

PRELIMINARY RESULTS OF RECENT LANDSLIDE SUSCEPTIBILITY MAPPING IN ALBEMARLE AND NELSON COUNTIES, VIRGINIA

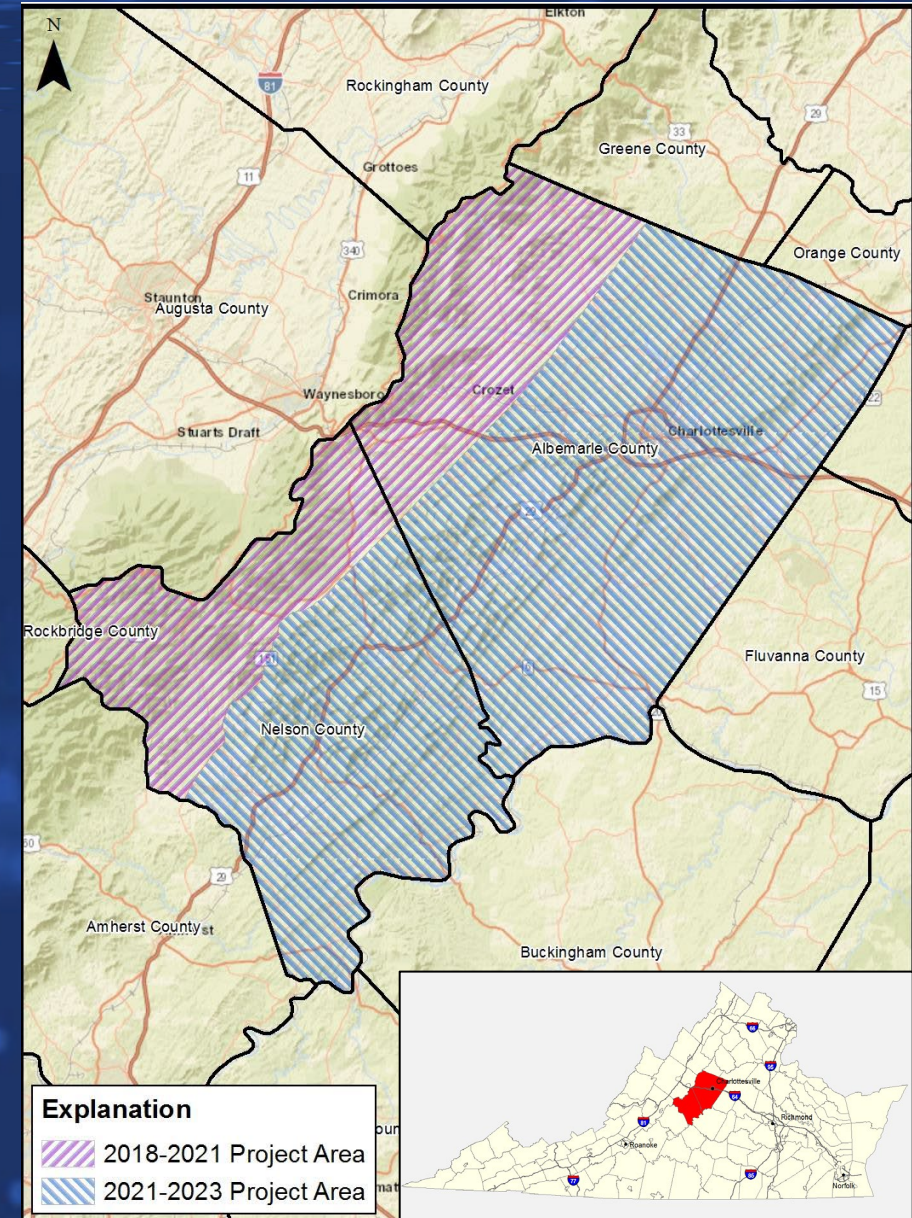
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anne.witt@energy.virginia.gov



VDEM-FEMA PRE-DISASTER MITIGATION GRANT PROJECTS IN NELSON & ALBEMARLE COUNTIES:

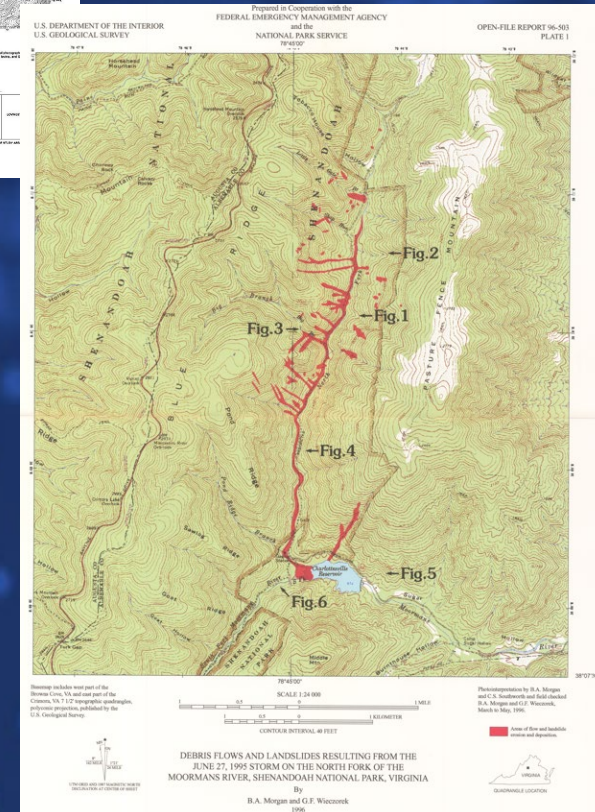
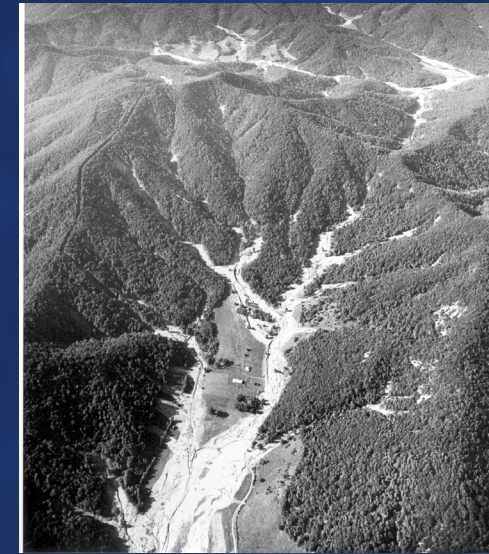
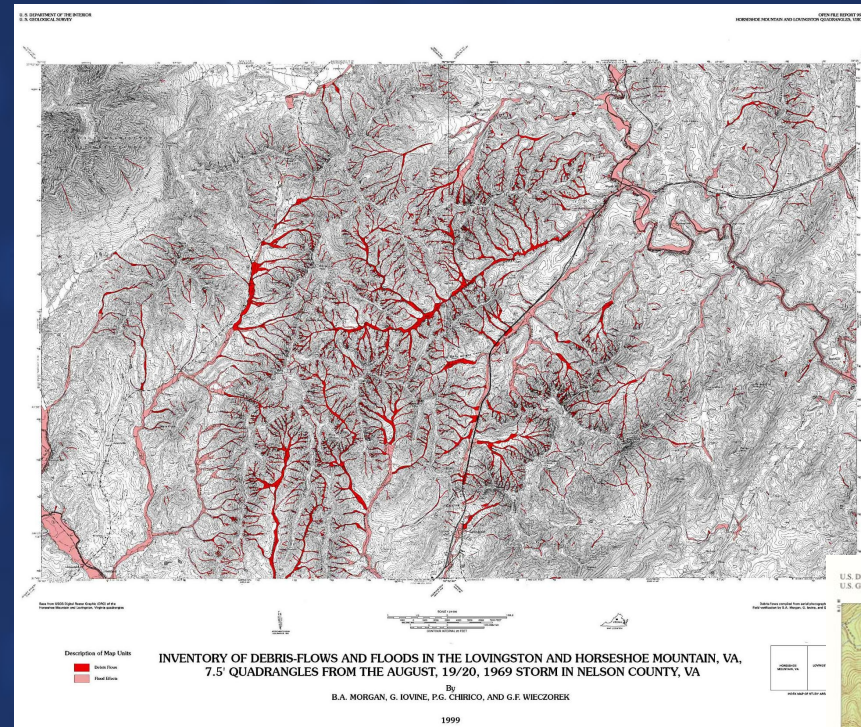
Western Landslide Risk Assessment (2018-2022)
Eastern Landslide Risk Assessment (2021-2023)

- Received funding to support 1 full-time grant funded geologist for 3 years
- Goal: Complete a landslide hazard map for Nelson and Albemarle Counties to identify at-risk properties and infrastructure
- First in Commonwealth to use high-resolution LIDAR
- Western Study area delivered March 2022
- Final Maps will be delivered Sept 2024



BACKGROUND

- Study area was affected by two major rainfall events which generated 100s to 1000s of landslides
 - Hurricane Camille (1969) – Nelson County
 - Severe Thunderstorm (1995) – Western Albemarle County
- USGS produced inventory maps of part of the study area (1996, 1999)



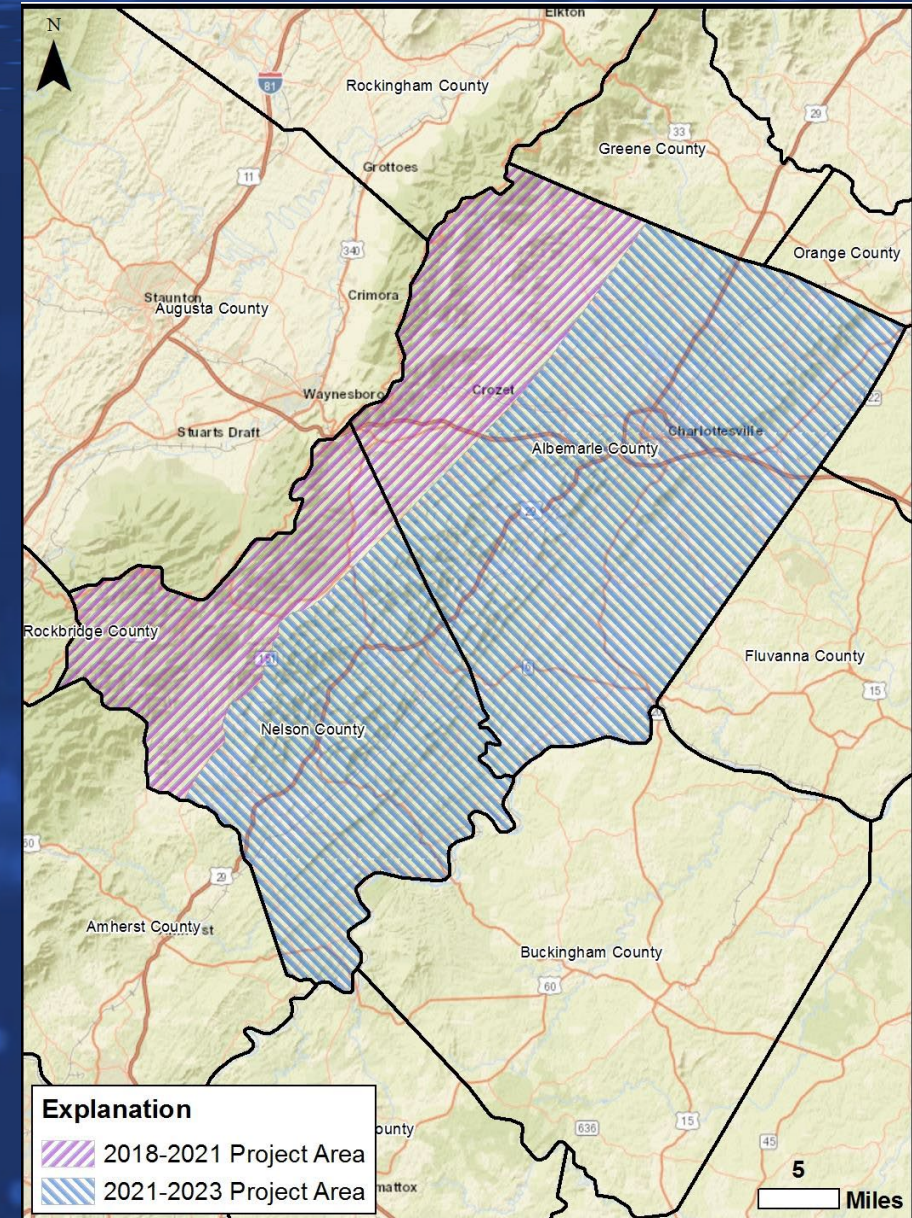
VDEM-FEMA PRE-DISASTER MITIGATION GRANT PROJECTS IN NELSON & ALBEMARLE COUNTIES:

Western Landslide Risk Assessment (2018-2022)

Eastern Landslide Risk Assessment (2021-2023)

This project will be completed in four phases:

1. Remote sensing of modern and prehistoric landslides in the study area using LIDAR
2. Geologic field mapping of landslide prone areas
3. Landslide susceptibility mapping and modeling
4. Presentation of data products and results to the planning community and the public.



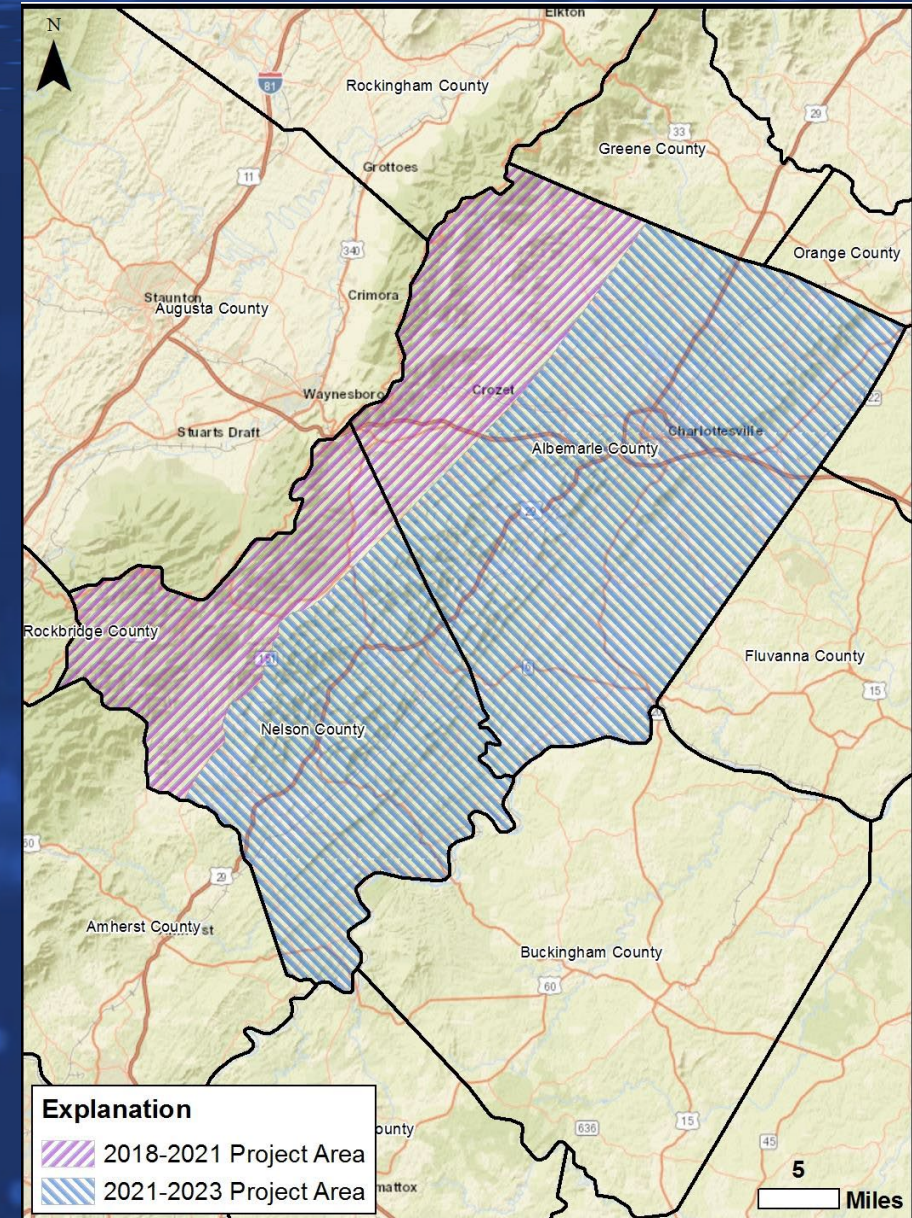
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Western Landslide Risk Assessment (2018-2022)

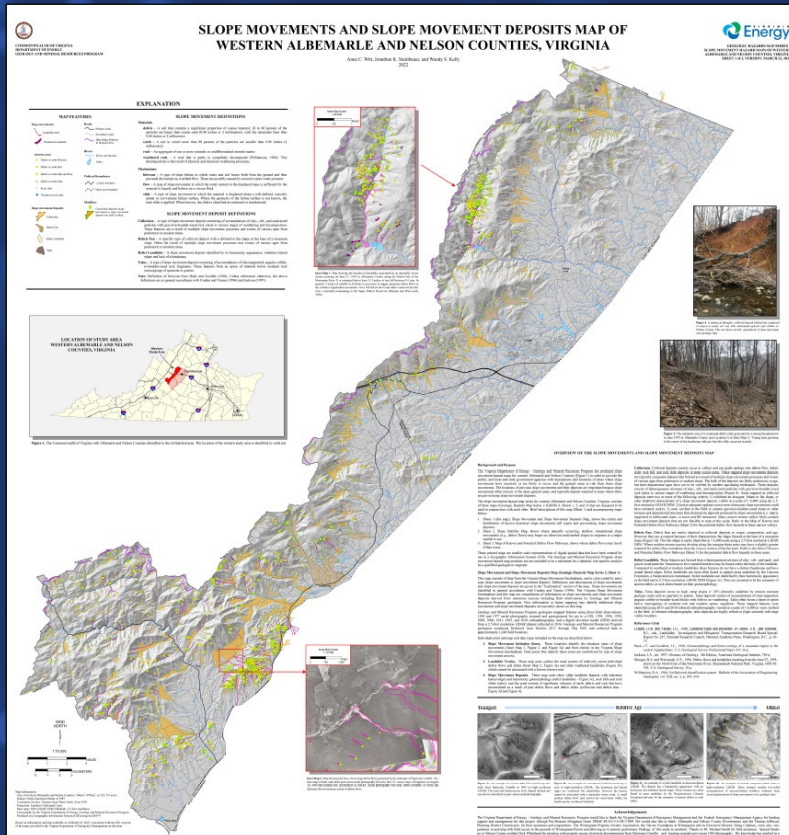
Eastern Landslide Risk Assessment (2021-2023)

This project will be completed in four phases:

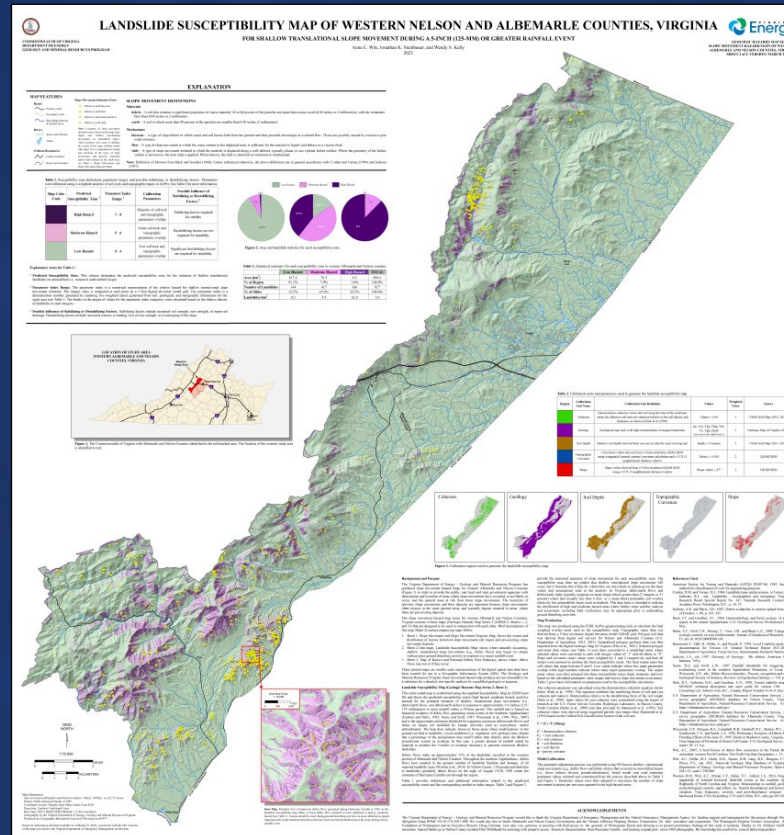
- ~~1. Remote sensing of modern and prehistoric landslides in the study area using LIDAR~~
- ~~2. Geologic field mapping of landslide prone areas~~
3. Landslide susceptibility mapping and modeling (complete in western study area)
4. Presentation of data products and results to the planning community and the public (ongoing)



