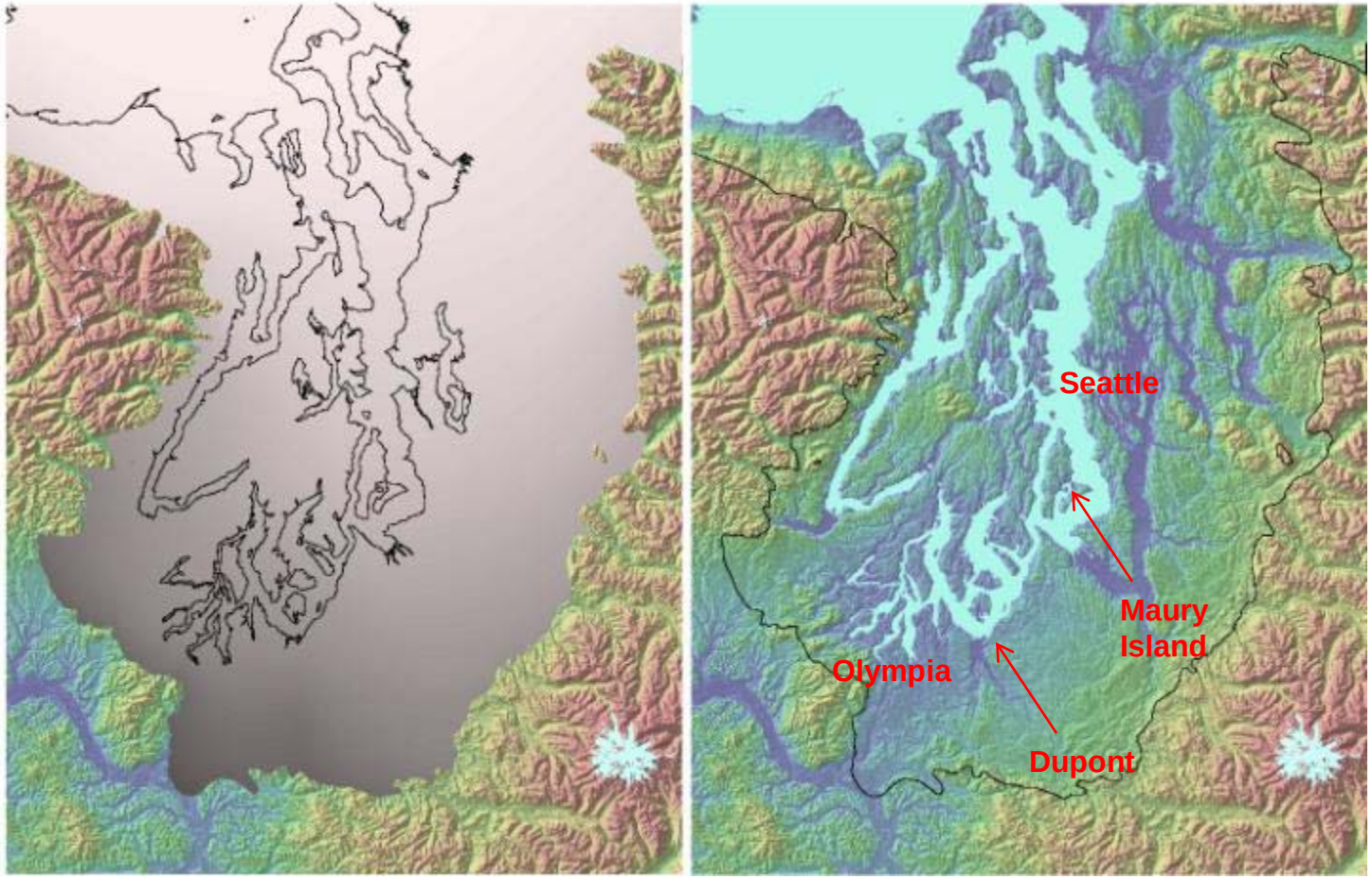
Vashon vs Wisconsin Glaciation



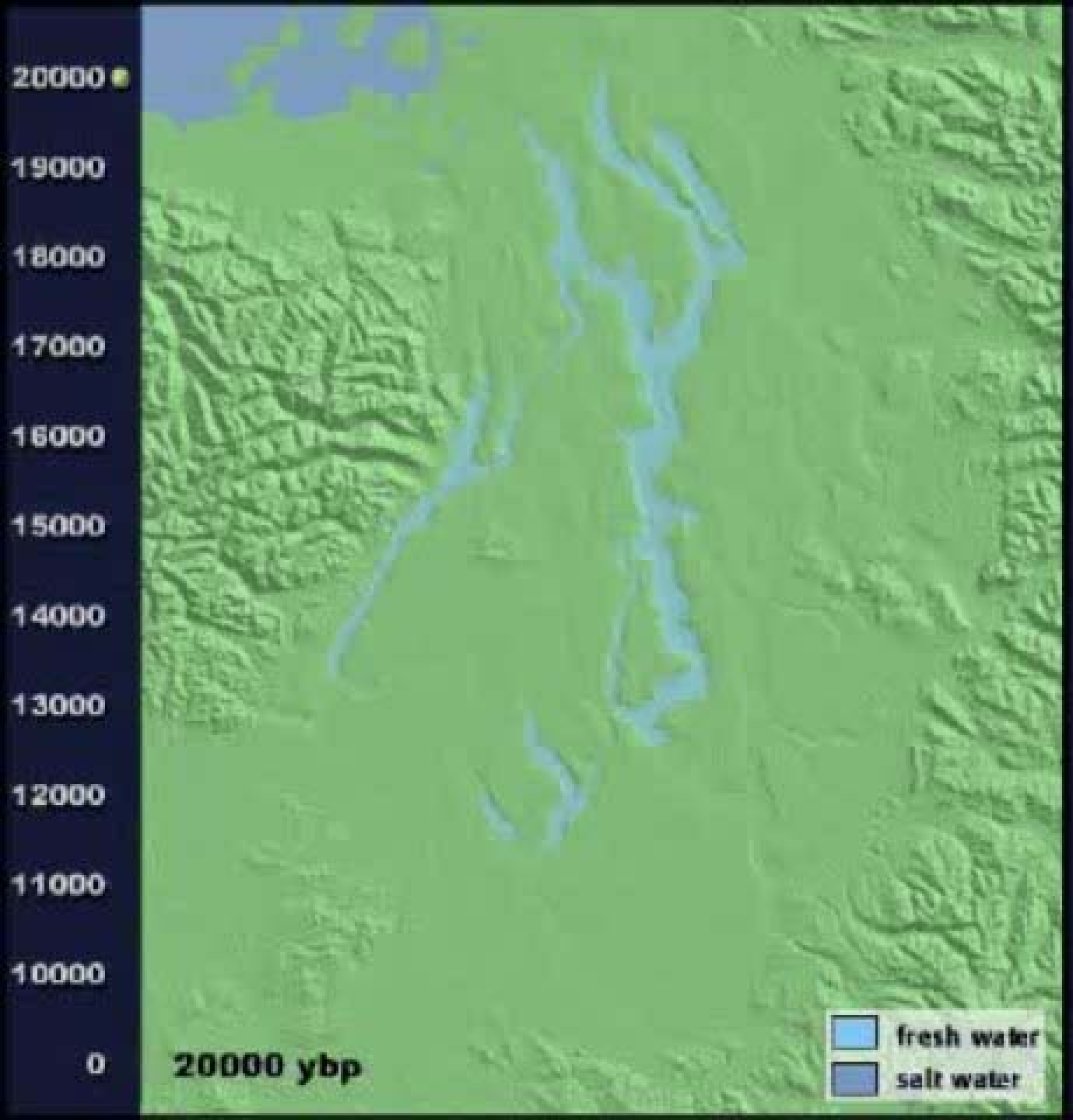
Extent of Glacial Advance

13,000 years ago

Present day



http://duff.geology.washington.edu/mdbrg/mdbrg/areas/Puget_Lobe/index.html



Reconstructing the last (Vashon) continental glaciation of the Puget Lowland

Ralph Haugerud,
Harvey Greenburg

Sometime around 20,000 calendar years before present (ybp), ice from the Coast Mountains of British Columbia began filling the Fraser Lowland. The Puget Lobe of the ice sheet reached the US border after 19,000 ybp, Seattle about 17,000 ybp, and its farthest south extent (just south of Olympia) at about 16,900 ybp. The ice front then retreated even more rapidly than it advanced, and Seattle was ice-free by about 16,400 ybp. By about 15,000 ybp the ice front was again back at the border.

