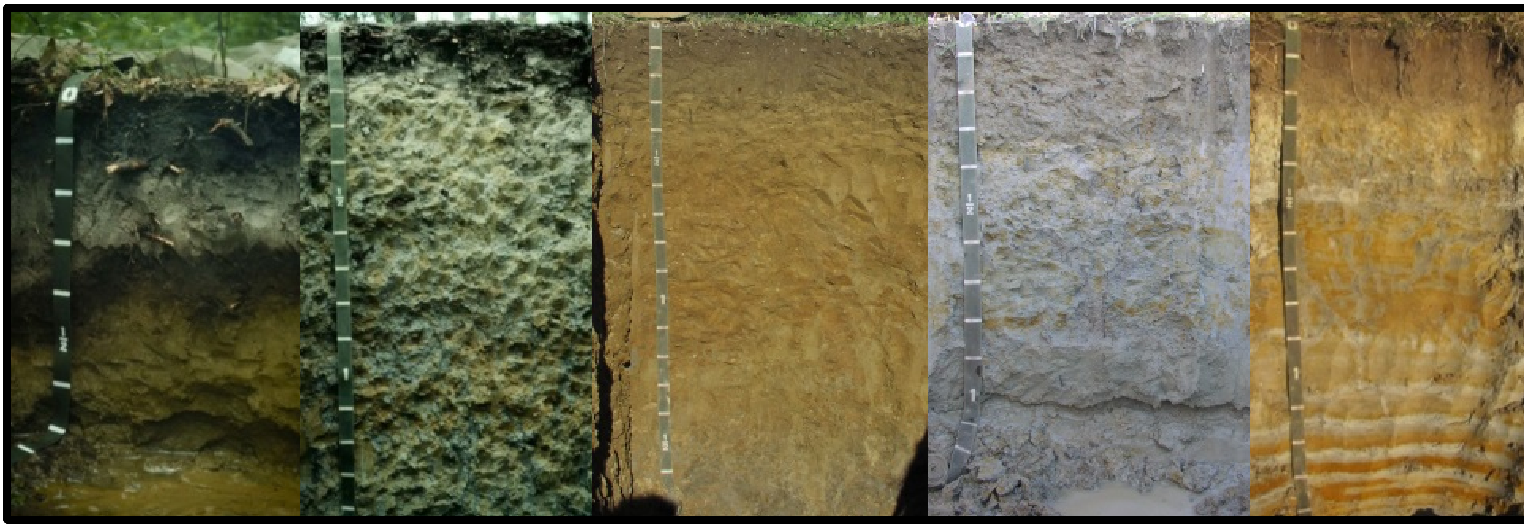
National
Cooperative
Soil
Survey

National Cooperative Soil Survey Conference

June 16-20, 2013

Annapolis, Maryland

Guidebook for Field Trips



University of Maryland, Dept. Environ. Sci. & Tech.

DEPARTMENT OF ENVIRONMENTAL SCIENCE & TECHNOLOGY
College of Agriculture & Natural Resources
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USDA, Natural Resources Conservation Service

USDA NRCS Natural Resources Conservation Service

Mid-Atlantic Association of Professional Soil Scientists

Page

2013 NCSS National Conference Agenda

"Soil Survey-Planning for Soil Health in the Critical Zone"

Sunday, June 16, 2013				
800AM-5PM	Western Maryland Piedmont field Tour (lunch & snacks included)			
9:00AM-5PM	NCERA3 Research Group Mtg(small board room 12-15 people)			
1:30-5PM	Registration-Loews Hotel Lobby			
5PM-9PM	Welcome no host reception- Loews Hotel			
Monday, June 17, 2013				
Time	**Plenary Room (Ballroom A/B)**	**Ballroom C**	**Windjammer**	**Skipjack**
7:30-8:00AM	Coffee in the Atrium			
8:00AM-8:15AM	Welcome to Maryland- STC NRCS MD Deena M. Wheby, State Conservationist, NRCS, Maryland			
8:15AM-8:30AM	Welcome to the NCSS Conference - Dr. William Bowerman, Chair, Environmental Science and Technology, University of Maryland			
8:30AM-8:40AM	Welcome, Introductions of NCSS Conference Members- Dr. Martin Rabenhorst, Univ. of Maryland Dean Cowherd, USDA-NRCS			
8:40-9:00 AM	Video — Climate Change The Role and Importance of U.S. National Cooperative Soil Survey in Conservation Jason Weller, Acting Chief, NRCS			
9:00AM-9:20AM	Update on Soil Survey Accomplishments in the USDA-NRCS-Micheal Golden, Deputy Chief, Soil Survey and Resource Assessment, NRCS			
9:20AM-9:30AM	Questions and Discussion			
9:30AM-10:00AM	Coffee in the Atrium			
10:00AM-10:30AM	The Future of the U.S. Soil Survey Questions and Discussion from the Partnership-Dave Smith, Director, Soil Science Division, NRCS			
10:30AM-10:45AM	Geospatial Technology to Support NRCS and NCSS--Jennifer Sweet, National Geospatial Center of Excellence, NRCS			

2013 NCSS National Conference Agenda

"Soil Survey-Planning for Soil Health in the Critical Zone"

Monday, June 17, 2013				
Time	**Plenary Room (Ballroom A/B)**	**Ballroom C**	**Windjammer**	**Skipjack**
10:45AM-11:00AM	Federal Lands Partnership with the NCSS- Stephanie Connolly, USFS Larisa Ford, BLM			
11:00AM-11:45AM	Panel - Regional Conferences Recommendations- North Central (Dr. C. Lee Burras, Iowa State Univ.) Northeast (Luis Hernandez, Massachusetts NRCS) South (Doug Slabaugh, Tennessee NRCS) West (Ron Raney, Oregon NRCS)			
11:45AM-12:05PM	Expanding Horizons of SSSA — Recruitment, Soil Judging, and Student Participation--Dr. Dave Lindbo, NCSU SSSA President			
12:05PM-12:15PM	Conference Logistics for Committee Meetings (Levin)			
12:15-1:30PM	Lunch on own			
1:30-3:00PM	**NCSS Interpretations Forum** (West Virginia State University, a new cooperator (Dr. Amir Hass, WVSU); Activities at the NSSC(Robert Dobos, NSSC);Disaster interps response from Sandy Hurricane Disaster(Turrene); Interpretations and Soil Health Conservation Planning on the Farm(Robinette)) & Technical Poster (5 minutes each)presentations	**New Technology Business Meeting-** Review of the Regional Conference Recommendations	**Soil and Ecological Dynamics Committee**--Drs. Susan Andrews and Mike Duniway, co-chairs. Overview: NRCS' Dynamics Concepts, Projects, Needs; Discussion: Members Identify Role of New Standing Committee in NCSS; Recommendations and Action Items	**NCSS Standards:**Dave Smith; Loerch; Galbraith; Chiaretti Review and discuss the process to propose, review and approve proposals to NCSS standards. Review decisions and conclusions on active proposals to NCSS standards.
3:30-5:00PM	**Poster presentations (5min each) Soil Survey Regional Offices 1-12, Students and technical posters-**Roy Vick (Moderator)	**New Technology Business Meeting-**Review of the Regional Conference Recommendations	**NCSS Interpretations Committee Business Meeting --**Review charges from Regional Conferences	**NCSS Standards:** Charetti; Galbraith; Scheffe Review decisions and conclusions on active proposals to NCSS standards and gain consensus on approval; Focus on amendments to standards recommended in final ICOMANTH report
5:30-8:00PM	**Reception** (Atrium) - Technology Display, Computer Demos and Posters			

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"Soil Survey-Planning for Soil Health in the Critical Zone"

Tuesday, June 18, 2013				
Time	**Plenary Room (Ballroom A/B)**	**Ballroom C**	**Windjammer**	**Skipjack**
7:30-8:00AM	Coffee in the Atrium			
8:00AM-8:10AM	**Introduction — Planning for Soil Health in the Critical Zone**--Dr. Wayne Honeycutt, Deputy Chief for Science and Technology, NRCS (Moderator)			
8:10AM-8:35AM	**Soil Health and Sustainable Agriculture — Considering the Critical Zone-**Dr. Michelle Wander, Professor, Univ. of Illinois			
8:35AM-9:15AM	**Visions for Soil and Critical Zone Monitoring With a Systems Approach**--Dr. Eugene Kelly, Professor, Colorado State Univ. and Dr. Oliver Chadwick, Univ. of California, Santa Barbara			
9:15AM-9:40AM	**National Ecological Observatory Network**- Drs. Ed Ayres, Soil Scientist and Eve-Lyn Hinckley, Staff Scientist, NEON, Inc.			
9:40AM-10:00AM	**Questions, Discussion, and Summary** - Dr. Wayne Honeycutt			
10:00AM-10:30AM	Coffee in the Atrium			
10:30AM-12Noon	**New Technology Committee** - focus on new mapping and laboratory technology field tools Integrating New Data Sources in WebSoilSurvey--Dave Hoover, NRCS Geomorphons--Phillip Owens GamaRay Sensors--Cristine Morgan, TAMU, Jim Thompson, WVU	**Soil and Ecological Dynamics Committee--** Dr. Susan Andrews Discussion: Explore actions and research needed to facilitate the inventory and prediction of dynamic soil properties. Recommendations.	**NCSS Interpretations** --Impacts of Gas and Oil exploration and extraction Joe Kraft NRCS-PA Technical Soil Services	**NCSS Standards:** Scheffe; Ransom; Chiaretti; Discuss effort to update the Soil Survey Manual; review strategy, approach and status; discuss priority topics and individual assignments. Report on progress in development of "Field guide to Soil Taxonomy" by working group; review draft document; gather input and comment on future direction and additions.
Noon-1:30PM	Lunch on own			

2013 NCSS National Conference Agenda
"Soil Survey-Planning for Soil Health in the Critical Zone"

Tuesday, June 18, 2013				
Time	**Plenary Room (Ballroom A/B)**	**Ballroom C**	**Windjammer**	**Skipjack**
1:30-3:00PM	**NCSS Standards** --Report of Universal Soil Classification working group – Hempel • Jon Hempel-progress of the IUSS Universal Soil Classification working group • Joe Chiaretti (remote)-profile descriptions comparisons • Phillip Owens-USC Cold Soil Task Group • Maxine Levin-consolidation considerations of WRB and ST • Horizon Classification system-Hempel for Alex McBratney • Curtis Monger (remote)- horizon nomenclature designations • Phillip Owens-progress with soil moisture/temp regimes	**Soil and Ecological Dynamics Committee**-- Drs. Susan Andrews and Mike Duniway, co-chairs Discussion: Explore actions and research needed to facilitate the study and description of ecological sites. Posters related to topic (5 minutes each) Recommendations.	**NCSS Interpretations** --Cooperators Forest Service perspective Stephanie Connolly, FS-MNF Private Industry perspective Gary Jellick, Acorn Environmental Inc Opportunities for collaboration Urban interpretations discussion Amir Hass, WVSU	**New Technology Committee Business Meeting -** Finalize reccommendations Discussion communications over the next two years, to strengthening the technology forums at the Regional meetings, to methods of promoting technological improvements in soils work.
3:00PM-3:30PM	Coffee in the Atrium			
3:30-5:00PM	**Soil and Ecosystem Dynamics Committee Forum -**Dr. Susan Andrews (Moderator) •Measuring the Retained Water and Sequestered Organic Carbon Contents of Soil Profiles in Aroostook and Piscatiquis Cos, ME -- Geoffrey Davies and Ghabbour • A Novel, GIS-based Approach to Developing Ecological Sites in Highly Variable Landscapes of the Eastern US -- Alex W. Ireland and Patrick J. Drohan • Plants Need Water: Controlling Organic Matter Structure to Improve Soil Wet-ability--Marcus Kleber • The Use of Data Mining for Dynamic Soil Properties --Carmen Ugarte • RaCA Project Update—Skye Wills and Susan Andrews **Discussion**	**Research Agenda Committee; Loerch, Williams, Cavallaro;** Review of regional research topics and discussion of future research agenda; finalize recommendations	**Ethics Workshop for Soil Consultants--SSSA Certification**	**NCSS Standards --NCSS Bylaws**: Scheffe, Chiaretti; Rabenhorst; Review NCSS conference bylaws and bring current with decisions from past board meetings. Prepare report or proposals to bring before the Business meeting of entire group.

2013 NCSS National Conference Agenda

"Soil Survey-Planning for Soil Health in the Critical Zone"

Wednesday, June 19, 2013

6:30AM-6PM	The Delmarva Peninsula Tour will depart from the Loews Annapolis Hotel at 6:30 a.m. and will return to the Loews Annapolis at 8:30 p.m. Content: The tour will be focused on hydrology and soils in late Pleistocene deposits, and the potential impact of climate change and sea level rise. The tour will depart from the Loews Annapolis Hotel at 6:30 a.m. and will visit sites on the Delmarva Peninsula on Maryland's Eastern Shore. These will include a) soil topohydrosequences formed in late Pleistocene dunes of the Parsonsburg formation; b) a topohydrosequence of hydric soils along a submerging marsh landscape at Blackwater National Wildlife Refuge; and c) soils formed in loess deposits near Chesapeake Bay. The tour will conclude with a cookout dinner (possibly with crab) at Sandy Point State Park on Chesapeake Bay. Buses will return to the Loews Annapolis at 8:30 p.m. Lunch, dinner, and breaks are included.
6-8:30 PM	Banquet (Cookout) on the Beach

Thursday, June 20, 2013

Time	Plenary Room (Ballroom A/B)	Ballroom C	Windjammer	Skipjack
6:30AM-8:00AM	Coffee in the Atrium			
7:00-8:00AM		**NIFA** AFRI Project Directors Meeting	**Federal Agency** discussion	**University Representatives** Strategic Planning for the Future of NCSS
8:00 AM-9:30 AM	Joint Townhall---**University Representatives/Agency Representatives and Private Sector / Consulting Soil Scientists** Strategic Planning for the Future of NCSS	**NIFA** AFRI Project Directors Meeting		
9:30AM-10:00AM	Atrium - Break -**NIFA AFRI Project Directors Meeting** Posters w/Coffee			

Thursday, June 20, 2013

Time	Plenary Room (Ballroom A/B)	Ballroom C		
10:00AM-Noon	**International Forum(20 minutes each)** World Soil Resources Plan(Haiti)-Thomas Reinsch, PhD Africa Soil Information Service: Recent Progress in Developing Digital Soil Maps of Africa-Sonya Ahmed, Columbia University Mapping the Soils of Mexico-Eliseo Guerrero Challenges to Sustaining agriculture production in Nepal and Bhutan--Jon Galbraith, VATech **2013 NCSS Award Winners(10 minutes each)** NCSS SS of the Year-Lindsay Hodgman NCSS Achievement--Skip Bell NCSS Cooperator of the Year--Mark Stolt, URI	**NIFA** AFRI Project Directors Meeting		
12PM-1:30PM	**Group Lunch** **Special Guest Speaker-**Niel Bogner, retired SCS Director of Engineering--History of CCC Camps in Maryland and early SCS Conservation **NCSS Awards — David Smith / Roy Vick / Maxine Levin**	**NIFA AFRI Project Directors Meeting** Poster session, Lunch or join NCSS Banquet		
1:30- 1:50PM	Soil and Ecosystem Dynamics Committee (Andrews)	**NIFA** AFRI Project Directors Meeting		
1:50-2:00PM	Report from NCSS Standards Standing Committee (Loerch)	**NIFA** AFRI Project Directors Meeting		
2:00 2:20PM	Report from Interpretations Committee (Dobos)	**NIFA** AFRI Project Directors Meeting		
2:20-2:40PM	Report from Research Agenda Standing Committee (Williams)	**NIFA** AFRI Project Directors Meeting		
2:40-3:00PM	Report from New Technology Standing Committee (Hoover)	**NIFA** AFRI Project Directors Meeting		

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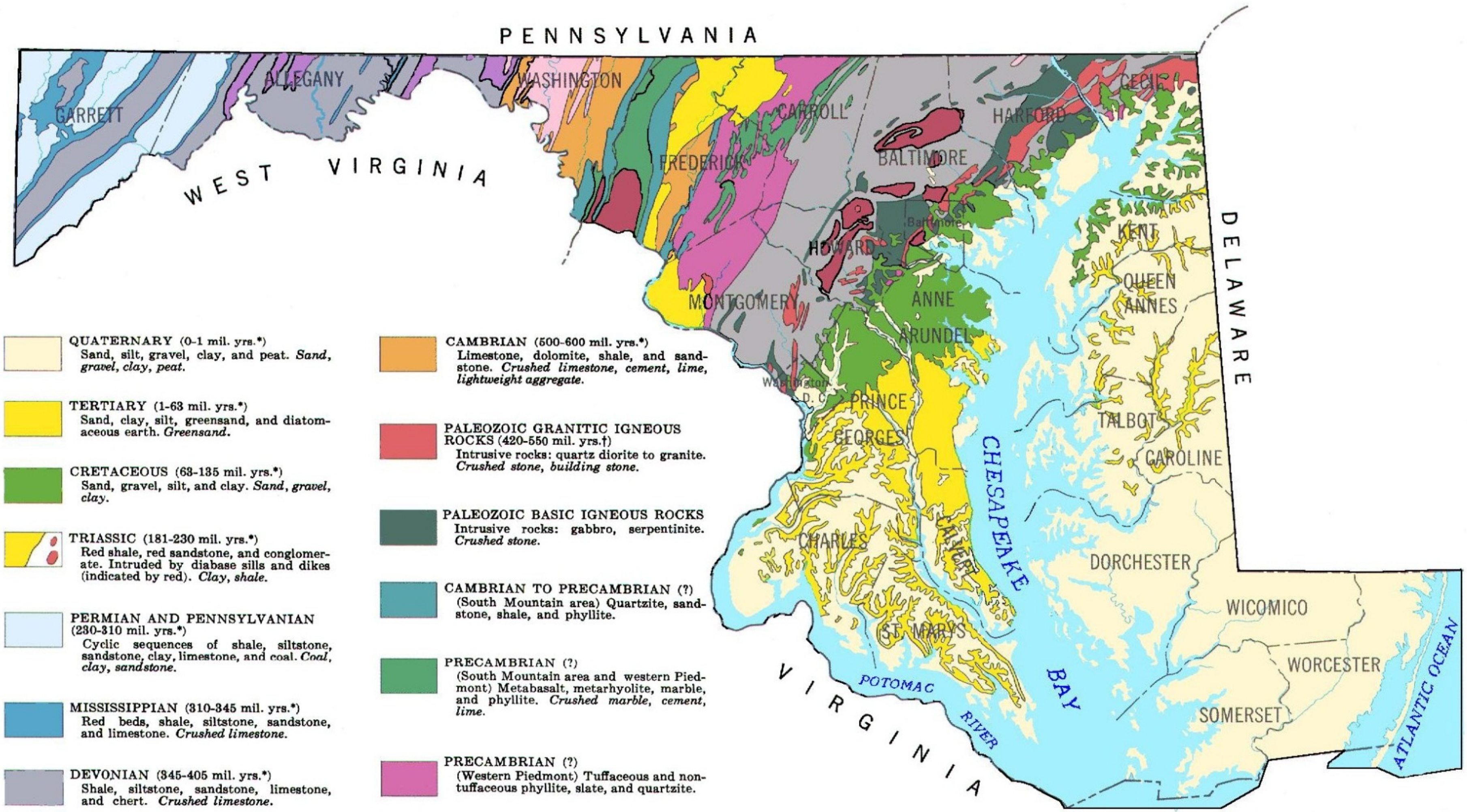
Thursday, June 20, 2013				
Time	**Plenary Room (Ballroom A/B)**	**Ballroom C**		
3:00-3:30PM	Atrium- Coffee			
3:30-3:40PM	Summary Report from Universities' Breakout and Ongoing Issues (with discussion) (TBA)	**NIFA** AFRI Project Directors Meeting		
3:40- 4:00PM	Summary Report from Federal Agency and Private Consultants Breakout and Ongoing Issues	**NIFA** AFRI Project Directors Meeting		
4:00-4:10PM	Recommendations from Student Coalition (TBA)	**NIFA** AFRI Project Directors Meeting		
4:10- 4:40PM	Business Meeting with Entire Group	**NIFA** AFRI Project Directors Meeting		
4:40-5:00PM	David Smith(Roy Vick), NCSS Chair--Closing Remarks Review of Action Register; General Announcements; Announcement of Next National and Regional NCSS Conferences	**NIFA** AFRI Project Directors Meeting		

List of conference Participants

Name	Organization	City/State
Sonya Ahamed	CIESIN, Columbia University	Summit, NJ
Debbie Anderson	USDA-NRCS	Raleigh, NC
Susan Andrews	USDA-NRCS-NSSC	Lincoln, NE
Edward Ayres	NEON	Boulder, CO
John Beck	USDA NRCS	Saint Paul, MN
James Brewer	USDA NRCS	Easton, MD
Robert Bricker	MAPSS	CATONSVILLE, MD
C. Lee Burras	Iowa State University	Ames, IA
Nancy Cavallaro	USDA/NIFA	Washington, DC
Joseph Chiaretti	USDA-NRCS-NSSC	Lincoln, NE
Michelle Clendenin	NRCS	Durham, NC
Loretta Collins	The University of Maryland	Beltsville, MD
Stephanie Connolly	USFS Monongahela NF	Elkins, WV
William Cowherd	NRCS	Annapolis, MD
Susan Crow	University of Hawaii Manoa	Honolulu, HI
Geoffrey Davies	Northeastern University	Boston, MA
Susan Davis	NRCS Maryland	La Plata, MD
Nancy Dean	BLM	Washington, DC
Susan Demas	USDA NRCS	Hammonton, NJ
Robert Dobos	USDA NRCS	Lincoln, NE
Patrick Drohan	The Pennsylvania State University	University Park, PA
Laf Erickson	Atlantic Resource Management, Inc.	Ocean View, DE
Delvin S. Fanning	Unversity of Maryland	College Park, MD
Charles Ferguson	USDA-NRCS	Raleigh, NC
Larisa Ford	BLM	Washington, DC
Aaron Friend	NRCS Maryland	Frederick, MD
John Galbraith	Virginia Tech	Blacksburg, VA
Paula Gale	University of Tennessee at Martin	Martin, TN
Tim Gerber	NRCS Maryland	Bel Air, MD
Elham Ghabbour	Northeastern University	Boston, MA
Micheal Golden	USDA NRCS	Beltsville, MD
James Gordon	NRCS	Temple, TX
Michelle Guck	NRCS Maryland	Annapolis, MD
Amir Hass	WEST VIRGINIA STATE UNIVERSITY	Institute, WV
Douglas Helms	NRCS	Arlington, VA
Jon Hempel	USDA-NRCS	Lincoln, NE
Luis Hernandez	USDA-NRCS-SSR-12	Amherst, MA
Eve-Lyn Hinckley	National Ecological Observatory Network	Boulder, CO
Lindsay Hodgman	USDA-NRCS	Bangor, ME
C. Wayne Honeycutt	USDA/NRCS	Washington, DC
David Hoover	USDA-NRCS-NSSC	Lincoln, NE
David Hopkins	NCSS State Liasion	Fargo, ND
Emanuel Hudson	USDA Forest Service	Atlanta, GA
Alex Ireland	Pennsylvania State University	University Park, PA
Gary Jellick	Acorn Environmental, Inc.	Severna Park, MD
Michael Jones	NRCS-Soil Survey	Morgantown, WV
Phillip King	USDA NRCS	Georgetown, DE
Markus Kleber	Oregon State University	Corvallis, OR
Lee Koss	BLM	Washington, DC
Joseph Kraft	USDA NRCS	Harrisburg, PA

Name	Organization	City/State
Mark Kuzila	School of Natural Resources	Lincoln, NE
Maxine Levin	USDA-NRCS	Beltsville, MD
David Lindbo	NC State University	Raleigh, NC
Cameron Loerch	USDA-NRCS-NSSC	Lincoln, NE
Charles Love	USDA	Auburn, AL
Douglas Malo	South Dakota State University	Brookings, SD
Paul McDaniel	University of Idaho	Moscow, ID
Cathy McGuire	USDA-NRCS	Phoenix, AZ
Elena Mikhailova	Clemson University	Clemson, SC
McKinley-Ben Miller	BLM	Washington, DC
Amanda Moore	MAPSS	Annapolis, MD
Cristine Morgan	Texas A&M Univeristy	College Station, TX
Brian Needelman	University of Maryland	College Park, MD
Jeff Olson	U.S. Forest Service	Mena, AR
Kenneth Olson	Univ. of Illinois	Urbana, IL
Omayra Ortiz - Santiago	NRCS	Beltsville, MD
Phillip Owens	Purdue Univeristy	West Lafayette, IN
Christopher Palardy	University of Maryland - College Park	College Park, MD
Amy Parrish	Advanced Land and Water, Inc.	Sykesville, MD
Ariane Peralta	Indiana University	Bloomington, IN
Martin Rabenhorst	Univ. of MD College Park	College Park, MD
Ron Raney	USDA Natural Resources Conservation Service	Portland, OR
Mickey Ransom	Kansas State University	Manhattan, KS
Paul Reich	USDA NRCS	Beltsville, MD
Thomas Reinsch	USDA NRCS	Beltsville, MD
James (Chad) Remley	USDA-NRCS	Salina, KS
Carl Robinette	NRCS	Flintstone, MD
Jocelyn Robinson	Atlantic Resource Management, Inc.	Ocean View, DE
Ann Rossi	University of Maryland	College Park, MD
Ken Scheffe	USDA-NRCS-NSSC	Lincoln, NE
Joey Shaw	Auburn University	Auburn University, AL
Diane Shields	USDA/NRCS	Centreville, MD
James (Doug) Slabaugh	USDA - NRCS	Nashville, TN
David Smith	USDA, NRCS	Washington, DC
Bongkeun Song	Virginia Institute of Marine Science	Gloucester Point, VA
Gary Struben	USDA/NRCS	Indianapolis, IN
Jennifer Sweet	USDA-NRCS-NGCE	Fort Worth, TX
Pam Thomas	USDA-NRCS	Washington, DC
Jim Thompson	West Virginia Univeristy	Morgantown, WV
Rob Tunstead	USDA NRCS	Hammonton, NJ
James Turenne	USDA NRCS	Warwick, RI
Judith Turk	The Richard Stockton College of New Jersey	Galloway, NJ
Carmen M. Ugarte	University of Illinois at Urbana and Champaign	Urbana, IL
Joseph A. Valentine	Delaware Valley College	Doylestown, PA
Mike Vepraskas	NC State University	Raleigh, NC
David Verdone	USDA/NRCS	Frederick, MD
Roy Vick	USDA-NRCS	Washington, DC
Michelle Wander	University of Illinois at Urbana-Champaign	Urbana, IL
Candiss Williams	USDA-NRCS-NSSC	Lincoln, NE
Dan Wing	USDA-NRCS	Raleigh, NC



QUATERNARY (0-1 mil. yrs.*)
Sand, silt, gravel, clay, and peat. *Sand, gravel, clay, peat.*

TERTIARY (1-63 mil. yrs.*)
Sand, clay, silt, greensand, and diatomaceous earth. *Greensand.*

CRETACEOUS (63-135 mil. yrs.*)
Sand, gravel, silt, and clay. *Sand, gravel, clay.*

TRIASSIC (181-230 mil. yrs.*)
Red shale, red sandstone, and conglomerate. Intruded by diabase sills and dikes (indicated by red). *Clay, shale.*

PERMIAN AND PENNSYLVANIAN (230-310 mil. yrs.*)
Cyclic sequences of shale, siltstone, sandstone, clay, limestone, and coal. *Coal, clay, sandstone.*

MISSISSIPPIAN (310-345 mil. yrs.*)
Red beds, shale, siltstone, sandstone, and limestone. *Crushed limestone.*

DEVONIAN (345-405 mil. yrs.*)
Shale, siltstone, sandstone, limestone, and chert. *Crushed limestone.*

SILURIAN (405-425 mil. yrs.*)
Shale, mudstone, sandstone, and limestone. *Glass sand, crushed limestone.*

ORDOVICIAN (425-500 mil. yrs.*)
Limestone, dolomite, shale, siltstone, and red beds. Slate and conglomerate in northern Harford County. *Crushed limestone, cement, clay, lime.*

CAMBRIAN (500-600 mil. yrs.*)
Limestone, dolomite, shale, and sandstone. *Crushed limestone, cement, lime, lightweight aggregate.*

PALEOZOIC GRANITIC IGNEOUS ROCKS (420-550 mil. yrs.†)
Intrusive rocks: quartz diorite to granite. *Crushed stone, building stone.*

PALEOZOIC BASIC IGNEOUS ROCKS
Intrusive rocks: gabbro, serpentinite. *Crushed stone.*

CAMBRIAN TO PRECAMBRIAN (?)
(South Mountain area) Quartzite, sandstone, shale, and phyllite.

PRECAMBRIAN (?)
(South Mountain area and western Piedmont) Metabasalt, metarhyolite, marble, and phyllite. *Crushed marble, cement, lime.*

PRECAMBRIAN (?)
(Western Piedmont) Tuffaceous and nontuffaceous phyllite, slate, and quartzite.

PRECAMBRIAN (?)
(Eastern Piedmont) Schist, metagraywacke, quartzite, marble, and metavolcanic rocks. *Crushed stone, crushed marble, building stone.*

PRECAMBRIAN BASEMENT COMPLEX (1100 mil yrs.†)
Gneiss, migmatite, and augen gneiss.

MARYLAND GEOLOGICAL SURVEY
Kenneth N. Weaver, Director

GENERALIZED GEOLOGIC MAP OF MARYLAND‡

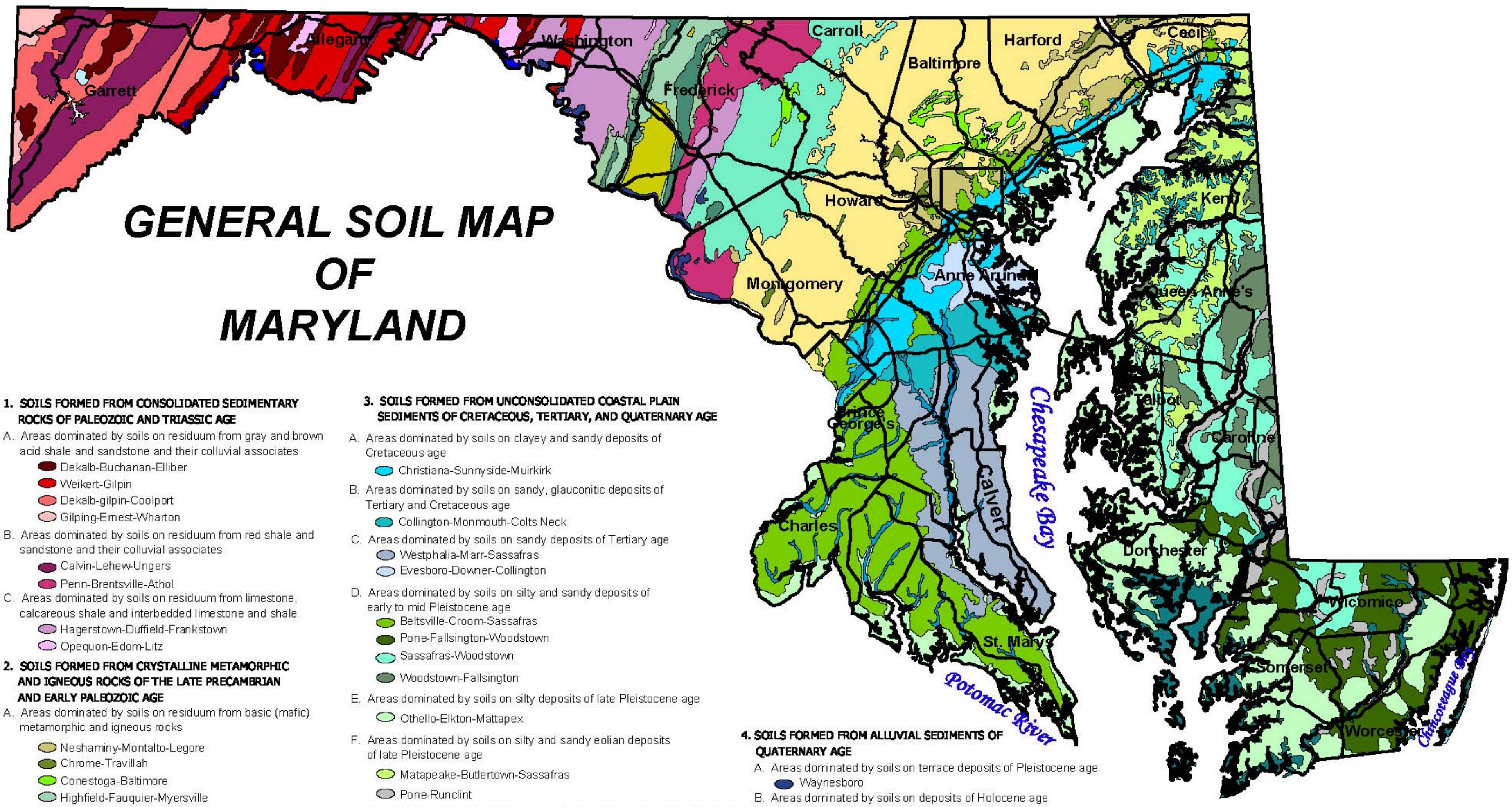
1967

10 0 10 20 30 40
1 inch equals 25 miles

Most important mineral products in italics.
* Age ranges from Kulp, J. L., 1961, Geologic time scale: Science, v. 133, no. 3459, p. 1105-1114.
† Radiometric dates made on Maryland rocks.

‡ A detailed Geologic Map of Maryland, 1968 at a scale of 1 inch equals 4 miles, is also available.

GENERAL SOIL MAP OF MARYLAND



1. SOILS FORMED FROM CONSOLIDATED SEDIMENTARY ROCKS OF PALEOZOIC AND TRIASSIC AGE

A. Areas dominated by soils on residuum from gray and brown acid shale and sandstone and their colluvial associates
- Dekalb-Buchanan-Elliber
- Weikert-Gilpin
- Dekalb-gilpin-Coolport
- Gilping-Ernest-Wharton

B. Areas dominated by soils on residuum from red shale and sandstone and their colluvial associates
- Calvin-Lehew-Ungers
- Penn-Brentsville-Athol

C. Areas dominated by soils on residuum from limestone, calcareous shale and interbedded limestone and shale
- Hagerstown-Duffield-Frankstown
- Opequon-Edom-Litz

2. SOILS FORMED FROM CRYSTALLINE METAMORPHIC AND IGNEOUS ROCKS OF THE LATE PRECAMBRIAN AND EARLY PALEOZOIC AGE

A. Areas dominated by soils on residuum from basic (mafic) metamorphic and igneous rocks
- Neshaminy-Montalto-Legore
- Chrome-Travillah
- Conestoga-Baltimore
- Highfield-Fauquier-Myersville
- Myersville-Fauquier

B. Areas dominated by soils on residuum from acidic (felsic) metamorphic and igneous rocks and their colluvial associates
- Glenelg-Gaila-Occoquan
- Mt Airy-Brinklow-Blocktown
- Braddock-Thurmont-Hazel
- Edgemont-Chandler

3. SOILS FORMED FROM UNCONSOLIDATED COASTAL PLAIN SEDIMENTS OF CRETACEOUS, TERTIARY, AND QUATERNARY AGE

A. Areas dominated by soils on clayey and sandy deposits of Cretaceous age
- Christiana-Sunnyside-Muirkirk

B. Areas dominated by soils on sandy, glauconitic deposits of Tertiary and Cretaceous age
- Collington-Monmouth-Colts Neck

C. Areas dominated by soils on sandy deposits of Tertiary age
- Westphalia-Marr-Sassafras
- Evesboro-Downer-Collington

D. Areas dominated by soils on silty and sandy deposits of early to mid Pleistocene age
- Beltsville-Croom-Sassafras
- Pone-Fallsington-Woodstown
- Sassafras-Woodstown
- Woodstown-Fallsington

E. Areas dominated by soils on silty deposits of late Pleistocene age
- Othello-Elkton-Mattapex

F. Areas dominated by soils on silty and sandy eolian deposits of late Pleistocene age
- Matapeake-Butlertown-Sassafras
- Pone-Runclint

G. Areas dominated by soils on organic and sany deposits of Holocene age
- Honga-Bestpitch-Transquacking
- Coastal Beach

4. SOILS FORMED FROM ALLUVIAL SEDIMENTS OF QUATERNARY AGE

A. Areas dominated by soils on terrace deposits of Pleistocene age
- Waynesboro

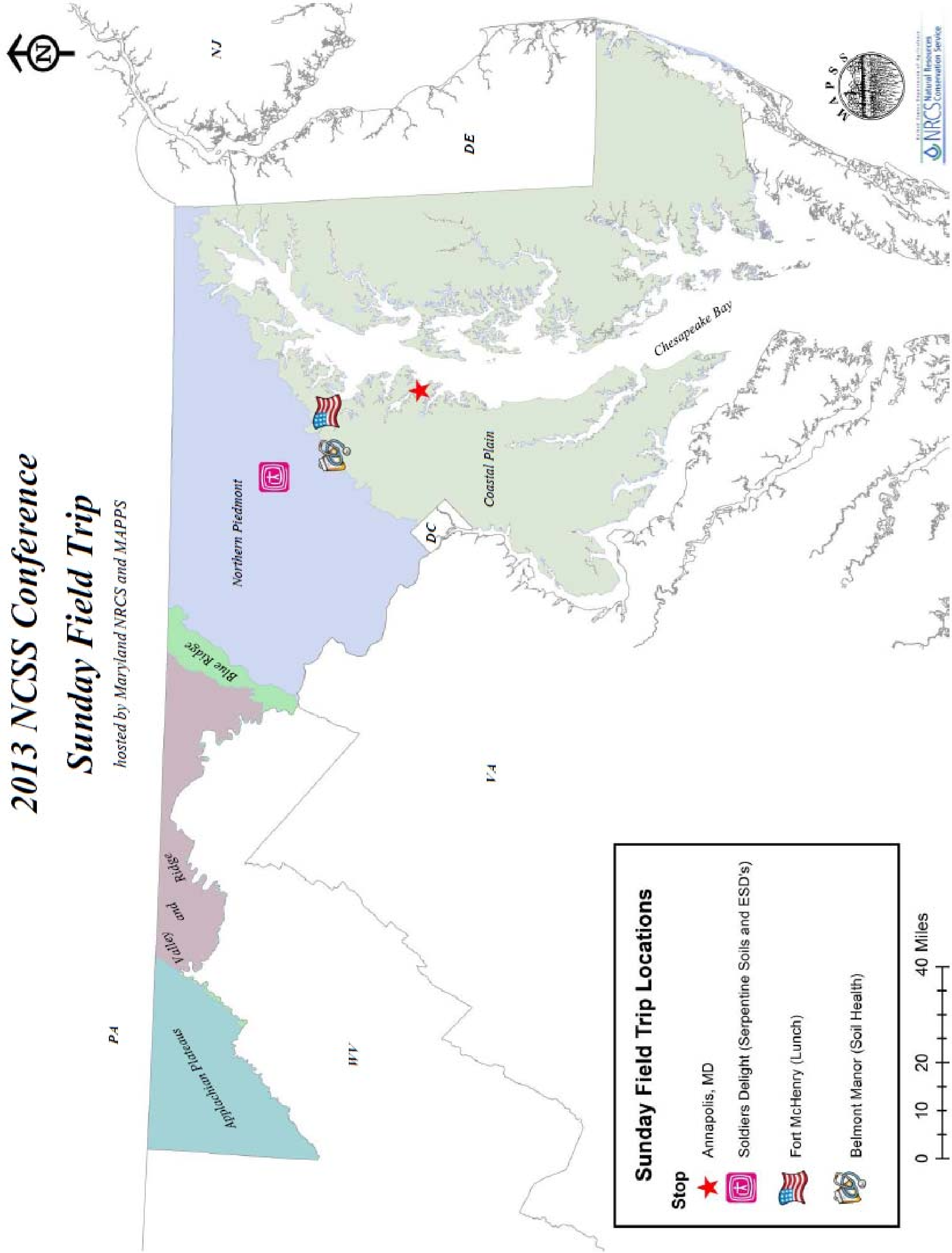
B. Areas dominated by soils on deposits of Holocene age
- Bibb-Bestpitch
- Philo-Pope-Atkins
- Freetown

5. NON - SOILS
- Water
- County Boundary

USDA is an equal opportunity provider and employer

Annapolis, MD

Sunday Field Trip - Maryland Piedmont



Acknowledgements and Thank You

The staff and authors of this guide book would like to thank those who made this tour possible. Mary Ellen Baker, General Manager, Belmont Manor and Historical Park, Howard County Department of Parks and Recreation; James E. Brewer, USDA/NRCS Resource Soil Scientist, MD; David Clausnizer,USDA/NRCS, Ecological Site Inventory Specialist, MA; Michelle Clendenin, USDA/ NRCS, Biologist, NC; Dean Cowherd, USDA/NRCS, Acting State Soil Scientist, MD/DE; Susan Y. Demas, USDA/NRCS MLRA Soil Scientist, NJ; James Doolittle, USDA/NRCS Research Soil Scientist, NE; Aaron K. Friend, USDA/NRCS MLRA Soil Scientist, MD; Phillip S. King, USDA/NRCS, Acting Assistant State Soil Scientist, DE; Joseph S. Kraft, USDA/NRCS, State Soil Scientist, PA; Maxine Levin, USDA/ NRCS, WDC; Steve McCoy, Acting Park Manager, Patapsco Valley State Park, Maryland Department of Natural Resources; and the staff of Patapsco Valley State Park, Maryland Department of Natural Resources; Mid Atlantic Association of Professional Soil Scientists (MAPSS), and in particular, MAPSS members Gary and Debbie Jellick; Amanda Moore, USDA/NRCS, WDC; Edwin Muniz, USDA/NRCS, Assistant State Soil Scientist, NJ; Randy Pheobus, USDA/NRCS, Earth Team Volunteer; MD; Dr. Martin C. Rabenhorst, Professor of Pedology, Director of Graduate Studies, University of Maryland, College Park; Carl E. Robinette, USDA/NRCS, (Retired) Soil Scientist, District Conservationist, MD; Diane A. Shields, (Retired) USDA/NRCS, Assistant State Soil Scientist, DE; Rob B. Tunstead, MLRA Soil Scientist, NJ; Wayne R. Tyndall, State Restoration Ecologist, Maryland Natural Heritage Program Wildlife and Heritage Service, Maryland Department of Natural Resources; and the Staff at Soldiers Delight Natural Environment Area; R. Jay Ugiansky, USDA/NRCS, Resource Conservationist, MD; David R. P. Verdone, USDA/NRCS MLRA Soil Scientist, MD: and all others who contributed to this event.

Tour Schedule
Sunday, June 16th

<u>Stop 1:</u> Soldiers Delight Natural Environment Area (SDNEA), part of Patapsco Valley State Park (PVSP)

<u>Stop2:</u> Lunch at Historical Fort McHenry; birthplace of our national anthem

<u>Stop 3</u>: Belmont Manor and Historical Park/Patapsco Valley State Park (PVSP)

	Mile Post	Time	Mileage	Drive time	Stop time
Depart Loews Annapolis Hotel	0	8:00 AM			
Soldiers Delight	43	9:00 AM	43	1:00	
Depart Soldiers Delight	43	11:15 AM			2:15
Arrive Ft. McHenry	69	11:50 AM	26	0:35	
Depart Ft. McHenry	69	2:20 PM			2:30
Arrive Belmont	81	2:45 PM	12	0:25	
Depart Belmont	81	5:00 PM			2:15
Arrive Loews Hotel	113	5:45 PM	32	0:45	

<u>Hazards and Warnings</u>

While on the field tour you should take precautions to protect yourself by being aware of plants and wildlife which could result in sickness or injury.

Poison Ivy:
Poison Ivy will cause and itchy rash in over half the U.S. population when the oil from the leaves is transferred by direct contact or inhalation through smoke when the plant is burned. **The basic rule is "Leaves of three, leave it be".**
http://www.wikihow.com/Identify-Poison-Ivy

Snakes:
Poisonous and non-poisonous: They should be avoided; they will leave you alone if you leave them alone.

Ticks:
There are several different species of ticks that can carry diseases. Lyme disease, and Rocky Mountain Spotted Fever are just two. If you spot black dots crawling on someone or yourself they should be removed as soon as possible. Insect repellent will be available. http://www.tickinfo.com/deertick.htm

Chiggers:
If you spot small red dots crawling on someone or yourself they should be removed as soon as possible. Some insect repellent will be available. http://www.ca.uky.edu/entomology/entfacts/ef630.asp

MLRA 148 – Northern Piedmont

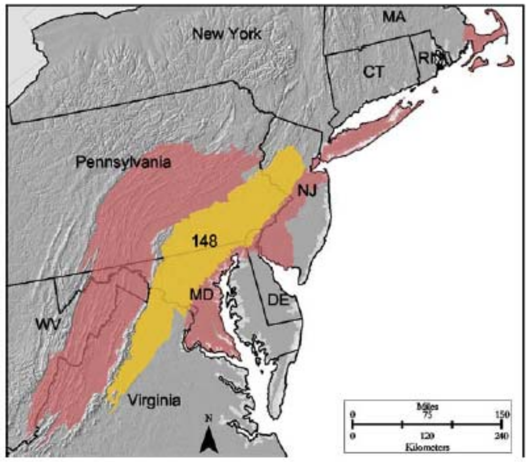


Figure 148-1: Location of MLRA 148 in Land Resource Region S.

Introduction

This area (shown in fig. 148-1) is in Pennsylvania (38 percent), Virginia (30 percent), Maryland (21 percent), New Jersey (10 percent), and Delaware (1 percent). It makes up about 12,800 square miles (33,170 square kilometers). Philadelphia, Pennsylvania, is on the eastern boundary of this area. The north end of the MLRA, just southwest of the densely populated area of northeast New Jersey, includes the cities of Morristown, Plainfield, Somerset, and New Brunswick, New Jersey. The part of the MLRA in the western suburbs of the District of Columbia includes the cities of North Bethesda, Potomac, Rockville, Gaithersburg, and Germantown, Maryland. Another heavily populated area includes the greater part of Baltimore, Maryland, and cities just to the west of Baltimore. Charlottesville, Virginia, also is in this area. Interstates 80, 78, 76, 70, and 66 cross this area from east to west. Interstates 83 and 95 cross the area from north to south. The Chesapeake and Ohio Canal National Historic Park, along the Potomac River, and the Manassas National Battle Field, in northern Virginia, are in this MLRA. The Gettysburg National Military Park, in Pennsylvania, is just inside the west edge of the MLRA. The Fort Detrick Military Reservation is in the part of the area in Maryland. Many State parks and a few State forests are in this MLRA.

Physiography

Most of this area is in the Piedmont Upland Section of the Piedmont Province of the Appalachian Highlands. The southwest end and the northwest portion of the southwest half of this MLRA and the southeast portion of the northeast half of the MLRA are in the Piedmont Lowlands Section of the same province and division. The northwest portion of the northeast half of the MLRA is in the New England Upland Section of the New England Province of the Appalachian Highlands. Most of this area is an eroded part of the Piedmont Plateau. This MLRA is mostly gently sloping or sloping. Intrusive dikes and sills form fairly sharp ridges that interrupt the less steep terrain. Differential erosion has created low areas where rocks are soft and high areas where rocks are resistant to erosion. The steeper slopes generally are on ridges at the higher elevations or on side slopes adjacent to drainages. Elevation is dominantly 330 to 985 feet (100 to 300 meters) but ranges from 80 to 985 feet (25 to 300 meters) in most areas. It is as much as 1,650 feet (505 meters) or more on some ridges and isolated peaks. A number of National Wild and Scenic Rivers occur in this area. From New Jersey to Virginia, these rivers include the Schuylkill, Octoraro, Patuxent, Monocacy, and Rappahannock Rivers and Goose Creek and Deer Creek. The Delaware River separates Pennsylvania and Delaware from New Jersey in this area. The Susquehanna River crosses the northern end of the area, and the Potomac River separates the District of Columbia and Maryland from Virginia at the southern end of the area.

Geology

Most of this area is above the “fall line” on the east coast. The fall line is the boundary between Coastal Plain sediments and the crystalline bedrock of the interior uplands. The eastern third of the area is underlain mainly by Lower Paleozoic to Precambrian sediments and igneous rocks that have been metamorphosed. The typical rock types in this part of the MLRA are granite, gabbro, gneiss, serpentinite, marble, slate, and schist. The central part of the area is a crustal trough or basin that formed during the Triassic period. This basin represents the ancestral Atlantic Ocean that formed when the European-African continental plate began its movement westward from the North American plate. Many of the rocks in this part of the MLRA are the same rocks as those in the western British Isles, since they were deposited at a time when the North American, European, and African plates were all one landmass. The rocks deposited in the basins include Triassic sandstone, shale, and conglomerate. These ancient basins have been uplifted and are now in the uplands in this MLRA. Numerous Jurassic diabase and basalt dikes and sills cut the sedimentary rocks in the basins. The far western part of this MLRA is underlain mostly by Cambrian to Silurian limestone. The northern boundary of the MLRA marks the southernmost extent of the Wisconsin glaciers. Earlier periods of glaciation extend farther south in north-central New Jersey and in eastern Pennsylvania. Unconsolidated stream alluvium (primarily sand and gravel) fills the major river valleys.

Climate
The average annual precipitation in this area is 37 to 52 inches (940 to 1,320 millimeters). The maximum precipitation occurs as high-intensity, convective thunderstorms in spring and early in summer. Droughts of 10 to 14 days are common in summer. Snowfall occurs in winter. The average annual temperature ranges from 48 to 57 degrees F (9 to 14 degrees C). The freeze-free period averages 205 days and ranges from 170 to 240 days.

Water
The surface water is of marginal quality. It is suitable for almost all uses if properly treated. The lower Delaware, many New Jersey rivers, and the Potomac River were degraded for many years by sedimentation from agriculture and coal mining, acid mine drainage and other contaminants from surface mining, and waste discharges from cities and industrial sites. Many of these sources have been treated, so the surface water is now improved and is suitable for most uses with treatment. Water for urban areas is supplied largely by municipal reservoirs. Most of the water used for irrigation comes from streams and ponds.

Soils
The dominant soil orders are Alfisols, Inceptisols, and Ultisols. The soils in the area dominantly have a mesic soil temperature regime, a udic soil moisture regime, and mixed, micaceous, or kaolinitic mineralogy. They are moderately deep to very deep, moderately well drained to somewhat excessively drained, and loamy or loamy-skeletal. Hapludalfs (Duffield, Neshaminy, and Penn series) and Dystrudepts (Manor, Parker, and Mt. Airy series) formed in residuum on hills. Fragiudalfs (Reedington series) formed in residuum on footslopes and in drainageways. Hapludults (Chester, Elioak, Gladstone, and Glenelg series) and Kanhapludults (Hayesville series) formed in residuum on hills, upland divides, and ridges. Fragiudults (Glenville series) formed in colluvium or residuum on hills. The far northeastern extent of the MLRA was affected by early periods of glaciation, and many soils formed in very deep, highly weathered till. The dominant soils in this part of the MLRA are Hapludalfs (Washington and Bartley series) and Fragiudults (Annandale and Califon series).

Biological Resources
This area supports deciduous hardwoods. Chestnut oak, white oak, red oak, hickories, ash, American elm, and yellow poplar are the major species. Yellow-poplar is especially abundant on the northeast-facing slopes. Tree growth and wood production are considerably less extensive in the Triassic basins than elsewhere in the area. Black walnut and black cherry grow on the well drained soils on flood plains. Eastern red cedar is common in many areas of abandoned cropland. Some of the major wildlife species in this area are whitetailed deer, fox, raccoon, muskrat, opossum, gray squirrel, cottontail, weasel, pheasant, ruffed grouse, and mourning dove. The abundance of black bear is increasing in the less densely populated, more mountainous northwest portion of the northeast half of this MLRA.

Land Use

Following are the various kinds of land use in this MLRA:

Cropland—private, 29%
Grassland—private, 10%
Forest—private, 25%
Urban development—private, 32%
Water—private, 2%
Other—private, 2%

Approximately one-third of this area is in farms, and one third either is urban or is urbanizing rapidly. The farms are intensively cropped in Maryland, in Pennsylvania, and in most of New Jersey. They are mostly in pasture or woodland in the northern parts of New Jersey and in Virginia. Forage crops, soybeans, and grain for dairy cattle make up the largest acreage of cropland. Forested areas, consisting mostly of farm woodlots, are extensive on the steepest parts of the area. Some areas are used for horticultural production, such as landscaping trees and shrubs and Christmas trees, and some are used by the forest products industry. Dairy farming, once a prominent activity, has greatly diminished within the past 30 years. Horse and "hobby" farms have become more numerous, particularly near the rural suburban fringe. Recreational uses, such as parks, athletic fields, and golf courses, are common in or near areas of urban or suburban development.
The major soil resource concern affecting this area is the conversion of nonurban land, especially prime farmland, to urban and suburban uses. Erosion and the resultant degradation of stream quality commonly occur during construction activities associated with urbanization. Other concerns are erosion and degradation of soil quality in areas used for grain crops year after year. The important conservation practices on cropland are those that reduce the hazard of erosion. They include contour farming, stripcropping, diversions, terraces, grassed waterways, crop rotations, cover crops, and crop residue management. Critical area planting, water- and sediment-control basins and urban storm-water management are important in the areas used for urban development.

149A—Northern Coastal Plain

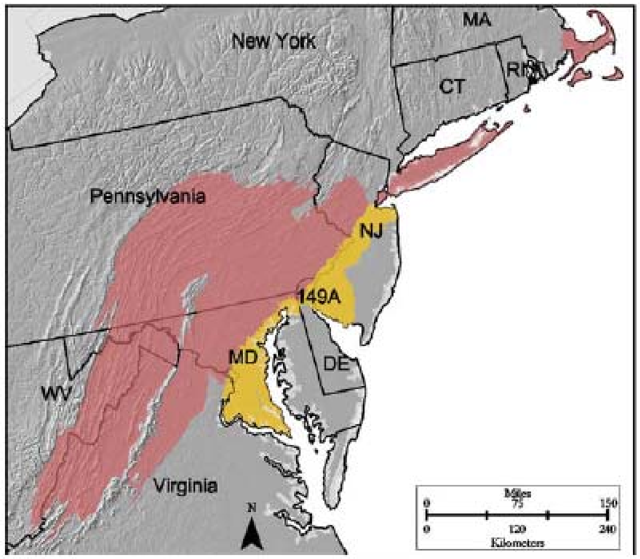


Figure 149A-1: Location of MLRA 149A in Land Resource Region S.

Introduction

This area (shown in fig. 149A-1) is in Maryland (47 percent), New Jersey (44 percent), Pennsylvania (4 percent), Delaware (3 percent), Virginia (1 percent), and the District of Columbia (1 percent). It makes up about 5,205 square miles (13,495 square kilometers). Interstate 95 corresponds broadly to the north and west boundary of the MLRA from Maryland through New Jersey. Major cities include Washington, DC, at the southern edge of the MLRA and Baltimore, Maryland, Wilmington, Delaware, East Brunswick, Trenton, Cherry Hill (and many other cities across the Delaware River from Philadelphia, Pennsylvania), and Vineland, New Jersey, at the northern end. Part of the Fort Dix Military Reservation is in this area in New Jersey. Aberdeen Proving Ground, the Fort George G. Meade Military Reservation, the United States Naval Academy in Annapolis, and the United States National Agricultural Research Center in Beltsville, Maryland, are all in the MLRA, as well as Andrews Air Force Base just east of Washington, DC. There are some State forests and numerous State parks, wildlife management areas, and national wildlife refuges in this area.

Physiography

This area is in the Embayed Section of the Coastal Plain Province of the Atlantic Plain. This area is a nearly level to rolling, dissected coastal plain that has been subjected to episodes of rising and falling sea levels. During low sea levels, eroding streams have dissected the area, leaving a series of terraces across the landscape. The Raritan, Delaware, and Chesapeake Bays are classic drowned river valleys. Elevation ranges from sea level to 330 feet (100 meters). It is less than 165 feet (50 meters) in most of the area. Local relief is mostly 6 to 35 feet (2 to 10 meters), but it is 100 feet (30 meters) or more in a few areas. The Delaware River separates Pennsylvania and Delaware from New Jersey in this area. It empties into the Delaware Bay. The Susquehanna River empties into the northern tip of the Chesapeake Bay in the area. The Raritan Bay marks the northern limit of the MLRA. The Potomac River separates the District of Columbia and Maryland from Virginia at the south tip of the area. The Anacostia, Patuxent, and Severn Rivers in Maryland and the Great Egg Harbor and Maurice Rivers in New Jersey are designated as National Wild and Scenic Rivers.

Geology

Most of this area is underlain by unconsolidated sand, silt, and clay sediments deposited in the near-shore environment of late Cretaceous seas. The rise and fall of sea level resulted in sand deposits separated by layers of clay and silt. High winds during periods of maximum glacial advance redeposited some of the sandy and silty sediments downwind. In addition, these sediments are sorted downwind from coarsest to finest and from thickest to thinnest. The north and west boundary of this MLRA almost parallels the “fall line” on the eastern seaboard. The fall line separates the bedrock of the interior uplands and the Coastal Plain. The Coastal Plain sediments are a source of ground water for the large cities built just below the fall line in this area. Southeast Maryland and New Jersey are covered by unconsolidated gravel deposited in the Tertiary and reworked by the Quaternary seas and erosion. This reworking left a pebble line as a pedisediment marker that separates the older deposits from the more recent eolian depositions. Glauconite is a common mineral in many of the unconsolidated sediments in the Northern Coastal Plain. Some gabbro, serpentine, Precambrian metamorphic rocks, and Triassic red shale are exposed along the extreme western edges of this area. The fall line is irregular, so some of the crystalline rocks that occur west of the fall line also occur in this area.

Climate
The average annual precipitation in this area is 40 to 47 inches (1,015 to 1,195 millimeters). Near the coast, most of the precipitation falls as high-intensity, convective thunderstorms in midsummer. The seasonal snowfall ranges from little or none in the southern part of the area to 30 inches (75 centimeters) in the northern part. The average annual temperature is 52 to 58 degrees F (11 to 14 degrees C). The freeze-free period averages 220 days and ranges from 190 to 250 days. Temperatures and the length of the freeze-free period decrease from south to north and from the coast inland.

Water
Reservoirs on the Potomac and Upper Chesapeake tributary streams supply water to the District of Columbia, and the reservoirs on the Upper Chesapeake also supply Baltimore and its suburbs with drinking water. All of the ground water used in the urbanized corridor running along the north and west edges of this area comes from the unconsolidated sand and gravel in the Coastal Plain aquifer system. Some of these aquifers are the Potomac, Raritan, Magothy, Atlantic City 800-foot sand, Englishtown, and the Kirkwood-Cohansey. Domestic supplies are obtained mainly from shallow wells, but large supplies must be obtained from deep wells. The rocks in this aquifer system dip to the east and become thicker towards the ocean. Water from wells drilled closer to the ocean may have high levels of chloride because of seawater intrusion. Since this aquifer system is at or very near the surface throughout this area, the water is highly susceptible to contamination from land use activities.

Soils
The dominant soil orders are Ultisols. Some Entisols, Inceptisols, Spodosols, and Histosols also occur. The soils in this area have a mesic soil temperature regime, an aquic or udic soil moisture regime, and mixed, siliceous, or glauconitic mineralogy. They are very deep, excessively drained to very poorly drained, and primarily loamy or sandy. Some Hapludults formed in fluviomarine deposits on terraces and flats (Downer, Hammonton, Sassafras, and Woodstown series) and in near-shore marine deposits containing glauconite on uplands (Adelphia, Freehold, Collington, and Holmdel series). Other Hapludults formed in sandy eolian deposits (Galestown and Tinton series) and in silty loess deposits (Matapeake and Mattapex series). Fragiudults formed in old alluvium on hills and relict stream terraces (Aura series) and in silty deposits on broad flats (Beltsville series). Quartzipsamments (Evesboro and Lakehurst series) formed in eolian or marine sand deposits on dunes and flats along streams. Haplosaprists (Manahawkin series) formed in freshwater bogs and along stream corridors, and Sulfihemists (Transquaking series) formed in organic deposits in estuarine and tidal marshes. Alaquods (Atsion series) formed in sandy marine deposits on braided stream channels and broad lowlying flats.

