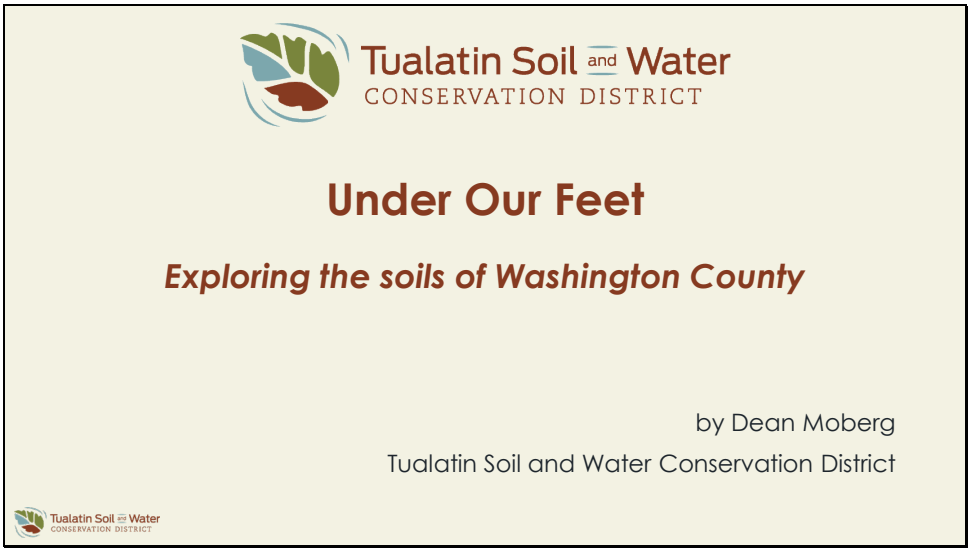
Slide 1

This is a talk Dean gave to the North Plains Historical Society on 4 May 2026.

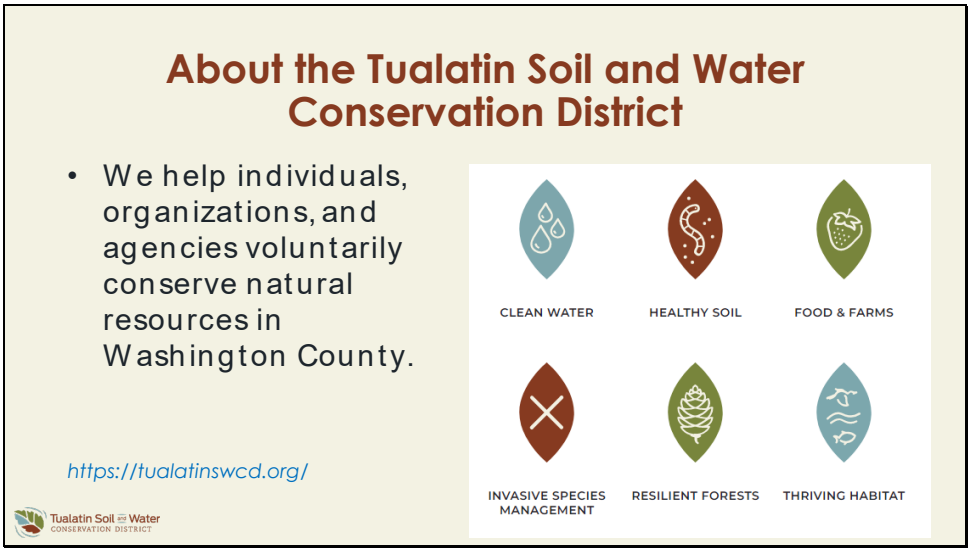
30 minutes followed by Q&A

Bring:
- Business cards with website link
- Computer
- Presentation on flash drive
- Soil survey hard copy
- Soils of Oregon
- Sand

Slide 2


Tualatin Soil and Water
CONSERVATION DISTRICT
Under Our Feet
Exploring the soils of Washington County
by Dean Moberg
Tualatin Soil and Water Conservation District
Tualatin Soil and Water
CONSERVATION DISTRICT

Slide 3



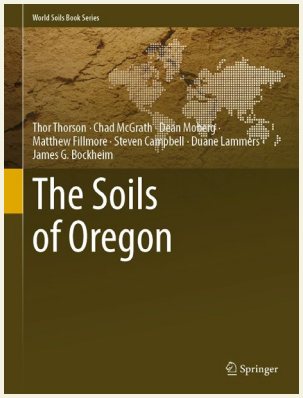
The Tualatin SWCD is not regulatory.
Priorities shown.

https://tualatinswcd.org/

Slide 4

About Dean

- USDA – 35 years (now volunteer)
- Tualatin Soil and Water Conservation District Director
- Co-author *The Soils of Oregon*



Tualatin Soil and Water Conservation District

Slide 5

Overview

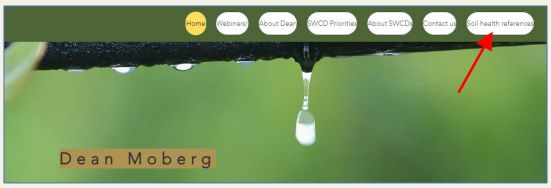
1. Soils 101
2. Soil classification
3. Wash Co soils
4. Soil health
5. For more info

Tualatin Soil and Water Conservation District

Photo is road cut west of Buxton, off Hwy 26 near the railroad trestle.

