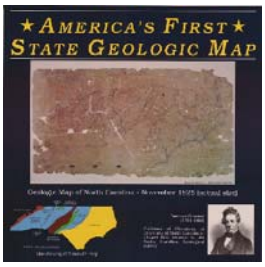
Geologic Data of the North Carolina Geological Survey – From Historic Data to Modern Detailed Geologic Mapping



1823 – State Legislature passed an act…. *"to commence and carry on a geological and mineralogical survey of the various regions of the State;….."*

1825 - America's First State Geologic Map

Phil Bradley - North Carolina Geological Survey

Division of Energy, Mineral and Land Resources

North Carolina Geological Survey

Division of Energy, Mineral and Land Resources

Mission

Our mission is to provide unbiased and technically accurate applied earth science scientific information to address societal needs.

Keepers of Geologic Data for North Carolina

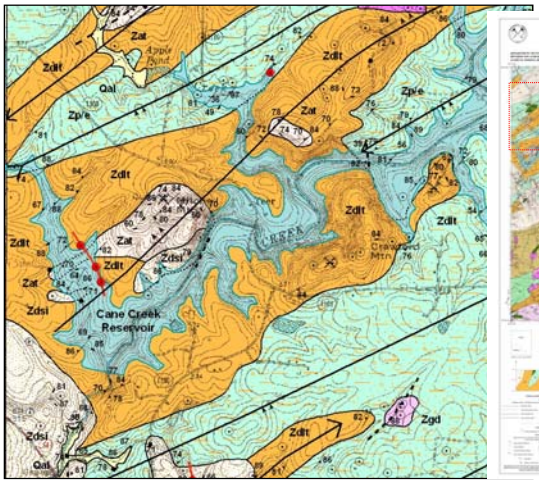
- **Maps, publications, core, rock samples, etc…**
- **1985 State Map**
- **Detailed geologic maps**

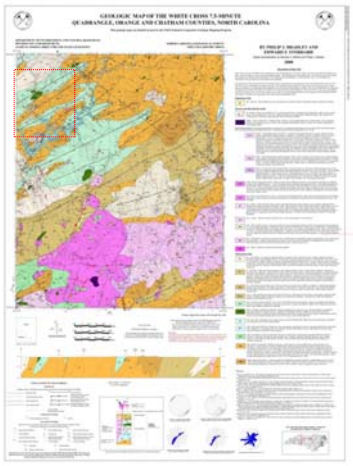
Why do you Care?

- **99% (or more) of time detailed geology may not matter for a site or investigation.**
- **But occasionally detailed geology may have a big impact on success of site work/investigation**
- **Our goal is to provide resources to help identify that other 1% of out-of-ordinary geologic condition(s) that could have an impact on a project by utilizing existing geologic data from the NCGS**

Detailed Geologic Maps

"The number 1 fundamental resource for the geologist."

