APPLIED GEOLOGY IS AN "ESSENTIAL" PROFESSION

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2019-2020 AEG Past President
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OUTLINE

- Your Geologic Toolkit
- Critical & non-critical facilities
- Site Characterization and the "Geologic" Content of Nuclear License Applications
- Case Studies
- Conclusions

Poll Question 1

- Are you a member of AEG?
  - Full Member
  - Student Member

GEO TOOLKIT

- Geologic education
- Sound fundamentals
- Enhance your toolkit - “on the job”
- Get out of your comfort zone
- Sharpen communication skills
- **Never** stop learning!!!
- Licensing

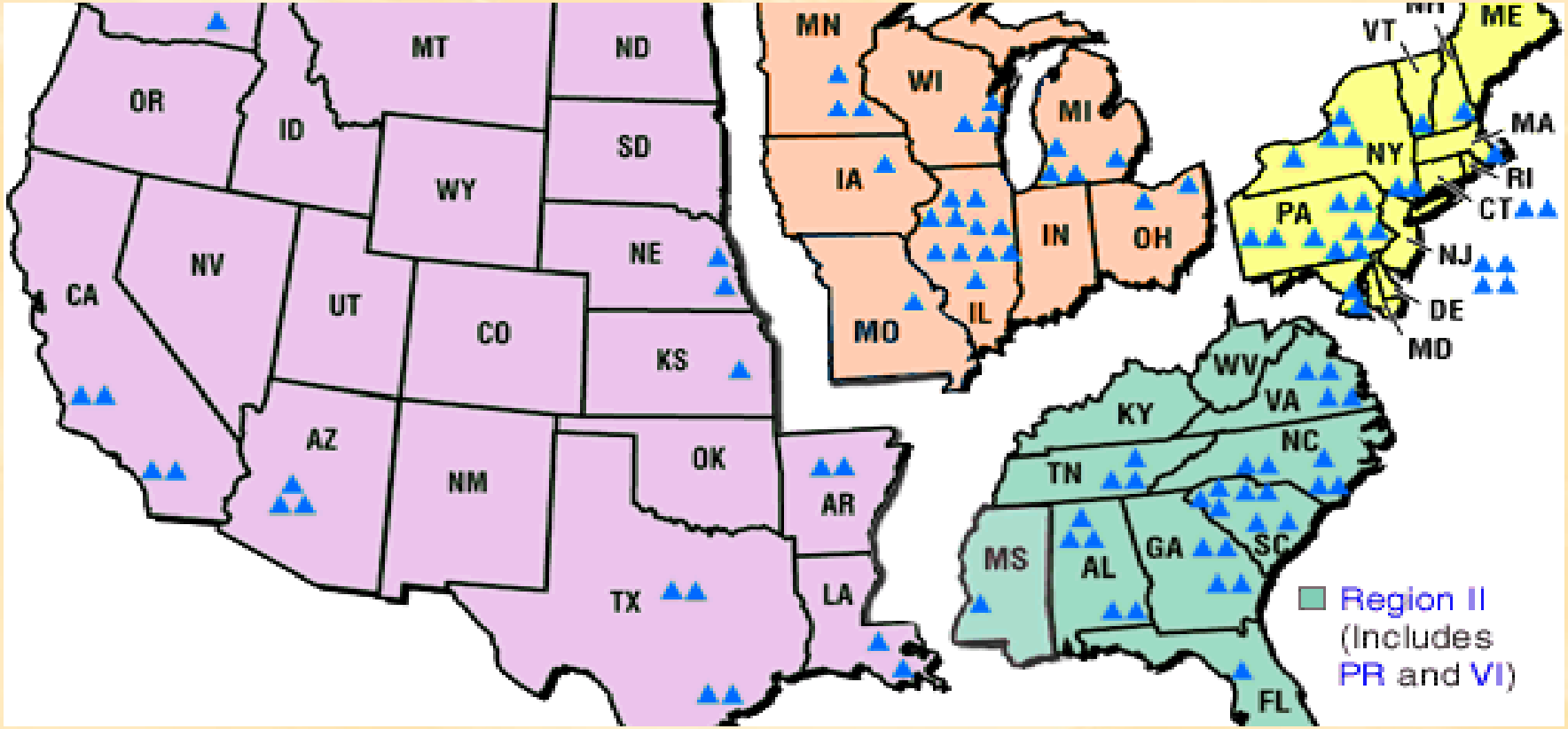
Poll Question 2

- Are you a licensed professional
  - Geologist
  - Engineer
  - Other

"CRITICAL FACILITIES"