Slide 6

References Online

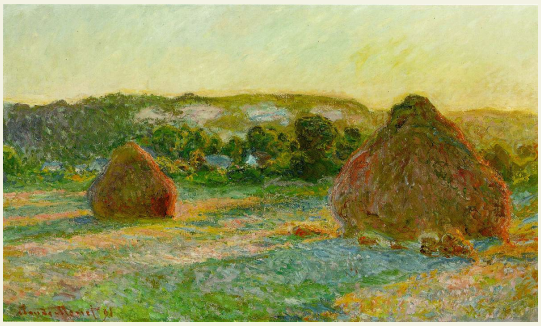


May 2026 North Plains soil talk
Dean's soils presentation to the North Plains Historical Society are available *here.*

Tualatin Soil and Water Conservation District

Slide 7

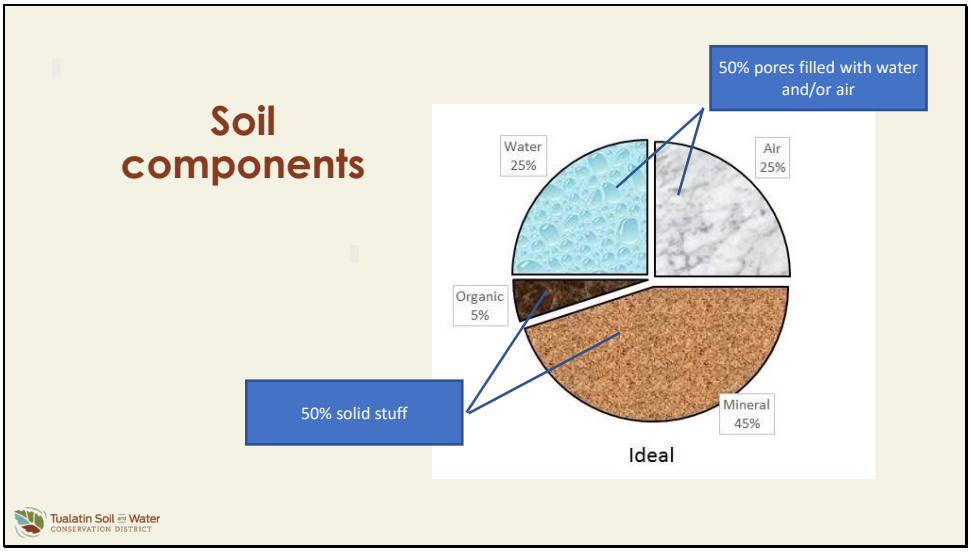
1. Soils 101



Monet,
Haystacks

Tualatin Soil and Water Conservation District

Slide 8



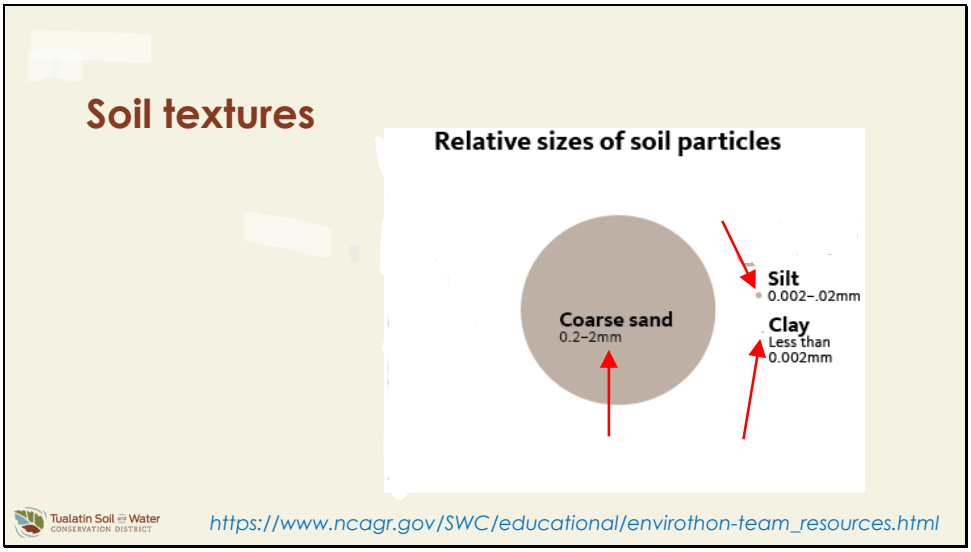
In general terms, soils have about 50% pore space.

For notes, but not talk:
Surprisingly, sandy soils tend to have less pore space (35-50%) than silt or clay soils (40-60%). We think of clay soils as “heavy” because their pores are small and hold water tightly, whereas sandy soils have large pores that drain more quickly. So the “heaviness” of clay soils is due to the water they hold, not a lower porosity.

Because the solid stuff has a bulk density of about 2.67 g / cc, a healthy soil with at least 50% pore space has a bulk density of 1.33 g / cc or less.
1.33 g/cc is about 83 lb/ft3

References:
North Carolina State Extension, https://content.ces.ncsu.edu/extension-gardener-handbook/1-soils-and-plant-nutrients
Brady, N. (1990). The nature and properties of soil. MacMillan Publishing, NY.

