2017 Northeast Regional Pedology Field Tour

Pennsylvania Portion

University of Delaware | College of Agriculture & Natural Resources
Department of Plant & Soil Sciences

USDA United States Department of Agriculture
Natural Resources Conservation Service

Delaware Department of Agriculture
Serving Agriculture and Protecting Consumers

Stroud Water Research Center
50 Years Est. 1967

Chester County Department of Facilities and Parks

Delaware Valley University

Supervisors of Amity Township Berks County

Jacobsburg State Park

Pulte Homes

Tuskes Homes

The Joseph Torre Family

Acknowledgements

Those of you who have produced a tour such as this know that it takes cooperative efforts by a number of individuals and a number of sponsoring organizations. Sponsorship takes many forms, providing funding and resources, providing access to field sites, and allowing individuals the time to work on this project.

Sponsors

The University of Delaware

USDA Natural Resources Conservation Service

The County of Chester-Department of Facilities and Parks

The Stroud Water Research Center

Pulte Homes

Cedarville Engineering

Amity Township Supervisors Berks County

The Board of the PA. Association of Professional Soil Scientists

Tuskes Homes

Jacobsburg State Park

The Joseph Torre Family

Total Contracting and Quality Developers who supplied the back hoes

Individuals

Steven Dadio; Soil Scientist Cedarville Engineering

John Chibirka, soil scientist (PA), NRCS.

Bernard W. Sweeney, PhD the Stroud Center

Jay Gregg, Park Superintendent Chester Co.

PA PORTION OF THE 2017 NE PEDOLOGY FIELD TRIP

DAY TWO

Wednesday: Piedmont province - Chester and Berks Counties

NOTE: Lunch will be provided at the Stroud Water Research Center

8:00 AM Nottingham County Park-Serpentine Barrens- the Chrome series
150 Park Road Nottingham, PA 19362
Park entrance: 39.740953 -76.0339
Meet at the Pavilion 39.738861 -76.0339

10:30 AM Stroud Water Research Center-Glenelg series and a buried Hatboro series
970 Spencer Road Avondale, PA 19311
Meet at the Parking lot: 39.859589 -75.782994

3:00 PM Pulte Homes-Chester Springs Development-
A drip irrigation wastewater system and BMP's for stormwater
Located on Birch run Rd in Ludwig's Corner near intersection of RT 401 and 100
Meet at: 40.119239 -75.687586

4:00 PM Amity Township Floodplain Site
Anthracite alluvium-Gibraltar series presentation by Matt Ricker
Located on Old Philadelphia Rd. east of River Bridge Rd Amity Twp. Berks Co.
Parking lot: 40.253592 -75.727383

7:00 PM Dinner at Caitlyn & Cody's Diner 1907 John Fries Highway Quakertown, PA
215-536-8888 location: 40.434172 -75.416989
Located between the Comfort Inn and the Hampton Inn

DAY THREE

Thursday: The Great Valley (locally called the Lehigh Valley) of the Ridge and Valley Province
Northampton County

NOTE: Lunch will not be provided today. There is a WaWa near the motels for your purchase of a lunch for today.

7:30 AM meet at the parking lot of Caitlyn & Cody's Diner
Travel to Road cut Rt. 663
Exposure of igneous Diabase-contact metamorphic Hornfels and Sedimentary red Triassic shale
Location: 40.420719 -75.450489

9:00 AM Tuskes Home Saratoga Farms - pre-Wisconsin till over carbonate- Washington series
4316 Saratoga Drive Nazareth, PA Location: 40.712072 -75.327847

10:30 AM Jacobsburg State Park-mountain colluvium over old till- unnamed series
Meet at the horse Trailer parking lot on Belfast Rd near Keller Rd
Location: 40.796522 -75.311833

Noon: Lunch on your own at the Jacobsburg Environmental Center
400 Belfast Road Nazareth, PA location: 40.784458 -75.292992

1:30 PM Torre Site- Wisconsin till- Wurtsboro and Volusia series
535 Institute Drive Bangor, PA 18013
Gate to field at 40.928739 -75.171942 Park in the field along the tree row
DO NOT PARK ON THE ROAD unless the field is wet.

3:00 PM Delaware Water Gap -Arrow Island Overlook –LAST STOP!
Rt 611 Upper Mount Bethel Township
Location: 40.95835 -75.12179
Just south of Rt. 80

Nottingham County Park-Serpentine Barrens- the Chrome series
150 Park Road Nottingham, PA 19362
Park entrance: 39.740953 -76.0339
Meet at the Pavilion 39.738861 -76.0339

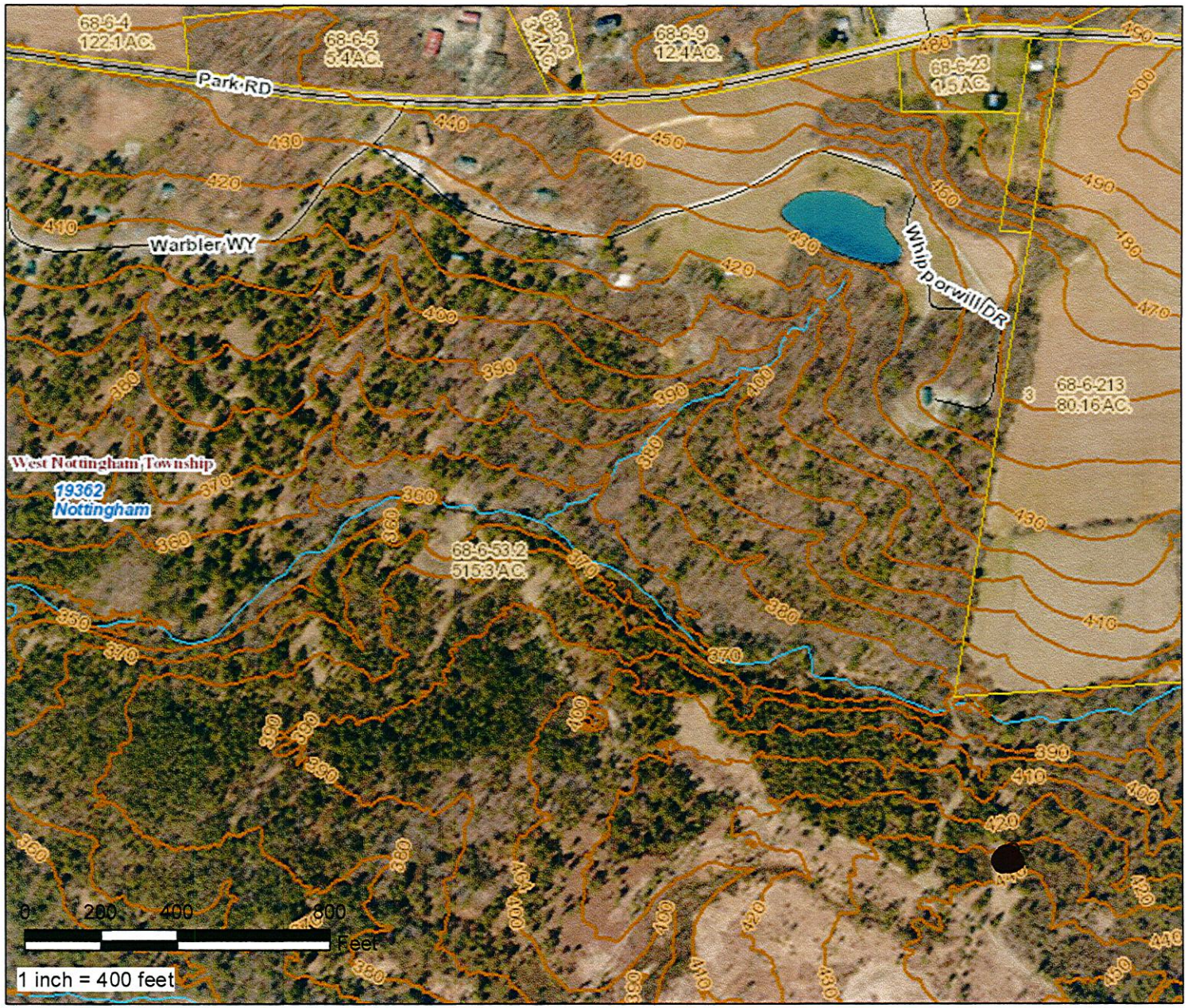
Jay Gregg, CPRP

Park Superintendent

Southern region

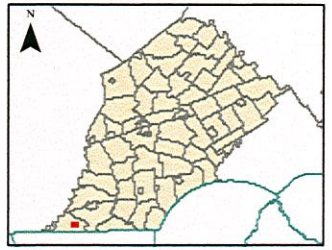
NOTES:

Nottingham Park



COUNTY OF CHESTER

PENNSYLVANIA



Map Created:
Sunday, June 04, 2017

County of Chester

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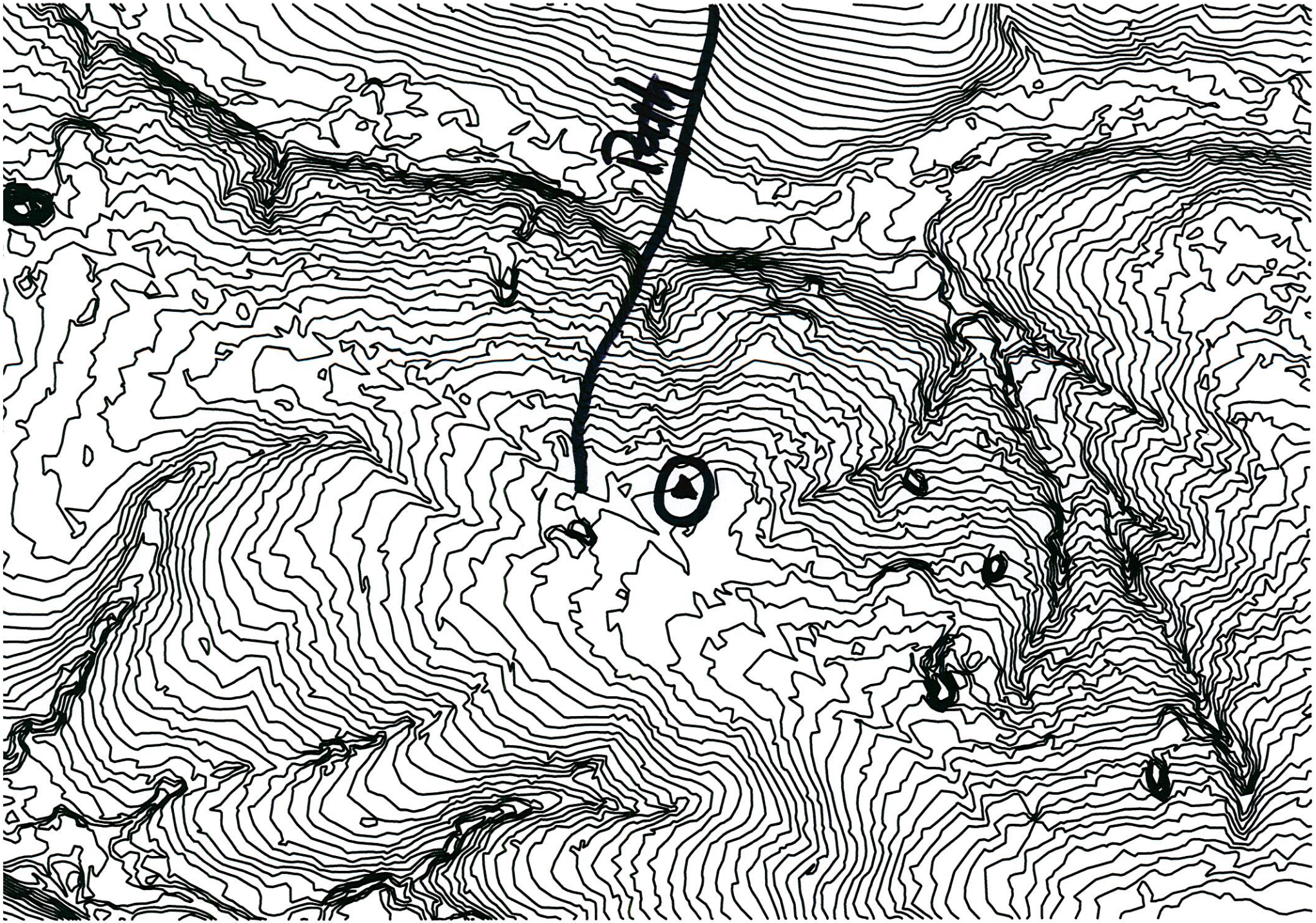

Nottingham Cty Park Scale: 1:200

PEDON DESCRIPTION

Print Date: Jun 12 2017
Description Date: May 10 2001
Describer: John Chibirka, Dave Kingsbury, Diane Shields
Site ID: S2001PA029004 - Nottingham County Park Progress Field Review
Site Note: prescribed burn area last burned one year ago. inordinate amount of charcoal collected in bulk sample of Oi.
Pedon ID: 01PA029004
Pedon Note:
Lab Source ID: SSL
Lab Pedon #: 01N0862
User Transect ID:
Soil Name as Described/Sampled: Lithic Hapludalfs
Classification: Fine-loamy, active, mesic Lithic Hapludalfs
Soil Name as Correlated: Lithic Argiudolls
Classification: Clayey, smectitic, superactive, mesic Lithic Argiudolls
Pedon Type: representative pedon for component
Pedon Purpose: full pedon description
Taxon Kind: taxon above family
Associated Soils: Aldino, Chrome, Conowingo
Physiographic Division:
Physiographic Province:
Physiographic Section:
State Physiographic Area:
Local Physiographic Area: Nottingham County Park - Serpentine Barrens
Geomorphic Setting: on shoulder of nose slope of None Assigned
Upslope Shape: convex
Cross Slope Shape: convex
Particle Size Control Section: 10 to 23 cm.

Description origin: NASIS
Diagnostic Features: mollic epipedon 0 to 23 cm.
argillic horizon 10 to 23 cm.
lithic contact 23 to 24 cm.

Country:
State: Pennsylvania
County: Chester
MLRA: 148 -- Northern Piedmont
Soil Survey Area: PA029 -- Chester County, Pennsylvania
Map Unit:
Quad Name:
Std Latitude: 39.7338905
Std Longitude: -76.0325012

Primary Earth Cover: Tree cover
Secondary Earth Cover: Other grass/herbaceous cover
Vegetation:
Parent Material: Serpentine
Bedrock Kind: Serpentinite
Bedrock Depth:
Bedrock Hardness: strongly cemented
Bedrock Fracture Interval: less than 10 centimeters
Surface Fragments: 1.0 percent nonflat angular strongly cemented 10- to 30-millimeter Serpentinite fragments
Description database: MLRA03_Raleigh

Top Depth (cm)	Bottom Depth (cm)	Restriction Kind	Restriction Hardness
23	24	bedrock, lithic	Very strongly cemented

Cont. Site ID: S2001PA029004 - Nottingham County Park Progress Field Review **Pedon ID:** 01PA029004

Slope (%)	Elevation (meters)	Aspect (deg)	MAAT (C)	MSAT (C)	MWAT (C)	MAP (mm)	Frost-Free Days	Drainage Class	Slope Length (meters)	Upslope Length (meters)
11.0	140.0	315						well		

Oi--0 to 1 centimeters (0.0 to 0.4 inches); slightly decomposed plant material, dark brown (7.5YR 3/4) crushed, dry; many fine roots top of horizon; abrupt smooth boundary. Lab sample # 01N04633

A--1 to 10 centimeters (0.4 to 3.9 inches); very dark gray (10YR 3/1) interior silt loam, very dark grayish brown (10YR 3/2) crushed, dry; 15 percent clay; strong fine granular structure; friable, nonsticky, slightly plastic; many medium roots throughout; 8 percent flat angular Serpentinite fragments; neutral, pH 6.8, Hellige-Truog; clear smooth boundary. Lab sample # 01N04634

Bt--10 to 23 centimeters (3.9 to 9.1 inches); dark brown (7.5YR 3/2) interior silt loam, dark brown (7.5YR 3/3) crushed, dry; 24 percent clay; moderate medium subangular blocky structure; friable, moderately sticky, moderately plastic; many fine roots throughout; 15 percent distinct 7.5YR 3/2), moist, clay films on all faces of peds; 10 percent flat angular Serpentinite fragments; slightly alkaline, pH 7.5, Hellige-Truog; gradual wavy boundary. Lab sample # 01N04635

R--23 centimeters (9.1 inches);, olive (5Y 4/4) broken face, dry; 1 percent prominent 7.5YR 3/2), moist, clay films on rock fragments; 99 percent flat angular Serpentinite fragments; moderately alkaline, pH 8.0, Hellige-Truog.

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*** Primary Characterization Data ***

(Chester, Pennsylvania)

Pedon ID: 01PA029004

Print Date: Jun 12 2017 11:12AM

Sampled as on May 3, 2001: Lithic Hapludalfs , Fine-loamy, active, mesic Lithic Hapludalfs
Revised to correlate on Nov 29, 2002: Lithic Argiudolls ; Clayey, smectitic, superactive, mesic Lithic Argiudolls

SSL - Project C2001USPA176 CHESTER CO
- Site ID S2001PA029004 - Nottingham County Park Progress Field Review Lat: 39° 44' 2.01" north Long: 76° 1' 57.00" west MLRA: 148
- Pedon No. 01N0862
- General Methods 1B1A, 2A1, 2B

United States Department of Agriculture
Natural Resources Conservation Service
National Soil Survey Center
Kellogg 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
01N04633	Oi	Oi	0-1	S01PA-029-004-1	PIT #1		SPM	
01N04634	A	A	1-10	S01PA-029-004-2	PIT #1		SIL	SICL
01N04635	Bt	Bt	10-23	S01PA-029-004-3	PIT #1		SIL	CL

Pedon Calculations

Calculation Name	Result	Units of Measure
Weighted Particles, 0.1-75mm, 75 mm Base	22	% wt
Clay, carbonate free, Weighted Average	38	% wt
Clay, total, Weighted Average	38	% wt
CEC Activity, CEC7/Clay, Weighted Average, Set 1	0.75	(NA)
LE, Whole Soil, Summed to 1m	Depth error	cm/m
Volume, >2mm, Weighted Average	1	% vol

Weighted averages based on control section: 10-23 cm

PSDA & Rock Fragments

Layer	Depth (cm)	Horz	Prep	Lab Texture	Clay (<.002)	Total Silt (.002-.05)	Total Sand (.05-2)	Clay Fine (<.002)	CO_3 (<.002)	Silt Fine (.002-.02)	Silt Coarse (.02-.05)	Sand VF (.05-.10)	Sand F (.10-.25)	Sand M (.25-.50)	Sand C (.5-1)	Sand VC (1-2)	Rock Fragments (mm) Weight (2-5)	(5-20)	(20-75)	(.1-75)	>2 mm whole soil
					<	.002	.05	<	<	.002	.02	.05	.10	.25	.5	1	2	5	20	.1-	wt %
					.002	-.05	-2	.0002	.002	-.02	-.05	-.10	-.25	-.50	-1	-2	-5	-20	-75	75	whole
					% of <2mm Mineral Soil												% of <75mm				soil
					3A1a1a			3A1a1a		3A1a1a		3A1a1a	3A1a1a	3A1a1a	3A1a1a	3A1a1a					
01N04633	0-1	Oi	S														1	1	–	–	2
01N04634	1-10	A	S	sicl	32.7	55.2	12.1	28.7		38.6	16.6	2.8	3.7	4.0	1.5	0.1	tr	tr	–	9	tr
01N04635	10-23	Bt	S	cl	37.9	38.0	24.1	21.7		25.4	12.6	3.7	5.6	8.4	5.3	1.1	1	1	–	22	2

*** Primary Characterization Data ***

(Chester, Pennsylvania)