- Important to health and safety
- Important to the environment
- Nuclear Facilities
  - Power plants, waste repositories
- Non-nuclear Facilities
  - Dams, bridges, tunnels, schools, hospitals

Locations of Operating Reactors



License Application

- Safety Analysis Report
  - 2.5.1.1 Regional Geology
  - 2.5.1.2 Site Geology
  - 2.5.2 Vibratory Ground Motion
  - 2.5.3 Surface Deformation
- Environmental Report

Site Characterization

Association of Environmental & Engineering Geologists

Connecting Professionals, Practice and the Public

Geology

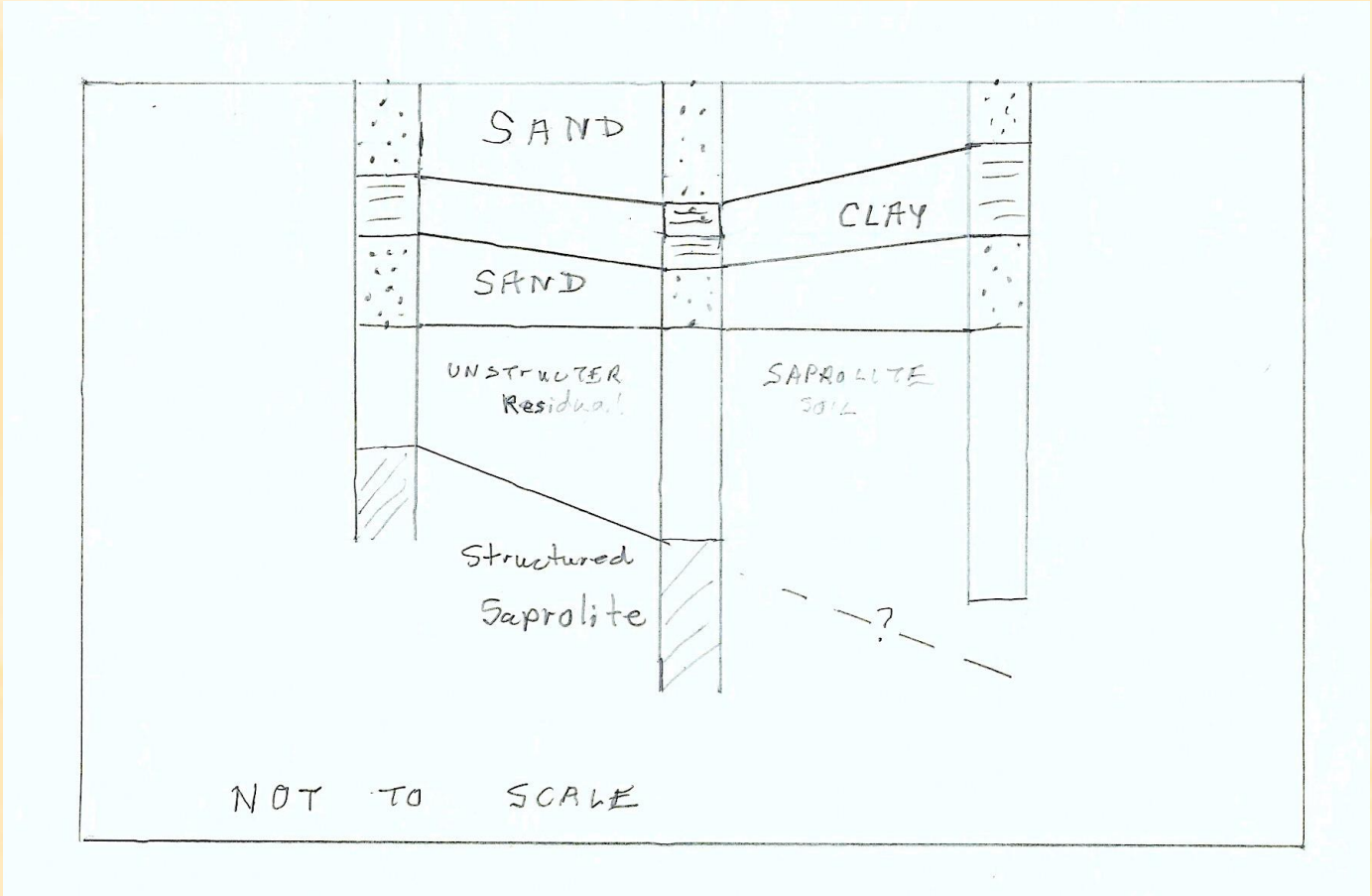
- Physiography & Geomorphic Processes
  - Emphasis on Quaternary Processes
- Stratigraphy
- Geologic History
- Structural Geology & Tectonic Processes
  - Integrates geologic history & tectonics
- Engineering Geology