Where to find rocks

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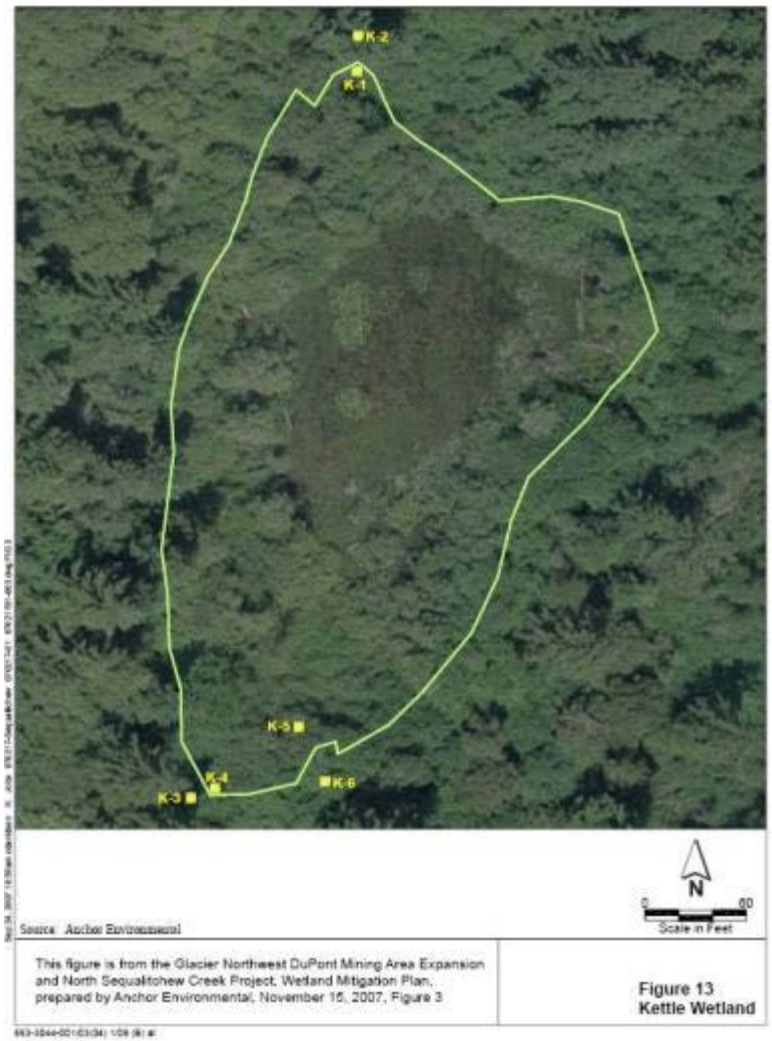
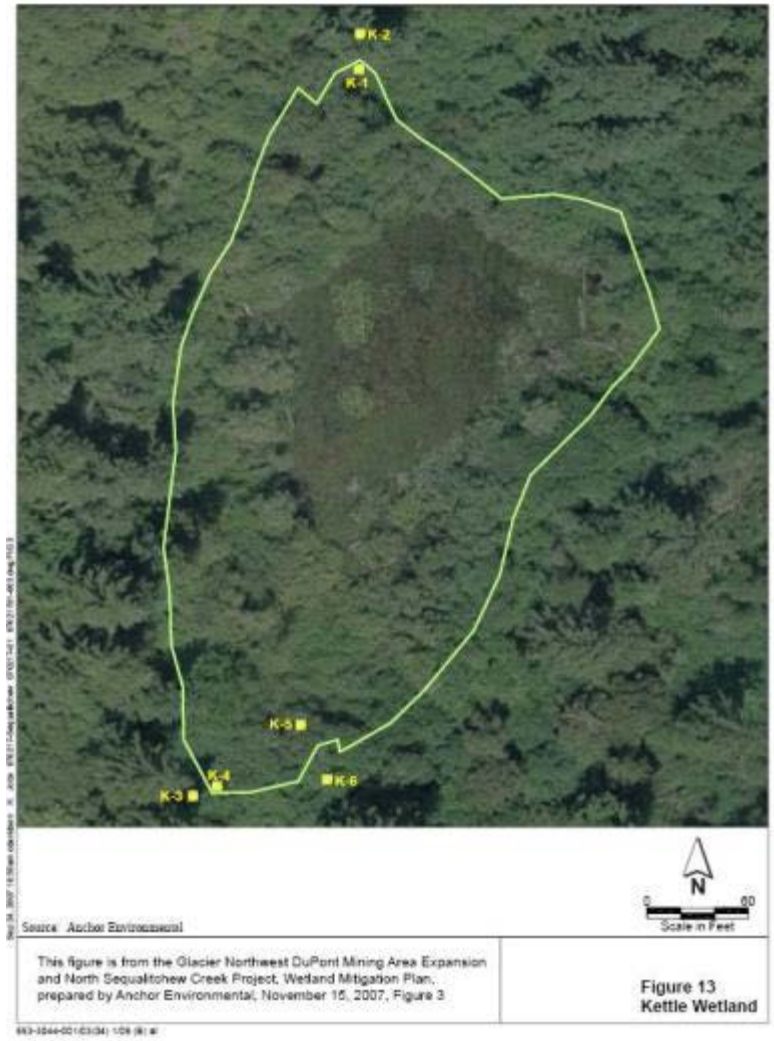


http://www.ci.dupont.wa.us/files/library/f6d6dcacc6577ce3_o.pdf

Where to find rocks

- Basically any where around here.
- Sand and gravel is abundant from Bellingham to Olympia and North Bend to Lilliwaup.
- For sand and gravel to be useful for engineering purposes size IS important.