Slide 9

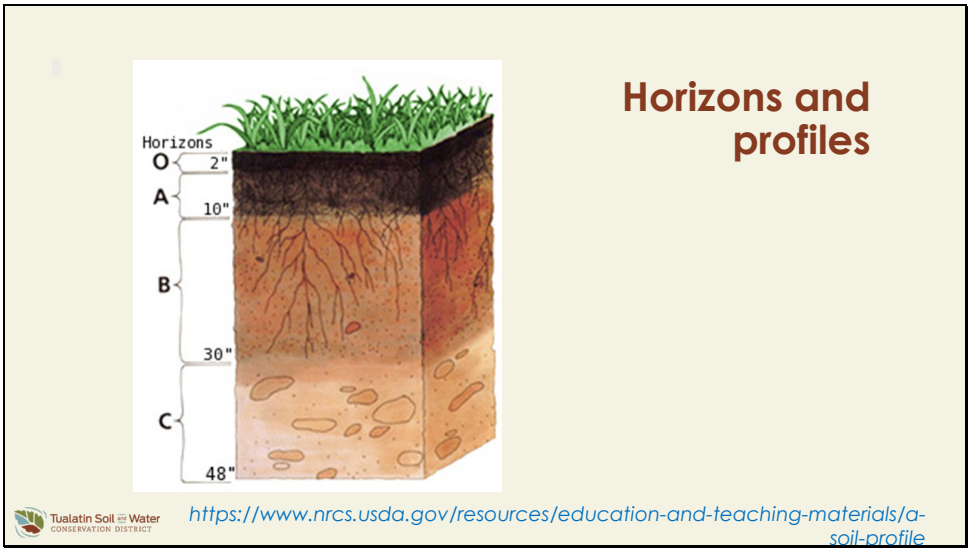


The mineral part of soil is sand, silt, and clay, which are particles with different sizes. Loam is a pretty even mix of all three textures.

If you had a machine that could shrink you down to be so tiny that a grain of sand looked like the size of a car, then a particle of clay would look like a grain of sand. In other words, there is a huge difference in the size of sand and clay particles.
Demo with grain of sand.

Sand is usually easy to dig and drains water easily.
But clay holds onto more nutrients, organic matter, and water.

Slide 10



Organic matter slowly added to A horizon (“topsoil”).
In wet climates, clay slowly moves downward to B horizon (“subsoil”).
In dry climates, calcium sometimes moves downward to B horizon.
“C” horizon is not changed much and is pretty much what the parent material looked like before the A and B horizons started to form.

Slide 11

2. Soil classification

Van Gogh,
The Sower

Tualatin Soil and Water Conservation District

Slide 12

Order vs. series

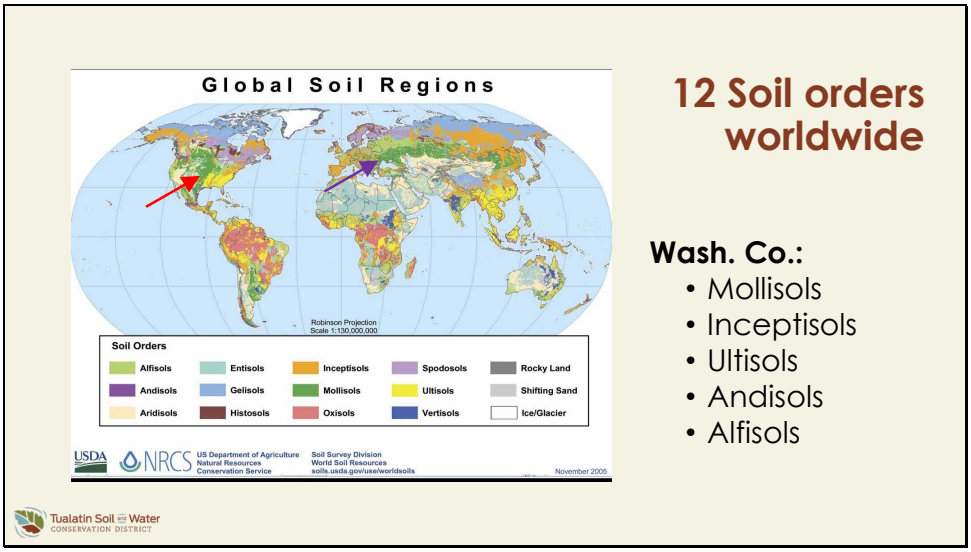
- **Order**
  - Insects: lepidoptera
  - Soils: ultisols

- **Species and series**
  - Insects: monarch butterfly
  - Soils: Jory

Tualatin Soil and Water Conservation District

Monarch photo courtesy of US Fish and Wildlife Service.
Jory photo is from The Soils of Oregon, Thorson et al. (2022).

Slide 13



There are 12 soil orders around the world, 10 of which occur in Oregon: Gellisols (arctic) and oxisols (tropical) do not occur here.

Some Wash Co soils are mollisols. Soil scientist James Cassidy at Oregon State University has compared the abundance of mollisols in the US and Russia to their capacity as super powers. Note the dark green mollisols in the US "bread basket" and in Ukraine (just above the Black Sea).

