Geologic Investigations for Animal Waste Storage Structures

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Which sites need an investigation?

- All of them (to some degree).
- Intensity of investigation depends on:
  - Level of planning
  - Geologic complexity of the site
  - Type of structure

NRCS Policy

An investigation is required for any conservation practice, practice component, or structure that involves significant ground construction activity.

Objectives of geologic investigations

- Determine and describe:
  - site stratigraphy
  - material properties and quantities
  - groundwater conditions
  - potential impacts of proposed structure(s)

Levels of Investigation

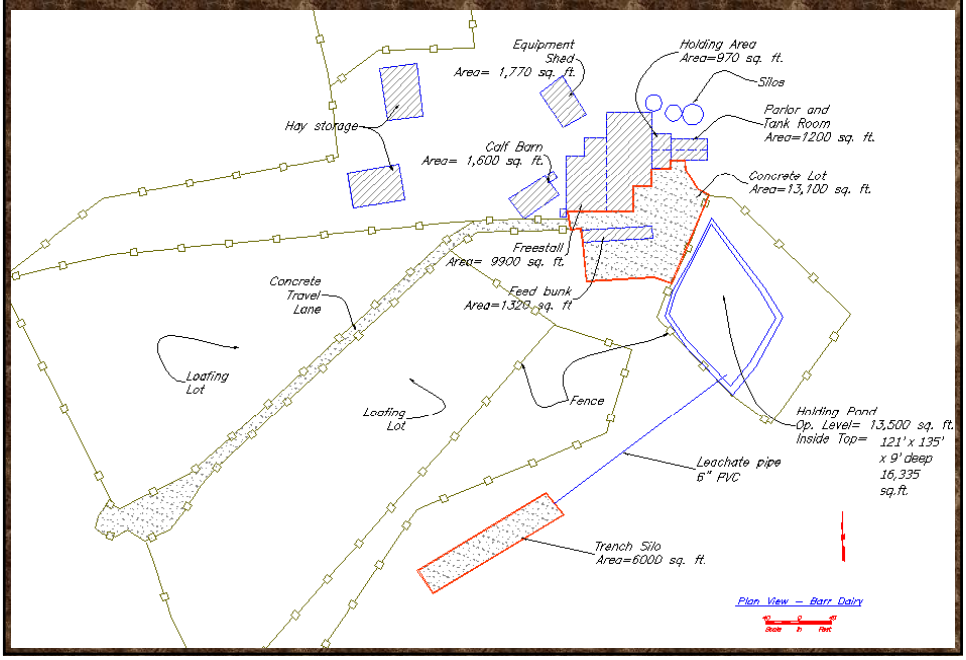
- Reconnaissance
- Preliminary
- Detailed (for design)
- Construction or As-built

Site Investigation

Examples of questions to ask about the site and proposed structure

- Will the foundation be adequate to support the structure?
- Can on-site materials be used in building the structure?
- What are the ground water conditions?
- Is bedrock near the surface?
- Are there geologic hazards at the site?