Biological Resources
This area supports pine and hardwoods. Loblolly pine, Virginia pine, shortleaf pine, southern red oak, black oak, scarlet oak, pin oak, willow oak, northern red oak, black walnut, yellow-poplar, sweetgum, and red maple are the dominant species. Some of the major wildlife species in this area are whitetailed deer, cottontail, squirrel, waterfowl, and songbirds.

Land Use

Following are the various kinds of land use in this MLRA:
Cropland—private, 13%
Grassland—private, 3%
Forest—private, 25%; Federal, 2%
Urban development—private, 32%
Water—private, 18%; Federal, 1%
Other—private, 6%

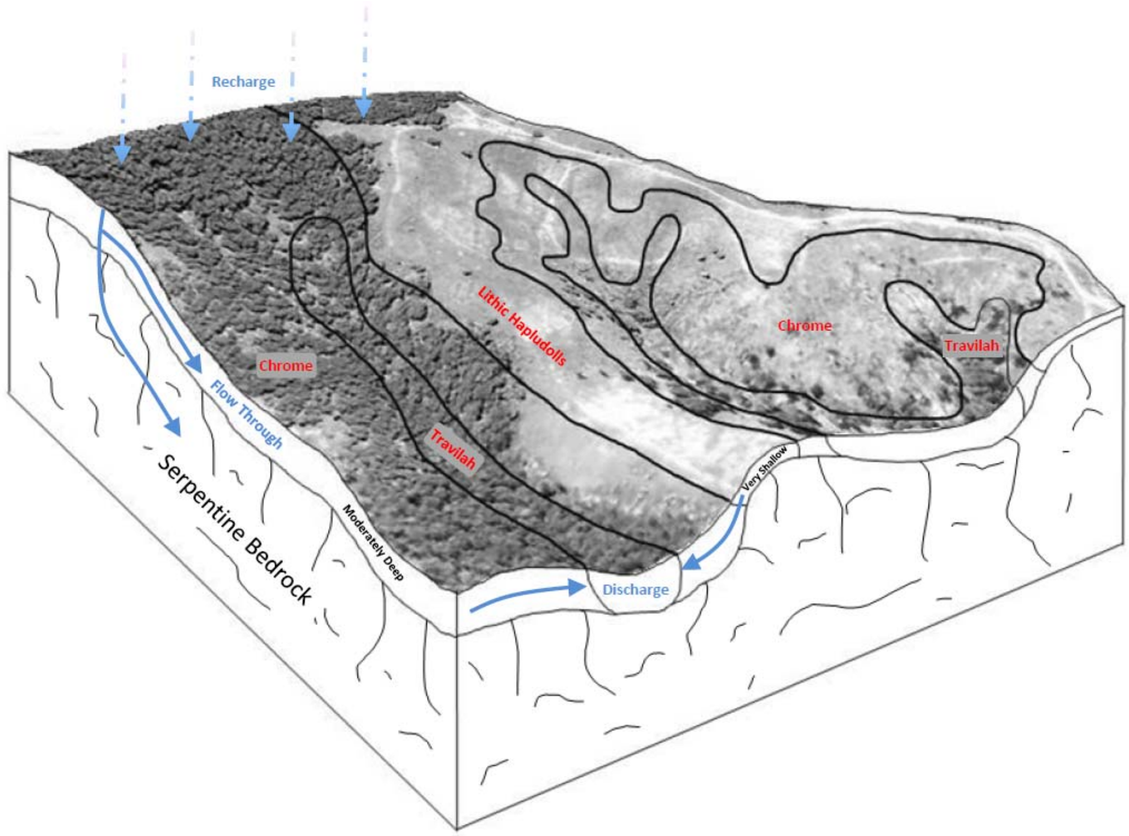
About half of this area is in farms. Nearly one-third of the area is used for urban development. The extent of urban development is expanding rapidly. The major crops in the area are vegetables, corn, soybeans, small grains, and fruits. Tobacco is a specialty crop in Maryland. Specialty crops in New Jersey are highbush blueberries and cranberries. Forage crops and grains for dairy cattle are important locally. Poultry, nursery stock, and sod farms also are important locally. Most of the woodland in the area is in farm woodlots, but some is in large holdings. Pine pulpwood and hardwood lumber are the principal forest products. State forests and parks are extensive in some areas. A narrow band along the coast is intensively developed for resorts and for recreation. The major soil resource concern affecting this area is the conversion of nonurban land, especially prime farmland, to urban and suburban uses. Erosion and the resultant degradation of stream quality commonly occur during construction activities associated with urbanization. Other concerns are erosion and degradation of soil quality in areas used for grain crops year after year. Improved drainage is needed on almost one-fourth of the farmland. The important conservation practices on cropland are those that reduce the hazard of erosion. They include crop residue management (including no-till and minimum tillage systems), conservation cover crops, nutrient management, grassed waterways, filter strips, and riparian buffers. Where livestock or poultry are part of the farm operation, management of animal waste, including storage of the waste, is important. Farmland preservation programs are vital to maintaining the agricultural resources in the area. Critical area planting, water- and sediment-control basins, and urban storm-water management are important in the areas used for urban development.

Sunday June 16, 2013

Stop 1: Soldiers Delight Natural Environment Area (SDNEA), part of Patapsco Valley State Park (PVSP). *Soldiers Delight Natural Environment Area conserves the largest remaining serpentine "barrens" ecosystem in the eastern United States. Habitats for more than 30 rare and endangered species are provided by a serpentine grassland and oak savanna ecosystem. Its conservation began in 1959 as a grassroots effort of two couples, soon followed by the formation of a "friends group" (Soldiers Delight Conservation, Inc.) that sought $1 donations from shoppers at local supermarkets to buy land. That effort has led to a Natural Environment Area of about 2,000 acres, under the biodiversity stewardship of the Maryland Department of Natural Resources, and the great majority of it has been designated a Wildlands by the Maryland General Assembly. Beginning about 25 years ago, the Department began restoration of this fire-frequent ecosystem with the support of the friends group, volunteers, and a number of state, federal, and private entities. Because of its evolutionary development during hot and dry periods of the Hypsithermal Interval at least 4,000 years ago, in conjunction with serpentine soil characteristics, this indigenous ecosystem is expected to be favored by predicted climate change* (By Wayne R. Tyndall, State Restoration Ecologist, Maryland Natural Heritage Program Wildlife and Heritage Service, Maryland Department of Natural Resources); For more information http://www.dnr.state.md.us/publiclands/central/soldiersdelight.asp

Topic: Introduction to Ecological Site Descriptions (ESD), their function and purpose. Soldiers Delight is part of the Serpentine barrens found in the Piedmont Region of Eastern United States. Participants will have the opportunity to look at soils formed from serpentine, and learn some of the history of chromite mining in the United States, and we will be looking at Maryland's first ESD. Additional work performed here was a Geophysical Investigation using GPR and EMI.

Serpentine Geology Catena
Block Diagram



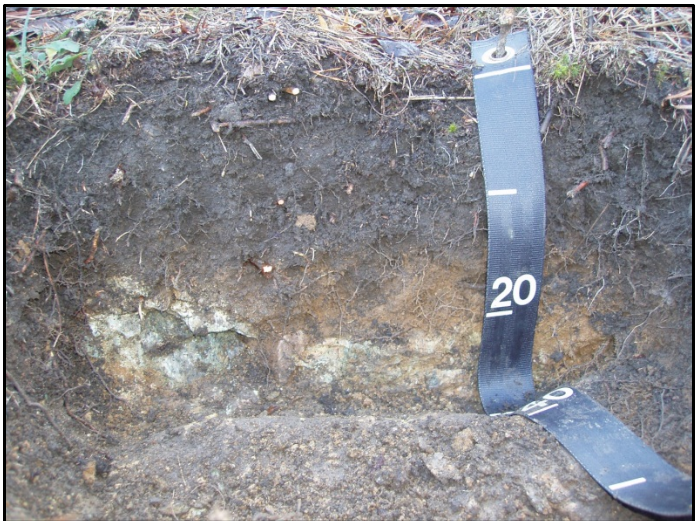
Serpentine Geology Catena

<u>Fine-silty, magnesic, mesic Lithic Hapludoll</u>
This unique well drained soil has yet to be established, but can be found in the serpentine geology on crests and nose slopes in the northern piedmont region. The profile is less than 25 cm to an aquitard of serpentine bedrock, high in OM throughout, extremely low Ca:Mg ratios (e.g. 0.25:1) and high in Ni and Cr. This thin profile has a very low AWC which drastically limits vegetative growth in the dry summer months. These edaphic properties create a unique grassland forb ecosystem that has drawn international attention.

<u>Chrome</u>
This well drained soil is found on broad convex interfluves and linear side slopes. It has many of the same chemical properties as the Lithic Hapludoll, but is 50 to 100 cm to serpentine bedrock. The silty clay loam textures found at 25 cm creates an aquitard, which results in a low Ksat and moderate AWC. This soil becomes very dry during summer months. The vegetative community is still very unique with slightly more tree species.

<u>Travilah</u>
This somewhat poorly drained soil can be found on base slopes, head slopes and concave areas within interfluves of serpentine geology. These are discharge areas for seeps, and accumulate overland flow during precipitation events. This soil has silty clay loam textures at 25 cm that act as an aquitard with a representative soil depth between 50 and 100 cm to bedrock. The profile has a moderate AWC that is sustained into the summer months by ground water discharge from higher elevations. This prolonged ground water table allows for more water demanding vegetation such as trees to persist.

SDNEA PEDON DESCRIPTION Pit 1



Description Date: 12/11/2012
Describer: David Verdone, Aaron Friend
NRCS sample number: S2012MD005001
Series: NONE
TAXONOMIC CLASS: **Loamy, mesic Lithic Hapludolls**

Location Description: About 620' northwest of the intersection of Deer Park road and Ward Chapel road; 950' North of Ward Chapel road and 375' West of Deer Park road along west side of BGE power lines in Soldiers Delight Natural Environment Area, in Baltimore County, Maryland; Latitude: 39 degrees 25 minutes 17.50 seconds north; Longitude: 76 degrees 50 minutes 30.00 seconds west; WGS84

Oe--0 to 2 centimeters; loose; clear smooth boundary.

A1--2 to 7 centimeters; black (10YR 2/1) very gravelly loam, very dark gray (10YR 3/1), dry; 22 percent clay; moderate fine granular structure; very friable, nonsticky, nonplastic; many fine roots throughout and common medium roots throughout and many very fine roots throughout; 45 percent nonflat subangular strongly cemented 2- to 75-millimeter serpentinite fragments; neutral, pH 6.6, pH indicator solutions; clear smooth boundary.

A2--7 to 15 centimeters; black (10YR 2/1) gravelly loam, dark gray (10YR 4/1), dry; 22 percent clay; moderate fine subangular blocky structure parting to weak fine granular structure; very friable, nonsticky, nonplastic; many fine roots throughout and common medium roots throughout and many very fine roots throughout; 29 percent nonflat subangular strongly cemented 2- to 75-millimeter serpentinite fragments; neutral, pH 6.8, pH indicator solutions; clear smooth boundary.

BC--15 to 21 centimeters; dark yellowish brown (10YR 3/6) gravelly clay loam; 28 percent clay; weak fine subangular blocky structure; very friable, nonsticky, slightly plastic; many fine roots throughout and common medium roots throughout and many very fine roots throughout; 15 percent nonflat subangular strongly cemented 2- to 75-millimeter serpentinite fragments; neutral, pH 7.0, pH indicator solutions; abrupt smooth boundary.

R--21 to 46 centimeters; few very fine roots in cracks

Lab Data: S2012MD005001

			Particle size								Bulk Density		
Depth (cm.)	Horizon	Texture Field	Total Clay	Total Silt	Total Sand	VFS	FS	MS	CoS	VCoS	> 2mm wt	Db 1/3 bar	Db Oven Dry	Water content 15 bar
0-2	Oe													85.5
2-7	A1	GR-SIL	21.9	32.5	45.6	5.4	9.2	11.9	11.5	7.6	45			20.9
7-15	A2	GR-SIL	22	33.5	44.5	5.3	11.5	9.4	11.7	6.6	29			18.2
15-21	BC	GR-SIL	28.4	45.2	26.4	5.8	8.4	5.8	4.6	1.8	15			16.6

	Extractable Bases						pH		OM, C, N, Fiber content							
Depth (cm.)	Ca	Mg	Na	K	Sum Bases	Base Saturation	pH 1:2 CaCl2	pH 1:1 H2O	Mineral OM	OM	Total OM	Total C	Total N	C/N Ratio	FibURb	FibRub
0-2	37.5	39.5	--	1.2			5.8	6.4	20	82	102	47.38	1.61	29	72	32
2-7	4.4	19.2	--	0.2	23.8	90	6	6.6				6.82	0.48	14		
7-15	2.6	17.9	--	0.1	20.6	100	6.3	7				3.82	0.33	11		
15-21	1.2	16.6	--	0.1	17.9	100	6.5	7.2				1.81	0.22	8		

	Dith-Cit-Ext			Major Elements mg/kg											
Depth (cm.)	Fe	Al	Mn	Al	Ca	Fe	K	Mg	Mn	Na	P	Si	Sr	Ti	Zn
0-2	0.4	--	tr												
2-7	3.5	0.1	0.2	14512	1482	88740	2232	127754	2813	766	530	151991	9	1061	23
7-15	5.1	0.2	0.3	12864	912	95011	1952	135360	2954	815	489	154337	5	841	17
15-21	4.8	0.1	0.2	15523	391	93540	2095	144725	1808	363	215	163981	tr	588	7

	Trace Elements mg/kg																			
Depth (cm.)	Al	As	Ba	Be	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	P	Pb	Sb	Se	Sn	Sr	V	W	Zn
0-2																					
2-7	0.09	8.98	120.18	0.4	0.71	210.02	2162.08	15.96	64	2439.58	0.75	2741.03	443.2	104.89	1.03	1051.89	2.75	10.61	39.35	0.19	115.29
7-15	0.04	4.96	109.59	0.37	0.26	241.82	2367.51	9.61	14	2657.62	0.5	3227.69	384.24	9.34	0.26	657.1	0.48	8.28	33.84	0.1	56.8
15-21	0.02	4.66	53.21	0.37	0.14	164.65	1352.77	6.87	24	1380.21	0.3	2572.4	133.96	3.72	0.12	448.11	0.35	5.4	27.35	0.1	38.87

X-Ray Fluorescence Trace Metal Results:

Project: Soil Fraction < 2 mm (ppm)

Depth cm	P	S	K	Ca	Ti	Cr	Mn	Fe	Co	Ni	Cu	Zn	As	Se	Rb	Sr	Zr	Cd	Ba	Pb
2-7	16378		4362	2008	2465	6110	2249	139882	998	3066	26	149	11		25.1	21.8	111		228	132
7-15	17281		4379	1126	1830	4483	1816	141106	1073	3670		70	6		21.7	16.3	87	26	214	9
15-21	15423		3456		959	3008	2077	129978	1153	3312	38	49	7		18.3	9.7	29		163	

Project: Soil Fraction > 2mm (ppm)

Depth cm	P	S	K	Ca	Ti	Cr	Mn	Fe	Co	Ni	Cu	Zn	As	Se	Rb	Sr	Zr	Cd	Ba	Pb
2-7	17886		2694	1258	1113	1569	1562	74478	582	2719	25	115	10		11.6	7.2	31		150	68
7-15			2191	408	821	2014	1622	86366	512	3260		39	4		5.6	4.7	21		116	
15-21	10533		2775		779	1105	1693	99451	665	2919	21	31			14.3	5.7	15		109	

Project: EPA Method (ppm)

Depth cm	P	S	K	Ca	Ti	Cr	Mn	Fe	Co	Ni	Cu	Zn	As	Se	Rb	Sr	Zr	Cd	Ba	Pb
2-7	23613		4559	3231	2087	4440	2850	123925	972	3095	28	130	16		21.9	19.1	94		235	128
7-15	19426		4436	1941	1997	3753	2236	139782	1042	3697		55	7		20.9	15.6	82		212	9
15-21	16446		3519	556	968	2122	2234	121070	966	3261		31	5		18.6	7.9	24		128	9

SDNEA PEDON DESCRIPTION Pit 2

Description Date: 12/11/2012
Describer: David Verdone, Aaron Friend
NRCS sample number: S2012MD005002
Series: Chrome
TAXONOMIC CLASS: **Fine, mixed, active, mesic Typic Hapludalfs**

Location Description: About 810' northwest of the intersection of Deer Park road and Ward Chapel road; 945' North of Ward Chapel road and 90' West of Deer Park road along east side of BGE power lines in Soldiers Delight Natural Environment Area, in Baltimore County, Maryland. Latitude: 39 degrees 25 minutes 20.50 seconds north; Longitude: 76 degrees 50 minutes 26.40 seconds west; WGS84.

Oe--0 to 2 centimeters; loose; abrupt smooth boundary.

A1--2 to 6 centimeters; black (10YR 2/1) silt loam; 19 percent clay; moderate medium granular structure; very friable, nonsticky, nonplastic; many fine roots throughout and common medium roots throughout and common very coarse roots throughout and many very fine roots throughout; 7 percent nonflat subangular strongly cemented 2- to 75-millimeter serpentinite fragments; very strongly acid, pH 4.5, pH indicator solutions; gradual smooth boundary.

A2--6 to 16 centimeters; dark brown (10YR 3/3) gravelly silt loam; 17 percent clay; moderate coarse granular structure; very friable, nonsticky, nonplastic; many fine roots throughout and common medium roots top of horizon and many very fine roots throughout; 19 percent nonflat subangular strongly cemented 2- to 75-millimeter serpentinite fragments; slightly acid, pH 6.5, pH indicator solutions; clear smooth boundary.

Bt1--16 to 24 centimeters; brown (7.5YR 4/4) very gravelly silt loam; 21 percent clay; moderate fine subangular blocky structure; friable, slightly sticky, slightly plastic; many fine roots throughout and common medium roots throughout and many very fine roots throughout; 10 percent distinct brown (7.5YR 4/4), moist, clay films on rock fragments and 25 percent distinct brown (7.5YR 4/4), moist, clay films on all faces of peds; 37 percent nonflat subangular strongly cemented 2- to 75-millimeter serpentinite fragments; neutral, pH 6.8, pH indicator solutions; clear smooth boundary.

Bt2--24 to 56 centimeters; dark reddish brown (5YR 3/4) channery clay; 52 percent clay; moderate medium subangular blocky structure; friable, moderately sticky, moderately plastic; and common fine roots throughout and common very fine roots throughout; 10 percent distinct dark reddish brown (5YR 3/4), moist, clay films on all faces of peds and 35 percent distinct dark reddish brown (5YR 3/4), moist, clay films on all faces of peds; 29 percent nonflat subangular strongly cemented 2- to 150-millimeter serpentinite fragments; neutral, pH 7.0, pH indicator solutions; clear smooth boundary.

C--56 to 65 centimeters; strong brown (7.5YR 4/6)very channery silt loam; 21 percent clay; structureless massive structure parts to subangular blocky structure; friable, slightly sticky, slightly plastic; common very fine roots throughout; 20 percent distinct strong brown (7.5YR 4/6), moist, clay films on surfaces along root channels; 39 percent nonflat subangular strongly cemented 2- to 150-millimeter serpentinite fragments; neutral, pH 7.0, pH indicator solutions; abrupt smooth boundary

R--65 to 90 centimeters; few very fine roots in cracks; 10 percent distinct brown (7.5YR 4/4), moist, clay films on bedrock.

Lab Data: S2012MD005002

			Particle size									Bulk Density		
Depth (cm.)	Horizon	Texture Field	Total Clay	Total Silt	Total Sand	VFS	FS	MS	CoS	VCoS	> 2mm wt	Db 1/3 bar	Db Oven Dry	Water content 15 bar
0-2	Oe													55.1
2-6	A1	GR-SIL	19	64.2	16.8	2.4	3.5	3.7	4.1	3.1	7			41.9
6-16	A2	GR-SIL	17.2	64.4	18.4	2.2	3	5.7	3.8	3.7	19	1.11	1.2	8.6
16-24	Bt1	GR-SIL	21.1	58.8	20.1	2.4	3.4	2.9	6.2	5.2	37	1.32	1.43	9.7
24-56	Bt2	CN-CL	52.5	35.9	11.6	2.5	3.2	2.3	2.5	1.1	29	1.33	1.57	21.8
56-65	C	CN-SIL	20.8	52.4	26.8	5.6	7	6.5	5.6	2.1	39			12

	Extractable Bases						pH		OM, C, N, Fiber content							
Depth (cm.)	Ca	Mg	Na	K	Sum Bases	Base Saturation	pH 1:2 CaCl2	pH 1:1 H2O	Mineral OM	OM	Total OM	Total C	Total N	C/N Ratio	FibURb	FibRub
0-2	17.8	29.5	tr	0.9	48.2	66	4.8	5.2	27	56	83	32.71	1.45	23	72	20
2-6	14	23.2	--	0.6	37.8	56	4.3	4.6				27.78	1.26	22		
6-16	0.8	6.9	--	0.1	7.8	84	5.4	6.0				2.2	0.2	11		
16-24	0.4	7.8	--	0.1	8.3	97	5.9	6.7				1.2	0.1	11		
24-56	0.3	16.6	--	0.2	17.1	83	6.2	6.9				0.86	0.08	10		
56-65	0.2	8	--	tr	8.2	92	6.4	7.1				0.28	0.01	19		

	Dith-Cit-Ext			Major Elements mg/kg											
Depth (cm.)	Fe	Al	Mn	Al	Ca	Fe	K	Mg	Mn	Na	P	Si	Sr	Ti	Zr
0-2	1.9	0.1	0.1												
2-6	2.3	0.2	tr	17398	4178	39534	3461	41896	663	1393	593	117349	21	1664	46
6-16	3.9	0.3	0.1	27763	928	76107	5122	91575	1059	2480	350	213461	22	2743	71
16-24	4.2	0.3	0.1	32844	725	84165	5822	102143	993	2314	316	206552	21	2507	65
24-56	11.6	0.7	0.1	52350	208	155055	3391	88465	1530	474	315	158617	3	1462	26
56-65	5.3	0.2	0.1	18349	97	95021	1331	127651	1114	173	148	192992	--	549	7

Depth (cm.)	Trace Elements mg/kg																			
	Ag	As	Ba	Be	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	P	Pb	Sb	Se	Sn	Sr	V	W	Zn
0-2																					
2-6	0.1	5.6	116.02	0.42	0.43	61.5	1182.37	17.49	242	545.2	1.67	1465.97	510.94	119.13	1.54	1459.33	3.03	17.68	38.84	0.27	93.01
6-16	0.04	5.9	98.36	0.65	0.17	119.86	2107.87	9.66	48	823.93	0.77	2123.04	225.05	22.28	0.29	616.99	1.04	11.14	40.07	0.04	79.75
16-24	0.02	6.62	83.42	0.8	0.15	119.14	1898.23	10.61	29	741.83	0.7	2821.1	164.08	9.17	0.19	551.9	0.72	10.36	42.22	0.03	56.78
24-56	0.03	11.79	92.48	1.73	0.21	164.56	1390.21	26.32	90	998.58	1.18	5645.61	194.38	7.36	0.44	690.1	1.27	7.65	57	0.04	94.9
56-65	0.01	4.98	39	0.63	0.16	150.38	1228.2 9	10.6	29	848.98	0.5	3907.28	87.88	3.04	0.13	176.63	0.44	3.51	29.85	0.07	50.05

X-Ray Fluorescence Trace Metal Results:

Project: Soil Fraction < 2 mm (ppm)

Depth cm	P	S	K	Ca	Ti	Cr	Mn	Fe	Co	Ni	Cu	Zn	As	Se	Rb	Sr	Zr	Cd	Ba	Pb
2-6		2175	3810	5539	1788	1010	450	38049	214	1492	17	128	14		29.9	31.7	109		167	164
6-16	12823		6038	523	3749	4367	852	75286	827	2805	25	106	6		32.5	35	255		250	30
16-24			7547		3568	2309	701	92637	947	3813		66	6		35.4	31.5	204		258	10
24-56	16524		1851		702	1579	1249	130356	1192	5837		54	7		11.9	4.2	20		141	
56-65	33155		5259		2349	3134	2144	232173	1650	8015	56	99	11		31.6	8.4	61		328	

Project: Soil Fraction > 2mm (ppm)

Depth cm	P	S	K	Ca	Ti	Cr	Mn	Fe	Co	Ni	Cu	Zn	As	Se	Rb	Sr	Zr	Cd	Ba	Pb
2-6		2886	3011	9510	1086	441	542	33956	255	1667		136	11	4	26.9	25	66	21	155	147
6-16	15219		5864	698	3365	2295	1655	103146	1011	3369		93	9		20.8	21.1	159		260	36
16-24	10343		7097		3311	2202	889	96697	900	3590	1021	160	6		22.8	18	118		225	12
24-56	19532		1660		685	1312	1247	120021	818	5523	33	45	7		10.1	3.2	18			
56-65	23347		4320		1981	2223	1555	193389	1266	7036	45	82	9		25.6	7.2	48		283	

Project: EPA Method (ppm)

Depth cm	P	S	K	Ca	Ti	Cr	Mn	Fe	Co	Ni	Cu	Zn	As	Se	Rb	Sr	Zr	Cd	Ba	Pb
2-6		2878	3774	6411	1630	778	449	32925	293	1397	19	102	9		26.5	30.9	95		151	156
6-16	11637		7078	1152	4110	2677	838	74415	831	2774	27	87			32.3	33.5	278		263	28
16-24	12326		8011	877	3897	1962	795	83883	816	3593	23	52			35	30	190		249	13
24-56	20798		1704		863	1604	1194	128547	1072	5933		47	6		10	4	20			
56-65	42629		5884	478	2586	2867	2242	231567	1661	8024		75	13		33.6	9.2	60		309	

Brief summary of EPA Method:

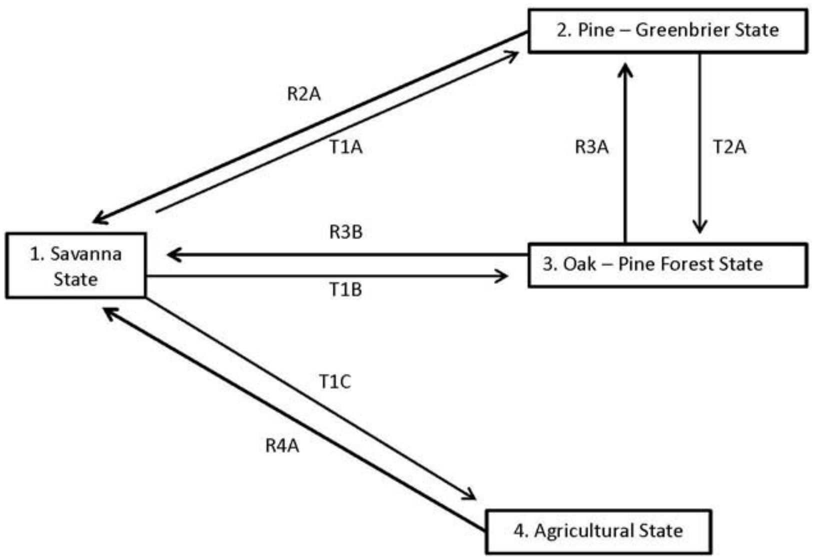
The FPXRF technologies described in this method use either sealed radioisotope sources or x-ray tubes to irradiate samples with x-rays. When a sample is irradiated with x-rays, the source x-rays may undergo either scattering or absorption by sample atoms. This latter process is known as the photoelectric effect. When an atom absorbs the source x-rays, the incident radiation dislodges electrons from the innermost shells of the atom, creating vacancies. The electron vacancies are filled by electrons cascading in from outer electron shells. Electrons in outer shells have higher energy states than inner shell electrons, and the outer shell electrons give off energy as they cascade down into the inner shell vacancies. This rearrangement of electrons results in emission of x-rays characteristic of the given atom. The emission of x-rays, in this manner, is termed x-ray fluorescence.

Under this method, inorganic analytes of interest are identified and quantitated using a field portable energy-dispersive x-ray fluorescence spectrometer. Radiation from one or more radioisotope sources or an lectrically excited x-ray tube is used to generate characteristic x-ray emissions from elements in a sample. Up to three sources may be used to irradiate a sample. Each source emits a specific set of primary x-rays that excite a corresponding range of elements in a sample. When more than one source can excite the element of interest, the source is selected according to its excitation efficiency for the element of interest. For measurement, the sample is positioned in front of the probe window. This can be done in two manners using FPXRF instruments, specifically, in situ or intrusive. If operated in the in situ mode, the probe window is placed in direct contact with the soil surface to be analyzed. When an FPXRF instrument is operated in the intrusive mode, a soil or sediment sample must be collected, prepared, and placed in a sample cup. The sample cup is then placed on top of the window inside a protective cover for analysis. Sample analysis is then initiated by exposing the sample to primary radiation from the source. Fluorescent and backscattered x-rays from the sample enter through the detector window and are converted into electric pulses in the detector. The detector in FPXRF instruments is usually either a solid-state detector or a gas-filled proportional counter. Within the detector, energies of the characteristic x-rays are converted into a train of electric pulses, the amplitudes of which are linearly proportional to the energy of the x-rays. An electronic multichannel analyzer (MCA) measures the pulse amplitudes, which is the basis of qualitative xray analysis. The number of counts at a given energy per unit of time is representative of the element concentration in a sample and is the basis for quantitative analysis. Most FPXRF instruments are menu-driven from software built into the units or from personal computers (PC). The measurement time of each source is user-selectable. Shorter source measurement times (30 seconds) are generally used for initial screening and hot spot delineation, and longer measurement times (up to 300 seconds) are typically used to meet higher precision and accuracy requirements.

Ecological Site Description

Classification of land is useful for management. NRCS uses a hierarchical classification system, with the finest scale consisting of soil maps and ecological sites. These are considered to be specific enough for use in land management decisions. An ecological site description (ESD) is defined as, "a distinctive kind of land with specific physical characteristics that differs from other kinds of land in its ability to produce a distinctive kind and amount of vegetation." An ecological site is a function of the natural processes and environment (including soils) that occur in an area, and it is assumed that components of soil survey map units (soil series and phases of series) provide a framework for ecological site differentiation. The heart of an ESD is a State and Transition Diagram that describes vegetation dynamics, management and disturbance interactions.

Serpentine Upland – 148XS002



Refer to narrative in the Plant Community Section for detailed descriptions of these transitions/pathways. **T1A, T2A** – Succession without fire or management for 10 to 20 years. **R2A** – Low-intensity fire and/or intensive management. **R3A, R3B** – High intensity crown fire. **T1B** –Succession with management for greenbrier and eastern red cedar. **T1C** – Pasture or cultivation with gypsum application. **R4A** – Re-introduction of native species or succession. **NOTE: this STM is a rough draft intended only as a starting point for discussion.**

ESDs provide information utilized during steps of the conservation planning process. Specific examples include, providing information on wildlife habitat for WHIP projects; suitable plantings for sites in planning for Forestry EQIP, CSP, CRP, information concerning invasive species; appropriate native species to plant; timber growth potential, and forage production/potential for domestic animals and wildlife.

ESDs generally contain the following: Physiographic features, Climate data, Water features: wetlands and streams, Soil data: from NASIS – morphological, chemical, physical and information about plant communities, State and transition diagrams, Narrative descriptions, Species composition, Cover and structure, Photographs, Wildlife and domestic animals, Hydrology, Recreational uses, Wood products, Forage production and Forest site productivity.

Supporting documentation may include similar ecological sites, type location, relationship to other classifications and references. Data repositories currently employ ESIS for vegetation data and completed ecological site descriptions. NASIS is used primarily for correlations of soils with ecological sites as well as some vegetation data.

Serpentine Upland

Savanna – State 1

The Savanna State is the most diverse vegetative community that occurs on Chrome soils in the Serpentine Barrens. These intact communities are believed to be created/perpetuated by natural and/or Native American fires. Fire frequency plays a vital role in reducing the encroachment of invasive species such as eastern red cedar, Virginia pine, red maple and greenbrier. These fires prevent succession from occurring by keeping the tree canopy open and promoting low growing vegetation that needs full sun to thrive. This state has the highest number of endemic species

Reference Community – Savanna – Community Phase 1.1

Serpentine Upland - Savanna State (Soldiers Delight, Baltimore County, MD)

Pine – Greenbrier – State 2

The Pine-Greenbrier State is represented by the dominance of pine overstory with a thick well established understory of greenbrier ranging from new growth to 6’ to 8’ high. Successful management requires fire or herbicides, as mowing of these areas has proven futile. The greenbrier in these areas is propagated via rhizomes and bird dropping.

Reference Community – Pine – Greenbrier – Community Phase 2.1

Serpentine Upland – Pine – Greenbrier State (Nottingham Park, Chester County, PA)

Oak - Pine Forest State 3 – State 3

The Oak-Pine Forest State is a succession community represented by mixed hardwoods of chestnut oak, beech, red maple and post oak with a few remnant large pines. The unique edaphic properties of the soil result in these trees having very low sites indexes. The understory may consist of sparsely distributed plants of lowbush blueberry, greenbrier and warm season grasses to name a few. This state is the least diverse vegetative community with the least number of endemic species.

Reference Community – Oak – Pine Forest – Community Phase 3.1

Serpentine Upland – Oak – Pine State (Pilot Barrens, Cecil County, MD

Geophysical Investigations at Soldiers Delight Natural Environment Area, Owings Mills, Maryland.

Soils and residuum weathered from serpentinite rock contain significant amounts of ferromagnetic minerals, which affect their magnetic properties and the use of both ground-penetrating radar (GPR) and electromagnetic induction (EMI). In order to further evaluate the response of these geophysical tools over serpentine soils, a brief study was conducted in the Soldiers Delight Natural Environment Area (SDNEA).

Ground penetrating radar has been used extensively within USDA-NRCS to chart the depth to rock and to determine the composition of soil map units based on depth criteria. At a site within the SDNEA, GPR was used to chart the depth to bedrock. Nine radar traverses were completed using a 400 MHz antenna. The site is located in an area of Chrome soil. The moderately deep, well-drained Chrome (fine, mixed, superactive, mesic Typic Hapludalfs) soil formed in residuum weathered from serpentinite in the Northern Piedmont. Figure 1 is a radar record that was obtained within the SDNEA. Along this radar record, the soil/rock interface varies in depth from about 25 to 55 cm.

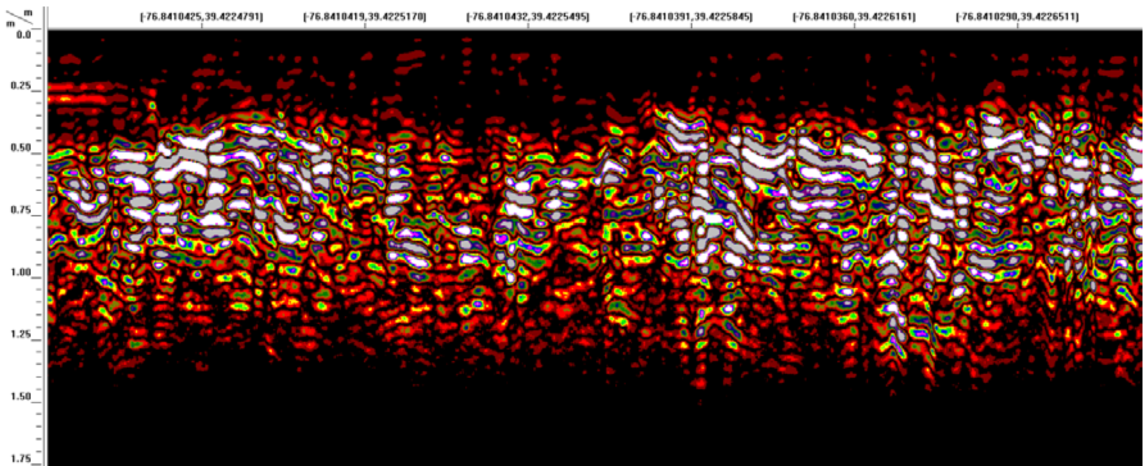


Figure1. This radar record, which was collected with a 400 MHz antenna within the Soldiers Delight Natural Environment Area.

Figure 2 is a *Google Earth* image showing the distribution of soils by depth classes along the radar traverse lines that were completed within the SDNEA. Based on 35,550 geo-referenced radar measurements, the depth to bedrock averaged 25.1 cm with a range of 0.0 to 76.2 cm. In the areas traversed with GPR, soils are dominantly shallow (Lithic Hapludalfs; 96 % of area) with minor inclusions of moderately deep soil (Chrome series; 4 % of area).

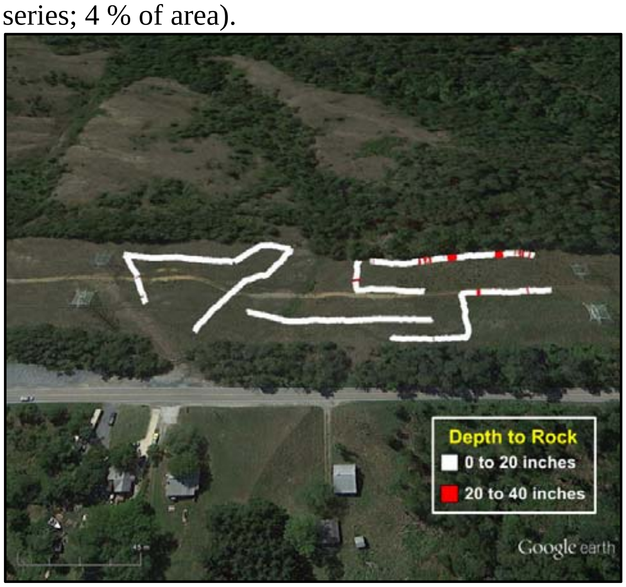


Figure 2. This Google Earth image shows the locations of the GPR traverses within the Soldiers Delight Natural Environment Area. Major depth classes are indicated by color-codes used along each of these traverse lines.

Electromagnetic induction sensors are used to measure the apparent electrical conductivity (EC_a) of soils. Spatial variations in EC_a have been associated with differences in soils and soil properties and used to help identify management zones, direct soil sampling, and predict variations in soils, soil properties, and crop yields. Traditionally, EMI surveys have focused on the electrical properties and neglected the magnetic properties of soils. Magnetic susceptibility is a measure that indicates the presence of iron-bearing minerals in soils and rocks. The in-phase response of EMI sensors can be used to measure or infer the magnetic properties of soils.
In a recent study in southeastern Pennsylvania, the responses of an EMI meter were significantly greater in magnitude and more variable at a site underlain by serpentinite and micaceous schist than a site underlain by micaceous schist alone. In addition, the average concentrations of Fe, Cr, Ni, and Ti (measured with portable X-ray fluorescence) were significantly higher in the site underlain by micaceous schist and serpentinite.

Figure 3 contains plots of EMI data collected from sites located in the Northern Piedmont. For each site, both quadrature (EC_a) and in-phase data are shown. For comparative purposes, the same color scales and color ramps are used in all plots of similar data (quadrature or in-phase). The *Serpentinite* site is located in Soldiers Delight Natural Environment Area, in Baltimore County, Maryland. The *Micaceous Schist* site is located in Chester County, Pennsylvania.

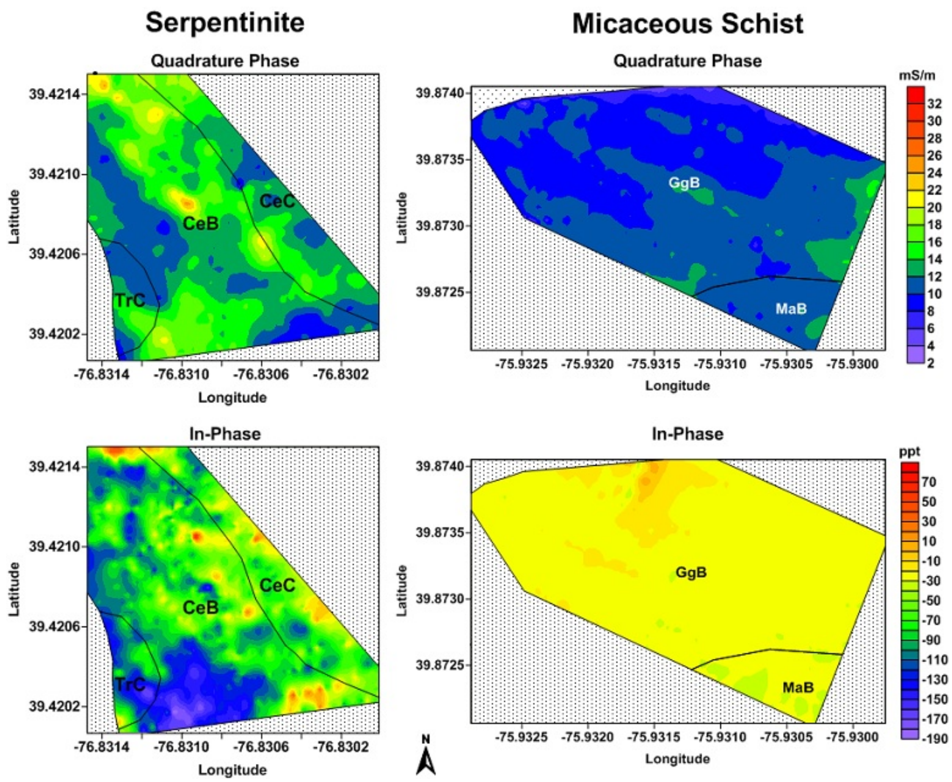


Figure 3. These plots of EMI data were collected over soils developed from residuum weathered from different parent rocks.

Over serpentinite, both the in-phase and quadrature responses are affected by the relatively high concentrations of ferromagnetic minerals and the resulting spatial patterns are unique. Extreme positive and negative EMI responses produce distinguishing pockmarked spatial patterns over serpentine soils (Figure 3). These patterns do not coincide with changes in soil type or hydrology, but appear to reflect trends in the underlying structure of the serpentinite. These patterns are believed to reflect the presence of high and variable concentrations of heavy metals, which will affect soil use and management. As evident in Figure3, significant differences in the EMI response and presumably the concentrations of heavy metals occur over very short distances. Knowledge of these properties and their high spatial variability can help manage and preserve the rare and endangered species that populate the serpentine barrens of Soldiers Delight.
(By, James Doolittle, USDA/NRCS Research Soil Scientist, NE.)

Stop 2: Lunch at Historical Fort McHenry; birthplace of our national anthem. ***O! say can you see,...by the dawn's early light, a large red, white and blue banner? Whose broad stripes and bright stars . . . were so gallantly streaming! over the star-shaped Fort McHenry during the Battle of Baltimore, September 13-14, 1814. The valiant defense of the fort inspired Francis Scott Key to write "The Star-Spangled Banner."***

History of Fort McHenry

FORT McHENRY: AN AMERICAN FORT
Revolutionary War 1776-1783
Fort McHenry's history began in 1776 when the citizens of Baltimore Town feared an attack by British ships. An earthen star fort known as Fort Whetstone was quickly constructed. The fort, like Baltimore, was never attacked during our first conflict with England.
The Formative Years, 1794-1811
In 1793, France declared a war on England that became known as the Napoleonic Wars. In 1794, Congress authorized the construction of a series of coastal forts to protect our maritime frontier. Construction began on Fort McHenry in 1798 and, by 1803, the masonry walls we view today were completed. The fort was named for James McHenry, our second Secretary of War. In 1809, the U.S. Army's first light artillery unit was organized here.
The War of 1812
On June 18, 1812, the United States declared war on England, in part to "preserve Free Trade & Sailor's Rights." In August 1814, British forces marched on Washington, defeated U.S. forces, and burned the Capitol. Then, on September 13-14, the British attacked Fort McHenry. The failure of the bombardment and sight of the American flag inspired Francis Scott Key to compose "The Star-Spangled Banner."
Construction Period, 1829-1842
Following the War of 1812, new methods of coastal defense brought about changes that resulted in the fort we view today. Among the changes was the addition of a second story with porches on the buildings and the completion of new earthen battery with larger guns.
The Mexican War, 1846-1848
During the war years, Maryland units, as well as federal units, were trained here before being sent to war with Mexico. Soon after this conflict, Colonel R.E. Lee came to Baltimore to supervise construction of Fort Carroll (1848-1852) in Baltimore harbor.
The Civil War, 1861-1865
During the war, Baltimore was an important rail and communications center. Union troops occupied Baltimore to ensure that Maryland remained in federal control. In 1861, members of the Maryland Legislature were imprisoned at Fort McHenry to prevent any passage of an Act of Secession. Following the Battle of Gettysburg in 1863, nearly 7,000 Confederate soldiers were imprisoned here.
Spanish - American War, 1898
While "Remember the Maine" became the battle cry of Americans in our war with Spain, Fort McHenry's only involvement was the training of the 6th U.S. Artillery here before being sent to Cuba. Several forts were built along the Patapsco River to protect the approach to Baltimore.
Farewell Fort McHenry, 1912
By the late 19th century Fort McHenry was of little military value. On July 20, 1912, the last active garrison, the 141st Coastal Artillery Company, departed Fort McHenry ending over 110 years of service at the fort. Two years later the City of Baltimore held the centennial celebration of the Battle of Baltimore.
World War I Period, 1917-1925
In 1917, the U.S. Army established General Hospital No.2, a 3,000 bed facility to treat wounded soldiers

returning from Europe. The hospital developed into a major surgical center, specializing in neuro and reconstructive surgery. In 1922, two years after the hospital closed, the army began to remove the buildings. In 1925, Fort McHenry was established as a national park under the War Department.

U.S. Army Restoration Period, 1925-1933

With the closure of the hospital, the U.S. Army began the first restoration of the fort to its mid-nineteenth century appearance. In the 1930's the Works Progress Administration continued the work. The fort's present view is a result of that work.

National Park Service, 1933-Present

In 1933, by executive order, Fort McHenry was transferred to the U.S. Department of the Interior, National Park Service. In 1939 it was redesignated a national monument and historic shrine. Today, nearly 600,000 visitors visit annually. Park Rangers provide a variety of interpretive services and special programs.

World War II, 1942-1945

Although a national park land, a portion of the fort was leased to the U.S. Coast Guard for port security work and as a fire training station aboard ships for nearly 28,000 U.S. Coast Guardsmen. They also kept a watchful eye on the nearby shipyards where Liberty ships were being built.

The 21st Century: The Next 200 Years

For 200 years Fort McHenry has guarded the American flag in war and peace. Today, the professional fields of research, archeology, architecture and interpretation continue to provide new and innovative tools for the National Park Service to develop productive resource management guidelines to help preserve this special place.

(From National Park service web site) http://www.nps.gov/fomc/historyculture/history-of-fort-mchenry.htm

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Stop 3: Belmont Manor and Historical Park and Patapsco Valley State Park (PVSP)

A Brief History of Belmont

In 1732, Caleb Dorsey of Annapolis and Hockley-in-the Hole on the Severn River purchased the land purchased the land (1,662 acres) on which Belmont now resides. (In 1695, the property was called Moore's Morning Choice.)At the time, a bustling and prosperous port thrived in Elkridge. One of Dorsey's sons, Caleb, Jr., owned several iron forges that fed into the Patapsco River and was an avid foxhunter. While tracking a rare gray fox, he found himself in unfamiliar territory, near the home of Priscilla Hill. Their fortuitous meeting resulted in friendship and then marriage. Caleb Dorsey, Sr. gave the land to his son as a wedding present. Caleb, Jr. then built the manor house. On either side of the front door were placed two carved plaques, "CPD 1738". Caleb, Jr. and Priscilla had three sons and six daughters. When Caleb, Jr. died in 1772, his son Edward inherited the property, along with the iron forges and several other tracts of land.

Following Edward's death in 1815, his headstrong daughter (also named Priscilla) gained ownership of the property and named it Belmont. Priscilla eloped with Alexander Hanson in 1805. Hanson founded the Federal Republican, a pro-British newspaper and he poured money into the endeavor. Due to Hanson's unpopular views, he was attacked during the War of 1812 and suffered permanent injuries.

After Hanson's death at the age of 33, Priscilla tried to run the farm, but financial problems beset her and she sold parcels of land in the 1830's. In 1839, she mortgaged the estate for $1,500. Realizing that her son, Charles, was addicted to horses and gaming, Priscilla stated in her will that if Charles ever compromised the estate, it was to be transferred to his wife and to her family. In 1875, the property went to a sheriff's auction, where it brought $25. However, because of Priscilla's foresight, the auction was contested and the property reverted back to Charles' children in 1879. His daughters Anna Marie and Florence stayed on the property while other siblings moved away.

In 1917, the property was passed to Mary Bowdoin Bruce, a descendant of Caleb, Jr. and Priscilla Dorsey. Mary and her husband, Howard Bruce, restored the estate to its original beauty. Howard was the vice president and general manager of Bartlett Hayward Company, a small steel factory. His prominence increased during World War I, and he became well respected in the financial and political arenas. During World War II, he was awarded the Distinguished Service Medal for his vital contribution to the war production effort.

Although Belmont remained a working farm, Bruce's predominant interest was in raising and breeding thoroughbred horses. He became the owner of the famed horse, Billy Barton, who won numerous races, including the Grand National Handicaps and the coveted Maryland Hunt Cup. Billy Barton is buried near the time-worn barn in full tack on, in an upright position, alongside another one of Bruce's horses.

In 1961, after Howard Bruce's death, the property passed to his cousin David Bruce, the former ambassador to Britain, who in turn gave Belmont to the Smithsonian Institute. The Smithsonian converted Belmont into a conference center, where generals, vice presidents, astronauts and many other notables were able to meet in a quiet and controlled setting.

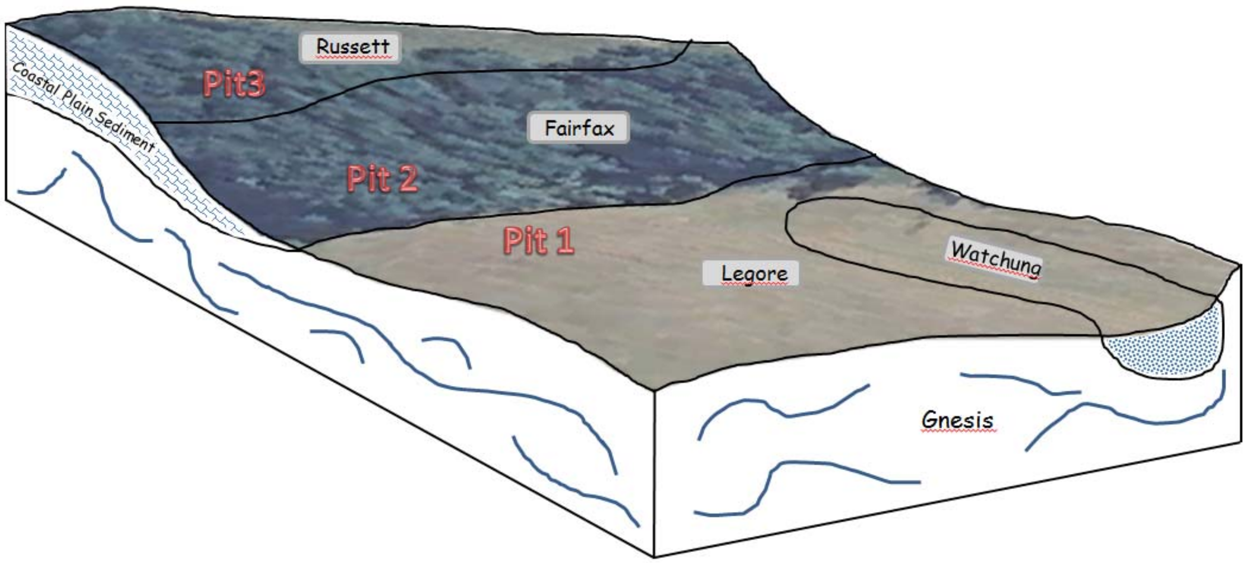
In 1983, the 85-acre estate was sold to the American Chemical Society, which continued the tradition of providing excellent hospitality to the world leaders.

In 2004, Belmont was purchased by Howard Community College. The College added hospitality classes to the Belmont experience while continuing the same traditions as the two previous owners.

On June 21, 2012, Howard County Government purchased Belmont to ensure the stewardship of *this beautiful site for the residents of Howard County. When fully operational, Belmont will become a popular venue for executive retreats, corporate trainings, weddings, company picnics and other special events. Environmental, preservation and historical programs will also be major components of the management plan.* (From Howard County Park and Recreation Open house pdf), additional information available at, http://www.howardcountymd.gov/belmont.htm

Topic: Introduction to Soil Health, its function and purpose. Participants will have the opportunity to examine soils along the fall line developed in Coastal Plain sediments and residuum from acid crystalline rock within a very short distance. We will be looking at the diverse use of soils in this region and how it relates to soil health. A demonstration of the soil health bucket kit will also be performed.

Belmont Manor Site
Soil Catena Block Diagram



Russett
Soils are very deep moderately well drained. They form in a mix or sandy and loamy fluviomarine deposits. They are on nearly level to moderately sloping soils on the Coastal Pains. The saturated hydraulic conductivity is moderately low to moderately high.

Fairfax
Soils are deep and well drained. The upper part of the solum is formed in a silty fluvial mantle. The lower part of the solum is formed in materials weathered from schist and gneiss. They are nearly level to moderately sloping soils on the Piedmont uplands. The saturated hydraulic conductivity is moderately high to high.

Legore
Soils are very deep, well drained soils on nearly level to very steep slopes on the Piedmont uplands. They formed in material weathered from diabase, diorite, and related rocks. The saturated hydraulic conductivity is moderately high to high.

Watchung
Soils are very deep, poorly drained soils on upland flats and depressions, in the Piedmont. They formed in residuum from basic rocks. The saturated hydraulic conductivity is moderately high in the A and C horizons and moderately low in B horizons.

Belmont Pedon Description Pit 1

Description Date: 03/05/2013
Describer: Carl Robinette, Aaron Friend, Susan Demas, David Verdone
NRCS sample number: S2013MD027001
Series: Legore
Site Note: This profile may have a thin capping of coastal plain deposits.
TAXONOMIC CLASS: **Fine, mixed, superactive, mesic Ultic Hapludalfs**

Location Description: In an open field about 1.7 miles west of I-95, 0.95 miles south of the Patapsco River, 1.0 miles north of Montgomery road, and 1065 feet north west of the end of Belmont Woods road, west of the Belmont Conference Center in Patapsco Valley State Park, in Howard County, Maryland; Latitude: 39 degrees 13 minutes 36.30 seconds north; Longitude: 76 degrees 44 minutes 53.30 seconds west; WGS84

A--0 to 5 centimeters; dark brown (7.5YR 3/3) clay loam; moderate medium granular structure, and moderate coarse granular structure; friable, nonsticky, nonplastic; common fine roots throughout and few medium roots throughout and common very fine roots throughout; 4 percent nonflat subrounded indurated 2- to 25-millimeter quartzite fragments; moderately acid; abrupt wavy boundary.

Ap--5 to 20 centimeters; dark brown (7.5YR 3/4) clay loam; moderate fine subangular blocky structure, and moderate medium subangular blocky structure; friable, nonsticky, nonplastic; common fine roots throughout and few medium roots throughout and common very fine roots throughout; 5 percent nonflat subrounded indurated 2- to 25-millimeter quartzite fragments; strongly acid; gradual wavy boundary.

Bt--20 to 38 centimeters; strong brown (7.5YR 4/6) clay loam; moderate fine subangular blocky structure, and moderate medium subangular blocky structure; friable, slightly sticky, slightly plastic; common fine roots throughout and few medium roots throughout and common very fine roots throughout; 70 percent continuous distinct strong brown (7.5YR 4/6), moist, clay films on all faces of peds; 6 percent nonflat subrounded indurated 2- to 25-millimeter quartzite fragments; very strongly acid; clear wavy boundary.

BCt--38 to 69 centimeters; brown (7.5YR 4/4) loam; weak medium subangular blocky structure; friable, nonsticky, nonplastic; common fine roots throughout and few medium roots throughout and common very fine roots throughout; 20 percent continuous distinct brown (7.5YR 4/4), moist, clay films on all faces of peds; 1 percent nonflat subrounded indurated 2- to 25-millimeter quartzite fragments; very strongly acid; gradual wavy boundary.

C/B--69 to 89 centimeters; yellowish brown (10YR 5/6) and yellowish brown (10YR 5/4) fine sandy loam; weak coarse subangular blocky structure; very friable, nonsticky, nonplastic; common very fine roots throughout; the Color for the C-part of the horizon is 10YR 5/4, and the B-part is 10YR 5/6; 6 percent nonflat subrounded indurated 2- to 25-millimeter quartzite fragments; very strongly acid; clear smooth boundary.

C1--89 to 132 centimeters; 80 percent light yellowish brown (10YR 6/4) and 8 percent strong brown (7.5YR 5/6) and 7 percent strong brown (7.5YR 5/8) and 5 percent olive brown (2.5Y 4/3) loam; structureless massive structure parts to weak very thick platy structure; very friable, nonsticky, nonplastic; few very fine roots throughout; very strongly acid; clear wavy boundary.

C2--132 to 191 centimeters; variegated 25 percent very dark grayish brown (2.5Y 3/2) and 23 percent reddish brown (5YR 4/4) and 22 percent yellowish red (5YR 4/6) and 15 percent very pale brown (10YR 8/2) and 10 percent light yellowish brown (10YR 6/4) and 5 percent 2.5YR 2.5/6 (2.5YR 2.5/6) fine sandy loam; structureless massive structure parts to weak very thick platy structure; very friable, nonsticky, nonplastic; 25 percent fine prominent irregular strongly cemented mica flakes, unspecified with sharp boundaries throughout; 1 percent nonflat subrounded indurated 2- to 25-millimeter quartzite fragment ; very strongly acid; The 10YR 8/2 color are weathered mineral possible feldspar, and the 2.5Y 3/2 color are mica (biotite?) flakes.