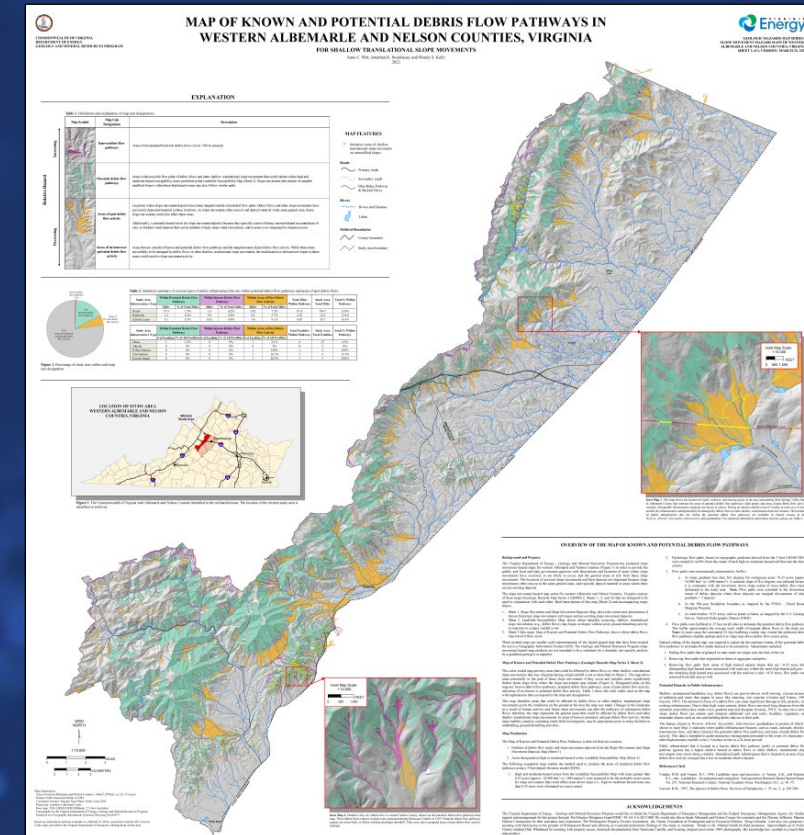
MARCH 2022 FEMA/VDEM DELIVERABLES



1 Landslide Inventory Map



2 Landslide Susceptibility Map



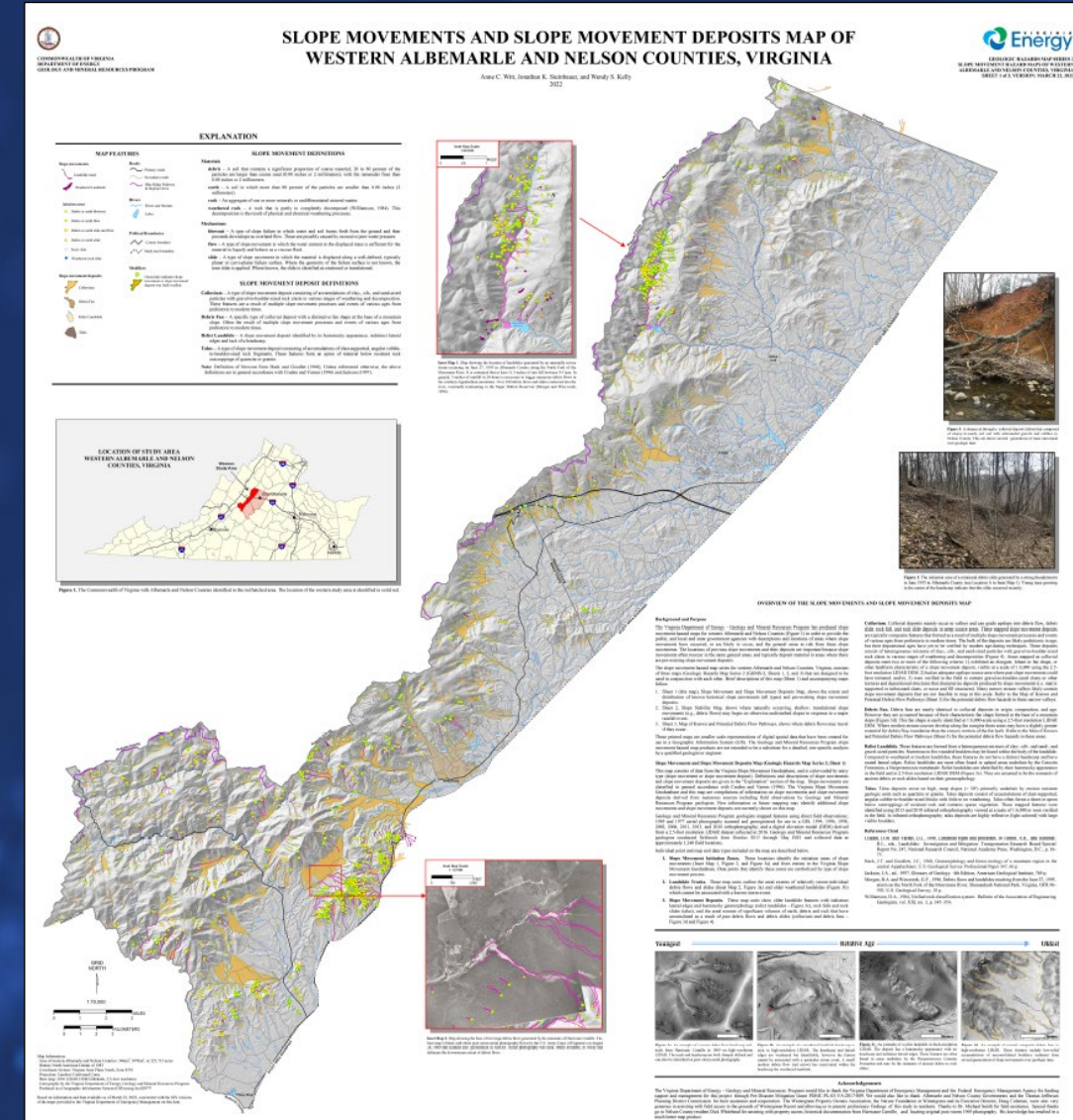
3 Landslide Pathway Map

*PDF maps, GIS data and metadata, users guide

VDEM-FEMA PRE-DISASTER MITIGATION GRANT PROJECTS IN NELSON & ALBEMARLE COUNTIES:

First county-scale landslide project in Virginia to use high-resolution 1-meter LIDAR data

- Current study results – 2 county area:
 - Landslides identified (headscarps): **7809**
 - Hurricane Camille 1969: **7241 (93%)**
 - June 27, 1995 Storm: **189 (2%)**
 - Landslides field verified by a Virginia Energy geologist: **415 (5%)**
 - Landslide outlines (tracks): **1772**
 - **73** Weathered & **146** Relict Landslides
 - Ancient landslide deposits: **1592**
- *Updated data as of April 2024**









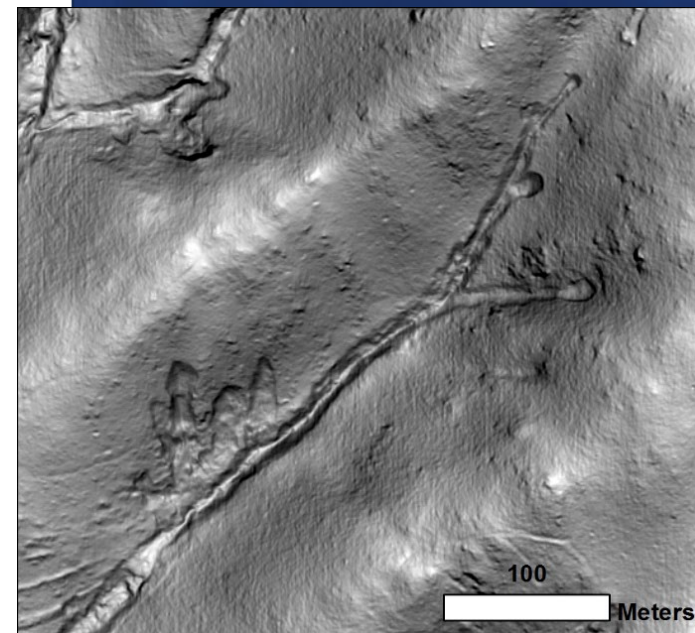
Anne C. Witt, Jonathan K. Sieckhaus, and Wendy S. Kelly



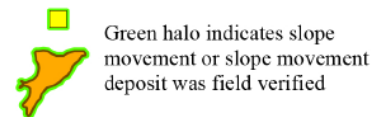
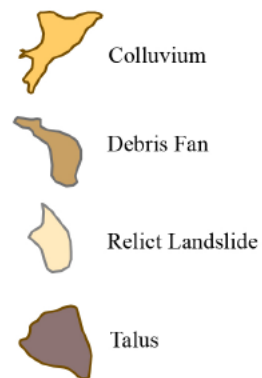
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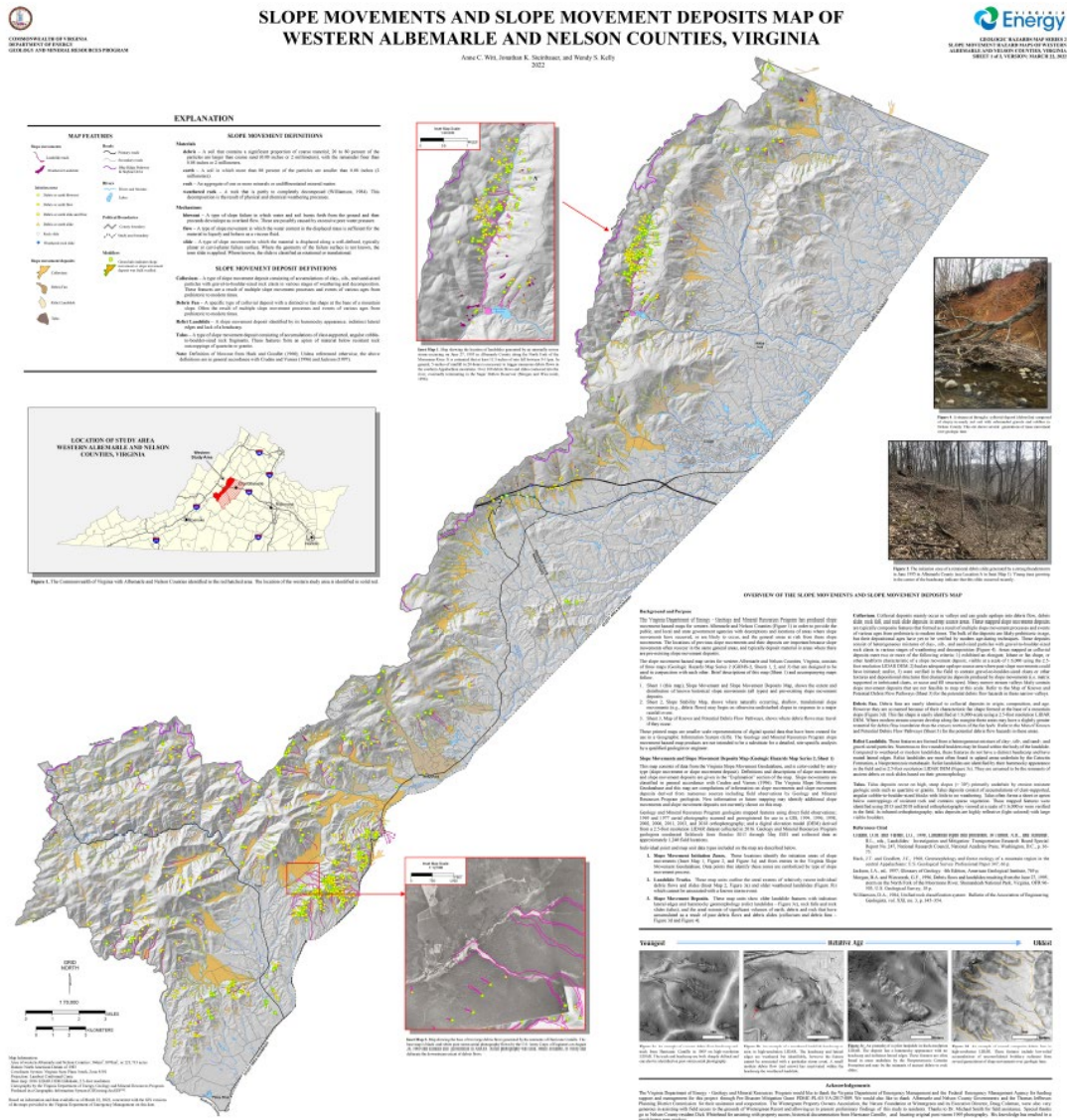
-  Debris or earth blowout
-  Debris or earth flow
-  Debris or earth slide and flow
-  Debris or earth slide
-  Rock slide
-  Weathered rock slide



Modern Landslide: track and headscarp sharply defined, can be identified on post-storm aerial photography



Weathered Landslide:
headscarp and lateral edges weathered but identifiable;
cannot be associated with storm event



1 Landslide Inventory Map

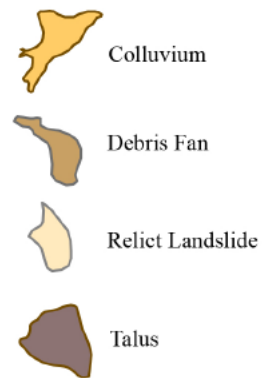
Slope movements



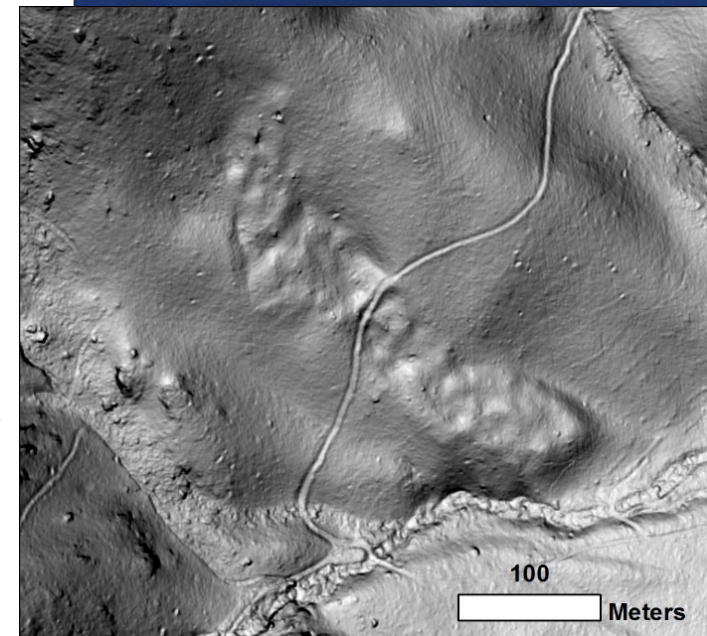
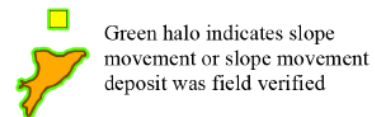
Initiation zones

- Debris or earth blowout
- Debris or earth flow
- Debris or earth slide and flow
- Debris or earth slide
- Rock slide
- Weathered rock slide

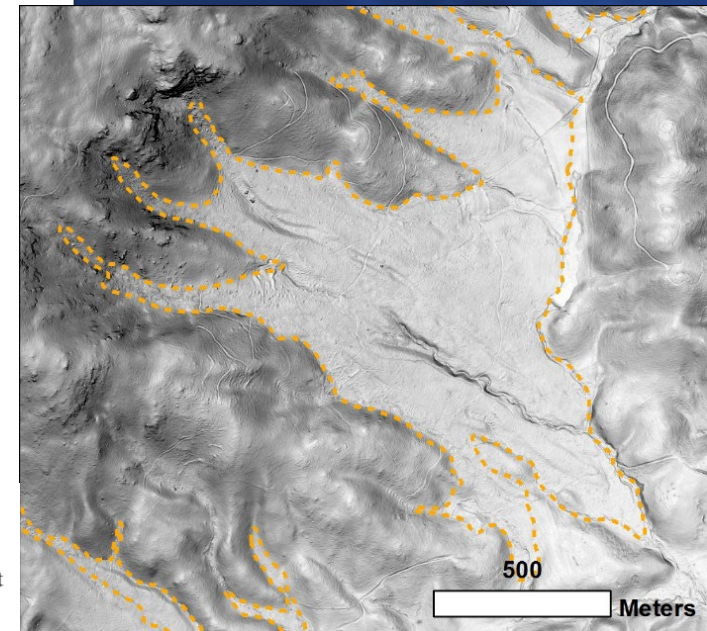
Slope movement deposits



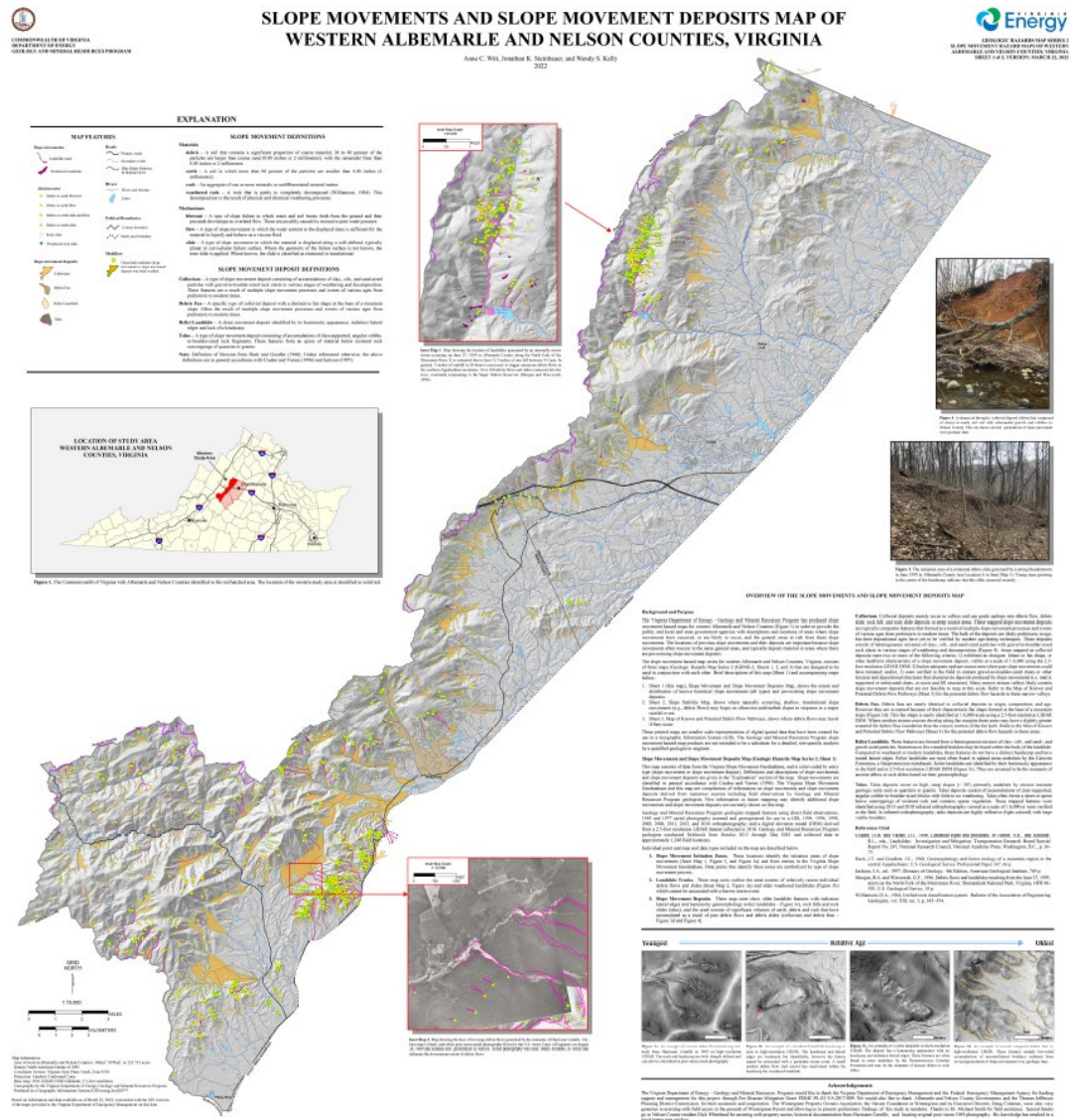
Modifiers



Relict Landslide:
hummocky appearance, indistinct lateral edges and no headscarp



Landslide Deposits:
low-relief accumulations of unconsolidated bouldery sediment



1 Landslide Inventory Map

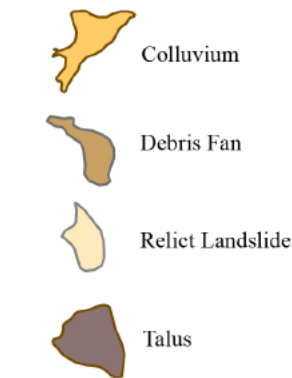
Slope movements



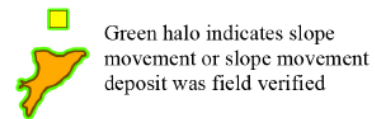
Initiation zones

- Debris or earth blowout 7
- Debris or earth flow 6087
- Debris or earth slide and flow 13
- Debris or earth slide 1696
- Rock slide 5
- Weathered rock slide 1