Only six soil orders occur in Washington County, and of these 5 are most common:

- Mollisols: "moll" is Latin for soft. Typically dark, fertile topsoil.
- Inceptisols: "inceptum" is Latin for "beginning." Less developed soil horizons.
- Ultisols: "ultimus" is Latin for "last" (old). Lower fertility, usually oxidized red color.
- Andisols: "andic" is a term that refers to volcanoes (like the Andes Mountains). Soil weathered from volcanic material.
- Alfisols: "alf" stands for alien life form, like the Muppet related puppet. But, joking aside, "alf" is not derived from any language. Somewhat like mollisols but topsoil is not so dark and is generally less fertile.

References:

https://www.uidaho.edu/cals/soil-orders

Slide 14

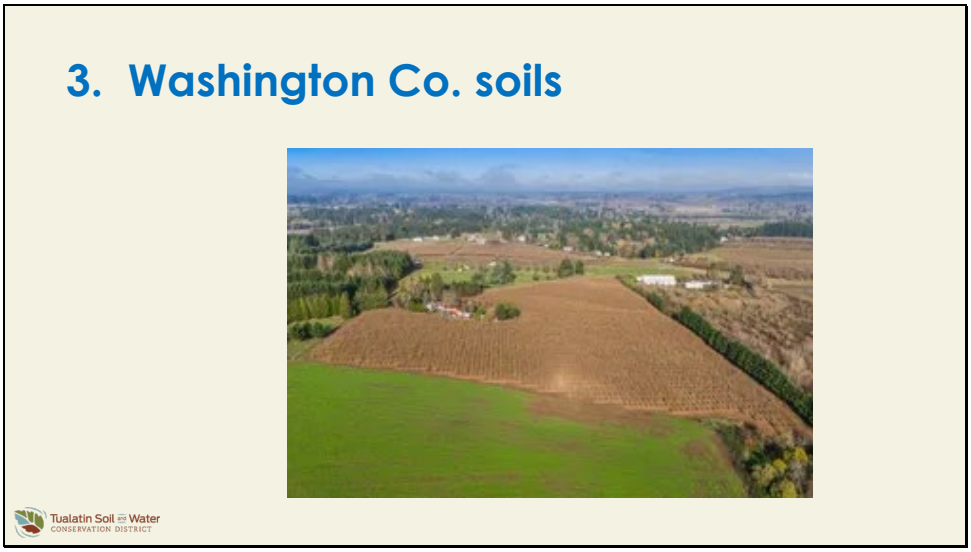
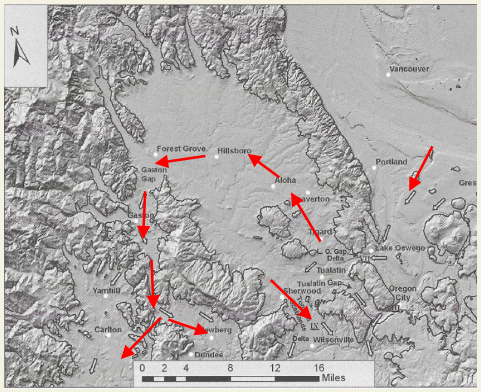


Photo credit: OFRI

Slide 15

Missoula floods



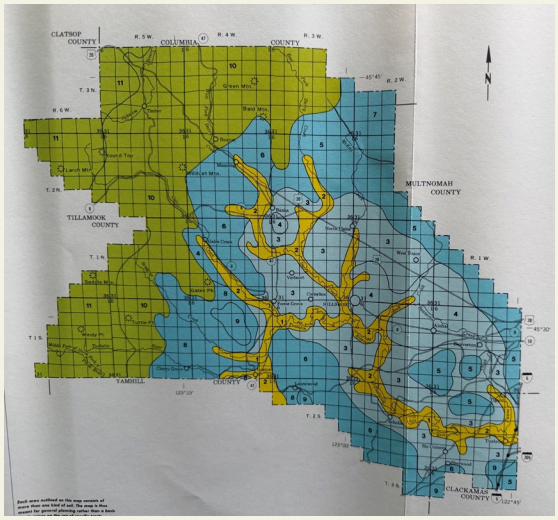
- 15,000-18,000 years ago
- Ice dam on Clark Fork River broke ~40 times
- Waves hundreds of feet high, 60 mph, 13x flow of Amazon River

As the flood backed up into the Willamette Valley, rock, gravel, sand settled out first, e.g. in Portland – Sandy area.
Smaller silt particles settled out in the northern Willamette Valley, including the Tualatin basin.
Smallest clay particles settled out last in the southern Willamette Valley (e.g., between Corvallis and Eugene).

Slide 16

Wash. Co. soils

- Simplified view.
- We will look at one soil from each color on this map



For notes, but don't read:
From highest to lowest elevation:

-Green: sloping to very steep mountainous areas of coast range – parent material is variable: basalt or sedimentary rock containing volcanic ash
-Dark blue: steeper uplands – parent material is variable: some Missoula flood sediments, some basalt (colluvium, residuum), some loess***
-Light blue: level to moderate terraces – parent material = Missoula floods and then developed pretty much in place
-Yellow: floodplains – parent material = Missoula flood sediments modified by stream erosion and deposition

*** Current thought is that the loess came from Columbia River floodplain at end of last ice age

Besides differences in parent material, these associations have different climates.
-Green area is udic: Rainfall is commonly well distributed throughout the year with stored moisture plus rainfall that is equal to, or exceeds, the amount of evapotranspiration.
-Yellow and blue are xeric: Soil moisture regime common to mediterranean climates with cool moist winters and warm dry summers. Rainfall can be fairly high, but it doesn't happen at optimum periods for plant growth.