Lab Data S2013MD027001:

			Particle size								
Depth (cm.)	Horizon	Texture Field	Total Clay	Total Silt	Total Sand	VFS	FS	MS	CoS	VCoS	> 2mm wt
0-5	A	SIL	35.1	41.1	23.8	5.5	7.5	6.5	3.5	0.8	4
5-20	Ap	SIL	37.3	39.7	23	5.8	7.3	7.3	1.7	0.9	5
20-38	Bt	SIL	37.1	32.1	30.8	8.9	14.8	5.4	1.3	0.4	6
38-69	BCt	L	24.5	31.4	44.1	15.1	19.3	7.2	2	0.5	1
69-89	C/B	SL	14.8	27	58.2	17.8	25.9	10.6	3.2	0.7	2
89-132	C1	FSL	16.8	32.3	50.9	17.3	23.8	8.6	1	0.2	
132-191	C2	SL	7.3	22.2	70.5	13.8	33.9	17	4.4	1.4	1

	Bulk Density		C/N			Dith-Cit-Ext		
Depth (cm.)	Db 1/3 bar	Db Oven Dry	Total C	Total N	C/N Ratio	Fe	Al	Mn
0-5			4.65	0.48	10	4.2	0.5	0.2
5-20	1.26	1.41	2.01	0.19	10	5.5	0.6	0.1
20-38	1.22	1.52	0.47	0.03	14	3.4	0.5	--
38-69	1.19	1.41	0.2	0.09	2	4.1	0.5	tr
69-89	1.17	1.26	0.12	--		3.4	0.4	--
89-132	1.16	1.26	0.06	0.05	1	1.7	0.3	--
132-191			0.06	0.08	1	2.8	0.4	tr

	pH		Extractable Bases					
Depth (cm.)	pH 1:2 CaCl2	pH 1:1 H2O	Ca	Mg	Na	K	Sum Bases	Base Saturation
0-5	4.9	5.6	12.9	6.9	0.1	1.3	21.2	72
5-20	4.8	5.5	11.4	5.9	tr	0.4	17.7	67
20-38	4.2	4.7	11.1	7.3	0.1	0.3	18.8	51
38-69	4	5	6.7	9.1	tr	0.2	16	42
69-89	4	4.8	4.7	9.4	tr	0.1	14.2	39
89-132	3.9	4.8	3.2	8.3	0.1	0.1	11.7	38
132-191	3.9	4.7	3.5	9.5	tr	0.1	13.1	31

Belmont Pedon Description Pit 2

Description Date: 03/05/2013
Describer: Phil King, Jim Brewer, Carl Robinette
NRCS sample number: S2013MD027002
Series: Fairfax
Site Note: This profile is a taxadjunct to the series due to particle size family is fine-loamy not fine.
TAXONOMIC CLASS: **Fine-loamy, mixed, active, mesic Typic Hapludults**

Location Description: In a forested area about 1.7 miles west of I-95, 0.95 miles south of the Patapsco River, 1.2 miles north of Montgomery road, and 1125 feet north west of the end of Belmont Woods road, west of the Belmont Conference Center in Patapsco Valley State Park, in Howard County, Maryland; Latitude: 39 degrees 13 minutes 37.80 seconds north; Longitude: 76 degrees 44 minutes 53.20 seconds west; WGS84

A--0 to 7 centimeters; very dark grayish brown (10YR 3/2) sandy loam; weak medium subangular blocky structure, and weak fine subangular blocky structure; very friable, nonsticky, nonplastic; common fine roots throughout and common medium roots throughout; common fine interstitial and common very fine interstitial pores; 6 percent nonflat well rounded very strongly cemented 2- to 75-millimeter quartzite fragments; neutral; abrupt wavy boundary.

Ap--7 to 25 centimeters; dark brown (7.5YR 3/4) and dark yellowish brown (10YR 3/4) sandy loam; weak medium subangular blocky structure; very friable, nonsticky, nonplastic; common fine roots throughout and common medium roots throughout; common fine tubular and common fine interstitial and common very fine interstitial pores; 5 percent nonflat well rounded very strongly cemented 2- to 75-millimeter quartzite fragments; moderately acid; abrupt wavy boundary
BA--25 to 39 centimeters; brown (7.5YR 4/3) loam; weak coarse subangular blocky structure, and weak medium subangular blocky structure; friable, nonsticky, nonplastic; common fine roots throughout and many coarse roots throughout and common very fine roots throughout; common fine interstitial and common fine tubular pores; 9 percent nonflat well rounded very strongly cemented 2- to 75-millimeter quartzite fragments; very strongly acid; clear smooth boundary.

Bt1--39 to 55 centimeters; red (7.5R 4/6) gravelly loam; moderate medium subangular blocky structure; friable, slightly sticky, slightly plastic; common fine roots throughout and common medium roots throughout; common fine interstitial and common fine tubular pores; 15 percent continuous faint clay films on all faces of peds and 15 percent continuous faint clay films on surfaces along pores; 18 percent nonflat well rounded very strongly cemented 2- to 75-millimeter quartzite fragments; very strongly acid; clear wavy boundary.

Bt2--55 to 70 centimeters; strong brown (7.5YR 5/6)gravelly clay loam; 32 percent clay; moderate fine subangular blocky structure, and moderate medium subangular blocky structure; firm, moderately sticky, moderately plastic; few fine roots throughout and few very fine roots throughout; common fine interstitial and common fine tubular pores; 15 percent continuous distinct clay films on all faces of peds and 15 percent continuous distinct clay films on surfaces along pores; 16 percent nonflat well rounded very strongly cemented 2- to 75-millimeter quartzite fragments; very strongly acid; clear wavy boundary.

Bt3--70 to 94 centimeters; 90 percent strong brown (7.5YR 5/6) and 10 percent yellowish brown (10YR 5/8) clay; strong medium subangular blocky structure; firm, moderately sticky, moderately plastic; few fine roots throughout and few medium roots throughout and few coarse roots throughout; common fine interstitial and common fine tubular pores; 15 percent continuous prominent clay films on all faces of peds and 15 percent continuous prominent clay films on surfaces along pores; 13 percent nonflat well rounded very strongly cemented 2- to 75-millimeter quartzite fragments; very strongly acid; clear wavy boundary.

Bt4--94 to 120 centimeters; 40 percent strong brown (7.5YR 5/6) and 30 percent strong brown (7.5YR 4/6) and 30 percent reddish yellow (7.5YR 6/8) clay loam; 30 percent clay; moderate medium prismatic structure parts to strong medium angular blocky structure; firm, moderately sticky, moderately plastic;

common fine roots throughout and few coarse roots throughout and common very fine roots throughout; common fine interstitial and common fine tubular pores; 15 percent continuous prominent clay films on all faces of peds and 15 percent continuous prominent clay films on surfaces along pores; 10 percent nonflat well rounded very strongly cemented 2- to 75-millimeter quartzite fragments; Discontinuous Iron stone pseudomorph; very strongly acid; clear smooth boundary.

2BC--120 to 155 centimeters; yellowish red (5YR 4/6) fine sandy loam; weak medium platy structure; friable, nonsticky, nonplastic; few fine roots throughout and few very fine roots throughout; many fine tubular and many very fine tubular pores; very strongly acid; Highly micaceous below 120 cm..

2CB--155 to 188 centimeters; strong brown (7.5YR 5/8) and yellowish red (5YR 4/6) fine sandy loam; nonsticky, nonplastic; few fine irregular and few very fine irregular pores; 2 percent nonflat subangular very strongly cemented 2- to 75-millimeter quartzite fragments; very strongly acid.

Lab Data S2013MD027002:

			Particle size								
Depth (cm.)	Horizon	Texture Field	Total Clay	Total Silt	Total Sand	VFS	FS	MS	CoS	VCoS	> 2mm wt
0-7	A	SL	11.9	23.1	65	2.5	7.1	32.4	19.9	3.1	6
7-25	Ap	SL	11.5	21.7	66.8	2.3	6.4	34	20.8	3.3	5
25-39	BA	SL	16	32	52	2.3	4.7	26.3	16.9	1.8	9
39-55	Bt1	L	26.1	38.5	35.4	1.6	3.3	14.4	12.7	3.4	18
55-70	Bt2	CL	33.6	35.3	31.1	2	3.5	11.1	11.2	3.3	16
70-94	Bt3	CL	42.2	28.9	28.9	2.1	3.5	10.5	9.7	3.1	13
94-120	Bt4	CL	37.7	26.8	35.5	2.3	3.7	15.3	11.7	2.5	10
120-155	BC	SL	15.8	16.6	67.6	11.4	29.1	20.2	5.9	1	
155-188	CB	SL	16.4	23	60.6	14.9	26.9	15.7	2.9	0.2	

	Bulk Density		C/N			Dith-Cit-Ext		
Depth (cm.)	Db 1/3 bar	Db Oven Dry	Total C	Total N	C/N Ratio	Fe	Al	Mn
0-7			2.75	0.27	10	1.4	0.1	0.1
7-25			1.03	0.1	10	1.2	0.1	0.1
25-39			0.61	0.05	12	1.7	0.2	0.1
39-55	1.58	1.65	0.35	0.03	12	2.3	0.2	tr
55-70	1.53	1.69	0.24	0.07	3	2.7	0.3	--
70-94	1.49	1.62	0.18	0.03	6	2.9	0.3	--
94-120	1.41	1.63	0.14	--		2.7	0.3	--
120-155			0.13	0.05	2	3.8	0.4	--
155-188			0.09	--		3.3	0.4	--

	pH		Extractable Bases					
Depth (cm.)	pH 1:2 CaCl2	pH 1:1 H2O	Ca	Mg	Na	K	Sum Bases	Base Saturation
0-7	6.0	6.6	7.3	2.2	tr	0.6	10.1	95
7-25	4.8	5.6	2.4	0.9	0.1	0.3	3.7	64
25-39	4.1	5	0.9	0.4	--	0.2	1.5	25
39-55	4.0	4.8	1.7	0.9	--	0.2	2.8	31
55-70	4.0	4.6	2.9	1.5	--	0.2	4.6	37
70-94	3.9	4.7	6.2	3.7	--	0.1	10	42
94-120	3.9	4.6	4.6	3.7	--	0.1	8.4	43
120-155	4.0	4.6	12.6	11	--	0.2	23.8	50
155-188	3.9	4.7	13.4	11.6	--	0.1	25.1	52

Belmont Pedon Description Pit 3

Description Date: 03/05/2013
Describer: Martin Rabenhorst, Rob Tunstead, Carl Robinette
NRCS sample number: S2013MD027003
Series: Russett
Site Note: This profile is a taxadjunct to the series due to Oxyaquic not Aquic, and a Paleudult not a Hapludult.
TAXONOMIC CLASS: **Fine, kaolinitic, mesic Oxyaquic Paleudults**

Location Description: In a forested area about 1.7 miles west of I-95, 0.95 miles south of the Patapsco River, 1.2 miles north of Montgomery road, and 1251 feet north west of the end of Belmont Woods road, west of the Belmont Conference Center in Patapsco Valley State Park, in Howard County, Maryland. Latitude: 39 degrees 13 minutes 40.20 seconds north; Longitude: 76 degrees 44 minutes 52.70 seconds west; WGS84

A--0 to 5 centimeters; dark brown (7.5YR 3/2) sandy loam; moderate medium granular structure; very friable, nonsticky, nonplastic; common fine roots throughout and common medium roots throughout; 7 percent nonflat well rounded very strongly cemented 2- to 75-millimeter quartzite fragments; moderately acid; clear smooth boundary.

Ap--5 to 17 centimeters; dark brown (7.5YR 3/3) coarse sandy loam; weak medium granular structure, and moderate medium subangular blocky structure; very friable, nonsticky, nonplastic; common fine roots throughout and many medium roots throughout and common coarse roots throughout and many very coarse roots throughout; 11 percent nonflat well rounded very strongly cemented 2- to 75-millimeter quartzite fragments; very strongly acid; clear wavy boundary.

BA--17 to 31 centimeters; brown (7.5YR 4/4) sandy clay loam; weak coarse subangular blocky structure, and weak medium subangular blocky structure; friable, nonsticky, nonplastic; common medium roots throughout and common coarse roots throughout and common very coarse roots throughout; 8 percent nonflat well rounded very strongly cemented 2- to 75-millimeter quartzite fragments; very strongly acid; clear wavy boundary.

Bt1--31 to 54 centimeters; strong brown (7.5YR 4/6) sandy clay loam; moderate medium subangular blocky structure, and moderate fine subangular blocky structure; firm, slightly sticky, slightly plastic; common medium roots throughout and common coarse roots throughout; 1 percent fine prominent irregular weakly cemented black (N 2/), moist, manganese masses throughout; 12 percent nonflat well rounded very strongly cemented 2- to 75-millimeter quartzite fragments; very strongly acid; clear smooth boundary.

Bt2--54 to 76 centimeters; variegated 70 percent strong brown (7.5YR 5/6) and 25 percent red (2.5YR 5/6) and 5 percent light brown (7.5YR 6/4) clay; moderate medium subangular blocky structure, and moderate fine subangular blocky structure; friable, moderately sticky, moderately plastic; common medium roots throughout and few coarse roots throughout; 3 percent fine prominent irregular weakly cemented black (N 2/), moist, manganese coatings on faces of peds; 13 percent nonflat well rounded very strongly cemented 2- to 75-millimeter quartzite fragments; very strongly acid; clear wavy boundary.

2Bt3--76 to 110 centimeters; variegated 62 percent strong brown (7.5YR 5/6) and 15 percent light yellowish brown (10YR 6/4) and 15 percent yellowish red (5YR 5/6) and 3 percent pale brown (10YR 6/3) clay; moderate coarse prismatic structure parts to moderate medium prismatic structure parts to moderate fine prismatic structure parts to moderate medium subangular blocky structure parts to moderate fine subangular blocky structure; friable, moderately sticky, moderately plastic; few medium roots throughout; 3 percent fine prominent irregular weakly cemented black (N 2/), moist, manganese masses throughout and 5 percent fine prominent irregular weakly cemented black (N 2/), moist, manganese coatings on faces of peds; 6 percent nonflat well rounded very strongly cemented 2- to 75-millimeter quartzite fragments; very strongly acid.

2Bt4--110 to 175 centimeters; variegated 45 percent strong brown (7.5YR 5/6) and 20 percent red (2.5YR 4/6) gravelly clay; moderate medium angular blocky structure, and moderate fine angular blocky structure; firm, moderately sticky, moderately plastic; few medium roots throughout; 35 percent coarse prominent irregular weakly cemented very pale brown (10YR 7/3), moist, iron depletions on faces of peds; 20 percent nonflat well rounded very strongly cemented 2- to 75-millimeter quartzite fragments; very strongly acid.

3BC1--175 to 200 centimeters; variegated 55 percent yellowish brown (10YR 5/8) and 30 percent light yellowish brown (2.5Y 6/4) and 15 percent yellowish red (5YR 5/6) clay; firm, slightly sticky, slightly plastic; few fine roots throughout; 3 percent nonflat well rounded very strongly cemented 2- to 75-millimeter quartzite fragments; very strongly acid.

3BC2--200 to 250 centimeters; variegated 60 percent light yellowish brown (2.5Y 6/4) and 30 percent yellowish red (5YR 5/6) and 10 percent yellowish brown (10YR 5/8) clay; friable, nonsticky, nonplastic; 4 percent nonflat well rounded very strongly cemented 2- to 75-millimeter quartzite fragments; very strongly acid.

Lab Data S2013MD027003:

			Particle size								
Depth (cm.)	Horizon	Texture Field	Total Clay	Total Silt	Total Sand	VFS	FS	MS	CoS	VCoS	> 2mm wt
0-5	A	SL	12	20.1	67.9	2.4	5.2	35.4	21	3.9	7
5-17	Ap	SL	11.3	19.4	69.3	1.7	5.2	34.9	23.6	3.9	11
17-31	BA	SL	21.9	21.2	56.9	1.7	4.4	30.3	17.7	2.8	8
31-54	Bt1	SCL	33.9	15.9	50.2	1.7	3.3	23.8	17.1	4.3	12
54-76	Bt2	CL	49.2	19.1	31.7	3.3	3.7	13.3	7.9	3.5	13
76-110	2Bt3	CL	53.1	22.1	24.8	4.2	6.9	7.2	5.2	1.3	6
110-175	2Bt4	CL	50.8	28.3	20.9	4.7	5.6	4.6	3.4	2.6	20
175-200	3Bc1	L	55.7	28.6	15.7	5.9	6.2	2.6	0.7	0.3	3
200-250	3Bc2	SIL	47.1	34.6	18.3	4.6	7.7	3.9	1.6	0.5	4

	Bulk Density		C/N			Dith-Cit-Ext		
Depth (cm.)	Db 1/3 bar	Db Oven Dry	Total C	Total N	C/N Ratio	Fe	Al	Mn
0-5			2.96	0.23	13	0.9	0.1	tr
5-17			1.43	0.12	11	0.9	0.1	tr
17-31	1.62	1.69	0.5	0.04	13	1.7	0.2	--
31-54	1.53	1.66	0.29	0.07	4	2.9	0.3	--
54-76	1.27	1.52	0.27	0.01	24	8.3	0.5	--
76-110	1.27	1.57	0.2	0.04	4	1.7	0.2	tr
110-175	1.41	1.58	0.1	0.08	1	5.1	0.3	0.1
175-200			0.12	0.07	1	5.9	0.5	0.1
200-250			0.13	--		2.8	0.5	tr

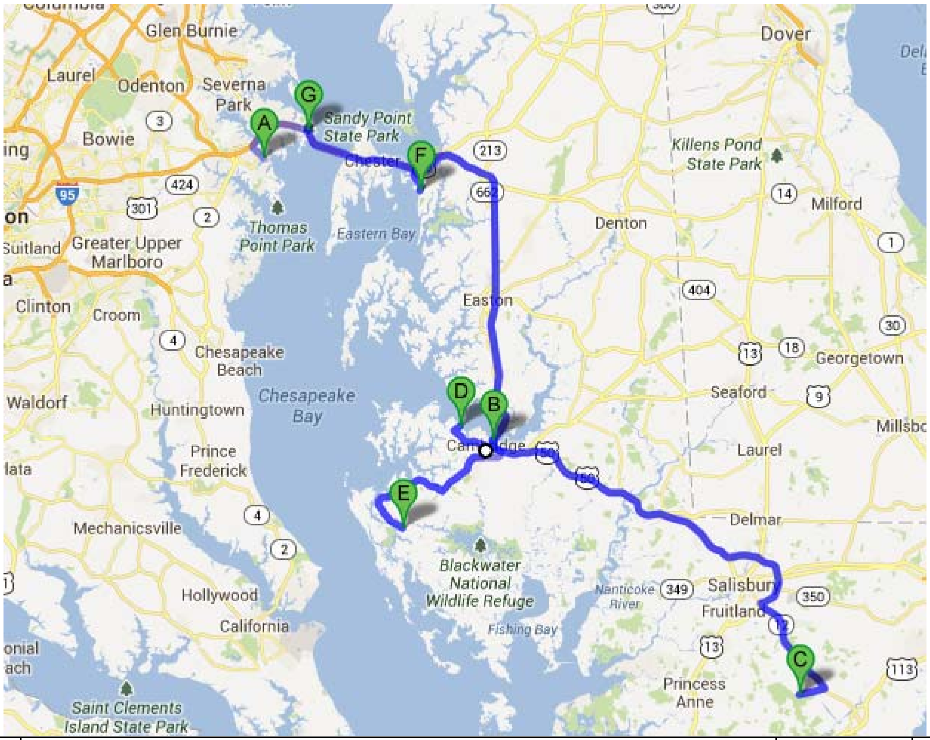
	pH		Extractable Bases					
Depth (cm.)	pH 1:2 CaCl2	pH 1:1 H2O	Ca	Mg	Na	K	Sum Bases	Base Saturation
0-5	5.2	5.8	5.3	1.8	--	0.4	7.5	83
5-17	4.2	5	1.7	0.8	--	0.2	2.7	42
17-31	3.9	4.8	1.6	1	--	0.2	2.8	36
31-54	3.9	4.7	2.2	1.5	--	0.1	3.8	34
54-76	3.9	4.6	3.8	3.3	--	0.1	7.2	41
76-110	3.9	4.7	4.9	6	--	0.1	11	42
110-175	4	4.7	1	2.1	--	tr	3.1	23
175-200	3.9	4.4	4.5	7.6	--	0.1	12.2	32
200-250	3.8	4.5	6.3	11.2	--	0.1	17.6	35

References

United States Department of Agriculture Handbook 296, Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin, 2006

United States Environmental Protection Agency, EPA/540/R-06/004, Innovative Technology Verification Report; XRF Technologies for Measuring Trace Elements in Soil and Sediment; Niton XLt 700 Series XRF Analyzer, February 2006

Wednesday Tour – Delmarva Peninsula



Point		Mile Post	Time
A	Depart Lowes Hotel Annapolis	0	6:30 AM
B	Cambridge - Coffee break and pit stop at Vistors Center	56	7:40 AM
	Depart Cambridge	56	8:10 AM
C	Arrive Snow Hill - Stop 1	112	9:15 AM
	Depart Snow Hill	112	11:15 AM
D	Arrive Cambridge - Lunch (Horn Point)	168	12:30 PM
	Depart Cambridge	168	1:15 PM
E	Arrive Blackwater National Wildlife Refuge - Stop 2	191	1:55 PM
	Depart Blackwater National Wildlife Refuge	191	3:10 PM
F	Arrive Talisman Farm - Stop 3	256	4:30 PM
	Depart Talisman Farm	256	5:45 PM
G	Arrive Sandy Point State Park - Heron Shelter	268	6:10 PM
	Depart Sandy Point State Park	268	8:10 PM
	Arrive Lowes Hotel	277	8:30 PM

Acknowledgment

This trip has been made possible only because of the help of many individuals who have contributed sacrificially of their time and energy. These contributions have taken the form of obtaining access to sites, providing technical information, making or updating soil descriptions, helping with site selection, excavation and preparation of pits and auger borings, collecting data, contributing graphics and text for this guidebook, and assisting with other logistics such as arranging for catering of meals and historical interpretation. We are especially grateful to the following friends and colleagues: Professor Del Fanning, Univ. of Maryland; Dean Cowherd, NRCS Acting State Soil Scientist; NRCS Soil Scientists Jim Brewer, Phil King, David Verdone, Aaron Friend, Rob Tunstead, and Susan Demas; Retired NRCS Soil Scientist Dianne Shields and Carl Robinette.

We are also especially grateful for the assistance provided by the Mid-Atlantic Association of Professional Soil Scientists (MAPSS). They have graciously provided drinks and snacks for the field trip, and have ensured that alternate beverages, not permitted through the State of MD purchasing system, were provided at the cookout at Sandy Point. There are many MAPSS members who have contributed in various ways to the success of this trip, but special thanks are due to Gary and Debbie Jellick for their service in the items described above.

We are also drawing upon research and information acquired by a number of former graduate students who studied at UMD over the last few decades, including: Margaret Condron, Ahmed Hussein, Melvin Tucker, John Wah and probably others. Thanks also are due Dr. Darrin Lowery for the contribution of his archaeological insights.

A special thanks is due to my ENST Capstone Group (Sara Elbeheiry, Keith Pivonski, Andrew Nichols, and Danielle Russo) who, for their Senior project, conducted the interviews and then edited and produced the video that will be played on the bus trip. This video will provide background information on the Chesapeake Bay area, and also important technical information related to each of the three stops.

If this field trip bears any measure of success, it is due in large measure to the hard work and support of all these great folks (as well, probably, to some unnamed persons who, regrettably, we may have failed to remember as we write this). Thank you - thank you - thank you.

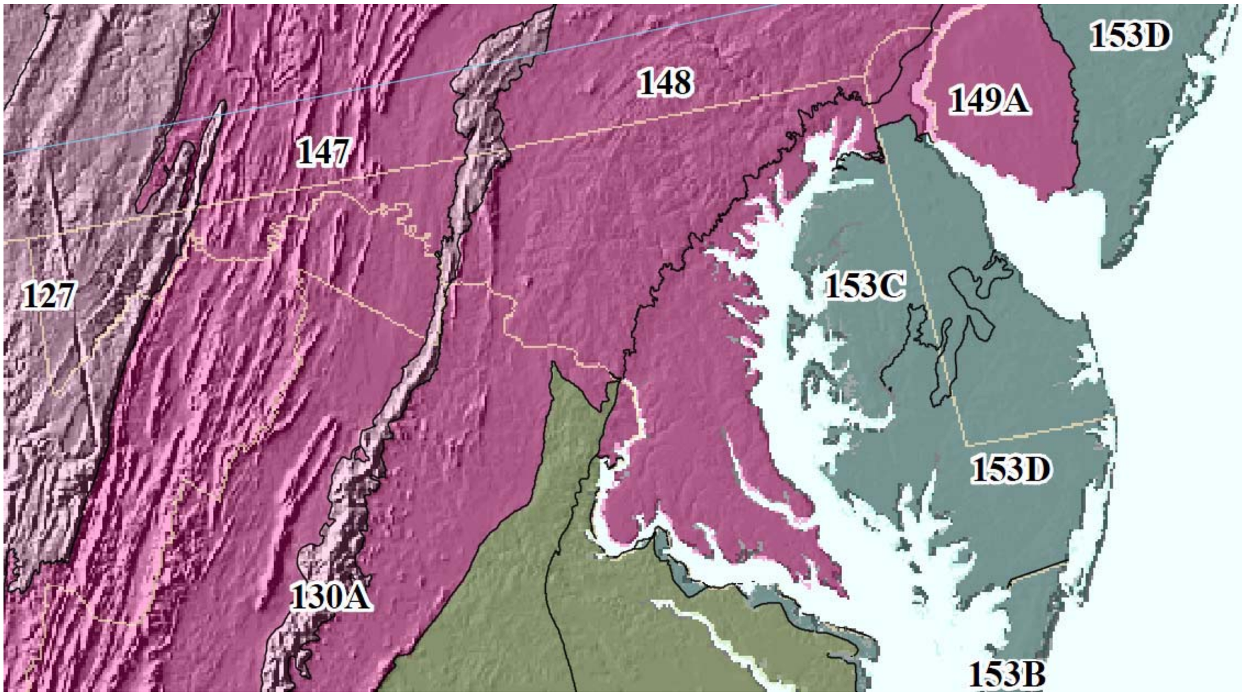
Marty Rabenhorst and Brian Needelman
June 2013

Hazards

Poison Ivy: There are two hazzards associated with this field trip for which you need to take some precaution. The first is poison ivy (Rhus radicans) which is a native plant in this region. Physical contact with this plant can cause allergic reactions developing rash, itching and in some individuals, more severe reactions can develop. The large old (fuzzy) vines which sometimes grow up trees have no resemblance to the smaller plants, but can be just as problematic. The old adage "an ounce of prevention is worth a pound of cure" is the best advice. Simply watch out for and avoid contact with this plant.

Deer Ticks: The second hazzard is the deer tick (*Ixodes scapularis.)* This insect can be a carrier of the bacterial spirochete (*Borrelia burgdorferi*) which causes lyme disease. In its early stage, lyme disease can be easily treated with antibiotics. If early treatment is neglected, later stages of the disease can be extremely debilitating. The ticks are small and hatch out in larger numbers at this time of year. They are endemic to the area, but are particularly problematic at Stop 1 (Furnace Road). We have sprayed the area along the paths and around the pit areas at this site. I would also suggest that insect repellents be applied around the boot and leg areas, that you stay on or near the paths and pits, and that you examine yourself carefully at the end of the day. If you see a tick on you DON'T PANIC! Simply pick it off and dispose of it. If you discover later in the day or evening that a tick has attached itself to you DON'T PANIC! Simply pull off the tick, and either dispose of the tick or place it in a ziplock plastic bag (while there is a simple blood test for the disease, sometime the ticks themselves can be analyzed.) Usually a tick must remain attached at least 24 hours in order to transmit the bacterium (if it is in fact carrying it.) If you think that a tick has been attached to you for a significant period of time, watch the bite area to see if it develops a characteristic pinkish ring around the bite and also note whether any flu-like symptoms develop. If either of these symptoms develop, you should see a physician for testing and possible treatment.

MLRAs 153C and 153D



MLRA 153C

Introduction
This area is in Maryland (62 percent) and Delaware (38 percent). It makes up about 2,015 square miles (5,225 square kilometers). The town of Middletown, Delaware, the city of Dover, Delaware, and the towns of Chestertown and Easton, Maryland, are in this area. U.S. Highways 13, 113, and 301 cross the area. Dover Air Force Base is in this MLRA, and a number of national wildlife management areas are throughout the MLRA.

Physiography
This area is in the Embayed Section of the Coastal Plain Province of the Atlantic Plain. It is a nearly level to gently sloping coastal plain. Elevation ranges from sea level to about 80 feet (0 to 25 meters). Local relief is only 6 to 15 feet (2 to 5 meters), even where flood plains or coves from the bay are incised. The extent of the major Hydrologic Unit Areas (identified by four-digit numbers) that make up this MLRA is as follows: Upper Chesapeake (0206), 72 percent, and Delaware (0204), 28 percent. The Chester and Choptank Rivers are both impounded in the part of this area in Maryland. The Smyrna, Leipsic, Murderkill, and St. Jones Rivers are in the part in Delaware.

Geology
This area is underlain by unconsolidated sand, silt, and clay deposited by ancient rivers as continental sediments. Between glacial periods, when sea level was much higher than it is today, the river sediments were mixed with marine sediments. In the northern part of the area, 1 to 3 feet (less than 1 meter) of loess covers these sediments. Ocean levels are again rising, so extensive tidal marshes are in areas along the Chesapeake and Delaware Bays where the mouths of rives are being further submerged.

Climate
The average annual precipitation in this area is 40 to 44 inches (1,015 to 1,120 millimeters). Convective summer thunderstorms provide a large amount of the total precipitation, but precipitation is relatively evenly distributed throughout the year. The average annual snowfall is typically about 6 inches (15 centimeters). The average annual temperature is 54 to 58 degrees F (12 to 14 degrees C). The freeze-free period averages 220 days and ranges from 205 to 235 days. It is shorter inland and longer along the bays.

Water
The total withdrawals average 425 million gallons per day (1,610 million liters per day). About 16 percent is from ground water sources, and 84 percent is from surface water sources. Rainfall, perennial streams, and ground water sources provide an abundance of water. Many of the soils require artificial drainage before they can be used for crops. During droughty periods, however, irrigation is needed on some of the sandy soils. The surface water is suitable for most uses. Most of the surface water is used for cooling thermoelectric power plants. Water for domestic, municipal, and industrial uses is obtained mainly from wells. One aquifer consists of the Quaternary and Tertiary alluvial deposits at the surface in eastern Maryland and from the center of this area and south in Delaware. The surficial sediments provide water that is soft and that has less than 100 parts per million (milligrams per liter) total dissolved solids. This water is used for domestic purposes and some public supplies and is heavily pumped for irrigation. The Chesapeake Group and Rancocas aquifers are sources of ground water beneath the surficial aquifer. The water in these aquifers has low levels of total dissolved solids, typically less than 200 parts per million (milligrams per liter), but iron concentrations typically exceed the secondary drinking water standard of 300 parts per billion (micrograms per liter) and the water is hard or very hard. These aquifers provide water for public supply and for industry. The intrusion of seawater can be a problem near the shorelines of the Chesapeake and Delaware Bays.

Soils
The dominant soils in this MLRA are Ultisols. Entisols and Inceptisols are of lesser extent. The soils in the area have an aquic or udic soil moisture regime, a mesic soil temperature regime, and mixed or siliceous mineralogy. They are very deep, dominantly well drained to poorly drained, and generally loamy or sandy in the mineral horizons. Well drained, loamy Hapludults (Sassafras, Downer, Hambrook, Unicorn, and Ingleside series) are on broad uplands. Moderately well drained Hapludults (Woodstown, Pineyneck, and Hammonton series) are in intermediate positions on the landscape. Poorly drained Endoaquults (Fallsington, Carmichael, and Hurlock series) are in low-lying areas. The soils generally formed in loamy or sandy coastal plain sediments. Significant areas of Hapludults (Matapeake, Nassawango, and Mattapex series) and Endoaquults (Othello and Elkton series) that formed in 1 to 3 feet (1 meter or less) of loess over sandy and loamy, stratified coastal plain deposits occur in the MLRA. Small areas of sandy soils that formed in sandy terrace deposits or ancient dunes associated with rivers are throughout the MLRA. Somewhat poorly drained to excessively drained Quartzipsamments (Evesboro, Runclint, Galloway, and Klej series) and Hapludults (Galestown and Cedartown series) and poorly drained Psammaquents (Askecksy series) are the dominant soils in these small areas. The flood plains, freshwater swamps, and low-lying flats are dominated by very poorly drained Humaquepts (Mullica, Indiantown, and Longmarsh series), Haplosaprists (Manahawkin and Puckum series), and Fluvaquents (Chicone and Zekiah series). The tidal marshes along the Chesapeake and Delaware Bays are dominated by very poorly drained Sulfihemists (Honga, Transquaking, Bestpitch, and Mispillion series) and Sulfaquents (Appoquinimink and Broadkill series).

Biology
The natural vegetation in this area consists mostly of white oak, red oak, hickory, blackgum, red maple, black oak, scarlet oak, chestnut oak, blackjack oak, sweetgum, loblolly pine, beech, Virginia pine, scrub oak, highbush blueberry, sweet pepperbush, greenbrier, laurel, sassafras, lowbush blueberry, holly, and mountain laurel. Some of the major wildlife species in this area are white-tailed deer, turkey, quail,

raccoon, rabbit, squirrel, wading shore birds, and numerous species of ducks and geese. The Chesapeake and Delaware Bays provide habitat for diverse populations of aquatic animal species. The Chesapeake Bay provides extensive habitat for shellfish.

Land Use

Cropland—40%
Grassland—2%
Forest—21%
Urban—7%
Water—25%
Other—5%

About one-half of this area is in farms. Farming is highly diversified. The main agricultural enterprise is the production of grain crops, such as soybeans and corn. Fruit and vegetable production and specialty crops, such as cranberries and blueberries, are important in the area. Many large-scale corporate farms produce the specialty crops. The production of poultry, truck crops, or fruit crops exceeds general farming in importance in some counties. Sod farms are important in some areas. Many large tracts of loblolly pine in areas of the wetter soils are managed for timber production. Native mixed pine and hardwood forests remain in large tracts or in areas of protected public lands in State forests and parks. Broad flats of marine and fluvial origin are drained by flat, wide, meandering, slow-moving streams. Ditch networks on large tracts have been developed to facilitate drainage for agricultural production. Rapid expansion of urban and suburban development is reducing the extent of farmland, particularly prime farmland, as well as forestland. The seafood industry is significant to the economy of the counties bordering the two bays. Several major soil resource concerns affect this area. The most significant of these is the reduction in the acreage of farmland and forestland caused by urban and suburban development. Water erosion and the resultant degradation of stream quality commonly occur during construction activities associated with urbanization. Urbanization often changes the character of agricultural communities, some of which have histories dating back to the colonial era. Increased runoff associated with urban development and agriculture commonly causes stream downcutting and widening and the subsequent deposition of sandy material along streambanks. Development of residential lagoons along shorelines can severely impact the adjacent wetlands and estuaries. Farmland preservation programs are vital to maintaining the agricultural resources in the area. Maintenance or improvement of water quality for recreation and fishing is critical to local economies, particularly in the shellfish habitat areas in the Chesapeake Bay. Conservation practices on cropland generally include systems of crop residue management (especially no-till and minimum-till systems), conservation cover crops, nutrient management, grassed waterways, filter strips, irrigation water management, and riparian buffers. Where livestock or poultry are part of the farm operation, management of animal waste, including storage of the waste, is important.

MLRA 153D

Introduction

This area is in New Jersey (46 percent), Maryland (35 percent), and Delaware (19 percent). It makes up about 5,045 square miles (13,075 square kilometers). The Chesapeake Bay and the Atlantic Ocean border this area. The Delaware Bay divides the area nearly in half. The MLRA includes Long Branch, Asbury Park, Lakewood, Hammonton, and Atlantic City, New Jersey; Cambridge, Salisbury, and Pocomoke City, Maryland; and Milford, Georgetown, and Seaford, Delaware. A short stretch of Interstate 195 crosses the northern tip of this area, in New Jersey. The Garden State Parkway parallels the coast in the part of this area in New Jersey, and the Atlantic City Expressway connects Atlantic City to Philadelphia, Pennsylvania. U.S. Highway 13 connects most of the rest of the area outside of New Jersey. Lakehurst Naval Air Station and most of Fort Dix are in the part of this area in New Jersey, and a number of national wildlife refuges and State forests are throughout the area. The Assateague Island National Seashore, consisting of most of Assateague Island, is in the part of the area in Maryland.

Physiography

This area is in the Embayed Section of the Coastal Plain Province of the Atlantic Plain. It is a nearly level to gently sloping coastal plain with dunes and beaches on the ocean and bay sides. Large areas of tidally flooded marshes occur, particularly between the numerous barrier islands and the mainland along the Atlantic Coast and along the bays. Elevation typically ranges from sea level to about 80 feet (0 to 25 meters). In the Barnegate Bay watershed in the northern part of the MLRA, however, remnants of old Coastal Plain deposits have a maximum elevation of more than 200 feet (60 meters). Local relief is only 6 to 15 feet (2 to 5 meters), even where flood plains or coves from the bay are incised. The extent of the major Hydrologic Unit Areas (identified by four-digit numbers) that make up this MLRA is as follows: Upper Chesapeake (0206), 50 percent; Delaware (0204), 49 percent; and Lower Hudson-Long Island (0203), 1 percent. From north to south, the major rivers in the area are the Shark, Manasquan, Toms, Yellow, Oswego, Wading, Mullica, Tuckahoe, Great Egg Harbor, and Maurice Rivers in New Jersey and the Mispillion, Broadkill, Gravelly, Indian, Nanticoke, Broad, Wicomico, Dividing, and Pokomoke Rivers in Delaware and Maryland. The Mullica River in New Jersey and the Pokomoke River in Maryland have been designated as National Wild and Scenic Rivers.

Geology

This nearly level to gently sloping coastal plain is made up of unconsolidated sand, silt, and clay deposited by ancient rivers as continental sediments. Between glacial periods, when sea level was much higher than it is today, the river sediments in this area were mixed with underlying marine sediments. During this period, major spits formed at the southern margin of both the New Jersey and the Delmarva peninsulas. The maximum elevation of these recently reformed areas is less than 20 feet (6 meters). In the part of this area in Maryland, 1 to 3 feet (1 meter or less) of loess covers these sediments. Ocean levels are again rising; therefore, extensive areas of tidal marsh are accreting and moving inland along the Chesapeake and Delaware Bays and the Atlantic Ocean, particularly at the mouths of rivers. Some areas of coastal beach dune sands are along the ocean.

Climate

The average annual precipitation in most of this area is 38 to 45 inches (965 to 1,145 millimeters). It is 47 inches (1,195 millimeters) at the northern end of the area, in New Jersey. Convective summer thunderstorms provide a large amount of the total precipitation, but precipitation is relatively evenly distributed throughout the year. The average annual snowfall is typically about 6 inches (15 centimeters). The average annual temperature is 52 to 59 degrees F (11 to 15 degrees C). The freeze-free period averages 220 days and ranges from 190 to 255 days. It is shorter in inland areas and longer along the Atlantic Ocean and the Chesapeake and Delaware Bays.

Water
The total withdrawals average 265 million gallons per day (1,005 million liters per day). About 84 percent is from ground water sources, and 16 percent is from surface water sources. Rainfall and perennial streams provide an abundance of water. Ground water discharge from the surficial aquifer throughout this area contributes to the perennial streamflows. Many of the soils require artificial drainage before they can be used for crops, but irrigation is needed on the sandier soils. The surface water is generally suitable for most uses. Contamination from agricultural runoff and municipal and industrial wastewater discharges causes some local water-quality problems. Near the coast, the surface water is brackish and is not used. Water for domestic, municipal, and industrial uses and for irrigation is obtained mainly from wells. The Coastal Plain aquifers in this MLRA are primarily Quaternary and Tertiary alluvial deposits at or very close to the surface. The surficial aquifers are the Columbia, Unconfined, and Kirkwood-Cohansey. They provide water that is soft or moderately hard and that typically has less than 100 parts per million (milligrams per liter) total dissolved solids. High levels of iron cause some problems for users throughout the MLRA. Since these are water-table aquifers, they are very susceptible to contamination from surface activities. Excessive withdrawals of ground water can result in the intrusion of seawater near the Delaware and Chesapeake Bays and on the coast of the Atlantic Ocean. These aquifers provide water for public supply and for industry. Aquifers lying beneath the surficial aquifers are known as the Chesapeake Group. Their water has low levels of total dissolved solids (typically less than 200 parts per million (milligrams per liter), but iron concentrations typically exceed the secondary drinking water standard of 300 parts per billion (micrograms per liter). Also, the water is hard or very hard. These aquifers provide water for public supply and for industry.

Soils
The dominant soil orders in this MLRA are Ultisols. Entisols, Histosols, Spodosols, and Inceptisols are of lesser extent. The soils in the area have a mesic soil temperature regime, an aquic or udic soil moisture regime, and mixed or siliceous mineralogy. They are very deep, very poorly drained to excessively drained, and generally loamy or sandy in the mineral horizons. A strip of coastal beach dune sand extends along the Atlantic Ocean in most of the MLRA. Well drained, loamy Hapludults (Sassafras, Downer, Hambrook, Nassawango, and Ingleside series) are on broad uplands. Moderately well drained Hapludults (Woodstown and Hammonton series) are in intermediate positions on the landscape. Poorly drained Endoaquults (Fallsington and Hurlock series) are in low-lying areas. These soils generally formed in loamy or sandy coastal plain sediments. The parts of the MLRA in Maryland and Delaware have significant areas of Hapludults (Matapeake and Mattapex series) and Endoaquults (Othello and Elkton series) that formed in 1 to 3 feet (1 meter or less) of loess over sandy and loamy, stratified coastal plain deposits. Large areas of sandy soils that formed in sandy coastal plain sediments or ancient dunes are throughout the MLRA. Somewhat poorly drained to excessively drained Quartzipsamments (Evesboro, Runclint, Lakehurst, Lakewood, and Klej series) and Hapludults (Galestown and Cedartown series) and poorly drained and very poorly drained Alaquods (Atsion and Berryland series) are the dominant soils. The flood plains, freshwater swamps, and low-lying flats are dominated by very poorly drained Humaquepts (Mullica series), Haplosaprists (Manahawkin and Puckum series), and Fluvaquents (Chicone series). The tidal marshes along the Chesapeake and Delaware Bays and between the barrier islands and the mainland are dominated by very poorly drained Sulfihemists (Honga, Transquaking, Bestpitch, and Mispillion series) and Sulfaquents (Appoquinimink, Broadkill, Purnell, and Boxiron series). Along the Atlantic Ocean, a broken line of barrier islands consisting of primarily coastal beaches and dunes is dominated by Udipsamments (Acquango and Brockatonorton series) and Quartzipsamments (Hooksan series).

Biology
The natural vegetation in this area consists mostly of pitch pine, blackgum, red maple, black oak, scarlet oak, chestnut oak, blackjack oak, Atlantic white cedar, sweetgum, white oak, hickory, shortleaf pine, Virginia pine, scrub oak, highbush blueberry, sheep laurel, sweet pepperbush, gallberry, greenbrier,

laurel, sassafras, lowbush blueberry, holly, and mountain laurel. Some of the major wildlife species in this area are white-tailed deer, turkey, quail, raccoon, rabbit, squirrel, wading shore birds, and numerous species of ducks and geese. The Chesapeake Bay provides extensive habitat for shellfish. Both the Chesapeake and Delaware Bays provide habitat for diverse populations of aquatic animal species.

Land Use

Cropland—15%
Grassland—1%
Forest—33%
Urban—11%
Water—29%
Other—11%

This area consists mainly of forestland, open water, or farmland. A significant acreage is urban land. The agricultural products in the area are primarily grain crops, such as soybeans and corn. Fruits and vegetables also are grown, and tobacco is grown in some areas in Maryland. Cranberries and blueberries are grown in New Jersey. Poultry production is important in the parts of the area in Delaware and Maryland, and much of the locally grown corn is used for feed. Large forested areas occur throughout the MLRA, particularly in the wetter low-lying areas. Numerous national wildlife refuges, State forests, State parks, and wildlife management areas occur throughout the MLRA. Seasonal tourism is a large part of the local economy, particularly along or near the barrier islands. Several major soil resource concerns affect this area. The most important is the loss of farmland and forestland to urban and suburban development. Water erosion and the resultant degradation of stream quality commonly occur during the construction activities associated with urbanization. Urbanization often changes the character of agricultural communities, some of which have histories dating back to the colonial era. Increased runoff associated with urban development and agricultural uses commonly causes stream downcutting and widening and the subsequent deposition of sandy material along streambanks. Development of residential lagoons along shorelines can have a severe impact on the adjacent wetlands and estuaries. Farmland preservation programs are vital to maintaining the agricultural resources in this area. Maintenance or improvement of water quality for recreation and fishing is critical to local economies and is particularly important in the shellfish habitat areas in the Chesapeake Bay. Conservation practices on cropland generally include systems of crop residue management (especially no-till and minimum-till systems), conservation cover crops, nutrient management, grassed waterways, filter strips, and riparian buffers. Where livestock or poultry are part of the farm operation, management of animal waste, including storage of the waste, is important.

Water Table Depth (Redox Features)	Fine-silty SiL/SiCL Bt	Fine-silty (>50" silts)	Fine-loamy SL/L surface SCL Bt	Fine-loamy SiL surface SiL/L Bt	Coarse-loamy L surface L/SL Bt	Coarse-loamy LS/SL surface SL Bt	Sandy (w/ Bt) LS Bt	Sandy (w/o Bt)
>72" W	Matapeake B		Sassafras B	Reybold B	Greenwich B	Downer B	Galestown A	Evesboro A
40-72" SWWD	Nassawango B		Hambrook B	Queponco B	Unicorn B	Ingleside B	Cedartown A	Runclint A
20-40" MW	Mattapex C	Leipsic C	Woodstown C	Manokin C	Pineyneck C	Hammonton B		Galloway B
	Butlertown C		Matawan C					
10-20" SWP	Crosiadore C			Annemessex C		*Glassboro* C		Klej C
0-10" P	Othello C/D	Tent C/D	Fallsington C/D	Quindocqua C/D	Carmichael C/D	Hurlock B/D		Askecksy B/D
	Elkton C/D							
	Whitemarsh C/D							
ponded to 0" VP	Kentuck C/D		Corsica C/D			Pone B/D		

Water Table Depth (Redox Features)	Fine SiCL/SiC/C Bt	Arenic SL Bt	Paleudults arenic/gross	Other (not in any drainage order)		Coarse-loamy (no Bt)		Sandy w/ Bh
>72" W		Fort Mott A	Henlopen A	Beaches D				
40-72" SWWD		Rosedale A		Udorthents B/D				
20-40" MW	Keyport C	Rockawalkin B	Pepperbox C					
10-20" SWP								
0-10" P	Lenni D							
ponded to 0" VP						Mullica B/D		Berryland B/D

Floodplain, Swamp, Tidal Marsh, Dune and Submerged Upland Soils		Thickness of O.M.						
		Umbric	Less than 8"	Thapto-hist	8" to 16"	16" to 51"	Greater than 51"	
Submerged-upland	Parent Mat.		Sunken D					
Floodplain-Fresh	Mineral var. OC	Longmarsh D	*Zekiah D	Chicone D				
		Indiantown D						
Swamp-Fresh	Woody over S					Manahawkin D	Puckum D	
	Woody over SiL/L					Lenape D		
Floodplain-Fresh, tidal influence	Herb. over Sil/Sicl		Nanticoke D	Mannington D				
Tidal-Brackish water	Herb. over S/LS				Purnell D	Mispillian D		
	Herb. over SiL/L		Broadkill D		Boxiron D	Honga D		
			Tangier D					
	Herb. over SiC/C					Bestpitch D	Transquaking D	
Dunes-Eolian/surf	Excessive drained		Acquango A					
	Mod. Well drained		Brockatonorton B					
	Poorly drained, sulf		*Salt Pond D*		*Fluvaquents in Dor.			

Pocomoke State Forest
Worcester County, MD
Topohydrosequences on Dunal Landscapes

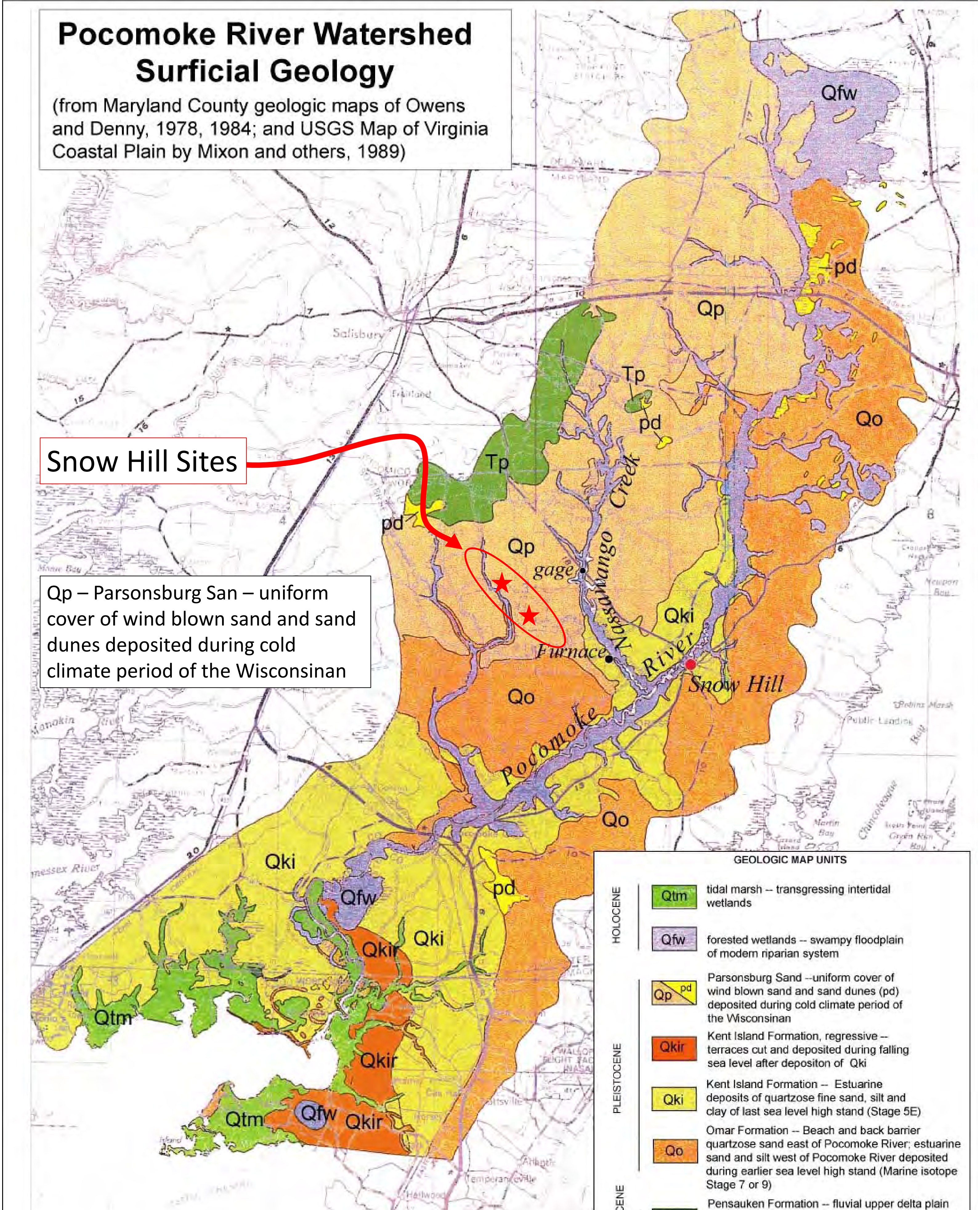
Much of the information at this stop (really, transects along two substops) was gathered and generated in association with the MS thesis of Margaret Condron (1990), although Richard Hall, former state soil science in DE (NRCS) (now deceased), continued to collect biweekly water table data at these sites for several years. In Margaret's thesis, data were collected from sites 2:1, 2:5 and 2:6. The pit for 2:1 has since been closed. The pit for site 2:5 and 2:6 are open for examination on this trip. In addition another pit is open (Margaret's site 2:2) and a description has been provided (although no data are available for this pit). The soils at 2:1 and 2:2 were both Typic Quartzipsamments. Although there was significant evidence of clay illuviation in 2:1, it was still insufficient for an argillic horizon to be recognized. Also, the water table occasionally comes within the lower horizons of site 2:2 while it never came within 2.5 meters of the surface of site 2:1.

Because of the inherent morphological variability in Spodosols, the profiles exposed on the faces of the pits have necessarily changed slightly over the last two decades. The descriptions in the guidebook were updated from the original 1990 descriptions, but are nevertheless about 10 years old. You will therefore understand if some of the horizon depths and designations may be different than those shown in the tables and figures from Margaret Condron's work.

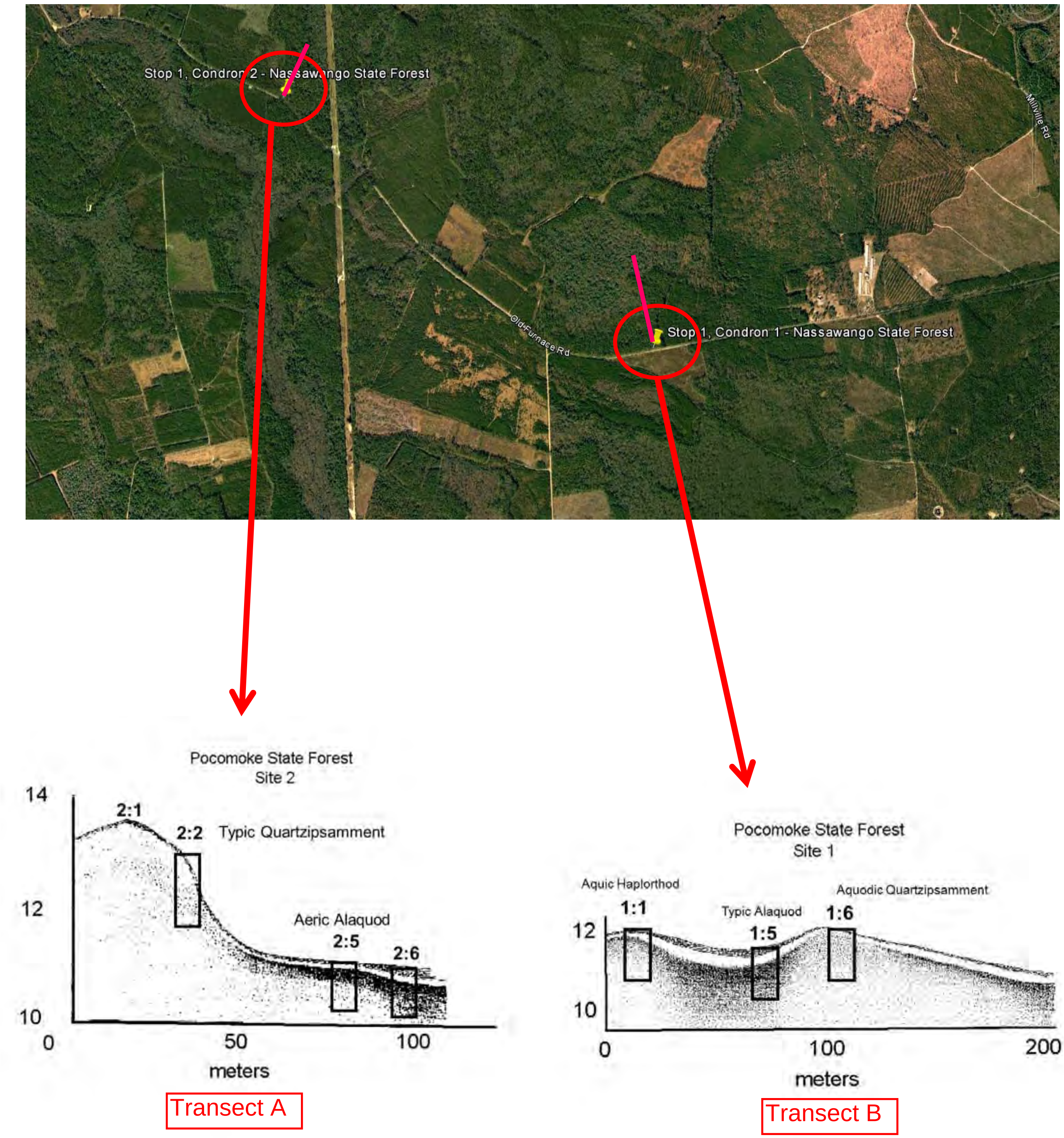
There are three pits open for examination along each of the two transects. Descriptions are provided and supporting data are also given in accompanying tables and figures. Morphological expression of spodic horizons in these landscapes appears closely related to hydrological conditions. Spodic horizons are best expressed in soils which would be considered poorly or very poorly drained, and may occur in somewhat poorly drained soils. It also appears that very sandy (sand and loamy sands) conditions are necessary for spodosols to form. When the parent materials become slightly more loamy (sandy loam side of loamy sands) spodic horizon morphology is no longer expressed.

Aluminum and iron chemistry is also very interesting in these systems. In the lower landscape positions, the recharge-flowthrough nature of the hydrology joined with the strongly reducing conditions and sandy, highly permeable materials result in loss of Fe. However, because Aluminum is not redox sensitive, it persists in the system and can be cheluviated during spodosol formation.

Because of the interest in carbon storage in soils, in addition to providing graphs of the carbon depth functions, the quantity of carbon sequestered in these soils has also been presented.