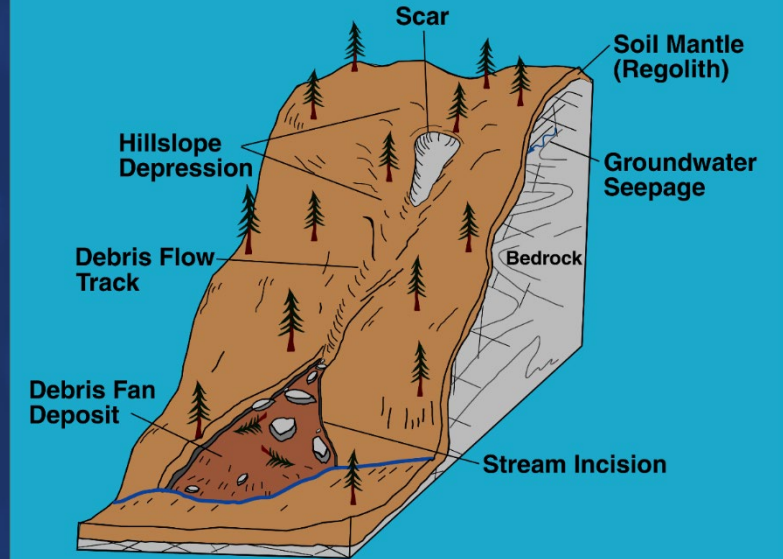
Slope movement deposits



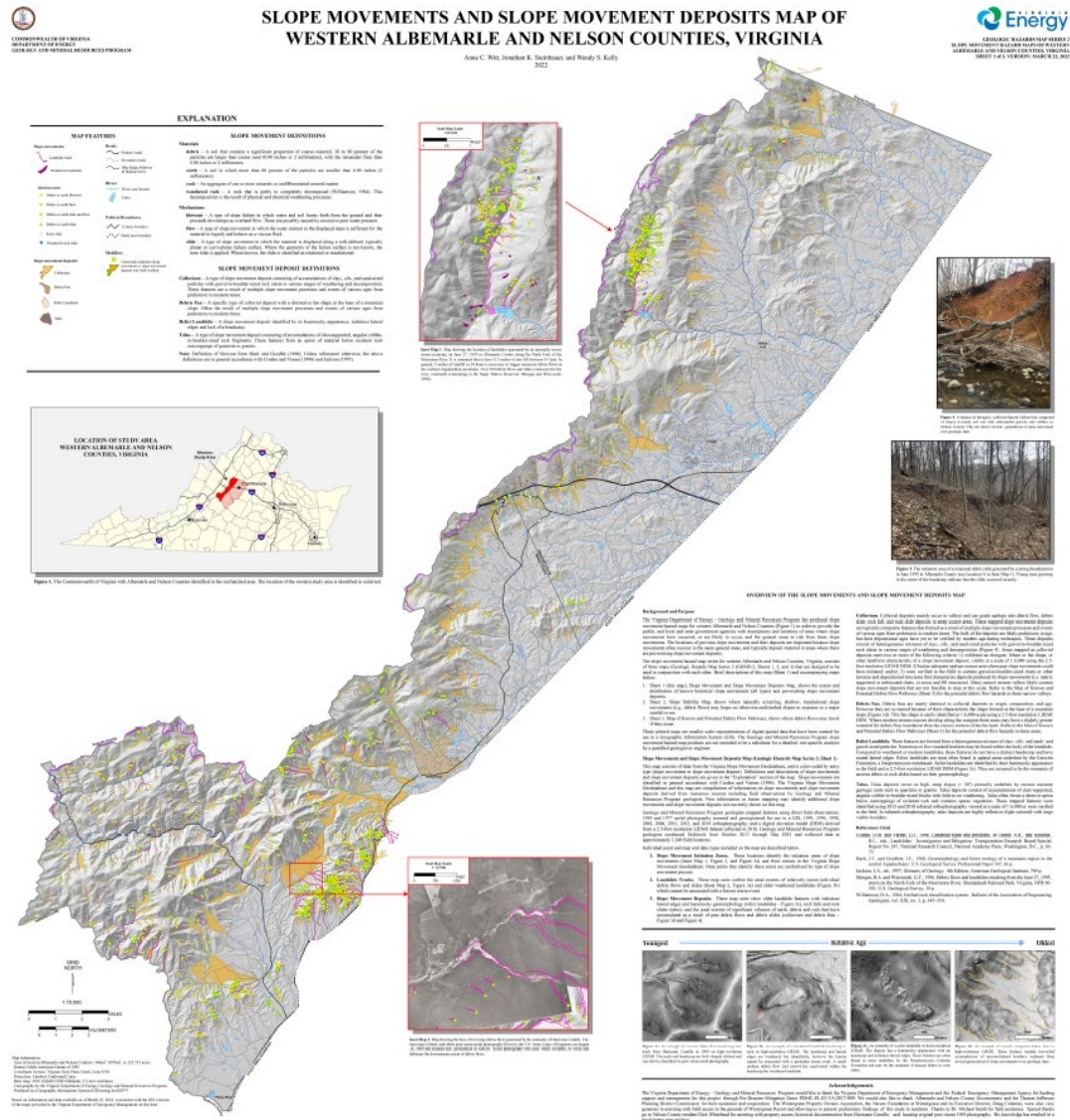
Modifiers



Typical Debris Flow



	Type of Movement	Slide Translational Rotational	Flow	Topple	Fall	Composite
M A T E R I A L	Earth (>80% <2mm)					
	Debris (>20% >2mm)		X			
	Weathered Rock (PDS-CDS)					
	Rock (STS-VFS)					



1 Landslide Inventory Map

Slope movements

- Landslide track
- Weathered Landslide

Initiation zones

- Debris or earth blowout 7
- Debris or earth flow 6087
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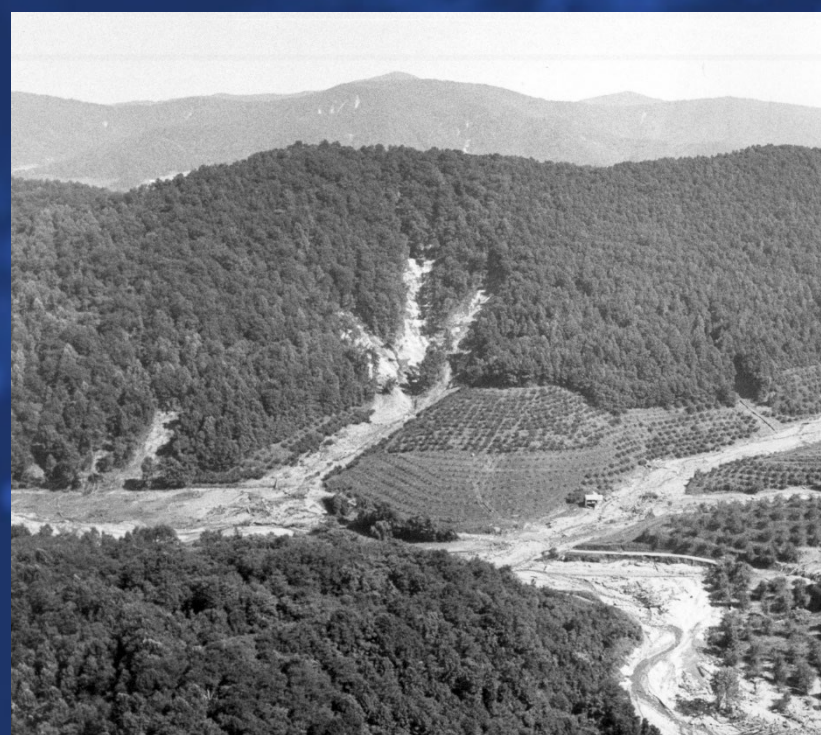


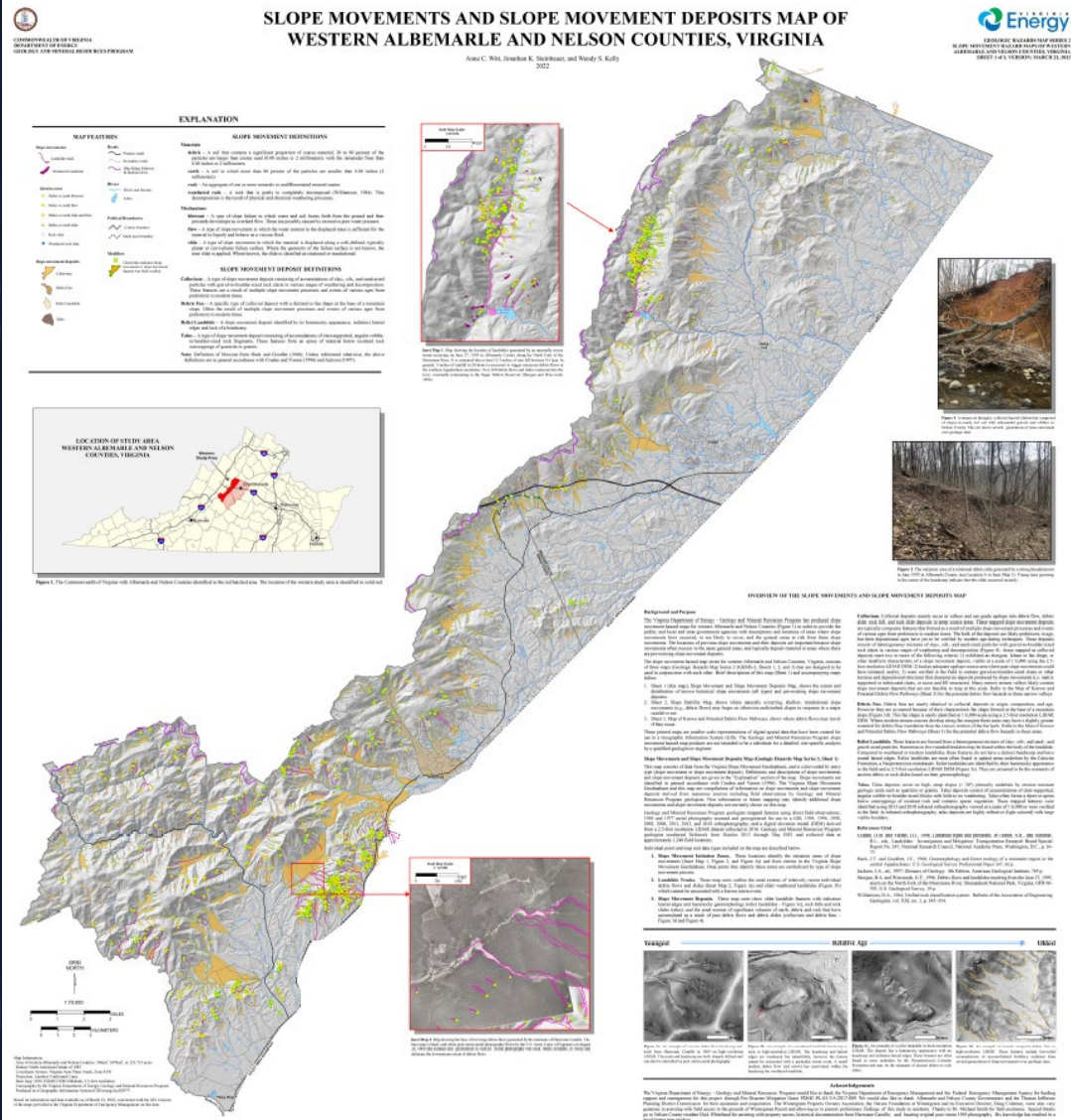
Slope movement deposits

- Colluvium
- Debris Fan
- Relict Landslide
- Talus

Modifiers

- Green halo indicates slope movement or slope movement deposit was field verified





1 Landslide Inventory Map

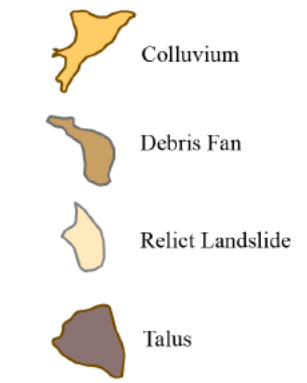
Slope movements



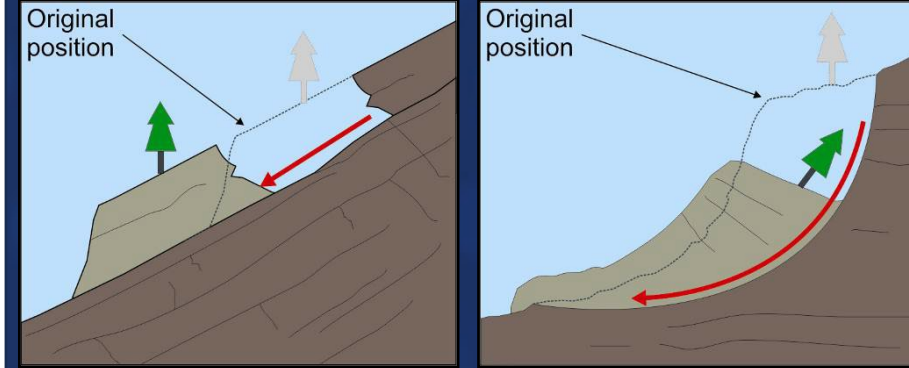
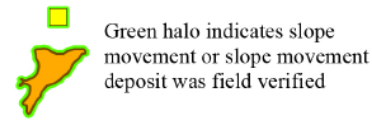
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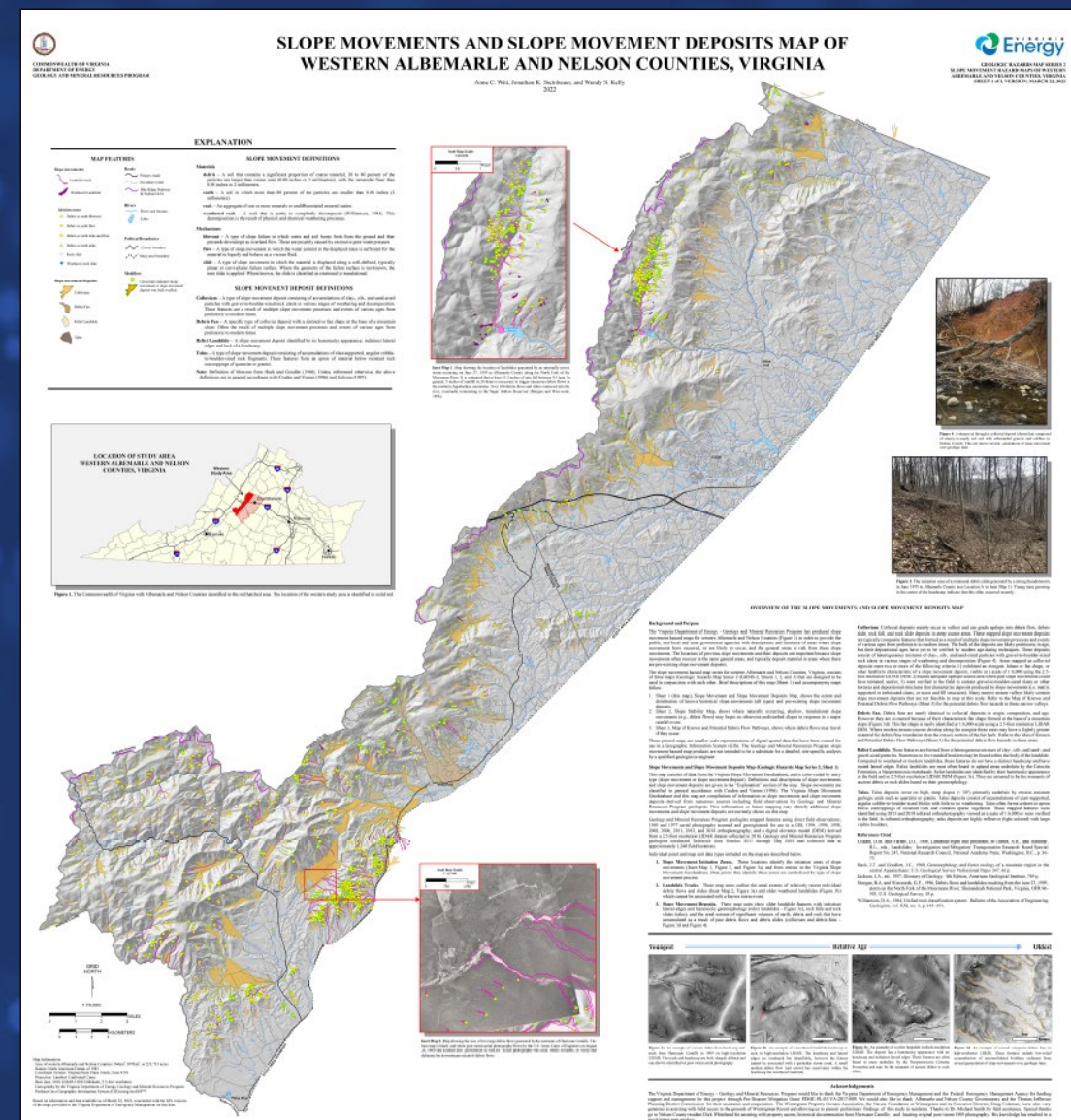
Slope movement deposits



Modifiers



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M A T E R I A L	Earth (>80% <2mm)					
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	Rock (STS-VFS)					



1 Landslide Inventory Map

Slope movements



Initiation zones

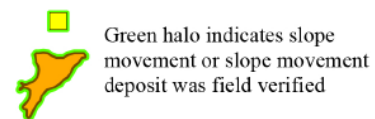
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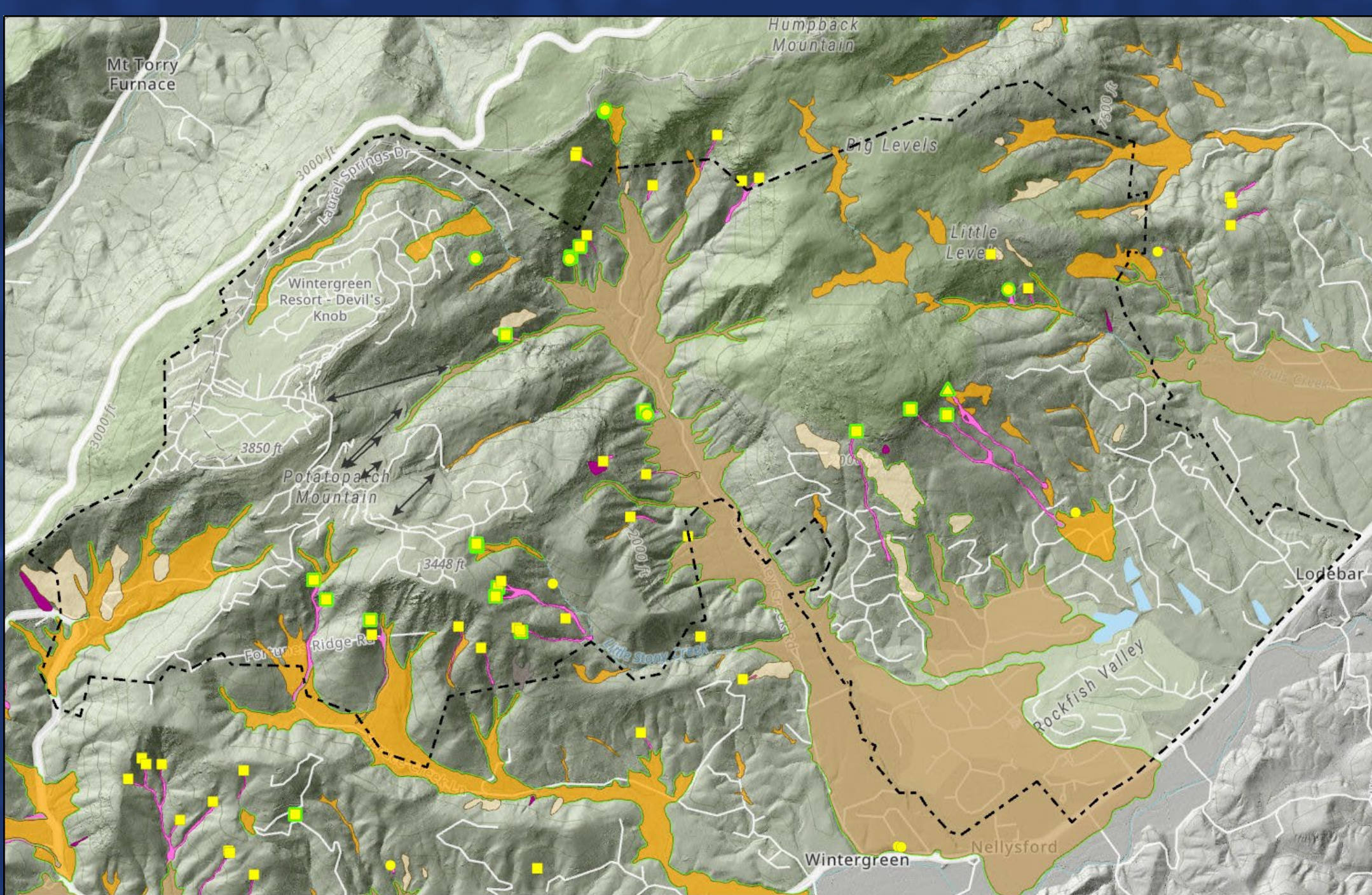


Slope movement deposits



Modifiers





Slope movements

- Landslide track
- Weathered Landslide

Initiation zones

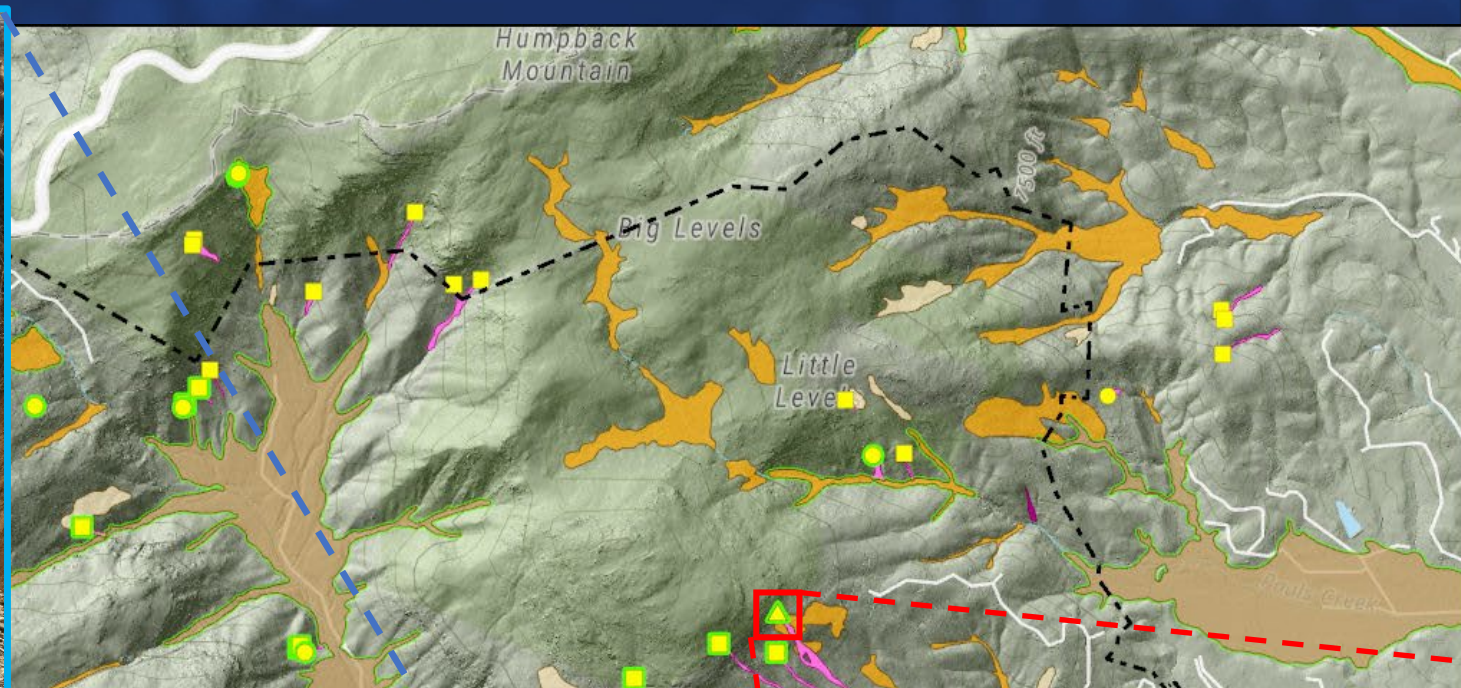
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Slope movement deposits

- Colluvium
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- Relict Landslide
- Talus

Modifiers

- Green halo indicates slope movement or slope movement deposit was field verified