Note that definitions for many soil terms (e.g. xeric) can be found at:
https://www.soils.org/publications/soils-glossary?q=publications/soils-glossary/#

Slide 17

Tolke silt loam

- Andisol
- Elev. 800 – 2,500 ft
- MAP = 80 – 100 in
- Parent = volcanic or tuffaceous sedimentary rock
- Well drained
- Restrictive: >80 in

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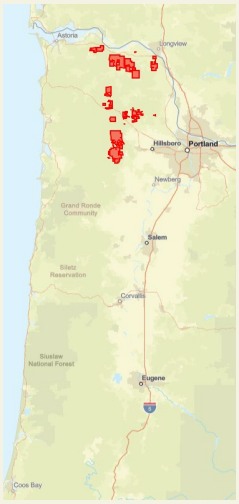


Tolke mostly occurs in higher elevations of Columbia, Washington, and Yamhill Counties.
Tuffaceous = rock that developed when volcanic ash consolidates.
Udic moist soil. This is a different climate than the drier Mediterranean climate at lower elevations in Washington County.

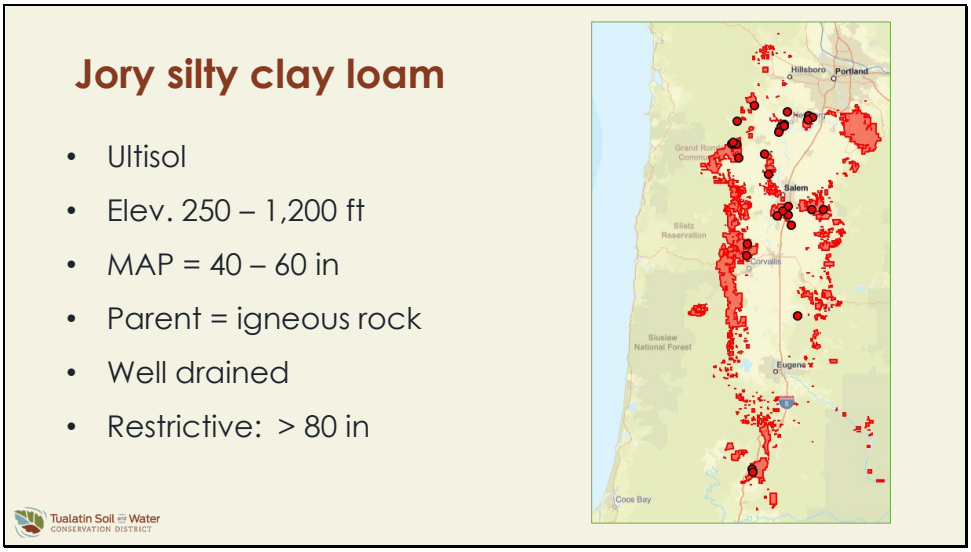
References:
- Web Soil Survey: https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx
- Soil Series Extent Explorer: https://casoilresource.lawr.ucdavis.edu/see/#

Slide 18

Sample on left is upper 14 inches. Middle photo is the next 10 inches.
Shiny object is a nickel for perspective.
Thick duff layer.

Photos by Dean taken about 2 miles west of Timber.

Slide 19



Note that Jory occurs in foothills on the west side of the Cascades and the east side of the Coast Range throughout Oregon.
Jory is an ultisol (older soil).
Xeric Mediterranean climate

References:
- Web Soil Survey: https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx
- Soil Series Extent Explorer: https://casoilresource.lawr.ucdavis.edu/see/#

Slide 20

It is old and highly weathered, with visible red color from iron oxides.
Less fertile than valley bottom soils, which is good for wine grapes.

References:
Soil profile photo courtesy of The Soils of Oregon, Springer (2022).
https://link.springer.com/book/10.1007/978-3-030-90091-5

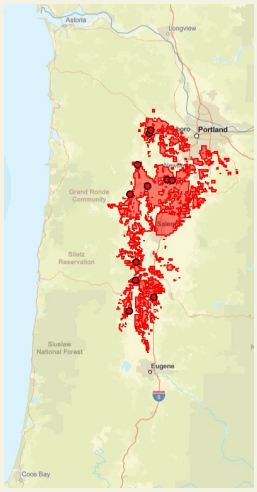
Vineyard photo courtesy of Soil Science Society of America
https://www.soils4teachers.org/files/s4t/k12outreach/or-state-soil-booklet.pdf

Slide 21

Woodburn silt loam

- Mollisol
- Elev. 150 – 400 ft
- MAP = 40 – 50 in
- Parent = Missoula flood deposits
- Moderately well drained
- Restrictive: > 80 in