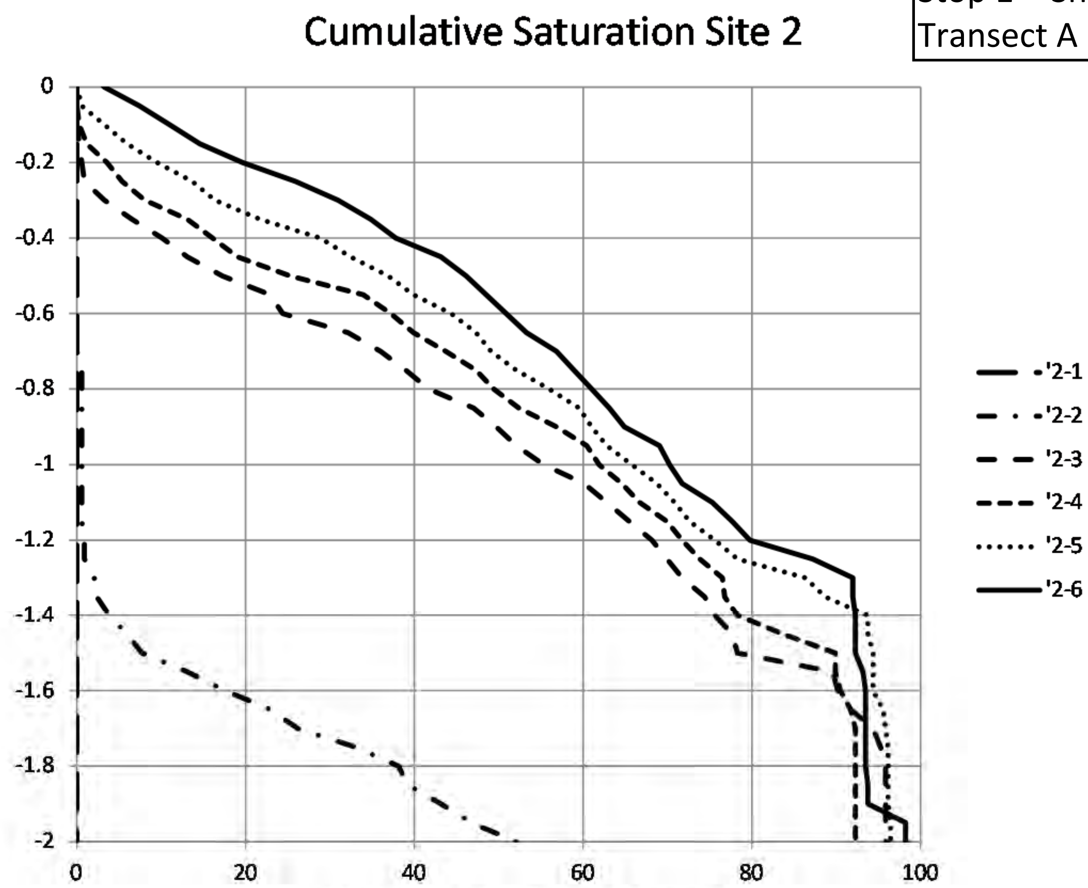


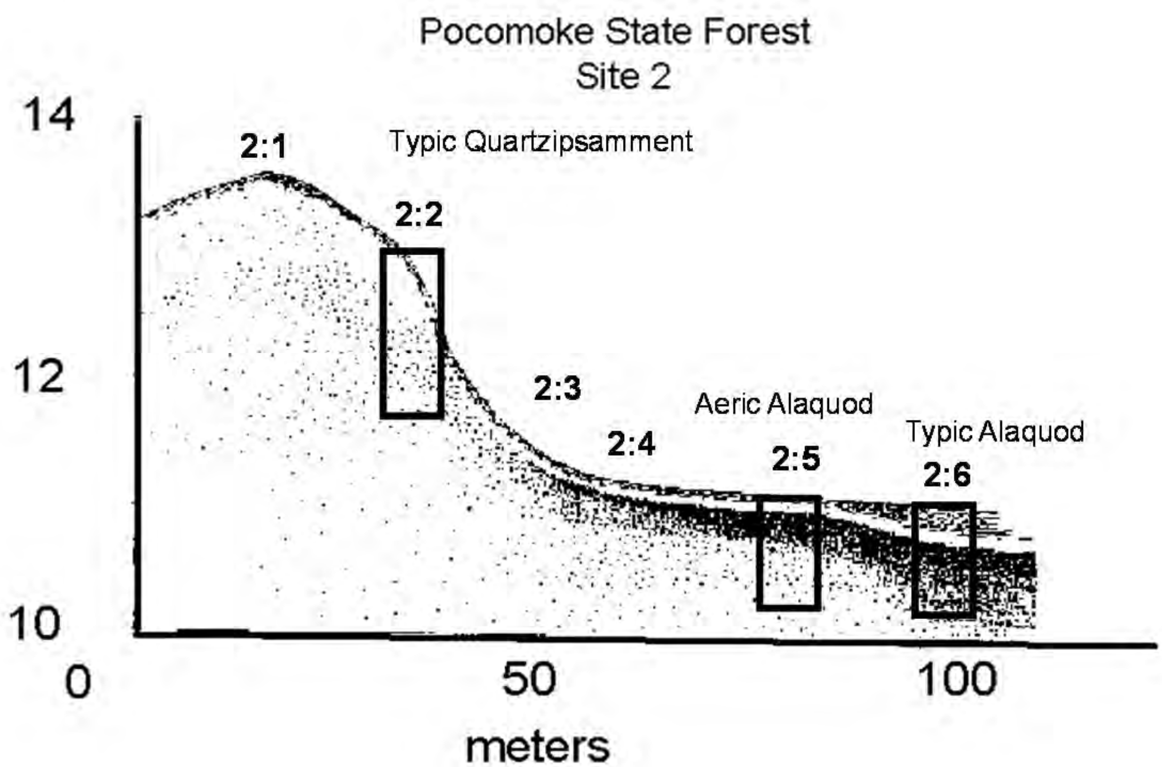
Bog Iron Formation in the Nassawango Watershed, Maryland
By Owen P. Bricker, Wayne L. Newell, and Nancy S. Simon
U.S. Geological Survey Open-File Report 03-346



Stop 1, Condron 2 - Nassawango State Forest
Stop 1, Condron 1 - Nassawango State Forest
Old Furnace Rd
Millville Rd
Pocomoke State Forest
Site 2
14
12
10
0
50
100
meters
2:1
2:2
Typic Quartzipsamment
Aeric Alaquod
2:5
2:6
Transect A
Pocomoke State Forest
Site 1
Aquic Haplorthod
Typic Alaquod
Aquodic Quartzipsamment
1:1
1:5
1:6
12
10
0
100
200
meters
Transect B

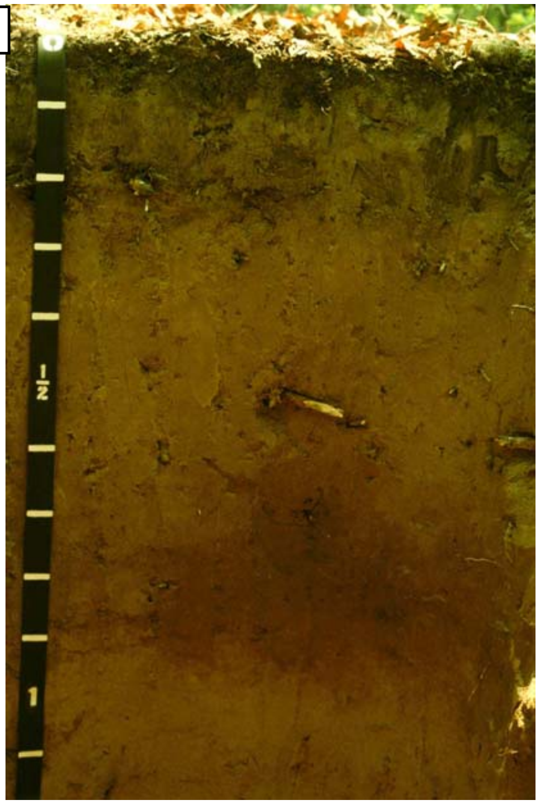
Stop 1 - Snow Hill
Transect A





***Soil OM from pedon 2:5, 2Ab horizon 190-200 cm; dated by Beta Analytic at 10,200 +/- 270 YBP**

Stop 1 - Snow Hill



PEDON 2:1 (PIT NOT OPEN AT THIS TIME)
Soils Series: Evesboro
Soil Survey # S90-MD-047-006
Geographically Associated Soils: Klej, Atsion, Berryland
Location: Pocomoke State Forest; on Old Furnace Rd, 4.75 W of Rt. 12, on N side of the road
Latitude:38-12-54-N
Longitude: 075-31-30-W
Classification: siliceous, mesic Typic Quartzipsamment
Physiography: Dune in Coastal Plain
Geomorphic Position: on upper third, summit of an interfluve
Elevation: 12 m MSL
Precipitation: 124 cm udic moisture regime
MLRA: 153b
Hydraulic Conductivity: very high
Drainage Class: somewhat excessively drained
Land Use: forest land not grazed
Particle Size Control Section: 25 to 100 cm
Parent Material: eolian-sand material
Described By: Margaret Condron, Martin Rabenhorst, Mark Elless, 7/90.

Oe--0 to 0 cm; abrupt smooth boundary.

A1--0 to 7 cm; gray (10YR 5/1) sand; single grain; loose; an E horizon appears to be forming in the lower 2 cm. It may be from an old plow layer; clear wavy boundary.

A2--7 to 20 cm; olive brown (2.5Y 4/4) loamy sand; weak medium subangular blocky structure; very friable; this horizon may be the lower part of a plow layer; clear smooth boundary.

BA--20 to 68 cm; yellowish brown (10YR 5/4) loamy sand; weak coarse subangular blocky structure; very friable; clear smooth boundary.

Bt--68 to 96 cm; dark yellowish brown (10YR 4/6) loamy sand; weak coarse subangular blocky structure; very friable; clay bridging; clear smooth boundary.

CB--96 to 193 cm; light yellowish brown (10YR 6/4) sand; single grain; loose; there were approximately 10% lamellae (7.5YR 4/4) in the sand; clear smooth boundary.

C1--193 to 248 cm; light yellowish brown (2.5Y 6/4) sand; single grain; loose; there were approximately 2% lamellae; clear smooth boundary.

C2--248 to 284 cm; light yellowish brown (2.5Y 6/4) sand; single grain; loose; clear smooth boundary.

C3--284 to 312 cm; yellowish brown (10YR 5/6) sand; common fine distinct yellowish red (5YR 5/8) soft masses of iron; single grain; loose; clear smooth boundary.

C4--312 to 358 cm; light yellowish brown (2.5Y 6/4) sand; few fine distinct light brownish gray (2.5Y 6/2) iron depletions, and strong brown (7.5YR 5/8) soft masses of iron; single grain; loose.

Note: The Bt horizon is insufficiently expressed (insufficient % clay increase) to constitute an argillic horizon.

Stop 1 - Snow Hill

PEDON 2:2
Soils Series: Evesboro
Soil Survey #
Geographically Associated Soils: Evesboro, Atsion, Berryland,
Location: Pocomoke State Forest; Old Furnace Rd., 4.75 miles west of Rt. 12, on the N side of the Rd.
Latitude:38-12-54-N
Longitude: 075-31-30-W
Classification: siliceous, mesic Typic Quartzipsamment
Physiography: Dune in Coastal Plain
Geomorphic Position: on upper third, back slope of a side slope
Slope Characteristics: northeast facing convex horizontal, convex vertical
Elevation: 12 m MSL
Precipitation: 124 cm udic moisture regime
MLRA: 153b
Hydraulic Conductivity: very high
Drainage Class: somewhat excessively drained
Land Use: forest land not grazed
Particle Size Control Section: 25 to 100 cm
Parent Material: eolian-sand material
Diagnostic Horizons:
Described By: M. C. Rabenhorst and S. Burch, June 1998; revised by George Demas and Richard Hall, 10/98. Revised M. C. Rabenhorst June 14, 2012

Oe--7 to 0 cm; dark reddish brown (5YR 2.5/2) moderately decomposed plant material; abrupt smooth boundary.

AE--0-6 cm; dark gray (10YR 4/1) sand; structureless single grain; loose; extremely acid; common fine and very fine roots, abrupt smooth boundary.

Ap2--10 to 17 cm; very dark grayish brown (10YR 3/2) sand; structureless single grain; very friable; common fine and very fine roots; extremely acid; abrupt smooth boundary.

Bw1--17 to 33 cm; dark yellowish brown (10YR 4/4) sand; weak medium subangular structure; very friable; common fine and medium distinct dark brown (7.5YR 4/6) mottles (not redoximorphic features); common fine and very fine roots; very strongly acid; gradual smooth boundary.

Bw2--33 to 55 cm; yellowish brown (10YR 5/4) sand; single grain; loose; common distinct dark brown (7.5YR 3/4)weakly cemented mottles (not redoximorphic features); few fine and very fine roots; very strongly acid; gradual smooth boundary.

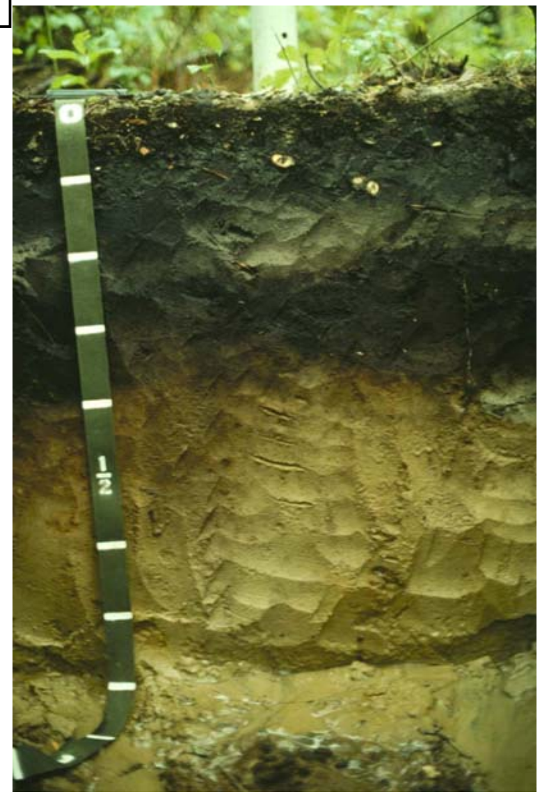
BC1--55 to 84 cm; yellowish brown (10YR 6/4) sand; many medium faint pale yellow (2.5Y 7/3) zones of sand stripping; single grain; loose; few very fine roots; very strongly acid; gradual smooth boundary.

BC2--84-115 cm; light yellowish brown (2.5Y 6/4) sand; few fine distinct yellowish brown (10YR 5/6) soft masses of iron; few fine distinct pale yellow (5Y 7/3) zones of sand stripping; single grain; loose; very strongly acid; gradual smooth boundary.

C--115-160 cm; brownish yellow (10YR 6/6) sand; few fine prominent light gray (10YR 7/2) zones of sand stripping; brown (10YR 5/3) and black (10YR 2/1) vertical root channel; single grain; loose; very strongly acid.

Note: This pedon was not sampled for analysis.

Stop 1 - Snow Hill



PEDON 2:5
Soils Series: Atsion Soil Survey # S90-MD-047-008
Geographically Associated Soils: Evesboro, Klej, Berryland
Location: Pocomoke State Forest; on Old Furnace Rd., 4.75 miles W of Rt. 12, on the N side of the road.
Latitude:38-12-54-N; Longitude: 075-31-30-W
Classification: sandy, siliceous, mesic Aeric Alaquod
Physiography: Dune in Coastal Plain
Slope Characteristics: northeast facing convex horizontal, plane vertical
Elevation: 12 m MSL Precipitation: 124 cm udic moisture regime
Hydraulic Conductivity: very high
Drainage Class: poorly drained
Parent Material: eolian-sand material
Diagnostic Horizons: 10 to 17 albic, 17 to 43 cm spodic
Described By: M.A. Condron, M.C. Rabenhorst, M.P. Elless, Date: 7/90; Revised by: G.P. Demas and R. Hall, 10/98 . Revised M.C. Rabenhorst June 7, 2010.

Oe--5 to 0 cm; dark reddish brown (5YR 3/2) moderately decomposed plant material; abrupt smooth boundary.

A--0 to 10 cm; black (10YR 2/1) sand; structureless single grain; loose; common fine and very fine roots; extremely acid; clear wavy boundary.

E--10 to 17 cm; dark grayish brown (10YR 4/1) sand; single grain; loose; the horizon thickness ranged from 1-8 cm; few common roots; extremely acid; clear smooth boundary.

Bh--17 to 24 cm; black (5YR 2/1) loamy sand; weak medium subangular blocky structure; friable; Deep lenses of the Bh material made up 20% of the pedon and extended to 85cm; few fine roots; extremely acid; clear wavy boundary.

Bhsm--24 to 41 cm; dark reddish brown (5YR 3/3) loamy sand; weak medium subangular blocky structure; firm; this horizon was discontinuous and ranged from 0-18cm in thickness; few medium roots; extremely acid; clear wavy boundary.

BCm--41 to 62 cm; yellowish brown (10YR 5/4) sand; common fine and medium distinct dark yellowish brown (10YR 4/6) soft masses of iron or possibly reddish organic staining; weak medium subangular blocky structure; weakly cemented and friable; approximately 50-60% of the pedon had soft masses of iron, although there were zones 20-30 cm thick without such soft masses of iron; dark brown (10YR 3/3 root channels; clear wavy boundary.

CB--62 to 85 cm; light yellowish brown (2.5Y 6/3) sand; few fine distinct reddish yellow (7.5YR 6/8) soft masses of iron; single grain; loose; few coarse roots; very strongly acid; gradual wavy boundary.

Cg1--85 to 144 cm; light gray (5Y 7/2) sand; single grain; loose; few medium distinct pale brown (10YR 6/3) soft masses of iron; very strongly acid.

Cg2--144 to 185 cm; dark grayish brown (2.5Y 4/2) sand; single grain; loose; this horizon was sampled with a bucket auger.

2Ab--185 to 195 cm; dark brown (10YR 3/3) loamy sand; This horizon was sampled with a bucket auger.

2AC--195 to 223 cm; very dark grayish brown (10YR 3/2) sand; single grain; loose; this horizon was sampled with a bucket auger.

Note: The radiocarbon age of the 2Ab horizon was determined to be 10,200 +/- 270 years. This suggests that the sandy sediments at this site are approximately 10,000 years old, and they are part of the Parsonsburg Formation.

***Soil OM from 2Ab horizon; dated by Beta Analytic at 10,200 +/- 270 YBP**

PEDON 2:6
Soils Series: Berryland Soil Survey # S90-MD-047-009
Location: Pocomoke State Forest; on Old Furnace Rd., 4.75 miles W of Rt. 12, on the N side of the road.
Latitude: 38-12-54-N Longitude: 075-31-30-W
Classification: sandy, siliceous, mesic Aeric Alaquod
Physiography: Dune in Coastal Plain
Geomorphic Position: on a slope & in a depression, toe slope of a nose slope
Slope Characteristics: northeast facing convex horizontal, plane vertical
Elevation: 12 m MSL MLRA: 153
Drainage Class: very poorly drained Particle Size Control Section: 25 to 100 cm
Parent Material: eolian-sand material
Described By: Margaret Condron, Martin Rabenhorst, Mark Elless Date: 12/90
Revised by M. C. Rabenhorst June 14, 2012.

Oe--5 to 0 cm; clear smooth boundary.

A--0 to 18 cm; black (N 2.5) loamy sand; weak medium granular structure; friable; clear smooth boundary.

E--18 to 23 cm; dark grayish brown (10YR 4/2) sand; single grain; loose; clear wavy boundary.

Bh--23 to 32 cm; black (7.5YR 2.5/1) loamy sand; weak medium subangular blocky structure; friable; in 20-30% of the pedon there are 5-50cm tongues of Bh material that extend to 80-90cm depth; clear irregular boundary.

Bhs--32 to 40 cm; very dark brown (7.5YR 2.5/2) loamy sand; weak medium subangular blocky structure; friable; A fairly continuous 3cm thick band of Bh material extends around the pedon. There are also vertical and diagonal rods of Bh material that may be along old root channels.

BC--40 to 60 cm; light olive brown (2.5Y 5/4) loamy sand; weak medium subangular blocky structure; very friable; few distinct dark brown (10YR3/3) soft masses of Fe.

CB1—60-104 cm; light yellowish brown (2.5YR 6/4) sand; weak medium subangular blocky structure; very friable; few distinct dark yellowish brown (10YR4/4) soft masses of Fe.

CB2--104 to 139 cm; pale olive (5Y 6/3) sand; This horizon was sampled with a bucket auger.

Cg1--139 to 175 cm; light olive gray (5Y 6/2) sand; this horizon was sampled with a bucket auger.

Cg2--175 to 205 cm; light olive gray (5Y 6/2) sand; this horizon was sampled with a bucket auger.

Characterization data from three pedons selected to represent different degrees of spodic horizon expression along the transect.

Pedon	Horizo	Depth (cm)	Fed	Fep	Feo	Ald	Alp	Alo	Ct	Cp	Fep+Alp/ %Clay	Cp+Alp/ %Clay	Fep+Alp/ Fed+Ald	CEC pH 8.2	ODOE	NaF pH	%Sand	%Silt	%Clay	BD
			g/kg																	g/cm3
2:1	Oe	1-0																		
	A1	0-9	0.4	0.2	0.2	0.1	0.2	0.1	7.3	1.1	0.01	0.02	0.80	3.27	0.010	7.70	91.8	1.5	6.7	
	A2	9-20	1.6	0.6	0.5	0.3	0.5	0.4	4.2	1.4	0.01	0.03	0.58	3.31	0.008	8.12	90.9	1.5	7.6	1.42
	BA1	20-44	2.2	0.7	0.4	0.8	0.8	0.9	2.2	0.8	0.02	0.02	0.50	2.61	0.013	9.70	90.0	1.3	8.7	1.44
	BA2	44-69	3.0	0.7	0.3	0.6	0.6	0.5	2.2	0.8	0.02	0.02	0.36	2.19	0.017	6.90	90.6	0.8	8.6	
	Bt	69-98	4.5	1.1	0.5	0.8	2.6	0.8	1.0	0.6	0.04	0.03	0.70	4.72	0.020	9.12	88.2	2.3	9.5	1.57
	CB1	98-149	1.0	0.2	0.1	0.1	0.4	0.2	0.3	0.2	0.05	0.05	0.55	1.12	0.011	7.95	97.7	1.0	1.3	1.66
	CB2	149-19	1.2	0.3	0.1	0.1	0.5	0.3	0.3	0.3	0.06	0.06	0.62	0.00	0.008	8.05	97.5	1.2	1.3	1.66
	C1	194-24	1.2	0.3	0.1	0.1	0.3	0.2	0.3	0.3	0.04	0.04	0.46	0.45	0.008	8.00	97.6	1.2	1.2	
	C2	249-28	1.0	0.2	0.1	0.1	0.3	0.2	0.0	0.3	0.04	0.04	0.45	0.00	0.007	8.10	97.7	0.9	1.4	
	C3	284-31	1.3	0.4	0.4	0.1	0.3	0.2	0.4	0.3	0.05	0.04	0.50	0.00	0.009	8.20	97.5	1.0	1.5	
	C4	313-35	1.1	0.4	0.3	0.1	0.3	0.2	0.2	0.3	0.04	0.04	0.58	0.00	0.008	8.20	97.9	0.5	1.6	
2:5	Oe	5-0																		
	A	0-10	0.1	0.1	0.1	0.0	0.1	0.1	13.3	2.9	0.02	0.24	2.00	8.07	0.010	7.15	93.8	5.0	1.2	1.55
	E	10-17	0.0	0.0	0.0	0.0	0.0	0.0	2.8	0.9	0.00	0.06	0.00	1.82	0.008	7.53	92.9	5.7	1.5	1.70
	Bh	17-30	0.3	0.4	0.2	5.6	8.1	5.9	34.2	30.8	0.11	0.49	1.44	37.80	1.132	11.25	85.7	6.4	7.9	1.20
	Bhs	30-43	0.5	0.3	0.2	2.6	3.6	3.0	9.0	8.3	0.10	0.29	1.26	12.96	0.186	11.37	89.6	6.3	4.1	1.53
	BC	43-80	0.9	0.6	0.2	0.8	2.6	1.1	2.0	1.9	0.07	0.10	1.88	3.45	0.024	10.58	91.6	4.0	4.4	1.64
	C1	80-100	0.1	0.2	0.0	0.4	1.8	0.8	1.0	0.8	0.07	0.09	4.00	2.98	0.013	10.35	96.5	0.7	2.8	
	C2	100-14	0.0	0.0	0.0	0.1	0.8	0.4	0.7	0.7	0.04	0.08	8.00	1.12	0.010	9.95	96.7	1.3	2.0	
	C3	145-18	0.0	0.0	0.0	0.1	0.5	0.4	0.6	0.7	0.02	0.05	5.00	1.49	0.010	9.55	97.1	0.4	2.5	
	2Ab	185-19	0.0	0.2	0.0	1.8	3.1	1.8	16.4	7.7	0.05	0.15	1.83	10.46	0.065	10.75	78.8	14.0	7.3	
	2AC	195-22	0.1	0.1	0.0	0.2	0.9	0.8	1.4	1.6	0.04	0.09	3.33	4.93	0.018	9.80	96.5	0.7	2.9	
2:6	Oe	5-0																		
	A	0-23	0.2	0.2	0.2	0.4	0.8	2.7	43.0	6.9	0.02	0.16	1.67	35.85	0.020	6.80	88.6	6.8	4.7	1.15
	E	23-31	0.0	0.0	0.0	0.0	0.0	0.1	4.0	2.6	0.00	0.16	0.00	9.69	0.008	7.55	92.4	5.9	1.7	
	Bh	31-45	0.1	0.1	0.1	6.1	6.4	8.8	36.2	19.7	0.09	0.37	1.05	41.89	0.770	11.50	84.0	8.9	7.1	1.24
	BC/Bh	45-75	0.2	0.1	0.1	3.8	4.2	6.3	13.4	12.2	0.10	0.38	1.08	20.95	0.184	10.95	86.2	9.5	4.3	1.61
	BC2	75-105	0.0	0.1	0.0	0.4	1.4	1.0	1.9	1.6	0.06	0.13	3.75	4.39	0.035	10.25	97.3	0.4	2.3	
	BC3	105-14	0.0	0.0	0.0	0.0	0.9	0.4	0.6	0.6	0.07	0.11	0.00	3.48	0.010	9.45	97.9	0.8	1.3	
	C1	140-17	0.0	0.2	0.0	0.1	2.5	0.1	0.8	0.7	0.26	0.33	27.00	2.16	0.010	9.52	98.4	0.6	1.0	
	C2	175-20	0.0	0.0	0.0	0.0	1.4	0.1	0.3	0.5	0.11	0.15	0.00	0.00	0.010	8.45	95.5	3.3	1.2	

Field Indicators of Hydric Soils in the United States (Version 7.0) for use in LRRs S and T

IMPORTANT NOTES

1. Soil Chroma should not be rounded to make the chroma meet the requirements of an indicator. A soil matrix with chroma between 2 and 3 should be described as having chroma of 2+. It does not have chroma of 2 and would not meet the requirements of any indicator that requires chroma of 2 or less.
2. All mineral layers above any layers meeting the requirements of any indicator(s), except for indicators A16, S6, F8, F12, F19, F20, and F21 have a dominant chroma of 2 or less, or the thickness of the layer(s) with a dominant chroma of more than 2 is less than 15 cm (6 inches).
3. Unless otherwise noted, nodules and concretions are not considered to be redox concentrations.

IMPORTANT DEFINITIONS

Depleted matrix. For loamy and clayey material (and sandy material in areas of indicators A11 and A12), a depleted matrix refers to the volume of a soil horizon or subhorizon in which the processes of reduction and translocation have removed or transformed iron, creating colors of low chroma and high value (fig. 45). A, E, and calcic horizons may have low chromas and high values and may therefore be mistaken for a depleted matrix; however, they are excluded from the concept of depleted matrix unless the soil has common or many distinct or prominent redox concentrations occurring as soft masses or pore linings. In some areas the depleted matrix may change color upon exposure to air (see Reduced matrix); this phenomenon is included in the concept of depleted matrix. The following combinations of value and chroma identify a depleted matrix:

1. Matrix value of 5 or more and chroma of 1 or less with or without redox concentrations occurring as soft masses and/or pore linings; or
2. Matrix value of 6 or more and chroma of 2 or less with or without redox concentrations occurring as soft masses and/or pore linings; or
3. Matrix value of 4 or 5 and chroma of 2 and 2 percent or more distinct or prominent redox concentrations occurring as soft masses and/or pore linings; or
4. Matrix value of 4 and chroma of 1 and 2 percent or more distinct or prominent redox concentrations occurring as soft masses and/or pore linings.

Gleyed matrix. Soils with a gleyed matrix have the following combinations of hue, value, and chroma (the soils are not glauconitic):
1. 10Y, 5GY, 10GY, 10G, 5BG, 10BG, 5B, 10B, or 5PB with value of 4 or more and chroma of 1; or
2. 5G with value of 4 or more and chroma of 1 or 2; or
3. N with value of 4 or more; or
In some places the gleyed matrix may change color upon exposure to air. (See Reduced matrix). This phenomenon is included in the concept of gleyed matrix.

QUICK TEST TO DETERMINE IF FIELD INDICATORS ARE NOT PRESENT?

Anywhere within the 0-15 cm zone:
1. Do organic soil materials or mucky modified textures exist?
2. Does the soil have a chroma less than or equal to 2?
3. Are there distinct or prominent redox concentrations as soft masses or pore linings?
If answer to all three question is NO, there are no NRCS FIs present (possible exceptions are F19, F20, F21). Consider if this might be a possible problem site based on hydrology or based on vegetation.
If the answer to any of the questions is YES, this means there MIGHT BE a FI present. Proceed with evaluation to identify which (if any) FI may be present. (Note: an affirmative answer to one of these questions does NOT mean that the soil DOES have a FI present, but only that it MIGHT have a FI present).

ALL SOILS

A1. Histosol. Classifies as a Histosol.
A2. Histic Epipedon. A histic epipedon underlain by mineral soil material with chroma of 2 or less. Aquic conditions or artificial drainage are required.
A3. Black Histic. A layer of peat, mucky peat, or muck 20 cm (8 in.) or more thick starting within the upper 15 cm (6 in.) of the soil surface having hue 10YR or yellower, value 3 or less, and chroma 1 or less; and is underlain by mineral soil material with chroma of 2 or less..
A4. Hydrogen Sulfide. A hydrogen sulfide odor within 30 cm (12 in.) of the soil surface.
A5. Stratified Layers. Several stratified layers starting within the upper 15 cm (6 in.) of the soil surface. One or more of the layers: a) has value 3 or less with chroma 1 or less ; b) and/or it is muck, mucky peat, peat, or mucky modified mineral texture. The remaining layers have chroma 2 or less. Any sandy material that constitutes the layer with value of 3 or less and chroma of 1 or less, have at least 70 percent of the visible soil particles must be masked with organic material, viewed through a 10x or 15x hand lens. If observed without a hand lens, the particles appear to be close to 100 percent masked.
A6. Organic Bodies. (T only) Presence of 2% or more organic bodies of muck or a mucky modified mineral texture, approximately 1 to 3 cm (0.5 to 1 in.) in diameter, starting within 15 cm (6 in.) of the soil surface. In some soils the organic bodies are smaller than 1 cm.
A7. 5 cm Mucky Mineral. (T only) A mucky modified mineral surface layer 5 cm (2 in.) or more thick starting within 15 cm (6 in.) of the soil surface.
A9. 1 cm Muck. (T only) A layer of muck 1 cm (0.5 in.) or more thick with value 3 or less and chroma 1 or less starting within 15 cm (6 in.) of the soil surface.
A10. 2 cm Muck. (S only) A layer of muck 2 cm (0.75 in.) or more thick with value 3 or less and chroma 1 or less starting within 15 cm (6 in.) of the soil surface.
A11. Depleted Below Dark Surface. A layer with a depleted or gleyed matrix that has 60% or more chroma 2 or less starting within 30 cm (12 inches) of the soil surface that has a minimum thickness of either:
a. 15 cm (6 inches), or
b. 5 cm (2 inches) if the 5 cm (2 inches) consists of fragmental soil material.
Loamy/clayey layer(s) above the depleted or gleyed matrix must have value 3 or less and chroma 2 or less. Sandy layer(s) above the depleted or gleyed matrix must have value 3 or less, chroma 1 or less, and at least 70% of the visible soil particles must be covered, coated or similarly masked with organic material.
A12.Thick Dark Surface. A layer at least 15cm (6 inches) thick with a depleted matrix that has 60% or more chroma 2 or less (or a gleyed matrix) starting below 30cm (12 inches) of the surface. The layer (s) above the depleted or gleyed matrix have value 2.5 or less and chroma 1 or less to a depth of 30cm (12 inches) and value 3 or less and chroma 1 or less in the remainder of the epipedon. If the epipedon is sandy at least 70% of the visible soil particles must be covered, coated, or similarly masked with organic material."

SANDY SOILS

S1. Sandy Mucky Mineral. (Region S only) A mucky modified mineral layer 5 cm (2 in.) or more thick starting within 15 cm (6 in.) of the soil surface.

S4. Sandy Gleyed Matrix. A gleyed matrix which occupies 60% or more of a layer starting within 15 cm (6 in.) of the soil surface.

S5. Sandy Redox. A layer starting within 15 cm (6 in.) of the soil surface that is at least 10 cm (4 in.) thick, and has a matrix chroma 2 or less with 2% or more distinct or prominent redox concentrations as soft masses and/or pore linings.

S6. Stripped Matrix. A layer starting within 15 cm (6 in.) of the soil surface in which iron/manganese oxides and/or organic matter have been stripped from the matrix exposing the primary base color of soil materials. The stripped areas and translocated oxides and/or organic matter form a faint diffuse splotchy pattern of two or more colors. The stripped zones are 10 percent or more of the volume and are rounded.

S7. Dark Surface. A layer 10 cm (4 in.) or more thick starting within the upper 15 cm (6 in.) of the soil surface with a matrix value 3 or less and chroma 1 or less. At least 70% of the visible soil particles must be covered, coated, or similarly masked with organic material. The matrix color of the layer immediately below the dark layer must have a chroma of 2 or less.

S8. Polyvalue Below Surface. A layer with value 3 or less and chroma 1 or less starting within 15 cm (6 in.) of the soil surface underlain by a layer(s) where translocated organic matter unevenly covers the soil material forming a diffuse splotchy pattern. At least 70% of the visible soil particles in the upper layer must be covered, coated, or masked with organic material. Immediately below this layer, the organic coating occupies 5% or more of the soil volume and has value 3 or less and chroma 1 or less. The remainder of the soil volume has value 4 or more and chroma 1 or less.

S9. Thin Dark Surface. A layer 5 cm (2 in.) or more thick within the upper 15 cm (6 in.) of the surface, with value 3 or less and chroma 1 or less. At least 70% of the visible soil particles in this layer must be covered, coated, or masked with organic material. This layer is underlain by a layer(s) with value 4 or less and chroma 1 or less to a depth of 30 cm (12 in.) or to the spodic horizon, whichever is less.

LOAMY AND CLAYEY SOILS

F2. Loamy Gleyed Matrix. A gleyed matrix that occupies 60% or more of a layer starting within 30 cm (12 in.) of the soil surface.

F3. Depleted Matrix. A layer with a depleted matrix that has 60% or more chroma 2 or less:
a. 5 cm (2 inches) thick if entirely within the upper 15 cm (6 inches) of the soil, or
b. 15 cm (6 inches) thick, starting within 25 cm (10 inches) of the soil surface.

F6. Redox Dark Surface. A layer at least 10 cm (4 in.) thick entirely within the upper 30 cm (12 in.) of the mineral soil that has either:
– a. matrix value 3 or less and chroma 1 or less and 2% or more distinct or prominent redox concentrations as soft masses or pore linings,
– b. matrix value 3 or less and chroma 2 or less and 5% or more distinct or prominent redox concentrations as soft masses or pore linings.

F7. Depleted Dark Surface. Redox depletions, with value 5 or more and chroma 2 or less, in a layer at least 10 cm (4 in.) thick entirely within the upper 30 cm (12 in.) of the mineral soil that has:
– a. matrix value 3 or less and chroma 1 or less and 10% or more redox depletions, or
– b. matrix value 3 or less and chroma 2 or less and 20% or more redox depletions.

F8. Redox Depressions. In closed depressions subject to ponding, 5% or more distinct or prominent redox concentrations as soft masses or pore linings in a layer 5 cm (2 in.) or more thick entirely within the upper 15 cm (6 in.) of the soil surface.

F12. Iron/Manganese Masses. (T only) On floodplains, a layer 10 cm (4 in.) or more thick with 40% or more chroma 2 or less, and 2% or more distinct or prominent redox concentrations as soft iron/manganese masses with diffuse boundaries. The layer occurs entirely within 30 cm (12 in.) of the soil surface. Iron/manganese masses have value 3 or less and chroma 3 or less; most commonly they are black. The thickness requirement is waived if the layer is the mineral surface layer.

F13. Umbric Surface. (T only) On concave positions of interstream divides and in depressions, a layer 15 cm (6 in.) or more thick starting within the upper 15 cm (6 in.) of the soil surface with value 3 or less and chroma 1 or less immediately underlain by a layer 10 cm (4 in.) or more thick with chroma 2 or less.

F19. Piedmont Flood Plain Soils. (MLRAs 149A and 148 in S); On active flood plains, a mineral layer at least 15 cm (6 inches) thick starting within 25 cm (10 inches) of the soil surface with a matrix (60 percent or more of the volume) chroma less than 4 and 20% or more distinct or prominent redox concentrations as soft masses or pore linings.

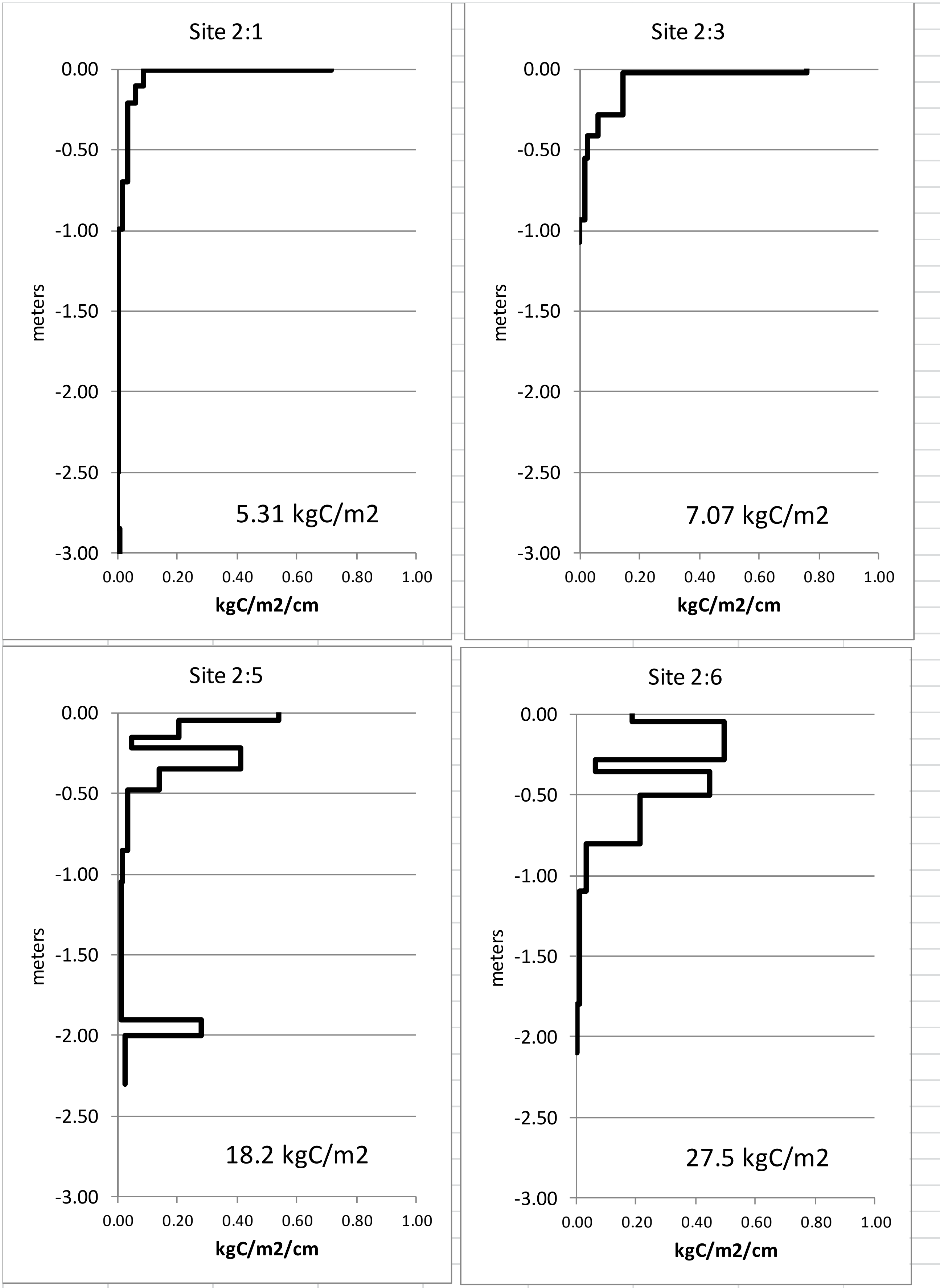
F20. Anomalous Bright Loamy Soils. (MLRA 149A in S and MLRA 153C and 153D in T;) Within 200m (656 feet) of estuarine marshes or waters and within 1 m (3.28 feet) of mean high water, a mineral layer at least 10cm (4 inches) thick starting within 20 cm (8 inches) of the soil surface with a matrix (60 percent or more of the volume) chroma less than 5 and 10 percent or more distinct or prominent redox concentrations as soft masses or pore linings and/or depletions. Anomalous Bright Loamy Soils (ALBS) User Notes: ALBS soils are expected to exist on linear to convex landforms that are adjacent to estuarine marshes or waters.

F21. Red Parent Material. (MLRA 147 and 148 of LRR S; testing in all LRRs) A layer derived from red parent materials that is at least 10 cm (4 inches) thick, starting within 25 cm (10 inches) with a hue of 7.5YR or redder. The matrix has a value and chroma less than or equal to 4; must contain 10 % or more depletions and/or distinct or prominent redox concentrations (combined). Redox depletions should differ in color by having: a. Value one or more units higher and chroma one or more units lower than the matrix, or b. Value of 4 or more and chroma of 2 or less. Where used, soils/parent materials must have Color Change Propensity Index (CCPI) values below 30 (Rabenhorst and Parikh, 2000.)

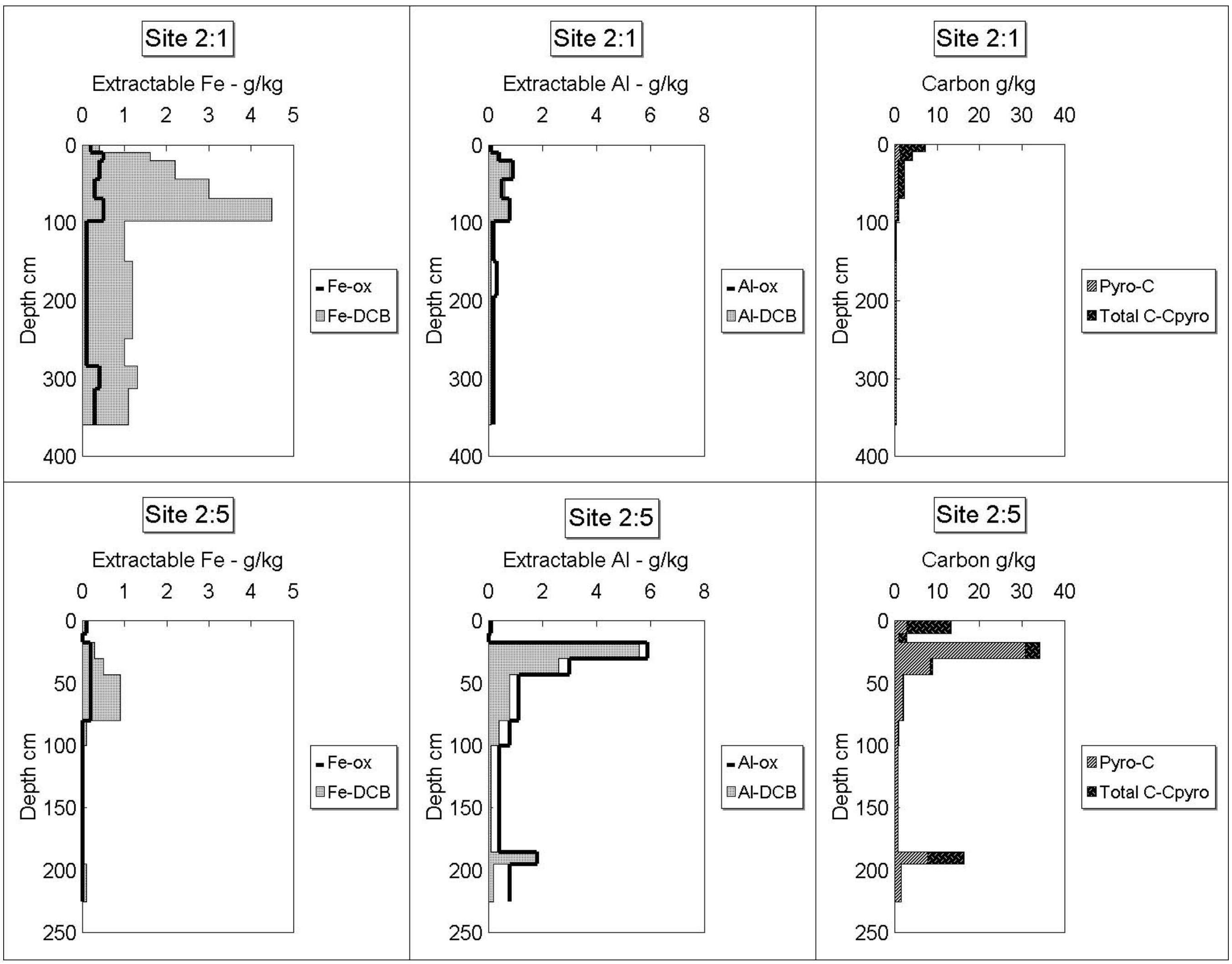
Updated April 21, 2012
M.C. Rabenhorst

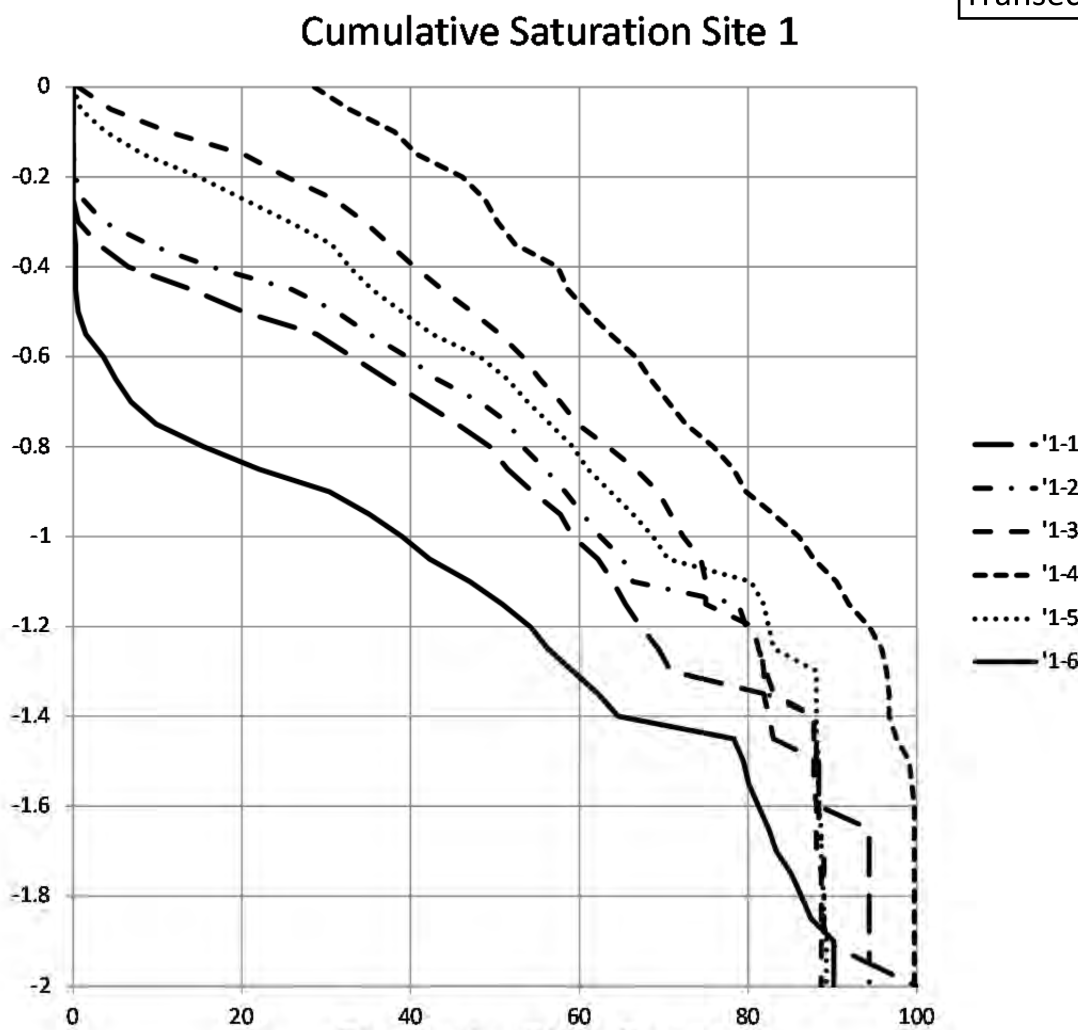
Organic Carbon Depth Functions

Stop 1 - Snow Hill

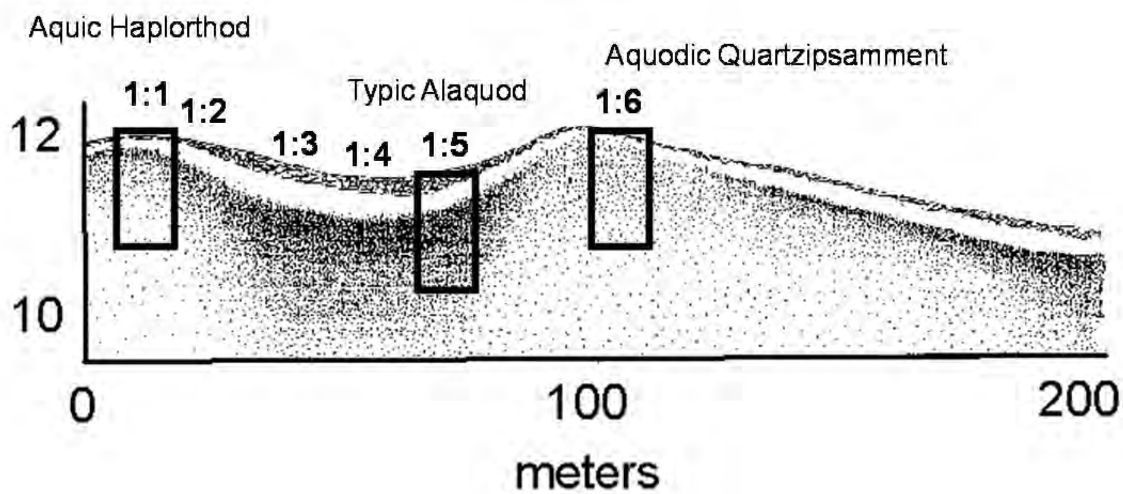


Iron, Aluminum and Carbon Depth Functions





Pocomoke State Forest
Site 1



Stop 1 - Snow Hill

PEDON 1:1
Soil Survey # S90-MD-047-001 Geographically Associated Soils: Evesboro, Atsion, Berryland
Location: Pocomoke State Forest; on Old Furnace Rd., 2.5 miles W of Rt. 12, on N side of road.
Latitude:38-12-10-N Longitude: 075-29-35-W
Classification: sandy, siliceous, mesic Aquic Haplorthod
Physiography: Dune in Coastal Plain
Geomorphic Position: on upper third, summit of an interfluve
Elevation: 12 m MSL MLRA: 153b Hydraulic Conductivity: very high
Drainage Class: somewhat poorly drained Land Use: forest land not grazed
Particle Size Control Section: 25 to 100 cm Parent Material: eolian-sand material
Diagnostic Horizons: 14 - 20 cm albic; 20 to 30 cm spodic
Described By: Margaret Condron, Martin Rabenhorst, Mark Elless, Dick Hall, 7/90.
Revised by: George Demas and Dick Hall, 10/98.

Oe--5 to 0 cm; dark reddish brown (2.5YR 3/4) moderately decomposed plant materials, abrupt wavy boundary.

A--0 to 8 cm; black (5Y 2/1) loamy sand; weak medium granular structure; very friable; common medium and fine roots; extremely acid; clear smooth boundary.

E--8 to 14 cm; gray (7.5YR 6/1) loamy sand; weak medium subangular blocky structure; very friable; few coarse and medium roots; extremely acid; clear wavy boundary.

Bh--14 to 20 cm; black (5YR 2.5/1) loamy sand; massive; friable; the soil consistence is slightly brittle; few coarse and medium roots; extremely acid; clear smooth boundary.

Bhs--20 to 31 cm; dark brown (7.5YR 3/3) loamy sand; massive; friable; the soil consistence is slightly brittle; few coarse and medium roots; extremely acid; clear smooth boundary.

Bs--31 to 44 cm; yellowish brown (10YR 5/6) loamy sand; weak medium subangular blocky structure; very friable; gradual wavy boundary.

BC--44 to 92 cm; pale brown (10YR 6/3) loamy sand; few coarse brown (7.5YR 4/6) iron concentrations which are slightly brittle to firm; common medium distinct reddish yellow (7.5 YR 6/8) soft masses of iron; extremely acid; massive; very friable; gradual wavy boundary.

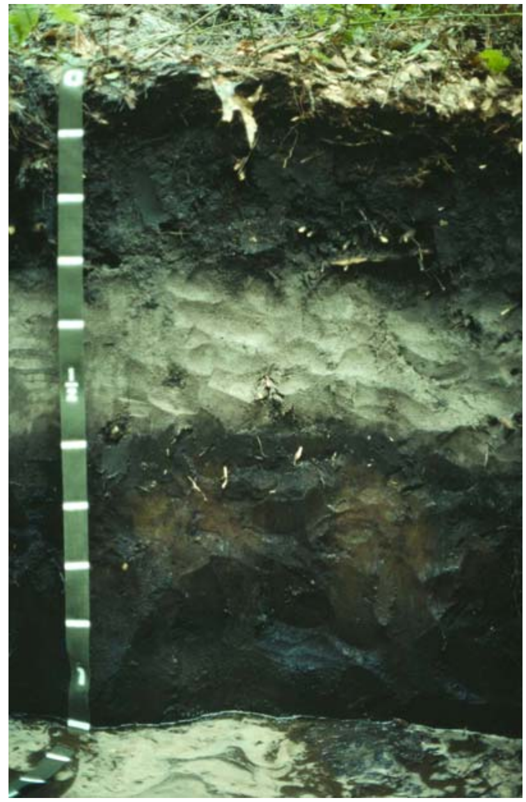
Cg--92 to 130 cm; white (2.5Y 8/1) sand; few coarse pale yellow (2.5Y 8/2 mottles; light brownish gray 2.5Y 6/2) root channels.

NOTE: When the pedon was originally sampled in 1990, the horizonation identified at that time (and depicted in accompanying characterization data) was as follows: Oe--5 to 0 cm; A--0 to 12 cm; E--12 to 20 cm; Bh--20 to 25 cm; Bhs--25 to 30 cm; Bs--30 to 43 cm; BC--43 to 104 cm; C--104 to 119 cm. The soil was then classified as an Aquic Haplorthod.

When the pedon was described in 1998, the horizonation identified at that time was Oe--5 to 0 cm; A--0 to 14 cm; E--14 to 20 cm; Bhs--20 to 24 cm; Bs--24 to 61 cm;BC1--61 to 73 cm; BC2--73-92 cm; Cg--92 to 130 cm. The soil was then classified as an Aquodic Quartzipsamment.

PEDON 1:5

Stop 1 - Snow Hill



Soils Series: Atsion
Soil Survey # S90-MD-047-003
Geographically Associated Soils: Evesboro, Klej, Berryland
Location: Pocomoke State Forest; on Old Furnace Rd., 2.5 miles W of Rt. 12, on the N side of the road.
Latitude:38-12-10-N Longitude: 075-29-35-W
Classification: sandy, siliceous, acid Aeric Alaquod
Physiography: Dune in Coastal Plain
Geomorphic Position: on a slope & in a depression, foot slope of an interfluve
Elevation: 12 m MSL
Hydraulic Conductivity: very high
Drainage Class: very poorly drained
Land Use: forest land not grazed
Particle Size Control Section: 25 to 100 cm
Parent Material: eolian-sand material
Diagnostic Horizons: 19 to 31 albic, 31 to 254 cm spodic
Described By: Margaret Condron, Martin Rabenhorst, Mark Elless, 7/90. Revised by: George Demas and Richard Hall, 10/98.

Oe--4 to 0 cm; abrupt smooth boundary.

A--0 to 21 cm; black (N 2.5) loamy sand; weak medium subangular blocky structure; very friable; few fine and common medium roots; extremely acid; clear smooth boundary.

E--19 to 31 cm; gray (10YR 6/1) sand; single grain; loose; the horizon thickness ranges from 10-30 cm; few coarse and common medium and fine roots; extremely acid; clear wavy boundary.

Bh--31 to 41 cm; black (10YR 2/1) loamy sand; weak coarse subangular blocky structure; friable; common medium roots; extremely acid; clear wavy boundary.

Bhsm--41 to 92 cm; dark reddish brown (5YR 3/2) loamy sand; massive; firm by humus; there are pockets of Bh1 material, like krotovinas, that comprise 10-25% of the material; few medium roots; extremely acid; clear broken boundary.

B'h1--92 to 122 cm; dark reddish brown (5YR 2.5/2) sand; massive; very friable; few medium roots; extremely acid; clear wavy boundary.

B'h2--122 to 140 cm; black (10YR 2/1) loamy sand with common medium distinct gray (7.5YR 6/1) pockets of depleted areas; very strongly acid; gradual wavy boundary.

Bhs--140 to 208 cm; dark brown (7.5YR 3/2) sand.

Bs--208 to 254; dark brown (7.5YR 3/4) sand.

BC--254 to 294 cm; yellowish brown (10YR 5/6) sand.

NOTE: When the pedon was originally sampled in 1990, the horizonation identified at that time (and depicted in accompanying characterization data) was as follows: Oe--5 to 0 cm; A--0 to 22 cm; E--22 to 50 cm; Bh1--50 to 58 cm; Bhsm--58 to 81 cm; Bh2--81 to 140 cm ; Bh3--114 to 162 cm; Bhs--162 to 208 cm; Bs--208 to 254; BC--254 to 294 cm. The A horizon is approaching the thickness necessary for the soil to be a Typic Alaquod (Berryland series.)

PEDON 1:6
Soil Survey # S90-MD-047-004 Geographically Associated Soils: Evesboro, Atsion, Klej, Berryland
Location: Pocomoke State Forest; on Old Furnace Rd., 2.5 miles W of Rt. 12, N side of road
Latitude:38-12-10-N Longitude: 075-29-35-W
Classification: siliceous, mesic Aquodic Quartzipsamment
Geomorphic Position: on upper third, summit of an interfluve
Elevation: 12 m MSL Precipitation: 124 cm udic moisture regime
Drainage Class: moderately well drained Particle Size Control Section: 25 to 100 cm
Parent Material: eolian-sand material
Described By: Margaret Condron, Martin Rabenhorst, Mark Elless, 7/90;
Revised by: George Demas and Richard Hall, 10/98.

Ph

Oe--2 to 0 cm; dark reddish brown (5YR 3/2) moderately decomposed plant material; abrupt smooth boundary.

A--0 to 7 cm; very dark gray (10YR 3/1) loamy sand; weak medium granular structure; very friable; few medium and common fine and very fine roots; extremely acid; clear smooth boundary.

E--7 to 15 cm; brown (7.5YR 5/2) loamy sand; weak medium subangular blocky structure; very friable; clear irregular boundary.

Bw--15 to 33 cm; dark yellowish brown (10YR 4/6) loamy sand; weak medium and coarse subangular blocky structure; friable; approximately 5-10% of the horizon had darker zones (10YR 3/4); few medium and common fine roots; extremely acid; gradual smooth boundary.

BC1--33 to 61 cm; yellowish brown (10YR 5/4) loamy sand; weak coarse subangular blocky structure; very friable; few coarse and common medium roots; extremely acid; clear smooth boundary.

BC2--61 to 94 cm; light olive gray (5Y 6/2) loamy sand; common medium strong brown (7.5YR 5/8) soft masses of iron; massive; very friable; few coarse roots; very strongly acid; gradual smooth boundary.

94--116 to 165; light yellowish brown (2.5Y 6/4) sand; few medium brown (7.5YR 5/4) soft masses of iron; few medium roots; very strongly acid; single grain.

C--165 to 175 cm; light gray (2.5Y 7/2) sand; strong brown (7.5YR 5/8) soft masses of iron; this horizon was sampled with a bucket auger.