Pedon ID: 01PA029004

Print Date: Jun 12 2017 11:12AM

Sampled As : Lithic Hapludalfs
Fine-loamy, active, mesic Lithic Hapludalfs

USDA-NRCS-NSSC-Soil Survey Laboratory ; Pedon No. 01N0862

Bulk Density & Moisture

Layer	Depth (cm)	Horz	Prep	(Bulk Density) 33 kPa	Oven Dry	Cole Whole Soil	Water Content 6 kPa	10 kPa	33 kPa	1500 kPa	1500 kPa Ratio Moist	AD/OD	WRD Whole Soil	Aggst Stabl 2-0.5mm	(Ratio/Clay) CEC7	1500 kPa
				g cm^{-3}			% of < 2mm						cm^3 cm^{-3}	%		
				DbWR1	DbWR1				DbWR1	3C2a1a		3D1				
01N04633	0-1	Oi	S							78.3		1.118				
01N04633	0-1	Oi	M							111.4						
01N04634	1-10	A	S	1.10	1.25	0.043			34.9	24.5		1.049	0.11		1.00	0.75
01N04635	10-23	Bt	S	1.07	1.26	0.055			39.4	22.9		1.059	0.17		0.75	0.60

Carbon & Extractions

Layer	Depth (cm)	Horz	Prep	Total C	Total N	Total S	Est OC	OC (WB)	C/N Ratio	Dith-Cit Ext Fe	Dith-Cit Ext Al	Dith-Cit Ext Mn	Ammonium Oxalate Extraction Al+½Fe	ODOE Fe	ODOE Al	ODOE Si	Na Pyro-Phosphate Mn	Na Pyro-Phosphate C	Na Pyro-Phosphate Fe	Na Pyro-Phosphate Al	Na Pyro-Phosphate Mn
				% of <2 mm						% of < 2mm							mg kg^{-1}	% of < 2mm			
				4H2a	4H2a	4H2a				4G1	4G1	4G1		4G2	4G2	4G2	4G2				
01N04633	0-1	Oi	S	36.62	1.70	0.15			22	2.0	0.2	0.1	0.17	0.05	0.25	0.04	0.02	491.8			
01N04634	1-10	A	S	5.48	0.43	0.02			13	6.2	0.3	0.2	0.57	0.08	0.90	0.12	0.09	1373.8			
01N04635	10-23	Bt	S	2.01	0.21	0.01			10	6.5	0.2	0.2	0.72	0.08	1.24	0.10	0.15	2179.0			

CEC & Bases

Layer	Depth (cm)	Horz	Prep	NH_4OAC Extractable Bases Ca	Mg	Na	K	Sum Bases	Acidity	Extr Al	Extr Mn	CEC8 Sum Cats	CEC7 NH_4 OAC	ECEC Bases +Al	Al	Base Saturation Sum	Base Saturation NH_4OAC
				cmol(+) kg^{-1}							mg kg^{-1}	cmol(+) kg^{-1}				%	
				4B1a1	4B1a1	4B1a1	4B1a1		4B2a1a1				4B1a1				
01N04633	0-1	Oi	S	19.4	36.6	0.5	0.8		52.6				84.3				
01N04634	1-10	A	S	4.7	23.9	0.1	0.2	28.9	11.1			40.0	32.8			72	88
01N04635	10-23	Bt	S	2.3	22.0	0.2	0.3	24.8	6.0			30.8	28.4			81	87

Pedon ID: 01PA029004
Sampled As Lithic Hapludalfs
USDA-NRCS-NSSC-Soil Survey Laboratory

*** Primary Characterization Data ***

(Chester, Pennsylvania)
Fine-loamy, active, mesic Lithic Hapludalfs
; Pedon No. 01N0862

Print Date: Jun 12 2017 11:12AM

Salt

Water Extracted From Saturated Paste

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- Elec Cond 1:2	-19- Exch Na	-20- SAR
				(- - mmol(+) L^{-1}	- -)			(- - -				mmol(-) L^{-1}					- - -)	(- - %	- - -)	(- - dS m^{-1}	- -)	%	
01N04634	1-10	A	S																			tr	
01N04635	10-23	Bt	S																			1	

pH & Carbonates

Layer	Depth (cm)	Horz	Prep	-1- pH KCl	-2- pH $CaCl_2$ 0.01M 1:2	-3- pH H_2O 1:1	-4- pH Sat Paste	-5- pH Oxid	-6- pH NaF	-7- Carbonate As $CaCO_3$ <2mm	-8- Carbonate As $CaCO_3$ <20mm	-9- Gypsum As $CaSO_4{\cdot}2H_2O$ <2mm	-10- Gypsum As $CaSO_4{\cdot}2H_2O$ <20mm	-11- Resist ohms
					4C1a2a	4C1a2a			4C1a1a1	(- - - %			- - -)	cm^{-1}
01N04633	0-1	Oi	S		5.2	5.6			6.9					
01N04634	1-10	A	S		6.2	6.5			8.3					
01N04635	10-23	Bt	S		6.6	6.9			8.7					

Organic

Layer	Depth (cm)	Horz	Prep	-1- Mineral Content	-2- OM TC*1.724	-3- OM+ Min	-4- Total C	-5- Total N	-6- C/N	-7- Fiber Content Unrub	-8- Fiber Content Rub	-9- NaPyro Color	-10- Decomp State	-11- Limnic Matter	-12- pH $CaCl_2$	-13- pH H_2O	-14- Bulk Density 33 kPa	-15- Bulk Density 33 kPa rewet	-16- Bulk Density OD	-17- Proj Subs
				(- - - %		- - -)			ratio	% (by vol)								g cm^{-3}		cm cm^{-1}
				5A			4H2a	4H2a								4C1a2a				
01N04633	0-1	Oi	S		63	90	36.62	1.70	22							5.6				1
01N04633	0-1	Oi	MW	27																
01N04634	1-10	A	S				5.48	0.43	13							6.5				tr
01N04635	10-23	Bt	S				2.01	0.21	10							6.9				1

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	-12- KCl Extr NO_3
					%	(- - -				mg kg^{-1}					- - -)
						4G2									
01N04633	0-1	Oi	S			70.3									
01N04634	1-10	A	S			97.4									
01N04635	10-23	Bt	S			32.7									

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Clay Mineralogy (<.002 mm)

Layer	Depth (cm)	Horz	Fraction	-1- X-Ray	-2-	-3-	-4-	-5-	-6- Thermal	-7-	-8-	-9-	-10- SiO_2	-11- Al_2O_3	-12- Fe_2O_3	-13- MgO	-14- CaO	-15- K_2O	-16- Na_2O	-17- EGME Retn	-18- Interpretation
				(- - - 7A1a1 peak size				- - -)	(- - - %			- - -)	(- - -			%			- - -)	mg g^{-1}	
01N04635	10.0-23.0	Bt	tcly	MT 3	TA 2	KK 2	MI 1	QZ 1													SMEC

FRACTION INTERPRETATION:
tcly - Total Clay <0.002 mm

MINERAL INTERPRETATION:
KK Kaolinite MI Mica MT Montmorillonite QZ Quartz TA Talc

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

INTERPRETATION (BY HORIZON):
SMEC - Smectitic

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USDA-NRCS-NSSC-Soil Survey Laboratory ; Pedon No. 01N0862

Sand - Silt Mineralogy (2.0-0.002 mm)

				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-	-15	-16-	-17-	-18-
						X-Ray				Thermal						Optical				EGME	Inter
													Tot Re			Grain Count				Retn	preta
	Depth		Fract													7B1a2					tion
Layer	(cm)	Horz	ion	(-------- peak size --------)					(-------- % ---------)				(---------- % ---------- -------)							mg g^{-1}	
01N04635	10.0-23.0	Bt	csi										45	QZ 33	FK 25	MS 20	MG 5	PO 4	PR 3		SMIX
														BT 3	OP 2	HN 2	CD 1	FM 1	GN tr		
														GS tr	AP tr	BY tr	CM tr	EP tr	FE tr		
														MZ tr	PD tr	RU tr	TM tr	TE tr	AR tr		
														ZR tr	ZO tr						

FRACTION INTERPRETATION:

csi - Coarse Silt 0.02-0.05 mm

MINERAL INTERPRETATION:

AP Apatite	AR Weatherable Aggregates	BT Biotite	BY Beryl	CD Chert (Chalcedony
CM Chlorite-Mica	EP Epidote	FE Iron Oxides (Goethite	FK Potassium Feldspar	FM Ferromagnesium Mineral
GN Garnet	GS Glass	HN Hornblende	MG Magnetite	MS Muscovite
MZ Monazite	OP Opaques	PD Piemontite	PO Plant Opal	PR Pyroxene
QZ Quartz	RU Rutile	TE Tremolite	TM Tourmaline	ZO Zoisite
ZR Zircon				

*** Primary Characterization Data ***

Pedon ID: 01PA029004 (Chester, Pennsylvania) Print Date: Jun 12 2017 11:12AM

Sampled As : Lithic Hapludalfs Fine-loamy, active, mesic Lithic Hapludalfs

USDA-NRCS-NSSC-Soil Survey Laboratory ; Pedon No. 01N0862

INTERPRETATION (BY HORIZON):

SMIX - Mixed Sand

*** Glossary of Codes ***

Print Date: Jun 12 2017 11:12AM

Reports: Primary Characterization Report;
Pedons: 01N0862;

*** Method Codes ***

Code	Description
3A1a1a	PSDA, Routine, Pipet
3C2a1a	Water Retention, 15 Bar, Pressure-Plate, <2mm
3D1	Water Retention, ADOD
4B1a1	CEC and Cations, NH4OAc
4B2a1a1	Extractable Acidity, BaCl2-Triethanolamine, Titration
4C1a1a1	pH, 1N NaF
4C1a2a	pH, Routine, 1:1 Water and 1:2 0.01M CaCl2
4G1	Cations, Dithionite-Citrate Extractable
4G2	Cations, Acid Oxalate Extractable
4H2a	Total N, C, S
5A	Mineral Content, Loss on Ignition
7A1a1	X-ray Diffraction, Thin Film on Glass, Resin Pretreatment
7B1a2	Optical Analysis, Full Grain Count
DbWR1	Bulk Density and Water Retention, Pressure-Plate, Clods

*** Preparation Codes ***

Code	Description / List of Methods
Caj	The moist soil clod used for bulk density determinations DbWR1
Maa	The moist whole soil including all coarse fragments 5A
Mjj	The moist soil passing a No. 10-mesh sieve kept in the moist state 3C2a1a
Sjf	The air-dried soil passing a No. 10-mesh sieve ground to pass a No. 80-mesh sieve 4H2a, 4B1a1
Sjj	The air-dried soil passing a No. 10-mesh sieve 3A1a1a, 3C2a1a, 3D1, 4G1, 4G2, 4B1a1, 4B2a1a1, 4C1a2a, 4C1a1a1, 7A1a1, 7B1a2

*** Instrument Sets ***

Instrument Set Name	List of Methods
CEC and bases-Set 1 (AA-PE300 and Auto 1030 Analyzer)	4B1a1
elementar Vario EL	4H2a
ICP-TJ61E and Cary 50 Conc (absorbance)	4G2
Instrument Not Specified	3C2a1a, 3D1, DbWR1, 5A, 7B1a2
Omega PCL-200 Pressure Calibrator	3A1a1a
Perkin Elmer Aanalyst 300	4G1
Titroprocessors	4B2a1a1, 4C1a2a, 4C1a1a1
X-ray diffractometer	7A1a1

*** Analyzed Size Fractions ***

Size Fraction	List of Methods
<0.002 mm	7A1a1
<2 mm	3A1a1a, 3C2a1a, 3D1, DbWR1, 4G1, 4G2, 4B1a1, 4B2a1a1, 4C1a2a, 4C1a1a1
<80 Mesh	4H2a, 4B1a1
0.02-0.05 mm	7B1a2

LOCATION CHROME PA+MD

Established Series
Rev. JDC-MJ
10/2008

CHROME SERIES

The Chrome series consists of moderately deep, well drained soils. They formed in residuum weathered mostly from serpentine. They are on convex upland slopes of 0 to 45 percent. Saturated hydraulic conductivity is moderately high to high. Mean annual precipitation is 43 inches. Mean annual temperature is 52 degrees F.