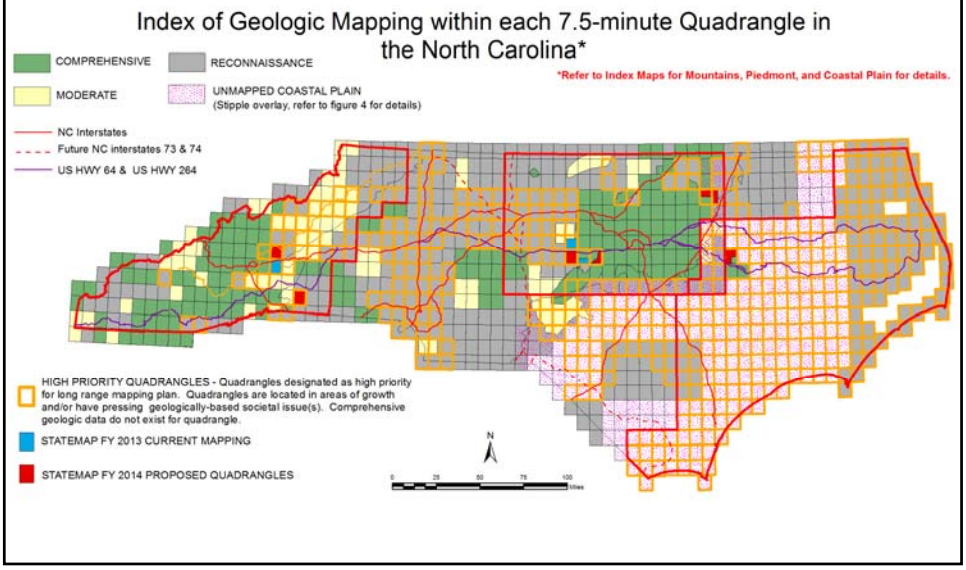


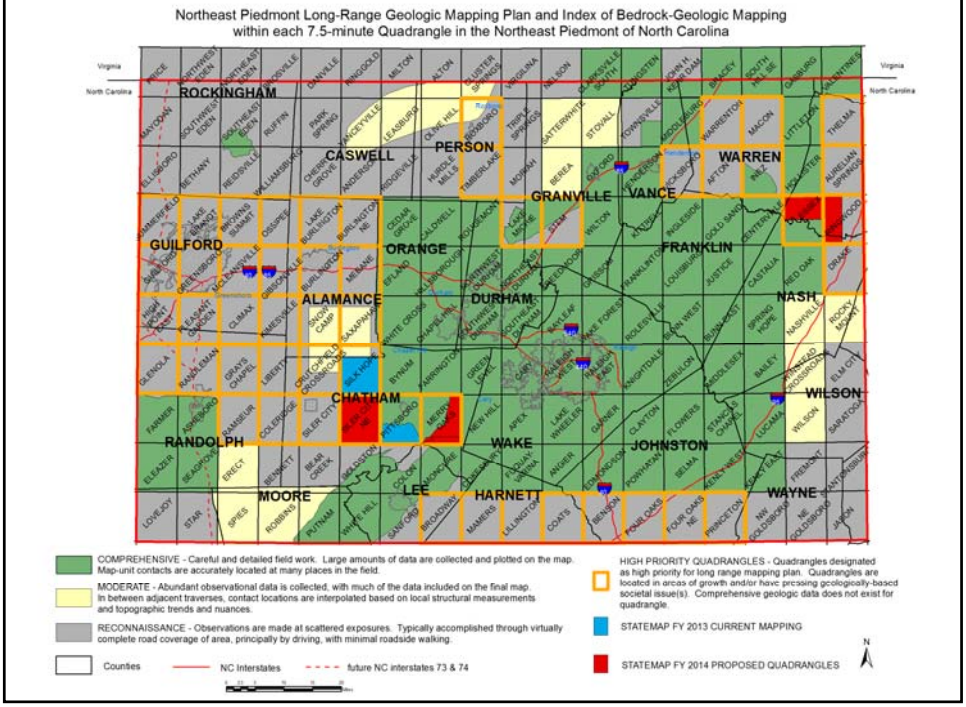


Partially Funded by: USGS science for a changing world

Detailed Geologic Maps

"The number 1 fundamental resource for the geologist."





Mountains and Piedmont - Geologic Data Collection

-**In general we collect geologic data the same way its been collected for almost 200 years**

-**Record observations** **(pen and paper and/or field computer)**
-**Collect structural measurements**
-**Collect samples for later analysis**

-**Keep our observations separate from our interpretations**

Generally the same process for landslide mapping and bedrock mapping

Tools in the Field

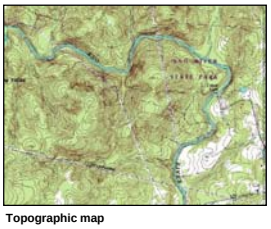
Hand lens

Rock hammer

Brunton Compass

Field computer

Field book



Topographic map

Scale bar and photograph identification board

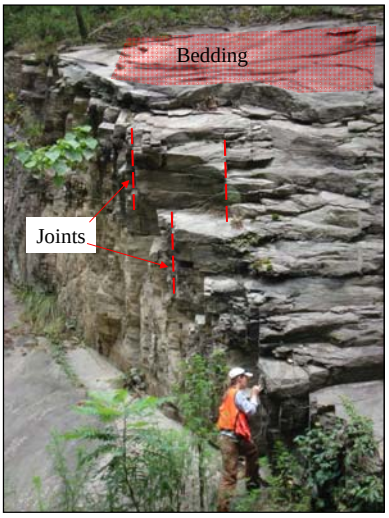
Field camera

Collecting Geologic Data and Measurements

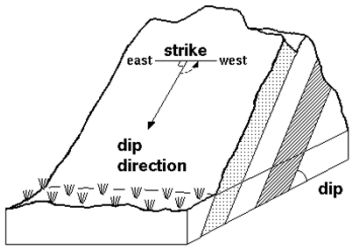
General Steps for Detailed Geologic Mapping:
-Drive all roads
-Walk all streams
-Find "all" outcrops of rock
(and native large boulders and cobbles, etc….)

At the outcrop
-Record GPS location data for outcrop
-Record general observations of outcrop
-Break off piece with hammer
-Look at with hand lens
-Describe the rock type
-Collect measurements of structural features
(bedding, joints, foliations, etc.)

Collecting Geologic Data and Measurements



-What are structural features and measurements?



Source of figure - http://earthsci.org/processes/struct/section/strike.gif

Some Common Features:

Bedding – the original layering plane when the material was deposited

Foliation – planar features commonly formed from the growth of platy minerals during metamorphism

Joint – a fracture in rock where there has been no movement in the plane of the fracture

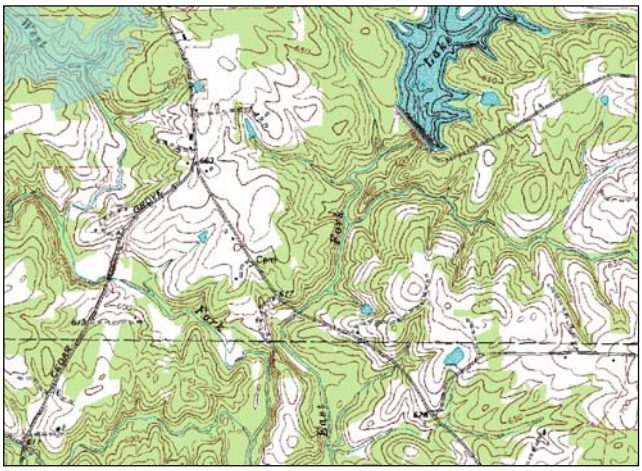
Fault - a fracture in rock where there has been movement in the plane of the fracture




Making Geologic Maps

Detailed Geologic Maps are based on observations and measurements collected in field

Step 1: Start with the base USGS 7.5-minute topographic map

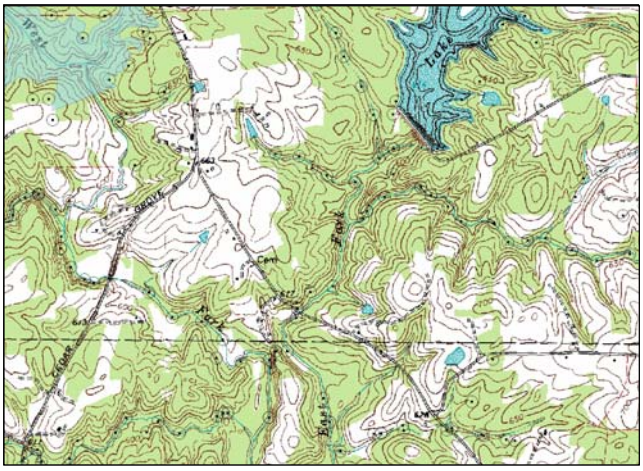


Cedar Grove 7.5-Minute Topographic Map, Orange County, NC

Making Geologic Maps

Detailed Geologic Maps are based on observations and measurements collected in field