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Hjulstroin Diagram

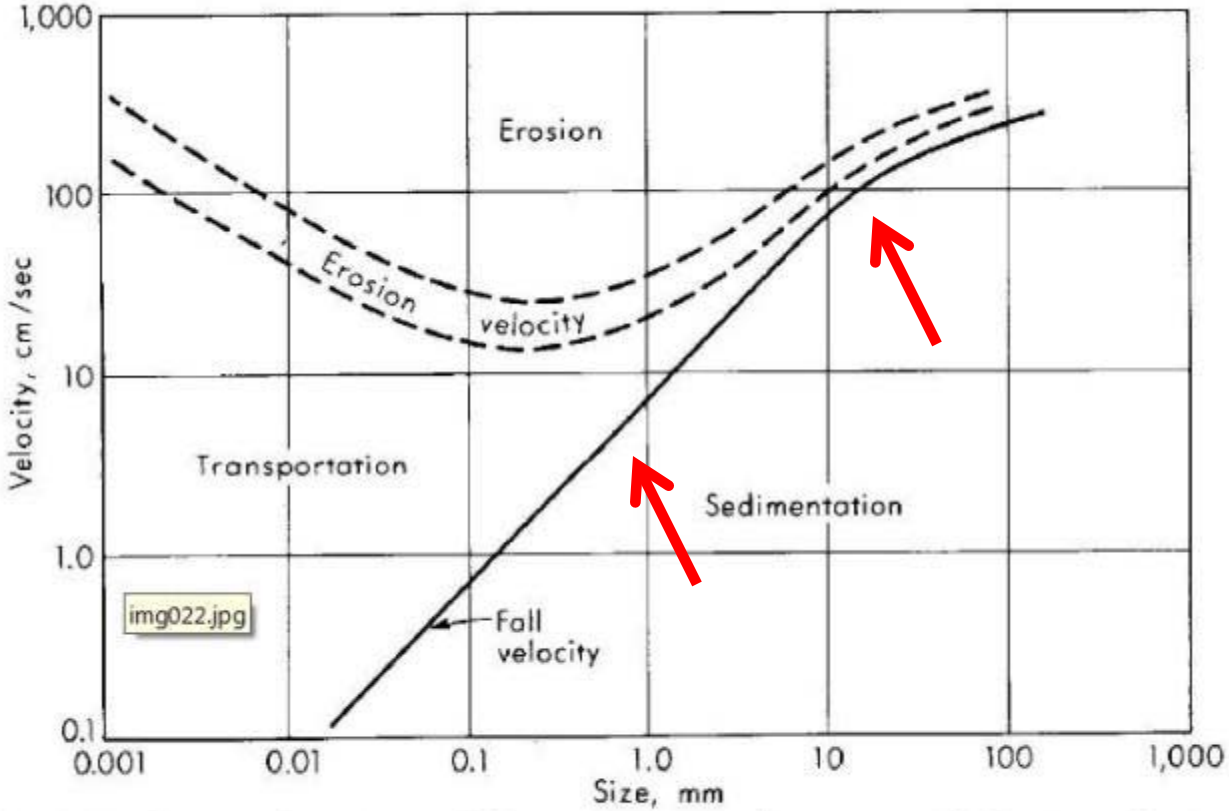
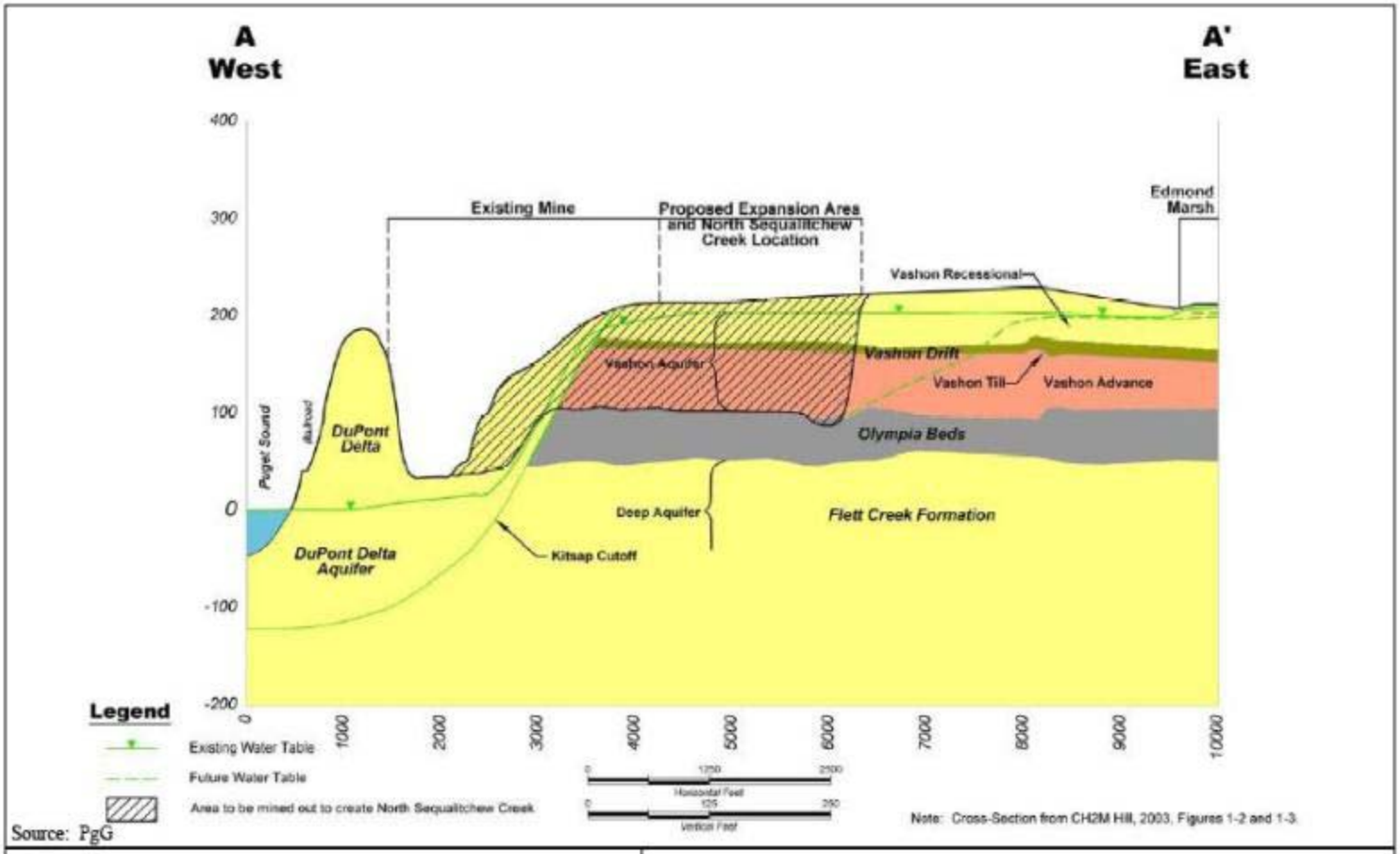


Fig. 4.4 Curves of erosion and deposition for uniform material. Erosion velocity shown as a band. [Redrawn from Hjulstrom (1935).]