NOTE: When the pedon was originally sampled in 1990, the horizonation identified at that time (and depicted in accompanying characterization data) was as follows: Oe--2 to 0 cm; clear smooth boundary. A--0 to 7 cm; E--7 to 15 cm; Bw--15 to 45 cm; BC1--45 to 91 cm; BC2--91 to 116 cm; BC3--116 to 165; C--165 to 175 cm.
A horizon, 5 cm or more thick, either below an Ap horizon or at a depth of 18 cm or more from the mineral soil surface, whichever is deeper, that has one or more of the following:

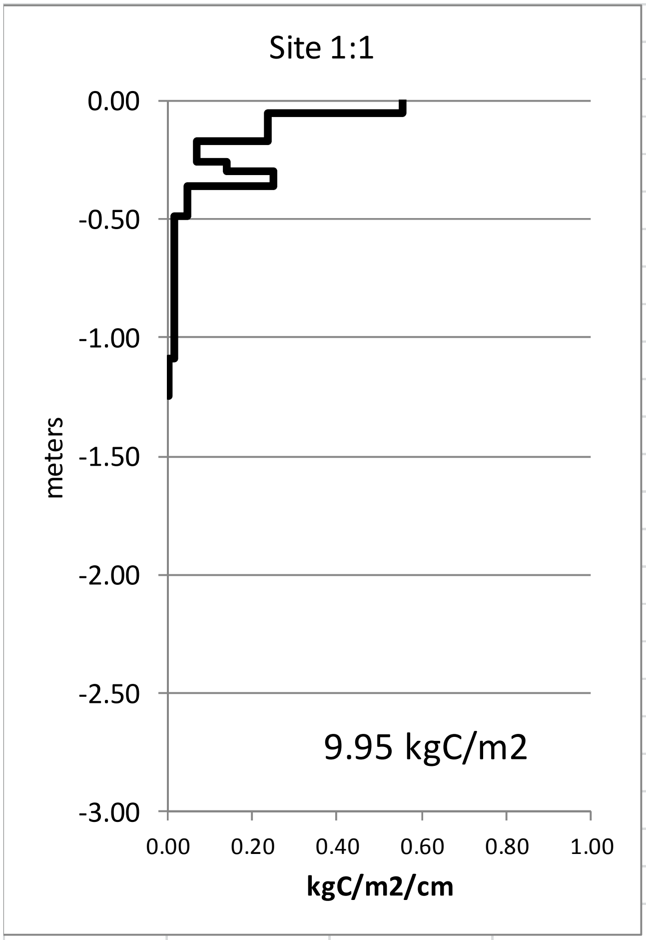
b. Al plus 1/2 Fe percentages (by ammonium oxalate) totaling 0.25 or more, and half that amount or less in an overlying horizon;

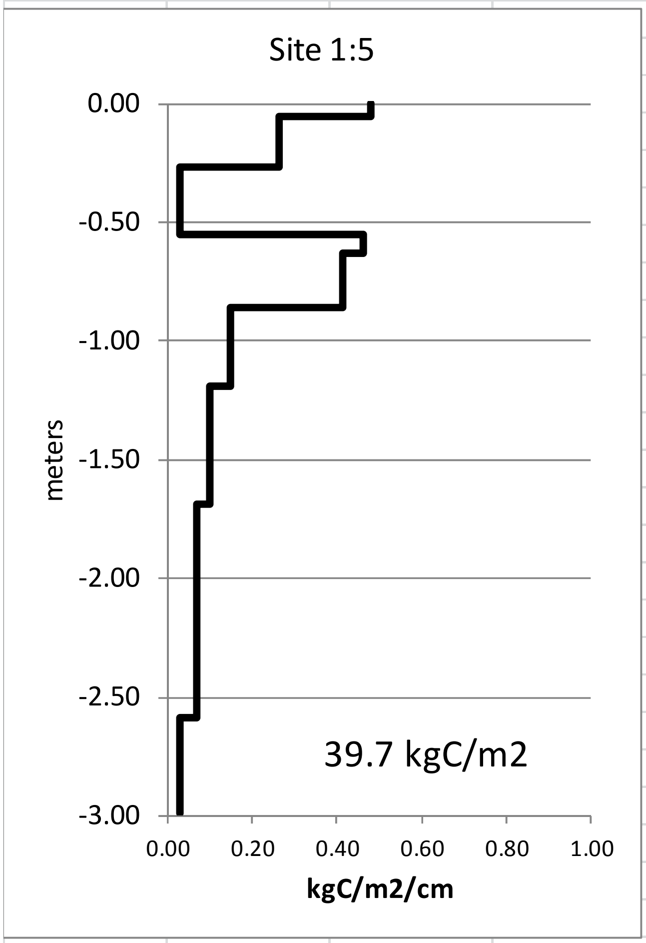
Characterization data from three pedons selected to represent different degrees of spodic horizon expression along the transect.

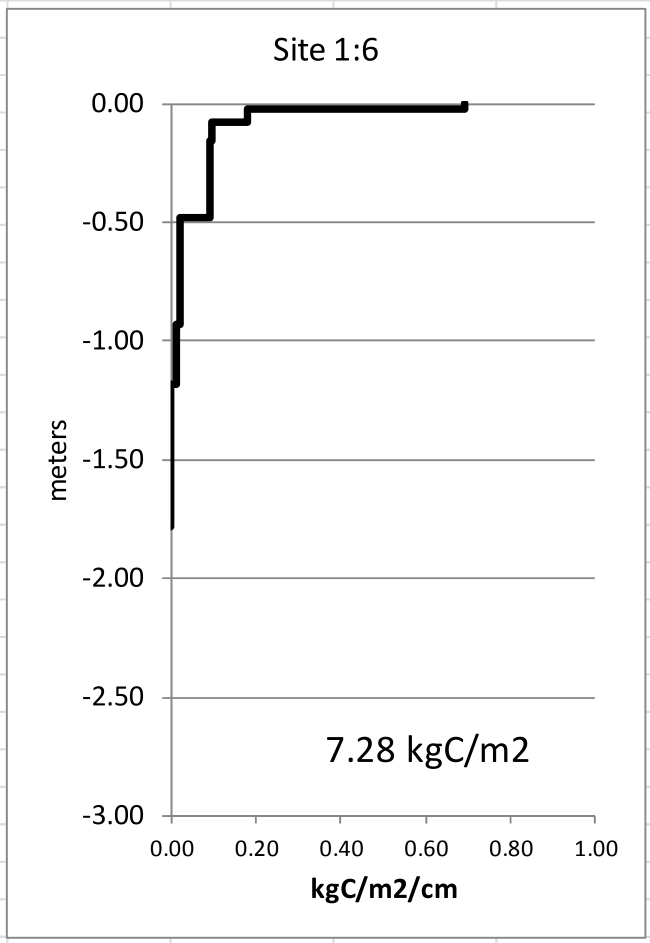
Pedon	Horizon	Depth (cm)	Fed	Fep	Feo	Ald	Alp	Alo	Ct	Cp	Fep+Alp/ %Clay	Cp+Alp/ %Clay	Fep+Alp/ Fed+Ald	CEC pH 8.2	ODOE	NaF pH	%Sand	%Silt	%Clay	BD
			g/kg																	g/cm3
1:1	Oe	6-0																		
	A	0-12	2.0	0.1	0.1	0.1	0.2	0.2	27.8	5.5	0.02	0.40	1.00	17.2	0.012	6.95	95.1	3.5	1.4	0.86
	E	12-21	0.2	0.1	0.0	0.0	0.0	0.0	4.4	2.2	0.02	0.19	1.00	9.5	0.010	7.45	93.6	5.2	1.2	1.57
	Bh	21-25	2.2	1.8	2.4	0.9	0.9	1.0	11.8	8.4	0.08	0.26	0.87	15.8	0.460	8.10	89.5	7.0	3.5	1.20
	Bhs	25-31	4.4	3.0	1.6	4.7	4.0	2.8	19.4	16.8	0.16	0.46	0.77	30.3	0.436	10.70	86.4	9.1	4.5	
	Bs	31-44	3.2	1.4	3.5	1.9	1.4	5.8	3.4	2.6	0.09	0.13	0.55	10.4	0.020	10.10	88.6	8.2	3.1	1.40
	BC	44-104	2.3	1.4	1.0	0.7	0.6	0.6	1.0	1.2	0.06	0.05	0.67	7.5	0.006	8.95	94.6	2.1	3.3	1.62
	C	104-12	0.3	0.1	0.0	0.1	0.2	0.7	0.1	0.1	0.02	0.02	0.75	2.0	0.001	8.40	98.0	0.4	1.6	1.62
1:5	Oe	6-0																		
	A	0-22	0.3	0.2	0.2	0.3	0.6	0.4	21.1	7.2	0.04	0.34	1.33	15.3	0.014	6.95	92.8	5.0	2.3	1.24
	E	22-50	0.0	0.0	0.0	0.0	0.0	0.0	1.8	1.0	0.00	0.07	0.00	4.9	0.008	7.70	93.5	5.1	1.4	1.57
	Bh1	50-58	0.1	0.1	0.1	2.7	4.4	3.2	35.4	25.7	0.04	0.24	1.61	35.9	0.801	7.82	80.8	6.6	12.6	1.30
	Bhsm	58-81	0.1	0.2	0.2	4.8	7.5	5.5	28.0	25.0	0.11	0.47	1.57	28.4	0.748	11.14	84.9	8.2	6.9	1.48
	Bh2	81-114	0.1	0.0	0.0	0.7	3.7	0.8	9.5	7.7	0.09	0.29	4.63	9.0	0.221	7.65	95.3	0.7	4.0	1.58
	Bh3	114-16	0.0	0.0	0.0	0.4	0.8	0.5	6.2	5.5	0.04	0.32	2.00	4.4	0.110	7.95	97.5	0.6	1.9	
	Bhs	164-20	0.0	0.0	0.0	0.4	0.7	0.5	4.2	4.2	0.04	0.25	1.75	2.8	0.101	8.45	97.8	0.2	2.0	
	Bs	209-25	0.0	0.0	0.0	0.6	0.8	0.7	4.2	4.4	0.04	0.25	1.33	5.4	0.132	9.33	97.8	0.1	2.1	
	BC	254-29	0.0	0.0	0.0	0.2	0.6	0.4	1.8	2.2	0.04	0.14	3.50	0.7	0.040	9.05	97.9	0.1	2.0	
1:6	Oe	4-0																		
	A	0-6	0.2	0.1	0.1	0.0	0.2	0.0	15.0	3.5	0.02	0.30	1.50	5.0	0.011	7.15	96.2	2.6	1.2	
	E	6-14	0.3	0.2	0.1	0.0	0.2	0.0	6.4	2.0	0.03	0.18	1.33	0.5	0.017	7.60	95.6	3.2	1.2	1.49
	Bw	14-46	2.9	2.5	1.2	2.4	4.2	2.8	6.8	5.0	0.19	0.26	1.26	8.8	0.052	10.45	91.5	4.9	3.6	1.32
	BC1	46-91	1.4	1.0	0.3	0.6	1.1	0.6	1.3	1.0	0.06	0.06	1.05	0.5	0.008	9.05	91.9	4.4	3.7	1.52
	BC2	91-116	1.2	1.2	0.6	0.3	1.1	0.4	0.7	0.6	0.10	0.07	1.53	0.9	0.008	9.00	96.8	0.8	2.4	
	BC3	116-16	0.5	0.3	0.2	0.6	0.4	0.2	0.0	0.4	0.04	0.05	0.64	0.0	0.004	8.53	97.7	0.6	1.7	
	C	166-17	0.3	0.1	0.1	0.0	0.4	0.3	0.0	0.4	0.03	0.04	1.67	0.0	0.004	8.48	98.1	0.0	1.9	

Organic Carbon Depth Functions

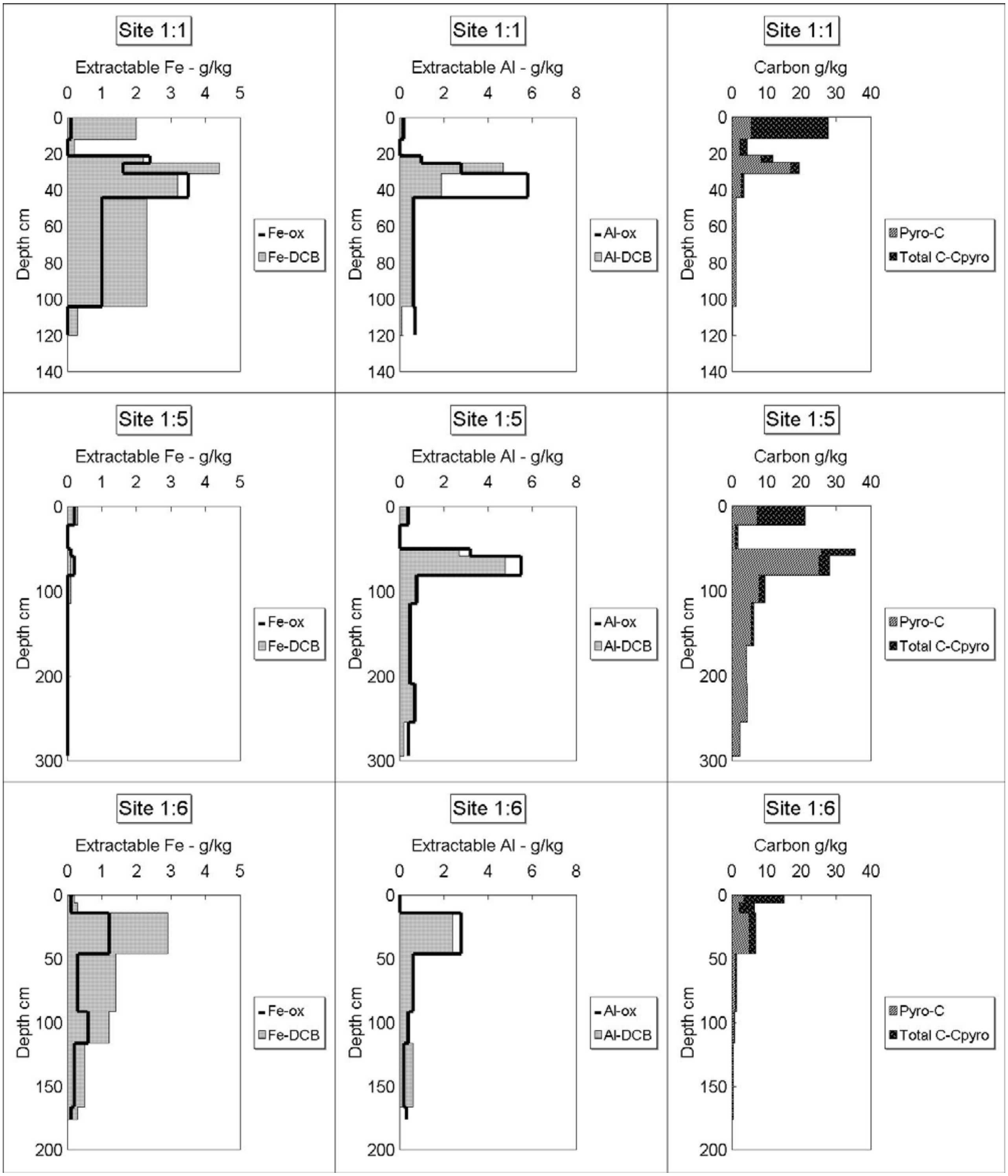
Stop 1 - Snow Hill







Iron, Aluminum and Carbon Depth Functions



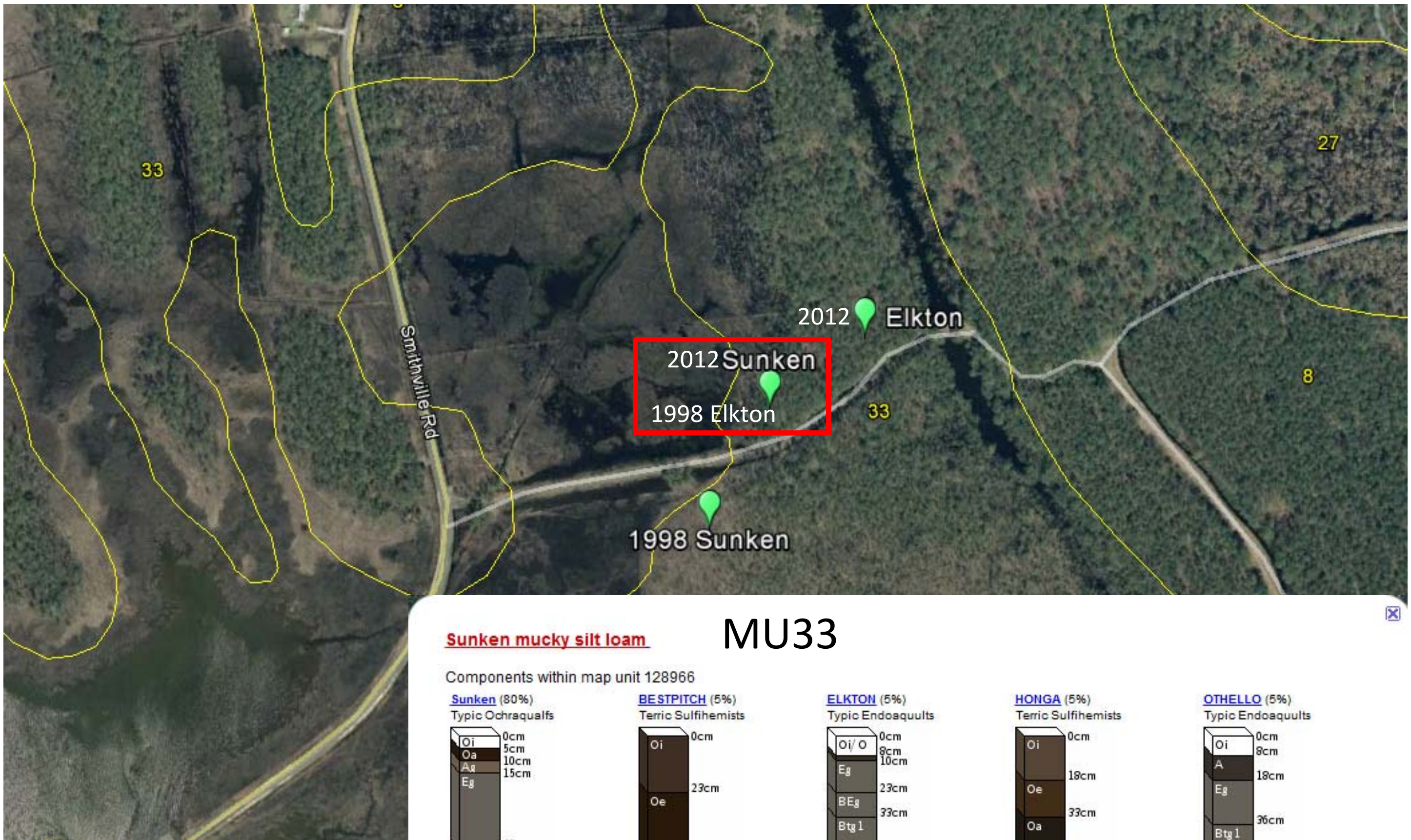
Blackwater National Wildlife Refuge, Moneystump Swamp Area E
Dorchester County, MD
Sea Level Rise and Submerging Coastal Environments

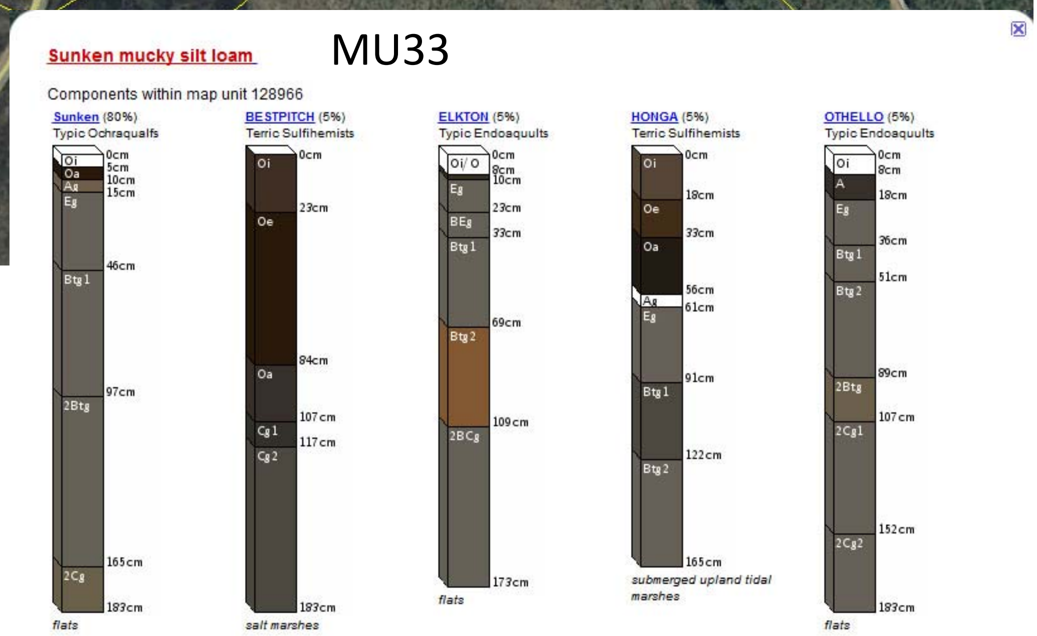
At this stop we will examine a series of soils which transition between the upland and the coastal marsh. A MacCaulay sampler will be used to extract cores from the Honga soil series in the marsh (Terric Sulfihemist). The official series description for the Honga series is included, although it was not described at this site. Two pits are also open for examination representing the Elkton series (fine silty mixed mesic, Typic Endoaquults) and the Sunken Series (fine silty mixed mesic, Typic Endoaqualfs). The profile descriptions are given for these two pits and the official series description (OSD) for the Sunken series is also provided. Data from the two pits are restricted to pH and EC measurements, which are presented in the following figure. Additional data from other studies in the general area are provided and discussed briefly below. Waterproof footwear is recommended at this stop.

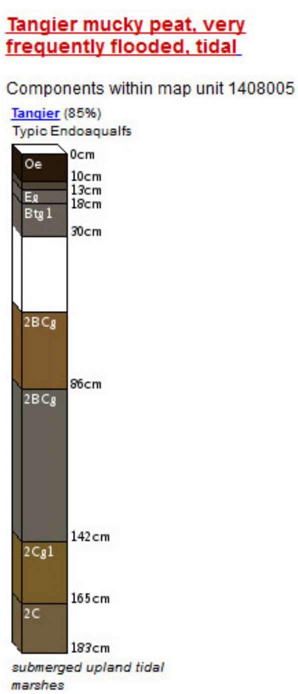
Background and Supporting Information

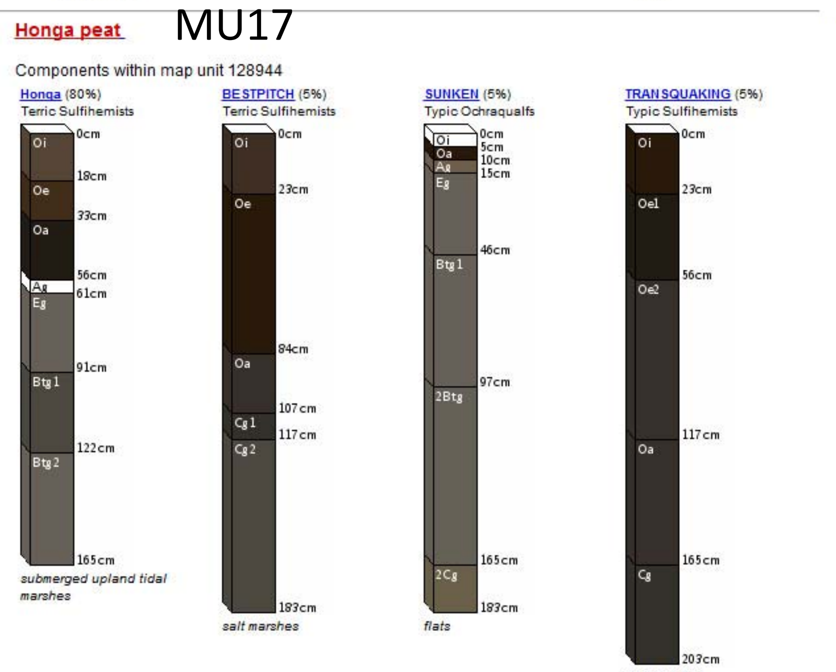
At the time of the glacial maximum, sea level is reported to have been 150 m lower than at present. Subsequently, as a result of glacial melting and ocean warming, sea level has been rising to the present levels. Initially, the rates of sea level rise to too high to permit establishment of vegetation in the intertidal zone. As the rates of sea level rise slowed, marsh vegetation was able to become established. Sea level has continued to rise over the last few thousand years, and long term rates of sea level rise in the vicinity of Chesapeake Bay are estimated to have been approximately 0.5 to 1 mm per year. Rates during the last century are higher and have been estimated to range from 2-4 mm/year, or in some locations as great as 7 mm/yr.

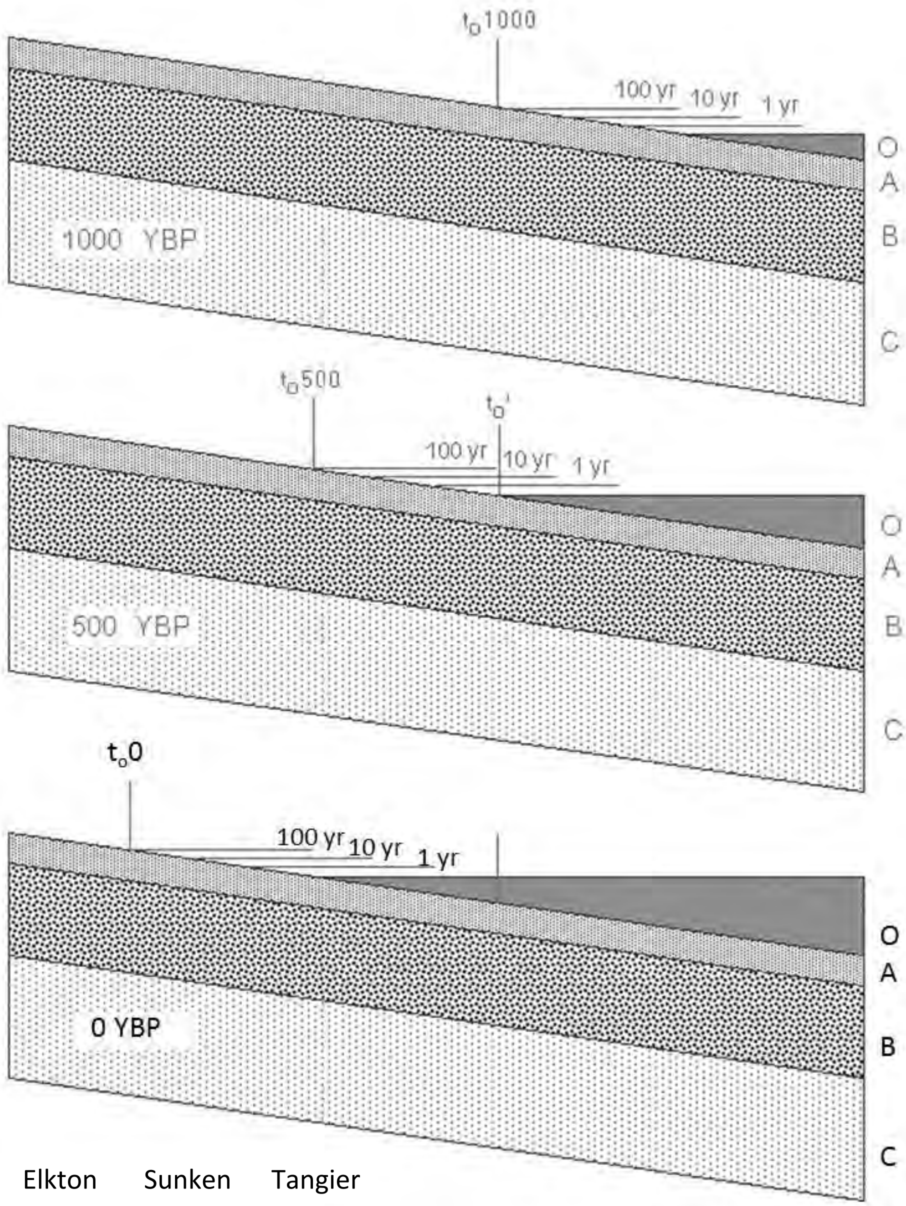
As sea level continues to rise (partially accentuated by coastal subsidence) low-lying upland areas are gradually inundated by estuarine waters. Initially, this might occur as rare or occasional instances of inundation by storm tides. Eventually, however, marsh grasses such as Spartina patens can be seen encroaching upon stands of loblolly pine. With rising sea level, the pines become adversely affected by high water and brackish conditions, and eventually forests give way to a dominance of marsh vegetation. Within the marsh, high rates of primary productivity and slow rates of organic matter decomposition (caused by peraquic conditions) joined with the trapping of mineral sediment, allows the organic horizons in marsh soils to accrete vertically.

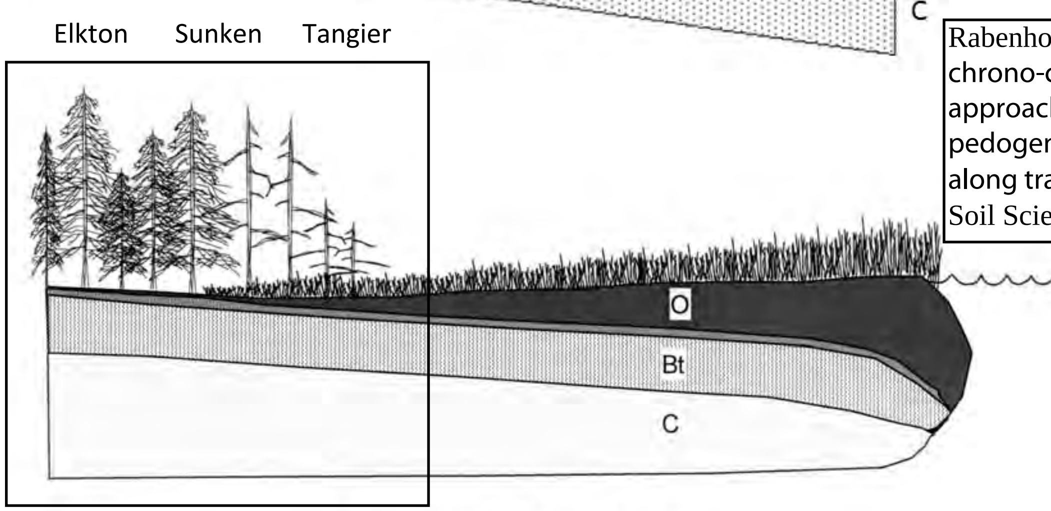

33
27
2012 Elkton
2012 Sunken
1998 Elkton
Smithville Rd
33
8
1998 Sunken


Sunken mucky silt loam
MU33
Components within map unit 128966
Sunken (80%)
Typic Ochraqualfs
Oi Oa Ag Eg Btg1 2Btg 2Cg
0cm 5cm 10cm 15cm 46cm 97cm 165cm 183cm
flats
BESTPITCH (5%)
Terric Sulfihemists
Oi Oe Oa Cg1 Cg2
0cm 23cm 84cm 107cm 117cm 183cm
salt marshes
ELKTON (5%)
Typic Endoaquults
Oi/O Eg BEg Btg1 Btg2 2BCg
0cm 8cm 10cm 23cm 33cm 69cm 109cm 173cm
flats
HONGA (5%)
Terric Sulfihemists
Oi Oe Oa Ag Eg Btg1 Btg2
0cm 18cm 33cm 56cm 61cm 91cm 122cm 165cm
submerged upland tidal marshes
OTHELLO (5%)
Typic Endoaquults
Oi A Eg Btg1 Btg2 2Btg 2Cg1 2Cg2
0cm 8cm 18cm 36cm 51cm 89cm 107cm 152cm 183cm
flats


Tangier mucky peat, very frequently flooded, tidal
Components within map unit 1408005
Tangier (85%)
Typic Endoaqualfs
Oe Eg Btg1 2BCg 2BCg 2Cg1 2C
0cm 10cm 13cm 18cm 30cm 86cm 142cm 165cm 183cm
submerged upland tidal marshes

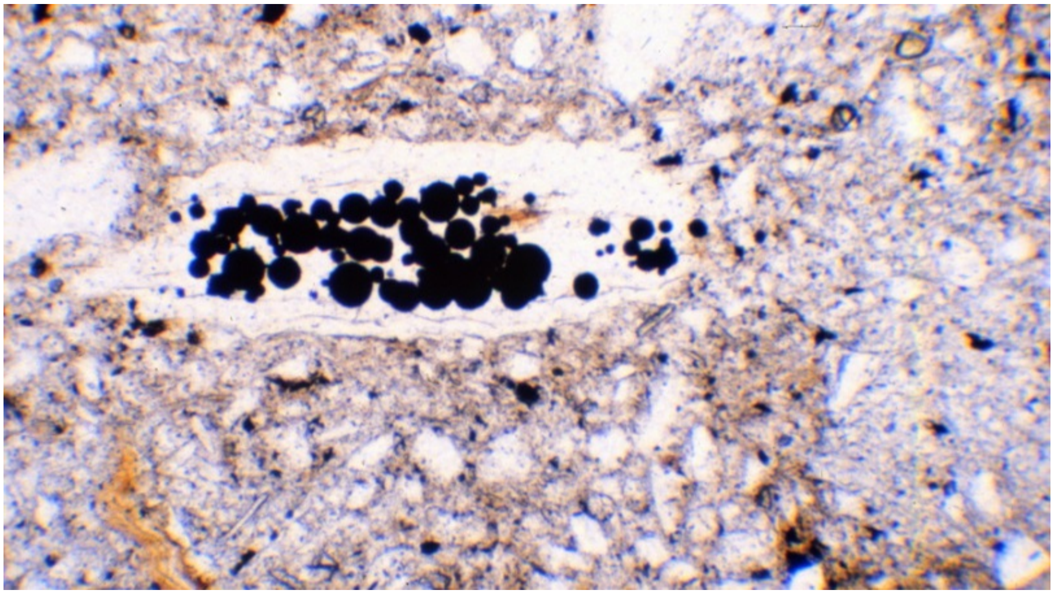

Honga peat
MU17
Components within map unit 128944
Honga (80%)
Terric Sulfihemists
Oi Oe Oa Ag Eg Btg1 Btg2
0cm 18cm 33cm 56cm 61cm 91cm 122cm 165cm
submerged upland tidal marshes
BESTPITCH (5%)
Terric Sulfihemists
Oi Oe Oa Cg1 Cg2
0cm 23cm 84cm 107cm 117cm 183cm
salt marshes
SUNKEN (5%)
Typic Ochraqualfs
Oi Oa Ag Eg Btg1 2Btg 2Cg
0cm 5cm 10cm 15cm 46cm 97cm 165cm 183cm
flats
TRANSQUAKING (5%)
Typic Sulfihemists
Oi Oe1 Oe2 Oa Cg
0cm 23cm 56cm 117cm 165cm 203cm
salt marshes



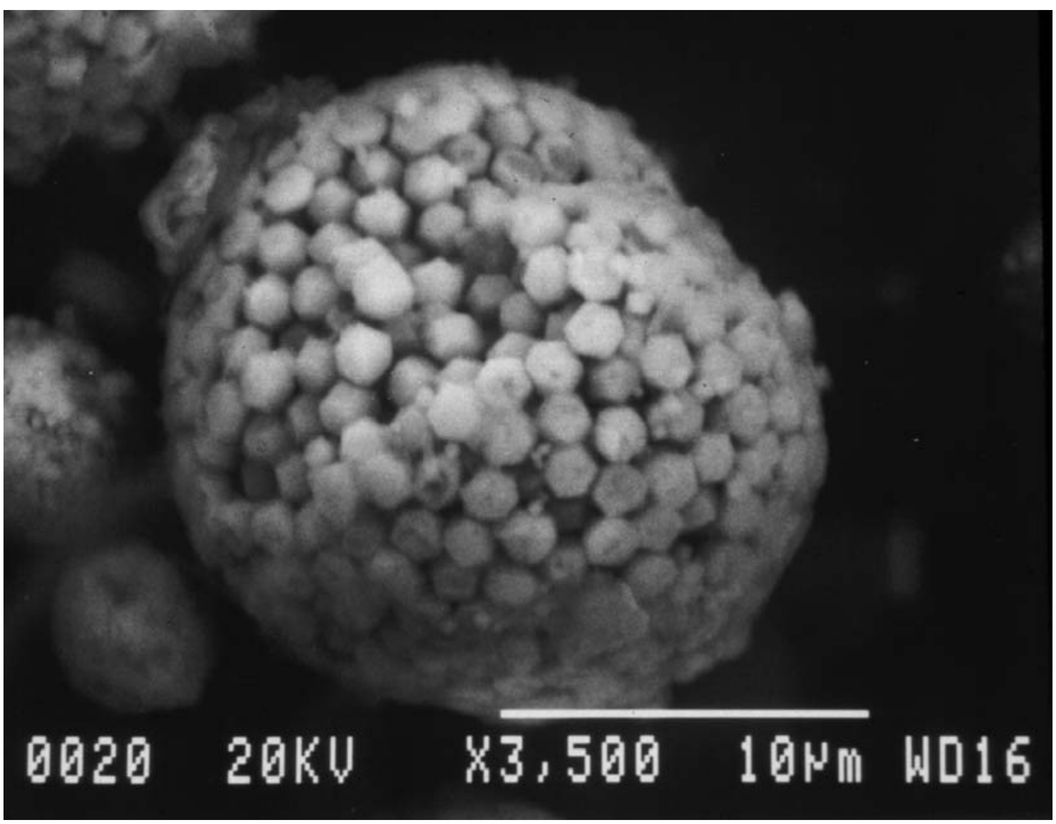


Rabenhorst, M. C. 1997. The chrono-continuum: An approach to modeling pedogenesis in marsh soils along transgressive coastlines. Soil Science 162: 2-9.

Submerged Upland Marsh



Thin section showing pyrite framboids forming in a vacant root channel in a submerged Btg horizons. Iron comes from the soil and sulfide is generated in the immediate vicinity due to the availability of oxidizable carbon from senesced plant roots. The framboids are mostly silt sized (plane light).



Scanning electron micrograph (SEM) of pyrite framboid collected from a tidal marsh soil.

There are two distinct periods during the gradual tidal submergence. The first period occurs while the upland soils become progressively affected by occasional tidal inundation with increasing frequency as sea level rises. This period continues until mhw is approximately at the level of the soil surface. As sea level continues to rise, the second period begins during which progressively thickening organic horizons develop which are permanently saturated with tidal water. In these soils histic epipedons will initially develop, and as the organic materials continue to thicken, they will eventually develop into Histosols. If these organic soils are sampled and studied, properties of better drained upland soils are preserved, such as the presence of argillic horizons. At the same time, properties reflecting the current conditions are also evident.

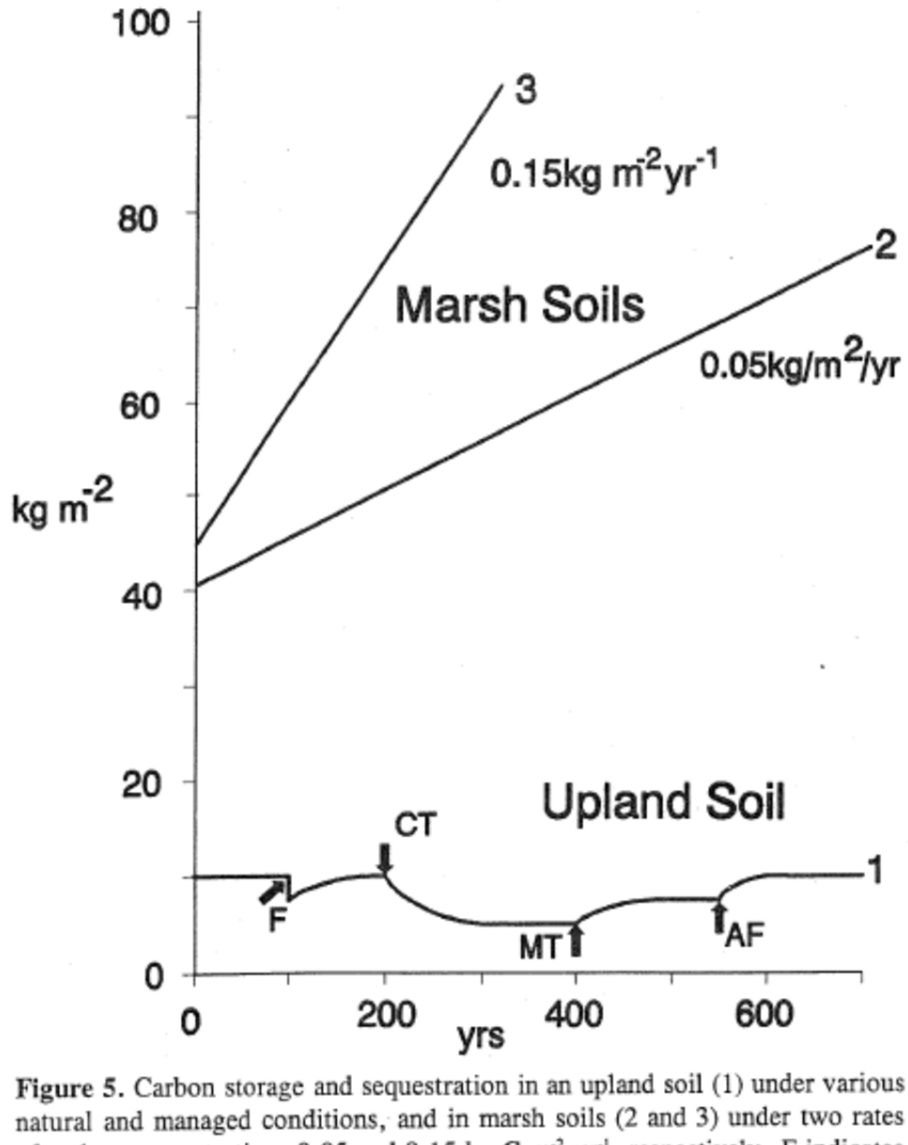
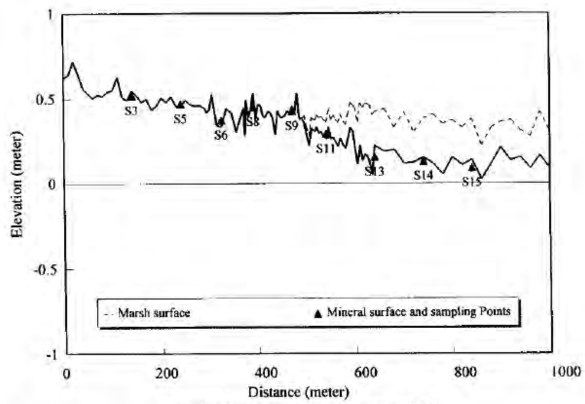


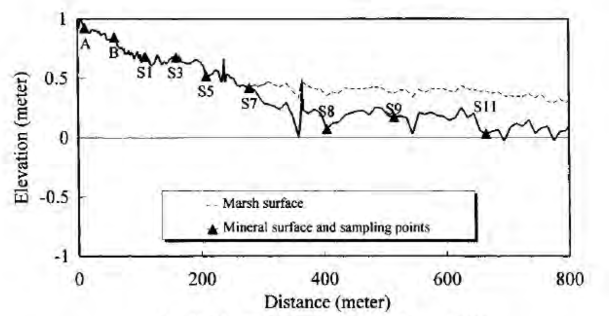
Figure 5. Carbon storage and sequestration in an upland soil (1) under various natural and managed conditions, and in marsh soils (2 and 3) under two rates of carbon sequestration, 0.05 and 0.15 kg C m^{-2} yr^{-1}, respectively. F indicates fire; CT indicates conventional tillage agriculture; MT indicates minimum tillage agriculture; AF indicates agro-forestry.

Rabenhorst, M. C. 1995. Carbon storage in tidal marsh soils. pp 93-103. *In* R. Lal, J. Kimble, E. Levine, and B.A. Stewart (eds.) *Soils and Global Change*. Proceedings of the International Soil Symposium on Greenhouse Gases and Carbon Sequestration. Columbus, Ohio. April 5-9, 1993. Lewis Publishers, CRC, Boca Raton.



Vertical Exaggeration Approximately 400X.

Fig. 1. Topographic cross section of Cedar Creek research site.



Vertical Exaggeration Approximately 200X.

Fig. 2. Topographic cross section of Hell Hook research site.

Increased salinity and ESP over time (with increased frequency of inundation)

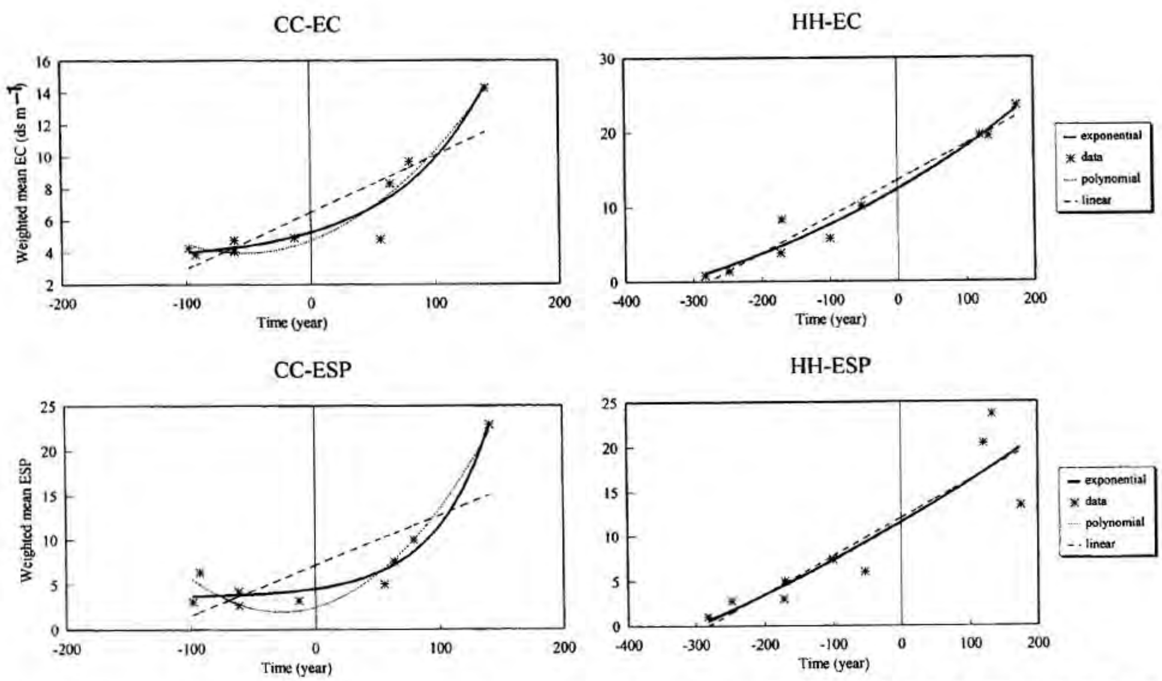


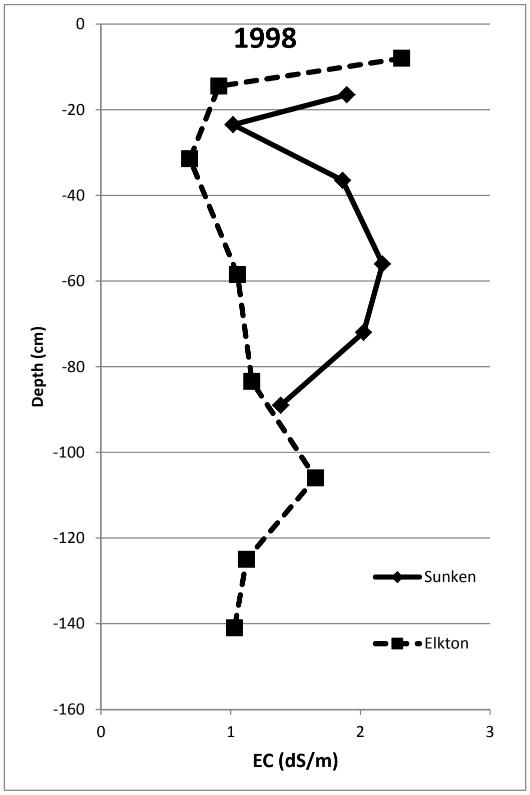
Fig. 5. Chronofunctions for electrical conductivity (EC) and exchangeable sodium percentage (ESP) for the Hell Hook (HH) and Cedar Creek (CC) research sites, constructed using the weighted mean values for the upper 50 cm of the soil.

Hussein, A. H., and M. C. Rabenhorst. 2001. Modeling the Impact of Tidal Inundation on Submerging Coastal Landscapes of the Chesapeake Bay. Soil Sci. Soc. Am J. 65:932-941.

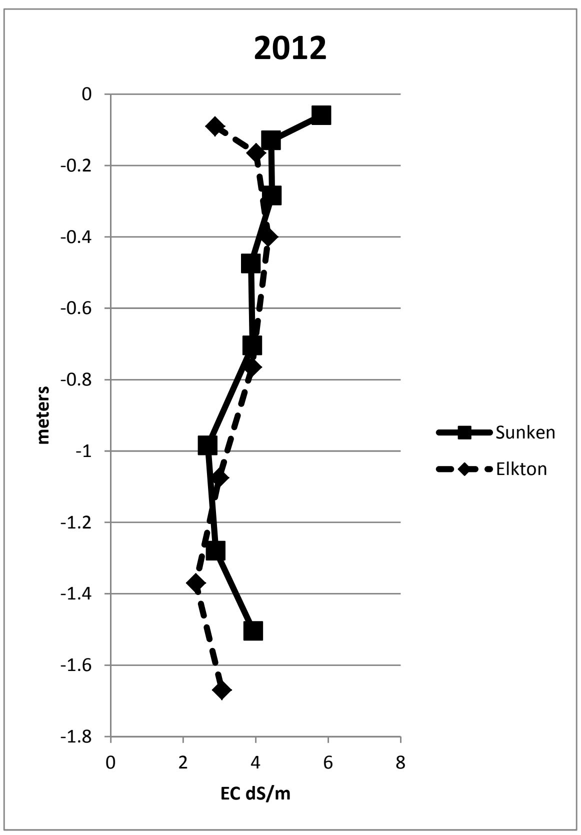
In these systems, as one moves seaward, and downward elevationally, one also is moving along a chronological continuum. Given the rates of sea level rise, *any increment along the geomorphic surface could be translated into an increment in time, with regard to marsh pedogenesis*. The geomorphic surface itself becomes equivalent to a ***chrono-continuum*** (Rabenhorst, 1997).

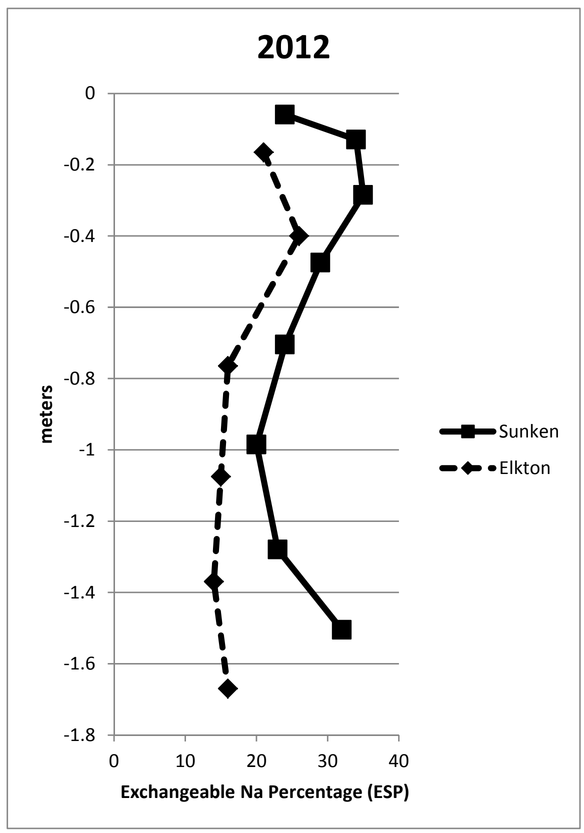
Two theses have been completed at the Univ. of Maryland over the last couple of years which have focused on marsh pedogenesis in submerging landscapes. Dr. Ahmed Hussein addressed the impact of occasional periodic tidal inundation on mineral soil in his dissertation entitled "Soil chronofunctions in submerging coastal areas of Chesapeake Bay." Some data from his dissertation showing the effects of tidal inundation AT ANOTHER SITE are presented**.** The work by Melvin Tucker focused on the storage of organic carbon in these transgressive systems. Because these systems are transgressive and O horizons are accreting vertically and laterally, coastal marshes are thought to be important sinks for organic carbon

EC and ESP in pairs of pedons sampled in 1998 and in 2012 . The Elkton is slightly higher on the landscape than Sunken. The pedon called Elkton in 1998 was sampled as the Sunken pedon in 2012.



Note that the 1998 data were run in the UMD Pedology lab on a 1:5 soil:water extract; The 2012 data were run through the lab in Lincoln. The pedon sampled as "Elkton" in 1998, was sampled as "Sunken" in 2012.





U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SCS - SOI - 232 G
Rev. 2 - 81

SOIL DESCRIPTION

Stop 2 - Blackwater NWR
Elkton 2012

Soil type Elkton?

File No.

Area Blackwater – "Moneystump" | Date 11-15-12 | Stop No.