TAXONOMIC CLASS: Fine, mixed, superactive, mesic Typic Hapludalfs

TYPICAL PEDON: Chrome silt loam, 3 to 8 percent slopes, moderately eroded on a southeast facing slope in an early succession woodland. (Colors are for moist interior soil unless otherwise noted.)

Ap--0 to 7 inches; dark olive brown (2.5Y 3/3), light yellowish brown (2.5Y 6/3) dry; silt loam; moderate fine and very fine granular structure; friable, slightly sticky, slightly plastic; many very fine roots throughout; many medium pores; 8 percent subangular channers; slightly acid; abrupt smooth boundary. (3 to 8 inches thick)

Bt--7 to 23 inches; dark yellowish brown (10YR 4/4) channery clay loam; moderate medium subangular blocky structure; friable, moderately sticky, very plastic; common fine roots throughout; common very fine pores ; few distinct clay films on faces of peds; 25 percent subangular channers; moderately acid; clear wavy boundary. (5 to 20 inches thick)

C--23 to 30 inches; dark yellowish brown (10YR 4/4) very channery clay loam; massive; firm, moderately sticky, very plastic; few medium roots throughout; few medium pores; Common distinct clay films on rock fragments; 40 percent channers and 10 percent angular flags; neutral; abrupt irregular boundary. (0 to 20 inches thick)

R--30 inches; dark grayish green (5GY 4/2) exterior, dry serpentine bedrock.

TYPE LOCATION: Delaware County, Pennsylvania; Middletown Township; about .375 miles east-southeast of Lima, along the south side of Route 1 about 3200 feet east of the junction of Route 452 (North Pennell Road) and about 200 feet south of Route 1 and about 125 feet southeast of entrance to Riddle Memorial Hospital off of US Route 1 on a southeast facing slope in a early succession woodland.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 10 to 35 inches. Depth to bedrock is 20 to 40 inches. Rock fragments mostly of serpentine range from 0 to 30 percent in the solum and from 10 to 80 percent in the C horizon. Reaction ranges from moderately acid through neutral.

The A horizon has hue of 10YR or 5Y, value and chroma of 3 through 5. Fine-earth texture is loam, silt loam, clay loam or silty clay loam.

The Bt horizon has hue of 7.5YR through 2.5Y, value of 3 through 6 and chroma of 0 through 6. Fine-earth texture is silt clay loam, clay loam, silty clay or clay. Average percent clay in the control section is greater than 35.

The C horizon, where present, has hue of 7.5YR through 5GY, value of 3 through 6 and chroma of 0 through 6. Fine-earth texture is silty clay loam, clay loam, clay, sandy clay loam or sandy loam.

COMPETING SERIES: Briggsville, Edenton, Eldean, Lamoille, Newnata, Paintcreek, Redbrush, Upshur, Woodsfield, and Wynn are in the same family. Briggsville, Eldean, Lamoille, Newnata, Paintcreek, Upshur, Woodsfield and Wynn soils have bedrock at a depth greater than 40 inches. Briggsville soils have carbonates ranging in depths from 20 to 40 inches and have no rock fragments in the control section. Edenton soils have a paralithic contact with calcareous shale and limestone within depths of 20 to 40 and have fragments of glacial gravel. Eldean soils have carbonates within depths of 18 to 36 inches and have dominant rock fragments composed of glacial chert, limestone and shale gravel. Lamoille soils have a rock fragment of more than 35 percent in the lower half of the series control section and have matrix hues of 10YR or 2.5Y in the lower third of the series control section. Newnata soils have a lithic contact with limestone bedrock within depths of 40 to 60 inches. Paintcreek soils have a lithic contact of dolomite bedrock at depths greater than 60 inches. Redbrush soils have dominant rock fragments in the particle control section of quartz and mafic gneiss gravel and cobbles and have a lithic contact with mafic gneiss bedrock within depths of 20 to 40 inches. Upshur soils have hues 5YR or redder in the subsoil and have a sand content of less than 10 percent sand in the particle-size control section. The Woodsfield soils have rock fragments consisting of shale, siltstone and sandstone. Wynn soils have rock fragments composed of glacial limestone gravel and cobbles and have a paralithic contact with calcareous shale and limestone within depths of 20 to 40 inches.

GEOGRAPHIC SETTING: Chrome soils are on nearly level to steep convex uplands of the Northern Piedmont. Slopes range from 0 to 45 percent. They formed in residuum weathered from serpentine, or from other basic rocks high in magnesium. Climate is humid and temperate with mean annual precipitation of 38 to 46 inches; mean annual temperature ranges from 45 to 55 degrees F. The frost-free season ranges from 170 to 200 days.

GEOGRAPHICALLY ASSOCIATED SOILS: Aldino, Baile, Chester, Conowingo, Glenelg, Glenville, Legore, Manor, Montalto, Mount Lucus, Neshaminy, Relay and Watchung soils are on adjacent uplands. Comus, Codorus and Hatboro soils are on nearby floodplains. Aldino and Glenville soils have fragipans. Baile, Watchung and Hatboro soils are poorly drained. Chester, Glenelg, Comus, Legore, Manor, Montalto, Neshaminy and Relay soils have bedrock deeper than 40 inches. Conowingo soils are somewhat poorly drained. Mount Lucus and Codorus soils are moderately well and somewhat poorly drained.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Well drained. Runoff is medium to very rapid. Saturated hydraulic conductivity is moderately high to high.

USE AND VEGETATION: Typical vegetation is described as pine-savannah. Unfavorable physical and chemical properties of serpentine soils, such as shallowness, stoniness, low available water capacity and high levels of iron and magnesium and low levels of silica and calcium make these soils unfavorable for plant growth, especially in mixed hardwoods, resulting in a unique prairie-pine ecosystem termed barrens". In some instances these soils may contain plant toxic levels of nickel, chromium and cobalt (Mansburg, 1984). Approximately 90 percent of the Chrome soils are in woodland or in pasture. About 10 percent of the soils are cultivated.

DISTRIBUTION AND EXTENT: Maryland and Pennsylvania. The series is of small extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Morgantown, West Virginia

SERIES ESTABLISHED: Montgomery County, Maryland, 1959.

REMARKS: Previously updated in 3/90. The 4/2004 EJM-EAW revision added superactive cation-exchange activity class. Extensive revisions in 10/2008 as it was re-described for updating needs. User pedon ID in NASIS: 07PA045001. This series is proposed to be listed as a rare or unique soil series.

Diagnostic horizons and other features recognized in this pedon are:

a. Ochric epipedon - the zone from the surface to a depth of 7 inches (Ap horizon).
b. Argillic horizon - the zone from about 7 to 23 inches (Bt horizon).
c. Lithic Contact 30 inches (R horizon)

National Cooperative Soil Survey
U.S.A.

Stroud Water Research Center-Glenelg series and a buried Hatboro series
970 Spencer Road Avondale, PA 19311
Meet at the Parking lot: 39.859589 -75.782994

Bernard W. Sweeney, PhD
President
Senior Research Scientist
484-356-7211
sweeney@stroudcenter.org