Glacier Northwest Mine, Dupont WA



This figure is from the Final Supplemental Environmental Impact Statement, Glacier Northwest DuPont Mining Area Expansion and North Sequalitchew Creek Project, May 1, 2007, Figure 3.4-1

Figure 9
Generalized Geologic Cross Section

553-3044-001/03(04) 1/09 (B) ai

http://www.ci.dupont.wa.us/files/library/7f935eba98ef7cef_o.pdf

Why Dupont and Maury Island?

- Thin layer of till → easy to get sand and gravel
- The sand and gravel are clean

Aggregate Properties

Physical Properties

Chemical Properties

General Characteristics

Physical Properties

Absoprtion, Porosity, and Permeability

Surface Texture

Strength and Elasticity

Density and Specific Gravity

Aggregate Voids

Hardness

Particle Shape

Coatings

Undesirable Physical Components

Surface Texture

Cement bond

- Smooth
- Rough

Workability

- Rough requires more asphalt cement
- Rough requires more water Portland Cement

Grip

- Resistance to wear to maintain
- Limestone wears easily
- Marble, Basalt have good resistance to wear/smoothing

Absorption, Porosity, and Permeability

Pore characteristics

- Size
- Number
- Interconnection pores

-Affect the strength of the aggregate, abrasion resistance, surface texture, specific gravity, bonding capabilities, and resistance to freezing and thawing.

-Absorption relates to the particle's ability to take in a liquid.

-Porosity is a ratio of the volume of the pores to the total volume of the particle.

-Permeability refers to the particle's ability to allow liquids to pass through. If the rock pores are not connected, a rock may have high porosity and low permeability.

Strength and Elasticity

Strength

- **Resistance of an aggregate to tensile and compressiv**

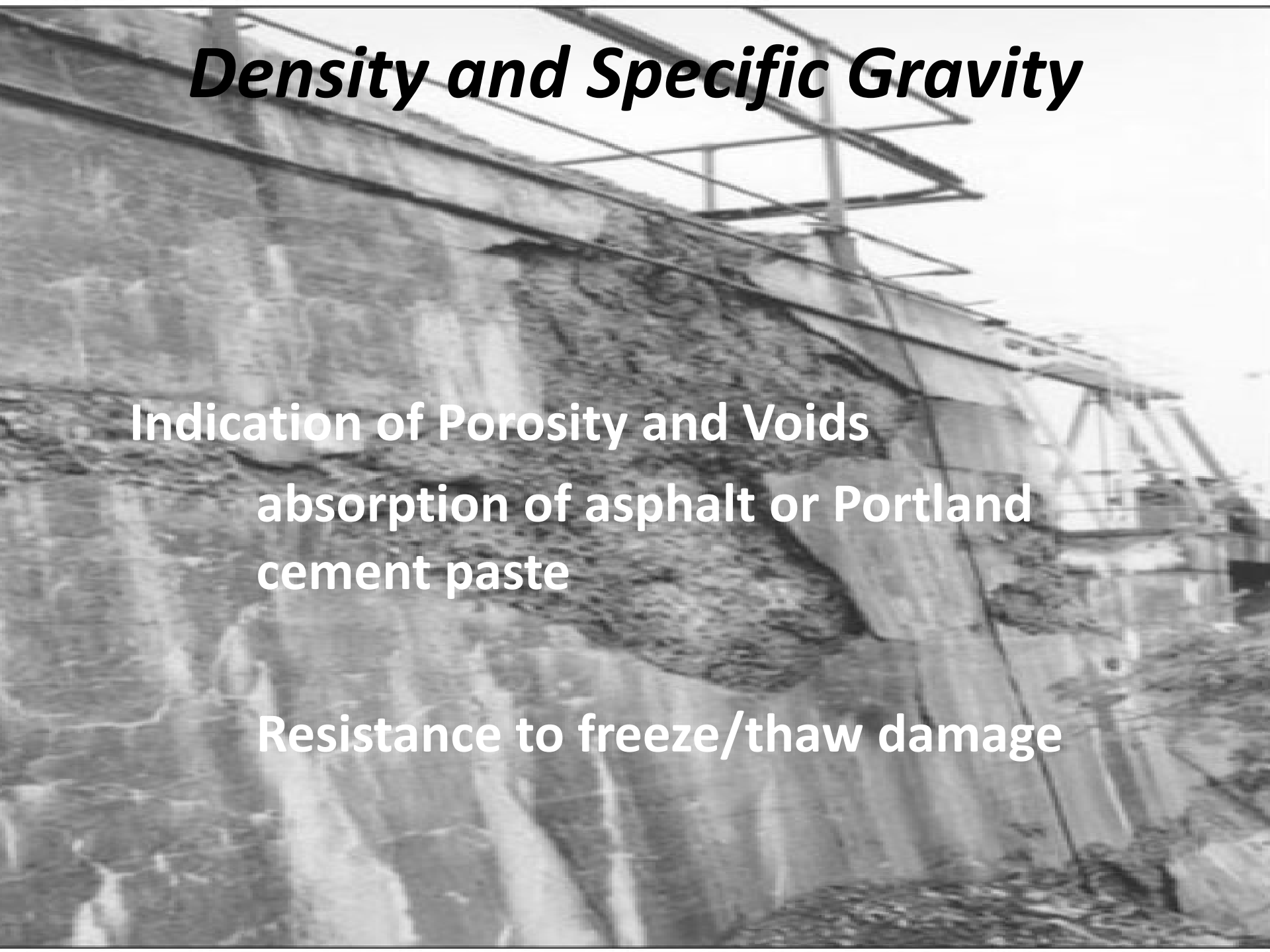
Elasticity

Ability of material to deform

Resistance to freeze/thaw cycle

Want both properties to maximize durability of the compo material.