Unit 1 of V.C Summer

Federal Court House

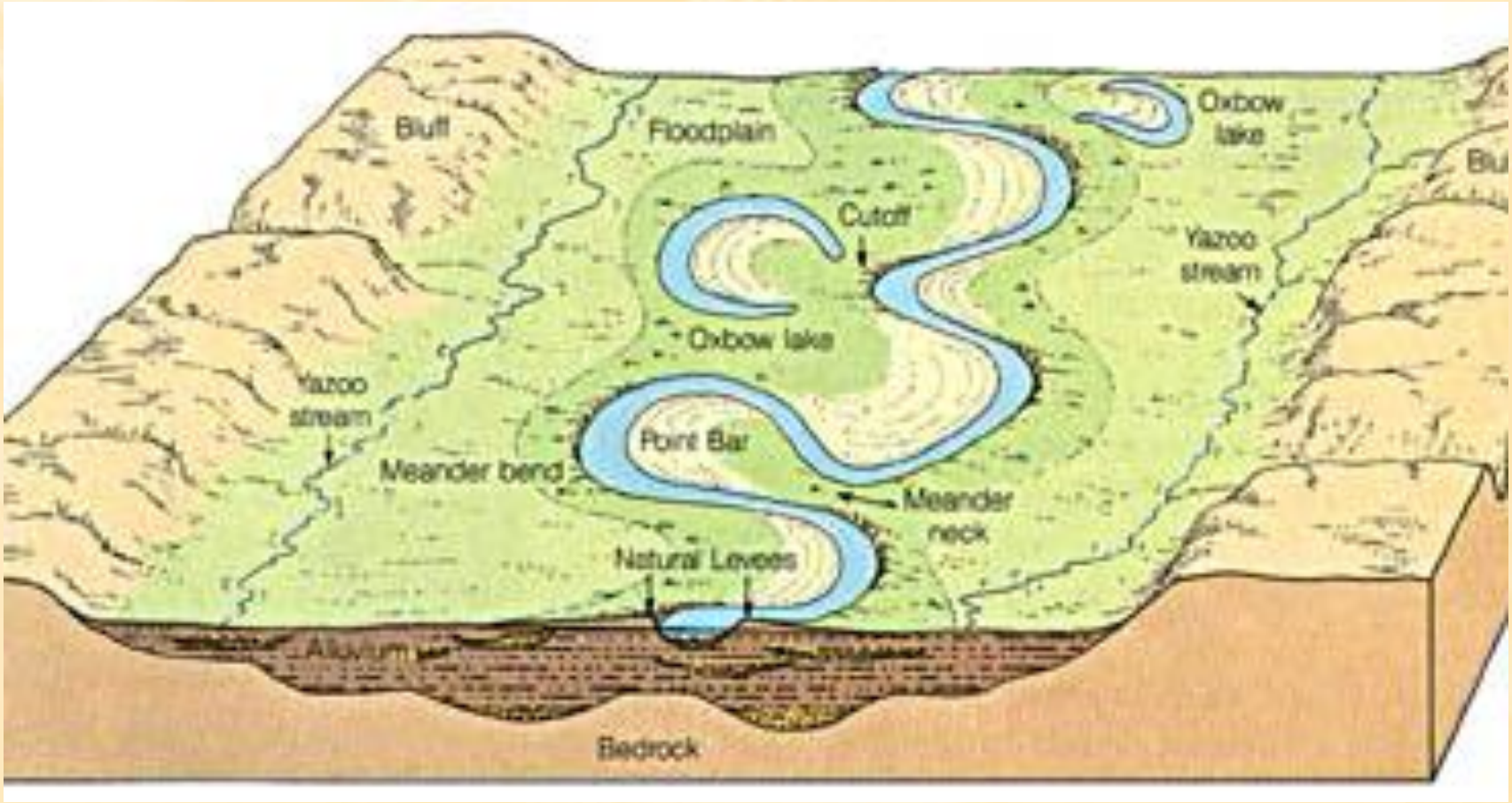
- Forensic Investigation
- Foundation Failure
  - –Used nuclear facility QA procedures
  - –Early phase used 3 boreholes
  - –Geotechnical Data Interpretation
    - Sampling plan
    - Site data
  - –Geologic interpretation of multiple borings