Classification

Location 38°26' 00.2" N 76° 13' 53.7"

N. veg. (or crop) Loblolly, red maple, willow oak | Climate

Parent material

Physiography

Relief | Drainage | Salt or alkali

Elevation | Gr. water | Stoniness

Slope | Moisture

Aspect | Root distrib. | % Clay *

Erosion | % Coarse fragments * | % Coarser than V.F.S. *

Permeability

Additional notes

M. Rabenhorst, P. King, J. Brewer, D. Shields

Subsamples for X Ray Fluorescence

* Control section average

Horizon	Depth cm	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary				
Oe	0-6.5		2.5YR 2.5/1											
A	6.5-11		7.5YR 2.5/1	sil										
Eg	11-22	20% fi 5YR 3/3 + root channels 3/4	2.5Y 4/2	12% c sil		7.5YR 4/3 soft masses 50%								
Btg1 *	22-58	40% 10YR 4/4	2.5Y 5.5/1.5	23% c sil						* auger starting from 51 cm				
Btg2	58-95	35% m 7.5YR 5/6 fi 5YR 4/6 5% root channels	2.5Y 5/1	37% c sicl										
Bt	95-120	30% 7.5YR 5/6 10% 2.5Y 5/2	10YR 5/4	hvy ~ sicl	36% c.									
B'tg1	120-154	25% 10YR 5/6 1% fine 5YR 3/4	2.5Y 5/1.5	28% c sicl										
B'tg2	154-178	10YR 5/3 10YR 5/6	10Y 6/0.5	25% sil										

*** Primary Characterization Data ***

Pedon ID: S2012MD019002 — (Dorchester County, Maryland) — Print Date: Apr 26 2013 8:23AM

Sampled As : Elkton — Fine-silty, mixed, active, mesic Typic Endoaquult

USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 13N0422

PSDA & Rock Fragments

				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-
				(- - - - - Total - - - - - -)			(- - Clay - - -)		(- - - - Silt - - - - -)		(- - - - - - - - - - - - Sand - - - - - - - - - - - -)					(Rock Fragments (mm))				
				Clay	Silt	Sand	Fine	CO_3	Fine	Coarse	VF	F	M	C	VC	(- - - - - - - - Weight - - - - - - - -)				>2 mm
				<	.002	.05	<	<	.002	.02	.05	.10	.25	.5	1	2	5	20	.1-	wt %
	Depth			.002	-.05	-2	.0002	.002	-.02	-.05	-.10	-.25	-.50	-1	-2	-5	-20	-75	75	whole
Layer	(cm)	Horz	Prep	(- - - - - - - - - - - - - - - - % of <2mm Mineral Soil - - - - - - - - - - - - - - - -)												(- - - - - - - % of <75mm - - - - - -)				soil
				3A1a1a					3A1a1a		3A1a1a	3A1a1a	3A1a1a	3A1a1a	3A1a1a					
13N01705	0-7	Oe	S													--	--	--	--	--
13N01706	7-11	A	S													--	--	--	--	--
13N01707	11-22	Eg	S	15.8	81.2	3.0			50.6	30.6	2.2	0.6	0.1	0.1	tr	--	--	--	1	--
13N01708	22-58	Btg1	S	23.2	74.4	2.4			43.7	30.7	2.1	0.2	0.1	tr	--	--	--	--	tr	--
13N01709	58-95	Btg2	S	34.6	59.8	5.6			37.9	21.9	4.5	1.0	0.1	tr	--	--	--	--	1	--
13N01710	95-120	Bt	S	46.1	44.4	9.5			30.7	13.7	5.5	2.3	1.0	0.5	0.2	--	--	--	4	--
13N01711	120-154	B'tg1	S	30.8	57.3	11.9			36.4	20.9	9.8	2.0	0.1	tr	--	--	--	--	2	--
13N01712	154-180	B'tg2	S	23.3	54.6	22.1			31.8	22.8	17.8	4.0	0.3	tr	--	--	--	--	4	--

Bulk Density & Moisture

				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-
				(Bulk Density)		Cole	(- - - - - - - - - - - Water Content - - - - - - - - - - -)						WRD	Aggst		
				33	Oven	Whole	6	10	33	1500	1500 kPa	Ratio	Whole	Stabl	(- - Ratio/Clay - -)	
	Depth			kPa	Dry	Soil	kPa	kPa	kPa	kPa	Moist	AD/OD	Soil	2-0.5mm	CEC7	1500 kPa
Layer	(cm)	Horz	Prep	(- - - g cm^{-3} - - -)			(- - - - - - - - - - - - pct of < 2mm - - - - - - - - - - - -)						cm^3 cm^{-3}	%		
										3C2a1a		3D1				
13N01705	0-7	Oe	S									1.085				
13N01706	7-11	A	S									1.030				
13N01707	11-22	Eg	S							7.0		1.010			0.54	0.44
13N01708	22-58	Btg1	S							10.4		1.013			0.41	0.45
13N01709	58-95	Btg2	S							16.2		1.022			0.49	0.47
13N01710	95-120	Bt	S							24.4		1.026			0.40	0.53
13N01711	120-154	B'tg1	S							15.7		1.016			0.42	0.51
13N01712	154-180	B'tg2	S							10.1		1.013			0.46	0.43

Stop 2 - Blackwater NWR
Elkton

*** Primary Characterization Data ***

Pedon ID: S2012MD019002 (Dorchester County, Maryland) Print Date: Apr 26 2013 8:23AM

Sampled As : Elkton Fine-silty, mixed, active, mesic Typic Endoaquult

USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 13N0422

Water Content

Layer	Depth (cm)	Horz	Prep	-1- (- - Atterberg - -) (- - - Limits - - -) LL	-2- PI	-3- (- - - - - Bulk Density - - - - -) Field	-4- Recon 33 kPa	-5- Recon Oven Dry	-6- (- - - Water Content - - -) Field	-7- Recon 33 kPa	-8- (- - - Sieved Samples - - -) 6 kPa	-9- 10 kPa	-10- 33 kPa	-11- 100 kPa	-12- 200 kPa	-13- 500 kPa
				pct <0.4mm		(- - - - - - - - g cm^{-3}	- - - - - - - -)		(- - - - - - - - - - - - % of < 2mm							- - - - - - - - - - - -)
															3C1e1a	
13N01707	11-22	Eg	S												13.7	
13N01708	22-58	Btg1	S												16.9	
13N01709	58-95	Btg2	S												22.9	
13N01710	95-120	Bt	S												33.1	
13N01711	120-154	B'tg1	S												22.9	
13N01712	154-180	B'tg2	S												17.5	

Carbon & Extractions

Layer	Depth (cm)	Horz	Prep	-1- (- - - - - Total C	-2- N	-3- S - - - - -)	-4- Est OC	-5- OC (WB)	-6- C/N Ratio	-7- (- - - Dith-Cit Ext Fe	-8- Al	-9- Mn - - -)	-10- (- - - - - - Ammonium Oxalate Extraction Al+½Fe	-11- ODOE	-12- Fe	-13- Al	-14- Si	-15- Mn - - - - - -)	-16- (- - - Na Pyro-Phosphate C	-17- Fe	-18- Al	-19- Mn - - -)
				(- - - - - - - - - - % of <2 mm				- - - - - - - - - -)		(- - - - - - - - - - - - - - - - - - % of < 2mm								- - - - - - - - - - - - - - - - -)	mg kg^{-1}	(- - - - - - % of < 2mm		- - - - -)
				4H2a	4H2a	4H2a				4G1	4G1	4G1										
13N01705	0-7	Oe	S	47.81	1.45	0.17	47.8		33													
13N01706	7-11	A	S	12.61	0.57	0.05	12.6		22													
13N01707	11-22	Eg	S	1.04	0.05	0.02	1.0		20	0.3	0.1	–										
13N01708	22-58	Btg1	S	0.41	0.03	0.03	0.4		14	0.9	0.1	–										
13N01709	58-95	Btg2	S	0.19	0.08	0.03	0.2		2	1.1	0.1	–										
13N01710	95-120	Bt	S	0.28	0.14	0.06	0.3		2	7.9	0.4	–										
13N01711	120-154	B'tg1	S	0.12	0.09	0.02	0.1		1	0.5	0.1	–										
13N01712	154-180	B'tg2	S	0.16	0.05	0.02	0.1		3	0.5	0.1	–										

Stop 2 - Blackwater NWR
Elkton

*** Primary Characterization Data ***

Pedon ID: S2012MD019002 (Dorchester County, Maryland) Print Date: Apr 26 2013 8:23AM

Sampled As : Elkton Fine-silty, mixed, active, mesic Typic Endoaquult

USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 13N0422

CEC & Bases

Layer	Depth (cm)	Horz	Prep	-1- Ca	-2- Mg	-3- Na	-4- K	-5- Sum Bases	-6- Acid-ity	-7- Extr Al	-8- KCl Mn	-9- CEC8 Sum Cats	-10- CEC7 NH_4 OAC	-11- ECEC Bases +Al	-12- Al Sat	-13- Base Saturation Sum	-14- Base Saturation NH_4OAC
				(NH_4OAC Extractable Bases)													
				(cmol(+) kg^{-1})							mg kg^{-1}	(cmol(+) kg^{-1})			(%)		
				4B1a1a	4B1a1a	4B1a1a	4B1a1a		4B2b1a1	4B3a1a	4B3a1a		4B1a1a				
13N01705	0-7	Oe	S	9.2	10.5	6.1	1.4		166.2	5.8	3.1		96.2				
13N01707	11-22	Eg	S	0.5	1.6	1.8	0.1	4.0	13.4	3.4	0.1		8.5				47
13N01708	22-58	Btg1	S	0.8	2.5	2.5	0.1	5.9	12.6	4.0	0.1		9.5				62
13N01709	58-95	Btg2	S	1.8	4.5	2.6	0.1	9.0	21.3	9.8	0.4		17.0				53
13N01710	95-120	Bt	S	2.4	4.7	2.8	0.1	10.0	26.4	10.3	0.5	36.4	18.3	20.3	51	27	55
13N01711	120-154	B'tg1	S	2.3	3.3	1.8	0.1	7.5	14.5	6.9	0.5		13.0				58
13N01712	154-180	B'tg2	S	2.5	2.4	1.7	0.1	6.7	10.9	5.0	0.6		10.8				62

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Salt

Layer	Depth (cm)	Horz	Prep	-1- Ca	-2- Mg	-3- Na	-4- K	-5- CO_3	-6- HCO_3	-7- F	-8- Cl	-9- PO_4	-10- Br	-11- OAC	-12- SO_4	-13- NO_2	-14- NO_3	-15- H_2O	-16- Total Salts	-17- Elec Cond	-18- Pred Elec Cond	-19- Exch Na	-20- SAR
				(Water Extracted From Saturated Paste)																			
				(mmol(+) L^{-1})				(mmol(-) L^{-1})										(%)		(dS m^{-1})		%	
				4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2		4F2	4F1a1a1		
13N01706	7-11	A	S	2.0	7.5	14.3	0.6	--	--	--	21.7	--	0.1	--	4.6	--	0.1	115.4		2.88			
13N01707	11-22	Eg	S	3.9	12.5	22.7	0.2	--	--	--	28.1	--	0.1	--	14.0	--	0.1	45.2		4.01	1.20	21	
13N01708	22-58	Btg1	S	4.4	13.6	25.8	0.1	--	--	--	30.8	--	--	--	16.7	--	0.2	57.6		4.35	1.63	26	
13N01709	58-95	Btg2	S	5.2	13.6	21.5	0.1	--	--	--	21.5	--	--	--	22.9	--	0.3	70.6		3.90	1.73	16	
13N01710	95-120	Bt	S	4.7	9.8	16.0	0.1	--	--	--	16.0	--	--	--	16.5	--	0.2	105.2		2.99	1.84	15	
13N01711	120-154	B'tg1	S	4.2	6.3	12.4	0.1	--	--	--	11.4	--	--	--	13.3	--	0.1	79.1		2.35	1.16	14	
13N01712	154-180	B'tg2	S	7.7	8.4	15.5	0.2	--	--	--	15.8	--	--	--	18.6	--	0.2	56.7		3.07	1.11	16	

Stop 2 - Blackwater NWR
Elkton

*** Primary Characterization Data ***

Pedon ID: S2012MD019002 (Dorchester County, Maryland) Print Date: Apr 26 2013 8:23AM

Sampled As : Elkton Fine-silty, mixed, active, mesic Typic Endoaquult

USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 13N0422

Stop 2 - Blackwater NWR Elkton

PSDA & Rock Fragments

Layer	Depth (cm)	Horz	Prep	-1- Total Clay < .002	-2- Total Silt .002 -.05	-3- Total Sand .05 -2	-4- Clay Fine < .0002	-5- Clay CO_3 < .002	-6- Silt Fine .002 -.02	-7- Silt Coarse .02 -.05	-8- Sand VF .05 -.10	-9- Sand F .10 -.25	-10- Sand M .25 -.50	-11- Sand C .5 -1	-12- Sand VC 1 -2	-13- Rock Fragments (mm) Weight 2 -5	-14- Weight 5 -20	-15- Weight 20 -75	-16- .1- 75	-17- >2 mm wt % whole soil
				(----------- % of <2mm Mineral Soil											-----------)	(------- % of <75mm			------)	
				3A1a1a					3A1a1a		3A1a1a	3A1a1a	3A1a1a	3A1a1a	3A1a1a					
13N01705	0-7	Oe	S													--	--	--	--	--
13N01706	7-11	A	S													--	--	--	--	--
13N01707	11-22	Eg	S	15.8	81.2	3.0			50.6	30.6	2.2	0.6	0.1	0.1	tr	--	--	--	1	--
13N01708	22-58	Btg1	S	23.2	74.4	2.4			43.7	30.7	2.1	0.2	0.1	tr	--	--	--	--	tr	--
13N01709	58-95	Btg2	S	34.6	59.8	5.6			37.9	21.9	4.5	1.0	0.1	tr	--	--	--	--	1	--
13N01710	95-120	Bt	S	46.1	44.4	9.5			30.7	13.7	5.5	2.3	1.0	0.5	0.2	--	--	--	4	--
13N01711	120-154	B'tg1	S	30.8	57.3	11.9			36.4	20.9	9.8	2.0	0.1	tr	--	--	--	--	2	--
13N01712	154-180	B'tg2	S	23.3	54.6	22.1			31.8	22.8	17.8	4.0	0.3	tr	--	--	--	--	4	--

Bulk Density & Moisture

Layer	Depth (cm)	Horz	Prep	-1- (Bulk Density) 33 kPa	-2- Oven Dry	-3- Cole Whole Soil	-4- Water Content 6 kPa	-5- 10 kPa	-6- 33 kPa	-7- 1500 kPa	-8- 1500 kPa Moist	-9- Ratio AD/OD	-10- WRD Whole Soil	-11- Aggst Stabl 2-0.5mm	-12- (-- Ratio/Clay --) CEC7	-13- 1500 kPa
				(--- g cm^{-3} ---)			(----------- pct of < 2mm				-----------)		cm^3 cm^{-3}	%		
										3C2a1a		3D1				
13N01705	0-7	Oe	S									1.085				
13N01706	7-11	A	S									1.030				
13N01707	11-22	Eg	S							7.0		1.010			0.54	0.44
13N01708	22-58	Btg1	S							10.4		1.013			0.41	0.45
13N01709	58-95	Btg2	S							16.2		1.022			0.49	0.47
13N01710	95-120	Bt	S							24.4		1.026			0.40	0.53
13N01711	120-154	B'tg1	S							15.7		1.016			0.42	0.51
13N01712	154-180	B'tg2	S							10.1		1.013			0.46	0.43

*** Primary Characterization Data ***

Pedon ID: S2012MD019002 (Dorchester County, Maryland) Print Date: Apr 26 2013 8:23AM

Sampled As : Elkton Fine-silty, mixed, active, mesic Typic Endoaquult

USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 13N0422

Stop 2 - Blackwater NWR Elkton

pH & Carbonates

				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-
				(pH					)	(Carbonate As $CaCO_3$	)	(Gypsum As $CaSO_4*2H_2O$	)	Resist
	Depth				$CaCl_2$ 0.01M	H_2O	Sat			<2mm	<20mm	<2mm	<20mm	ohms
Layer	(cm)	Horz	Prep	KCl	1:2	1:1	Paste	Oxid	NaF	(%			)	cm^{-1}
					4C1a2a	4C1a2a	4F2			4E1a1a1a1		4E2a1a1a1		
13N01705	0-7	Oe	S		3.3	3.5								
13N01706	7-11	A	S				3.8			tr		–		
13N01707	11-22	Eg	S		3.8	4.1	4.0			tr		–		
13N01708	22-58	Btg1	S		3.9	4.1	4.1			tr		–		
13N01709	58-95	Btg2	S		3.8	3.9	4.0			tr		–		
13N01710	95-120	Bt	S		3.7	3.8	4.0					–		
13N01711	120-154	B'tg1	S		3.8	4.0	4.1			tr		–		
13N01712	154-180	B'tg2	S		3.8	4.0	4.0			tr		–		

Organic

				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-
				Mineral	Est	Min +	Est	Total	Est OC	Fiber Content		NaPyro	Decomp	Limnic	(pH	)	(Bulk Density		)	Proj
	Depth			Content	OM	Est OM	OC	N	/N	Unrub	Rub	Color	State	Matter	$CaCl_2$	H_2O	33 kPa	33 kPa rewet	OD	Subs
Layer	(cm)	Horz	Prep	(%				)	ratio	% (by vol)								$g\ cm^{-3}$		$cm\ cm^{-1}$
				5A				4H2a		5C	5C	5C			5C	4C1a2a				
13N01705	0-7	Oe	MW	15	82	97				48	32	10YR 6/4			3.3					
13N01705	0-7	Oe	S				47.8	1.45	33							3.5				
13N01706	7-11	A	S				12.6	0.57	22											
13N01707	11-22	Eg	S				1.0	0.05	20							4.1				
13N01708	22-58	Btg1	S				0.4	0.03	14							4.1				
13N01709	58-95	Btg2	S				0.2	0.08	2							3.9				
13N01710	95-120	Bt	S				0.3	0.14	2							3.8				
13N01711	120-154	B'tg1	S				0.1	0.09	1							4.0				
13N01712	154-180	B'tg2	S				0.1	0.05	3							4.0				

*** Primary Characterization Data ***

Pedon ID: S2012MD019002 (Dorchester County, Maryland) Print Date: Apr 26 2013 8:23AM

Sampled As : Elkton Fine-silty, mixed, active, mesic Typic Endoaquult

USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 13N0422

Clay Mineralogy (<.002 mm)

Layer	Depth (cm)	Horz	Fraction	-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-
				X-Ray					Thermal				Elemental							EGME	Inter
													SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	K_2O	Na_2O	Retn	pretation
				7A1b1					7A4a												
				(- - - - peak size - - - -)					(- - - - % - - - -)				(- - - - % - - - -)							$mg\ g^{-1}$	
13N01708	22-58	Btg1	tcly	KK 3	VR 2	MI 1	GE 1				KK 42	GE 13									CMIX
13N01709	58-95	Btg2	tcly	VR 2	MT 2	KK 2															VERM
13N01710	95-120	Bt	tcly	GE 2	KK 1	VR 1	LE 1	MT 1													CMIX

FRACTION INTERPRETATION:

tcly - Total Clay, <0.002 mm

MINERAL INTERPRETATION:

GE - Goethite KK - Kaolinite LE - Lepidocrocite MI - Mica MT - Montmorillonite

VR - Vermiculite

RELATIVE PEAK SIZE: 5 Very Large 4 Large 3 Medium 2 Small 1 Very Small 6 No Peaks

Stop 2 - Blackwater NWR
Elkton

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

SCS - SOI - 232 G
Rev. 2 - 81

Stop 2 - Blackwater NWR
Sunken 2012

Soil type Sunken ... No.

Area Blackwater – Moneystump | Date 11-15-12 | Stop No.

Classification

Location 38°25′58.3″ N 76°13′56.5″ W.

N. veg. (or crop) loblolly pine, bayberry, willow oak (1) | Climate

Parent material

Physiography

Relief | Drainage | Salt or alkali

Elevation | Gr. water | Stoniness

Slope | Moisture

Aspect | Root distrib. | % Clay *

Erosion | % Coarse fragments * | % Coarser than V.F.S. *

Permeability

Additional notes

M. Rabenhorst, J Brewer, P King, D. Shields

* Control section average

Horizon	Depth cm	Color		Texture	Structure	Consistence			Reaction	Boundary				
		Dry	Moist			Dry	Moist	Wet						
Oe	0-5		5YR 2.5/2											
A	5-7		7.5YR 2.5/1	sil										
Eg	7-19	1% f 10YR 4/4 root chann	2.5Y 5/1	20% sil										
BEg	19-38	10% 10YR 5/4, 5/6 masses f 7.5YR 3/4 – 3%, root channels	2.5Y 5/1	sil										
* Btg1	38-57	17% 10YR 5/4 3% 7.5YR 4/6 root channels	2.5Y 5/1 - 40% " 5/2 - 40%	sicl			* auger samples start 50 cm; above from small pit							
Btg2	57-84	10YR 5/4 7.5YR 4/6	2.5Y 5/1 - 50% 5/2 - 30%	sicl - 30% c										
Btg3	84-113	2.5Y 5/3 - 30%	2.5Y 5/1 - 45% 10YR 5/6 - 25%	sicl - 38% c										
2BCg1	113-143	5% 10YR 5/6	5Y 6/1 - 65% 2.5Y 6/2 - 30%	18% c l										
2BCg2	143-158	43% 2.5Y 5/4 2% 7.5YR 3/4	5Y 6/0.5 - 55%	l or vfsl — Marty										

Stop 2 - Blackwater NWR
Sunken

Described as Elkton in 1998;
(Maybe Sunken in 2012)

Soil Series: Elkton Map Unit Name: Elkton mucky silt loam, very wet
Site Identification #: 98MD019001 Lab Pedon #: 98MD019002
Soil Survey Area #: 019 MLRA: 153D County FIPS Code: 019
Soil Survey Area Name: Dorchester Co.
Location Description: Moneystump Swamp, Area E, 2100 ft. NE of Beaverdam Ck.
Geographically Associated Soils: Honga, Sunken, Othello, Kentuck, Keyport
Classification: fine-silty, mixed, mesic, Typic Endoaquults
Natural Drainage Class: poorly drained
Vegetative Information: Loblolly Pine, wax myrtle, white grass, sweet gum, willow oak, blackgum, holly
Described by: M. Rabenhorst, J. Brewer , 10/07/1998

Oe--0 to 6 cm; dark reddish brown (5YR 3/2), rubbed, hemic material; common medium and fine roots throughout**;** abrupt smooth boundary.

A--6 to 10 cm; very dark grayish brown (10YR 3/2), broken face, silt loam; moderate fine granular structure; very friable; common medium and fine roots throughout; 10.0 percent clay; abrupt wavy boundary.

Eg--10 to 19 cm; gray (5Y 6/1), broken face, silt loam; weak coarse platy structure; friable; common coarse, medium, fine and very fine roots throughout; 12.0 percent clay; common fine threads yellowish brown (10YR 5/4) soft masses of pedogenic iron accumulation throughout; clear smooth boundary. Iron accumulations occur in channels and pores of live roots (oxidized rhizospheres).

BEg--19 to 44 cm; gray (5Y 6/1), broken face, silt loam; weak medium and coarse subangular blocky structure; friable; common medium, fine and very fine roots throughout; 16.0 percent clay; many medium irregular light olive brown (2.5Y 5/4) soft masses of iron accumulation pedogenic throughout and common fine irregular yellowish brown (10YR 5/6) soft masses of pedogenic iron accumulation throughout; clear smooth boundary. 10YR 5/6 iron accumulations occur in channels and pores of live roots (oxidized rhizospheres).

Btg1--44 to 73 cm; gray (2.5Y 5/1), broken face, silty clay loam; weak medium subangular blocky structure; friable; common coarse, medium, fine, and very fine roots throughout; 28.0 percent clay; few faint continuous gray (2.5Y 5/1), moist, clay films on faces of peds; common medium and coarse irregular light yellowish brown (2.5Y 6/4) soft masses of iron accumulation pedogenic throughout and common medium irregular strong brown (7.5YR 5/6) soft masses of pedogenic iron accumulation throughout; gradual smooth boundary.

Btg2--73 to 94 cm; 30 percent grayish brown (2.5Y 5/2), broken face, and 30 percent grayish brown (10YR 5/2), broken face, silty clay; moderate coarse prismatic structure parting to moderate coarse subangular blocky; firm; common medium, fine and very fine roots throughout; 41.0 percent clay; common distinct continuous gray (2.5Y 5/1), moist, clay films on faces of peds; many coarse irregular yellowish brown (10YR 5/8) soft masses of pedogenic iron accumulation throughout and common fine irregular dark yellowish brown (10YR 4/6) soft masses of iron accumulation pedogenic throughout; gradual wavy boundary. 10YR 4/6 iron accumulations occur in root channels.

Btg3--94 to 118 cm; 30 percent yellowish brown (10YR 5/6), broken face, and 30 percent light olive gray (5Y 6/2), broken face, and 30 percent yellowish brown (10YR 5/8), broken face, silty clay; moderate coarse prismatic structure parting to moderate medium and coarse subangular blocky; firm; common very fine, fine, and medium roots; 45.0 percent clay; few prominent continuous gray (5Y 5/1), moist, clay films on faces of peds; common fine irregular strong brown (7.5YR 5/8) soft masses of pedogenic iron accumulation throughout; clear smooth boundary. Iron accumulations occur in root channels.

Btg4--118 to 132 cm; 40 percent pale olive (5Y 6/4), broken face, and 40 percent greenish gray (10Y 6/1), broken face, silty clay; moderate coarse prismatic structure; very firm; 45.0 percent clay; few prominent continuous gray (5Y 5/1), moist, clay films on faces of peds; common fine irregular strong brown (7.5YR 5/8) soft masses of pedogenic iron accumulation throughout; gradual smooth boundary.

BCg--132 to 150 cm; 40 percent greenish gray (10Y 6/1), broken face, and 30 percent pale olive (5Y 6/3), broken face, silt loam; weak coarse subangular blocky structure; firm; 25.0 percent clay; common medium irregular light olive brown (2.5Y 5/6) soft masses of iron accumulation pedogenic throughout and common fine irregular yellowish brown (10YR 5/8) soft masses of pedogenic iron accumulation throughout.

Stop 2 - Blackwater NWR
Described as Sunken in 1998

Soil Series: Sunken Map Unit Name: Sunken mucky silt loam
Site Identification #: 98MD019000 Lab Pedon #: 98MD019001
Soil Survey Area #: 019 MLRA: 153D County FIPS Code: 019
Soil Survey Area Name: Dorchester Co.
Location Description: Moneystump Swamp, Area E, 2100 ft. NE of Beaverdam Ck.
Geographically Associated Soils: Honga, Elkton, Othello, Kentuck
Classification: fine-silty, mixed, mesic, Typic Endoaqualfs
Natural Drainage Class: Very poorly drained
Vegetative Information: Loblolly Pine, Marsh Hay grass, wax myrtle, 3-square
Described by: M. Rabenhorst, J. Brewer, 10/07/1998

Notes: The clay films and structure of this soil has been dispersed and degraded due to the salts from the inundation of brackish waters.

Oi--0 to 8 cm; very dark brown (7.5YR 2/2), rubbed, peat; abrupt smooth boundary. Material made up of partially decomposed pine needles and grass leaves.

Oe--8 to 13 cm; very dark brown (7.5YR 2/2), rubbed, mucky peat; abrupt smooth boundary.

A--13 to 20 cm; very dark grayish brown (10YR 3/2), broken face, silt loam; massive; 15.0 percent clay; clear wavy boundary.

Eg--20 to 27 cm; gray (2.5Y 5/1), broken face, silt loam; massive; common very fine and fine roots throughout; 20.0 percent clay; common fine threads reddish yellow (7.5YR 6/8) soft masses of iron accumulation pedogenic throughout; clear wavy boundary. Iron accumulations occur in channels and pores of live roots (oxidized rhizospheres).

BEg--27 to 46 cm; gray (N 5/0), broken face, silt loam; weak very fine subangular blocky structure; common very fine and fine roots in cracks; 26.0 percent clay; many medium irregular yellowish brown (10YR 5/8) soft masses of iron accumulation pedogenic throughout and common fine threads yellowish red (5YR 4/6) soft masses of iron accumulation pedogenic throughout; gradual smooth boundary. Thread shaped iron accumulations occur in channels and pores of live roots (oxidized rhizospheres).

Btg1--46 to 66 cm; gray (N 5/0), broken face, silty clay loam; weak fine subangular blocky structure; common very fine and fine roots throughout; 37.0 percent clay; few distinct continuous gray (N 6/0) clay films on faces of peds; common medium irregular yellowish brown (10YR 5/6) soft masses of iron accumulation pedogenic throughout and common medium irregular light gray (N 7/0) soft iron depletions pedogenic throughout; gradual smooth boundary.

Btg2--66 to 78 cm; gray (N 6/0), broken face, silty clay loam; weak coarse prismatic structure; common very fine and fine roots in mat at top of horizon; 33.0 percent clay; common prominent patchy gray (N 5/0) clay films; many medium and coarse irregular brownish yellow (10YR 6/8) soft masses of iron accumulation pedogenic throughout and many coarse irregular light gray (N 7/0) soft iron depletions pedogenic throughout; gradual wavy boundary.

Btg3--78 to 100 cm; 40 percent gray (N 6/0), broken face, and 20
percent gray (2.5Y 5/1), broken face, silty clay loam; moderate coarse prismatic structure parting to weak very thick platy; common very fine and fine roots in mat at top of horizon; 34.0 percent clay; common distinct continuous dark gray (N 4/0) clay films on faces of peds and in pores; many coarse irregular dark yellowish brown (10YR 4/6) soft masses of iron accumulation pedogenic throughout and common fine irregular yellowish red (5YR 4/6) soft masses of iron accumulation pedogenic throughout. This horizon contains silt loam material (2.5Y 4/2) associated in the interior of verticle iron accumulations which are 5 to 15 cm. across. This material also includes iron accumulations of 5YR 4/4 (10%).

*** Primary Characterization Data ***

Pedon ID: S2012MD019001 (Dorchester County, Maryland) Print Date: Apr 26 2013 8:23AM
Sampled As : Sunken Fine-silty, mixed, active, mesic Typic Endoaqualf
USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 13N0421

PSDA & Rock Fragments

				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-
				(- - - - - Total - - - - - -)			(- - Clay - - -)		(- - - - Silt - - - - -)		(- - - - - - - - - - - - Sand - - - - - - - - - - - -)					(Rock Fragments (mm))				
				Clay	Silt	Sand	Fine	CO_3	Fine	Coarse	VF	F	M	C	VC	(- - - - - - - - Weight - - - - - - - -)				>2 mm
				<	.002	.05	<	<	.002	.02	.05	.10	.25	.5	1	2	5	20	.1-	wt %
	Depth			.002	-.05	-2	.0002	.002	-.02	-.05	-.10	-.25	-.50	-1	-2	-5	-20	-75	75	whole
Layer	(cm)	Horz	Prep	(- % of <2mm Mineral Soil -)												(- - - - - - - % of <75mm - - - - - -)				soil
				3A1a1a					3A1a1a		3A1a1a	3A1a1a	3A1a1a	3A1a1a	3A1a1a					
13N01696	0-5	Oe	S													--	--	--	--	–
13N01697	5-7	A	S	13.4	78.6	8.0			46.7	31.9	4.4	3.2	0.2	0.2	tr	--	--	--	4	–
13N01698	7-19	Eg	S	21.8	73.2	5.0			43.5	29.7	4.0	0.9	0.1	tr	tr	--	--	--	1	–
13N01699	19-38	BEg	S	26.4	67.5	6.1			39.7	27.8	4.8	1.2	0.1	tr	–	--	--	--	1	–
13N01700	38-57	Btg1	S	31.0	59.4	9.6			35.5	23.9	6.1	3.3	0.1	0.1	–	--	--	--	4	–
13N01701	57-84	Btg2	S	31.1	59.3	9.6			36.2	23.1	7.2	2.3	0.1	--	–	--	--	--	2	–
13N01702	84-113	Btg3	S	41.6	45.3	13.1			30.1	15.2	10.4	2.6	0.1	tr	–	--	--	--	3	–
13N01703	113-143	2BCg1	S	24.7	50.7	24.6			26.9	23.8	19.4	5.1	0.1	tr	tr	--	--	--	5	–
13N01704	143-158	2BCg2	S	15.9	45.1	39.0			21.1	24.0	26.8	12.0	0.2	tr	tr	--	--	--	12	–

Bulk Density & Moisture

				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-
				(Bulk Density)		Cole	(- - - - - - - - - - - Water Content - - - - - - - - - - -)						WRD	Aggst		
				33	Oven	Whole	6	10	33	1500	1500 kPa	Ratio	Whole	Stabl	(- - Ratio/Clay - -)	
	Depth			kPa	Dry	Soil	kPa	kPa	kPa	kPa	Moist	AD/OD	Soil	2-0.5mm	CEC7	1500 kPa
Layer	(cm)	Horz	Prep	(- - - g cm^{-3} - - -)			(- - - - - - - - - - - - pct of < 2mm - - - - - - - - - - - -)						cm^3 cm^{-3}	%		
										3C2a1a		3D1				
13N01696	0-5	Oe	S									1.087				
13N01697	5-7	A	S							21.7		1.030			2.70	1.62
13N01698	7-19	Eg	S							10.6		1.013			0.55	0.49
13N01699	19-38	BEg	S							13.7		1.015			0.46	0.52
13N01700	38-57	Btg1	S							17.8		1.020			0.48	0.57
13N01701	57-84	Btg2	S							20.7		1.020			0.48	0.67
13N01702	84-113	Btg3	S							26.7		1.024			0.42	0.64
13N01703	113-143	2BCg1	S							10.6		1.013			0.43	0.43
13N01704	143-158	2BCg2	S							7.6		1.009			0.42	0.48

Stop 2 - Blackwater NWR
Sunken

Stop 2 - Blackwater NWR
Sunken

*** Primary Characterization Data ***

Pedon ID: S2012MD019001 (Dorchester County, Maryland) Print Date: Apr 26 2013 8:23AM

Sampled As : Sunken Fine-silty, mixed, active, mesic Typic Endoaqualf

USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 13N0421

Water Content

Layer	Depth (cm)	Horz	Prep	-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-
				(- - Atterberg - -)		(- - - - - Bulk Density - - - - -)			(- - - - - Water Content - - - - -)							
				(- - - Limits - - -)		Field	Recon	Recon	Field	Recon	(- - - Sieved Samples - - -)					
				LL	PI		33 kPa	Oven Dry		33 kPa	6 kPa	10 kPa	33 kPa	100 kPa	200 kPa	500 kPa
				pct <0.4mm		(- - - g cm^{-3} - - -)			(- - - % of < 2mm - - -)							
															3C1e1a	
13N01697	5-7	A	S												34.5	
13N01698	7-19	Eg	S												17.6	
13N01699	19-38	BEg	S												19.9	
13N01700	38-57	Btg1	S												22.2	
13N01701	57-84	Btg2	S												21.5	
13N01702	84-113	Btg3	S												30.1	
13N01703	113-143	2BCg1	S												19.5	
13N01704	143-158	2BCg2	S												12.7	

Carbon & Extractions

Layer	Depth (cm)	Horz	Prep	-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-
				(- - - - - Total - - - - -)			Est	OC	C/N	(- - - Dith-Cit Ext - - -)			(- - - - - - Ammonium Oxalate Extraction - - - - - -)						(- - - Na Pyro-Phosphate - - -)			
				C	N	S	OC	(WB)	Ratio	Fe	Al	Mn	Al+½Fe	ODOE	Fe	Al	Si	Mn	C	Fe	Al	Mn
				(- - - % of <2 mm - - -)						(- - - % of < 2mm - - -)								mg kg^{-1}	(- - - % of < 2mm - - -)			
				4H2a	4H2a	4H2a				4G1	4G1	4G1										
13N01696	0-5	Oe	S	47.34	1.74	0.47	47.3		27													
13N01697	5-7	A	S	14.03	0.59	0.16	14.0		24													
13N01698	7-19	Eg	S	1.43	0.11	0.03	1.4		13	--	0.1	–										
13N01699	19-38	BEg	S	0.55	0.10	0.02	0.5		5	0.5	0.1	–										
13N01700	38-57	Btg1	S	0.35	0.02	0.02	0.4		15	0.8	0.1	–										
13N01701	57-84	Btg2	S	0.41	0.08	0.03	0.4		5	0.6	0.1	–										
13N01702	84-113	Btg3	S	0.28	0.11	0.04	0.3		3	3.6	0.3	–										
13N01703	113-143	2BCg1	S	0.18	0.07	0.02	0.2		2	0.2	tr	–										
13N01704	143-158	2BCg2	S	0.14	0.06	0.01	0.1		2	0.2	tr	–										

*** Primary Characterization Data ***

Pedon ID: S2012MD019001 (Dorchester County, Maryland) Print Date: Apr 26 2013 8:23AM

Sampled As : Sunken Fine-silty, mixed, active, mesic Typic Endoaqualf

USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 13N0421

Stop 2 - Blackwater NWR Sunken

CEC & Bases

				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-
				(------ NH_4OAC Extractable Bases -----)								CEC8	CEC7	ECEC		(---- Base ----) (- Saturation -)	
								Sum	Acid-	Extr	KCl	Sum	NH_4	Bases	Al		
Layer	Depth (cm)	Horz	Prep	Ca	Mg	Na	K	Bases	ity	Al	Mn	Cats	OAC	+Al	Sat	Sum	NH_4OAC
				(---- cmol(+) kg^{-1} ----						----)	mg kg^{-1}	(---- cmol(+) kg^{-1} ---)			(-------- % --------)		
				4B1a1a	4B1a1a	4B1a1a	4B1a1a		4B2b1a1	4B3a1a	4B3a1a		4B1a1a				
13N01696	0-5	Oe	S	11.7	13.9	27.8	1.8		166.8	2.1	0.1		99.7				
13N01697	5-7	A	S	4.0	5.4	8.7	0.3	18.4		5.6	0.1		36.2	24.0	23		51
13N01698	7-19	Eg	S	1.5	3.3	4.0	0.2	9.0	14.2	3.0	tr	23.2	12.0	12.0	25	39	75
13N01699	19-38	BEg	S	1.3	2.9	4.2	0.2	8.6	14.9	4.0	tr		12.1				71
13N01700	38-57	Btg1	S	1.5	2.5	4.2	0.1	8.3	20.8	8.1	0.1	29.1	14.8	16.4	49	29	56
13N01701	57-84	Btg2	S	2.2	2.7	3.6	0.1	8.6	22.2	8.1	0.1		14.8				58
13N01702	84-113	Btg3	S	4.5	3.9	3.5	0.1	12.0	24.3	7.7	0.3		17.6				68
13N01703	113-143	2BCg1	S	3.9	2.8	2.4	0.1	9.2	9.5	2.6	0.4		10.5				88
13N01704	143-158	2BCg2	S	4.4*	2.6	2.1	0.1	9.2	4.1	0.4	0.6		6.6				100

*Extractable Ca may contain Ca from calcium carbonate or gypsum. CEC7 base saturation set to 100.

Salt

				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
				(---- Water Extracted From Saturated Paste ----														----)	Total	Elec	Pred Elec	Exch	
Layer	Depth (cm)	Horz	Prep	Ca	Mg	Na	K	CO_3	HCO_3	F	Cl	PO_4	Br	OAC	SO_4	NO_2	NO_3	H_2O	Salts	Cond	Cond	Na	SAR
				(----- mmol(+) L^{-1} -----)				(---- mmol(-) L^{-1} ----									----)	(---- % ----)		(-- dS m^{-1} --)		%	
				4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2		4F2	4F1a1a1		
13N01697	5-7	A	S	3.8	10.9	40.6	0.7	--	--	--	49.0	--	0.2	--	7.4	--	0.3	117.0		5.82	3.77	24	
13N01698	7-19	Eg	S	2.4	6.1	33.5	0.3	--	--	--	36.8	--	0.3	--	4.8	--	0.7	51.1		4.43	1.45	34	
13N01699	19-38	BEg	S	2.3	5.8	33.2	0.3	--	--	--	38.0	--	0.3	--	4.3	--	0.4	53.4		4.45	1.50	35	
13N01700	38-57	Btg1	S	2.5	4.7	27.6	0.2	--	--	--	31.4	--	0.2	--	4.5	--	0.1	62.2		3.87	1.49	29	
13N01701	57-84	Btg2	S	3.8	5.6	27.3	0.1	--	--	--	31.1	--	0.1	--	5.9	--	0.1	59.6		3.91	1.43	24	
13N01702	84-113	Btg3	S	4.9	4.8	15.4	tr	--	--	--	17.8	--	0.3	--	8.7	--	0.1	92.6		2.68	1.46	20	
13N01703	113-143	2BCg1	S	6.0	5.2	16.3	0.1	--	--	--	19.5	--	0.1	--	9.4	--	--	63.8		2.90	1.13	23	
13N01704	143-158	2BCg2	S	10.4	7.9	21.3	0.1	--	--	--	28.2	--	0.1	--	11.7	--	0.1	46.8		3.94	1.19	32	

*** Primary Characterization Data ***

Pedon ID: S2012MD019001 (Dorchester County, Maryland) Print Date: Apr 26 2013 8:23AM
Sampled As : Sunken Fine-silty, mixed, active, mesic Typic Endoaqualf
USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 13N0421

Stop 2 - Blackwater NWR Sunken

pH & Carbonates

Layer	Depth (cm)	Horz	Prep	-1- KCl	-2- pH $CaCl_2$ 0.01M 1:2 4C1a2a	-3- pH H_2O 1:1 4C1a2a	-4- Sat Paste 4F2	-5- Oxid	-6- NaF	-7- Carbonate As $CaCO_3$ <2mm (%) 4E1a1a1a1	-8- Carbonate <20mm (%)	-9- Gypsum As $CaSO_4$*$2H_2O$ <2mm (%) 4E2a1a1a1	-10- Gypsum <20mm (%)	-11- Resist ohms cm^{-1}
13N01697	5-7	A	S				3.9					–		
13N01698	7-19	Eg	S		4.3	4.7	4.5					–		
13N01699	19-38	BEg	S		4.2	4.5	4.3			tr		–		
13N01700	38-57	Btg1	S		3.9	4.2	4.1					–		
13N01701	57-84	Btg2	S		3.9	4.2	4.1			tr		–		
13N01702	84-113	Btg3	S		3.9	4.0	4.2			tr		–		
13N01703	113-143	2BCg1	S		4.1	4.3	4.3			tr		–		
13N01704	143-158	2BCg2	S		4.5	4.7	4.6			tr		–		

Organic

Layer	Depth (cm)	Horz	Prep	-1- Mineral Content (%) 5A	-2- Est OM (%)	-3- Min + Est OM (%)	-4- Est OC (%)	-5- Total N (%) 4H2a	-6- Est OC /N ratio	-7- Fiber Content Unrub % (by vol) 5C	-8- Fiber Content Rub 5C	-9- NaPyro Color 5C	-10- Decomp State	-11- Limnic Matter	-12- pH $CaCl_2$ 5C	-13- pH H_2O 4C1a2a	-14- Bulk Density 33 kPa	-15- Bulk Density 33 kPa rewet g cm^{-3}	-16- Bulk Density OD	-17- Proj Subs cm cm^{-1}
13N01696	0-5	Oe	MW	16	82	98				48	38	10YR 7/4			3.8					
13N01696	0-5	Oe	S				47.3	1.74	27											
13N01697	5-7	A	S				14.0	0.59	24											
13N01698	7-19	Eg	S				1.4	0.11	13							4.7				
13N01699	19-38	BEg	S				0.5	0.10	5							4.5				
13N01700	38-57	Btg1	S				0.4	0.02	15							4.2				
13N01701	57-84	Btg2	S				0.4	0.08	5							4.2				
13N01702	84-113	Btg3	S				0.3	0.11	3							4.0				
13N01703	113-143	2BCg1	S				0.2	0.07	2							4.3				
13N01704	143-158	2BCg2	S				0.1	0.06	2							4.7				

Stop 2 - Blackwater NWR Sunken

*** Primary Characterization Data ***

Pedon ID: S2012MD019001 (Dorchester County, Maryland) Print Date: Apr 26 2013 8:23AM

Sampled As : Sunken Fine-silty, mixed, active, mesic Typic Endoaqualf

USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 13N0421

Clay Mineralogy (<.002 mm)

				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-
				X-Ray					Thermal				Elemental							EGME	Inter
													SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	K_2O	Na_2O	Retn	preta
	Depth		Fract	7A1b1					7A4a												tion
Layer	(cm)	Horz	ion	(- - - peak size - - -)					(- - - % - - -)				(- - - % - - -)							mg g^{-1}	
13N01700	38-57	Btg1	tcly	VR 3	MT 2	KK 2	MI 1	GE 1													VERM
13N01701	57-84	Btg2	tcly	VR 2	KK 2	MT 2	MI 1	GE 1													VERM
13N01702	84-113	Btg3	tcly	KK 2	GE 1	VR 1	MT 1	MI 1			KK 27 GI 2	GE 11									CMIX

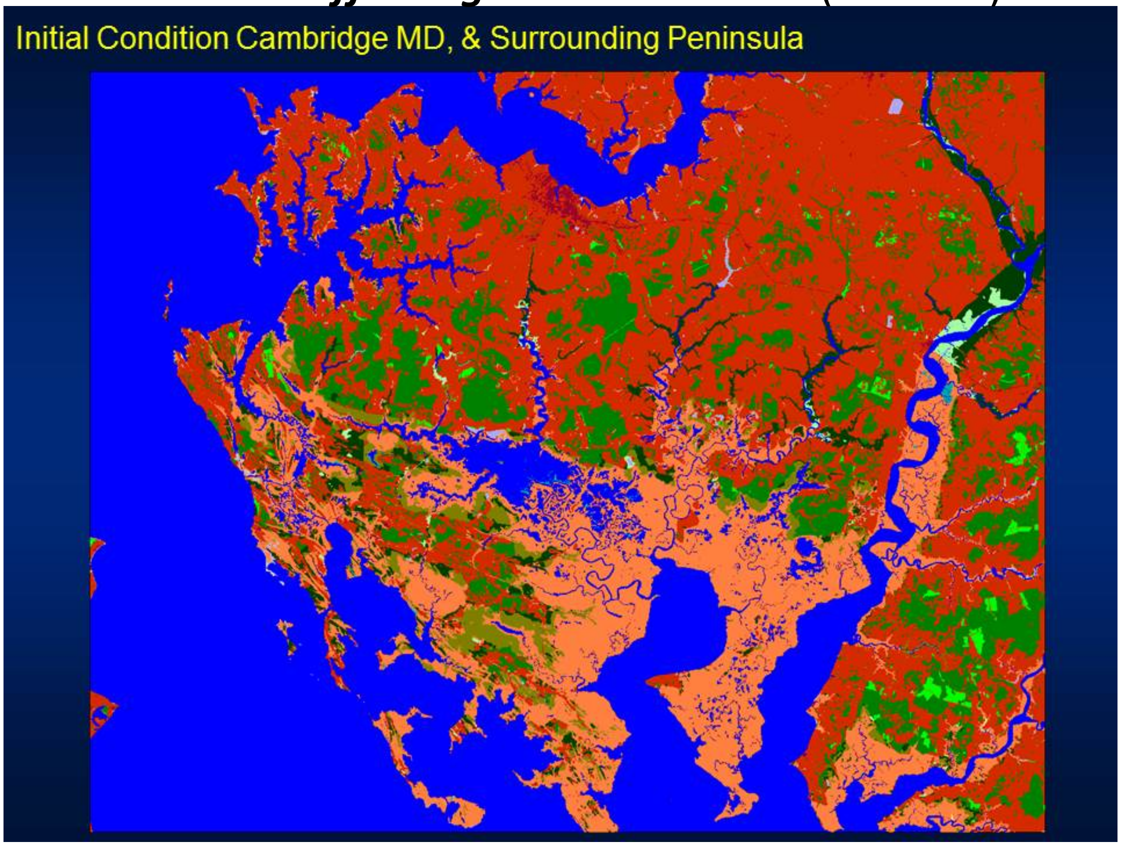
FRACTION INTERPRETATION:
tcly - Total Clay, <0.002 mm

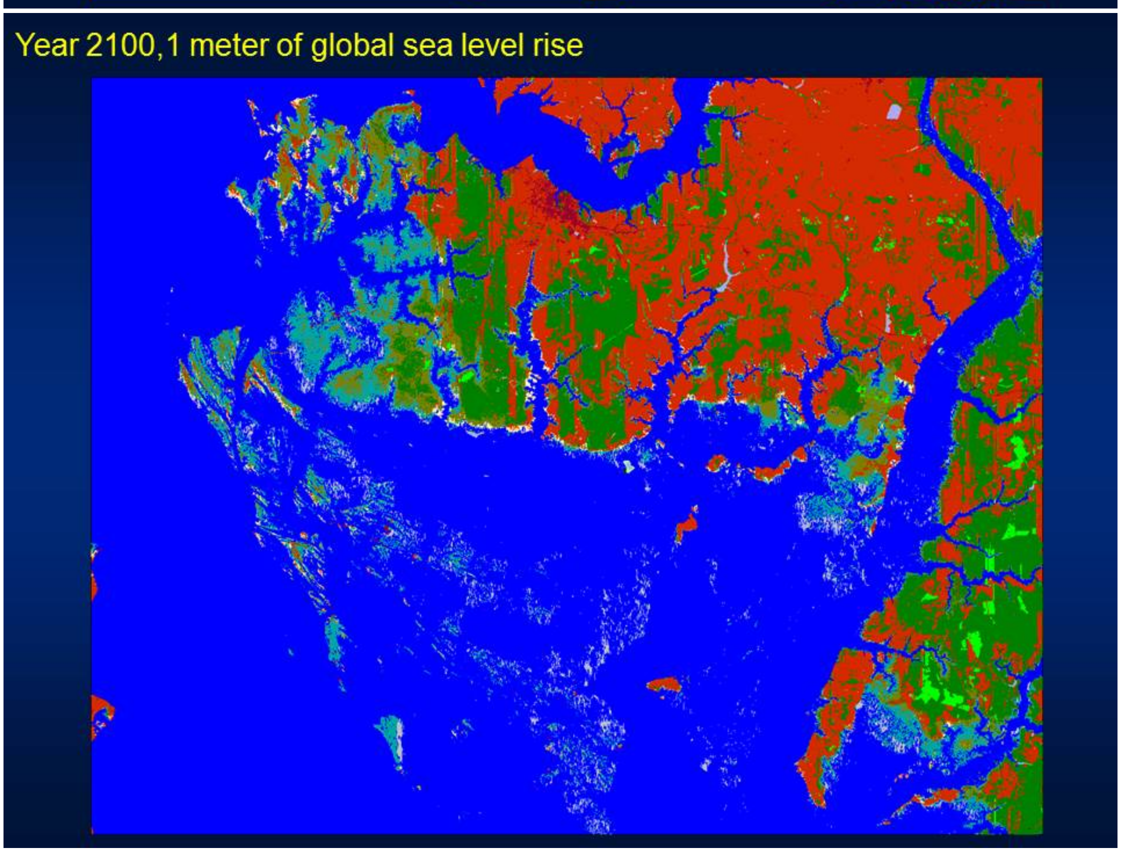
MINERAL INTERPRETATION:
GE - Goethite GI - Gibbsite KK - Kaolinite MI - Mica MT - Montmorillonite
VR - Vermiculite

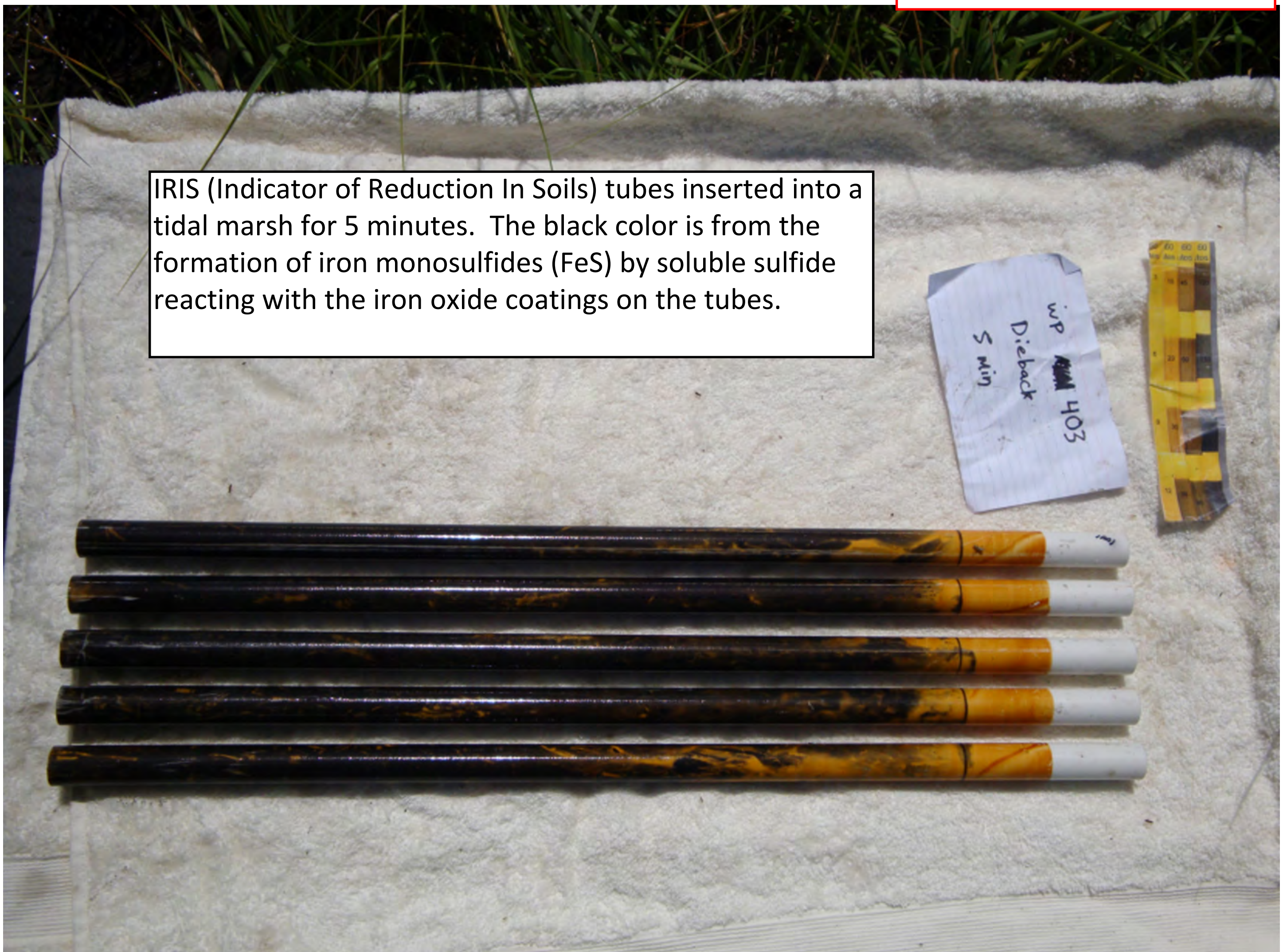
RELATIVE PEAK SIZE: 5 Very Large 4 Large 3 Medium 2 Small 1 Very Small 6 No Peaks

Predicted effect on Chesapeake Bay Tidal Marshes of approximately 1 meter rise in sea level.

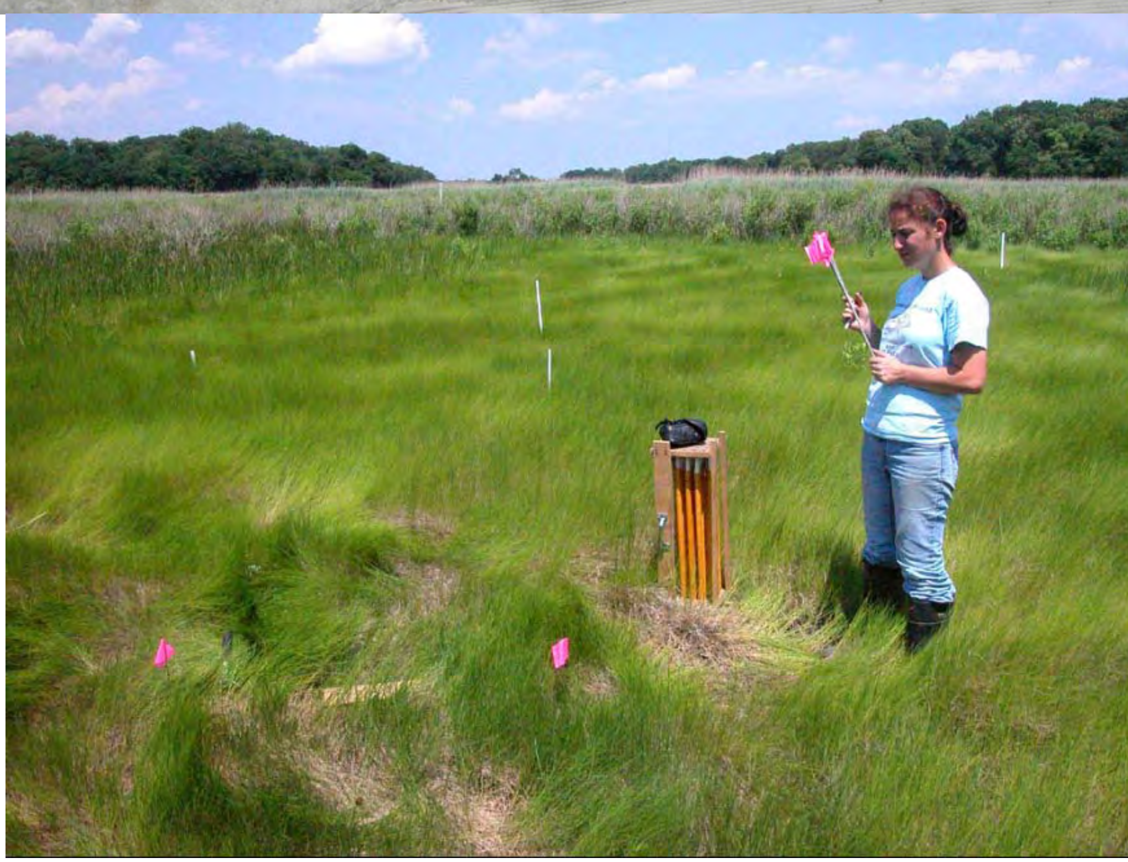
Sea Level Affecting Marshes Model **(*SLAMM*)**





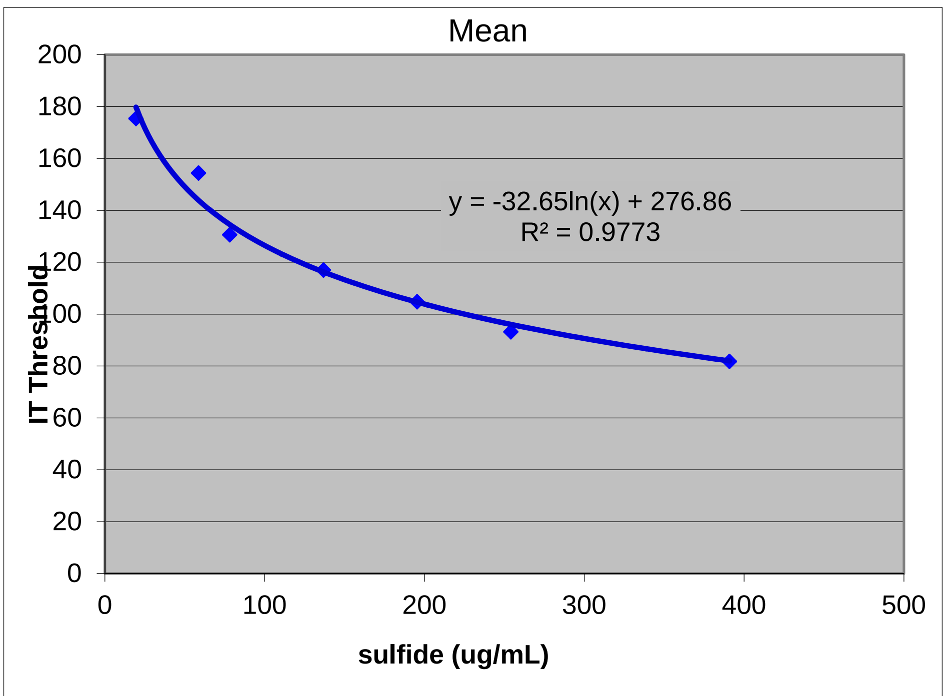


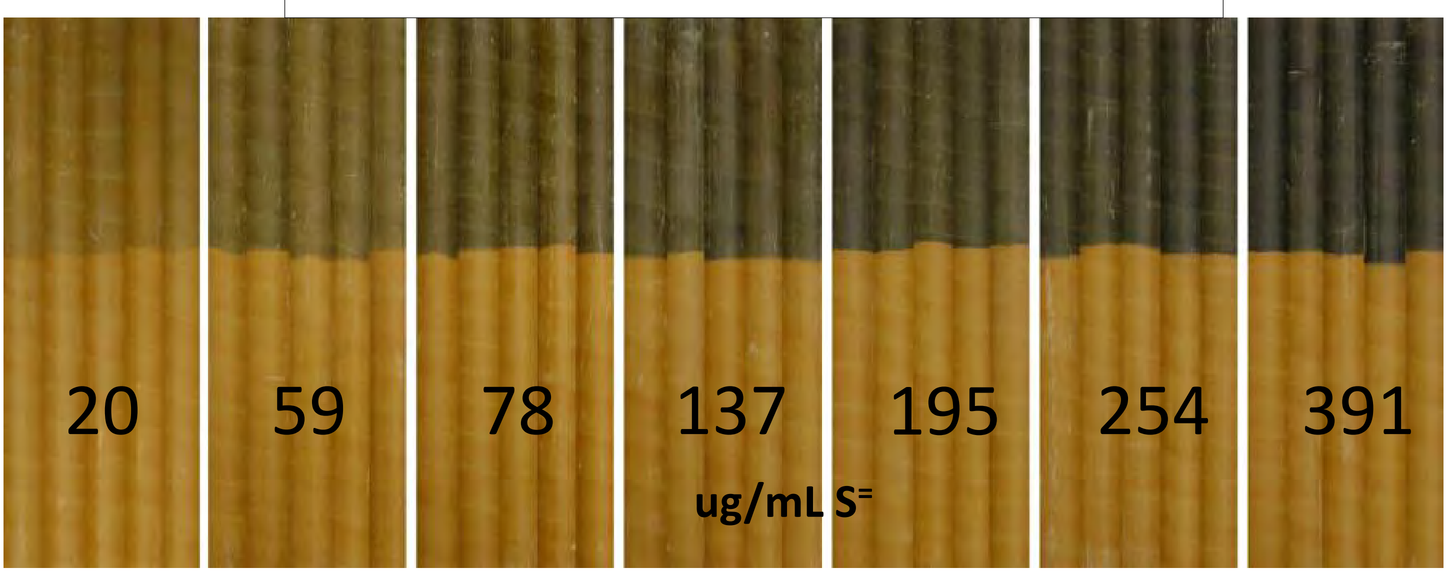
IRIS (Indicator of Reduction In Soils) tubes inserted into a tidal marsh for 5 minutes. The black color is from the formation of iron monosulfides (FeS) by soluble sulfide reacting with the iron oxide coatings on the tubes.



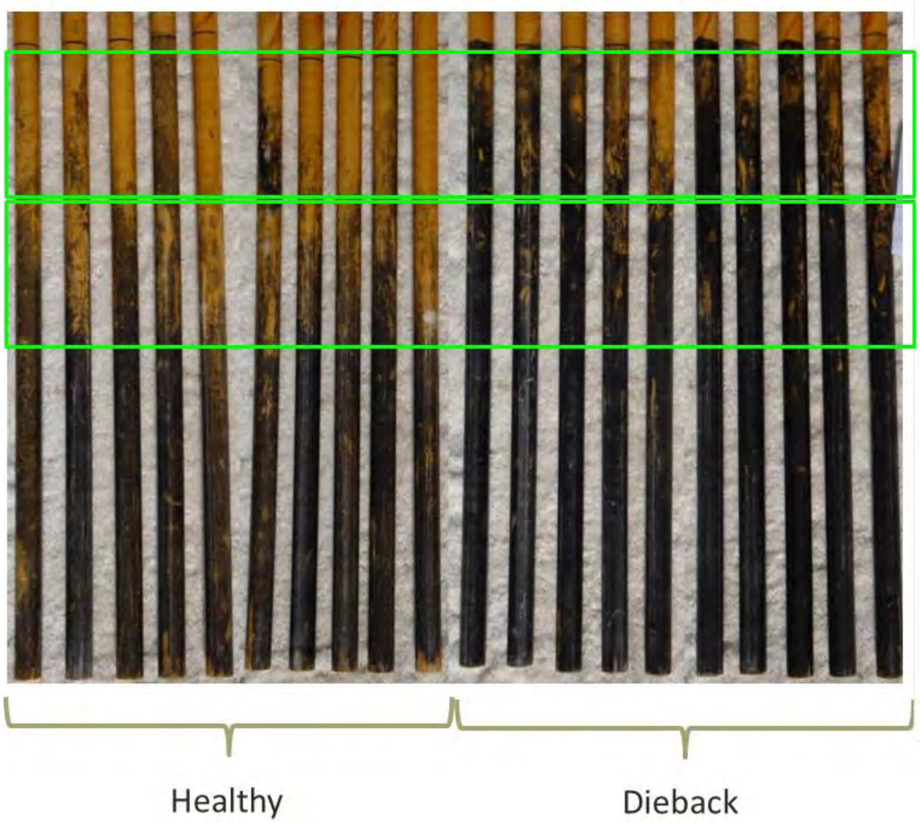
Standards

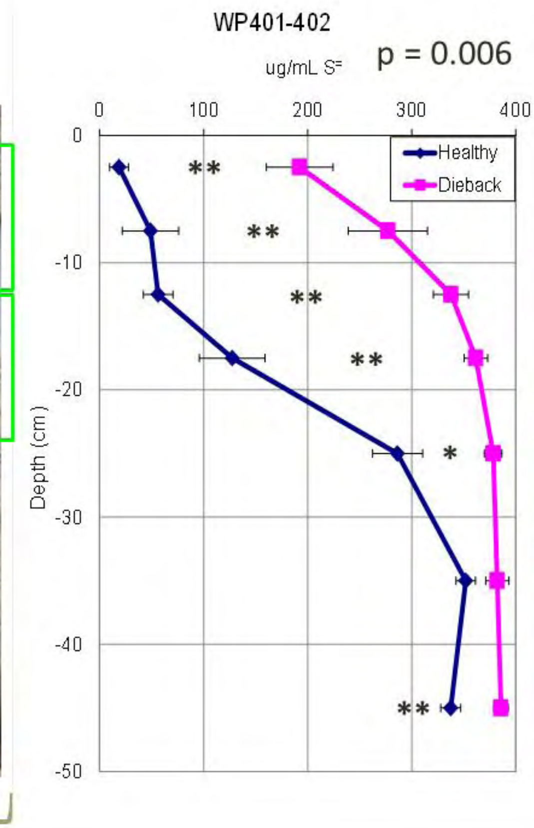
- IRIS tubes were exposed to known concentrations of sulfide for fixed time (5 min) and photographed
- Identical to field methods
- Image Tool 3.0 software





IRIS tubes used to quantify soluble porewater sulfide in tidal marsh soils. Using IRIS tubes, it was shown that the porewater sulfide concentration was significantly higher in areas where marsh grasses (*Spartina alterniflora*) had suffered dieback, than in areas where the *S. alterniflora* had healthy growth.