Step 2: Plot the station locations from field (i.e. outcrops)

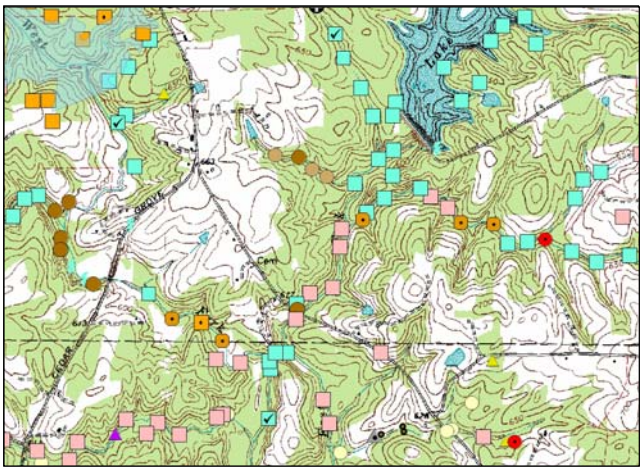


Cedar Grove 7.5-Minute Topographic Map, Orange County, NC

Making Geologic Maps

Detailed Geologic Maps are based on observations and measurements collected in field

Step 3: Color code symbols of each station based on rock type

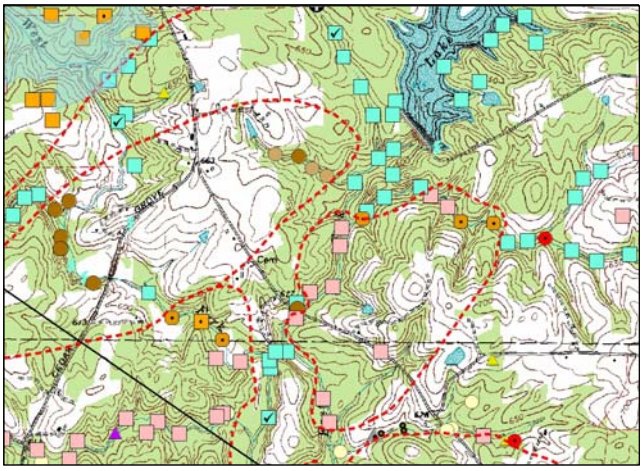


Cedar Grove 7.5-Minute Topographic Map, Orange County, NC

Making Geologic Maps

Detailed Geologic Maps are based on observations and measurements collected in field

Step 4: Draw lines (geologic contacts) surrounding groups of similar rock types

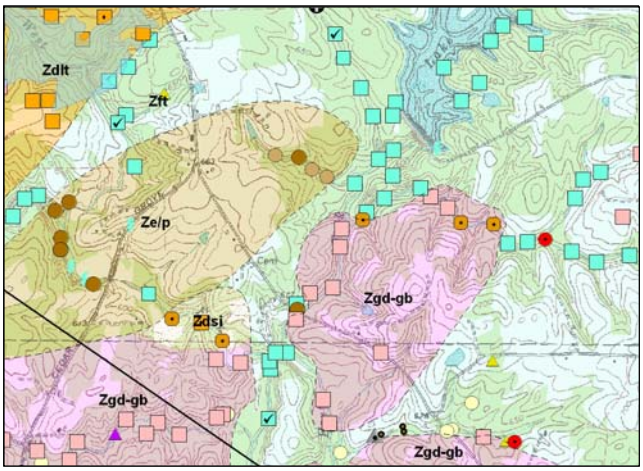


Cedar Grove 7.5-Minute Topographic Map, Orange County, NC

Making Geologic Maps

Detailed Geologic Maps are based on observations and measurements collected in field

Step 5: Color in the areas of similar rock types

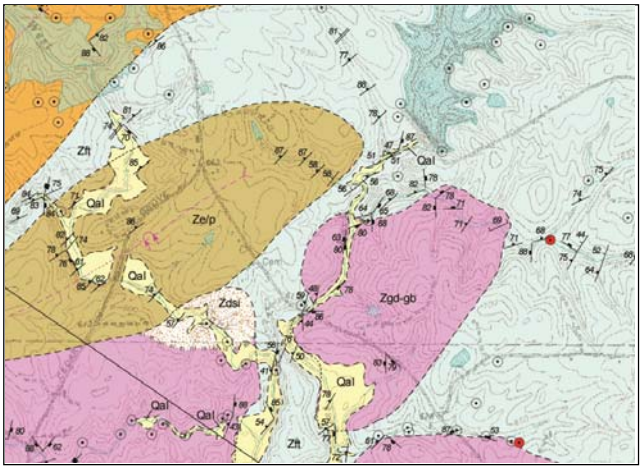


Cedar Grove 7.5-Minute Topographic Map, Orange County, NC

Making Geologic Maps

Detailed Geologic Maps are based on observations and measurements collected in field