Interpretation – 3 Boreholes

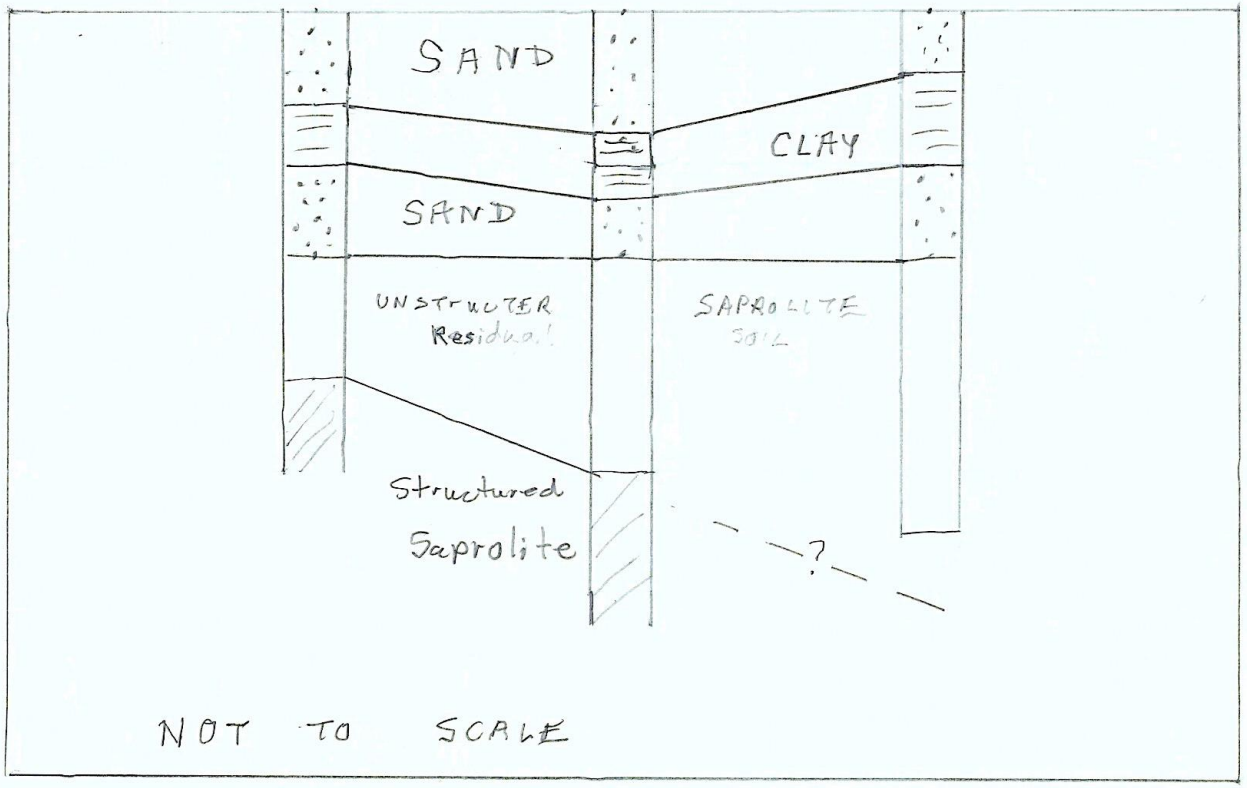


Meandering River

Interpretation – Meandering Stream



Solutions - independent of interpretation



Where Did the Paint Go?

- ILGS

The Paint Stopped Here!