Stop 2 - Blackwater NWR
Described as Sunken in 1998

Salinity Influence on Methane Emissions from Tidal Marshes

Hanna J. Poffenbarger & Brian A. Needelman & J. Patrick Megonigal

Abstract The relationship between methane emissions and salinity is not well understood in tidal marshes, leading to uncertainty about the net effect of marsh conservation and restoration on greenhouse gas balance.We used published and unpublished field data to investigate the relationships between tidal marsh methane emissions, salinity, and porewater concentrations of methane and sulfate, then used these relationships to consider the balance between methane emissions and soil carbon sequestration. Polyhaline tidal marshes (salinity >18) had significantly lower methane emissions (mean ± sd=1±2 gm^{-2} yr^{-1}) than other marshes, and can be expected to decrease radiative forcing when created or restored. There was no significant difference in methane emissions from fresh (salinity=0–0.5) and mesohaline (5–18) marshes (42±76 and 16±11 gm^{-2} yr^{-1}, respectively), while oligohaline (0.5–5) marshes had the highest and most variable methane emissions (150±221 gm^{-2} yr^{-1}). Annual methane emissions were modeled using a linear fit of salinity against log-transformed methane flux (logðCH4Þ ¼ _0:056 _ salinity þ 1:38; r^2 = 0. 5 2 ; p < 0.0001). Managers interested in using marshes as greenhouse gas sinks can assume negligible methane emissions in polyhaline systems, but need to estimate or monitor methane emissions in lower-salinity marshes.

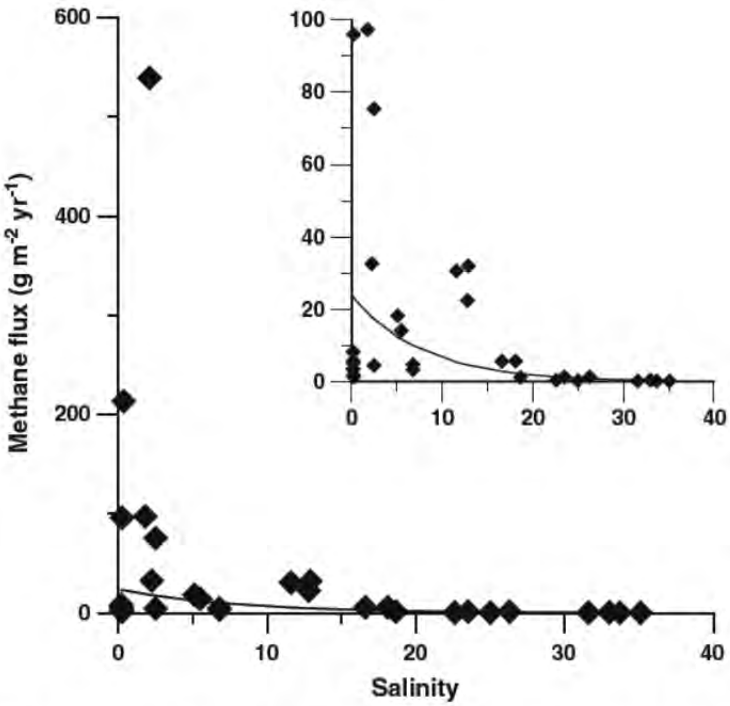


Fig. 1 Tidal marsh methane emissions versus salinity from published sources and field sites in Maryland, USA (Table 1). The black-line curve is the linear fit of the salinity data against the log-transformed methane flux data. The inset presents the same data and curve, but does not show points with emissions above 100 g CH_4 m^{-2} yr^{-1}

Table 2 Statistical summary and carbon dioxide equivalents of methane emissions by salinity class from tidal marshes based on published and new field data

Salinity Class	Salinity range		Methane emissions ($g\ m^{-2}\ yr^{-1}$)					Carbon dioxide equivalent of methane emissions ($Mg\ CO_2\ ha^{-1}\ yr^{-1}$) [a]			
	ppt	N	Mean	Median	Min	Max	Standard deviation	Mean	Median	Min	Max
Fresh	<0.5	8	41.9[a]	5.4	1.3	213	76	10.5	1.4	0.33	53
Oligohaline	0.5–5	5	150[b]	75.4	4.5	539	221	37.5	18.9	1.1	135
Mesohaline	5–18	8	16.4[a]	16.2	3.3	32.0	11	4.1	4.0	0.83	8.0
Polyhaline	>18	10	1.12[c]	0.40	0.2	5.7	2	0.3	0.10	0.10	1.4

[a] Calculated based on a methane global warming potential of 25 (100-yr time horizon)

Estuaries and Coasts (2012) 35:1432–1442
DOI 10.1007/s12237-012-9538-3

Stop 2 - Blackwater NWR
Described as Sunken in 1998

Vegetation Response to Prescribed Fire in Mid-Atlantic Brackish Marshes

Wesley A. Bickford, Brian A. Needelman, Raymond R. Weil, and Andrew H. Baldwin

Abstract Prescribed fire management generally stimulates plant biomass production in coastal marsh systems. This study was conducted to understand the interactive effects of the mechanisms of fire on vegetation production. The effects of canopy removal and ash deposition on biomass production were investigated in two manipulative experiments at the Blackwater National Wildlife Refuge, Dorchester County, MD. On non-burned sites, canopy removal increased biomass production above and belowground (40 and 260 %, respectively), while ash deposition showed no effect on production. On burned sites, post-burn canopy replacement decreased biomass production above and belowground (41 and 40 %, respectively). Production increased more in response to canopy removal at sites dominated by Schoenoplectus americanus than at sites dominated by Spartina patens and Distichlis spicata. Canopy removal was the dominant mechanism through which fire affected biomass production in this study. If increased biomass production is a desirable outcome, prescribed fire programs may benefit by maximizing canopy removal.

Fig. 2 Photos of canopy replacement construction over burned marsh

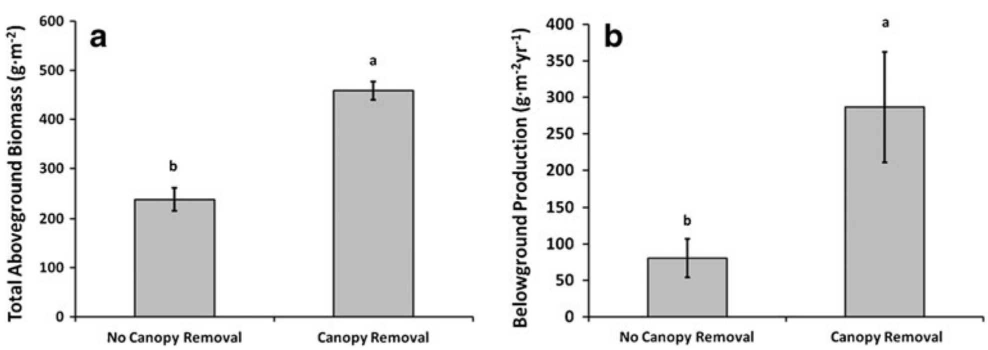


Fig. 5 Biomass production from sedge-dominated sites (2D and 7D) of No-Burn study. a Total aboveground biomass production, values represent the mean of 24 replicates (±standard error of the mean). Letters indicate the results of an ANOVA; means with the same letter were not significantly different from each other (α00.05). b Belowground production, values represent the mean production to a depth of 30 cm of 24 replicates (±standard error of the mean). Letters indicate the results of an ANOVA; means with the same letter were not significantly different from each other (α00.05)

Why do prescribed burns stimulate tidal marsh plant growth?

Burn Study Fact Sheet

The results of a University of Maryland study conducted at the Blackwater National Wildlife Refuge are summarized in this fact sheet. The study was a field-based manipulative experiment designed to better understand the mechanisms controlling plant response to prescribed burns in this region.

Prescribed burns

A prescribed burn is a management technique whereby fire is strategically set with the intent to benefit an ecosystem. This technique is also called a “controlled burn”, and wildlife managers often employ it in marshlands during the winter, when marsh vegetation is dormant and the water table is just above the soil surface. The result is a burn that moves very quickly, removing only aboveground biomass and avoiding detrimental deeper burns that could combust marsh peat or affect living roots or rhizomes. Fire is used in coastal marshes as an aid in hunting and trapping, to reduce fuel load build-up, to encourage plant species and structures that are favorable for target wildlife, and to stimulate the growth of marsh plants.

Possible reasons for the stimulation of marsh growth with prescribed burns

Land managers have long-recognized that prescribed burns stimulate marsh plant growth and research has provided data supporting this observation. However, the mechanism is not clear: is this stimulation is due to the deposition of ash, the removal of the plant canopy, or other mechanisms? Some people think the deposition of ash provides a fertilization effect, by making nutrients important to plant growth immediately available. Others believe that the removal of the canopy and/or accumulated litter increases light availability and soil temperatures early in the growing season. We conducted a manipulative, one-year experiment to test these possible mechanisms.

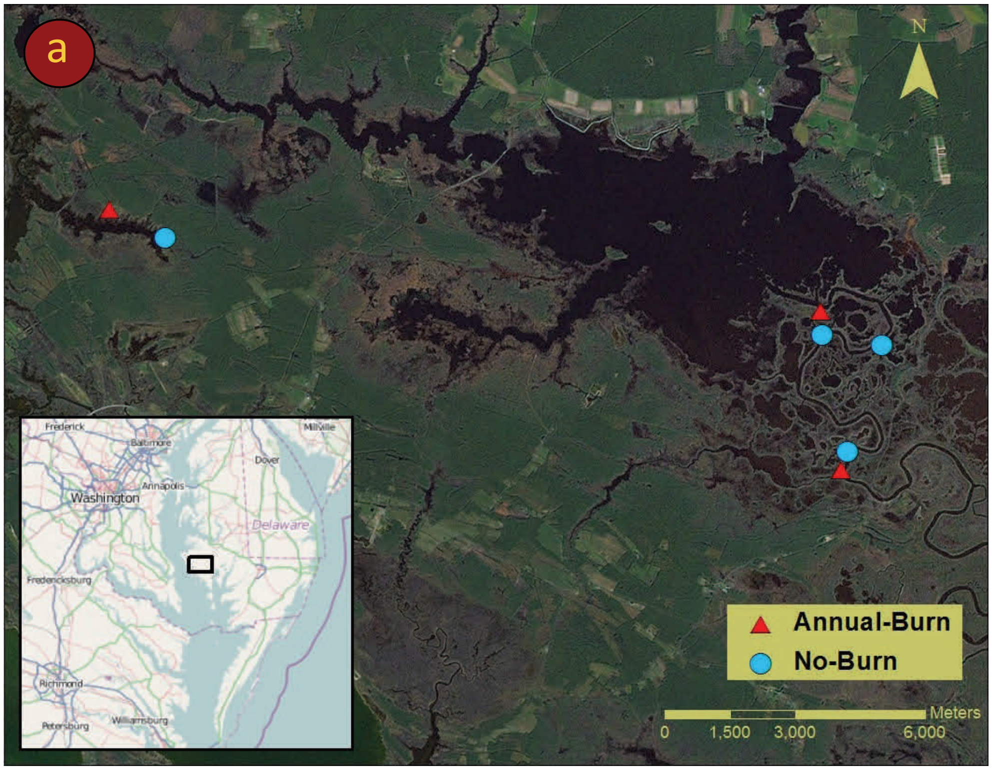
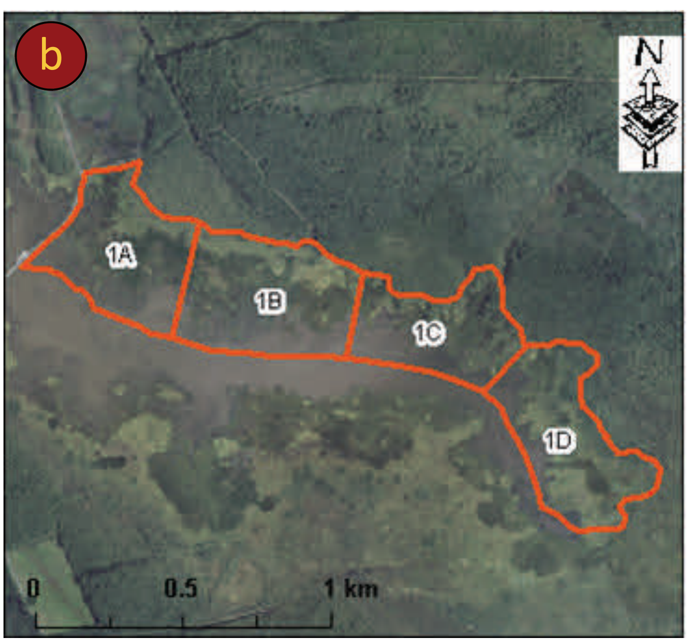
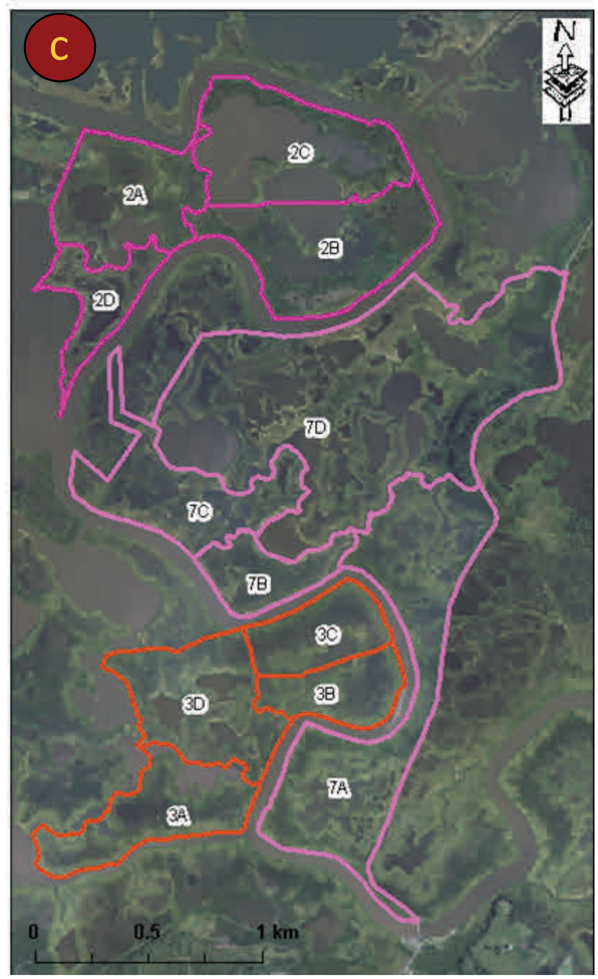


Fig. 1 The study was conducted at three annual-burn cells and four no-burn cells in the Blackwater National Wildlife Refuge on the Eastern Shore of Maryland (a). Close-ups provide more detail of the cells (b) (c).

Experimental design and methods

We conducted our study within the U.S. Fish and Wildlife Service's long-term burn rotation plots at the Blackwater National Wildlife Refuge in Dorchester County Maryland. We conducted two experiments—one within four No-Burn cells (1D, 2D, 3D, 7D) and one within three Annual-Burn cells (1A, 2A, 3A) (Fig. 1a, 1b, 1c).





Within each burn treatment cell, we established 3X4 meter treatment plots that were monitored and sampled for a range of environmental variables such as: plant species composition, cover, height, and aboveground biomass; belowground production; soil temperature; light availability at the soil surface; water level and chemistry; nutrient availability; and organic matter decomposition (Fig. 2). We had three replications per cell for each treatment (described on next two pages). The plots were located adjacent to plots established by the U.S. Geological Survey, who are conducting a long-term study on prescribed burns and marsh elevation change (Cahoon et al. 2010).

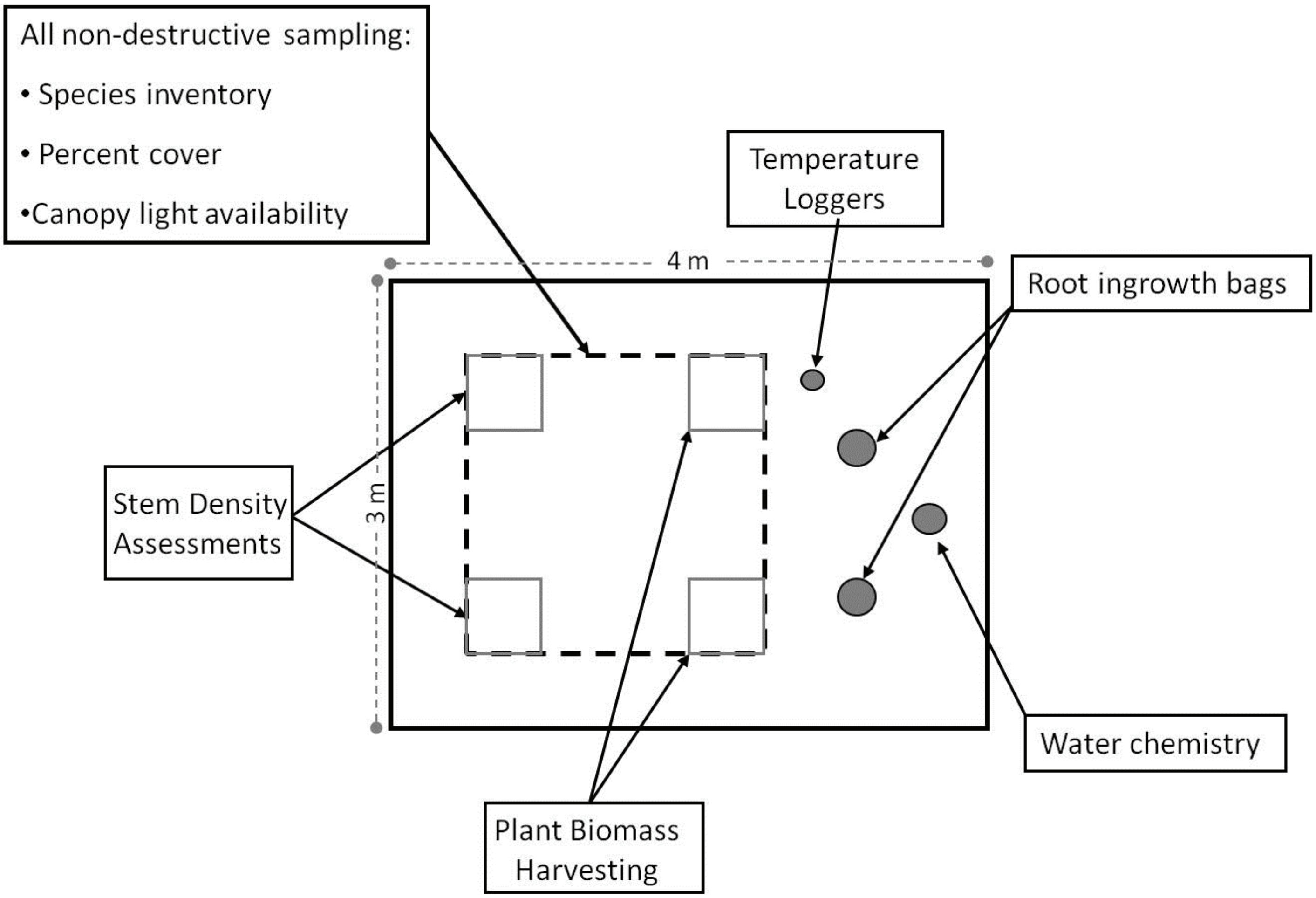


Fig. 2. Schematic of plot set-up. A temperature logger was installed at a depth of 5 cm. One of the three replicate plots per site was also equipped with a second logger at 20 cm. Each plot had a non-destructive and a destructive sampling area. All non-invasive data collection, such as the species composition assessment, was performed in non-destructive area while all invasive data collection, such as biomass harvest or installing instruments into the soil, was performed outside of the non-destructive zone. At the conclusion of the study, final biomass harvest was collected from the non-destructive zone, as this area remained relatively undisturbed throughout the field season. There was a 50-cm buffer around the perimeter where no sampling occurred. A well was established at each plot where water chemistry and water table height data were collected. Plots were identical in Annual-Burn and No-Burn experiments.

Our treatments at the No-Burn cells were: a control, canopy removal (using a hedge clippers), ash deposition (senesced plant materials removed, combusted, and re-applied), and canopy removal plus ash deposition (Fig. 3 and 4).

(Right) Fig. 3. Canopy removal at a No-Burn cell

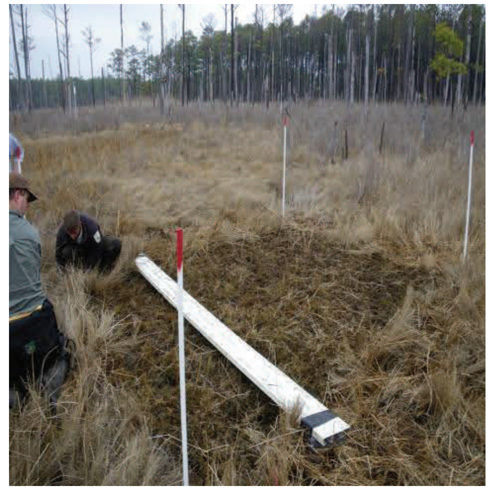


Fig. 4. Biomass was dried at 40°C for 24 hours and ignited in galvanized steel bins (a) (b) (c); After combustion, the ash was homogenized and spread evenly over the Ash Deposition plots using a 1-mm mesh sifter. This ash was deposited on the soil surface of the Ash Deposition and Canopy Removal + Ash Deposition plots in April 2009 (d).

Our treatments at the Annual-Burn cells were a control and canopy replacement. For canopy replacement, we used poultry fencing and nearby senesced vegetation to recreate the plant canopy following the burn. The idea behind this treatment was to determine if we could cancel out the positive effects of burning on plant growth solely by putting the canopy back (Fig. 5).

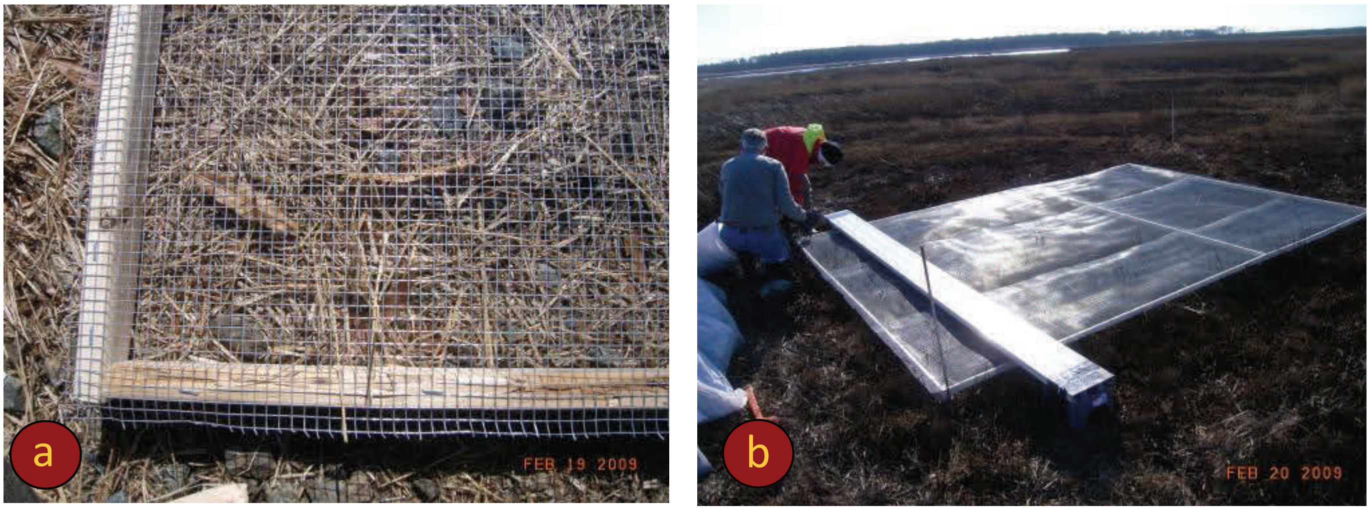


Fig. 5. Photos of canopy replacement treatment applied at annually burned sites. Poultry fencing was stapled to a wooden frame (a); artificial canopies were set ~15 cm above of the soil surface (b); senesced plant shoots were placed in mesh hardware cloth (c); new growth was able to grow through the artificial canopy (d).

Overall Results

We found that our ash deposition treatment had no effect on plant growth while our canopy removal and replacement treatments had very strong effects on plant growth. The canopy removal treatment yielded results that were comparable to the positive effects often observed on plant growth by prescribed burns, increasing aboveground biomass 40% and belowground production 160% (Fig. 6a and 6b). In contrast, canopy replacement decreased aboveground biomass 41% (Fig. 7).

Canopy replacement treatment at high tide

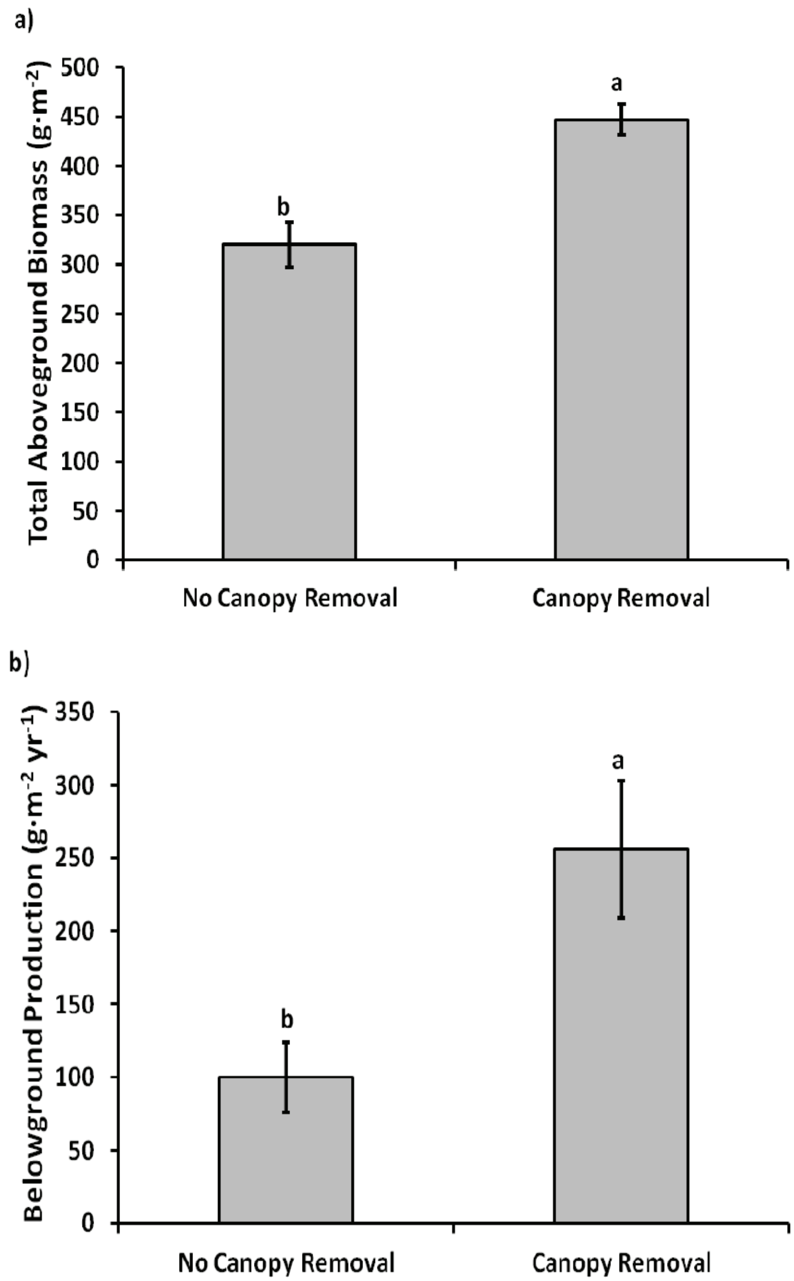


Fig. 6. Biomass production from No-Burn sites. a) Total aboveground biomass production, values represent the mean of 48 replicates (± standard error of the mean). b) Belowground production, values represent the mean production to a depth of 30 cm of 48 replicates (± standard error of the mean). Letters indicate the results of an ANOVA; means with different letters were significantly different from each other (a=0.05).

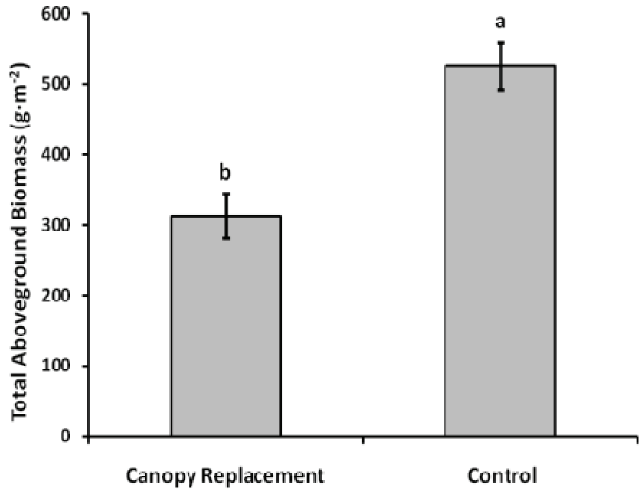


Fig. 7. Canopy replacement at annual-burn sites lowered total aboveground biomass. Different letters indicate significant differences (α=0.05).

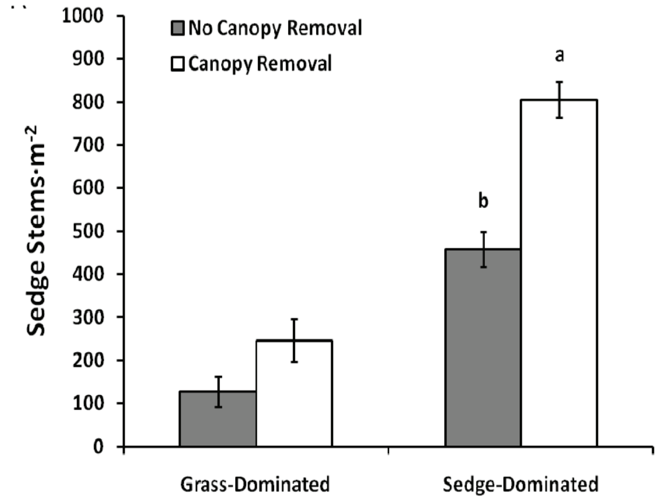


Fig. 8. Canopy removal increased sedge stem density at both grass and sedge-dominated sites. Different letters indicate significant differences (α=0.05).

Results by species

Our statistical analysis indicated that the effects of canopy removal were not consistent across our four study sites in the No-Burn experiment. Two of these sites were dominated by the sedge *Schoenoplectus americanus* while the other two were dominated by the grasses *Distichlis spicata* and *Spartina patens*. When we analyzed just the grass-dominated sites, we found that canopy removal had relatively minor or no effects on plant growth (the average biomass production at these sites was 457 g / m^2) . When we looked at the sedge-dominated sites, the effects of canopy removal were dramatic, including a 92% increase in aboveground biomass and a 250% increase in belowground production (Fig. 9). We also observed dramatic increases in the density of the sedges (Fig. 8), but not the grasses.

Sedge-dominated sites

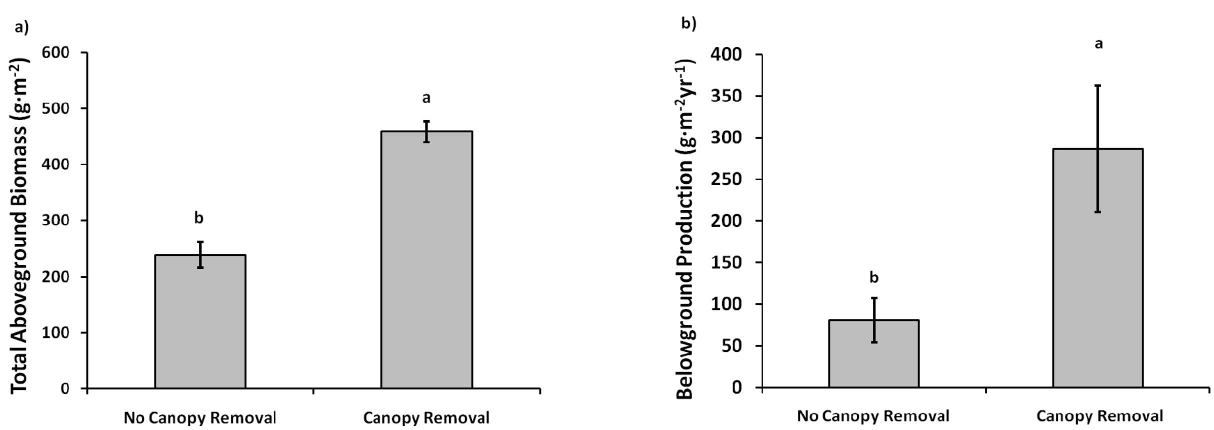


Fig. 9. Biomass production from sedge-dominated sites (2D and 7D) of No-Burn study. a) Total aboveground biomass production, values represent the mean of 24 replicates (± standard error of the mean). b) Belowground production, values represent the mean production to a depth of 30 cm of 24 replicates (± standard error of the mean). Letters indicate the results of an ANOVA; means with different letters were significantly different from each other (a=0.05).

Mechanisms

There are two explanations for why canopy removal may increase plant growth—increased light availability and increased soil temperatures. Both of these mechanisms are thought to be most important early in the growing season. We monitored light availability and did find that it increased dramatically following canopy removal. This effect diminished as the plant canopy was re-established, but it was present throughout that growing season. We also found that soil temperatures increased with canopy removals at depths of both 5 and 20 cm. The greatest increase in soil temperatures actually wasn't very early in the growing season (March to mid-April), which was probably because the marsh water levels were high during this period. Rather, we found that the greatest soil temperature increases were from mid-April to mid-June, when temperatures were about 0.5 to 2 °C warmer at 5 cm with canopy removal.

Why not nutrients?

We measured nutrient availability using four different methods – porewater, soils, resin capsules, and plant nutrient content – and found no increases in nutrients in our ash deposition treatment. Blackwater is a nitrogen limited system. As it turns out, the ash only contained 0.22 g nitrogen / m^2 (Table 1). This is probably not a sufficient fertilizer dose to generate a plant response when applied in the winter or early spring (plants are generally most nutrient-limited at their peak growth rate). Our combustion method generated relatively high burn temperatures (at least 320°C), which means that we had relatively low nitrogen in our samples. However, based on published models (Qian et al. 2009), even at lower burn temperatures the nitrogen content of our ash would likely have been in the range of 1 g Nitrogen / m^2; which based on our literature review probably still would not have generated a plant response (see Geatz, 2012). In general, we found that canopy removal by itself generated the type of plant growth stimulation that is commonly observed. We were able to reverse this effect with our canopy replacement treatment (which did have natural ash deposition). Overall, we found little support for nutrients as an important mechanism controlling plant response to fire in these systems.

Table 1. Elemental standing stocks of senesced vegetation and ash constituents applied to no-burn study sites along with percent volatilization. Standard error bars shown as well.

Element	Pre-Burn Biomass Constituents (g/m^2)	Percent Volatilized	Ash Constituents (g/m^2)
C	137.05 ± 11.73	93.87 ± 1.43	6.12 ± 0.67
N	3.46 ± 0.37	90.57 ± 2.14	0.22 ± 0.02
P	0.34 ± 0.03	50.55 ± 6.70	0.16 ± 0.02
K	5.13 ± 0.81	6.35 ± 4.51	4.96 ± 0.05
Ca	0.75 ± 0.08	4.67 ± 3.86	0.71 ± 0.06
Mg	1.20 ± 0.12	6.80 ± 7.36	1.10 ± 0.06
S	4.06 ± 0.60	84.82 ± 4.10	0.31 ± 0.03

Summary and implications

In a one-year manipulative study, we found that prescribed fire increased aboveground and belowground biomass production primarily through canopy removal, and not through fertilization by deposited ash. Biomass increases were greatest and most consistent following canopy removal in *S. americanus*-dominated communities. If increased biomass production is a desirable outcome, prescribed fire programs may benefit by maximizing canopy removal, particularly in *S. americanus*-dominated areas.

The data, figures, and tables in this fact sheet come from the following publications:

Bickford, W. A. 2011. Plant productivity and competitive response to prescribed fire in mid-Atlantic brackish marshes. M.S. Thesis, University of Maryland, College Park, MD, USA. 229p.

Bickford, W.A., A.H. Baldwin, B.A. Needelman, and R.R. Weil. 2012.Canopy disturbance alters competitive outcomes between two brackish marsh plant species. Aquatic Botany. doi:10.1016/j.aquabot.2012.05. 006

Bickford, W. A., B. A. Needelman, R. R. Weil, and A. H. Baldwin. 2012. Vegetation response to prescribed fire in Mid-Atlantic brackish marshes. Estuaries and Coasts 2012, DOI: 10.1007/s12237-012-9538-3

Geatz, G.W. 2012. Nutrient levels and organic matter decomposition in response to prescribed burns in Mid-Atlantic coastal marshes. M.S. Thesis. University of Maryland.

Geatz, G.W., B.A. Needelman, R.R. Weil, J.P. Megonigal. Nutrient Availability and Soil Organic Matter Decomposition Response to Prescribed Burns in Mid-Atlantic Brackish Marshes. (in review)

Citations

Cahoon D. R., G. Guntenspergen, S. Baird, J. Nagel, P. Hensel, J. Lynch, D. Bishara, P. Brennan, J. Jones, and C. Otto. 2010. Do annual prescribed fires enhance or slow the loss of coastal marsh habitat at Blackwater National Wildlife Refuge? Final Project Report (JFSP Number: 06-2-1-35). March 31, 2010. Beltsville, MD.

Qian, Y., S.L. Miao, B. Gu, and Y.C. Li. 2009. Estimation of postfire nutrient loss in the Florida everglades. J. Environ. Qual. 38:1812–1820.

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Some results presented in this fact sheet have not yet been peer-reviewed and should be interpreted as preliminary.

Publication

Year of Publication: 2012
Publisher: University of Maryland

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College of Agriculture & Natural Resources
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Sea Grant Maryland

Smithsonian Environmental Research Center

NATIONAL WILDLIFE REFUGE SYSTEM

PAGE DESIGN BY LAURENCE A. GINDI

Talisman Farm
Loess Deposits on the Delmarva Peninsula

Loess deposits on the Delmarva Peninsula were reported by Foss et al. in 1978. While thinner (generally < 1.5 m) than their midwestern counterparts, these loessal materials demonstrate classic characteristics of becoming more fine with increasing distance from the source (in this case the Susquehanna River channel of Chesapeake Bay) and becoming thinner with increasing distance from the source. Based upon carbon dates of buried A horizons at the base of some of the loess deposits, the loess was thought to be deposited at the very end of the Pleistocene.

At this stop an exposure along the bluff will be observed which contains silty deposits in the upper part but which grades into a sandier component in the lower part of the profile. As such, these soils are generally considered to be formed in loess over fluvio-deltaic coastal plain sediments. The poorly drained nature of the pedon puts it most closely to the Carmichael series.

Also of interest is the presence of sulfidic materials in the lower part of this soil (below sea level). Below is a graph showing the moist incubation of the dark 3Cg2 horizon materials. The characterization data for this horizon indicate that it has 0.95% OC and 0.91% S.

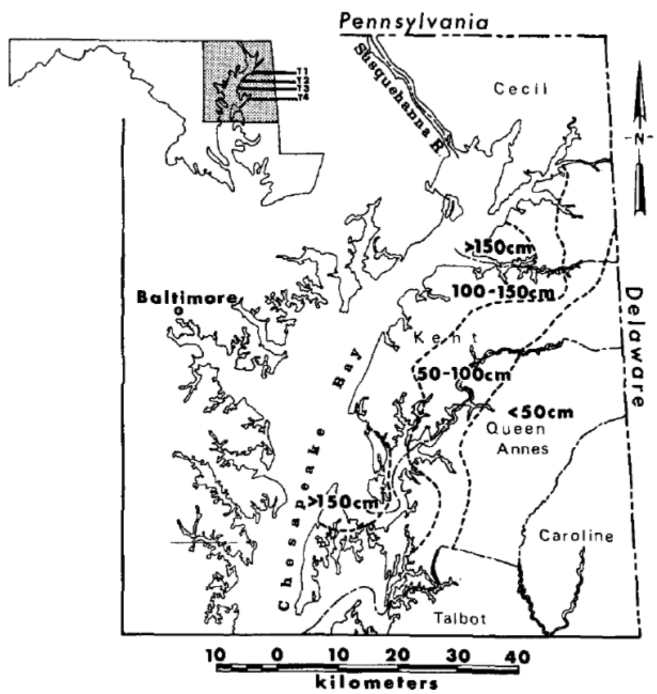


Fig. 1—Location of traverses (T1-T4) and thickness of loess deposits in the upper Eastern Shore of Maryland. Eastern Shore counties are indicated on map.

Foss, Fanning, Miller, and Wagner. 1978. Loess Deposits of the Eastern Shore of Maryland SSSAJ 42:329 – 334.


Ho
Bp
LZ
Ca
PiA
MtB
Pineyneck
HnB
Ca
Carmichael
Wh
PiA
Ot
Bluff - Carmichael
Wh
PiB
Ca
PiA
PiA

Pedon ID: S2012MD035002_Pineyneck

Description Date: 11/29/2012 12:16:13 PM
Describer: Diane Shields, Phil King, Jim Brewer, Marty Rabenhorst, Susan Demas, & Rob Tunstead
Text: The sample site is very close and just south of the an old landing strip per the USGS topo map.
Current Taxonomic Name: Pineyneck
Current Taxonomic Class: Coarse-loamy, mixed, active, mesic Aquic Hapludults
Non-MLRA Soil Survey Area: MD035 - Queen Anne's County, Maryland
Land Resource Region: T - Atlantic and Gulf Coast Lowland Forest and Crop Region
MLRA: 153C - Mid-Atlantic Coastal Plain
MLRA Region Office Area: 14 - Raleigh, NC
Physiographic Division: AL - Atlantic Plain
Physiographic Province: CP - Coastal Plain
MLRA Survey Office Management Area: 13-7 - Hammonton, New Jersey
Lat/Long: 38°55’46.992” north, 76°12’2.99” west
UTM: 395914E, 4309663N -- Datum WGS84, Zone 18
Location Description: Talisman Farm (Piney Neck) NCSS Conference 2013 pit just north of a drainage ditch in the old landing field per the Queenstown, MD 7.5' USGS topographic quadrangle.
Slope: 2 percent Elevation: 3.7 meters Aspect: 270°
Drainage: Moderately well drained
Parent Materials: silty eolian deposits over fluviomarine deposits
Particle Size Control Section: 37 to 79 centimeters
Diagnostic Features: Ochric epipedon: 0 to 26 centimeters, Argillic horizon: 37 to 79 centimeters, Redox depletions with chroma 2 or less: 68 to 93 centimeters, Lithologic discontinuity: 79 to 119 centimeters and Lithologic discontinuity: 119 to 205 centimeters

Ap1 --- 0 to 15 centimeters; dark brown (10YR 3/3) moist, loam; null percent sand; null percent silt; 9 percent clay; weak medium subangular blocky structure; friable; common fine roots throughout and moderately few medium roots throughout; clear wavy boundary.

Ap2 --- 15 to 26 centimeters; brown (10YR 4/3) moist, fine sandy loam; null percent sand; null percent silt; 10 percent clay; weak coarse subangular blocky structure; friable; moderately few fine roots throughout; abrupt smooth boundary.

BE --- 26 to 37 centimeters; yellowish brown (10YR 5/4) moist, loam; null percent sand; null percent silt; 14 percent clay; weak coarse subangular blocky structure; friable; moderately few fine roots throughout; 10% worm holes filled with Ap material.; gradual wavy boundary.

Bt1 --- 37 to 68 centimeters; yellowish brown (10YR 5/6) moist, loam; null percent sand; null percent silt; 22 percent clay; moderate medium subangular blocky structure; friable; moderately few fine roots throughout; 5 percent (few) discontinuous faint clay films on surfaces along pores; clear wavy boundary.

Bt2 --- 68 to 79 centimeters; strong brown (7.5YR 4/6) moist, silt loam; null percent sand; null percent silt; 22 percent clay; moderate medium subangular blocky structure; firm; very few fine roots throughout; 10 percent (few) faint clay films on vertical faces of peds; 5 percent (common) medium distinct irregular noncemented strong brown (7.5YR 4/6), moist, masses of oxidized iron diffuse throughout and 10 percent (common) medium distinct irregular noncemented grayish brown (10YR 5/2), moist, iron depletions clear throughout; abrupt wavy boundary.

2BC1 --- 79 to 93 centimeters; yellowish brown (10YR 5/6) moist, fine sandy loam; null percent sand; null percent silt; 11 percent clay; weak medium subangular blocky structure; firm; 10 percent (common) medium distinct irregular noncemented grayish brown (10YR 5/2), moist, iron depletions clear throughout and 10 percent (common) medium distinct irregular noncemented strong brown (7.5YR 4/6), moist, masses of oxidized iron clear throughout; clear smooth boundary.

2BC2 --- 93 to 119 centimeters; yellowish brown (10YR 5/6) moist, fine sandy loam; null percent sand; null percent silt; 9 percent clay; weak medium angular blocky structure; firm; 5 percent (common) medium distinct irregular noncemented very pale brown (10YR 7/3), moist, iron depletions clear throughout and 20 percent (many) medium distinct irregular noncemented strong brown (7.5YR 4/6), moist, masses of oxidized iron clear throughout; The concentrations are fine sand and the depletions are fsl. and 9YR 5/6 matrix color; clear smooth boundary.

3BC3 --- 119 to 155 centimeters; brown (10YR 5/3) moist, loam; null percent sand; null percent silt; 20 percent clay; weak coarse platy structure; friable; 20 percent (many) medium distinct irregular noncemented strong brown (7.5YR 4/6), moist, masses of oxidized iron diffuse throughout and 10 percent (common) medium distinct cylindrical noncemented grayish brown (10YR 5/2), moist, iron depletions clear on vertical faces of peds; clear irregular boundary.

3A --- 155 to 178 centimeters; dark gray (2.5Y 4/1) moist, fine sandy loam; null percent sand; null percent silt; 18 percent clay; weak medium subangular blocky structure; friable; coarse distinct irregular noncemented white (10YR 8/1), moist, iron depletions clear throughout and 25 percent (many) medium prominent irregular noncemented yellowish brown (10YR 5/6), moist, masses of oxidized iron clear throughout; Old surface horizon.; abrupt wavy boundary.

3Bg --- 178 to 205 centimeters; gray (10YR 5/1) moist, loam; null percent sand; null percent silt; 20 percent clay; weak coarse subangular blocky structure; friable; 20 percent (many) medium distinct irregular noncemented light gray (10YR 7/2), moist, iron depletions clear throughout, 2 percent (common) fine prominent irregular noncemented red (2.5YR 4/8), moist, masses of oxidized iron clear throughout and 15 percent (common) medium distinct irregular noncemented yellowish red (5YR 5/8), moist, masses of oxidized iron clear throughout.

***Using Soil OM from the 3A horizon (155 to 178 cm), an AMS date by Univ. of GA yielded a corrected age of 13,350 +/- 30 YBP (UGAMS #13696) which calibrates to 16,291 +/- 415 calYBP.**

THE ARCHAEOLOGY AND UPLAND SITE FORMATION PROCESSES AT TALISMAN FARM: A REGIONAL CONTEXT

By
Darrin L. Lowery, Ph.D.
6-3-2013

The stone tools found along the eroded shoreline at Talisman Farm in Queen Annes County, Maryland provide several sources of information about the site and how it fits within regional context. The assemblage includes a chert corner-notched knife, a patinated chalcedony corner-notched projectile point, and a silicified sandstone utilized flake (see Figure 1). The knife and projectile point are stylistically identical to regional Middle Atlantic artifacts that have been dated to circa 11,000 to 10,000 years old. These artifacts are typical of regional early Holocene-age prehistoric encampments associated with hunting and animal processing.

The importance of these specimens does not relate to their age, their size, or the stone materials used to in their manufacture. Similar-age artifacts are very common on the Delmarva Peninsula. The importance of these artifacts relates to damage and scaring on their surface. Even though the artifacts have eroded out of primary context, all three retain some evidence of their original contexts within the Talisman Farm soil profile. Oxidized iron streaks or scars along the faces of each artifact, as well as recent damage to some of the edges are all byproducts of farm equipment. As such, the damage indicates that these artifacts were in the plowzone (Ap-soil horizon). So we can conclude that these artifacts were not buried and were in the plowed surface at Talisman Farm. Aside from recent agriculture disturbances, the surface of Talisman Farm has essentially been weathering in place for at least 11,000 years.

In the region near Talisman Farm, there are three archaeological sites that have revealed diagnostic Clovis-age (circa 13,000 calyBP) artifacts immediately above a buried A-horizon or paleosol. The same buried A-horizon or paleosol was exposed at Talisman Farm. Early Holocane-age artifacts, similar to the examples associated with the plowed surface at Talisman Farms, have been found in the plowzone at other archaeological sites in the area. These other sites also have profiles with a buried A-horizon. Based on the damage, we can conclude that the diagnostic artifacts found at Talisman Farm suggest that the modern surface has been stable for at least 11,000 years. The degree of soil development also supports this contention. Based on the regional stratigraphic position of diagnostic Clovis-age artifacts, we can also conclude that the parent sediments encompassing the plowzone to a depth of ~1.5 meters were deposited during a very short interval between 13,000 and 11,000 years ago.

What is important about the period between 13,000 and 11,000 years ago? Based on the Greenland Ice Core data (see Figure 2), this short-interval of time correlates with the Younger Dryas cold period, which began circa 12,920 calyBP and ended circa 11,700 calyBP (see Figure 2). This was an episode of a return to full-glacial conditions. During this era, regional Middle Atlantic sea level was approximately -50 meters (-164 feet) to -45 meters (-147 feet) lower. As such, the parent sediments located stratigraphically above the buried A-horizon at Talisman Farm and many other locations along the western-side of the Delmarva Peninsula were deposited via aeolian processes during an extreme northern hemisphere cold event. Where did the parent sediments originate?

The 3Ab soil horizon located 1.5 meters beneath the surface at Talisman Farms produced a corrected C14-age of 13,350 +/- 30 rcyBP, which calibrates to 16,291 ± 412 calyBP. The 3Ab soil and the underlying horizons are markedly more developed compared with the overlying Younger Dryas-age loess at Talisman Farm. Given the structural break, the surface seems to have been eroded or deflated during a very short interval. The erosional unconformity is also indicated at several localities by the presence of Clovis-age artifacts as a lag deposit on top of this much older surface. It is presumed that the erosion, which deflated the region's uplands at the onset of the Younger Dryas, ultimately provided the parent material to be reworked in the lowlands and redeposited back into the uplands during the later phases of Younger Dryas via aeolian activity.

It is important to recognize the magnitude of climate change during the period between 15,000 years ago and 11,000 years ago and its potential impact on the region. At the end of the last glacial maximum, northern hemisphere warming was relatively slow. Around 14,800 years ago, the northern hemisphere began to rapidly warm. Between 14,620 and 14,320 years ago, the northern hemisphere temperatures as recorded in the Greenland Ice cores are analogous to current conditions. As a result, Holocene climax forests could have easily been established on the Delmarva Peninsula over this three hundred year period.

In tandem, global sea levels responded, as a result of the extreme warm temperatures. Sea levels during this extreme warm period rose twenty-meters (66 feet) during a short five-hundred year period starting around 14,500 years ago. Between 14,000 and 12,900 years ago, the northern hemisphere temperatures were comparable to conditions during the early Holocene. Many of our modern warm-adapted deciduous tree species had already colonized the Middle Atlantic region. For example, sweet gum (*Liquidambar styraciflua*) has been found within a Clovis-age hearth feature along the banks of the northern Delaware River, which was dated to 12,900 years old. A return to full-glacial conditions during the twelve-hundred year period associated with the Younger Dryas would have greatly stressed the well-established Holocene-like vegetation communities within the Middle Atlantic region. Extinct browsing and grazing animal species, such as mammoth, mastodon, giant bison, and horse would have further stressed and destabilized the upland landscapes in the region. As a result, the erosional unconformity evident may represent the combined impacts of rapid climatic change, vegetation modification, and biological stress.

It would seem that the period of most intense cold during the last ice age resulted in boreal upland environmental conditions. The 3Ab soil has been dated at other locations along the western flanks of the Delmarva Peninsula between circa 19,000 and 27,000 calyBP. As such, the buried surface correlates with Last Glacial Maximum (i.e., LGM) and immediate post-LGM as recorded in the northern hemisphere ice core record. Research has shown that this surface represents a cold-adapted grassland setting. A grassland environment is also suggested by the overall thickness of the buried A-horizon at Talisman Farm and other locations in the region. Additional plant taxa have been identified by the carbonized remains within this surface. Red spruce (*Picea rubens*), balsam fir (*Abies balsamea*), and "krummholz" yellow birch (*Betula alleghaniensis*) were recognized at Miles Point, which is located less than six miles from Talisman Farm. Importantly, the"krummholz" or twisted cell structures noted for the yellow birch imply high-wind conditions.

In summation, the combined disciplines of archaeology, soil science, geology, and climatology provide a very detailed and high-resolution record of individual study areas; such as the Delmarva Peninsula and Talisman Farm. Through the "eyes" of only one scientific discipline, the record from Talisman Farm and other similar sites may not have been recognized.

Figure 1. The image shows diagnostic early Holocene-age artifacts found along the eroded shoreline at Talisman Farm.

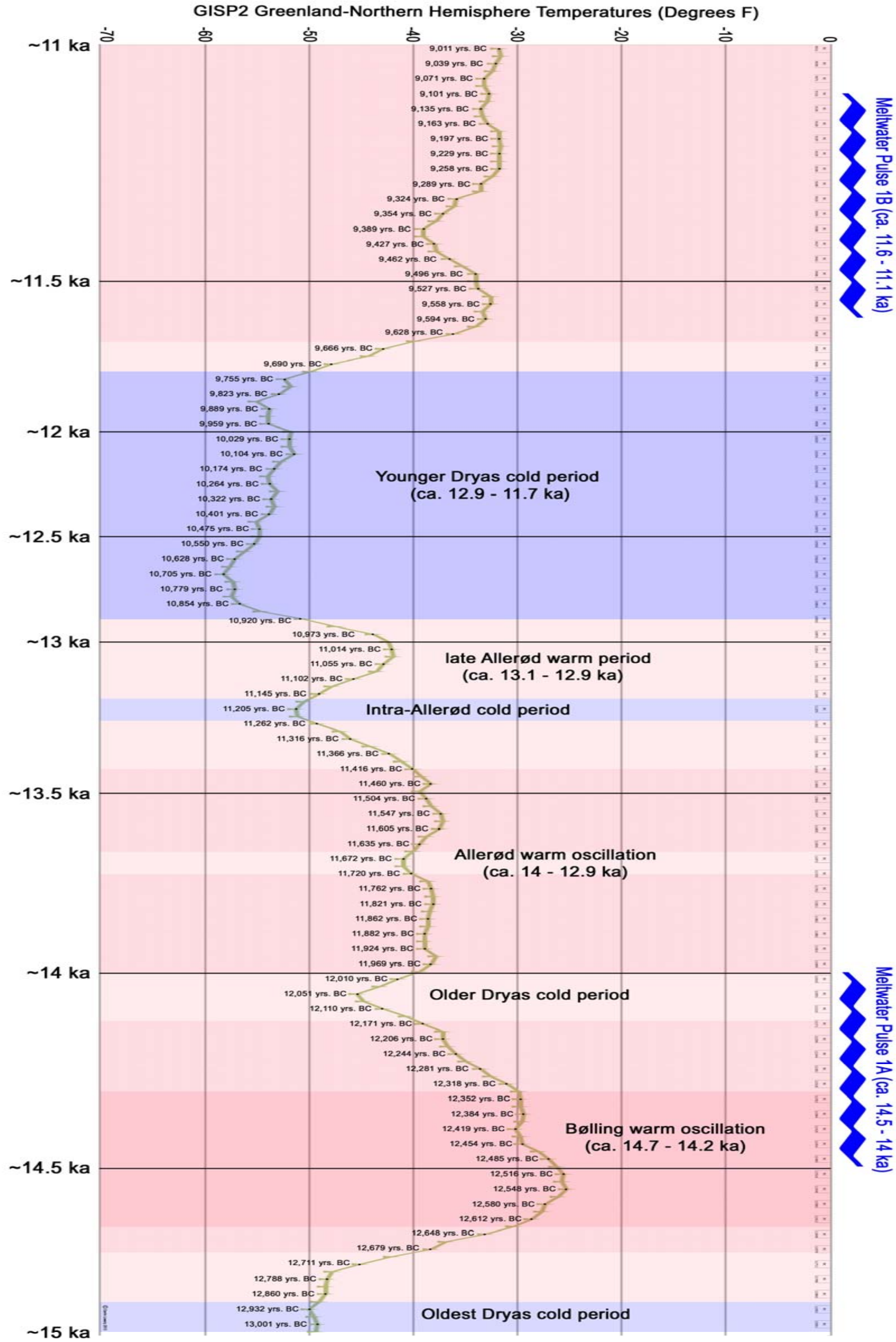


Figure 2. The illustration portrays the northern hemisphere climate change as recorded in the Greenland ice cores. Pulses of global sea level rise are also plotted. © Darrin Lowery 2013

Pineyneck Data

*** Primary Characterization Data ***

(Queen Anne's, Maryland)

Pedon ID: S2012MD035002

Print Date: Apr 26 2013 8:23AM

Sampled as on Nov 29, 2012: Pineyneck ; Coarse-loamy, mixed, active, mesic Aquic Hapludult
Revised to :

SSL - Project C2013USMD032 MD NCSS Conference
- Site ID S2012MD035002 Lat: 38° 55' 46.99" north Long: 76° 12' 2.99" west WGS84 MLRA: 153C
- Pedon No. 13N0424
- General Methods 1B1A, 2A1, 2B

United States Department of Agriculture
Natural Resources Conservation Service
National Soil Survey Center
Soil Survey Laboratory
Lincoln, Nebraska 68508-3866

Layer	Horizon	Orig Hzn	Depth (cm)	Field Label 1	Field Label 2	Field Label 3	Field Texture	Lab Texture
13N01719	Ap1		0.0-15.0	S2012MD035002-1			L	L
13N01720	Ap2		15.0-26.0	S2012MD035002-2			FSL	L
13N01721	BE		26.0-37.0	S2012MD035002-3			L	SIL
13N01722	Bt1		37.0-68.0	S2012MD035002-4			L	SIL
13N01723	Bt2		68.0-79.0	S2012MD035002-5			SIL	SIL
13N01724	2BC1		79.0-93.0	S2012MD035002-6			FSL	L
13N01725	2BC2		93.0-119.0	S2012MD035002-7			FSL	FSL
13N01726	3BC3		119.0-155.0	S2012MD035002-8			L	L
13N01727	3AB		155.0-178.0	S2012MD035002-9			FSL	FSL
13N01728	3Bg		178.0-205.0	S2012MD035002-10			L	FSL

Pedon Calculations

Calculation Name	Result	Units of Measure
Weighted Particles, 0.1-75mm, 75 mm Base	18.04	% wt
Volume, >2mm, Weighted Average	0	% vol
Clay, total, Weighted Average	17.719	% wt
Clay, carbonate free, Weighted Average	17.719	% wt
CEC Activity, CEC7/Clay, Weighted Average, CECd, Set 4	0.312	(NA)
LE, Whole Soil, Summed to 1m	0.4	cm/m

Weighted averages based on control section: 37-79 cm

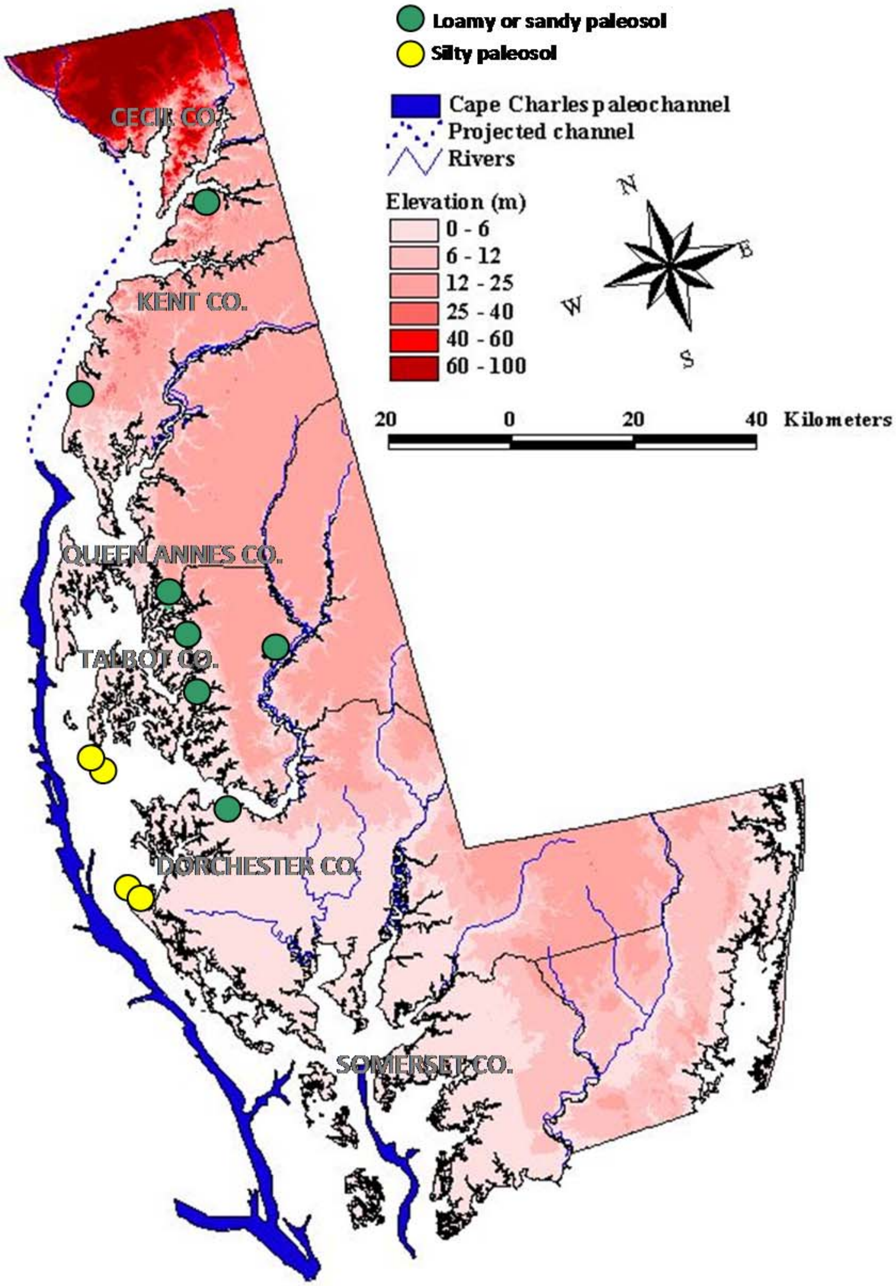


Figure 6-1. Location of paleosols. Silty paleosols were identified on the low terrace near the ancestral channel of the Susquehanna River. Loamy and sandy paleosols were identified on both the terrace and the upland. (Wah Dissertation)

Time divisions	Age* (ka)	Oxygen-isotope stage*		Climatic event	Sea level (m)
Holocene		1		Younger Dryas	-22[a]
	11			Bolling/Allerod	-26[b] -30[c]
Late Wisconsin		2		Late glacial maximum	-120[g] -85[h]
					+4.5[e] -40[i]
	35				
Middle Wisconsin		3			
	65				
Early Wisconsin		4			
	75				
Early Wisconsin/ Late Sangamon		5	a		+?[a] -7[d] -15[f]
			b		OR
			c		+?[a] -15[f]
			d		
	120				
Sangamon Interglacial			e	Peak interglacial	+6[a,d,e,f]

*Richmond and Fullerton (1986) and Bradley (1999); [a]Groot and Jordan (1999); [b]Kraft et al. (1987); [c]Colman (2000); [d]Tuscano and York (1992); [e]Owens and Denny (1979); [f]Gallup et al. (1994); [g]Fairbanks (1989); [h]Dillon and Oldale (1978); [i]Cronin (personal communication, 2002)

Figure 2-1. Oxygen-isotope stages, climatic events, and sea levels in the Mid-Atlantic region during the Late Pleistocene.