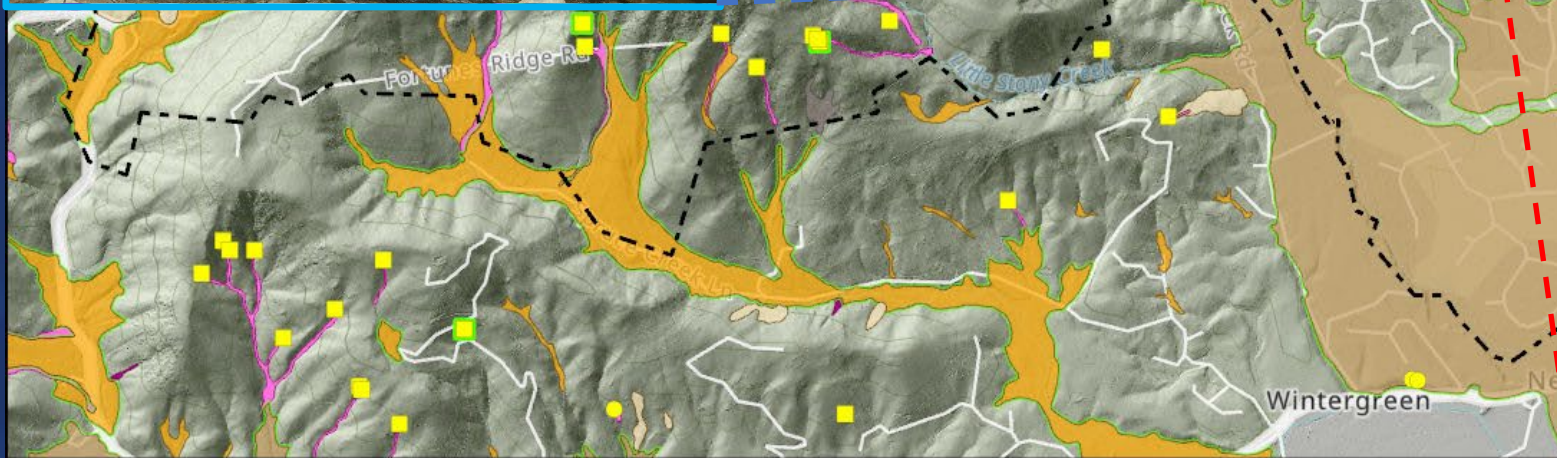


Slope movements

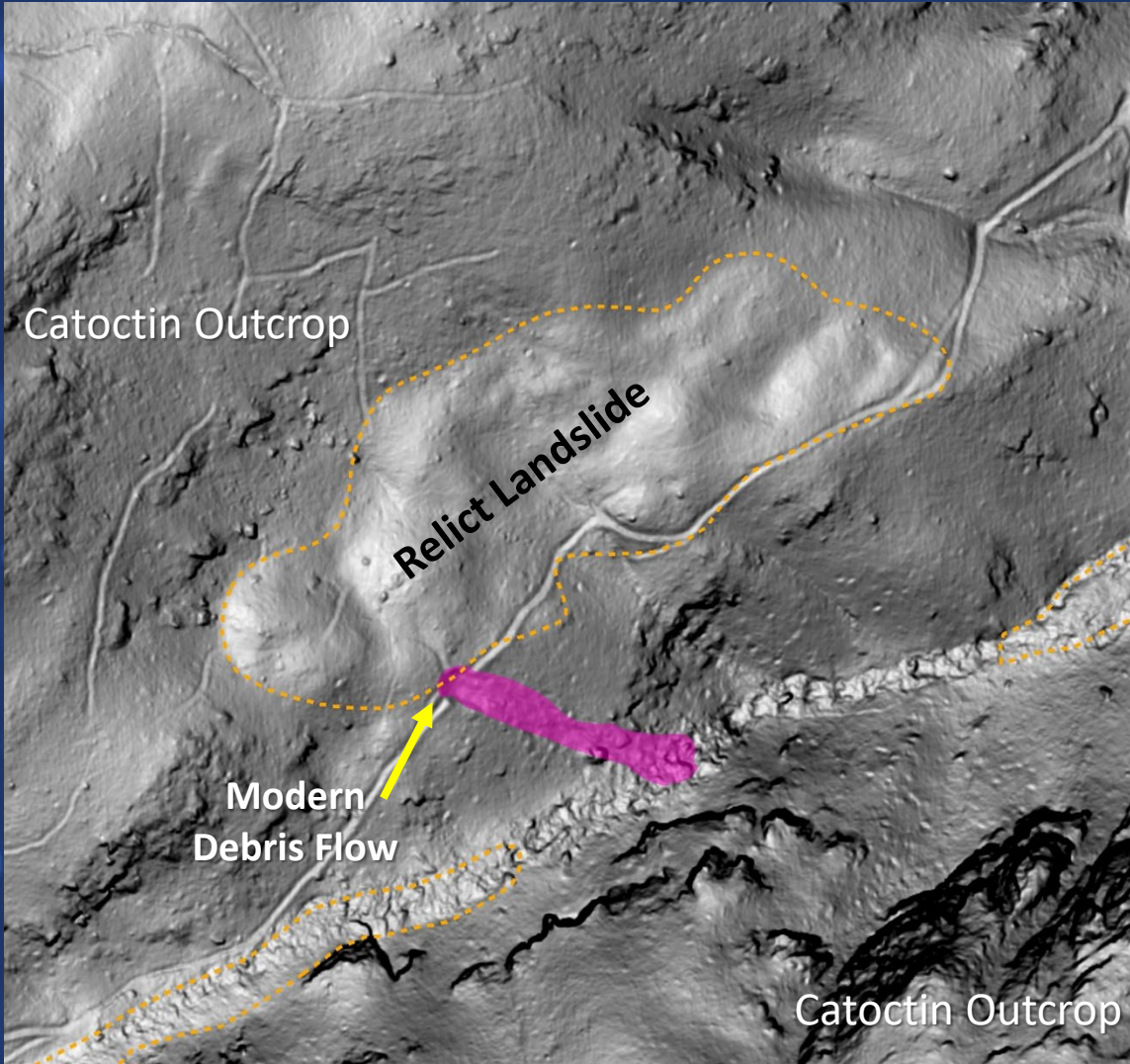
- Landslide track
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Initiation zones

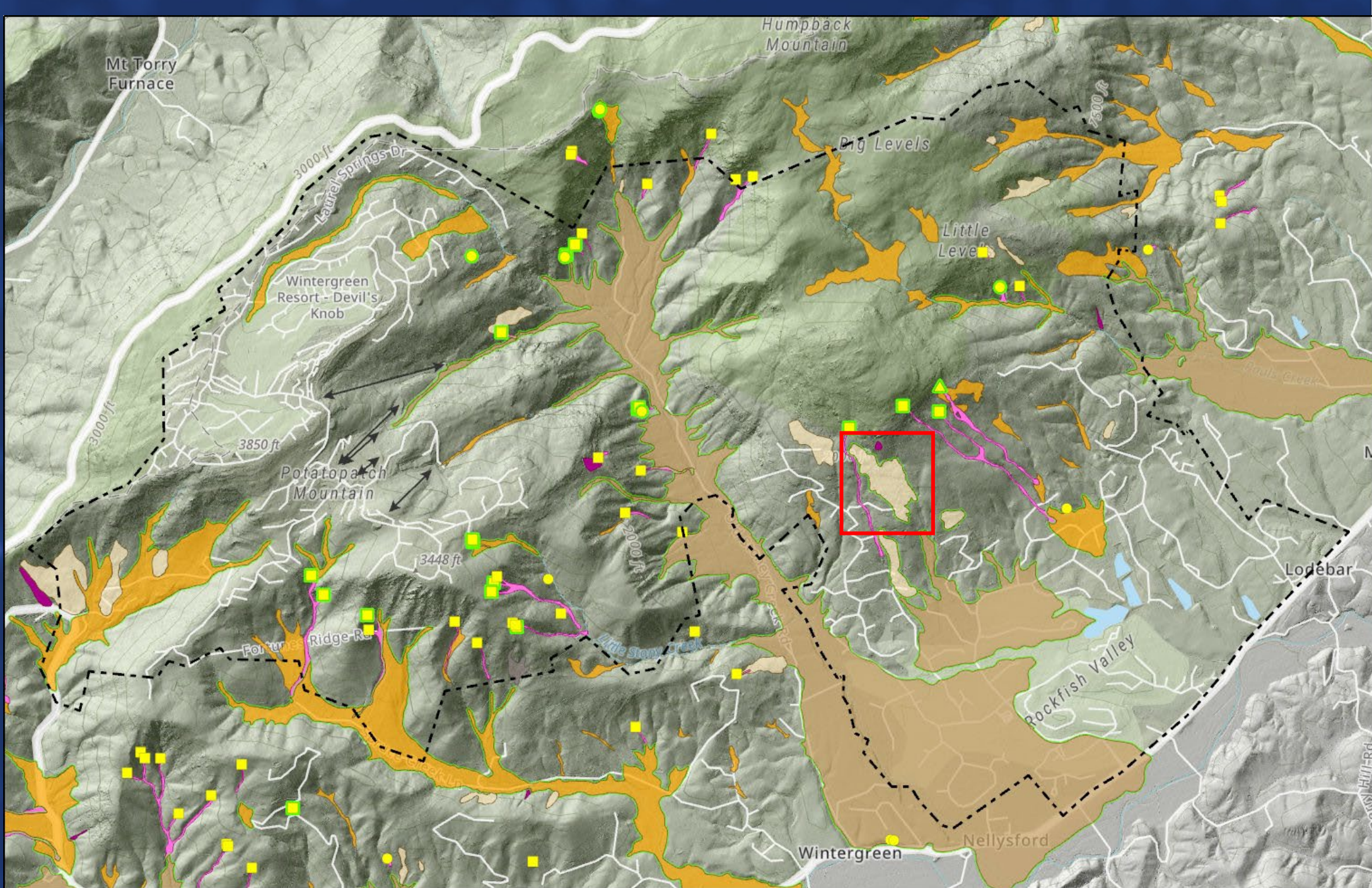
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RELICT LANDSLIDES



- Remnants of several generations of downslope movement
- All evidence of scarping and lateral boundaries have been weathered away over geologic time, leaving a hummocky surface exposure
- Sometimes occur below a cliff face or outcrop source
- Primarily found in areas underlain by Catoctin metabasalt
- Primary concern is for construction and initiation of new landslides



Slope movements

- Landslide track
- Weathered Landslide

Initiation zones

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Slope movement deposits

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Modifiers

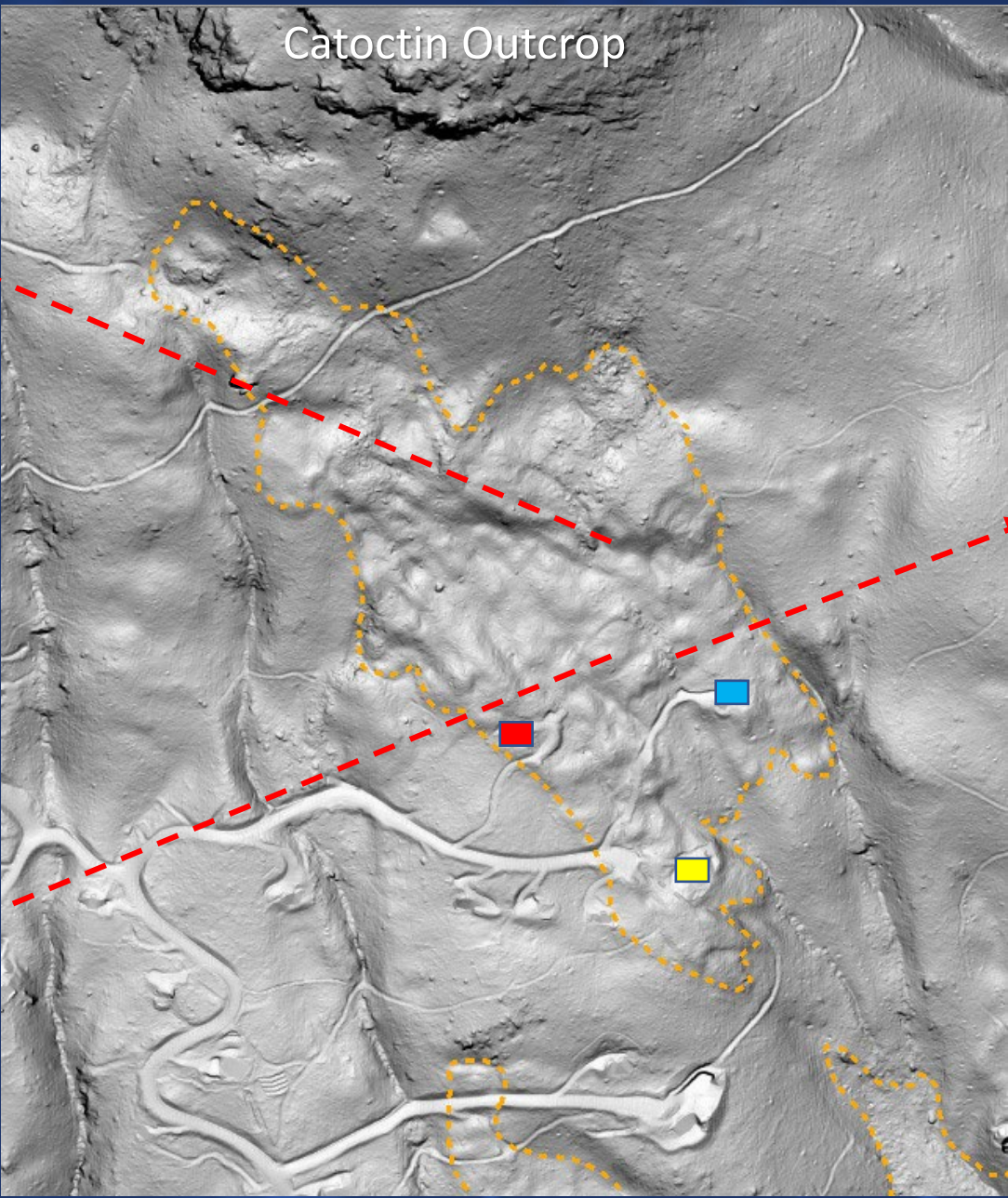
- Green halo indicates slope movement or slope movement deposit was field verified



Shelf of exposed bedrock within landslide deposit



Lobe of hummocky, cobble-to-boulder sized debris



Wintergreen Relict Landslide Deposit

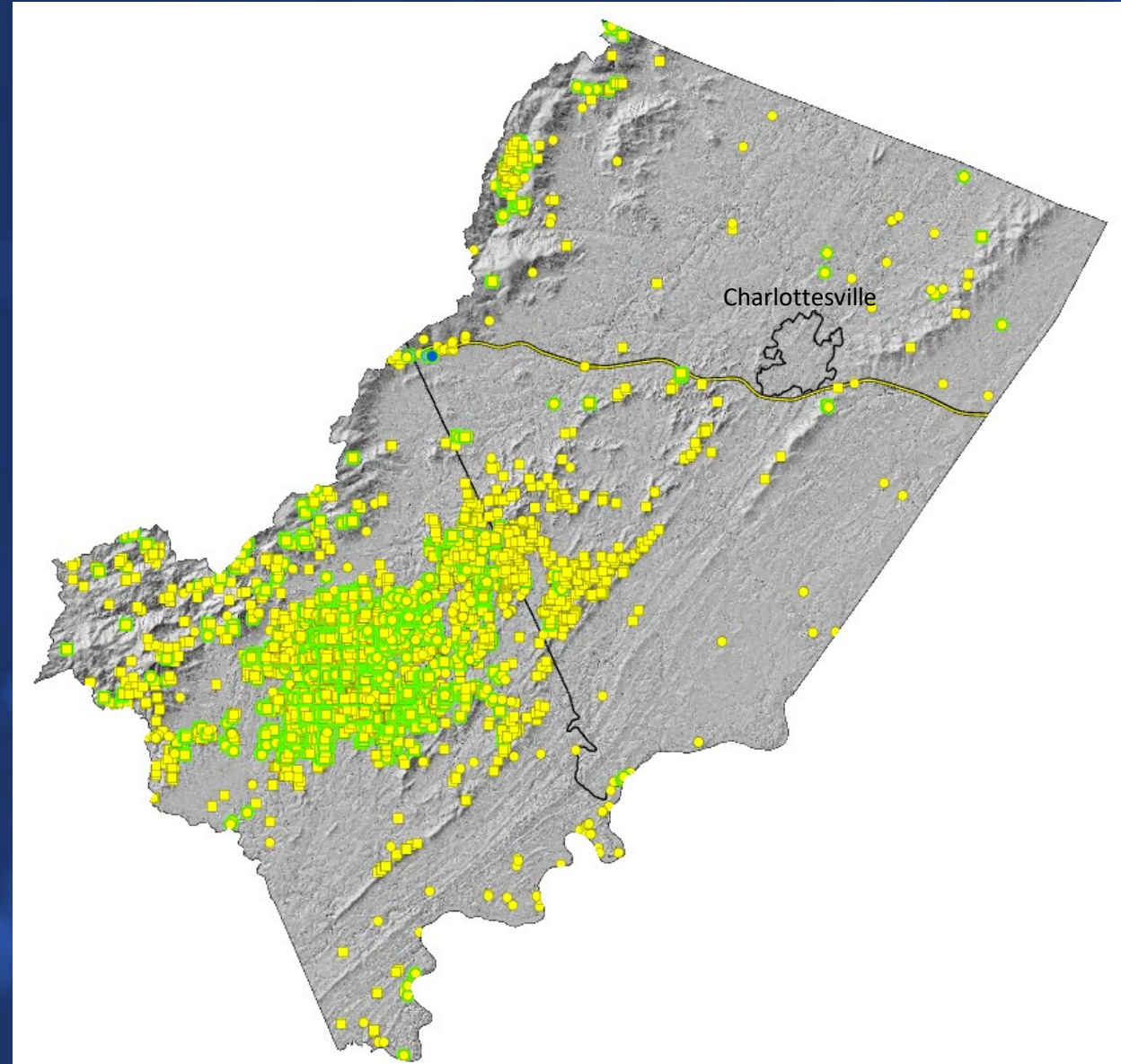


Boulder Stream

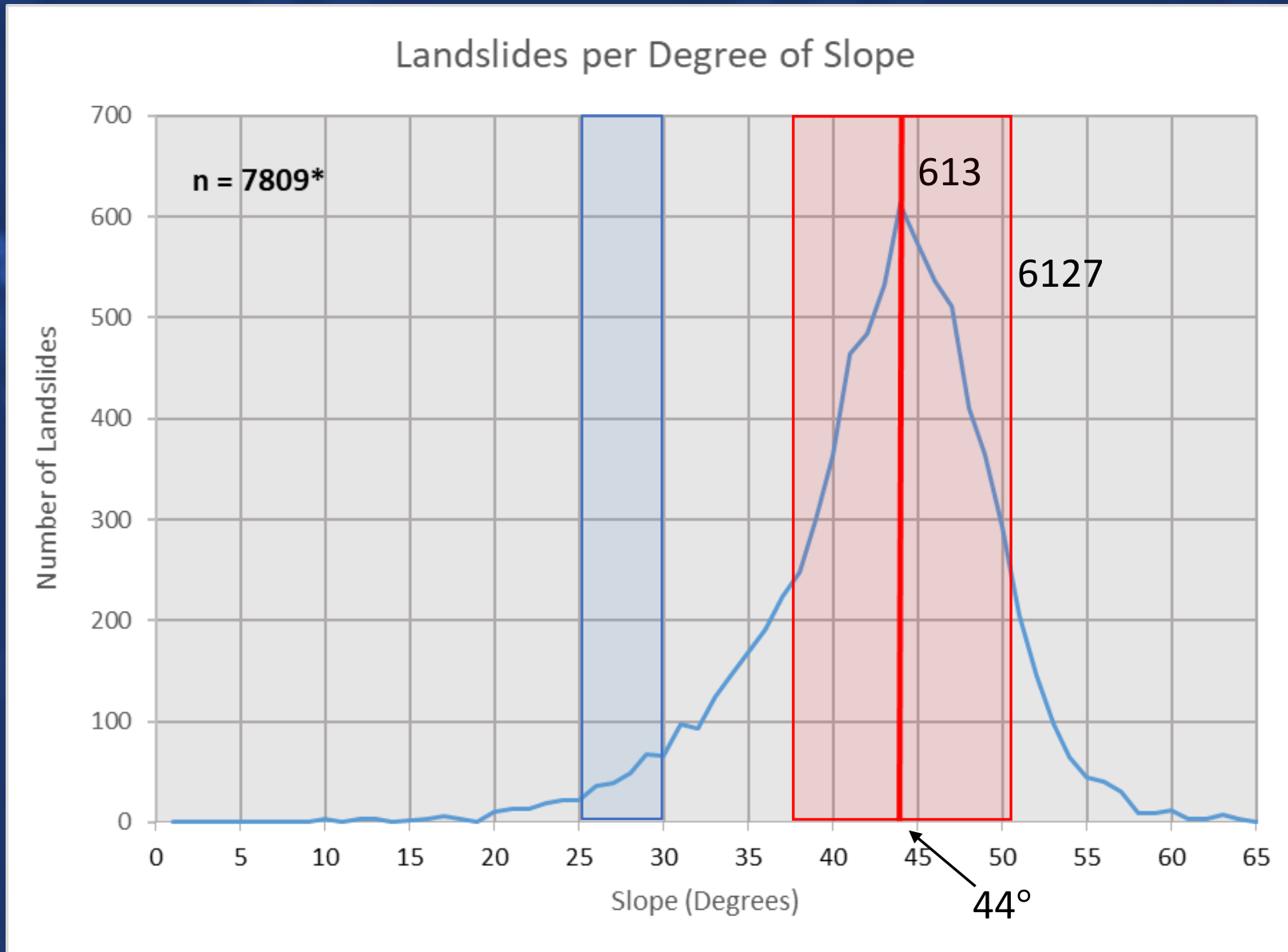
INVENTORY UPDATE

APRIL 2024

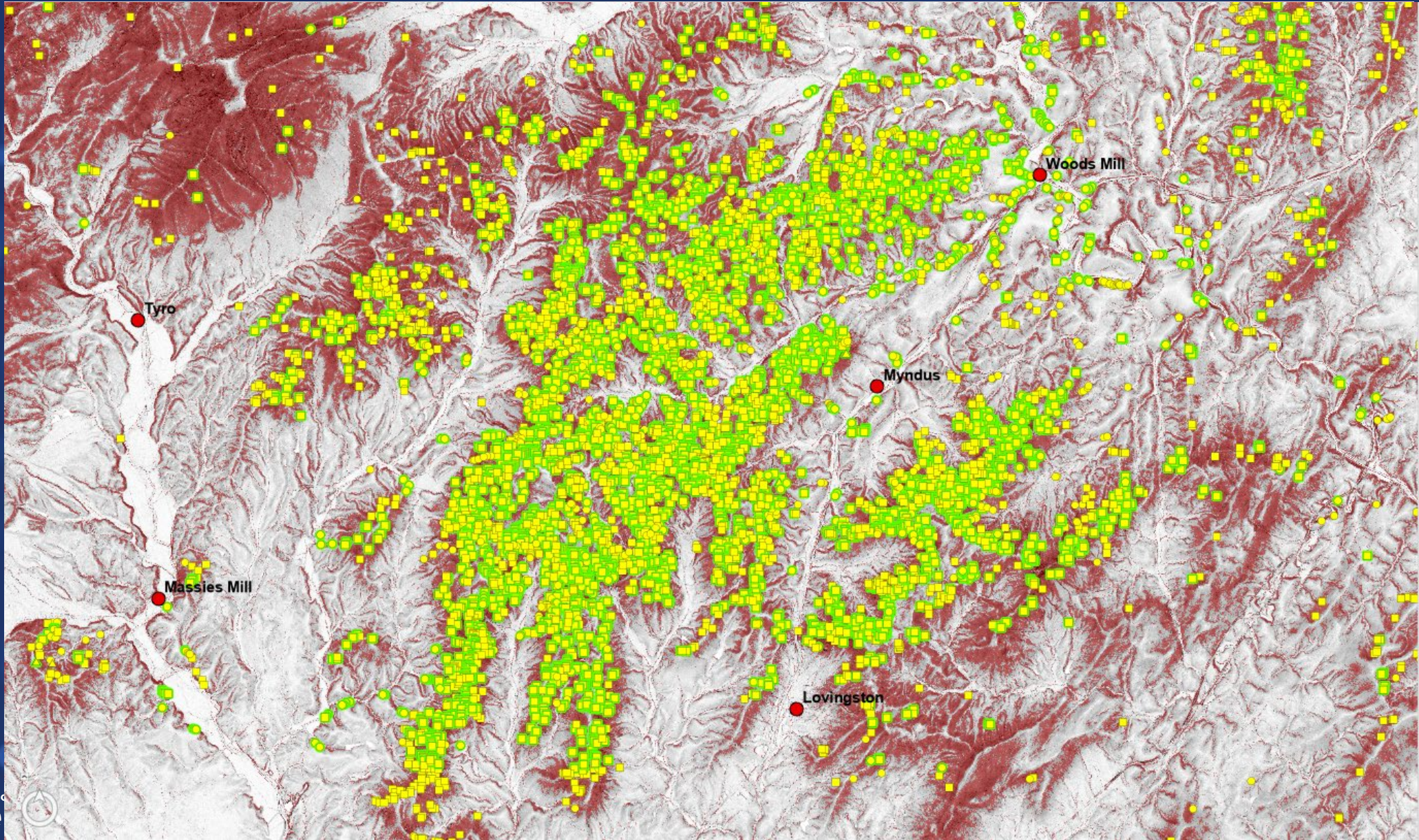
- Robust inventory allows us to perform helpful spatial statistics with pre-existing datasets (slope, aspect, elevation, geology, soil, etc)
- Constrains data used for susceptibility modeling
- Provides useful information to planners and emergency management about past landslide activity in an area