National Institute of Health

- Maryland Piedmont
- 4 geotechnical investigations
- 4 interpretations of site geology
  - 2 types of schist
  - Wissahickon Schist – “implication of weak rock”
  - Granite or diorite

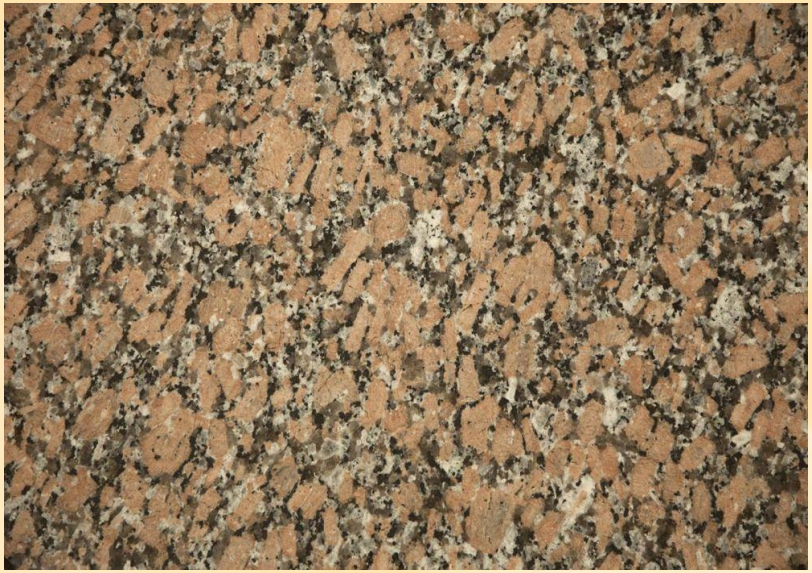
Wissahickon Formation

- No longer mapped in MD
- Type section in Philadelphia
- Easily excavated near surface (saprolite)
- Excavation bid document

Wissahickon Fm.