and

John D. Chibirka

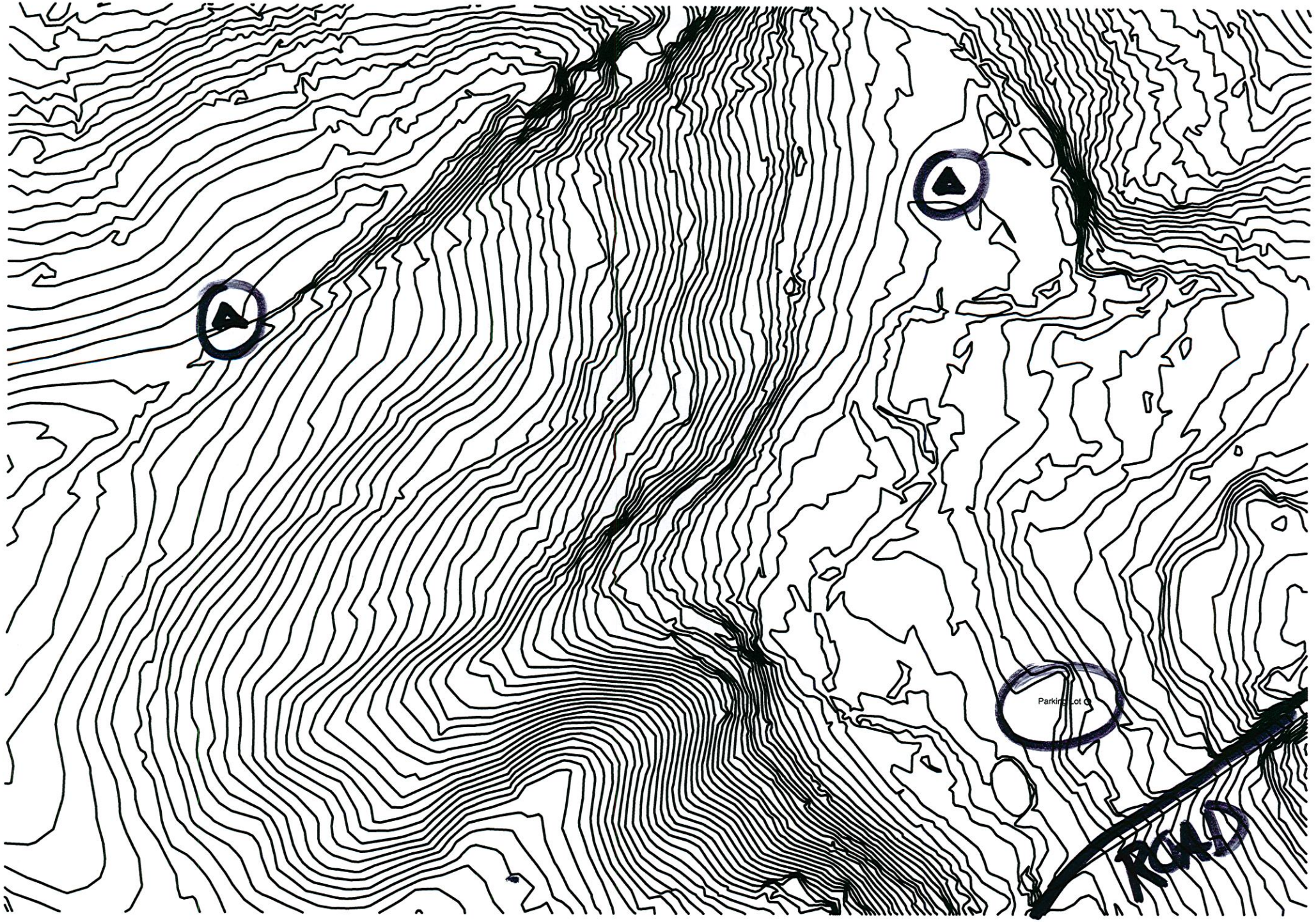
Resource Soil Scientist

USDA-NRCS

(610) 372-4655 X112

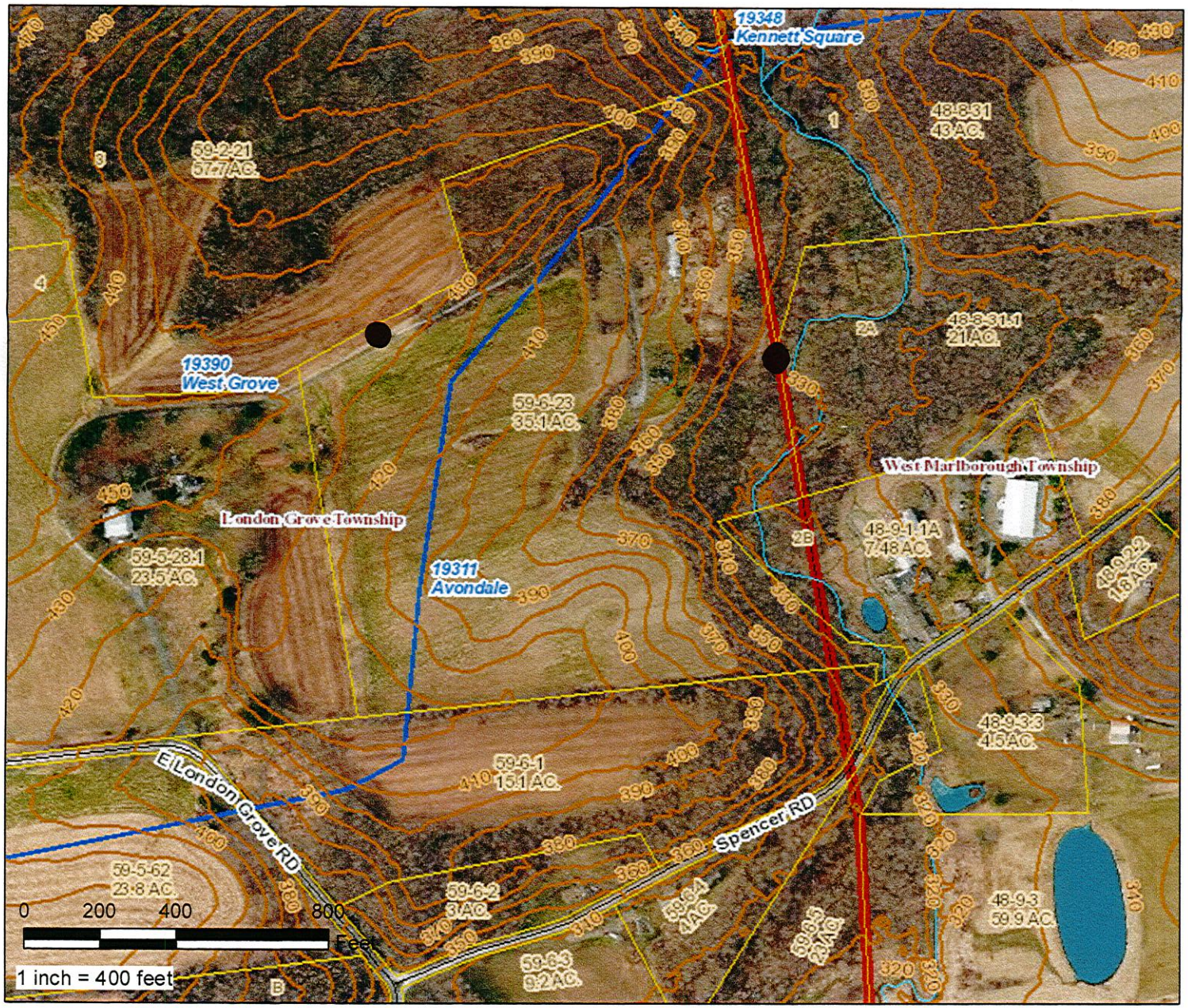
john.chibirka@pa.usda.gov

NOTES:



Stroud Water Research Center Scale: 1:200

Stroud Center



COUNTY OF CHESTER

PENNSYLVANIA

Map Created:
Sunday, June 04, 2017

County of Chester

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PEDON DESCRIPTION

Print Date: Jun 12 2017
Description Date: Oct 22 2003
Describer: JDC, VMM
Site ID: S2003PA029014
Site Note: This site is located in the Stroud Water Research Center property. The geology of the area is Setters Quartzite (Xsq) which includes white feldspatic quartzite; gray mica gneiss and mica schist. Cockeysville Marble is also in the vicinity.
Pedon ID: 03PA029014
Pedon Note: Rock Fragments were weighed and recorded for each horizon during the bulk sampling. The weight of the rock fragments <3/4 to >3 inches and the total weight of the bulk sample with the percent weight of rock fragments are as follows: horizon RF's weight total weight %weight of RF A1 0.0 10.0 0.0 A2 0.0 13.0 0.0 Bw 0.0 12.0 0.0 Bw/Ab 0.0 14.0 0.0 Agb 0.0 15.0 0.0 Bwgb1 0.0 12.0 0.0 Bwgb2 0.0 15.0 0.0 Bwgb3 0.0 12.0 0.0 2Cg1 39.0 62.0 62.9 2Cg2 25.0 48.0 52.08 3Cg 2.0 16.0 12.5 This pedon is slightly outside the Range in Characteristic's for Codorus for the following reasons: 1. Epipedon chroma colors are too low (suggest expanding RIC on OSED to include Chroma 1) 2. Upper Subsolum colors are too yellow and the lower subsolumn colors are too red. 3. Substratum chroma colors are too high (suggest expanding RIC on OSED to include Chroma 6 & 8)
Lab Source ID: SSL
Lab Pedon #: 04N0249
User Transect ID:
Soil Name as Described/Sampled: Codorus
Classification:
Soil Name as Correlated:
Classification:
Pedon Type:
Pedon Purpose: full pedon description
Taxon Kind:
Associated Soils: Chester, Comus, Edgemont, Gladstone, Glenelg, Glenville, Hatboro, Manor
Physiographic Division: Appalachian Highlands
Physiographic Province: Piedmont Province
Physiographic Section: Piedmont upland
State Physiographic Area:
Local Physiographic Area: Piedmont
Geomorphic Setting: on toeslope of base slope of hillside on piedmont
Upslope Shape: linear
Cross Slope Shape: linear
Particle Size Control Section: 25 to 100 cm.
Description origin: NASIS
Diagnostic Features: ochric epipedon 0 to 16 cm.
cambic horizon 16 to 53 cm.

Country:
State: Pennsylvania
County: Chester
MLRA: 148 -- Northern Piedmont
Soil Survey Area:
Map Unit:
Quad Name: West Grove, Pennsylvania
Std Latitude: 39.8622780
Std Longitude: -75.7835312
Primary Earth Cover: Tree cover
Secondary Earth Cover:
Vegetation: ash, beech, greenbrier, oak, walnut
Parent Material: alluvium over residuum weathered from mica schist
Bedrock Kind: Mica schist
Bedrock Depth:
Bedrock Hardness:
Bedrock Fracture Interval: less than 10 centimeters
Surface Fragments:
Description database: KSSL

Cont. Site ID: S2003PA029014 **Pedon ID:** 03PA029014

Slope (%)	Elevation (meters)	Aspect (deg)	MAAT (C)	MSAT (C)	MWAT (C)	MAP (mm)	Frost-Free Days	Drainage Class	Slope Length (meters)	Upslope Length (meters)
1.0	104.0	250	10.0			1,219		moderately well	457	0.0

A1--0 to 5 centimeters (0.0 to 2.0 inches); very dark gray (10YR 3/1) interior mucky silt loam, very dark grayish brown (10YR 3/2) interior, dry; 20 percent sand; 64 percent silt; 16 percent clay; strong medium granular structure; very friable, nonsticky, slightly plastic; extremely low horizontal penetration resistance; few very coarse roots throughout and common fine roots throughout and few coarse roots throughout; 100 percent medium prominent spherical 10YR 3/1), moist, worm casts throughout and very fine distinct platy 2.5Y 8/1), moist, mica flakes, unspecified throughout; neutral, pH 7.0, Hellige-Truog; percentage of mica flakes is 0.2 and whole horizon is worm casts; abrupt smooth boundary. Lab sample # 04N01091. Penetrometer Range = 0