UPDATED LANDSLIDE STATISTICS: SLOPE

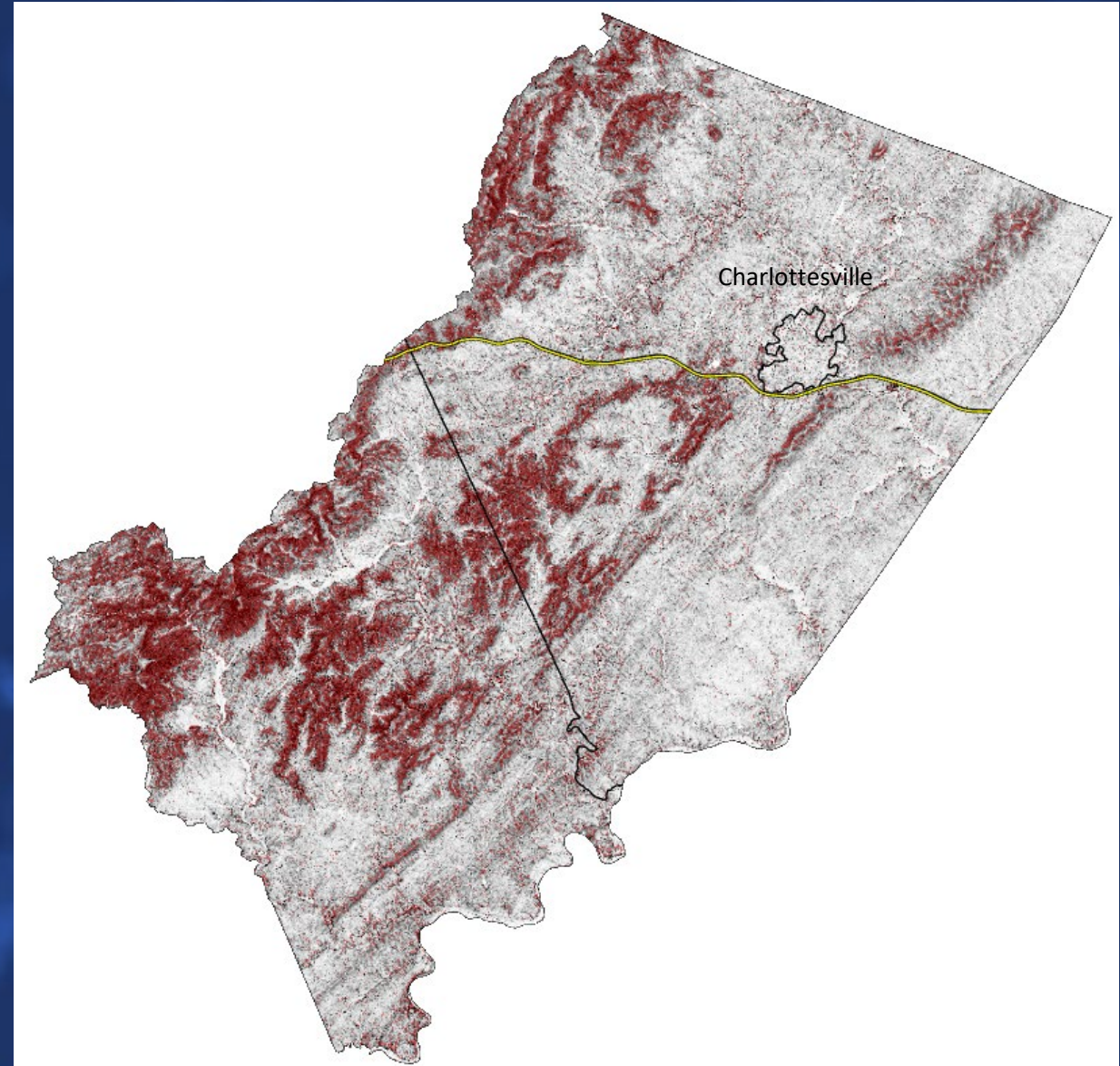


UPDATED LANDSLIDE STATISTICS: SLOPE



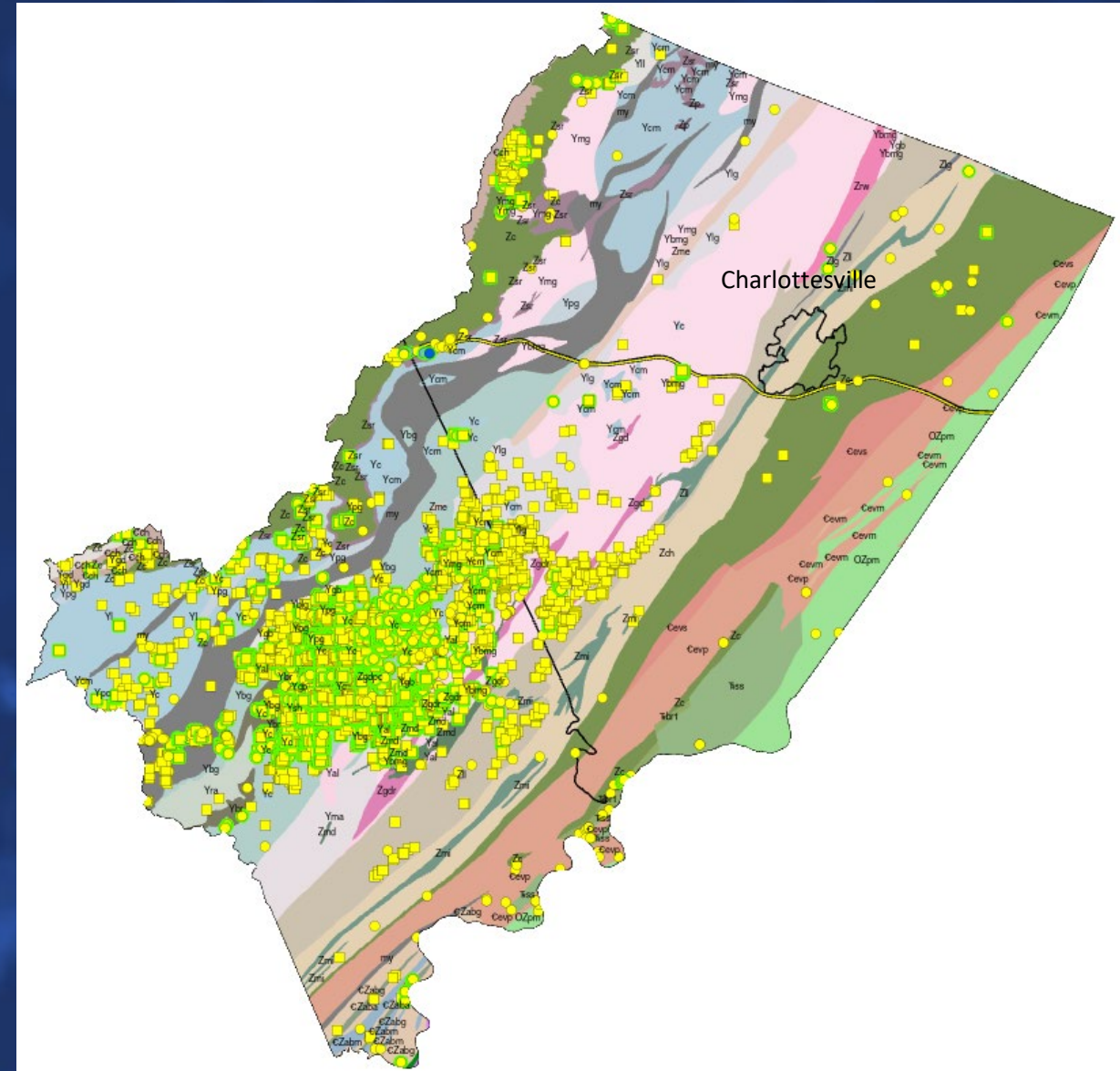
UPDATED LANDSLIDE STATISTICS: SLOPE

- Albemarle & Nelson = 1210 mi²
- Area of counties that has slopes steeper than 25° = 130 mi² or 11% of the study area
- 7676 (98%) of landslides occur on slopes greater than 25° → 59 landslides/mi²
- For higher degrees of slope, 40-50°, only 0.5% of study area → landslide density increases to 754/mi²

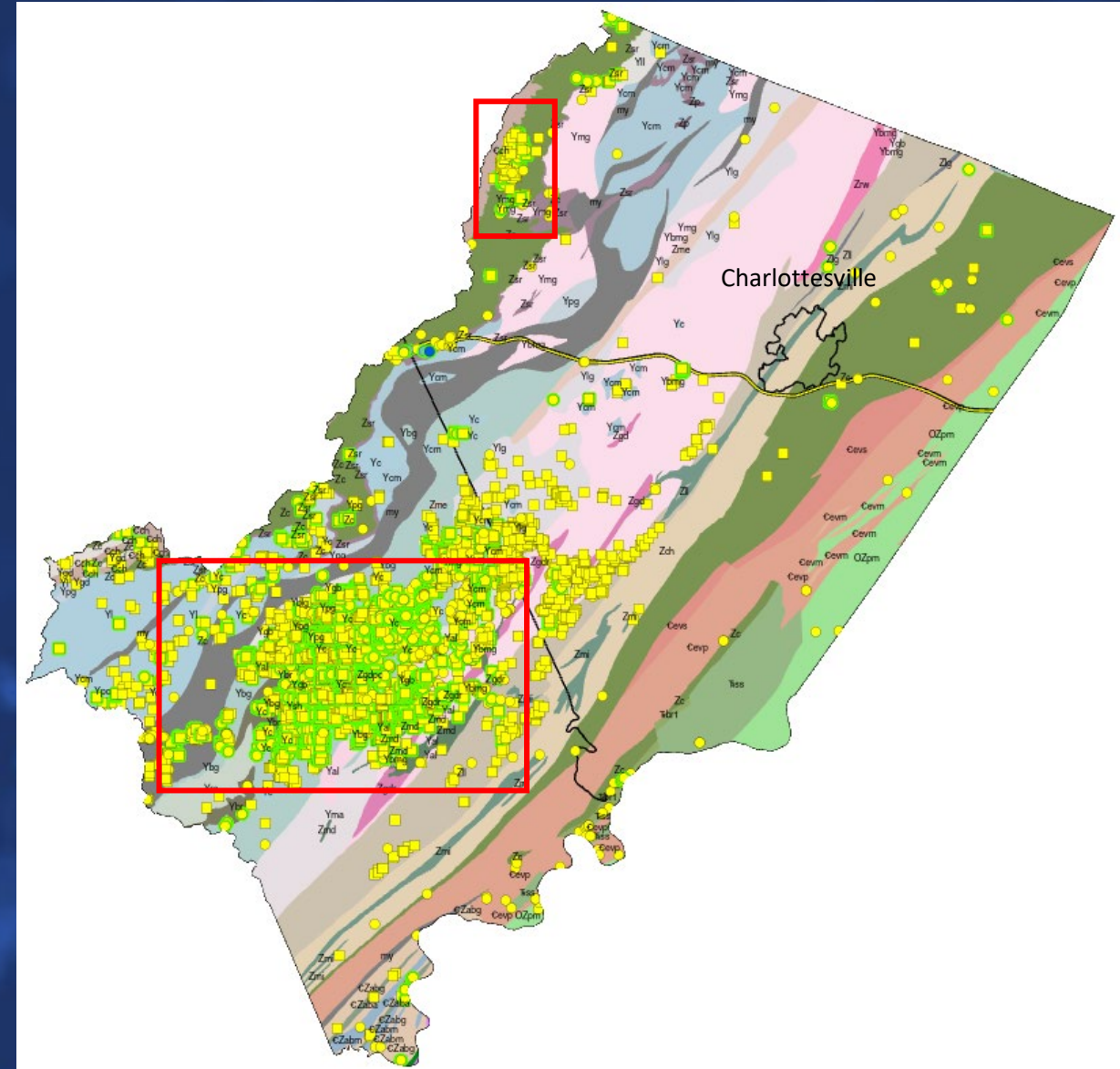
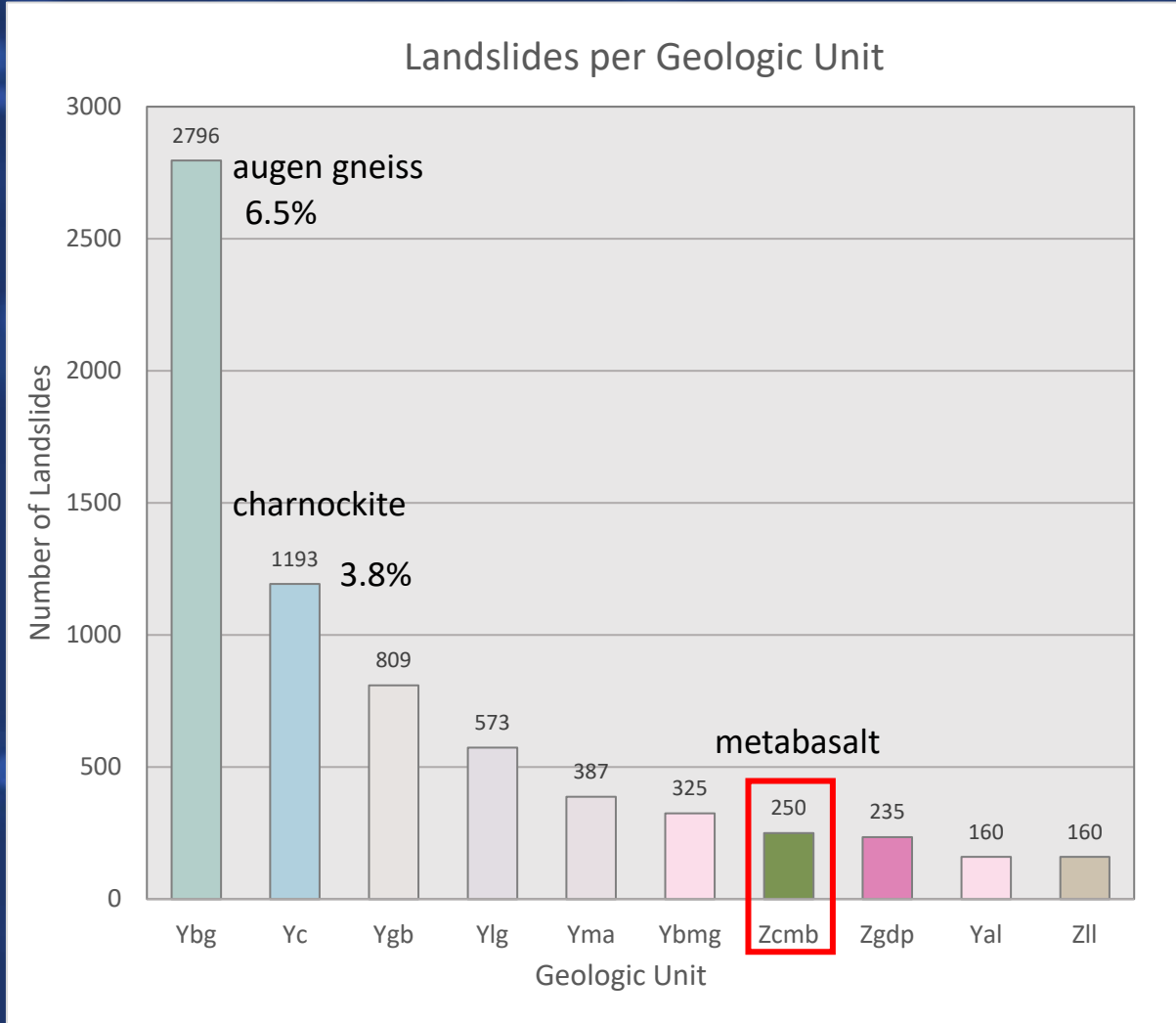