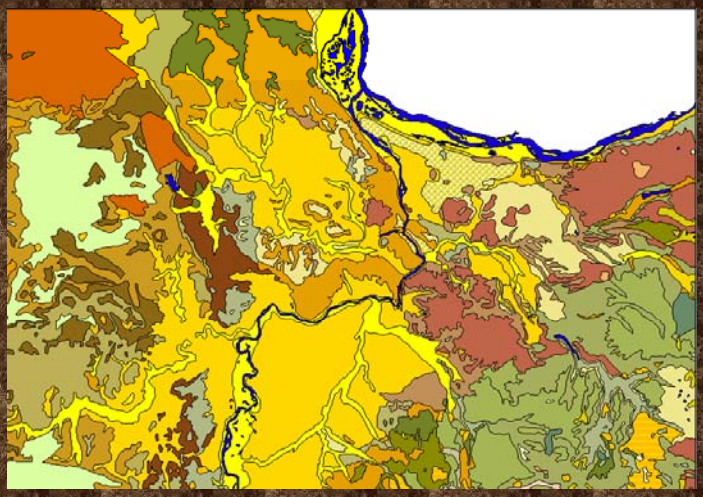
Siting Waste Storage Facilities



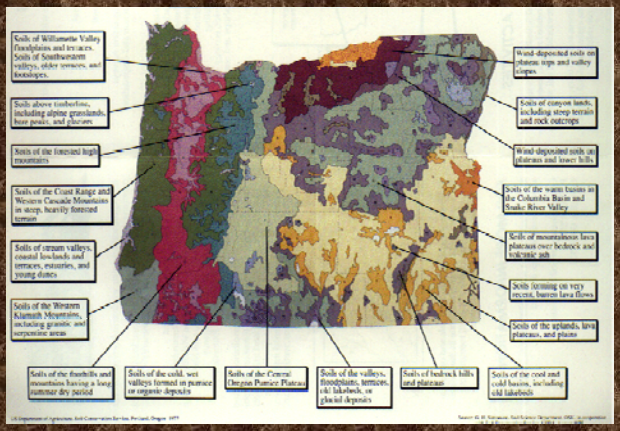
Collect and review existing data:

- Soils, topographic and geologic maps
- Well logs, aerial photos, mineral and water quality reports
- Location of wells and underground utilities
- Previous reports that may describe the site conditions

Geologic maps



GENERAL SOILS MAP



Make a site visit during which:

- Assess geomorphic setting:
  - What landforms make up the site?
  - Topography and drainage
  - Soil and/or rock materials exposed
  - Note other factors that can affect suitability

Check-out local conditions from any exposures available:

- Road cuts
- Streambank exposures
- Rock outcrops

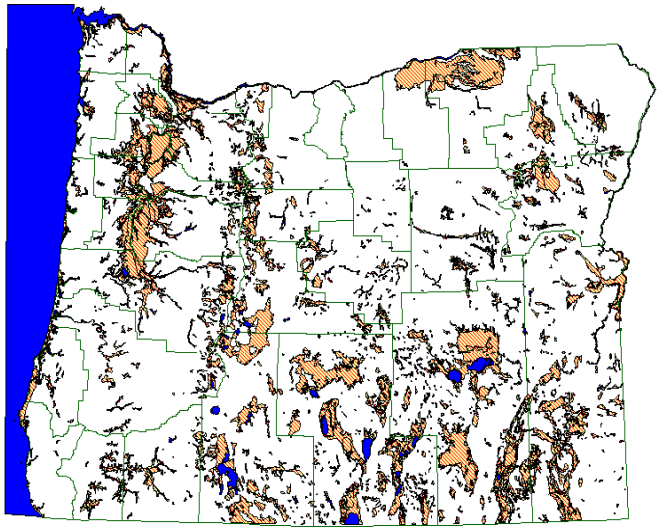
Manure storage structures

Roofed storage structures

Unlined Storage – Geologic Considerations

1. Permeability
2. Depth to Bedrock
3. Ground Strength
4. Depth to Water Table
5. Distance to Well

Shallow Aquifers



In-Ground Storage

Unlined (As Is)	Engineered Soil	Flexible Membranes	Concrete Liner

Cheaper ⇒ More Expensive

Problems: manure storage & groundwater

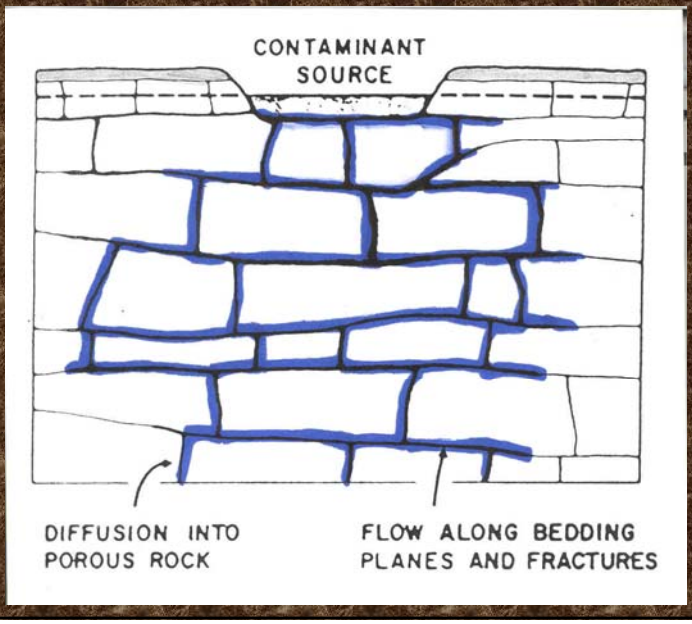
- Potential for water well contamination.
- Potential for uplift pressure against soil liner or concrete.
- Potential contamination of groundwater by seepage from structure.
- Potential for undetected springs.