A2--5 to 16 centimeters (2.0 to 6.3 inches); brown (10YR 4/3) interior silt loam, 99 percent dark grayish brown (10YR 4/2) interior and 1 percent red (2.5YR 4/6) interior, dry; 20 percent sand; 62 percent silt; 18 percent clay; moderate thick platy parts to moderate medium angular blocky structure; very friable, nonsticky, slightly plastic; moderate horizontal penetration resistance; common very coarse roots throughout and common fine roots throughout and few coarse roots throughout; common very fine low-continuity vesicular and common medium high-continuity tubular pores; 8 percent medium distinct dendritic 5YR 4/4), moist, iron-manganese masses On surfaces along root channels and 20 percent medium distinct dendritic 5YR 4/4), moist, iron-manganese masses On surfaces along pores; 5 percent medium prominent spherical 10YR 3/1), moist, worm casts throughout and very fine distinct platy 2.5Y 8/1), moist, mica flakes, unspecified throughout; neutral, pH 6.8, Hellige-Truog; percentage of mica flakes is 0.5; clear smooth boundary. Lab sample # 04N01092. Penetrometer Range = 1.4-2.3

Bw--16 to 41 centimeters (6.3 to 16.1 inches); brown (7.5YR 4/4) interior silt loam, brown (10YR 5/3) interior, dry; 15 percent sand; 66 percent silt; 19 percent clay; moderate coarse subangular blocky structure; very friable, slightly sticky, slightly plastic; moderate horizontal penetration resistance; common very coarse roots throughout and common medium roots throughout and few fine roots throughout; common very fine low-continuity vesicular and common medium high-continuity tubular pores; 1 percent very fine faint irregular 5YR 4/4), moist, iron-manganese masses On faces of peds; 2 percent fine and medium prominent spherical 10YR 3/1), moist, worm casts and 1 percent very fine distinct platy 2.5Y 8/1), moist, mica flakes, unspecified throughout; moderately acid, pH 6.0, Hellige-Truog; clear wavy boundary. Lab sample # 04N01093. Penetrometer Range = 1.3-2.2

Bw/Ab--41 to 53 centimeters (16.1 to 20.9 inches); 60 percent brown (10YR 4/3) interior and 35 percent very dark gray (7.5YR 3/1) interior silt loam, brown (10YR 4/3) interior, dry; 28 percent sand; 54 percent silt; 18 percent clay; moderate medium subangular blocky structure; friable, slightly sticky, slightly plastic; low horizontal penetration resistance; common medium roots throughout and few fine roots throughout; common very fine low-continuity vesicular and few medium high-continuity tubular pores; 5 percent medium distinct irregular 2.5YR 4/4), moist, iron-manganese masses On faces of peds; fine and medium prominent spherical 10YR 3/1), moist, worm casts and very fine distinct platy 2.5Y 8/1), moist, mica flakes, unspecified throughout; slightly acid, pH 6.5, Hellige-Truog; percentage of mica flakes is 0.5; percentage of worm casts is 0.5; abrupt wavy boundary. Lab sample # 04N01094. Penetrometer Range = 1.0-1.7

Agb--53 to 65 centimeters (20.9 to 25.6 inches); very dark gray (7.5YR 3/1) interior silt loam, dark grayish brown (10YR 4/2) interior, dry; 30 percent sand; 53 percent silt; 17 percent clay; moderate coarse subangular blocky structure; friable, moderately sticky, moderately plastic; low horizontal penetration resistance; few fine roots throughout; common very fine low-continuity vesicular and few medium high-continuity tubular pores; 8 percent medium prominent irregular 5YR 4/6), moist, iron-manganese masses Throughout and 20 percent coarse prominent irregular 2.5Y 5/1), moist, iron depletions Throughout; fine and medium prominent spherical 10YR 3/1), moist, worm casts and very fine distinct platy 2.5Y 8/1), moist, mica flakes, unspecified throughout; neutral, pH 6.8, Hellige-Truog; percentage of mica flakes is 0.5, percentage of worm casts is 0.5; abrupt wavy boundary. Lab sample # 04N01095. Penetrometer Range = 0.9-1.8

Bwgb1--65 to 86 centimeters (25.6 to 33.9 inches); 60 percent gray (5Y 5/1) interior and 25 percent dark gray (5Y 4/1) interior loam, 70 percent grayish brown (2.5Y 5/2) interior and 25 percent light greenish gray (10Y 7/1) interior and 5 percent light red (2.5YR 6/6) interior, dry; 45 percent sand; 31 percent silt; 24 percent clay; weak very coarse subangular blocky structure; friable, slightly sticky, slightly plastic; low horizontal penetration resistance; common very fine roots throughout; few very fine low-continuity vesicular and few medium high-continuity tubular pores; 10 percent coarse prominent irregular 5YR 5/8), moist, iron-manganese masses On surfaces along pores; fine and medium prominent spherical 10YR 3/1), moist, worm casts and very fine distinct platy 2.5Y 8/1), moist, mica flakes, unspecified throughout; 2 percent nonflat rounded 2 to 75-millimeter Quartzite fragments; neutral, pH 7.0, Hellige-Truog; percentage of mica flakes is 0.5, percentage of worm casts is 0.5; clear wavy boundary. Lab sample # 04N01096. Penetrometer Range = 0.6-1.2

Bwgb2--86 to 107 centimeters (33.9 to 42.1 inches); gray (2.5Y 5/1) interior sandy loam, 70 percent light greenish gray (5GY 7/1) interior and 30 percent brownish yellow (10YR 6/6) interior, dry; 60 percent sand; 23 percent silt; 17 percent clay; weak coarse subangular blocky structure; friable, slightly sticky, nonplastic; low horizontal penetration resistance; few very fine roots throughout; few very fine low-continuity vesicular and few medium high-continuity tubular pores; 1 percent very coarse prominent irregular 5YR 5/8), moist, iron-manganese masses Throughout and 40 percent very coarse prominent irregular 2.5Y 5/6), moist, iron-manganese masses Throughout; 2 percent very fine distinct platy 2.5Y 8/1), moist, mica flakes, unspecified throughout; 10 percent nonflat rounded 2 to 75-millimeter Quartzite fragments; neutral, pH 7.0, Hellige-Truog; abrupt wavy boundary. Lab sample # 04N01097. Penetrometer Range = 0.4-2.5

Bwgb3--107 to 116 centimeters (42.1 to 45.7 inches); gray (5YR 5/1) interior gravelly sandy loam, 55 percent light greenish gray (5GY 7/1) interior and 25 percent brownish yellow (10YR 6/6) interior and 20 percent yellowish red (5YR 4/6) interior, dry; 75 percent sand; 17 percent silt; 8 percent clay; strong very coarse angular blocky structure; friable, nonsticky, nonplastic; moderate horizontal penetration resistance; few very fine low-continuity vesicular pores; 5 percent medium distinct irregular 5YR 5/8), moist, iron-manganese masses Throughout and 5 percent medium distinct irregular 2.5YR 4/8), moist, iron-manganese masses Throughout; 1 percent very fine distinct platy 2.5Y 8/1), moist, mica flakes, unspecified throughout; 10 percent nonflat rounded 75 to 250-millimeter Quartzite fragments and 15 percent nonflat rounded 2 to 75-millimeter Quartzite fragments; neutral, pH 6.8, Hellige-Truog; free water at 107 cm; abrupt irregular boundary. Lab sample # 04N01098. Penetrometer Range = 2.8-3.6

2Cg1--116 to 155 centimeters (45.7 to 61.0 inches); 70 percent strong brown (7.5YR 4/6) interior and 30 percent light olive brown (2.5Y 5/6) interior extremely gravelly coarse sand; 92 percent sand; 4 percent silt; 4 percent clay; structureless single grain; loose, nonsticky, nonplastic; horizontal penetration resistance; 15 percent very coarse prominent irregular 7.5YR 5/1), moist, iron depletions Around rock fragments and 20 percent very coarse prominent irregular 5YR 5/8), moist, iron-manganese masses Around rock fragments; 2 percent very fine distinct platy 2.5Y 8/1), moist, mica flakes, unspecified throughout; 25 percent flat subrounded 380 to 600-millimeter Quartzite fragments and 32 percent nonflat subrounded 75 to 250-millimeter Quartzite fragments and 35 percent nonflat rounded 2 to 75-millimeter Quartzite fragments; slightly acid, pH 6.5, Hellige-Truog; gradual irregular boundary. Lab sample # 04N01099. Penetrometer Range = not able to be determined due to no structure and volume of rock fragments.

2Cg2--155 to 184 centimeters (61.0 to 72.4 inches); 50 percent reddish yellow (7.5YR 6/8) interior and 50 percent yellowish red (5YR 5/8) interior extremely stony coarse sand, reddish yellow (7.5YR 6/6) interior, dry; 94 percent sand; 3 percent silt; 3 percent clay; structureless single grain; loose,

nonsticky, nonplastic; horizontal penetration resistance; 40 percent medium and coarse prominent irregular 10YR 2/1), moist, masses of reduced iron Throughout; 2 percent very fine distinct platy 2.5Y 8/1), moist, mica flakes, unspecified throughout; 10 percent flat subangular 600-millimeter Quartzite fragments and 15 percent nonflat subrounded 75 to 250-millimeter Quartzite fragments and 30 percent flat subrounded 380 to 600-millimeter Quartzite fragments and 35 percent nonflat rounded 2 to 75-millimeter Quartzite fragments; neutral, pH 6.8, Hellige-Truog; abrupt irregular boundary. Lab sample # 04N01100. Penetrometer Range = not able to be determined due to no structure and volume of rock fragments.