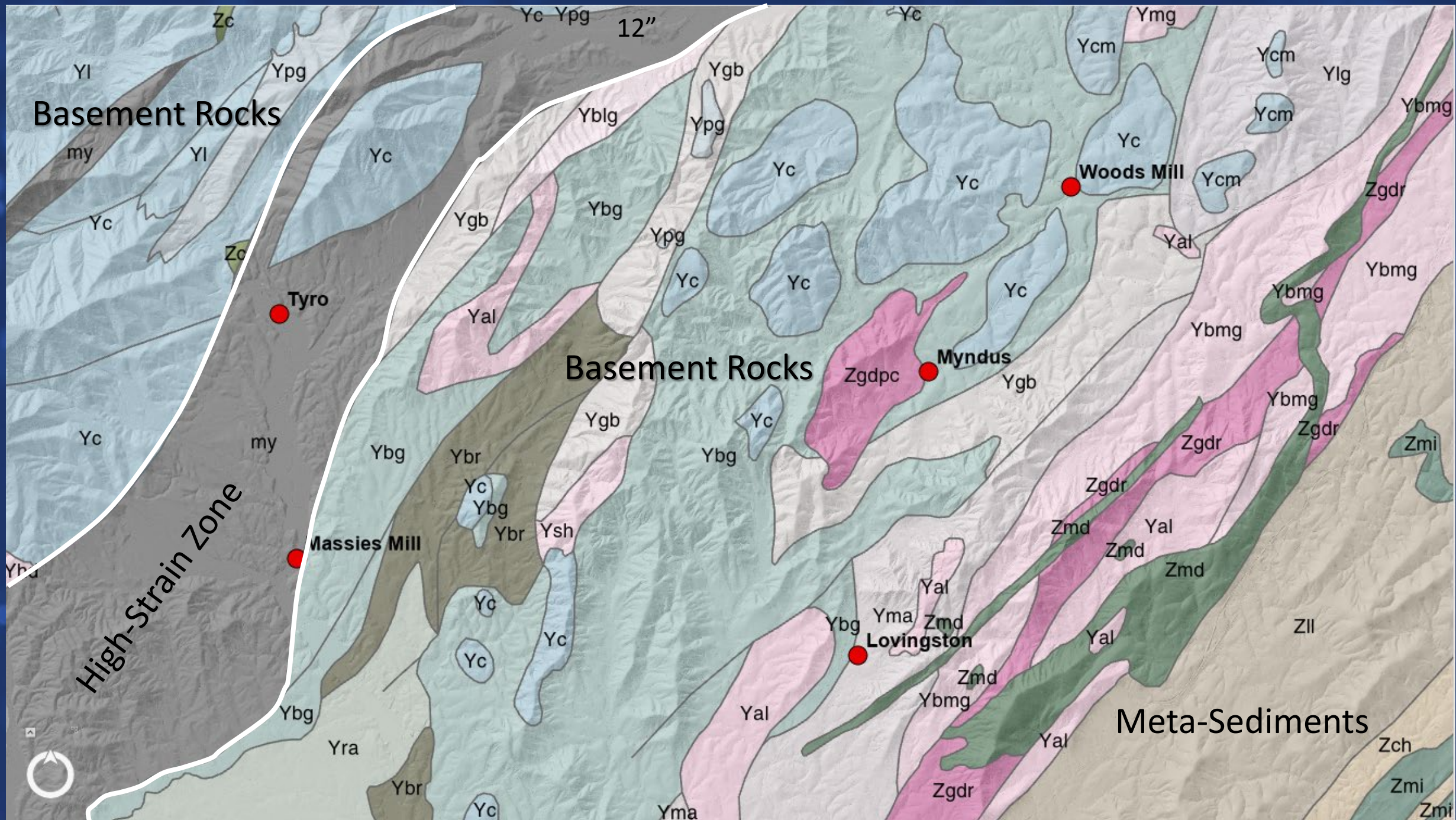
UPDATED LANDSLIDE STATISTICS: GEOLOGY

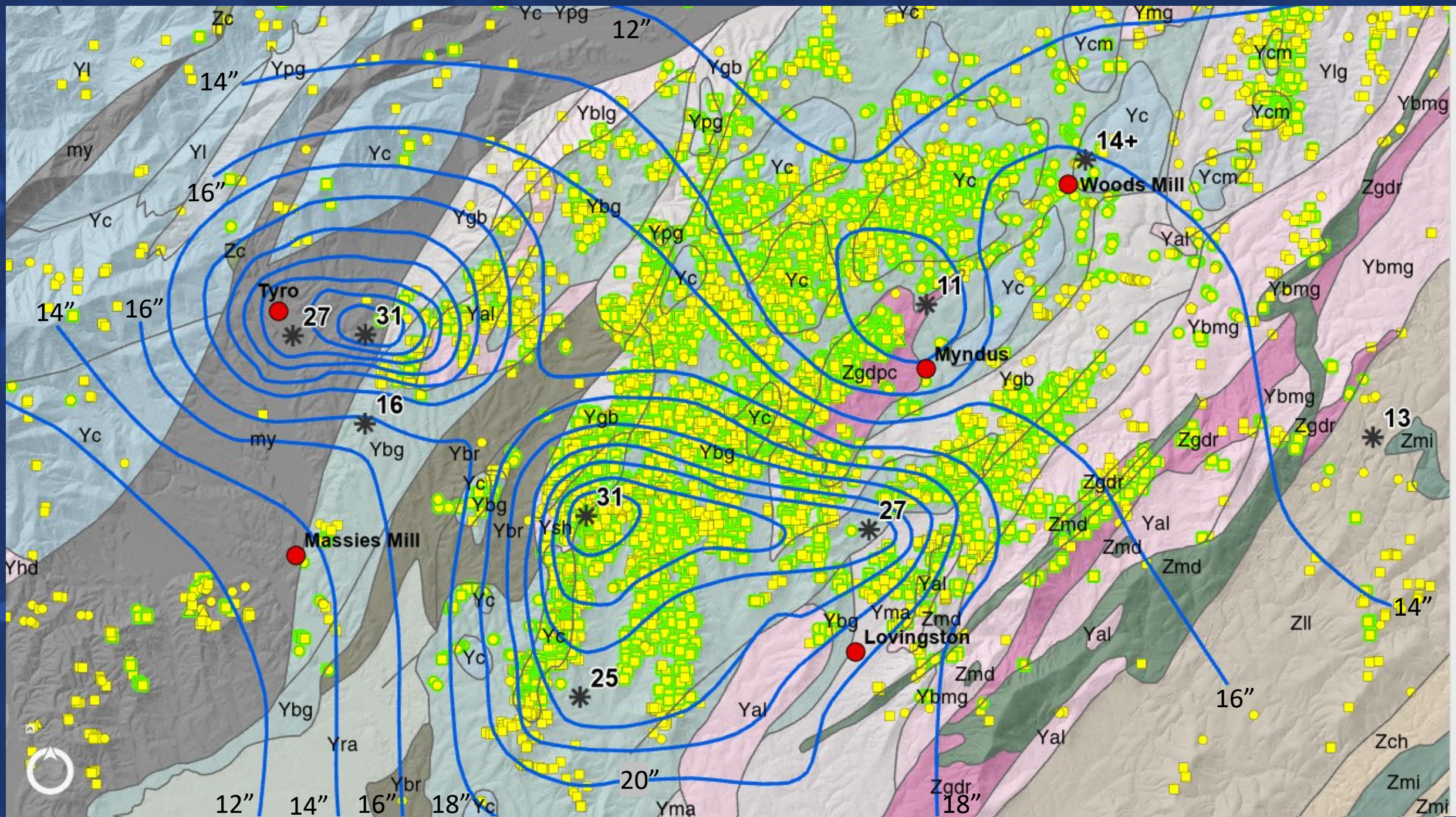
- Area is within the central and eastern flank of the Blue Ridge Geologic Province
- 48 different geologic units, based on geology from the Geologic Map of Virginia (2021)
- Nearly all the landslides (83%) occur in middle-to-late Proterozoic basement gneisses, meta-granitoids, and other meta-intrusive rocks

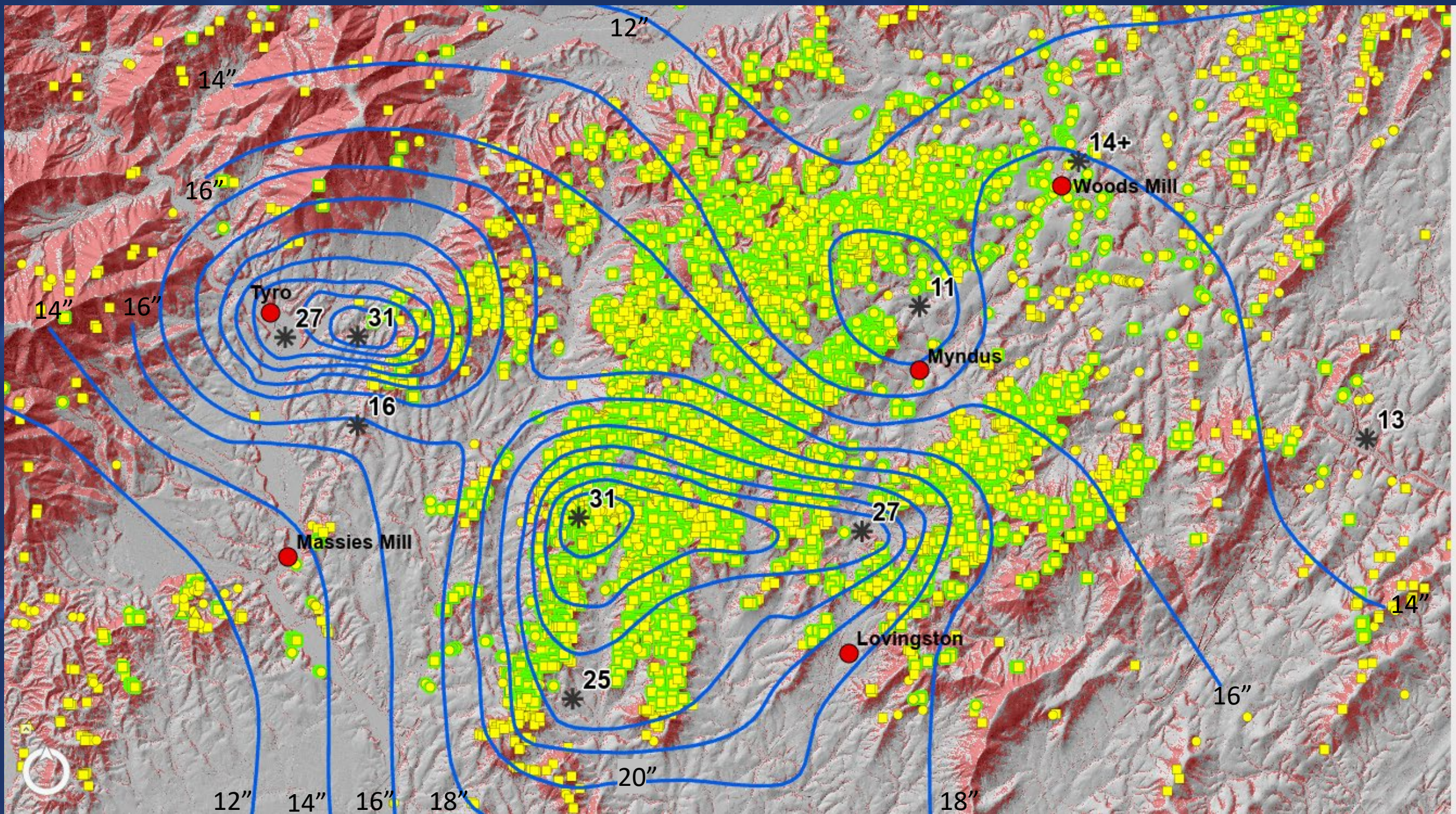


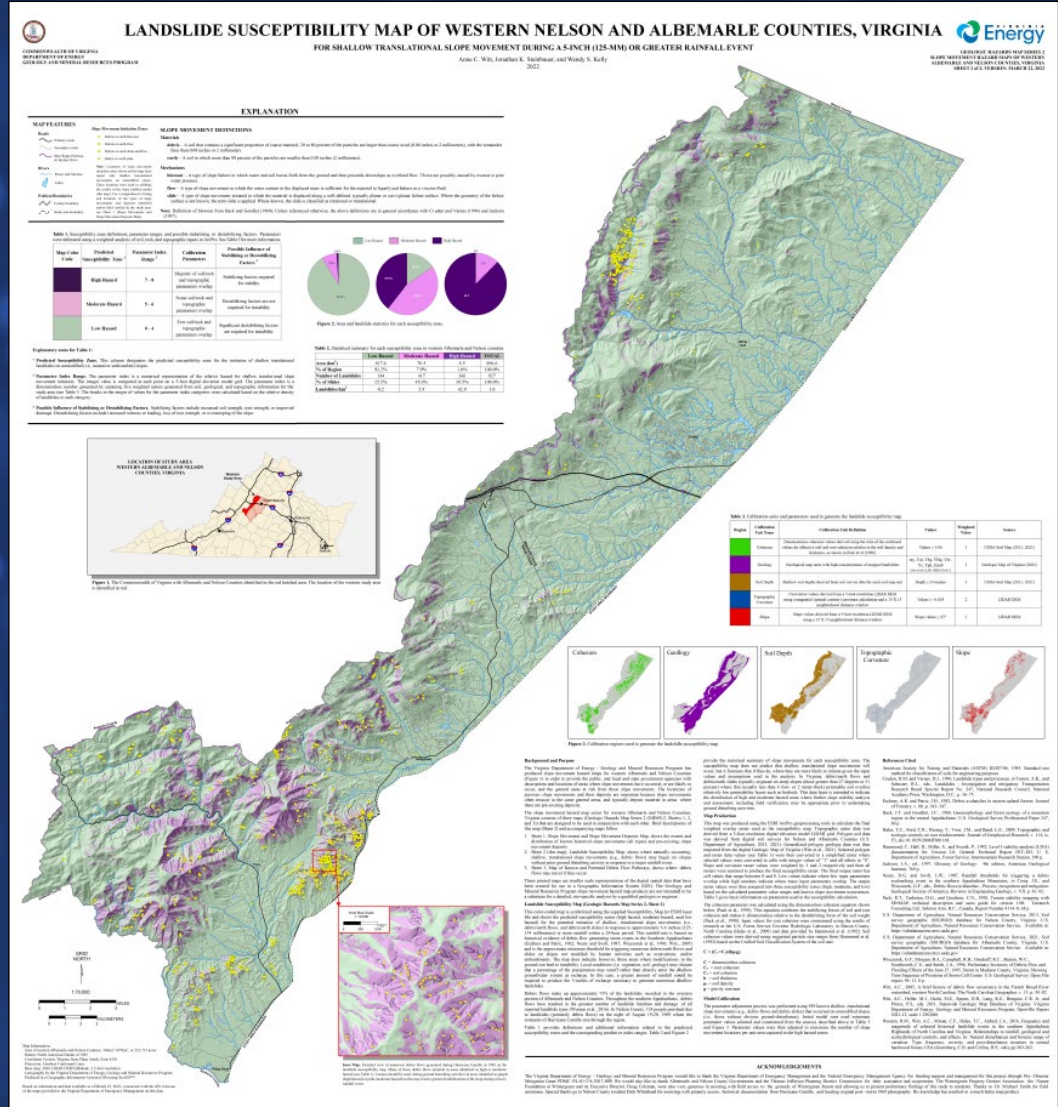
UPDATED LANDSLIDE STATISTICS: GEOLOGY





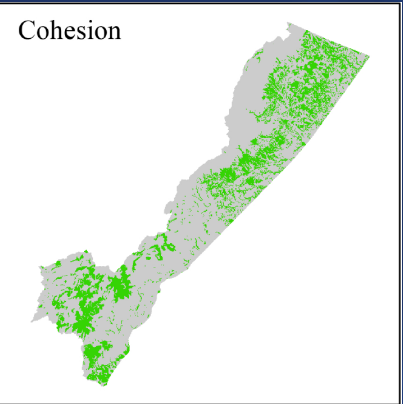




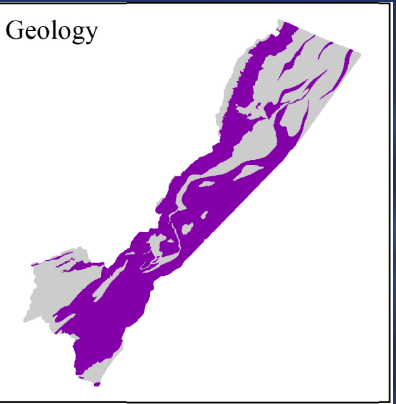


Region	Calibration Unit Name	Calibration Unit Definition	Values	Weighted Value	Source
	Cohesion	Dimensionless cohesion values derived using the ratio of the combined values for effective soil and root cohesion relative to the soil density and thickness, as shown in Pack et al (1998)	Values ≤ 0.06	1	USDA Soil Map (2013, 2021)
	Geology	Geological map units with high concentrations of mapped landslides	my, Yal, Ybg, Yblg, Ybr, Yc, Ygb, Zcmb (see source for definitions)	1	Geologic Map of Virginia (2021)
	Soil Depth	Shallow soil depths derived from soil survey data for each soil map unit	Depth ≤ 35 -inches	1	USDA Soil Map (2013, 2021)
	Topographic Curvature	Curvature values derived from a 5-foot resolution LIDAR DEM using a tangential (normal contour) curvature calculation and a 15 X 15 neighborhood distance window	Values ≤ -0.005	2	LIDAR DEM
	Slope	Slope values derived from a 5-foot resolution LIDAR DEM using a 15 X 15 neighborhood distance window	Slope values $\geq 27^\circ$	3	LIDAR DEM

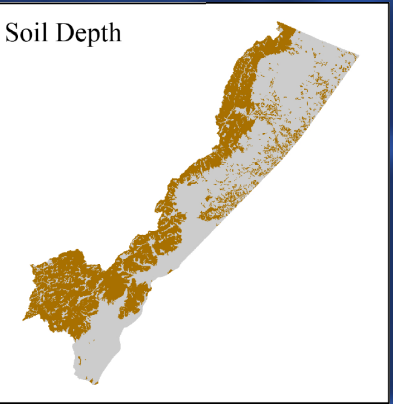
Cohesion



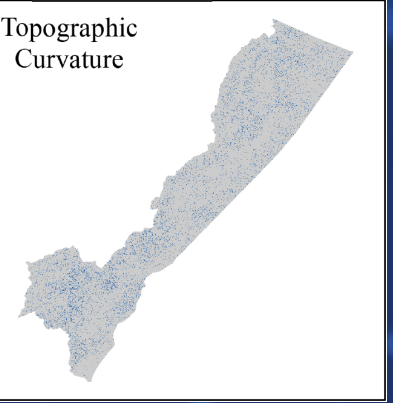
Geology



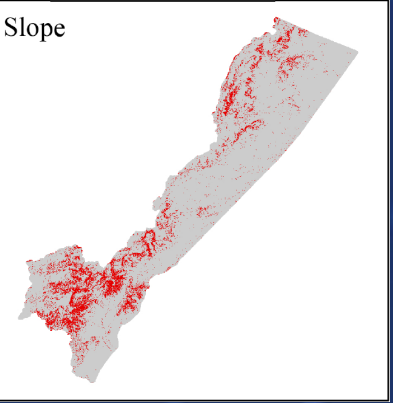
Soil Depth

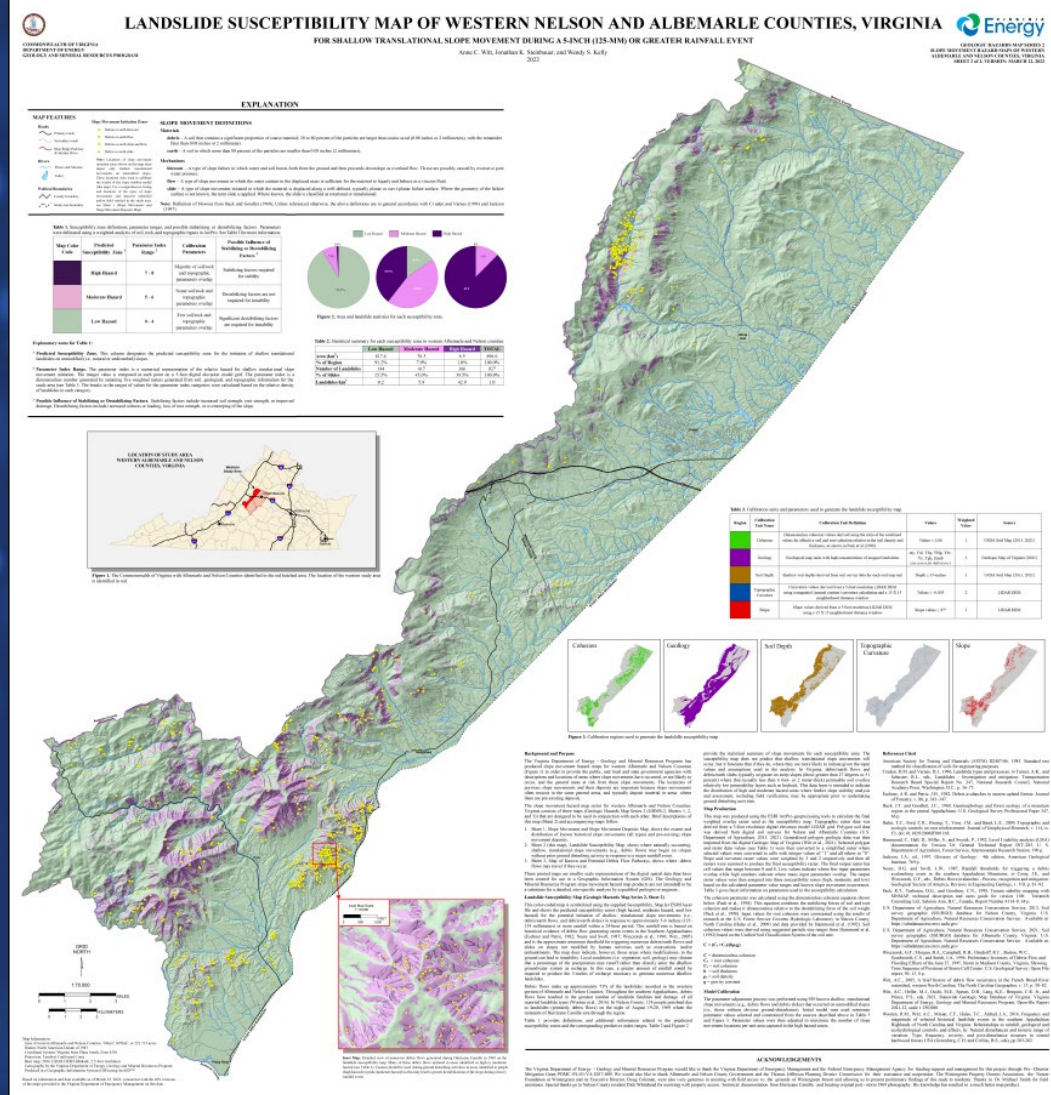


Topographic Curvature

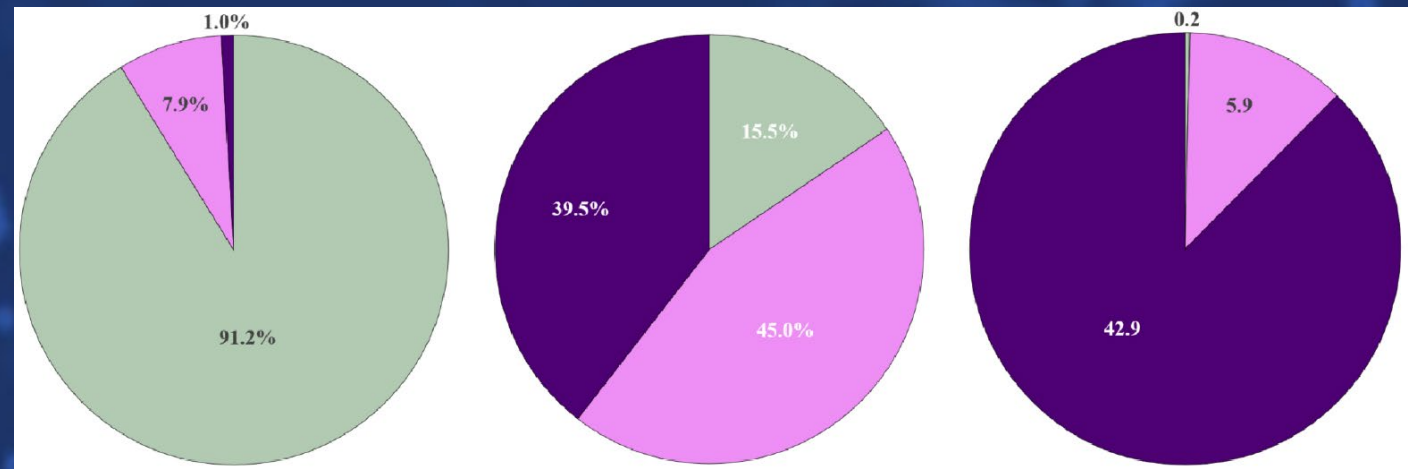


Slope

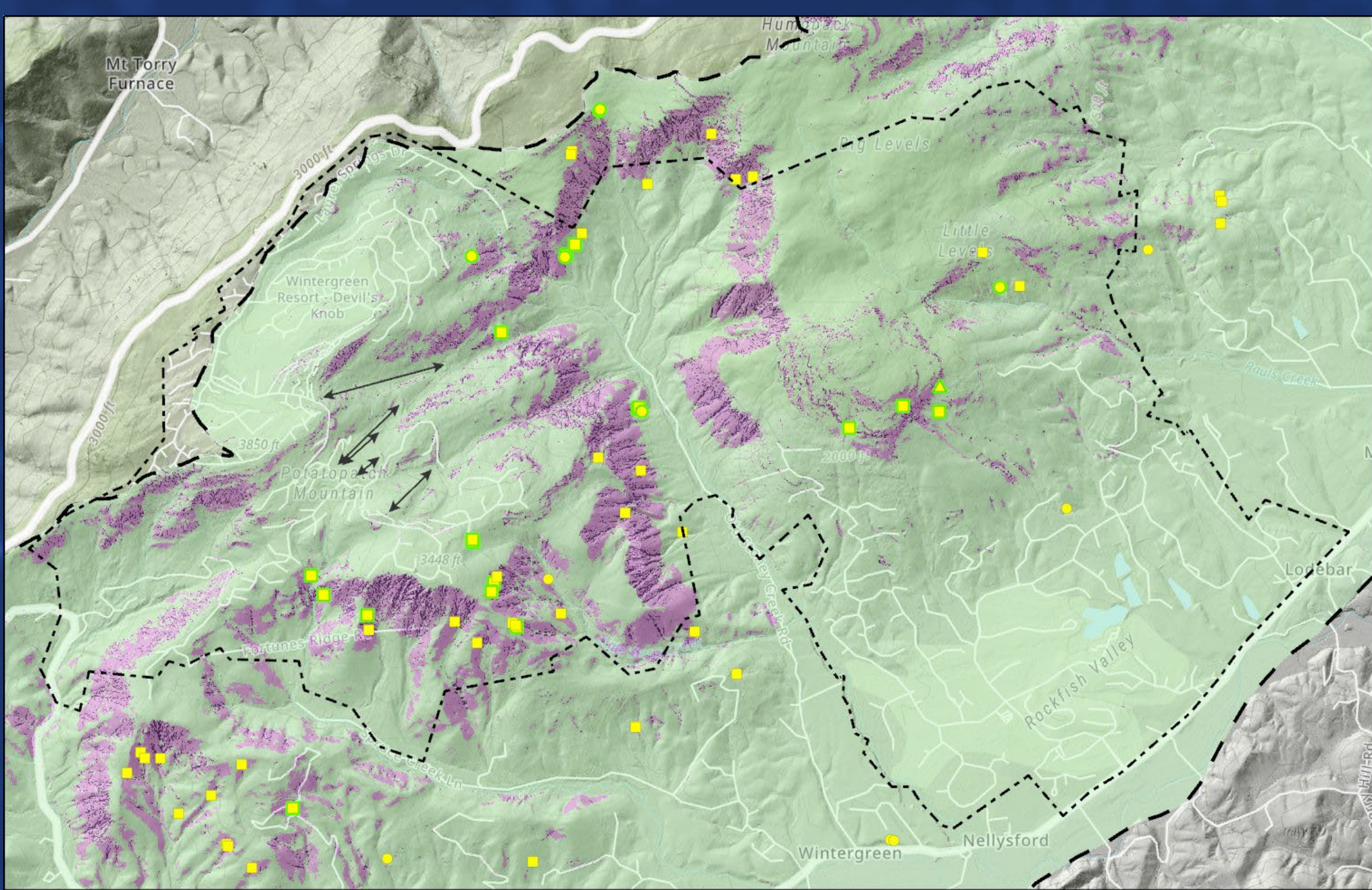




Map Color Code	Predicted Susceptibility Zone ¹	Parameter Index Range ²	Calibration Parameters	Possible Influence of Stabilizing or Destabilizing Factors ³
	High Hazard	7 - 8	Majority of soil/rock and topographic parameters overlap	Stabilizing factors required for stability
	Moderate Hazard	5 - 6	Some soil/rock and topographic parameters overlap	Destabilizing factors are not required for instability
	Low Hazard	0 - 4	Few soil/rock and topographic parameters overlap	Significant destabilizing factors are required for instability