Density and Specific Gravity



Indication of Porosity and Voids

absorption of asphalt or Portland cement paste

Resistance to freeze/thaw damage

Hardness

Resistance to abrasion and degradation

Soft aggregate-wears easily

Hard aggregate resists wear

Particle Shape

Crushed and rough aggregate

Workability

- Require more asphalt and PCC to coat the surface and make the mix workable.

Strength

- Greater interlock when consolidated
- Greater friction

Particle Shape

Smooth and round aggregate

Workability

- Less asphalt and PCC to coat the surface
- Makes the mix more workable.

Strength

- Reduced friction and interlock.

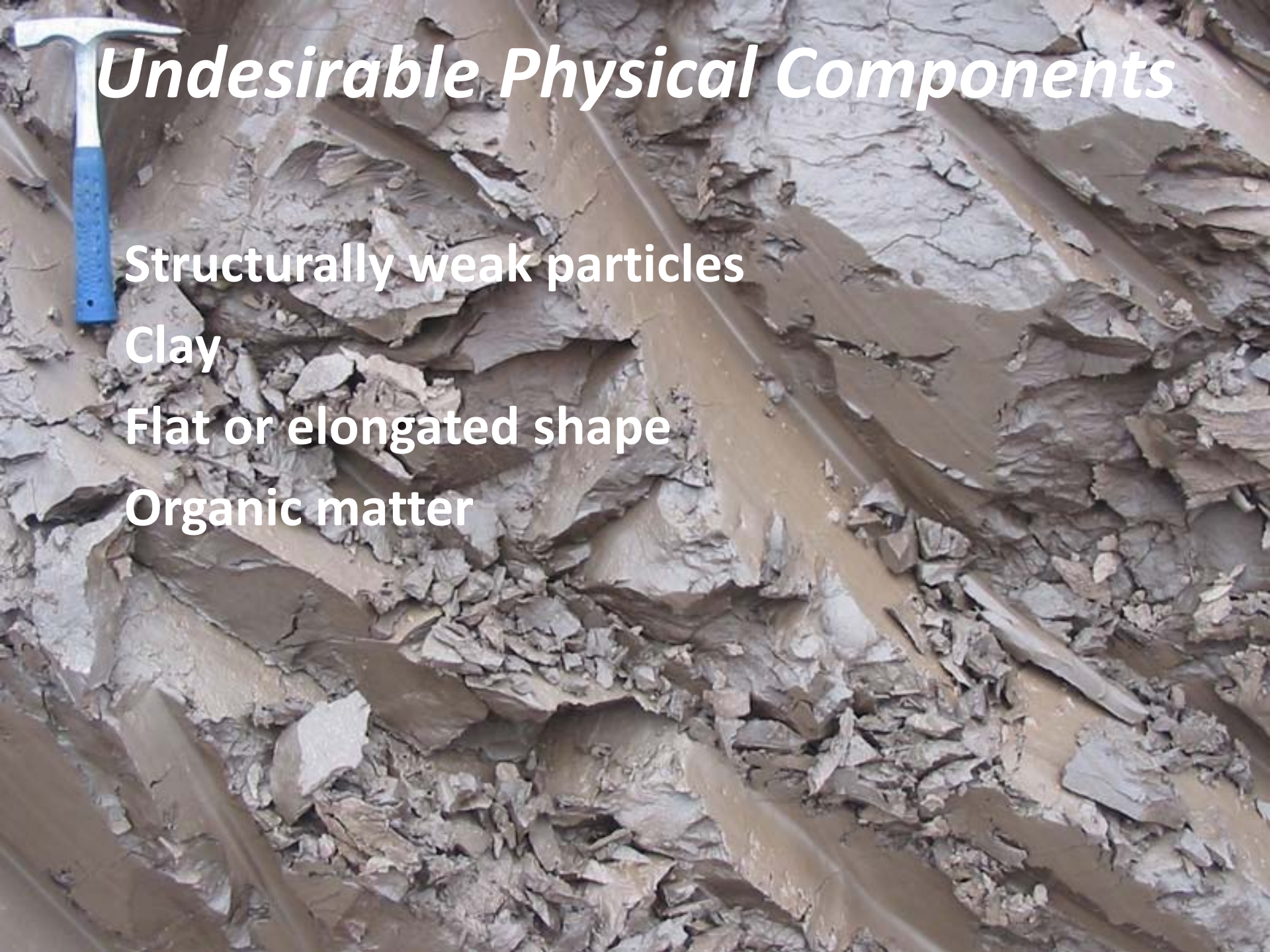
Coatings

Mineral deposits

Dust formed by crushing and handling.