*** Primary Characterization Data ***

Pedon ID: S2012MD035002 (Queen Anne's County, Maryland) Print Date: Apr 26 2013 8:23AM

Sampled As : Pineyneck Coarse-loamy, mixed, active, mesic Aquic Hapludult

USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 13N0424

PSDA & Rock Fragments

Layer	Depth (cm)	Horz	Prep	-1- Total Clay < .002	-2- Total Silt .002 -.05	-3- Total Sand .05 -2	-4- Clay Fine < .0002	-5- Clay CO_3 < .002	-6- Silt Fine .002 -.02	-7- Silt Coarse .02 -.05	-8- Sand VF .05 -.10	-9- Sand F .10 -.25	-10- Sand M .25 -.50	-11- Sand C .5 -1	-12- Sand VC 1 -2	-13- Rock Fragments Weight 2 -5	-14- Rock Fragments Weight 5 -20	-15- Rock Fragments Weight 20 -75	-16- Rock Fragments Weight .1- 75	-17- >2 mm wt % whole soil
				(- - - % of <2mm Mineral Soil - - -)												(- - % of <75mm - -)				
				3A1a1a					3A1a1a		3A1a1a	3A1a1a	3A1a1a	3A1a1a	3A1a1a					
13N01719	0-15	Ap1	S	8.5	44.3	47.2			23.1	21.2	12.8	24.4	9.2	0.7	0.1	--	--	--	34	--
13N01720	15-26	Ap2	S	7.8	44.9	47.3			23.6	21.3	10.8	24.4	11.0	1.0	0.1	tr	--	--	37	tr
13N01721	26-37	BE	S	12.6	53.0	34.4			32.5	20.5	9.5	17.3	6.7	0.7	0.2	--	--	--	25	--
13N01722	37-68	Bt1	S	17.5	53.0	29.5			31.6	21.4	9.6	13.3	6.1	0.4	0.1	--	--	--	20	--
13N01723	68-79	Bt2	S	18.4	60.6	21.0			34.2	26.4	8.2	9.9	2.8	0.1	--	--	--	--	13	--
13N01724	79-93	2BC1	S	11.1	37.3	51.6			17.9	19.4	12.6	27.3	11.1	0.6	tr	--	--	--	39	--
13N01725	93-119	2BC2	S	9.4	25.1	65.5			11.3	13.8	12.7	35.0	16.7	1.1	--	--	--	--	53	--
13N01726	119-155	3BC3	S	21.5	47.7	30.8			29.0	18.7	8.7	18.2	3.7	0.2	--	--	--	--	22	--
13N01727	155-178	3AB	S	19.9	26.9	53.2			15.0	11.9	15.7	36.1	1.3	0.1	--	--	--	--	38	--
13N01728	178-205	3Bg	S	16.8	23.4	59.8			14.1	9.3	17.9	41.1	0.7	0.1	--	--	--	--	42	--

Bulk Density & Moisture

Layer	Depth (cm)	Horz	Prep	-1- Bulk Density 33 kPa	-2- Bulk Density Oven Dry	-3- Cole Whole Soil	-4- Water Content 6 kPa	-5- Water Content 10 kPa	-6- Water Content 33 kPa	-7- Water Content 1500 kPa	-8- 1500 kPa Moist	-9- Ratio AD/OD	-10- WRD Whole Soil	-11- Aggst Stabl 2-0.5mm	-12- Ratio/Clay CEC7	-13- Ratio/Clay 1500 kPa
				(- - - g cm^{-3} - - -)			(- - - pct of < 2mm - - -)						cm^3 cm^{-3}	%		
				DbWR1	DbWR1				DbWR1	3C2a1a		3D1				
13N01719	0-15	Ap1	S	1.43	1.47	0.009			24.2	5.6		1.007	0.27		0.67	0.66
13N01720	15-26	Ap2	S	1.61	1.63	0.004			14.4	3.3		1.005	0.18		0.47	0.42
13N01721	26-37	BE	S	1.68	1.70	0.004			14.1	4.6		1.006	0.16		0.29	0.37
13N01722	37-68	Bt1	S	1.72	1.73	0.002			14.2	7.5		1.010	0.12		0.30	0.43
13N01723	68-79	Bt2	S	1.63	1.65	0.004			18.1	7.9		1.012	0.17		0.34	0.43
13N01724	79-93	2BC1	S	1.65	1.65	--			12.9	5.0		1.007	0.13		0.33	0.45
13N01725	93-119	2BC2	S	1.78	1.80	0.004			9.0	3.9		1.006	0.09		0.34	0.41
13N01726	119-155	3BC3	S							8.7		1.013			0.38	0.40
13N01727	155-178	3AB	S							3.8		1.014			0.40	0.19
13N01728	178-205	3Bg	S							6.8		1.009			0.43	0.40

Pineyneck Data

*** Primary Characterization Data ***

Pedon ID: S2012MD035002 (Queen Anne's County, Maryland) Print Date: Apr 26 2013 8:23AM

Sampled As : Pineyneck Coarse-loamy, mixed, active, mesic Aquic Hapludult

USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 13N0424

Water Content

Layer	Depth (cm)	Horz	Prep	-1- Atterberg Limits LL	-2- Atterberg Limits PI	-3- Bulk Density Field	-4- Bulk Density Recon 33 kPa	-5- Bulk Density Recon Oven Dry	-6- Water Content Field	-7- Water Content Recon 33 kPa	-8- Sieved Samples 6 kPa	-9- Sieved Samples 10 kPa	-10- Sieved Samples 33 kPa	-11- Sieved Samples 100 kPa	-12- Sieved Samples 200 kPa	-13- Sieved Samples 500 kPa
				pct <0.4mm		g cm^{-3}			% of < 2mm							
															3C1e1a	
13N01719	0-15	Ap1	S												9.6	
13N01720	15-26	Ap2	S												7.3	
13N01721	26-37	BE	S												10.8	
13N01722	37-68	Bt1	S												12.8	
13N01723	68-79	Bt2	S												14.1	
13N01724	79-93	2BC1	S												8.5	
13N01725	93-119	2BC2	S												6.3	
13N01726	119-155	3BC3	S												15.6	
13N01727	155-178	3AB	S												12.8	
13N01728	178-205	3Bg	S												11.9	

Carbon & Extractions

Layer	Depth (cm)	Horz	Prep	-1- Total C	-2- Total N	-3- Total S	-4- Est OC	-5- OC (WB)	-6- C/N Ratio	-7- Dith-Cit Ext Fe	-8- Dith-Cit Ext Al	-9- Dith-Cit Ext Mn	-10- Ammonium Oxalate Extraction Al+½Fe	-11- ODOE	-12- Fe	-13- Al	-14- Si	-15- Mn	-16- Na Pyro-Phosphate C	-17- Fe	-18- Al	-19- Mn
				% of <2 mm						% of < 2mm								mg kg^{-1}	% of < 2mm			
				4H2a	4H2a	4H2a				4G1	4G1	4G1										
13N01719	0-15	Ap1	S	1.80	0.19	0.01	1.8		10	0.4	0.1	--										
13N01720	15-26	Ap2	S	0.69	0.06	--	0.7		12	0.4	0.1	tr										
13N01721	26-37	BE	S	0.30	0.03	--	0.3		12	1.1	0.1	--										
13N01722	37-68	Bt1	S	0.20	0.04	--	0.2		6	1.2	0.1	--										
13N01723	68-79	Bt2	S	0.13	0.01	--	0.1		11	1.2	0.1	--										
13N01724	79-93	2BC1	S	0.07	0.04	--	0.1		2	0.7	0.1	--										
13N01725	93-119	2BC2	S	0.04	--	--	tr			0.4	tr	--										
13N01726	119-155	3BC3	S	0.08	0.03	--	0.1		3	1.1	0.1	--										
13N01727	155-178	3AB	S	0.07	0.06	tr	0.1		1	0.3	tr	--										
13N01728	178-205	3Bg	S	0.05	tr	--	tr		5	0.1	tr	--										

Pineyneck Data

*** Primary Characterization Data ***

Pedon ID: S2012MD035002 (Queen Anne's County, Maryland) Print Date: Apr 26 2013 8:23AM
Sampled As : Pineyneck Coarse-loamy, mixed, active, mesic Aquic Hapludult
USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 13N0424

CEC & Bases

Layer	Depth (cm)	Horz	Prep	-1- Ca	-2- Mg	-3- Na	-4- K	-5- Sum Bases	-6- Acid-ity	-7- Extr Al	-8- KCl Mn	-9- CEC8 Sum Cats	-10- CEC7 NH_4 OAC	-11- ECEC Bases +Al	-12- Al Sat	-13- Base Saturation Sum	-14- Base Saturation NH_4OAC
				(------ NH_4OAC Extractable Bases -----)													
				(- - - cmol(+) kg^{-1} - - -)							mg kg^{-1}	(- - - cmol(+) kg^{-1} - - -)			(- - - % - - -)		
				4B1a1a	4B1a1a	4B1a1a	4B1a1a		4B2b1a1	4B3a1a	4B3a1a		4B1a1a				
13N01719	0-15	Ap1	S	2.5	0.8	--	0.2	3.5	7.3	0.3	1.6	10.8	5.7	3.8	8	32	61
13N01720	15-26	Ap2	S	1.5	0.3	--	0.1	1.9	4.8	0.4	0.5	6.7	3.7	2.3	17	28	51
13N01721	26-37	BE	S	2.2	0.4	--	0.1	2.7	3.8	0.2	0.2	6.5	3.7	2.9	7	42	73
13N01722	37-68	Bt1	S	3.9	0.6	--	0.1	4.6	3.8			8.4	5.3			55	87
13N01723	68-79	Bt2	S	5.0	0.7	--	0.2	5.9	3.4			9.3	6.2			63	95
13N01724	79-93	2BC1	S	3.2*	0.4	--	0.1	3.7	2.1			5.8	3.7			64	100
13N01725	93-119	2BC2	S	2.7*	0.4	--	0.1	3.2	1.5			4.7	3.2			68	100
13N01726	119-155	3BC3	S	5.1	1.3	--	0.1	6.5	4.8			11.3	8.1			58	80
13N01727	155-178	3AB	S	4.2	2.3	0.2	0.1	6.8	5.2	0.7	tr	12.0	7.9	7.5	9	57	86
13N01728	178-205	3Bg	S	1.1	1.7	--	0.1	2.9	7.4	2.7	--		7.2				40

*Extractable Ca may contain Ca from calcium carbonate or gypsum. CEC7 base saturation set to 100.

Salt

Layer	Depth (cm)	Horz	Prep	-1- Ca	-2- Mg	-3- Na	-4- K	-5- CO_3	-6- HCO_3	-7- F	-8- Cl	-9- PO_4	-10- Br	-11- OAC	-12- SO_4	-13- NO_2	-14- NO_3	-15- H_2O	-16- Total Salts	-17- Elec Cond	-18- Pred Elec Cond	-19- Exch Na	-20- SAR
				(Water Extracted From Saturated Paste)																			
				(- - - mmol(+) L^{-1} - - -)				(- - - mmol(-) L^{-1} - - -)										(- - - % - - -)		(- - dS m^{-1} - -)		%	
13N01719	0-15	Ap1	S																			--	
13N01720	15-26	Ap2	S																			--	
13N01721	26-37	BE	S																			--	
13N01722	37-68	Bt1	S																			--	
13N01723	68-79	Bt2	S																			--	
13N01724	79-93	2BC1	S																			--	
13N01725	93-119	2BC2	S																			--	
13N01726	119-155	3BC3	S																			--	
13N01727	155-178	3AB	S																			3	
13N01728	178-205	3Bg	S																			--	

Pineyneck Data

*** Primary Characterization Data ***

Pedon ID: S2012MD035002 (Queen Anne's County, Maryland) Print Date: Apr 26 2013 8:23AM

Sampled As : Pineyneck Coarse-loamy, mixed, active, mesic Aquic Hapludult

USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 13N0424

pH & Carbonates

Layer	Depth (cm)	Horz	Prep	-1- KCl	-2- $CaCl_2$ 0.01M 1:2 4C1a2a	-3- H_2O 1:1 4C1a2a	-4- Sat Paste	-5- Oxid	-6- NaF	-7- Carbonate As $CaCO_3$ <2mm (%) 4E1a1a1a1	-8- Carbonate As $CaCO_3$ <20mm (%)	-9- Gypsum As $CaSO_4*2H_2O$ <2mm (%)	-10- Gypsum As $CaSO_4*2H_2O$ <20mm (%)	-11- Resist ohms cm^{-1}
13N01719	0-15	Ap1	S		4.5	4.9								
13N01720	15-26	Ap2	S		4.5	5.3								
13N01721	26-37	BE	S		5.0	5.9								
13N01722	37-68	Bt1	S		5.3	6.1								
13N01723	68-79	Bt2	S		5.5	6.4								
13N01724	79-93	2BC1	S		5.6	6.3								
13N01725	93-119	2BC2	S		5.6	6.4				–				
13N01726	119-155	3BC3	S		5.6	6.3				–				
13N01727	155-178	3AB	S		5.0	5.9				–				
13N01728	178-205	3Bg	S		4.2	5.1				tr				

Phosphorous

Layer	Depth (cm)	Horz	Prep	-1- Melanic Index	-2- NZ (%)	-3- Acid Oxal (mg kg^{-1})	-4- Anion Available	-5- Exch Resin Capacity	-6- Bray 1	-7- Bray 2	-8- Olsen	-9- H_2O	-10- Citric Acid	-11- Mehlich III 4D6a1	-12- KCl Extr NO_3
13N01719	0-15	Ap1	S											6.7	
13N01720	15-26	Ap2	S											3.4	
13N01721	26-37	BE	S											4.4	
13N01722	37-68	Bt1	S											1.6	

Pineyneck Data

*** Primary Characterization Data ***

Pedon ID: S2012MD035002 (Queen Anne's County, Maryland) Print Date: Apr 26 2013 8:23AM
Sampled As : Pineyneck Coarse-loamy, mixed, active, mesic Aquic Hapludult
USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 13N0424

Clay Mineralogy (<.002 mm)

Layer	Depth (cm)	Horz	Fraction	-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-
				X-Ray					Thermal				Elemental							EGME	Inter
													SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	K_2O	Na_2O	Retn	preta
				7A1b1					7A4a												tion
				(---------- peak size ----------)					(---------- % ----------)				(------------------ % ------------------)							$mg\ g^{-1}$	
13N01722	37-68	Bt1	tcly	KK 3	VR 2	MI 2					KK 32	GE 13									CMIX
13N01723	68-79	Bt2	tcly	KK 2	VR 2	MI 2	GE 1				KK 34	GE 16									CMIX

FRACTION INTERPRETATION:
tcly - Total Clay, <0.002 mm

MINERAL INTERPRETATION:
GE - Goethite KK - Kaolinite MI - Mica VR - Vermiculite

RELATIVE PEAK SIZE: 5 Very Large 4 Large 3 Medium 2 Small 1 Very Small 6 No Peaks

Pedon ID: S2012MD035001_Carmichael

Description Date: 11/29/2012 10:14:54 AM
Describer: Phil King, Susan Demas, Marty Rabenhorst, Diane Shields, Jim Brewer, & Rob Tunstead
Pedon Notes: Text: Consensus of the group thought that the site might have a particle size class of fine-loamy instead of coarse loamy.
Current Taxonomic Name: Carmichael
Current Taxonomic Class: Coarse-loamy, mixed, active, mesic Typic Endoaquults
Non-MLRA Soil Survey Area: MD035 - Queen Anne's County, Maryland
Land Resource Region: T - Atlantic and Gulf Coast Lowland Forest and Crop Region
MLRA Region Office Area: 14 - Raleigh, NC
Physiographic Division: AL - Atlantic Plain Physiographic Province: CP - Coastal Plain
Physiographic Section: EMS - Embayed section MLRA Survey Area: 13-7 - Hammonton, New Jersey
Lat/Long: 38°55’46” north, 76°12’5.99” west
UTM: 395841E, 4309633N -- Datum WGS84, Zone 18
Location Description: Talisman Farm (Piney Neck) NCSS Conference Field Tour site 2013 pit in the middle triangle of a retired landing field, 187 feet south of the northern runway, Queenstown, MD 7.5' USGS topographic quadrangle.
Landform: broad interstream divide
Slope: 1 percent Elevation: 2.1 meters Aspect: 270°
Drainage: Poorly drained
Parent Materials: silty eolian deposits over sandy fluviomarine deposits
Particle Size Control Section: 42 to 83 centimeters
Diagnostic Features: Endosaturation: 0 to 115 centimeters, Ochric epipedon: 0 to 42 centimeters, Aquic conditions: 0 to 115 centimeters, Reduced matrix: 31 to 115 centimeters, Albic horizon: 31 to 42 centimeters, Argillic horizon: 42 to 83 centimeters and Lithologic discontinuity: 83 to 115 centimeters

Ap1 --- 0 to 7 centimeters; very dark grayish brown (10YR 3/2) moist, loam; moderate coarse subangular blocky structure; friable, nonsticky, nonplastic; common fine roots throughout and common very fine roots throughout; clear wavy boundary.

Ap2 --- 7 to 31 centimeters; grayish brown (10YR 5/2) moist, loam; moderate coarse subangular blocky structure; friable, slightly sticky, slightly plastic; moderately few medium roots throughout, moderately few very fine roots throughout and moderately few fine roots throughout; 15 percent (common) medium prominent irregular noncemented yellowish red (5YR 5/6), moist, masses of oxidized iron clear throughout and 15 percent (common) fine prominent irregular noncemented yellowish red (5YR 5/6), moist, masses of oxidized iron clear throughout; abrupt smooth boundary.

Eg --- 31 to 42 centimeters; light gray (10YR 7/1) moist, fine sandy loam; moderate coarse subangular blocky structure; friable, slightly sticky, moderately plastic; moderately few fine roots throughout and moderately few medium roots throughout; 18 percent (common) coarse prominent irregular noncemented strong brown (7.5YR 5/6), moist, masses of oxidized iron diffuse throughout and 17 percent (common) medium prominent irregular noncemented strong brown (7.5YR 5/6), moist, masses of oxidized iron clear throughout; clear wavy boundary.

Btg --- 42 to 61 centimeters; gray (2.5Y 6/1) moist, sandy clay loam; null percent sand; null percent silt; 25 percent clay; moderate coarse subangular blocky structure; very friable, moderately sticky, moderately plastic; common medium roots throughout and common fine roots throughout; 3 percent (common) fine prominent irregular noncemented yellowish red (5YR 5/6), moist, masses of oxidized iron clear throughout and 20 percent (many) medium prominent irregular noncemented strong brown (7.5YR 5/6), moist, masses of oxidized iron clear throughout; clear irregular boundary.

BCtg --- 61 to 83 centimeters; gray (2.5Y 6/1) moist, fine sandy loam; massive; firm, slightly sticky, moderately plastic; common fine roots between peds and common medium roots between peds; 35 percent (many) coarse prominent irregular noncemented strong brown (7.5YR 5/8), moist, masses of oxidized iron clear throughout; Pockets of sandy clay loam in horizon.; abrupt wavy boundary.

2Cg --- 83 to 115 centimeters; light gray (2.5Y 7/1) moist, sand; single grain; loose, nonsticky, nonplastic; 6 percent (common) fine faint irregular noncemented brownish yellow (10YR 6/6), moist, masses of oxidized iron clear throughout.

Carmichael Data

*** Primary Characterization Data ***

Pedon ID: S2012MD035001 (Queen Anne's, Maryland) Print Date: Apr 26 2013 8:23AM

Sampled as on Nov 29, 2012: Carmichael ; Coarse-loamy, mixed, active, mesic Typic Endoaquult
Revised to :

SSL - Project C2013USMD032 MD NCSS Conference
- Site ID S2012MD035001 Lat: 38° 55' 46.00" north Long: 76° 12' 5.99" west WGS84 MLRA: 153C
- Pedon No. 13N0423
- General Methods 1B1A, 2A1, 2B

United States Department of Agriculture
Natural Resources Conservation Service
National Soil Survey Center
Soil Survey Laboratory
Lincoln, Nebraska 68508-3866

Layer	Horizon	Orig Hzn	Depth (cm)	Field Label 1	Field Label 2	Field Label 3	Field Texture	Lab Texture
13N01713	Ap1		0.0-7.0	S2012MD035001-1			L	L
13N01714	Ap2		7.0-31.0	S2012MD035001-2			FSL	L
13N01715	Eg		31.0-42.0	S2012MD035001-3			L	L
13N01716	Btg		42.0-61.0	S2012MD035001-4			L	L
13N01717	BCtg		61.0-83.0	S2012MD035001-5			SIL	FSL
13N01718	Cg		83.0-115.0	S2012MD035001-6			FSL	S

Pedon Calculations

Calculation Name	Result	Units of Measure
Weighted Particles, 0.1-75mm, 75 mm Base	30.917	% wt
Volume, >2mm, Weighted Average	0	% vol
Clay, total, Weighted Average	16.699	% wt
Clay, carbonate free, Weighted Average	16.699	% wt
CEC Activity, CEC7/Clay, Weighted Average, CECd, Set 4	0.438	(NA)

Weighted averages based on control section: 42-83 cm

PSDA & Rock Fragments

				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-
				(- - - - - Total		- - - - - -)	(- - Clay	- - -)	(- - - - Silt	- - - - -)	(- - - - - - - - - - - -		Sand	- - - - - - - - - - - -)		(Rock Fragments	(mm))			
				Clay	Silt	Sand	Fine	CO_3	Fine	Coarse	VF	F	M	C	VC	(- - - - - - - -	Weight	- - - - - - - -)		>2 mm
				<	.002	.05	<	<	.002	.02	.05	.10	.25	.5	1	2	5	20	.1-	wt %
	Depth			.002	-.05	-2	.0002	.002	-.02	-.05	-.10	-.25	-.50	-1	-2	-5	-20	-75	75	whole
Layer	(cm)	Horz	Prep	(- -					% of <2mm Mineral Soil						- -)	(- - - - - - -	% of <75mm		- - - - - -)	soil
				3A1a1a					3A1a1a		3A1a1a	3A1a1a	3A1a1a	3A1a1a	3A1a1a					
13N01713	0-7	Ap1	S	7.1	47.5	45.4			24.3	23.2	14.9	23.0	6.9	0.5	0.1	tr	--	--	31	tr
13N01714	7-31	Ap2	S	8.2	48.4	43.4			25.2	23.2	12.3	23.4	6.8	0.7	0.2	tr	--	--	31	tr
13N01715	31-42	Eg	S	11.0	46.7	42.3			29.6	17.1	16.4	21.9	3.8	0.2	--	--	--	--	26	--
13N01716	42-61	Btg	S	15.7	39.2	45.1			24.6	14.6	18.1	22.6	4.3	0.1	tr	--	--	--	27	--
13N01717	61-83	BCtg	S	17.5	26.7	55.8			13.5	13.2	21.5	33.1	1.0	0.2	tr	--	--	--	34	--
13N01718	83-115	Cg	S	2.3	9.9	87.8			4.9	5.0	20.8	38.1	26.5	2.0	0.4	--	--	--	67	--

Carmichael Data

*** Primary Characterization Data ***

Pedon ID: S2012MD035001 (Queen Anne's County, Maryland) Print Date: Apr 26 2013 8:23AM

Sampled As : Carmichael Coarse-loamy, mixed, active, mesic Typic Endoaquult

USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 13N0423

Bulk Density & Moisture

Layer	Depth (cm)	Horz	Prep	-1- (Bulk Density) 33 kPa (- - - g cm^{-3} - - -) DbWR1	-2- (Bulk Density) Oven Dry DbWR1	-3- Cole Whole Soil	-4- Water Content 6 kPa (pct of < 2mm)	-5- Water Content 10 kPa	-6- Water Content 33 kPa DbWR1	-7- Water Content 1500 kPa 3C2a1a	-8- Water Content 1500 kPa Moist	-9- Ratio AD/OD 3D1	-10- WRD Whole Soil cm^3 cm^{-3}	-11- Aggst Stabl 2-0.5mm %	-12- (Ratio/Clay) CEC7	-13- (Ratio/Clay) 1500 kPa
13N01713	0-7	Ap1	S	1.45	1.47	0.005			24.3	4.6		1.007	0.29		0.96	0.65
13N01714	7-31	Ap2	S	1.71	1.74	0.006			14.0	2.9		1.005	0.19		0.41	0.35
13N01715	31-42	Eg	S	1.78	1.83	0.009			12.9	3.9		1.005	0.16		0.34	0.35
13N01716	42-61	Btg	S	1.64	1.73	0.018			17.6	6.0		1.008	0.19		0.40	0.38
13N01717	61-83	BCtg	S	1.69	1.79	0.019			16.5	7.9		1.011	0.15		0.47	0.45
13N01718	83-115	Cg	S							1.1		1.002			0.65	0.48

Water Content

Layer	Depth (cm)	Horz	Prep	-1- (Atterberg Limits) LL pct <0.4mm	-2- (Atterberg Limits) PI	-3- Bulk Density Field (g cm^{-3})	-4- Bulk Density Recon 33 kPa	-5- Bulk Density Recon Oven Dry	-6- Water Content Field (% of < 2mm)	-7- Water Content Recon 33 kPa	-8- Sieved Samples 6 kPa	-9- Sieved Samples 10 kPa	-10- Sieved Samples 33 kPa	-11- Sieved Samples 100 kPa	-12- Sieved Samples 200 kPa 3C1e1a	-13- Sieved Samples 500 kPa
13N01713	0-7	Ap1	S												9.0	
13N01714	7-31	Ap2	S												6.9	
13N01715	31-42	Eg	S												10.0	
13N01716	42-61	Btg	S												11.6	
13N01717	61-83	BCtg	S												11.8	
13N01718	83-115	Cg	S												2.6	

Carmichael Data

*** Primary Characterization Data ***

(Queen Anne's County, Maryland)

Pedon ID: S2012MD035001 Print Date: Apr 26 2013 8:23AM

Sampled As : Carmichael Coarse-loamy, mixed, active, mesic Typic Endoaquult

USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 13N0423

Salt

Layer	Depth (cm)	Horz	Prep	-1- Ca	-2- Mg	-3- Na	-4- K	-5- CO_3	-6- HCO_3	-7- F	-8- Cl	-9- PO_4	-10- Br	-11- OAC	-12- SO_4	-13- NO_2	-14- NO_3	-15- H_2O	-16- Total Salts	-17- Elec Cond	-18- Pred Elec Cond	-19- Exch Na	-20- SAR
				(Water Extracted From Saturated Paste)																			
				(mmol(+) L^{-1})				(mmol(-) L^{-1})										(%)		(dS m^{-1})		%	
13N01713	0-7	Ap1	S																			--	
13N01714	7-31	Ap2	S																			--	
13N01715	31-42	Eg	S																			--	
13N01716	42-61	Btg	S																			--	
13N01717	61-83	BCtg	S																			--	
13N01718	83-115	Cg	S																			--	

pH & Carbonates

Layer	Depth (cm)	Horz	Prep	-1- KCl 4C1a2a3	-2- $CaCl_2$ 0.01M 1:2 4C1a2a	-3- H_2O 1:1 4C1a2a	-4- Sat Paste	-5- Oxid	-6- NaF	-7- Carbonate As $CaCO_3$ <2mm	-8- Carbonate As $CaCO_3$ <20mm	-9- Gypsum As $CaSO_4*2H_2O$ <2mm	-10- Gypsum As $CaSO_4*2H_2O$ <20mm	-11- Resist ohms cm^{-1}
				(pH)						(%)				
13N01713	0-7	Ap1	S	5.5	5.7	6.3								
13N01714	7-31	Ap2	S	3.9	4.4	5.1								
13N01715	31-42	Eg	S	3.4	4.0	4.8								
13N01716	42-61	Btg	S	3.3	3.9	4.7								
13N01717	61-83	BCtg	S	3.4	4.0	4.7								
13N01718	83-115	Cg	S	3.9	4.3	5.0								

Phosphorous

Layer	Depth (cm)	Horz	Prep	-1- Melanic Index	-2- NZ %	-3- Acid Oxal	-4- Anion Exch Available	-5- Resin Capacity	-6- Bray 1	-7- Bray 2	-8- Olsen	-9- H_2O	-10- Citric Acid	-11- Mehlich III 4D6a1	-12- KCl Extr NO_3
						(Phosphorous, mg kg^{-1})									
13N01713	0-7	Ap1	S											34.1	
13N01714	7-31	Ap2	S											11.2	
13N01715	31-42	Eg	S											0.9	
13N01716	42-61	Btg	S											0.7	

Carmichael Data

*** Primary Characterization Data ***

Pedon ID: S2012MD035001 (Queen Anne's County, Maryland) Print Date: Apr 26 2013 8:23AM

Sampled As : Carmichael Coarse-loamy, mixed, active, mesic Typic Endoaquult

USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 13N0423

Clay Mineralogy (<.002 mm)				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-
						X-Ray					Thermal					Elemental				EGME	Inter
													SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	K_2O	Na_2O	Retn	preta
	Depth		Fract			7A1b1						7A4a									tion
Layer	(cm)	Horz	ion	(- - - - - - - - -	peak size	- - - - - - - - - -	)		(- - - - - - - - -	%	- - - - - - - - -)		(- - - - - - - -			%			- - - - - - - -)	$mg\ g^{-1}$	
13N01716	42-61	Btg	tcly	KK 3	VR 2	MI 1	GE 1				KK 35	GE 10									CMIX
13N01717	61-83	BCtg	tcly	KK 3	VR 2	MT 2	MI 1				KK 45										CMIX

FRACTION INTERPRETATION:
tcly - Total Clay, <0.002 mm

MINERAL INTERPRETATION:
GE - Goethite KK - Kaolinite MI - Mica MT - Montmorillonite VR - Vermiculite

RELATIVE PEAK SIZE: 5 Very Large 4 Large 3 Medium 2 Small 1 Very Small 6 No Peaks

Carmichael Data

*** Primary Characterization Data ***

Pedon ID: S2012MD035001 (Queen Anne's County, Maryland) Print Date: Apr 26 2013 8:23AM

Sampled As : Carmichael Coarse-loamy, mixed, active, mesic Typic Endoaquult

USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 13N0423

Carbon & Extractions

				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-
				(- - - - - Total - - - - -)			Est	OC	C/N	(- - - Dith-Cit Ext - - -)			(- - - - - - Ammonium Oxalate Extraction - - - - - -)						(- - - Na Pyro-Phosphate - - -)			
	Depth			C	N	S	OC	(WB)	Ratio	Fe	Al	Mn	Al+½Fe	ODOE	Fe	Al	Si	Mn	C	Fe	Al	Mn
Layer	(cm)	Horz	Prep	(- - - - - - - - - - % of <2 mm - - - - - - - - - -)						(- - - - - - - - - - - - - - - - - - % of < 2mm - - - - - - - - - - - - - - - - -)								mg kg^{-1}	(- - - - - - % of < 2mm - - - - -)			
				4H2a	4H2a	4H2a				4G1	4G1	4G1										
13N01713	0-7	Ap1	S	1.66	0.16	0.02	1.7		10	0.4	tr	--										
13N01714	7-31	Ap2	S	0.40	0.03	--	0.4		15	0.4	tr	--										
13N01715	31-42	Eg	S	0.13	0.02	tr	0.1		8	0.4	tr	--										
13N01716	42-61	Btg	S	0.13	0.07	tr	0.1		2	0.6	0.1	--										
13N01717	61-83	BCtg	S	0.10	0.02	--	0.1		5	0.3	tr	--										
13N01718	83-115	Cg	S	0.05	0.01	--	tr		5	--	--	--										

CEC & Bases

				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-
				(- - - - - - NH_4OAC Extractable Bases - - - - -)								CEC8	CEC7	ECEC		(- - - - Base - - - -)	
								Sum	Acid-	Extr	KCl	Sum	NH_4	Bases	Al	(- Saturation -)	
	Depth			Ca	Mg	Na	K	Bases	ity	Al	Mn	Cats	OAC	+Al	Sat	Sum	NH_4OAC
Layer	(cm)	Horz	Prep	(- - - - - - - - - - - - - - - - - cmol(+) kg^{-1} - - - - - - - - - - - - - - - - - - -)							mg kg^{-1}	(- - - - cmol(+) kg^{-1} - - -)			(- - - - - - - - % - - - - - - - -)		
				4B1a1a	4B1a1a	4B1a1a	4B1a1a		4B2b1a1	4B3a1a	4B3a1a		4B1a1a				
13N01713	0-7	Ap1	S	4.0	1.6	--	0.2	5.8	4.4	--	0.9	10.2	6.8			57	85
13N01714	7-31	Ap2	S	1.0	1.0	--	tr	2.0	3.4	0.4	0.1	5.4	3.4	2.4	17	37	59
13N01715	31-42	Eg	S	0.5	0.9	--	tr	1.4	4.0	1.4	tr	5.4	3.7	2.8	50	26	38
13N01716	42-61	Btg	S	0.6	1.4	--	0.1	2.1	6.6	2.7	0.1	8.7	6.3	4.8	56	24	33
13N01717	61-83	BCtg	S	1.0	2.1	--	0.1	3.2	8.2	3.4	0.1	11.4	8.2	6.6	52	28	39
13N01718	83-115	Cg	S	0.2	0.3	--	tr	0.5	1.0	0.3	tr	1.5	1.5	0.8	38	33	33

Bluff - Carmichael

PEDON DESCRIPTION

Pedon ID: S2012MD035003_Carmichael
Description Date: 12/2/2012 10:22:36 AM
Describer: Diane Shields and Marty Rabenhorst
Current Taxonomic Name: Carmichael
Current Taxonomic Class: Coarse-loamy, mixed, active, mesic Typic Endoaquults
Lat/Long: 38°55’38.64” north, 76°12’8.88” west
UTM: 395768E, 4309408N -- Datum WGS84, Zone 18
Landscape: coastal plain
Slope: 0 percent   Elevation: 1.5 meters
Drainage: Poorly drained
Erosion: None - deposition
Primary Earth Cover: Crop cover; Secondary Earth Cover: Hayland
Parent Materials: silty eolian deposits over sandy fluviomarine deposits over marine deposits
Particle Size Control Section: 32 to 50 centimeters
Diagnostic Features: Ochric epipedon: 0 to 22 centimeters, Aquic conditions: 0 to 260 centimeters, Redox depletions with chroma 2 or less: 22 to 50 centimeters, Argillic horizon: 32 to 50 centimeters, Lithologic discontinuity: 50 to 200 centimeters and Lithologic discontinuity: 200 to 260 centimeters

Ap1 --- 0 to 4 centimeters; very dark grayish brown (10YR 3/2) moist, loam; moderate fine granular structure; friable; nonfluid; 10 percent (common) fine distinct irregular noncemented brown (7.5YR 4/4), moist, masses of oxidized iron clear throughout.

Ap2 --- 4 to 22 centimeters; dark grayish brown (10YR 4/2) moist, loam; moderate coarse platy structure; friable; nonfluid; 15 percent (common) fine distinct irregular noncemented yellowish red (5YR 4/6), moist, masses of oxidized iron clear throughout.

BEg --- 22 to 32 centimeters; grayish brown (10YR 5/2) moist, loam; weak medium subangular blocky structure; friable; nonfluid; 5 percent (common) medium faint irregular noncemented gray (10YR 6/1), moist, iron depletions clear throughout and 20 percent (many) medium distinct irregular noncemented strong brown (7.5YR 5/6), moist, masses of oxidized iron clear throughout.

Btg --- 32 to 50 centimeters; gray (10YR 5/1) moist, loam; moderate medium prismatic parting to moderate medium subangular blocky structure; firm; nonfluid; 10 percent (common) medium faint irregular noncemented light gray (10YR 7/1), moist, iron depletions clear throughout and 25 percent (many) medium distinct irregular noncemented strong brown (7.5YR 4/6), moist and brown (7.5YR 4/4), moist, masses of oxidized iron clear throughout; The texture was noted as being a "heavy" loam for the horizon indicating a significant bump up in clay percent..

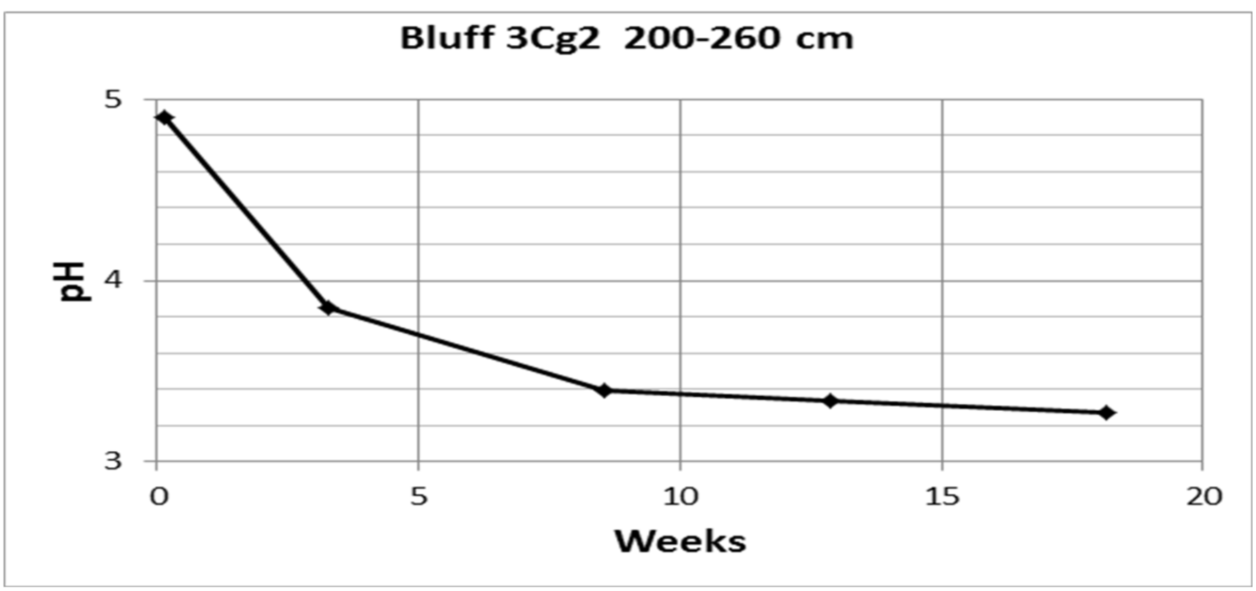
2BC --- 50 to 90 centimeters; 55 percent light yellowish brown (10YR 6/4) moist and 40 percent gray (2.5Y 5/1) moist, loamy sand, sandy loam; weak medium subangular blocky structure; very friable; nonfluid; 5 percent (common) medium distinct irregular noncemented strong brown (7.5YR 5/6), moist, masses of oxidized iron clear in matrix; The sandy loam texture was noted as being "heavy" containing a significant amount of clay possibly for a sl texture. 2 subsamples were taken for the "brown" and "gray.".

2BCg --- 90 to 110 centimeters; grayish brown (2.5Y 5/2) moist, loamy sand; weak medium subangular blocky structure; friable; nonfluid; 5 percent (common) medium distinct pendular noncemented yellowish brown (10YR 5/4), moist, masses of oxidized iron clear along lamina or strata surfaces and 20 percent (many) medium faint platy noncemented gray (2.5Y 6/1), moist, iron depletions clear along lamina or strata surfaces; 2 percent rounded 2 to 5 millimeters unspecified fragments.

2Cg --- 110 to 200 centimeters; 40 percent strong brown (7.5YR 5/8) moist, 30 percent gray (2.5Y 6/1) moist and 30 percent grayish brown (10YR 5/2) moist, stratified, loamy sand, clay loam, sandy loam; moderate medium platy structure; very friable; nonfluid; The loamy sand was very friable and the clay loam was firm. Horizontally banded strata, the gray was 2-3 cm thick and red were 3-5 cm thick in a repearting pattern. 3 subsamples were taken; red sandy, gray sandy, and gray clay loam..

3Cg --- 200 to 260 centimeters; (N 3/1) moist, silty clay loam; massive; firm; slightly fluid.

Moist Incubation pH



Bluff Carmichael

Way Point 21 S2012 MD035-003

??-27-12
M. Rabenhorst
D. Shields

Horizon	Depth (cm)	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary
Ap1	0-4	10% f. 7.5YR 4/4 conc.	10YR 3/2	l	2 gr		fr			
Ap2	4-22	15% 5YR 4/6 fine distc. throughout	10YR 4/2	l	2 co pl		fr			
BEg	22-32	5% 10YR 6/1 depl. 20% 7.5YR 5/6 conc.	10YR 5/2	l	1 m sbk		fr			
Btg	32-50	10% 10YR 7/1 depl. 25% med 7.5YR 4/4 + 4/6 conc.	10YR 5/1	hvy loam	2 m pr to 2 m sbk		fi			
2BC*	50-90	5% 7.5YR 5/6 conc. around borders of 10YR 6/4 zone	55% 10YR 6/4 / 40% 2.5Y 5/1	ls / hvy sl	1 m-l sbk		vfr / fr			
2BCg	90-110	20% 2.5Y 7/1 depl. ? vfsl 5% 10YR 5/4 conc.	2.5Y 5/2	ls 2% co frag rounded	1 m sbk + finer zones platy		fr			
2Cg + C **	110-200	Strat.	30% 10YR 5/2 - ls 30% 2.5Y 6/1 - cl 40% 7.5YR 5/8 - ls-sl		2 m platy		vfr (ls) fi (cl)			
3Cg	200+-260+		N 3.5/	sicl	massive		fi			

Notes (Consistence Wet / Reaction / Boundary columns):
- 2BCg: → gray are 2-3 cm thick; red = 3-5 cm thick
- 2Cg + C: horizontally banded strata; red sand, fine gray, co gray } repeated
- 3Cg: n value - bet 0.7 and 1; sl. fluid

* - two subsamples - "brown" + "gray"
** - three subsamples - "red sandy", "gray sandy", and "gray cl"

Bluff - Carmichael Data

*** Primary Characterization Data ***

Pedon ID: S2012MD035003 (Queen Anne's County, Maryland) Print Date: Apr 26 2013 8:23AM
Sampled As : Carmichael Coarse-loamy, mixed, active, mesic Typic Endoaquult
USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 13N0837

PSDA & Rock Fragments

Layer	Depth (cm)	Horz	Prep	-1- Total Clay < .002	-2- Total Silt .002 -.05	-3- Total Sand .05 -2	-4- Clay Fine < .0002	-5- CO_3 < .002	-6- Silt Fine .002 -.02	-7- Silt Coarse .02 -.05	-8- Sand VF .05 -.10	-9- Sand F .10 -.25	-10- Sand M .25 -.50	-11- Sand C .5 -1	-12- Sand VC 1 -2	-13- Rock Fragments Weight 2 -5	-14- Rock Fragments Weight 5 -20	-15- Rock Fragments Weight 20 -75	-16- .1- 75	-17- >2 mm wt % whole soil
				% of <2mm Mineral Soil												% of <75mm				
				3A1a1a				3A1a1a	3A1a1a		3A1a1a	3A1a1a	3A1a1a	3A1a1a	3A1a1a					
13N03140	0-4	Ap1	S	14.2	54.6	31.2			35.4	19.2	7.1	12.5	11.1	0.5	tr	--	--	--	24	--
13N03141	4-22	Ap2	S	9.6	52.7	37.7			30.3	22.4	7.0	16.4	13.1	1.2	tr	--	--	--	31	--
13N03142	22-32	BEg	S	15.8	58.4	25.8			33.7	24.7	7.7	12.5	5.0	0.6	tr	--	--	--	18	--
13N03143	32-50	Btg	S	29.1	50.0	20.9			29.0	21.0	7.2	9.0	4.3	0.4	tr	--	--	--	14	--
13N03145	50-90	2BC	S	19.9	13.5	66.6			7.0	6.5	8.0	32.5	24.1	1.8	0.2	--	--	--	59	--
13N03146	90-110	2BCg	S	11.5	13.4	75.1		--	8.6	4.8	11.7	35.4	23.8	3.7	0.5	1	2	--	64	3
13N03149	110-200	2Cg	S	34.9	34.3	30.8			26.6	7.7	5.4	22.0	3.1	0.3	tr	--	--	--	25	--
13N03150	200-260	3Cg	S	41.4	54.0	4.6			38.4	15.6	2.0	2.2	0.2	tr	0.2	--	--	--	3	--
13N03144	50-90	2BC	S	8.6	4.9	86.5			2.6	2.3	9.2	37.1	37.1	2.4	0.7	--	--	--	77	--
13N03147	110-200	2Cg	S	11.2	13.6	75.2		--	4.7	8.9	15.0	47.6	11.5	0.9	0.2	--	--	--	60	--
13N03148	110-200	2Cg	S	9.6	5.3	85.1		0.7	3.3	2.0	5.1	46.2	29.8	3.3	0.7	--	--	--	80	--

Bulk Density & Moisture

Layer	Depth (cm)	Horz	Prep	-1- Bulk Density 33 kPa	-2- Bulk Density Oven Dry	-3- Cole Whole Soil	-4- Water Content 6 kPa	-5- Water Content 10 kPa	-6- Water Content 33 kPa	-7- Water Content 1500 kPa	-8- 1500 kPa Moist	-9- Ratio AD/OD	-10- WRD Whole Soil	-11- Aggst Stabl 2-0.5mm	-12- Ratio/Clay CEC7	-13- Ratio/Clay 1500 kPa
				(g cm^{-3})			pct of < 2mm						cm^3 cm^{-3}	%		
										3C2a1a		3D1				
13N03140	0-4	Ap1	S							8.7		1.011			0.77	0.61
13N03141	4-22	Ap2	S							5.9		1.005			0.52	0.61
13N03142	22-32	BEg	S							5.3		1.006			0.32	0.34
13N03143	32-50	Btg	S							10.5		1.013			0.37	0.36
13N03145	50-90	2BC	S							7.8		1.011			0.45	0.39
13N03146	90-110	2BCg	S							4.3		1.005			0.43	0.37
13N03149	110-200	2Cg	S							13.4		1.014			0.39	0.38
13N03150	200-260	3Cg	S							18.4		1.014			0.29	0.44
13N03144	50-90	2BC	S							3.6		1.004			0.48	0.42
13N03147	110-200	2Cg	S							5.6		1.006			0.41	0.50
13N03148	110-200	2Cg	S							3.7		1.005			0.44	0.39

sl gry
brn ls
gray clayey
brown
gray

Bluff - Carmichael Data

*** Primary Characterization Data ***

Pedon ID: S2012MD035003 (Queen Anne's County, Maryland) Print Date: Apr 26 2013 8:23AM

Sampled As : Carmichael Coarse-loamy, mixed, active, mesic Typic Endoaquult

USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 13N0837

Water Content

Layer	Depth (cm)	Horz	Prep	-1- Atterberg Limits LL	-2- Atterberg Limits PI	-3- Bulk Density Field	-4- Bulk Density Recon 33 kPa	-5- Bulk Density Recon Oven Dry	-6- Water Content Field	-7- Water Content Recon 33 kPa	-8- Sieved Samples 6 kPa	-9- Sieved Samples 10 kPa	-10- Sieved Samples 33 kPa	-11- Sieved Samples 100 kPa	-12- Sieved Samples 200 kPa	-13- Sieved Samples 500 kPa
				pct <0.4mm		(- - g cm^{-3} - -)			(- - % of < 2mm - -)							
															3C1e1a	
13N03140	0-4	Ap1	S												15.7	
13N03141	4-22	Ap2	S												8.0	
13N03142	22-32	BEg	S												9.9	
13N03143	32-50	Btg	S												16.0	
13N03145	50-90	2BC	S												9.7	
13N03146	90-110	2BCg	S												6.2	
13N03149	110-200	2Cg	S												17.9	
13N03150	200-260	3Cg	S												26.7	
13N03144	50-90	2BC	S												4.7	
13N03147	110-200	2Cg	S												6.9	
13N03148	110-200	2Cg	S												4.9	

Carbon & Extractions

Layer	Depth (cm)	Horz	Prep	-1- Total C	-2- Total N	-3- Total S	-4- Est OC	-5- OC (WB)	-6- C/N Ratio	-7- Dith-Cit Ext Fe	-8- Dith-Cit Ext Al	-9- Dith-Cit Ext Mn	-10- Ammonium Oxalate Extraction Al+½Fe	-11- ODOE	-12- Fe	-13- Al	-14- Si	-15- Mn	-16- Na Pyro-Phosphate C	-17- Fe	-18- Al	-19- Mn	
				(- - % of <2 mm - -)						(- - % of < 2mm - -)								mg kg^{-1}	(- - % of < 2mm - -)				
				4H2a	4H2a	4H2a				4G1	4G1	4G1											
13N03140	0-4	Ap1	S	3.04	0.29	0.03	3.0		10	0.5	tr	--											
13N03141	4-22	Ap2	S	0.85	0.07	--	0.8		11	0.3	--	--											
13N03142	22-32	BEg	S	0.28	0.07	--	0.3		4	0.4	--	--											
13N03143	32-50	Btg	S	0.22	0.01	--	0.2		17	0.7	tr	--											
13N03145	50-90	2BC	S	0.13	0.05	--	0.1		2	--	--	--											
13N03146	90-110	2BCg	S	0.06	tr	--	tr		10	--	--	--											
13N03149	110-200	2Cg	S	0.10	0.06	--	0.1		1	--	tr	--											
13N03150	200-260	3Cg	S	0.95	0.08	0.91	0.9		11	0.1	tr	--											
13N03144	50-90	2BC	S	0.05	0.05	--	tr		tr	--	--	--											
13N03147	110-200	2Cg	S	0.12	0.04	--	0.1		2	1.9	0.1	--											brown
13N03148	110-200	2Cg	S	0.05	0.04	--	tr		tr	--	--	--											gray

*** Primary Characterization Data ***

Pedon ID: S2012MD035003 (Queen Anne's County, Maryland) Print Date: Apr 26 2013 8:23AM
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USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 13N0837

CEC & Bases

Layer	Depth (cm)	Horz	Prep	-1- Ca	-2- Mg	-3- Na	-4- K	-5- Sum Bases	-6- Acid-ity	-7- Extr Al	-8- KCl Mn	-9- CEC8 Sum Cats	-10- CEC7 NH_4 OAC	-11- ECEC Bases +Al	-12- Al Sat	-13- Base Saturation Sum	-14- Base Saturation NH_4OAC
				(NH_4OAC Extractable Bases)													
				(cmol(+) kg^{-1})							mg kg^{-1}	(cmol(+) kg^{-1})			(%)		
				4B1a1a	4B1a1a	4B1a1a	4B1a1a		4B2b1a1	4B3a1a	4B3a1a		4B1a1a				
13N03140	0-4	Ap1	S	6.1	2.2	–	0.2	8.5	12.2	0.1	0.9		10.9				78
13N03141	4-22	Ap2	S	3.5	1.1	–	tr	4.6	3.7	tr	0.2		5.0				92
13N03142	22-32	BEg	S	4.8*	1.0	–	–	5.8	3.1			8.9	5.1			65	100
13N03143	32-50	Btg	S	10.4*	1.4	–	0.1	11.9	5.6			17.5	10.7			68	100
13N03145	50-90	2BC	S	7.4	1.4	–	0.1	8.9	3.3				9.0				99
13N03146	90-110	2BCg	S	1.0	1.0	–	–	2.0		2.1	–		4.9				41
13N03149	110-200	2Cg	S	1.9	3.3	–	0.2	5.4		5.5	tr		13.7				39
13N03150	200-260	3Cg	S	8.1*	3.9	0.1	0.3	12.4		4.0	1.2		11.9				100
13N03144	50-90	2BC	S	3.1	0.8	–	–	3.9	2.2				4.1				95
13N03147	110-200	2Cg	S	0.5	1.0	–	–	1.5	6.6	1.5	–		4.6				33
13N03148	110-200	2Cg	S	0.6	1.0	–	tr	1.6	4.6	1.6	–		4.2				38

*Extractable Ca may contain Ca from calcium carbonate or gypsum. CEC7 base saturation set to 100.

Salt

Layer	Depth (cm)	Horz	Prep	-1- Ca	-2- Mg	-3- Na	-4- K	-5- CO_3	-6- HCO_3	-7- F	-8- Cl	-9- PO_4	-10- Br	-11- OAC	-12- SO_4	-13- NO_2	-14- NO_3	-15- H_2O	-16- Total Salts	-17- Elec Cond	-18- Pred Elec Cond	-19- Exch Na	-20- SAR
				(Water Extracted From Saturated Paste)																			
				(mmol(+) L^{-1})				(mmol(-) L^{-1})										(%)		(dS m^{-1})		%	
13N03140	0-4	Ap1	S																			--	
13N03141	4-22	Ap2	S																			--	
13N03142	22-32	BEg	S																			--	
13N03143	32-50	Btg	S																			--	
13N03145	50-90	2BC	S																			--	
13N03146	90-110	2BCg	S																			--	
13N03149	110-200	2Cg	S																			--	
13N03150	200-260	3Cg	S																			1	
13N03144	50-90	2BC	S																			--	
13N03147	110-200	2Cg	S																			--	
13N03148	110-200	2Cg	S																			--	

Bluff - Carmichael Data

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pH & Carbonates

				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-
				(------ pH					------)	(-- Carbonate --) As $CaCO_3$		(-- Gypsum ---) As $CaSO_4*2H_2O$		Resist
					$CaCl_2$ 0.01M	H_2O	Sat							
	Depth									<2mm	<20mm	<2mm	<20mm	ohms
Layer	(cm)	Horz	Prep	KCl	1:2	1:1	Paste	Oxid	NaF	(------ %			------)	cm^{-1}
					4C1a2a	4C1a2a				4E1a1a1a1				
13N03140	0-4	Ap1	S		4.8	5.1				tr				
13N03141	4-22	Ap2	S		5.0	5.7				tr				
13N03142	22-32	BEg	S		5.5	6.3								
13N03143	32-50	Btg	S		5.7	6.4								
13N03145	50-90	2BC	S		5.3	6.1				tr				
13N03146	90-110	2BCg	S		3.9	4.7				tr				
13N03149	110-200	2Cg	S							tr				
13N03150	200-260	3Cg	S		4.2	4.3				1				
13N03144	50-90	2BC	S		5.1	5.9				tr				
13N03147	110-200	2Cg	S							tr				
13N03148	110-200	2Cg	S							tr				

Phosphorous

				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-
					(------ Phosphorous								------)		KCl
				Melanic	NZ	Acid	Anion Exch	Resin	Bray	Bray	Olsen	H_2O	Citric	Mehlich	Extr
	Depth			Index		Oxal	Available	Capacity	1	2			Acid	III	NO_3
Layer	(cm)	Horz	Prep		%	(------ mg kg^{-1}								------)	
														4D6a1	
13N03140	0-4	Ap1	S											17.8	
13N03141	4-22	Ap2	S											4.4	
13N03142	22-32	BEg	S											3.1	
13N03143	32-50	Btg	S											3.1	

Bluff - Carmichael Data

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Clay Mineralogy (<.002 mm)

Layer	Depth (cm)	Horz	Fraction	-1-	-2-	-3- X-Ray 7A1b1	-4-	-5-	-6-	-7-	-8- Thermal	-9- 7A4a	-10- SiO_2	-11- Al_2O_3	-12- Fe_2O_3	-13- Elemental MgO	-14- CaO	-15- K_2O	-16- Na_2O	-17- EGME Retn	-18- Interpretation
				(----	peak size	----)			(----	%	----)		(----			%			----)	$mg\ g^{-1}$	
13N03143	32-50	Btg	tcly	KK 3	VR 3	MI 2	MT 2	GE 1			KK 44	GE 7									CMIX
13N03145	50-90	2BC	tcly	MM 3	KK 3	MI 3															CMIX
13N03144	50-90	2BC	tcly	VR 3	KK 3	MI 2															VERM

FRACTION INTERPRETATION:

tcly - Total Clay, <0.002 mm

MINERAL INTERPRETATION:

GE - Goethite KK - Kaolinite MI - Mica MM - Montmorillonite-Mica MT - Montmorillonite

VR - Vermiculite

RELATIVE PEAK SIZE: 5 Very Large 4 Large 3 Medium 2 Small 1 Very Small 6 No Peaks