3Cg3--184 to 234 centimeters (72.4 to 92.1 inches); grayish brown (2.5Y 5/2) interior silt, pale olive (5Y 6/3) interior, dry; 15 percent sand; 81 percent silt; 4 percent clay; structureless massive; friable, nonsticky, nonplastic; low horizontal penetration resistance; 10 percent very fine distinct platy 2.5Y 8/1), moist, mica flakes, unspecified throughout; slightly acid, pH 6.5, Hellige-Truog; saprolite from schist residuum. Lab sample # 04N01101. Penetrometer Range = 1.2

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*** Primary Characterization Data ***

(Chester, Pennsylvania)

Pedon ID: 03PA029014

Print Date: Jun 12 2017 11:13AM

Sampled as on Oct 20, 2003: Codorus ; Fine-loamy, mixed, active, mesic Fluvaquentic Dystrudepts
Revised to SSL on Sep 12, 2005: Codorus ; Coarse-loamy, mixed, active, mesic Aquic Dystric Eutrudept

SSL - Project: C2004USPA038 Buck, Chester & Lancaster Co.s
- Site ID: S2003PA029014 Lat: 39° 51' 44.20" north Long: 75° 47' 0.71" west MLRA: 148
- Pedon No: 04N0249
- General Methods 1B1A, 2A1, 2B

United States Department of Agriculture
Natural Resources Conservation Service
National Soil Survey Center
Kellogg 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
04N01091	A1	A1	0-5	S03PA-029-014-1			MK-SIL	L
04N01092	A2	A2	5-16	S03PA-029-014-2			SIL	SIL
04N01093	Bw	Bw	16-41	S03PA-029-014-3			SIL	SIL
04N01094	Bw/Ab	Bw/Ab	41-53	S03PA-029-014-4			SL	L
04N01095	Agb	Agb	53-65	S03PA-029-014-5			SIL	L
04N01096	Bwgb1	Bwgb1	65-86	S03PA-029-014-6			L	FSL
04N01097	Bwgb2	Bwgb2	86-107	S03PA-029-014-7			SL	FSL
04N01098	Bwgb3	Bwgb3	107-116	S03PA-029-014-8			GR-SL	FSL
04N01099	2Cg1	2Cg1	116-155	S03PA-029-014-9			GRX-COS	LCOS
04N01100	2Cg2	2Cg2	155-184	S03PA-029-014-10			STX-COS	LCOS
04N01101	3Cg3	3Cg3	184-234	S03PA-029-014-11			SI	VFSL

Pedon Calculations

Calculation Name	Result	Units of Measure
Weighted Particles, 0.1-75mm, 75 mm Base	31	% wt
Volume, >2mm, Weighted Average	0	% vol
Clay, total, Weighted Average	15	% wt
Clay, carbonate free, Weighted Average	15	% wt
CEC Activity, CEC7/Clay, Weighted Average, CECd, Set 1	0.47	(NA)

Weighted averages based on control section: 25-100 cm

*** Primary Characterization Data ***

(Chester, Pennsylvania)

Pedon ID: 03PA029014

Print Date: Jun 12 2017 11:13AM

Sampled As : Codorus Fine-loamy, mixed, active, mesic Fluvaquentic Dystrudepts

USDA-NRCS-NSSC-Soil Survey Laboratory ; Pedon No. 04N0249

PSDA & Rock Fragments

Layer	Depth (cm)	Horz	Prep	Lab Texture	Clay < .002	Silt .002-.05	Sand .05-2	Fine Clay < .0002	CO_3 < .002	Fine Silt .002-.02	Coarse Silt .02-.05	VF Sand .05-.10	F Sand .10-.25	M Sand .25-.50	C Sand .5-1	VC Sand 1-2	2-5	5-20	20-75	.1-75	>2 mm wt % whole soil
					(% of <2mm Mineral Soil)												(% of <75mm)				
					3A1a1a					3A1a1a		3A1a1a	3A1a1a	3A1a1a	3A1a1a	3A1a1a					
04N01091	0-5	A1	S	I	15.0	41.2	43.8			23.6	17.6	15.3	20.8	7.0	0.7	tr	--	--	--	29	--
04N01092	5-16	A2	S	sil	21.1	56.8	22.1			34.7	22.1	12.0	7.5	2.2	0.4	tr	--	--	--	10	--
04N01093	16-41	Bw	S	sil	19.8	56.0	24.2			34.1	21.9	12.1	9.4	2.5	0.2	tr	--	--	--	12	--
04N01094	41-53	Bw/Ab	S	I	17.9	37.1	45.0			19.6	17.5	13.7	20.5	8.5	2.1	0.2	tr	tr	--	31	1
04N01095	53-65	Agb	S	I	15.7	37.3	47.0			17.1	20.2	16.1	19.9	8.8	2.0	0.2	--	--	--	31	--

*** Primary Characterization Data ***

(Chester, Pennsylvania)

Pedon ID: 03PA029014 | Print Date: Jun 12 2017 11:13AM

Sampled As : Codorus | Fine-loamy, mixed, active, mesic Fluvaquentic Dystrudepts

USDA-NRCS-NSSC-Soil Survey Laboratory ; Pedon No. 04N0249

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		4G2	4G2	4G2	4G2	4G2				
04N01091	0-5	A1	S	7.79	0.70	0.07			11	1.5	0.2	0.1	0.33	0.19	0.37	0.14	0.02	421.2				
04N01092	5-16	A2	S	2.17	0.23	0.03			9	2.1	0.3	0.1	0.50	0.11	0.55	0.22	0.03	636.7				
04N01093	16-41	Bw	S	1.66	0.20	0.02			8	2.1	0.3	0.1	0.50	0.09	0.55	0.23	0.03	696.5				
04N01094	41-53	Bw/Ab	S	1.69	--	--				1.5	0.3	0.1	0.54	0.11	0.53	0.27	0.03	608.7				
04N01095	53-65	Agb	S	1.48	0.11	tr			13	0.8	0.2	tr	0.36	0.08	0.39	0.17	0.02	331.7				
04N01096	65-86	Bwgb1	S	0.55	0.05	tr			11	0.6	0.1	--	0.17	0.03	0.15	0.09	0.02	--				
04N01097	86-107	Bwgb2	S	0.21	0.02	tr			14	0.6	0.1	--	0.10	0.02	0.09	0.05	0.02	--				
04N01098	107-116	Bwgb3	S	0.21	0.01	tr			24	0.3	tr	--	0.08	0.02	0.08	0.04	0.02	--				
04N01099	116-155	2Cg1	S	0.09	tr	--			31	1.5	0.2	tr	0.23	0.03	0.29	0.08	0.02	73.1				
04N01100	155-184	2Cg2	S	0.09	0.03	--			3	3.6	0.3	0.1	0.39	0.05	0.58	0.10	0.03	522.9				
04N01101	184-234	3Cg3	S	0.01	0.01	--			2	1.2	0.1	0.1	0.07	0.01	0.06	0.03	0.01	376.7				

CEC & Bases

Layer	Depth (cm)	Horz	Prep	-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 -)	
				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				4B1a1a				
04N01091	0-5	A1	S	24.6*	5.4	--	0.5	30.5	16.9			47.4	30.0			64	100
04N01092	5-16	A2	S	6.6	1.6	--	0.2	8.4	14.3			22.7	13.7			37	61
04N01093	16-41	Bw	S	4.7	1.2	--	0.1	6.0	13.9			19.9	11.0			30	55
04N01094	41-53	Bw/Ab	S	4.0	1.1	--	tr	5.1	12.7			17.8	10.9			29	47
04N01095	53-65	Agb	S	4.0	1.1	--	tr	5.1	10.1			15.2	9.1			34	56
04N01096	65-86	Bwgb1	S	2.0	0.8	--	tr	2.8	4.7			7.5	4.6			37	61
04N01097	86-107	Bwgb2	S	1.5	1.1	--	tr	2.6	2.4			5.0	3.6			52	72
04N01098	107-116	Bwgb3	S	1.7	1.2	--	tr	2.9	2.3			5.2	4.0			56	73
04N01099	116-155	2Cg1	S	1.4	0.8	--	tr	2.2	3.1			5.3	2.8			42	79
04N01100	155-184	2Cg2	S	1.3	1.0	--	tr	2.3	4.7			7.0	3.8			33	61
04N01101	184-234	3Cg3	S	2.3*	2.5	--	0.1	4.9	1.3			6.2	4.3			79	100

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

*** Primary Characterization Data ***

(Chester, Pennsylvania)

Pedon ID: 03PA029014 | Print Date: Jun 12 2017 11:13AM

Sampled As : Codorus | Fine-loamy, mixed, active, mesic Fluvaquentic Dystrudepts

USDA-NRCS-NSSC-Soil Survey Laboratory ; Pedon No. 04N0249

Salt

Layer	Depth (cm)	Horz	Prep	-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 -)																	1:2		
																			Total	Elec	Elec	Exch	
				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} - -)		%	
																					4F1a1a1		
04N01091	0-5	A1	S																			--	
04N01092	5-16	A2	S																			--	
04N01093	16-41	Bw	S																			--	
04N01094	41-53	Bw/Ab	S																			--	
04N01095	53-65	Agb	S																			--	
04N01096	65-86	Bwgb1	S																			--	
04N01097	86-107	Bwgb2	S																			--	
04N01098	107-116	Bwgb3	S																			--	
04N01099	116-155	2Cg1	S																			--	
04N01100	155-184	2Cg2	S																			--	
04N01101	184-234	3Cg3	S																		0.08	--	

pH & Carbonates

Layer	Depth (cm)	Horz	Prep	-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-
				(- - - - - - - - - - - - - - - - - - pH - - - - - - - - - - - - - - - - -)						(- - Carbonate - -)		(- - Gypsum - - -)		
					$CaCl_2$					As $CaCO_3$		As $CaSO_4$*$2H_2O$		Resist
					0.01M	H_2O	Sat			<2mm	<20mm	<2mm	<20mm	ohms
				KCl	1:2	1:1	Paste	Oxid	NaF	(- - - - - - - - - - - - % - - - - - - - - - - -)				cm^{-1}
					4C1a2a	4C1a2a								
04N01091	0-5	A1	S		5.8	5.9								
04N01092	5-16	A2	S		5.2	5.6								
04N01093	16-41	Bw	S		5.1	5.5								
04N01094	41-53	Bw/Ab	S		5.9	6.0								
04N01095	53-65	Agb	S		5.9	5.8								
04N01096	65-86	Bwgb1	S		5.3	5.8								
04N01097	86-107	Bwgb2	S		5.5	6.2								
04N01098	107-116	Bwgb3	S		6.0	6.2								
04N01099	116-155	2Cg1	S		5.9	6.1								
04N01100	155-184	2Cg2	S		5.7	5.9								
04N01101	184-234	3Cg3	S		5.8	6.3								

Pedon ID: 03PA029014

Sampled As : Codorus

USDA-NRCS-NSSC-Soil Survey Laboratory

*** Primary Characterization Data ***

(Chester, Pennsylvania)