May affect bond strength

Washing is required to remove coatings



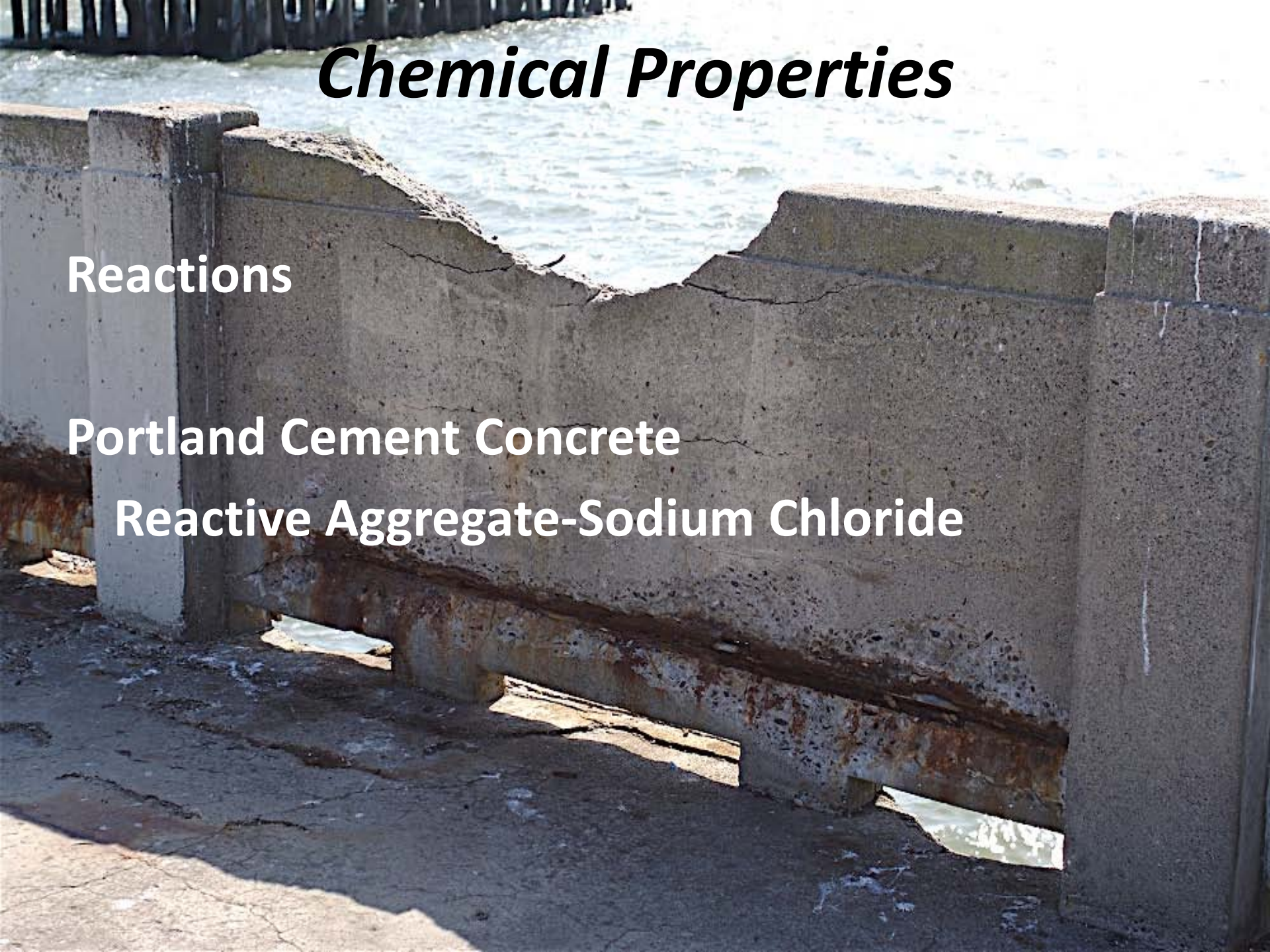
Undesirable Physical Components

Structurally weak particles

Clay

Flat or elongated shape

Organic matter



Chemical Properties

Reactions

Portland Cement Concrete

Reactive Aggregate-Sodium Chloride

General Characteristics: Compacted Aggregates

Base or Sub-base

- **Without Cementing agent**

PCC-rigid pavement sub-base used to:

- **Improve drainage,**
- **Protect a material that is susceptible to frost.**
- **Gradation is important to form solid base**

Asphalt-flexible pavement sub-base is used to:

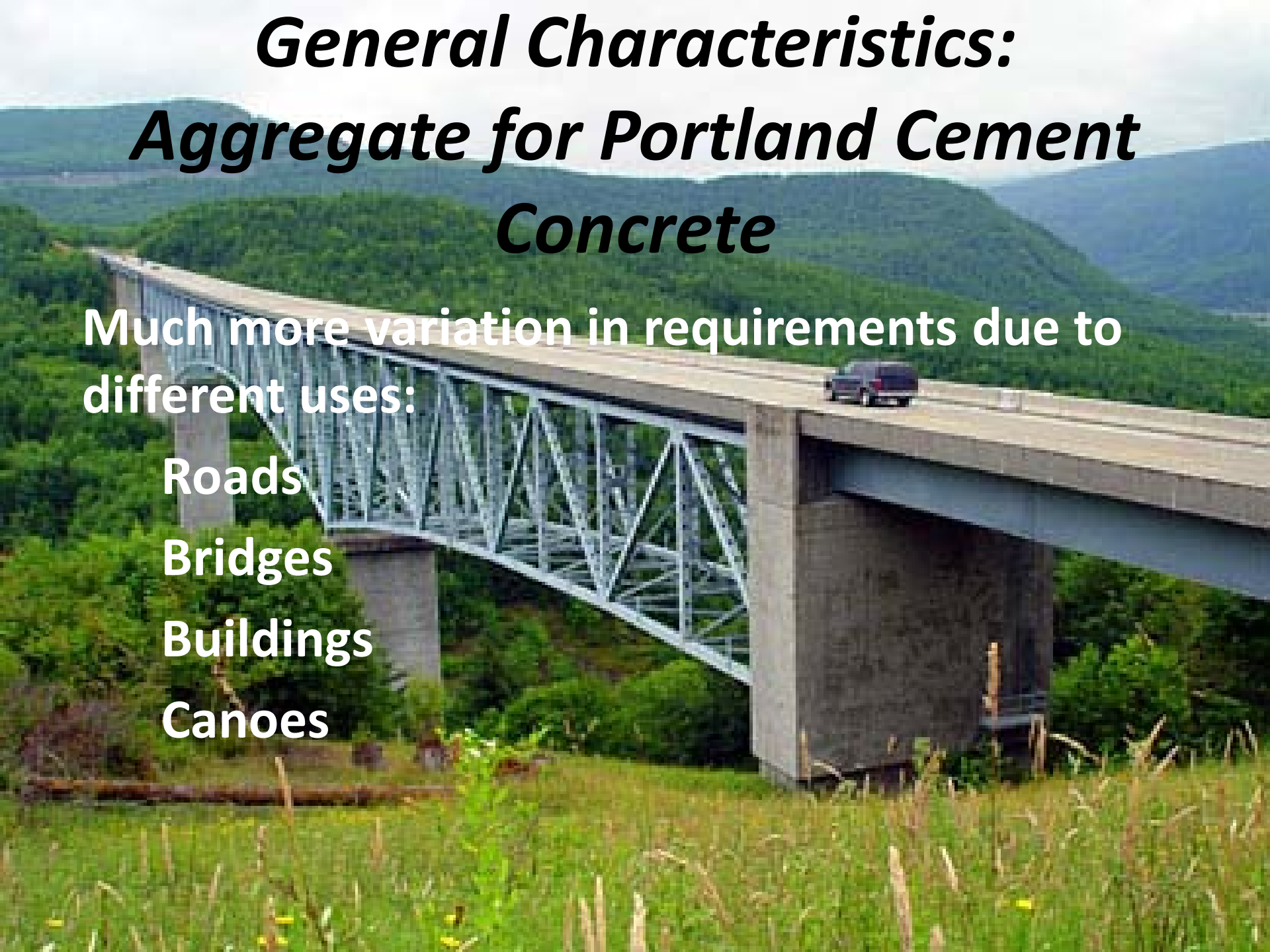
- **Carry the load**
- **Provide Strength to transmit load**
- **Gradation and stability**

General Characteristics: Aggregate for Hot Mix Asphalt

Five Aggregate requirements for HMA:

1) Strong, tough and durable
2) The ability to be crushed into bulky particles, without many flaky particles, slivers or pieces that are thin and elongated
3) Low porosity
4) Low permeability
5) Correct particle size and gradation for the type of pavement

General Characteristics: Aggregate for Portland Cement Concrete



Much more variation in requirements due to different uses:

- **Roads**
- **Bridges**
- **Buildings**
- **Canoes**

Aggregate for Portland Cement Concrete

Factors to consider:

1) The size and interconnection of voids

2) The texture of the particles

3) The gradation of the coarse and fine aggregates

4) The mineral composition of the particles

5) The shape

6) Abrasion resistance

7) Water absorption

Economics of Aggregates

- Market
  - Demand
  - Supply
  - Customers

www.marigoldlane.com/PICS/PeaGravel.jpg

- Future of Local Aggregate Industry
  - Repairs to aging buildings & roads
  - New construction projects
  - Growing cities

Demand of Gravel

- Always a demand
  - Highway 18 / 1-5 renovation projects
  - Currently 3 new proposed mining operations in WA
  - Housing developments
  - Building blocks of nearly all construction
  - Billion dollar industry!

www.reinforcedearth.com/Photos

mckinleyplayground.files.wordpress.com

- Economic Expansion = Gravel Demand ↑

Local Supply of Gravel

- ENDLESS!
  - Puget Sound is naturally blessed
    - Particularly south-sound prehistoric deltas
  - DuPont pit the size of downtown Tacoma?
    - [387 + 187(?)] acres x [80] ft deep
- Transportation
  - Trucks
  - Barges (1 barge = 186 trucks)

farm3.static.flickr.com/

Gravel Controversy

- Environmental Concerns
  - Destroying natural landscape
  - Groundwater contamination
  - Noise pollution
- Quarry Opposition
  - Land owners
  - Local Environmental groups

Problems with the Controversy

- Creating Artificial Shortage
  - Demand doesn't lower
  - Thus, prices increase

idahoyouthsoccer.org/imagedata/gavel.gif

- VERY Difficult to Mine New Quarries
  - Every project causes local outcry
  - Propositions get locked in the courts

The Future of Aggregates

- Here to Stay
  - Everlasting industry
  - Always a market
  - Always a demand
  - Always a local supply(?)

Sources and Resources

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