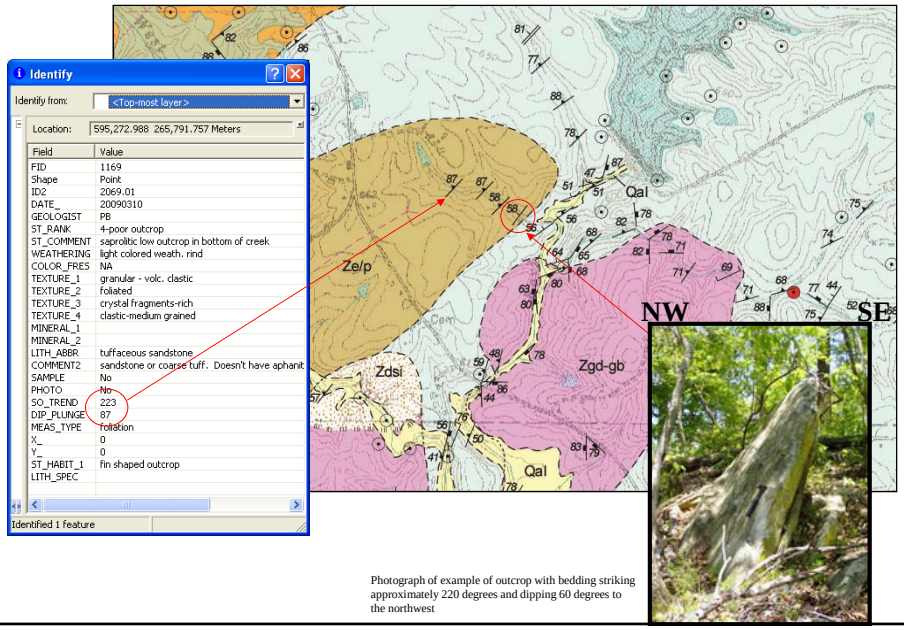
Step 6: Cartographer makes everything pretty!



Cedar Grove 7.5-Minute Topographic Map, Orange County, NC

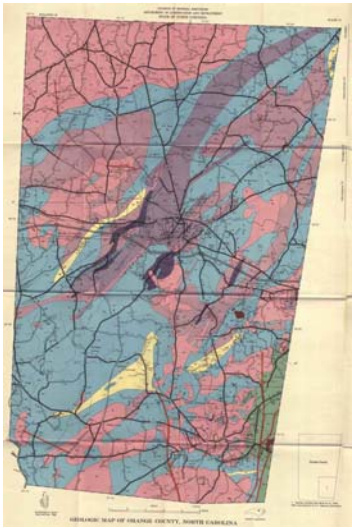
Making Geologic Maps

Detailed Geologic Maps are based on observations and measurements collected in field

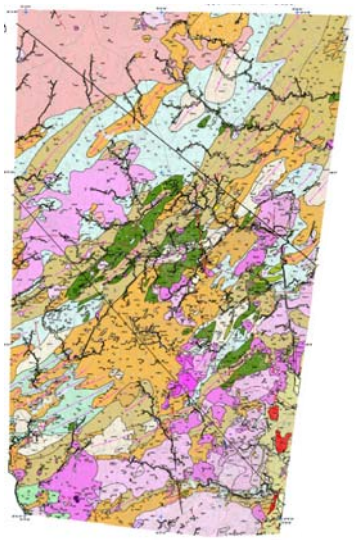


Photograph of example of outcrop with bedding striking approximately 220 degrees and dipping 60 degrees to the northwest

Work in Orange County



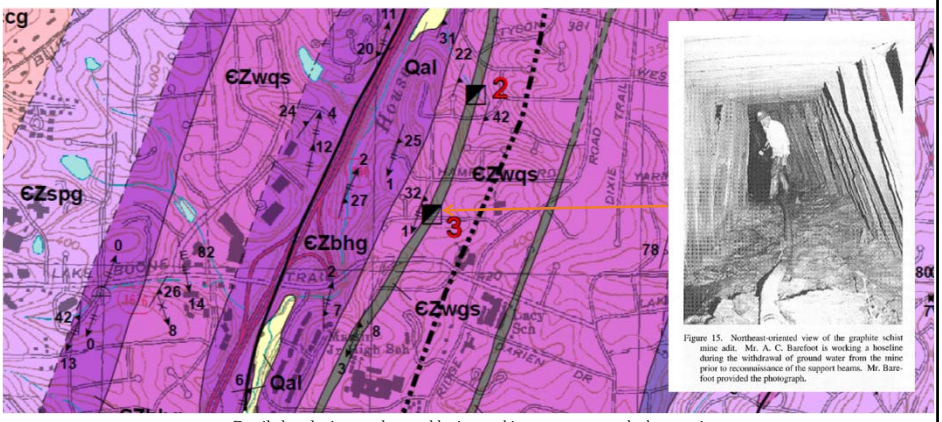
Allen and Wilson (1968)



Bradley, Hanna, Gay, Stoddard, Bechtel, Phillips, Fuemmeler (2012)

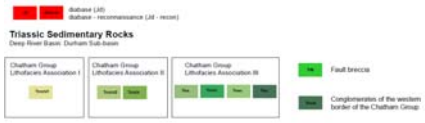
Geology mapped from 2003 to 2011

MINES AND PROSPECTS



Detailed geologic maps locate old mine workings more accurately than previous maps.