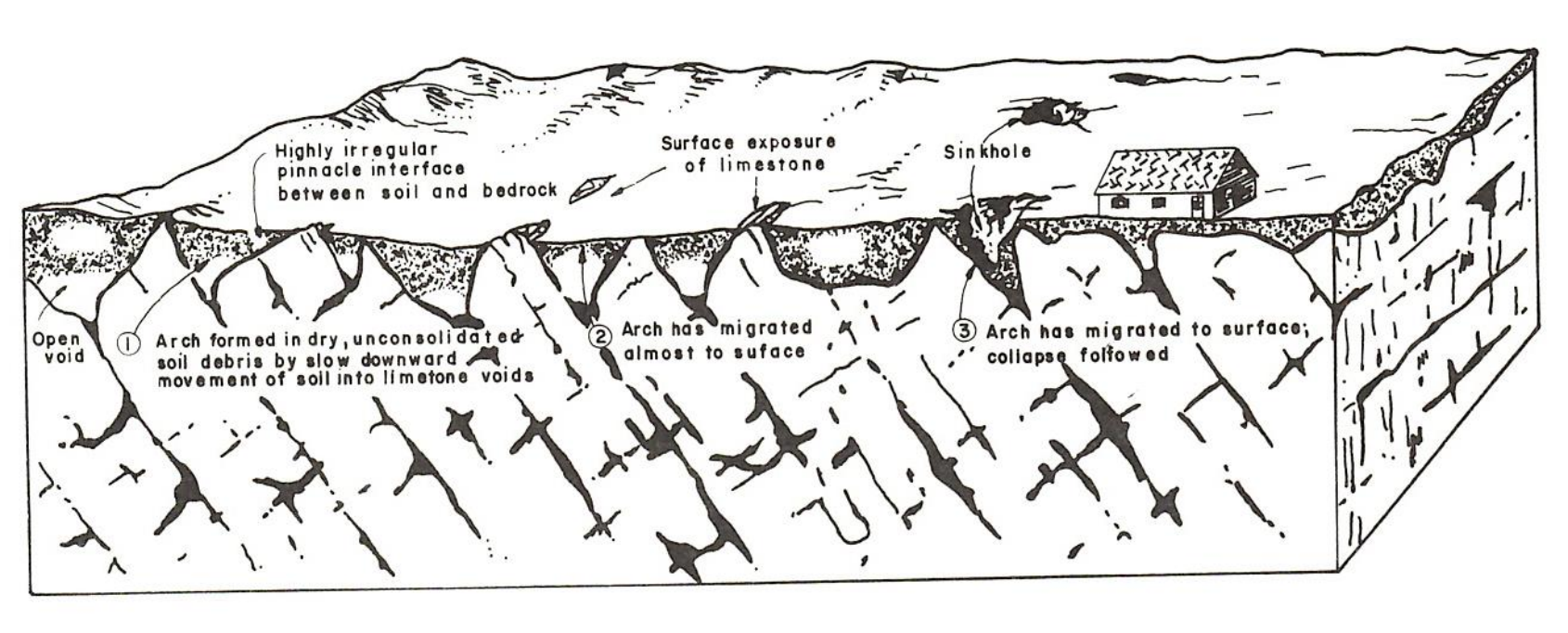
Igneous Rocks with Flow Foliation

- Granite

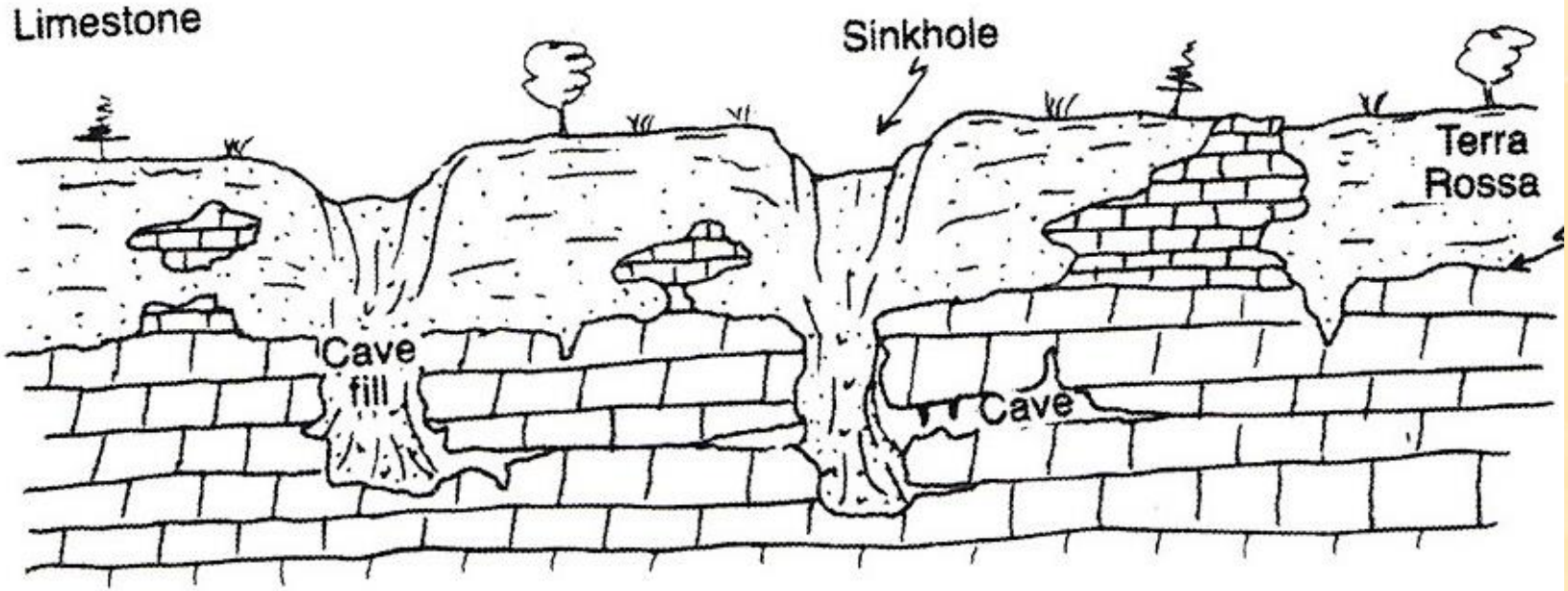


- Rhyolite

Investigation in Karst Terrain



Karst – Varied Depths



Valley & Ridge Geology

- Folded & Thrust Faulted Sedimentary Units
- Variations in dip directions
- Assumptions regarding V_s
- Implications for Design