1. All soil below grade are low permeability, $k < 10^{-6}$ cm/s

- Plasticity index, PI > 15
- Dry density, $\gamma_d \geq 90$ % Std Proctor
- Natural water content ≤ 90 %
- Fines (clay) content (< 200 sieve) $\geq 20\%$

2. Depth to bedrock (any kind) at grade is > 2 ft.

Flow Through Rock Fractures



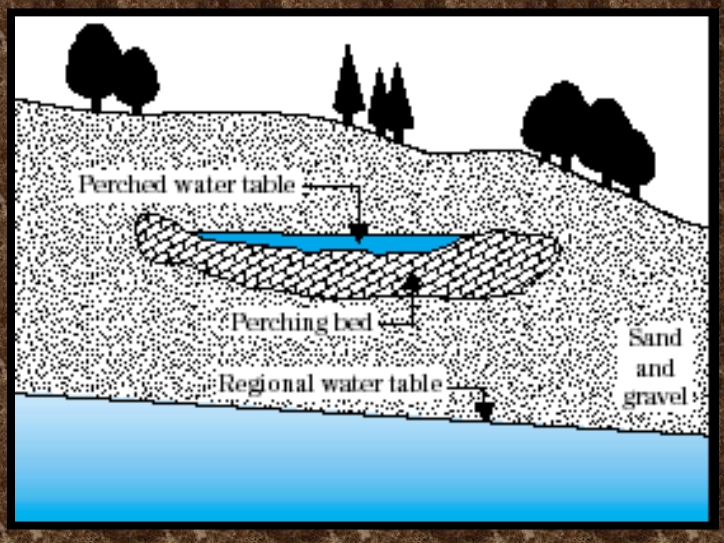
Bedrock Fracture Seepage

5. Distance to well meets regs.

Geologic Considerations -- Engineered Soil Liners

1. Same as for unlined, plus:
2. Perched water
3. Borrow material
4. Soil amendments

2. Perched Water Table



Control Perched Water and Seepage Zones

- Interceptor drains
- Relief drains
- Curtain Drains
- Outlet (gravity or pumping)

3. Borrow for Liner

- Reasonable haul distance
- Quantity – 150 % of design needs
- Quality – meets perm. values
- Construction workability
- Moisture ≤ 90 % saturation
- No de-watering of borrow site

4. Need for Soil Amendments

- Sandy soil – use bentonite
- Flocculated soil – use dispersants:
  - ✓ Polyphosphates
  - ✓ Soda ash (Na_2CO_3)
  - ✓ Salt (NaCl)

Geologic Considerations – Membrane Liner Storage

1. Water table
2. Puncture
3. Excavation type

Location of Water Table

- Seasonal high W. T. > 2 ft below grade
- Uplift pressure damages membranes

Above Ground Storage

- Steel Tanks
- Concrete Tanks

Other possible on-site problems

- Will erosion be a problem?
- Will sediment be a problem?
- Are there soft, compressible soils?
- Are there unstable slopes?

Are there slope stability problems?

(Unstable natural slopes or problem soils in foundation or cutbanks)

Equipment for Investigations

- Shovel, soil auger, measuring tape and notebook

Backhoe, excavator or bulldozer

- Backhoes can be used effectively to about 12 ft; some as deep as 16 ft.
- Benching the test pit allows for deeper sampling.

(Caution: use shoring or bench sidewalls)

Drilling is an option where depths or materials exceed limit of backhoes.

Flight auger and hollow-stem auger

Soil sampling:

- Collect samples of soils to be used for soil liner and earthen embankments.
- Sample foundation soils under concrete structures.
- Clean 5-gallon plastic buckets make good sample containers.
- Collect enough representative material for all testing.

Soil sampling:

- If bearing strength is suspect, collect undisturbed samples of weakest soil in foundation of concrete structures.
- Samples may be trimmed from a pedestal or sampling tube can be pushed into the horizon.

Other Siting Considerations

- Culture Resources
  - Known Native Americans
  - Check with local NRCS office
  - Local Knowledge
  - Stop –Wait – Investigate – Document
- On-Site Burial Pits
  - Hazardous Waste
  - Mortalities
  - Landfill material

Questions?