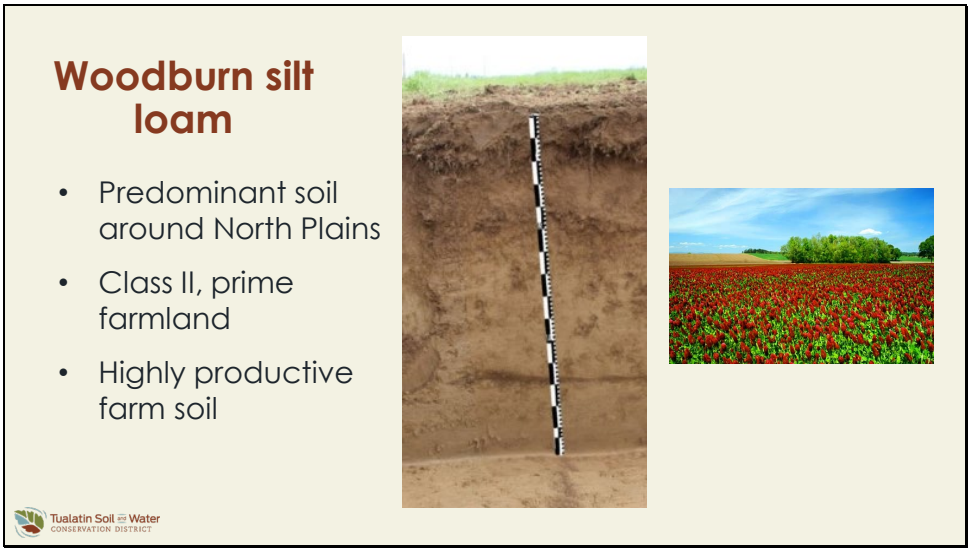
Tualatin Soil and Water Conservation District



A common farmland soil in the Willamette Valley, especially north of Salem.

References:
- Web Soil Survey: https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx
- Soil Series Extent Explorer: https://casoilresource.lawr.ucdavis.edu/see/#

Slide 22



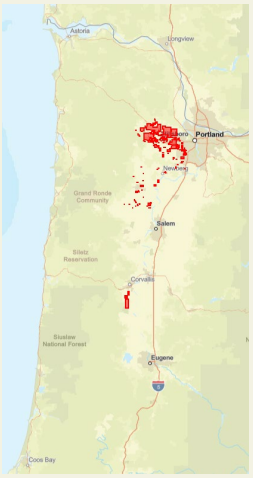
Each bar is probably 10 cm (~ 4 inches).

References:
Soil profile photo courtesy of The Soils of Oregon, Springer (2022).
https://link.springer.com/book/10.1007/978-3-030-90091-5

Slide 23

Verboort silty clay loam

- Elev. 150 – 300 ft
- MAP = 40 – 50 in
- Parent = stream channel alluvium in Missoula flood deposits
- Poorly drained, frequent flooding
- Restrictive: heavy clay at 16-26"



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Verboort silty clay loam occurs in floodplains or other low lying areas.
The parent material is silt and clay that was deposited by streams that ran through the Missoula flood deposits.
Younger than the Missoula floods.

References:
- Web Soil Survey: https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx
- Soil Series Extent Explorer: https://casoilresource.lawr.ucdavis.edu/see/#

Slide 24

Verboort silty clay loam

- Wetland in natural state
- Can be farmed with summer crops if drained
- Not good for houses

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References:
Google photo, street view (from Hwy 26 on ramp going west from North Plains)

Slide 25

4. Making soil healthier

Tualatin Soil and Water Conservation District

Schiros, *Roots*

Slide 26

Soil health definition (Dean's)

The ability of a soil to help us achieve reasonable goals without spending too much money or messing up the environment.

Photo by USDA-NRCS Oregon

Tualatin Soil and Water Conservation District

Reasonable: soil health practices won't help you grow apples in a wetland.
Money: soil health does not require buying topsoil.
Environment: soil health reduces the risk of nutrient and pesticide leaching.

Slide 27

Rx for soil health

- Minimize disturbance
- Keep soil covered
- Diverse plants
- Year-round live roots

Tualatin Soil and Water Conservation District

Photo by USDA-NRCS Oregon

For more info:

https://www.nrcs.usda.gov/resources/guides-and-instructions/soil-health-fact-sheets

Slide 28

5. More info

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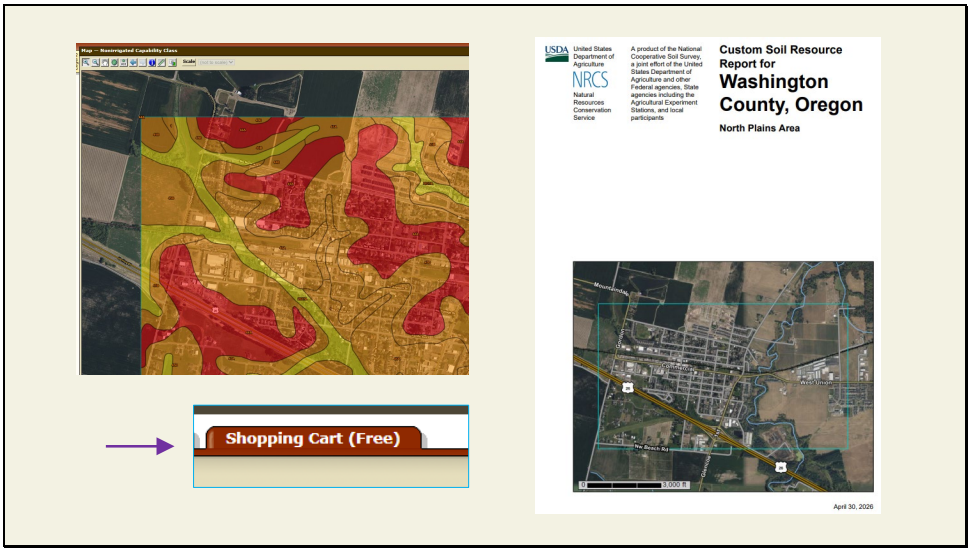
VanGogh, *Wheat Fields At Auvers*

Slide 29

Soil surveys were typically done county by county..
Click the green button to start.