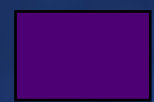
2 Landslide Susceptibility Map



Low
Hazard



Moderate
Hazard



High
Hazard

UPDATED LANDSLIDE STATISTICS: LANDSLIDE TRACK LENGTH

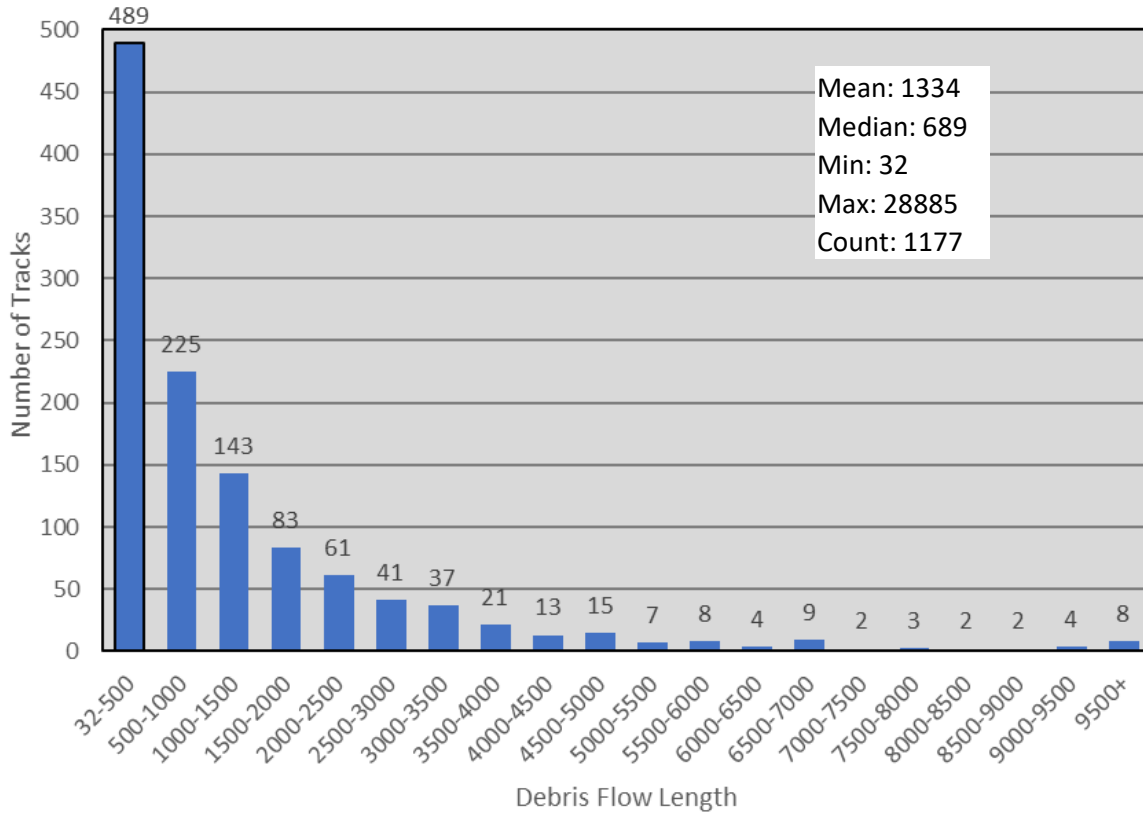
- Not only concerned about where landslides may start, but also where they go and what areas they may inundate.
- Path of destruction from a debris flow can be narrow.
- Use known debris flow tracks to estimate potential track length and width as part of “debris flow pathways” map.



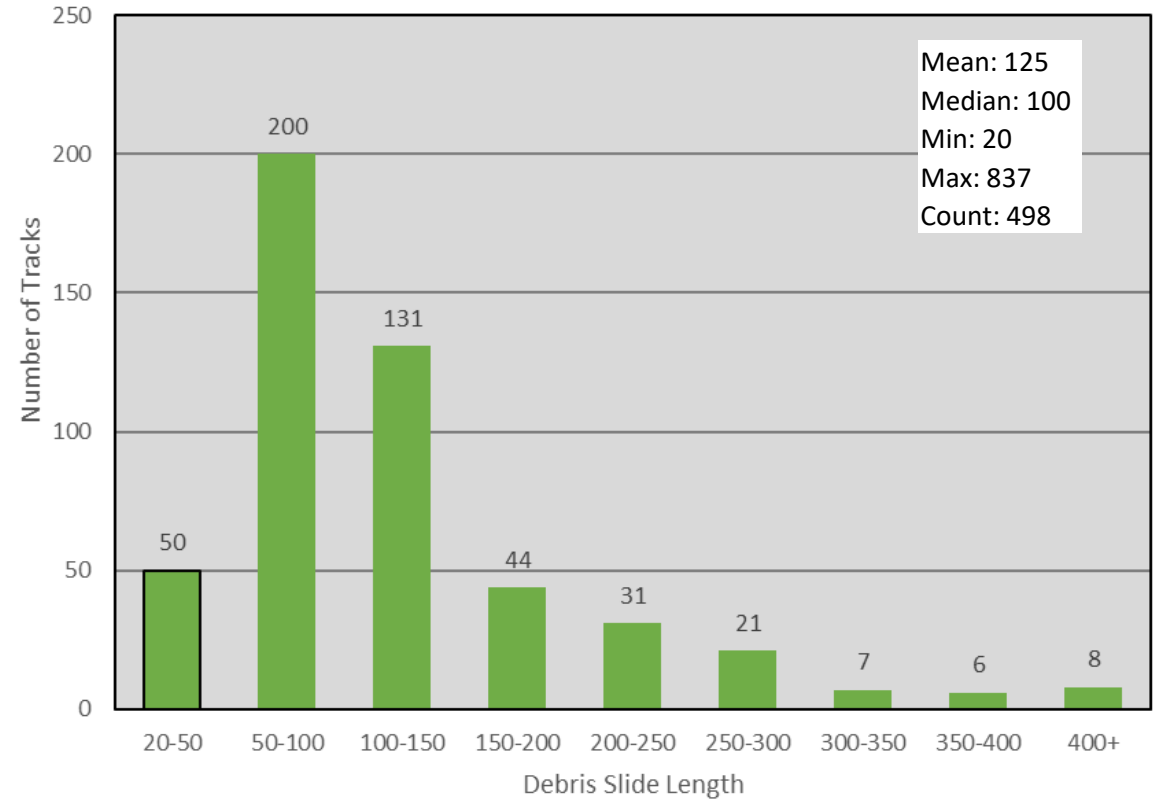
Davis Creek area of Nelson County, where 52 lives were lost, after Hurricane Camille in 1969. Nearly every first and second order stream in this area was inundated, generating a massive debris flow 5.3 miles long.

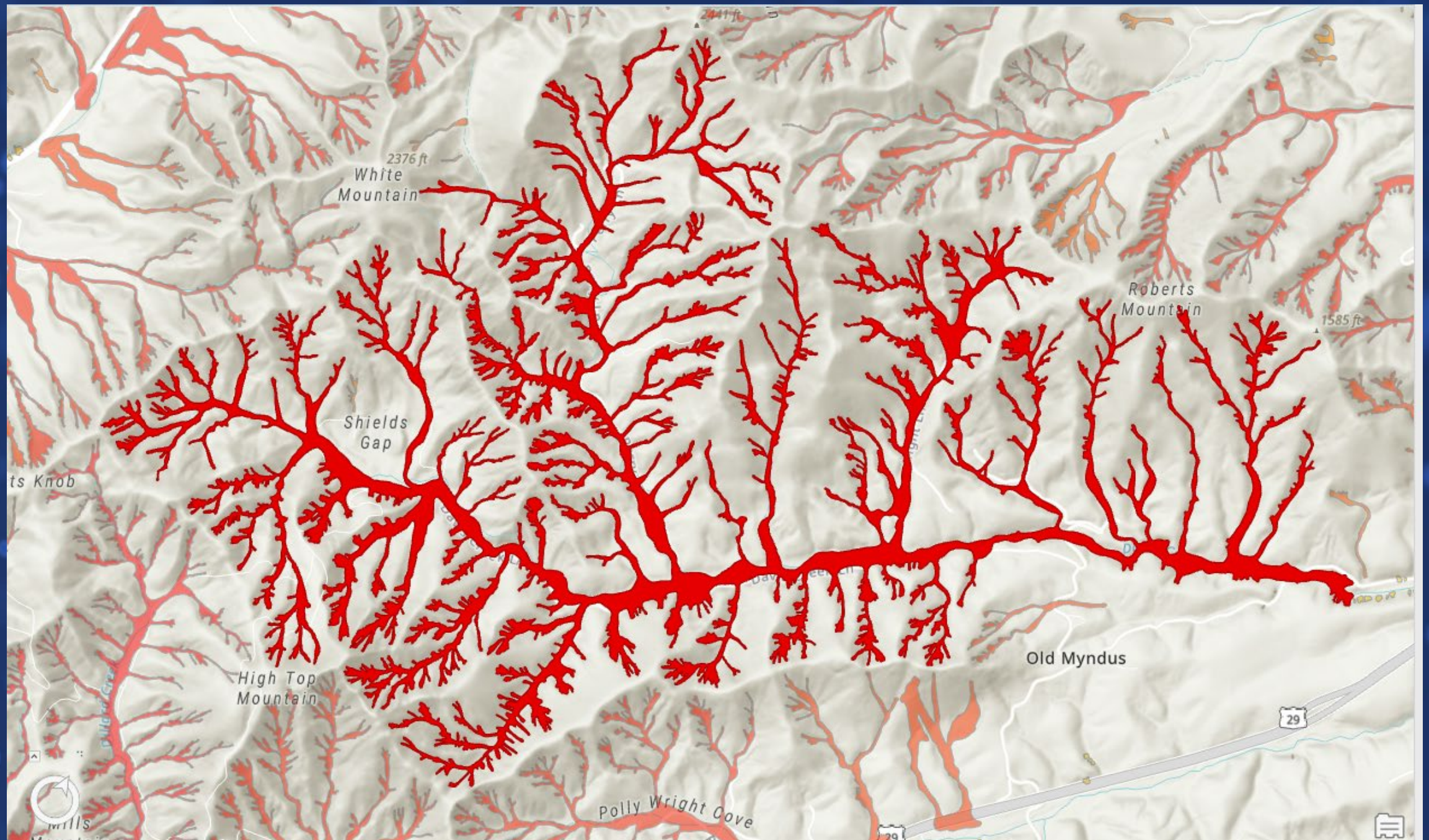
UPDATED LANDSLIDE STATISTICS: LANDSLIDE TRACK LENGTH

Debris Flow Track Length



Debris Slide Track Length





MAP OF KNOWN AND POTENTIAL DEBRIS FLOW PATHWAYS IN WESTERN ALBEMARLE AND NELSON COUNTIES, VIRGINIA

FOR SHALLOW TRANSLATIONAL SLOPE MOVEMENTS



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EXPLANATION

Table 1. Information of characters, including and description		
	Character	Description
Reproductive	Ship Stere	
	Ship Stere (Fig. 1a)	State of the reproductive sterile (sterile) flowers (sterile present)
Relative Height	Stemless sterile (Fig. 1b)	State of the sterile flowers (sterile) flowers (sterile present)
	Stemless sterile (Fig. 1c)	State of the sterile flowers (sterile) flowers (sterile present)
	Stemless sterile (Fig. 1d)	State of the sterile flowers (sterile) flowers (sterile present)
Stemless sterile	Stemless sterile (Fig. 1e)	State of the sterile flowers (sterile) flowers (sterile present)
	Stemless sterile (Fig. 1f)	State of the sterile flowers (sterile) flowers (sterile present)

MAP 1

- Legend**
- Hydrology**
- Intensive zones of shallow, transitional, deep freshwater or unconfined saline
 - Primary roads
 - Secondary roads
 - Other Ridge Features & Wetland Deline
- Wetlands**
- Rivers and Streams
 - Lakes
- Political Boundaries**
- County boundary
 - Neighborhood boundaries

Table 2. Statistical summary of various types of public infrastructures that are within potential debris flow pathways and area of past debris flows

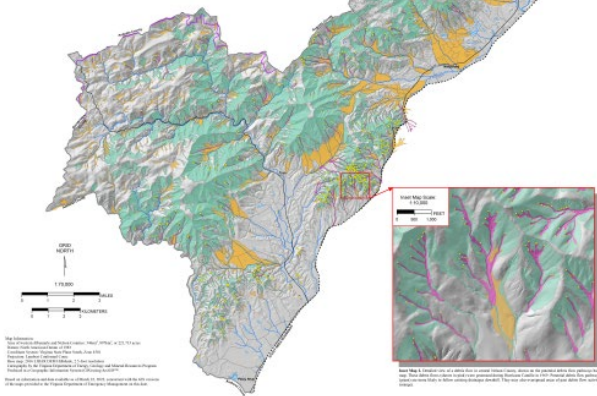
[illegible]

Figure 2. Percentages of study area within each map scale denomination.





Figure 1. The Commonwealth of Virginia with Adirondack and Nelson Counties identified in the red hatched area. The location of the six study areas is identified in solid red.



Background and Purpose

OVERVIEW OF THE MAP OF KNOWN AND POTENTIAL DEBRIS FLOW PATHWAYS

The Virginia Department of Energy - Geology and Mineral Resources Program has produced a generalized land-use map for western Albemarle and Nelson Counties (Figures 1) in order to provide public and local and state government agencies with descriptive maps and locations of areas where movements have occurred or are likely to occur, and the general area at risk from these movements. The locations of previous deep-seated movements and their deposits are important because movements often occur in the same general area, and typically deposit material in areas where they previously deposited.

The slope movement hazard map covers the western Albemarle and Nelson Counties, Virginia cover of these maps (Geological Research Staff Series 2-1990-01-02, Sheets 1, 2, and 20) that are designed to be used in conjunction with each other. Most data sources of this map (Sheet 2) and accompanying

1. *Figure 1: Slope Movement and Slope Movement Processes Map: shows the extent and distribution of recent slope movement (last 10 years) and existing large movement deposits.*
2. *Figure 2: Landslide Susceptibility Map: shows areas exhibiting existing, potential, and probable landslides. The map begins on digital without prior ground handling or data to improve its image quality or not.*
3. *Figure 3: Slope Map of Karam and Purnell Districts (Two Districts, data where data is not available) of the study area.*

Three primary maps are available: scale representations of the digital spatial data that have been used for the Geographic Information System (GIS). The Geology and Slope Movement Processes map is a digital map that is not available to be a substitute for a detailed, site-specific map by a qualified geologist or engineer.

This table tested map-programs across five could be affected by either lines or other shapes, inside shape movements that may originate from a high-density event and end but on which the map shows potentially in the path of those shape movements if they occur or occur. The map shows further shape shape from where the shape movements may occur (Figure 2). Designated such a map as, however, like a flow path, potential paths flow paths, areas of path debris flow and areas of no known or potential debris flow direction. Table 1 shows the other codes, used as the with explanations that correspond to the map and description.

Thus, slope identification are those that could be affected by debris, forces or other shallow, translational movements along the conditions on the ground at the time the slope was made. Changes to the line as a result of human activity and future slope movements can alter the boundaries of subsequent forces, therefore, the slope represents the general state that could be affected by debris forces and shallow, translational slope movement. In areas of future potential, and past debris, these activities, a slope stability analysis, including some field measurements, may be appropriate prior to using the underlying ground-detecting GPR data.

1. *Challenges of Robots: How location and shape information depend from the shape measurements and*

2. Areas designated as high or moderate hazard on the Landslide Susceptibility Map (Sheet 1).
The following sequential steps outline the method used to produce the area of predicted debris pathway using a 3-bar digital elevation model (DEM).

1. High and moderate hazard areas from the Landslide Susceptibility Map with areas greater than 0.25 acres (approx. 10,000 km^2 or 1,000 acres) were assumed to be the probable areas for slope movements that could affect water-driven slopes (i.e., high-to-moderate hazard areas less than 0.25 acres were eliminated as source areas).

ACKNOWLEDGMENTS

The Virginia Department of Energy - Geologic and Mineral Resources Program would like to thank support and management for the project through the Chesapeake-Wisconsin Trust (CWT), P.O. Box 2, A-2, District Commission for data acquisition and cooperation. The Wisconsin Property Owners Association, working with Solid Sciences to the grounds of Wisconsin River and allowing us to grant professional County resident Dale Whithead for assisting with property access. Technical assistance from J.

2. Hydrologic flow paths, based on topographic gradients derived from the 1:50,000 USGS 7.5-minute topographic map, from the center of each high-alkali-meadow located at that site to the adjacent stream.
3. Flow paths were automatically constructed as follows:
 - a. At each gradient node, the flow direction for comparison among -0.72 to 0.96 degrees ($10,000$ feet in $1,000$ meters) is assumed; values of flow directions are selected because 0 is consistent with the low-gradient down-slope aspect of most debris flow tracks delineated in the study area. Note: Flow paths were extended in the downstream direction until a flow direction where these segments are stopped (direction of steep gradient) is 5 degrees.

3. Flow paths originating upstream as suggested by the streamlines (Figure 10a) were mapped.
4. Flow paths were defined by 37 flow origin points to delineate the potential flow paths (Figure 10b). This buffer approximates the average width of mapped debris flows in the study area. Nodes in some cases are assumed to be flowlines because they extend the potential debris flow paths slightly up- and/or down-slope past above debris flow source areas.

Visual analysis of the diagram map was required to adjust the discontinuous extent of the potential debris flow paths to terminate flow paths deemed to be unrealistic. Adjustments included:

1. Ending flow paths that originated on non-saturated soil slopes on the basis of the fact

3. Removing the path from the segment in dense or aggregate vegetation.
4. Removing low paths from areas of high forest stand depth that are <0.25 acres of clearing, high forest area associated with low forest area, or low forest polygons, the remaining high forest area associated with the stand is also <0.25 acres. low paths was removed from that area as well.

The latter change is known as *bioherm* (biohermal) sedimentation (a portion of which almost is lost) (Fig. 1) indicates where gulls influence more features, such as rocks, sediments, and

Public information that is located in a known *advice flow* (publicly or privately *advice flow*) cannot be a further relative located in *advice flow* or other relative, nonrelative or other high-intensity spatial area (1/10th of size in a 1/10th of size).

References Cited

Forrest, D.M., 1997, The physics of debris flows. *Reviews of Geophysics*, **35**, no. 3, p. 243-266.