Deep River basin – Durham sub-basin
Rock Types

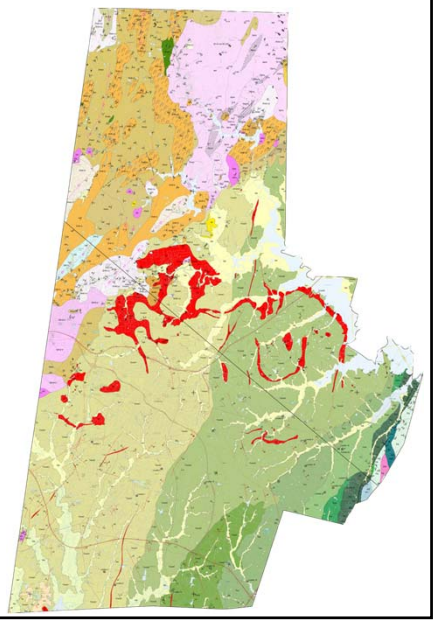


Conglomerates

Sandstones

Siltstones and Mudstones

Diabase



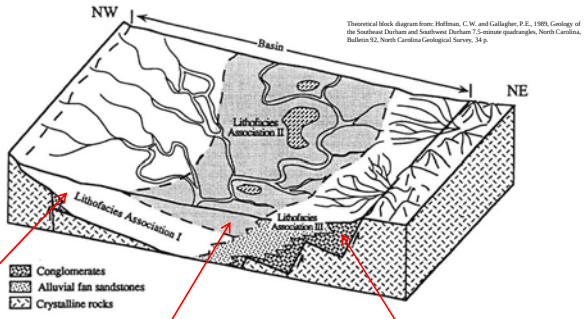
Triassic Basins in North Carolina

Main Rock Types:

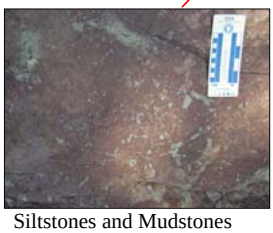
Conglomerates
Sandstones
Siltstone
Mudstones

Diabase intrusions

Minor Rock Types:
Coal
Limestone
Carbonate rich sediments

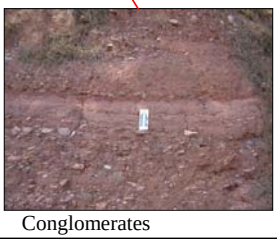


Theoretical block diagram from: Huffman, C.W. and Gallagher, P.E., 1989, Geology of the Southeast Durham and Southwest Durham 7.5-minute quadrangles, North Carolina, Bulletin 92, North Carolina Geological Survey, 34 p.



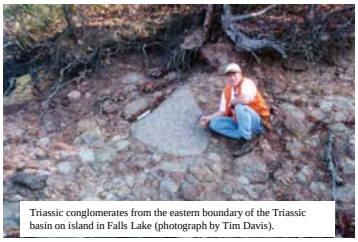
Siltstones and Mudstones

Sandstones



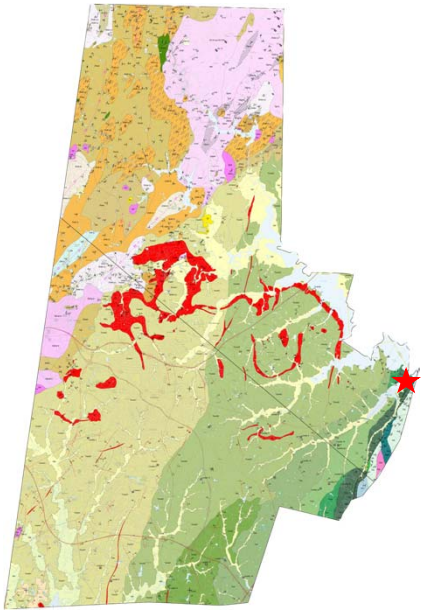
Conglomerates

Deep River basin – Durham sub-basin
Basin-margin conglomerates



Triassic conglomerates from the eastern boundary of the Triassic basin on island in Falls Lake (photograph by Tim Davis).

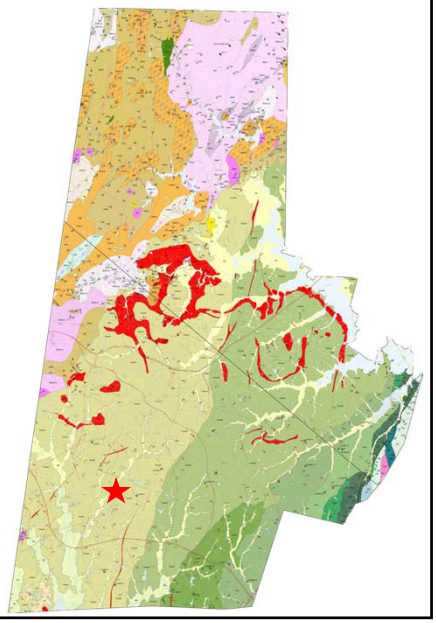
Triassic conglomerates along shore of Falls Lake