Reference:
https://websoilsurvey.nrcs.usda.gov/app/HomePage.htm?TARGET_APP=Web_Soil_Survey_application_lw4voo5icb2aq0hin25tpwiw

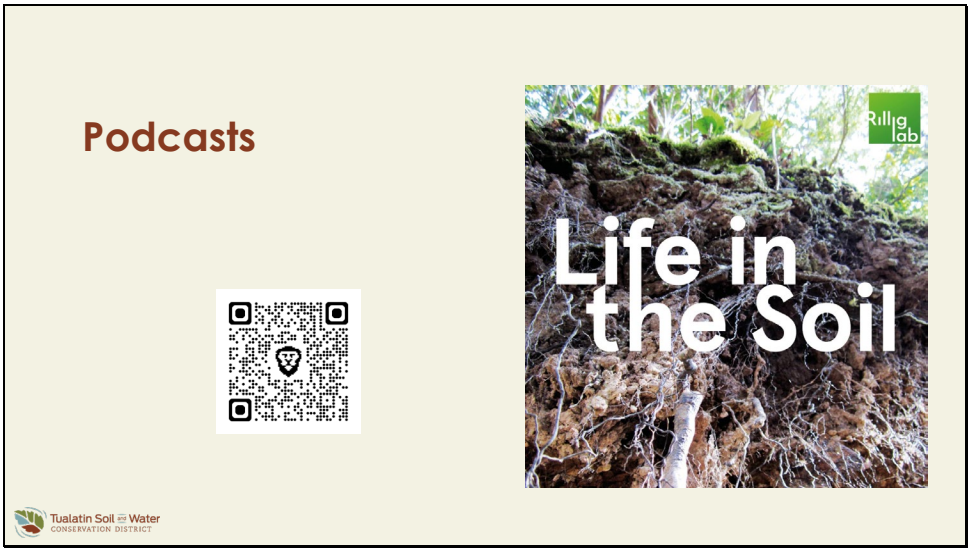
Slide 30



Many reports available, including suitability for homes with basements, crop yields, drainage, depth, trees to plant, even things like suitability for burying large quantities of livestock (in case of disease outbreak).
Colored map is non-irrigated capability class. (Red = 1, Orange = 2, Yellow = 3).

After generating all of the maps and tables you want, click “Shopping Cart (Free)” to download your report.

Slide 31



Interesting and informative series of discussion about soil biology. Accessible to all – you don't need a soils or biology degree.
Includes conversations with soil scientists in Europe and North America

https://rilliglab.org/podcast/

Slide 32

Thorson, T. (2022). The soils of Oregon. Springer, Cham, Switzerland. Available through Wash. Co. Comm. Library.

Simard, S. (2021). Finding the mother tree. Alfred A. Knopf, NY. Available in print and audio through Wash. Co. Comm. Library.

Nardi, J (2007). Life in the soil. University of Chicago Press, Chicago, IL. Available through Wash. Co. Comm. Library.

Eash, N. (2008). Soil science simplified. Blackwell Pub., Ames, Iowa . Available through Wash. So. Comm. Library.

Slide 33

Questions

Tualatin Soil and Water Conservation District

Slide 34

Slides not included due to time limits

The following slides were not included today.

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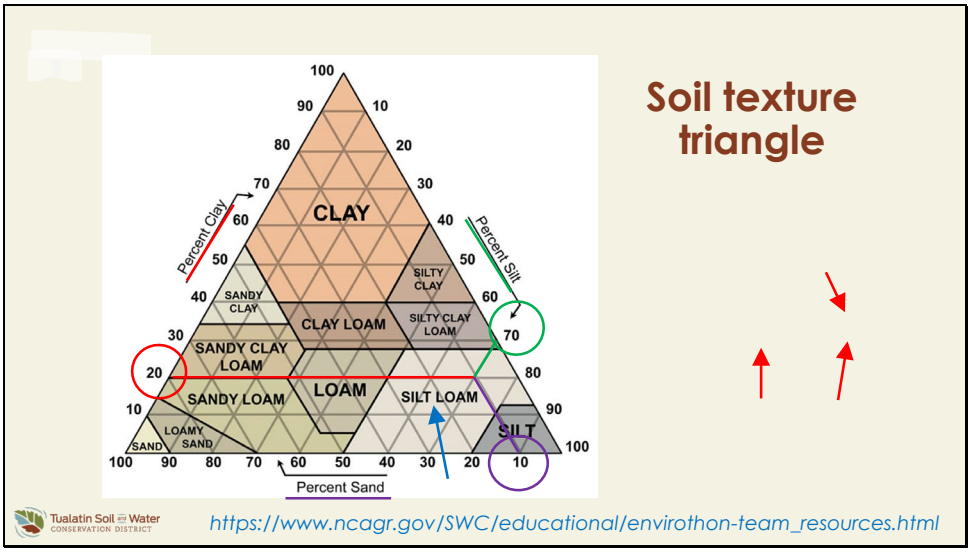
Slide 35



The mineral part of soil is sand, silt, and clay, which are particles with different sizes. Loam is a pretty even mix of all three textures.
Washington County soils are mostly silt loams and silty clay loams. Why is that? Stay tuned (Missoula floods).