Geologic Map in Oak Ridge Area

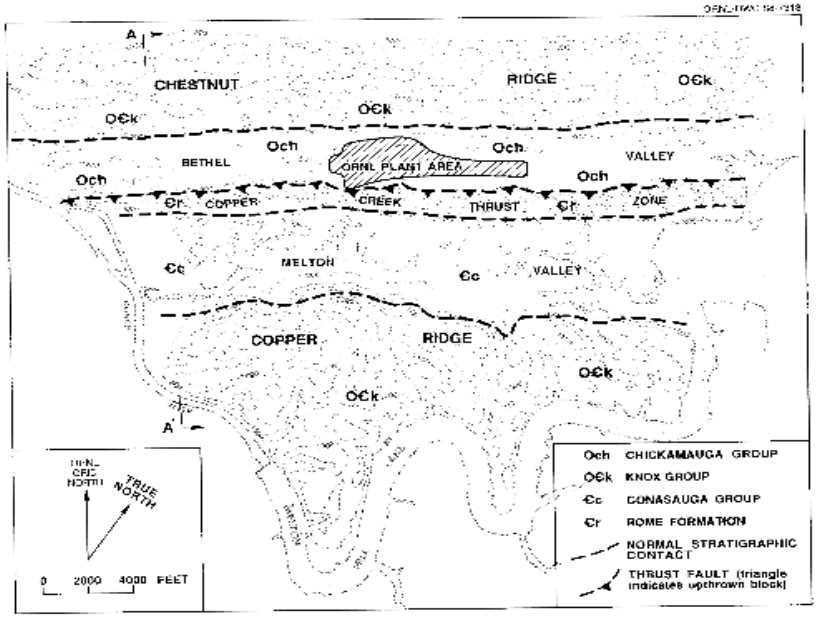


Fig. 2. Generalized geologic map of the ORNL area.

Cross Section near Oak Ridge

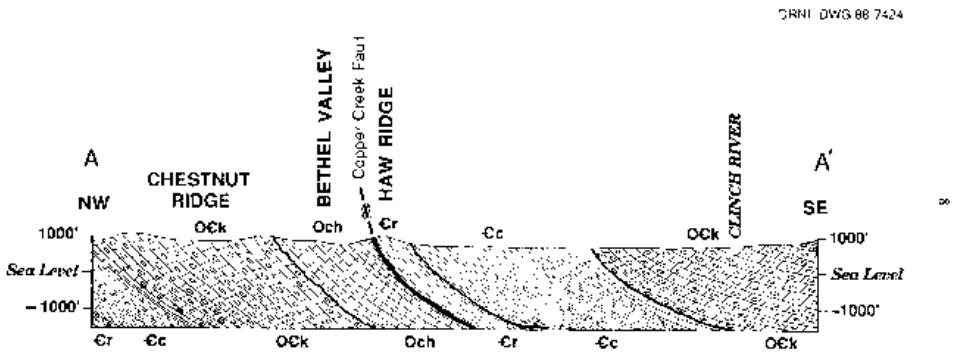
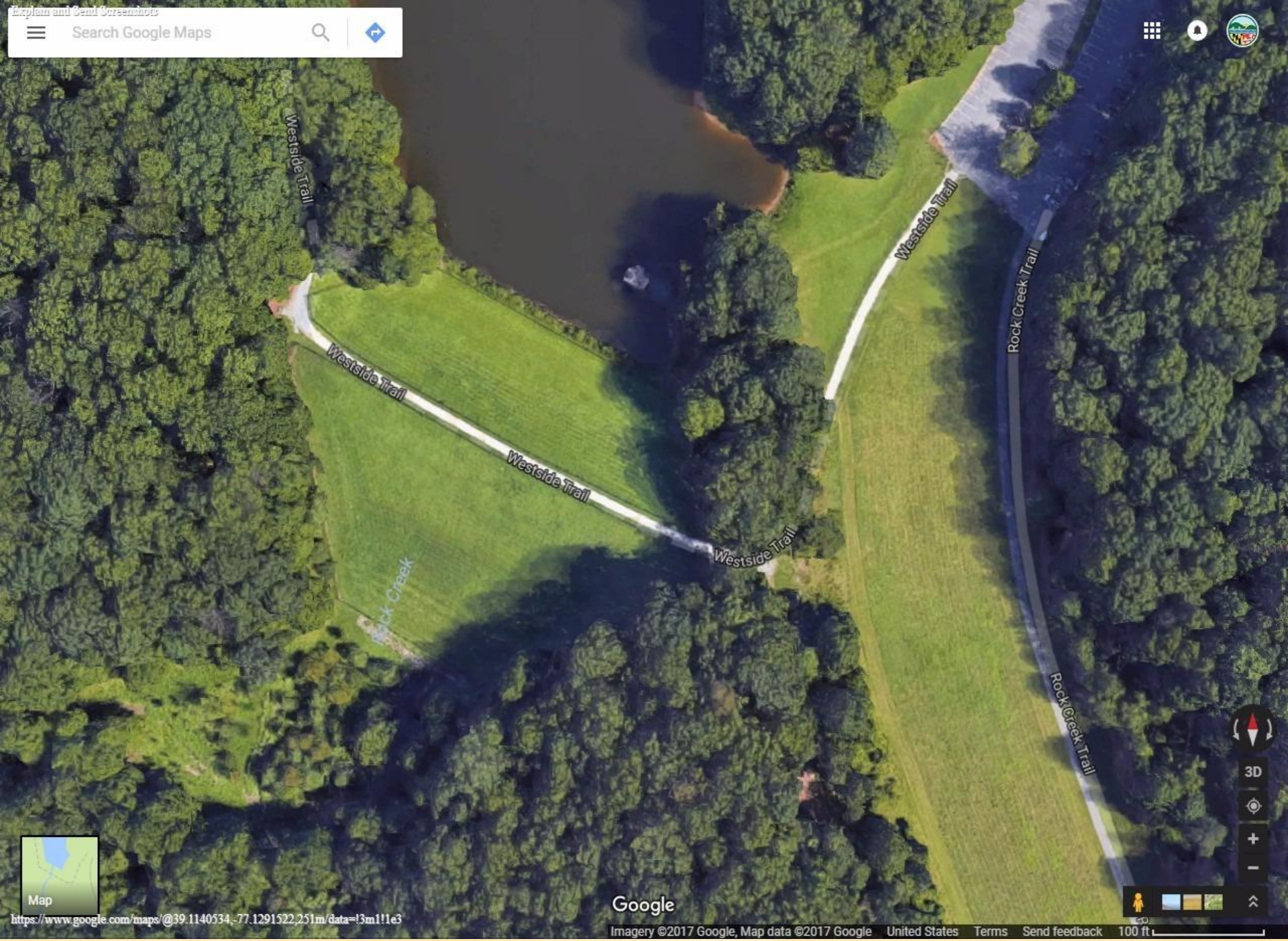