Triassic conglomerates along shore of Falls Lake

Deep River basin – Durham sub-basin

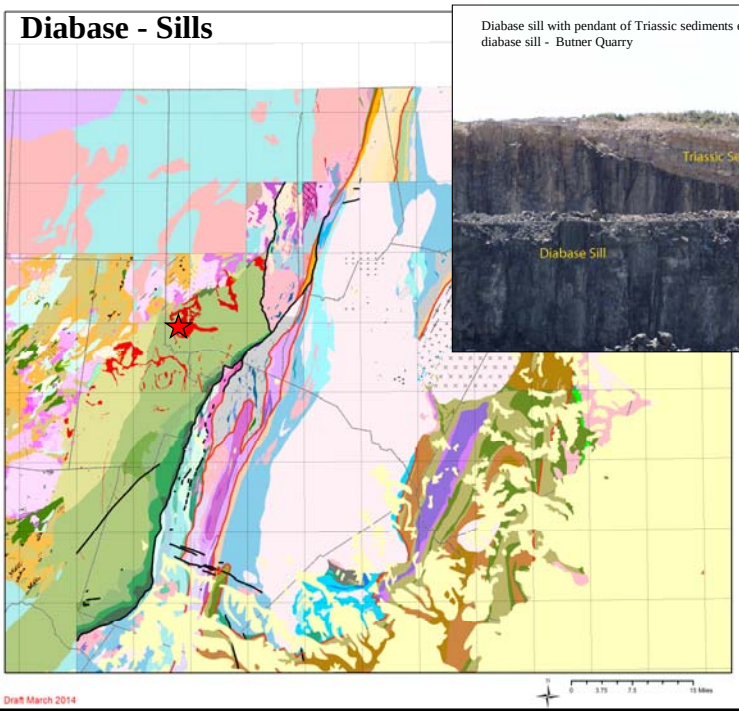
Sandstones and siltstones



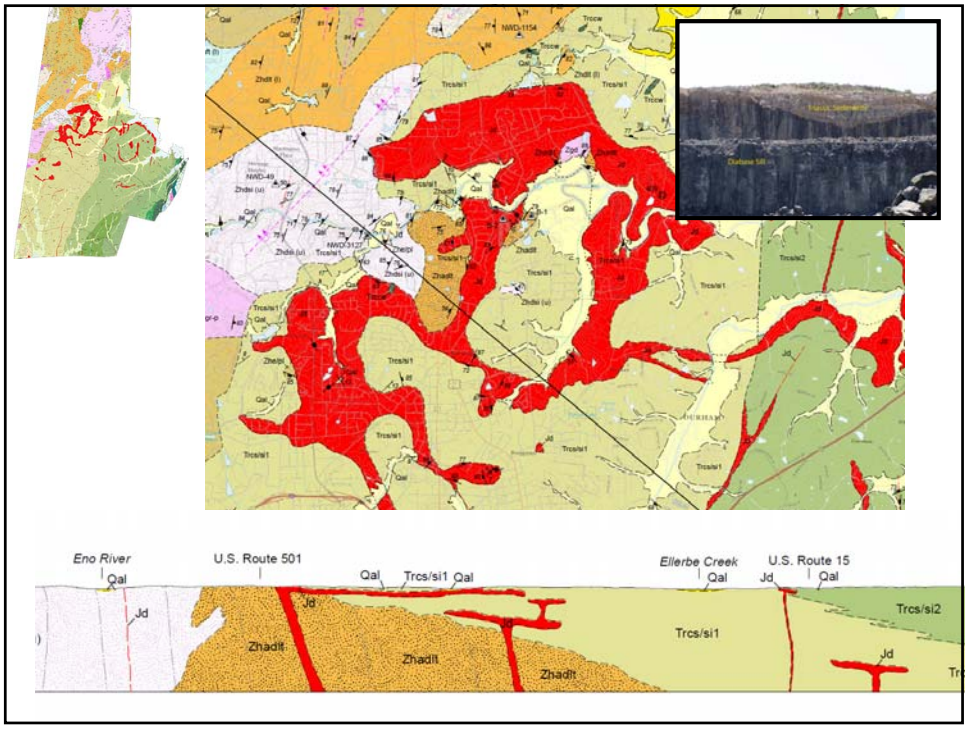
Diabase - Dikes

Diabase boulders from dike exposed off Briggs Ave, Durham, NC

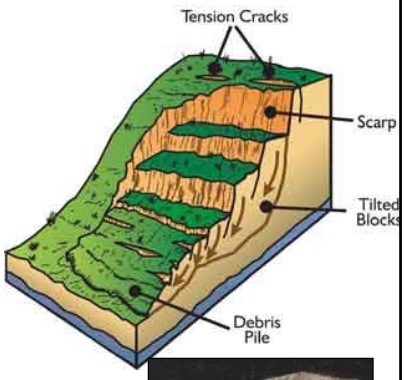
Diabase - Sills

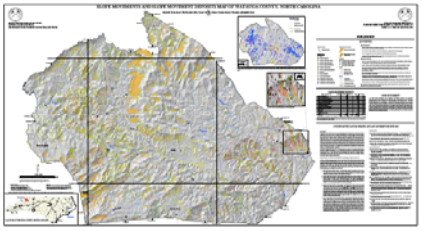


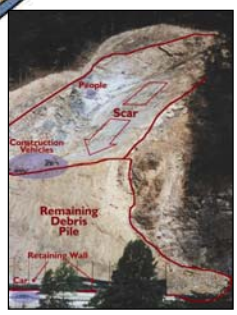
Diabase sill with pendant of Triassic sediments exposed in the Butner diabase sill - Butner Quarry



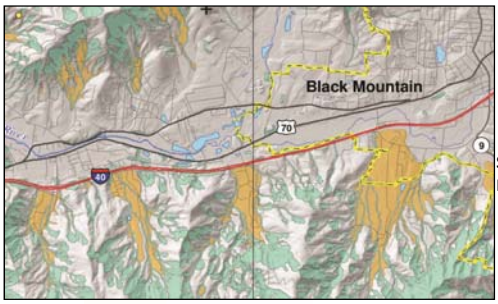
Slope Stability Issues

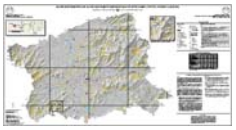






Landslide Hazard Maps

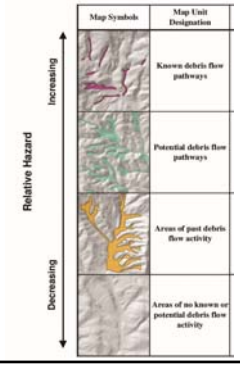




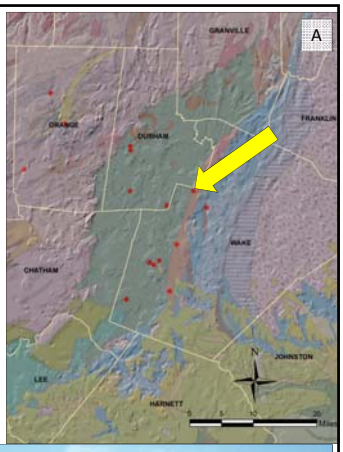
Slope Movements and Slope Movement Deposits Map of Buncombe County, North Carolina