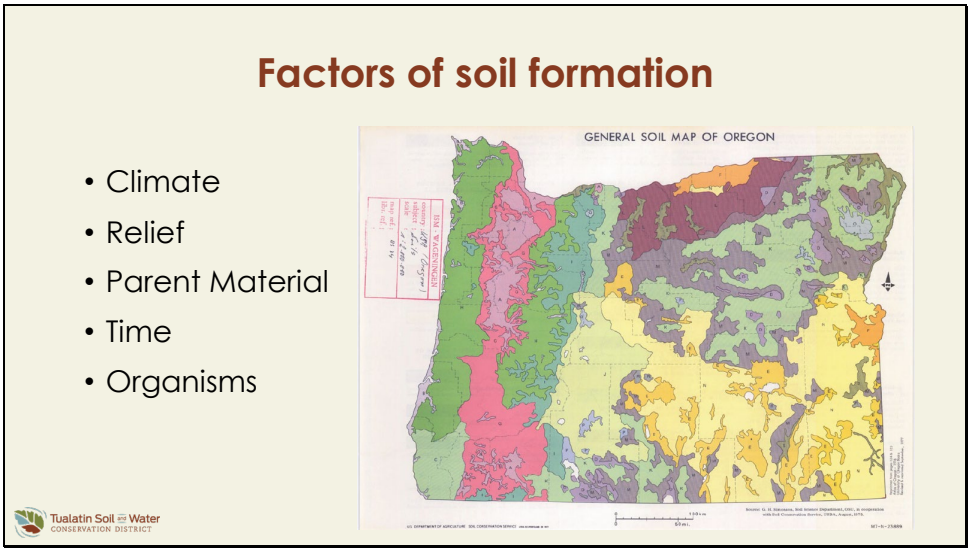
Sand is usually easy to dig and drains water easily.
But clay holds onto more nutrients, organic matter, and water.

Slide 36

Boulders were washed in on icebergs and then stranded as the floods receded and the icebergs melted.

Photo credits:
Erratic Rock State Park (Yamhill County) photo is from Highly Allocthonous (https://all-geo.org/highlyallochthonous/2009/06/the-lake-missoula-megafloods/)
Erratic boulder with scientists at Helvetia Vineyard, photo by Moberg.

Slide 37

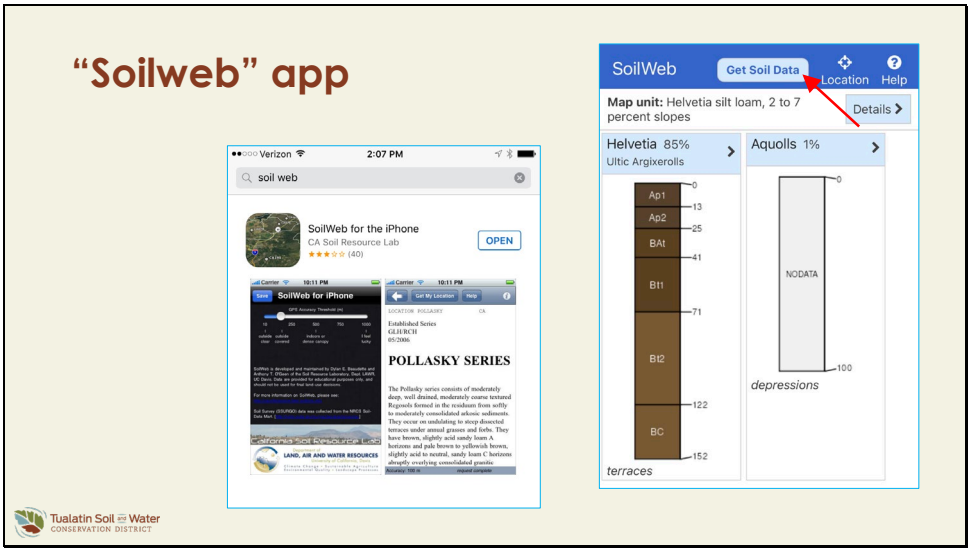


If two sites have the exact same ClORPT, they will have the exact same soil.

Quick examples:
Climate: coast (green) is wet and mild, different from SE OR (yellow), which is hot and dry.
Relief: go to eastern OR where it gets really hot and dry – the north facing slopes have more vegetation and thus more soil organic matter
Parent material: lower elev Will Valley (light pink) formed in flood deposits; higher elev (dark pink) was not flooded
Time: Cascade soils have been forming for a long time after volcanoes erupted, sandy soils around Hermiston (orange) are much younger
Organisms: Wapato Lake peat soils from marsh vegetation. Urban soils influenced by human organisms.

Soil map is from Oregon State University and The Soils of Oregon, Thorson et al. (2022).

Slide 38



Free download for your phone. Search "SoilWeb" in your phone's app store.

Click "Get Soil Data" to see the soil on which you stand.

Reference:
University of California, Davis: https://casoilresource.lawr.ucdavis.edu/gmap/