Fig. 3. Generalized geologic cross section of the ORNL area.

Lake Needwood Dam – MD Piedmont

- A ‘High Hazard’ dam;
- Earthen flood-control structure for Upper Rock Creek watershed;
- Storage capacity of the 75-acre reservoir - 196 million gallons;
- Designed to discharge 100-yr flood waters through the 42” diameter principal spillway over 10-days, reducing flooding risks downstream;
- Zoned embankment has clay-core;
- Cut-off trench (12’-20’ wide) located 20’ upstream from centerline down into weathered rocks – schist & gneiss in the foundation.

- Thanks to Visty Dalal – MDE Dam Safety Division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Foundation Preparation

- In 1965, single line grout curtain was constructed ONLY on the right abutment and below a portion on right side of the dam based on the soundness of rock in a single boring located in the valley bottom;
- Therefore, as per the 1962 reports, only 1/3 of the valley bottom was grouted before the dam was constructed.

Extreme Rain Event

- June 26, 2006 - heavy rains (~9 inches) resulted in a 23-foot rise in water level in the lake.

- June 28, 2006 – dam staff observed uncontrolled, concentrated seepage emanating from left abutment/embankment area (300 GPM), along with soil particles. This had significant potential for “piping failure”.

Seepage After Extreme Rain Event

Potential Causes for Seepage

- Fracture flow through foundation rock;
- Flow through abutments;
- Flow through rock/embankment contact;
- Flow through embankment defects;
- Ineffectiveness of downstream blanket drain; and
- Flow over the core in the dam

Lake Needwood Lessons

- Total repair cost to the new owner - $3 million.
- Dam hasn't had any problems since 2008 and is now actively monitored.
- Every dam project should have an engineering geologist involved with site characterization, design & construction
- Some cost-saving measures today can lead to higher costs in the future.

Conclusions

- Rigorous geologic investigations are fun
- Research informs our concepts
- Continue to learn and expand your experience
- Never stop learning
- Applying geologic knowledge is necessary for critical facilities

Never too young to start!

Any ?