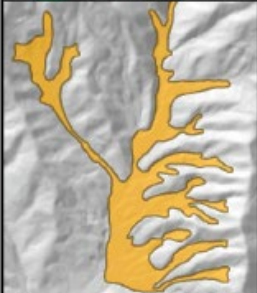
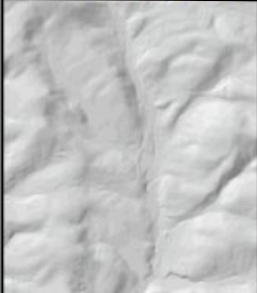
EDGEMENTS

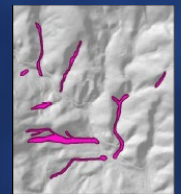
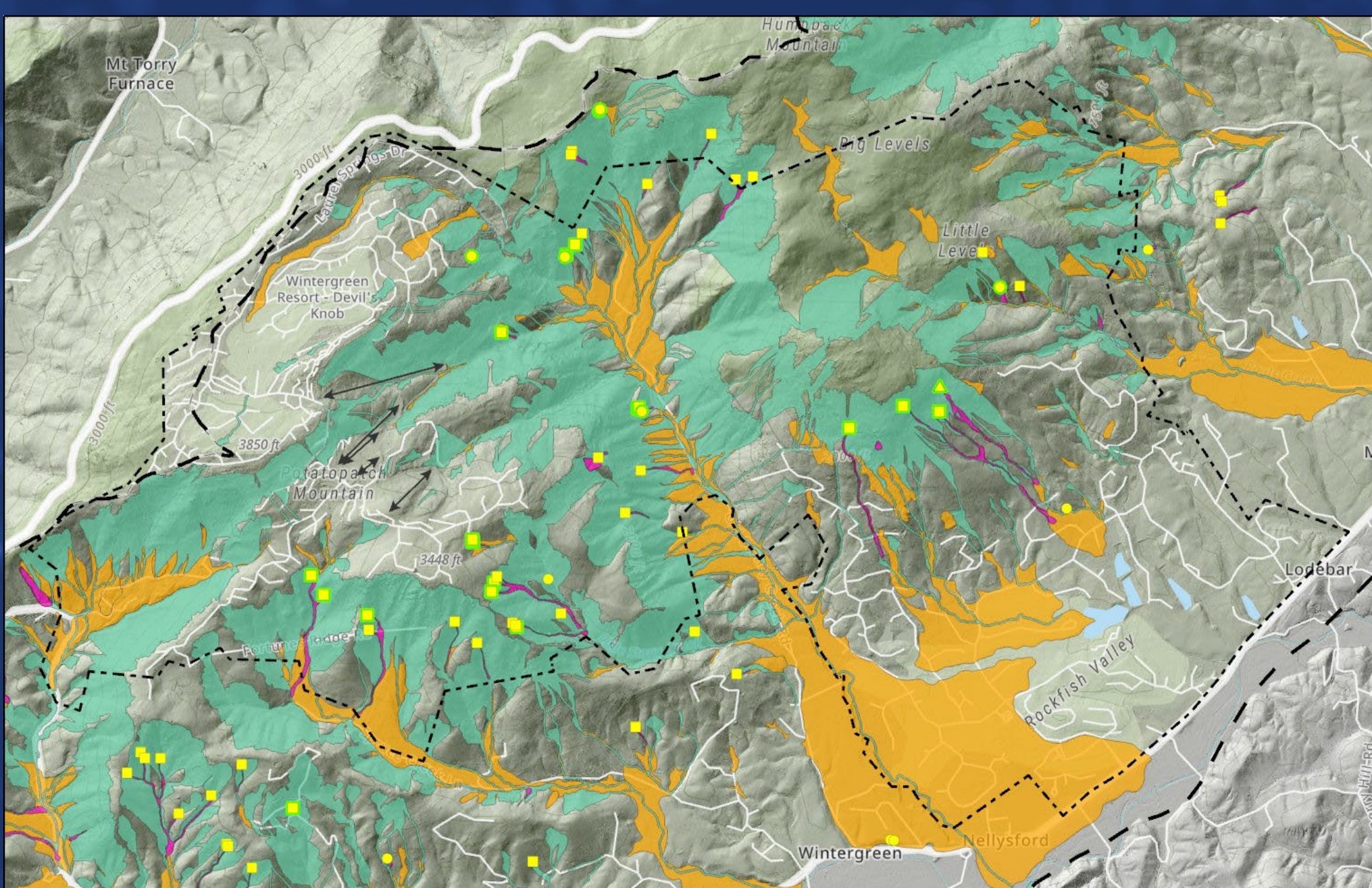
U.S. Department of Emergency Management and National Emergency Management Agency for funding. We would also like to thank Ashraf and Yuhua Chen for comments and the Thomas Jefferson Trust for the Nature Foundation at Washington and its Education Director, Doug Edwards. We are also very grateful to all of the people who assisted us in the field. Thanks to Dr. William Smith for field assistance, Special Agents at St. Nicholas Church, and locating original pre-1900 photographs. We acknowledge the excellent assistance of a staff at the

Relative Hazard

Increasing

Decreasing

Map Symbol	Map Unit Designation	Description
	Known debris flow pathways	Debris flow tracks (1969 to present)
	Potential debris flow pathways	Possible flow paths that initiate within high/moderate hazard susceptibility zones
	Areas of past debris flow activity	Mapped ancient landslide deposits
	Areas of no known or potential debris flow activity	Areas unlikely to be damaged by debris flows



Known Debris Flow Pathways



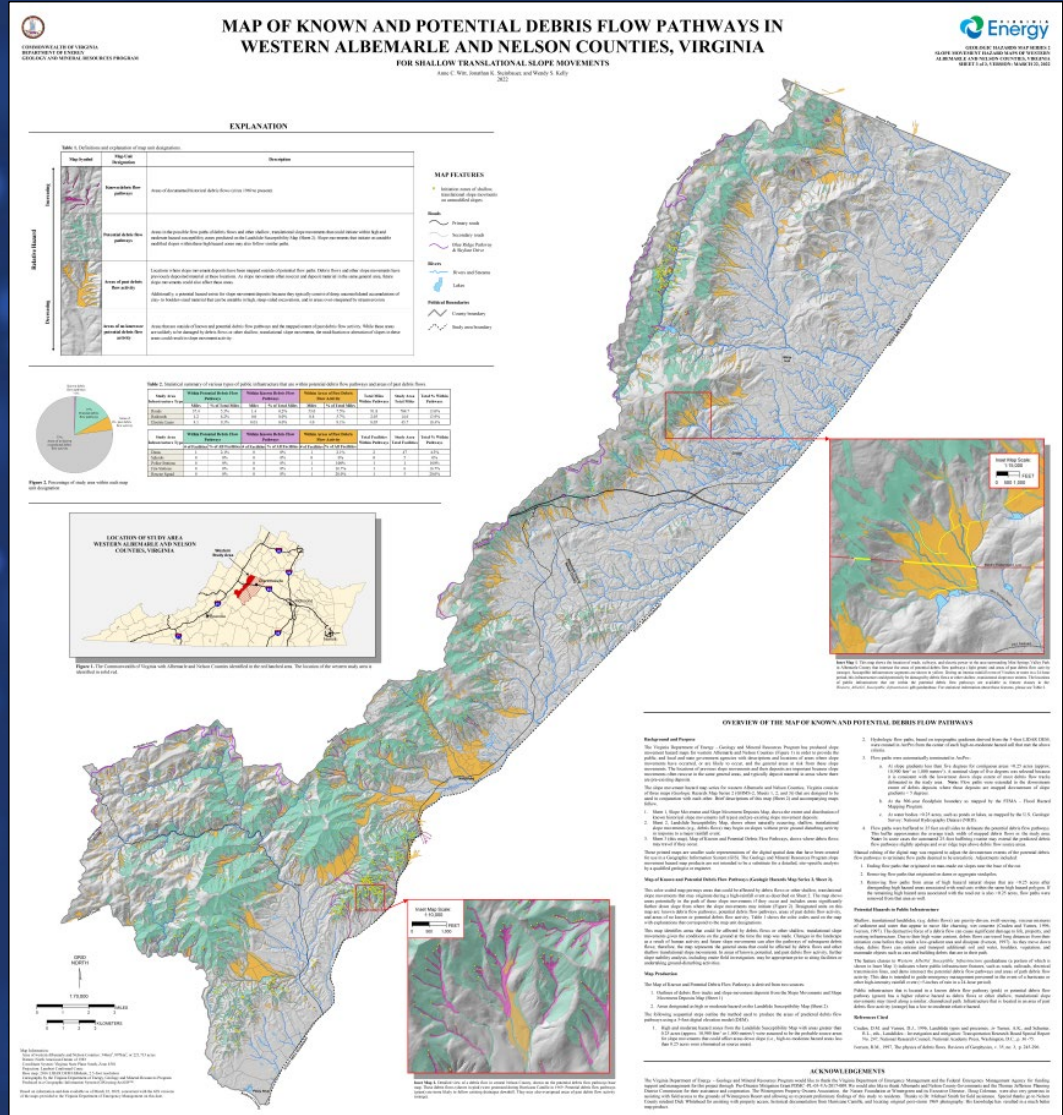
Potential Debris Flow Pathways



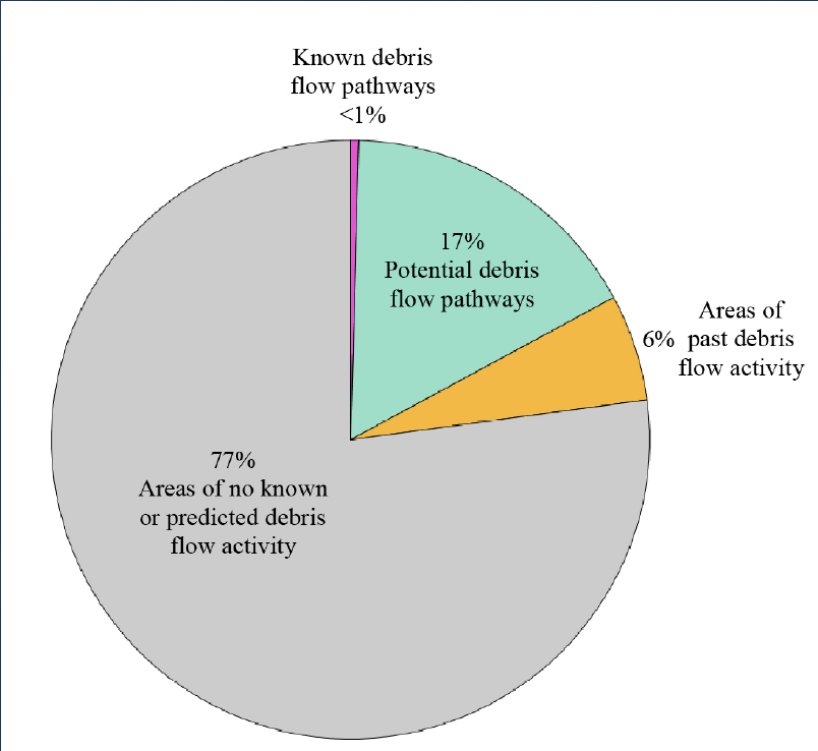
Areas of past DF activity



No known or potential hazard



3 Landslide Pathway Map



Study Area Infrastructure Type	Within Potential Debris Flow Pathways		Within Known Debris Flow Pathways		Within Areas of Past Debris Flow Activity		Total Miles Within Pathways	Study Area Total Miles	Total % Within Pathways
	Miles	% of Total Miles	Miles	% of Total Miles	Miles	% of Total Miles			
Roads	37.4	5.3%	1.4	0.2%	53.0	7.5%	91.8	704.7	13.0%
Railroads	1.2	8.2%	0.0	0.0%	0.8	5.7%	2.03	14.6	13.9%
Electric Lines	4.1	9.3%	0.01	0.0%	4.0	9.1%	8.05	43.7	18.4%

Study Area Infrastructure Type	Within Potential Debris Flow Pathways		Within Known Debris Flow Pathways		Within Areas of Past Debris Flow Activity		Total Facilities Within Pathways	Study Area Total Facilities	Total % Within Pathways
	# of Facilities	% of All Facilities	# of Facilities	% of All Facilities	# of Facilities	% of All Facilities			
Dams	1	2.1%	0	0%	1	2.1%	2	47	4.3%
Schools	0	0%	0	0%	0	0%	0	5	0%
Police Stations	0	0%	0	0%	1	100%	1	1	100%
Fire Stations	0	0%	0	0%	1	16.7%	1	6	16.7%
Rescue Squad	0	0%	0	0%	1	20.0%	1	5	20.0%

How to Use Landslide Hazard Maps

① Landslide Inventory Map → WHERE HAVE LANDSLIDES OCCURRED?

This map (also called the *Slope Movements and Slope Movement Deposits* map) identifies landslide features within the study area including:

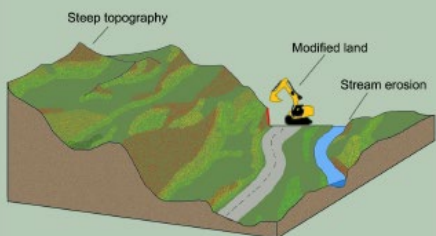


LANDSLIDE LOCATIONS are places where modern landslides start before sliding or flowing downhill.

LANDSLIDE OUTLINES are the boundaries of recent landslides. There are many different types of landslides, but most of these landslide outlines will identify *debris flows*.

LANDSLIDE DEPOSITS are large volumes of clay, silt, sand, and rocks that have accumulated over time as a result of multiple ancient landslide events.

② Landslide Susceptibility Map → WHERE COULD LANDSLIDES START?



These maps identify areas that may be at greater risk of failure during an extreme rainfall event (such as a hurricane). Susceptibility maps typically highlight areas of steepest topography, in addition to other factors that influence where a landslide may initiate. Soil thickness and type, geology, degree of fracturing, aspect, and vegetation can all be significant.

Slopes are more susceptible to failure in areas affected by clearcutting, burning, stream erosion, or site development. Such activities may cause reduction of soil cohesion or the oversteepening of slopes resulting in a greater risk of failure.

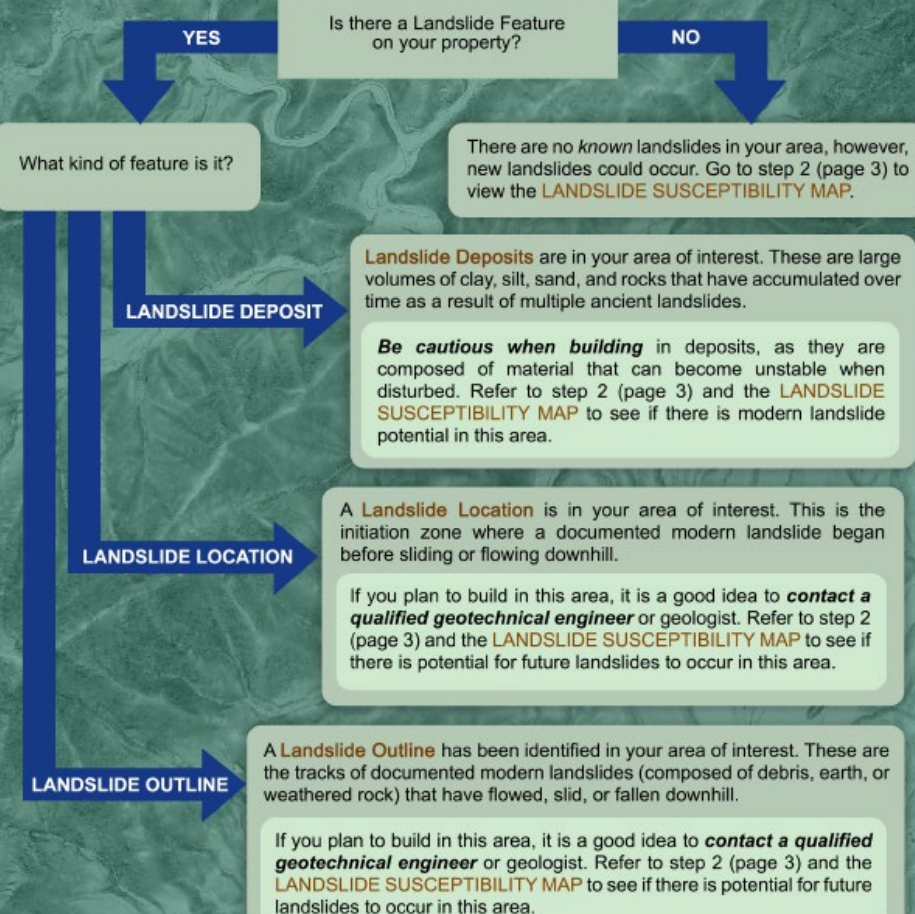
③ Landslide Pathway Map → WHERE COULD LANDSLIDES GO?



These maps identify the potential pathways a landslide could take if one were to occur during an extreme rainfall event. Landslides typically follow a path of least resistance downhill, such as a valley or drainage. Once a landslide encounters shallow topography, such as a flood plain, the material can spread outward covering a broader area.

What Should a Property Owner Do?

step 1 Begin with the Landslide Inventory Map (Slope Movements and Slope Movement Deposits Map)



What Should a Property Owner Do?

step
2

Look at the Landslide Susceptibility Map

YES

Is your area of interest in a stability zone ranked as **Moderate Hazard** or **High Hazard**?

NO

This area has been given a **Moderate to High landslide hazard ranking**. This ranking delineates where natural landslides (not due to construction) are **most likely** to occur during an extreme rainfall event. Several factors contribute to calculating a ranking system for determining moderate to high hazard zones: topographic slope, topographic curvature, soil depth and cohesion, and bedrock geology.

Your area of interest is in a relatively stable zone. However, even though landslides are not likely to *begin* in your area during a storm event, landslides could move across this area if they fail uphill from this location. Even in a relatively stable zone, a landslide may be triggered if construction or stream erosion cause **oversteepening** of an otherwise gentle slope.

Next refer to step 3 (page 4) and view the **LANDSLIDE PATHWAY MAP** for more information.

MODERATE
HAZARD ZONE

Your area of interest is within a **moderate landslide hazard zone**. Such areas have a moderate ranking with several contributing factors that could result in failure.

Use caution when building in these zones. Pay attention to any previously built cut or fill slopes for signs of instability such as tension cracks and slumping. Ensure stormwater runoff is effectively contained and appropriately directed. **Contact a qualified geotechnical engineer** for a **site assessment** if you have concerns. Refer to step 3 (page 4) and the **LANDSLIDE PATHWAY MAP** for more information.

HIGH
HAZARD ZONE

Your area of interest is within a **high landslide hazard zone**. Such areas have high ranking with multiple contributing factors that increase the probability of instability during an extreme storm event.

Use caution when building in these zones. It may be a good idea to **contact a qualified geotechnical engineer** or geologist for a **site assessment**. If your property is within one of these zones, monitor for evidence of instability such as cracks in soil, tilted trees, sagging or taut power lines, or leaking or broken pipes. Ensure stormwater runoff is effectively contained and appropriately directed. Refer to step 3 (page 4) and the **LANDSLIDE PATHWAY MAP** for more information.

What Should a Property Owner Do?

step
3

Look at the Landslide Pathway Map

Is your area of interest
in or near:

AREAS OF PAST DEBRIS FLOW ACTIVITY

Landslides accumulated in this area during ancient times (thousands to millions of years ago). Landslides often occur in the same areas and old material from previous landslides may become reactivated if a severe storm event were to occur or if such material is disturbed by building processes.

If you plan to build here, it is a good idea to contact a **qualified geotechnical engineer** or geologist for an evaluation if the area is deemed to be at risk and follow safe building guidelines in order to avoid creating unsafe oversteepened slopes.

NO KNOWN DEBRIS FLOW ACTIVITY

Landslides have not been recorded in this area. It is unlikely that damage could occur here due to landslides, **however** oversteepening of otherwise stable slopes due to excavation during construction could lead to slope failure.

If you plan to build here, be sure to follow safe building guidelines in order to avoid creating unsafe oversteepened slopes.

KNOWN DEBRIS FLOW PATHWAYS

These are documented landslides that occurred during historic time. Landslides often occur in the same areas and old material from previous landslides may become reactivated if severe storms occur or if such material is disturbed by construction.

If you plan to build here, it is a good idea to contact a **qualified geotechnical engineer** or geologist and follow safe building guidelines in order to avoid creating unsafe oversteepened slopes.

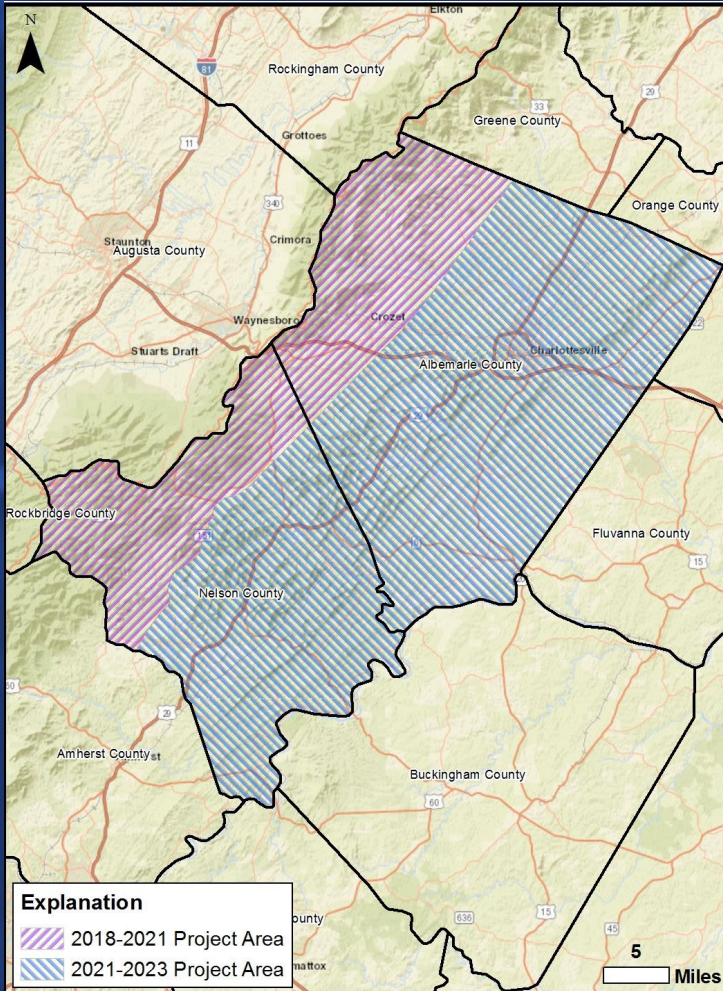
POTENTIAL DEBRIS FLOW PATHWAYS

These are estimated landslide pathways that could develop if an extreme storm event were to occur in this area. The exact width and length of an actual landslide here could vary from the map estimates.

Contact a qualified geotechnical engineer or geologist if you intend to build and follow safe building guidelines in order to avoid creating unsafe oversteepened slopes. If you live near a potential landslide pathway, be mindful of weather conditions and be prepared to leave for safer ground if a severe storm event occurs in your area.

Acknowledgements: This guide is modeled after the Geologic Stability Maps Quick Reference developed by Appalachian Landslide Consultants, PLLC

WE STILL HAVE A LOT OF WORK TO DO...



Complete the VDEM/FEMA grant in 2024

- Finish the final phase of the landslide susceptibility mapping
- Presentation of data products and results to the planning community and the public

NEW as of MARCH 2024: Virginia Energy received a BRIC 2022 grant from VDEM/FEMA to complete a statewide landslide inventory by 2027

https://www.energy.virginia.gov/geology/FEMA_landslide.shtml

Contact Information:



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Jonathan Steinbauer: Contract Geologist

https://energy.virginia.gov/geology/FEMA_landslide.shtml