Stability Index Map of Buncombe County, North Carolina

Map of Known and Potential Debris Flow Pathways in Buncombe County, North Carolina



I-540 near U.S. 70: Rotational Slide – Cut Slope Failure 1996-1999



DURHAM COUNTY

A

B

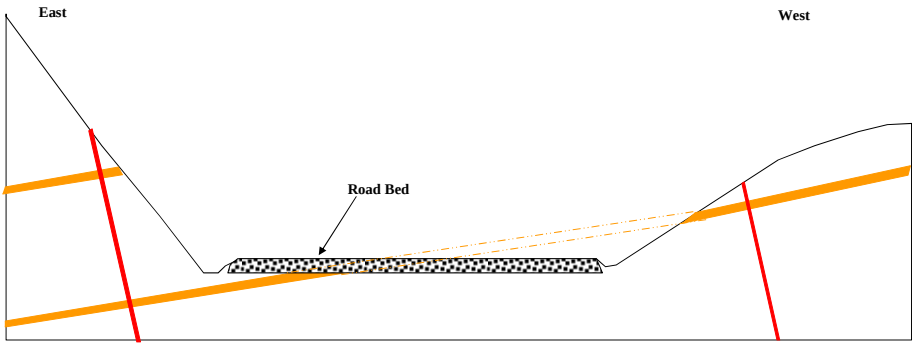
C

D

Photographs of minor slope failure on HWY 55 immediately north of the Kit Creek Road and HWY 55 intersection. Approximately 3.6 miles south of I-40.

Photograph Explanations:

A –View of slope failure looking southwest. Yellow book for scale is approximately 7.5 inches x 4.5 inches.
B - View looking in a southerly direction parallel to embankment
C – View looking down into top of slope failure
D – close-up photograph of weathered Triassic siltstone

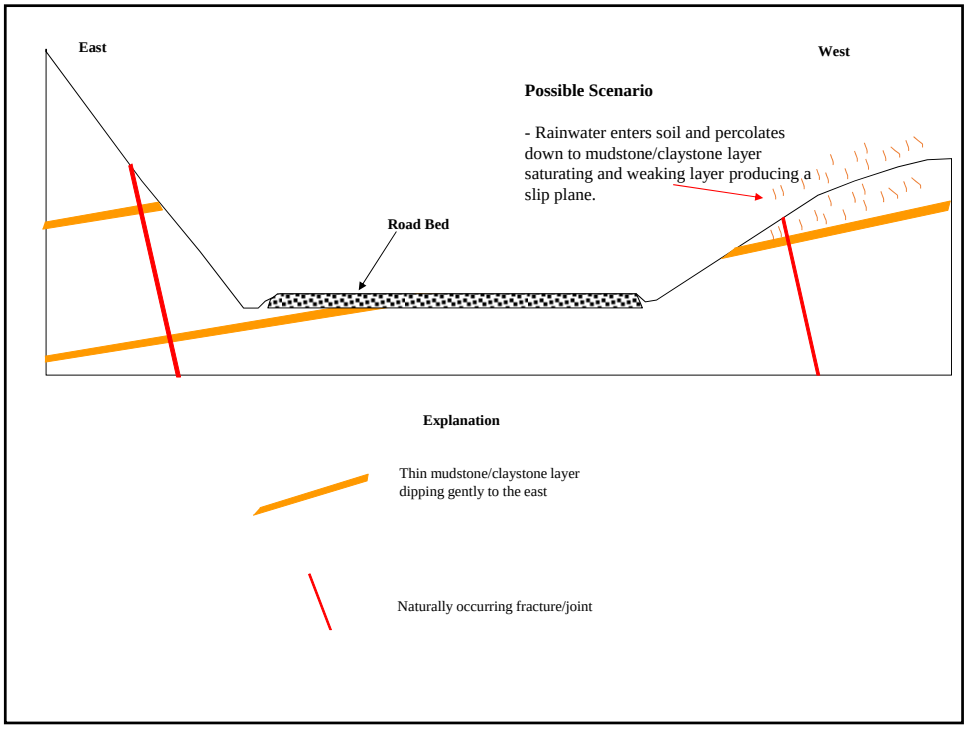


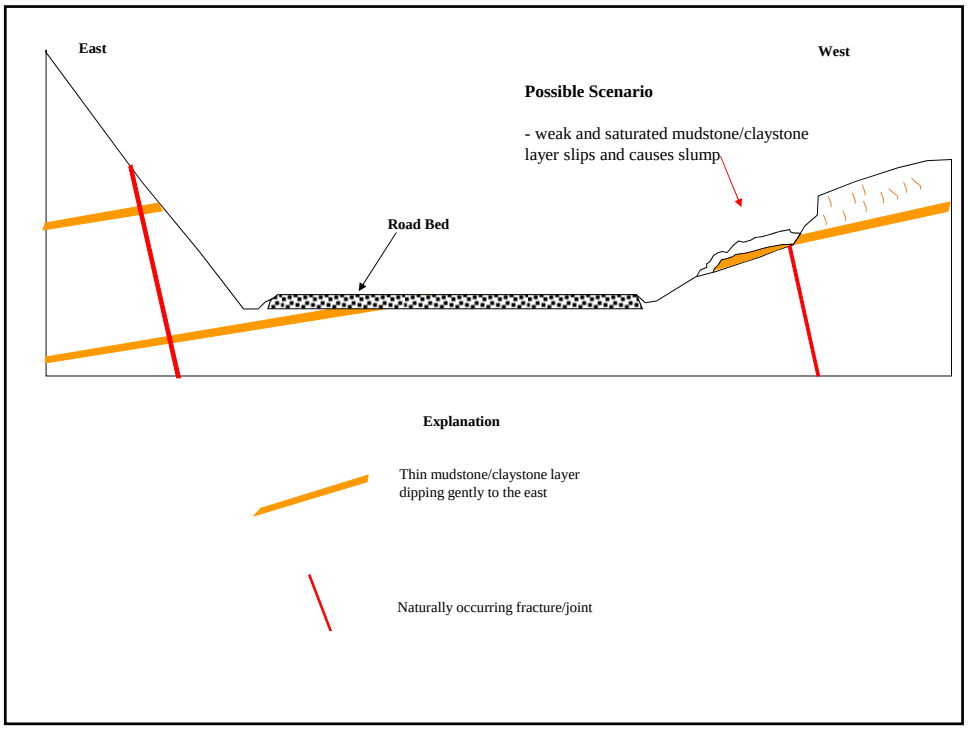
Explanation

Thin mudstone/claystone layer dipping gently to the east

Extension of mudstone/claystone layer before road construction

Naturally occurring fracture/joint


East
West
Possible Scenario
- Rainwater enters soil and percolates down to mudstone/claystone layer saturating and weaking layer producing a slip plane.
Road Bed
Explanation
Thin mudstone/claystone layer dipping gently to the east
Naturally occurring fracture/joint


East
West
Possible Scenario
- weak and saturated mudstone/claystone layer slips and causes slump
Road Bed
Explanation
Thin mudstone/claystone layer dipping gently to the east
Naturally occurring fracture/joint

1984 Duke Gardens Slope Problems

Approximate location of slope movement outline for the Duke Gardens-Flowers Drive rotational slide shown on 2010 orthophotography

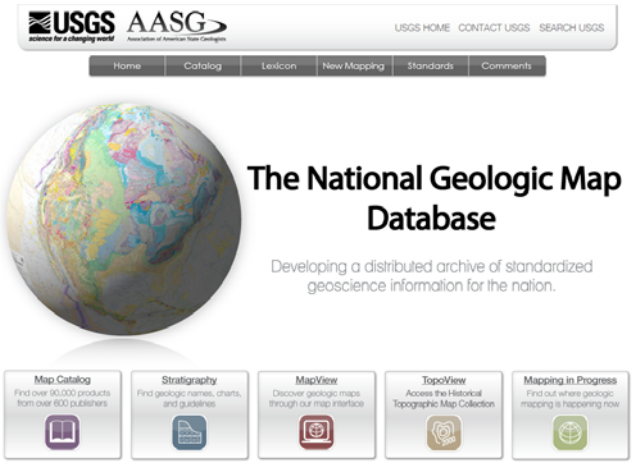
2/5/1984

2/12/1984

Late Feb. 1984

Resources

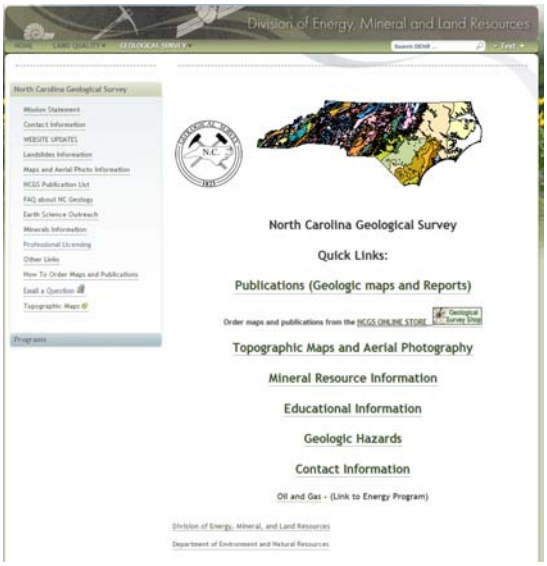
http://ngmdb.usgs.gov/ngmdb/ngmdb_home.html



National Geologic Map Database – Download digital versions of many maps from North Carolina

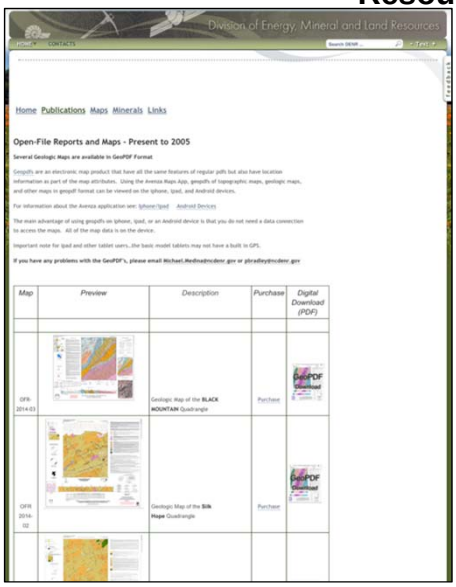
http://ngmdb.usgs.gov/ngmdb/ngmdb_home.html

Resources



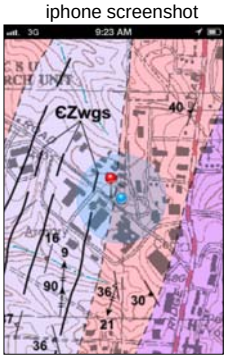
North Carolina Geological Survey Website
http://portal.ncdenr.org/web/lr/geological_home

Resources



GeoPDFs for iphone/ipad and Android

iphone screenshot



North Carolina Geological Survey Website
http://portal.ncdenr.org/web/lr/nc-open-file-reports

Resources

North Carolina Geological Survey Yahoo Shop
http://nc-maps.stores.yahoo.net/