Fine-loamy, mixed, active, mesic Fluvaquentic Dystrudepts

; Pedon No. 04N0249

Print Date: Jun 12 2017 11:13AM

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	-12- KCl Extr NO_3
						(- - - -	- - - -	- - - - Phosphorous	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -)	
						(- - - -	- - - -	- - - -	- - - - mg kg^{-1}	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -)
						4G2								4D6a1	
04N01091	0-5	A1	S			221.1								39.1	
04N01092	5-16	A2	S			212.2								2.9	
04N01093	16-41	Bw	S			126.6								1.7	
04N01094	41-53	Bw/Ab	S			63.0								1.2	
04N01095	53-65	Agb	S			41.5								2.6	
04N01096	65-86	Bwgb1	S			--								3.7	
04N01097	86-107	Bwgb2	S			--								1.8	
04N01098	107-116	Bwgb3	S			--								5.0	
04N01099	116-155	2Cg1	S			156.6								52.0	
04N01100	155-184	2Cg2	S			313.7								49.8	
04N01101	184-234	3Cg3	S			--								37.7	

Pedon ID: 03PA029014

Sampled As : Codorus

USDA-NRCS-NSSC-Soil Survey Laboratory

*** Primary Characterization Data ***

(Chester, Pennsylvania)

Fine-loamy, mixed, active, mesic Fluvaquentic Dystrudepts

; Pedon No. 04N0249

Print Date: Jun 12 2017 11:13AM

Clay Mineralogy (<.002 mm)

Layer	Depth (cm)	Horz	Fraction	-1- X-Ray	-2-	-3-	-4-	-5-	-6- Thermal	-7-	-8-	-9-	-10- SiO_2	-11- Al_2O_3	-12- Fe_2O_3	-13- MgO	-14- CaO	-15- K_2O	-16- Na_2O	-17- EGME Retn	-18- Interpretation
				7A1a1																	
				(- - - -	- - - - peak size	- - - -	- - - -	- - - -)	(- - - -	- - - - %	- - - -	- - - -)	(- - - -	- - - -	- - - -	- - - - %	- - - -	- - - -	- - - -)	mg g^{-1}	
04N01091	0.0-5.0	A1	tcly	KK 3	VR 3	MI 1	GE 1	QZ 1													CMIX
04N01093	16.0-41.0	Bw	tcly	KK 3	VR 3	MI 1	GE 1	HV 1													CMIX
				QZ 1																	
04N01096	65.0-86.0	Bwgb1	tcly	VR 4	KK 3	MI 1	LE 1	GE 1													VERM
				HV 1	QZ 1																
04N01099	116.0-155.0	2Cg1	tcly	KK 2	VR 2	MI 1	GE 1	LE 1													CMIX
				KH 1	QZ 1																
04N01101	184.0-234.0	3Cg3	tcly	KK 3	MI 3	KH 1	GE 1	HE 1													CMIX
				QZ 1																	

FRACTION INTERPRETATION:

tcly - Total Clay <0.002 mm

MINERAL INTERPRETATION:

GE Goethite	HE Hematite	HV Hydroxy-Interlayered Vermiculite	KH Halloysite	KK Kaolinite
LE Lepidocrocite	MI Mica	QZ Quartz	VR Vermiculite	

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

*** Primary Characterization Data ***

Pedon ID: 03PA029014 (Chester, Pennsylvania) Print Date: Jun 12 2017 11:13AM
Sampled As : Codorus Fine-loamy, mixed, active, mesic Fluvaquentic Dystrudepts
USDA-NRCS-NSSC-Soil Survey Laboratory ; Pedon No. 04N0249

INTERPRETATION (BY HORIZON):
CMIX - Mixed Clay VERM - Vermiculitic

*** Primary Characterization Data ***

Pedon ID: 03PA029014 (Chester, Pennsylvania) Print Date: Jun 12 2017 11:13AM
Sampled As : Codorus Fine-loamy, mixed, active, mesic Fluvaquentic Dystrudepts
USDA-NRCS-NSSC-Soil Survey Laboratory ; Pedon No. 04N0249

Sand - Silt Mineralogy (2.0-0.002 mm)

Layer	Depth (cm)	Horz	Fraction	-1- -2- -3- -4- -5- X-Ray (peak size)	-6- -7- -8- -9- Thermal (%)	-10- Tot Re	-11- -12- -13- -14- -15- -16- Optical Grain Count 7B1a2 (%)	-17- EGME Retn mg g^{-1}	-18- Interpretation
04N01091	0.0-5.0	A1	fs			55	QZ 51 FK 15 BT 8 MS 8 HN 7 PR 5 FE 4 VM 2 ZR tr TM tr GN tr AR tr OP tr		SMIX
04N01093	16.0-41.0	Bw	csi			59	QZ 53 FK 12 BT 9 MS 9 PR 5 HN 4 FE 2 OP 2 PO 1 AR 1 GN 1 FP tr BY tr MZ tr SP tr TE tr TM tr ZO tr ZR tr		SMIX
04N01096	65.0-86.0	Bwgb1	fs			58	QZ 56 FK 21 HN 8 MS 6 PR 5 AR 2 FE 1 OP 1 MZ tr BT tr FP tr GN tr TM tr		SMIX
04N01099	116.0-155.0	2Cg1	fs			45	QZ 39 FK 22 HN 11 MS 9 BT 6 PR 6 FE 3 OP 2 GN 1 AR tr MZ tr TM tr ZR tr		SMIX

*** Primary Characterization Data ***

Pedon ID: 03PA029014 (Chester, Pennsylvania) Print Date: Jun 12 2017 11:13AM
Sampled As : Codorus Fine-loamy, mixed, active, mesic Fluvaquentic Dystrudepts
USDA-NRCS-NSSC-Soil Survey Laboratory ; Pedon No. 04N0249

Sand - Silt Mineralogy (2.0-0.002 mm)

Layer	Depth (cm)	Horz	Fraction	-1- -2- -3- -4- -5- X-Ray (peak size)	-6- -7- -8- -9- Thermal (%)	-10- Tot Re	-11- -12- -13- -14- -15- -16- Optical Grain Count 7B1a2 (%)	-17- EGME Retn mg g^{-1}	-18- Interpretation
04N01101	184.0-234.0	3Cg3	vfs			33	BT 45 QZ 32 MS 21 OP 1 PR tr VM tr ZR tr FE tr FK tr HN tr		PMIC

FRACTION INTERPRETATION:
csi - Coarse Silt 0.02-0.05 mm vfs - Very Fine Sand 0.05-0.1 mm fs - Fine Sand 0.1-0.25 mm

MINERAL INTERPRETATION:

AR Weatherable Aggregates	BT Biotite	BY Beryl	FE Iron Oxides (Goethite	FK Potassium Feldspar
FP Plagioclase Feldspar	GN Garnet	HN Hornblende	MS Muscovite	MZ Monazite
OP Opaques	PO Plant Opal	PR Pyroxene	QZ Quartz	SP Sphene
TE Tremolite	TM Tourmaline	VM Vermiculite-Mica	ZO Zoisite	ZR Zircon

INTERPRETATION (BY HORIZON):
PMIC - Paramicaceous SMIX - Mixed Sand

*** Glossary of Codes ***

Print Date: Jun 12 2017 11:13AM

Reports: Primary Characterization Report
Pedons: 04N0249;

*** Method Codes ***

Code	Description
3A1a1a	PSDA, Routine, Pipet
3C2a1a	Water Retention, 15 Bar, Pressure-Plate, <2mm
3D1	Water Retention, ADOD
4B1a1a	CEC and Cations, NH4OAc, 2M KCl displacement
4B2b1a1	Extractable Acidity, BaCl2-Triethanolamine, Centrifuge
4C1a2a	pH, Routine, 1:1 Water and 1:2 0.01M CaCl2
4D6a1	Phosphorus, Mehlich III
4F1a1a1	Salt Prediction, 1:2 (w/v)
4G1	Cations, Dithionite-Citrate Extractable
4G2	Cations, Acid Oxalate Extractable
4H2a	Total N, C, S
7A1a1	X-ray Diffraction, Thin Film on Glass, Resin Pretreatment
7B1a2	Optical Analysis, Full Grain Count
DbWR1	Bulk Density and Water Retention, Pressure-Plate, Clods

*** Preparation Codes ***

Code	Description / List of Methods
Caj	The moist soil clod used for bulk density determinations DbWR1
Sjf	The air-dried soil passing a No. 10-mesh sieve ground to pass a No. 80-mesh sieve 4H2a
Sjj	The air-dried soil passing a No. 10-mesh sieve 3A1a1a, 3C2a1a, 3D1, 4G1, 4G2, 4B1a1a, 4B2b1a1, 4F1a1a1, 4D6a1, 4C1a2a, 7A1a1, 7B1a2

*** Instrument Sets ***

Instrument Set Name	List of Methods
Cary 50 Conc (absorbance)	4D6a1
CEC and bases-Set 1 (AA-PE300 and Auto 1030 Analyzer)	4B1a1a
elementar Vario EL	4H2a
ICP-PE4300 radial and Cary 50 Conc (absorbance)	4G2
Instrument Not Specified	3C2a1a, 3D1, DbWR1, 7B1a2
Markson electroMark Conductivity Meter	4F1a1a1
Omega PCL-200 Pressure Calibrator	3A1a1a
Perkin Elmer Aanalyst 400	4G1
Titroprocessors	4B2b1a1, 4C1a2a
X-ray diffractometer	7A1a1

*** Analyzed Size Fractions ***

Size Fraction	List of Methods
<0.002 mm	7A1a1
<2 mm	3A1a1a, 3C2a1a, 3D1, DbWR1, 4G1, 4G2, 4B1a1a, 4B2b1a1, 4F1a1a1, 4D6a1, 4C1a2a
<80 Mesh	4H2a
0.02-0.05 mm	7B1a2
0.05-0.1 mm	7B1a2
0.1-0.25 mm	7B1a2

Pulte Homes-Chester Springs Development-
A drip irrigation wastewater system and BMP's for stormwater
Located on Birch run Rd in Ludwig's Corner near intersection of RT 401 and 100
Meet at: 40.119239 -75.687586

Stephen Dadio, CPSS/CPSC

Environmental Manager

CEDARVILLE Engineering Group, LLC

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Pottstown, PA 19465

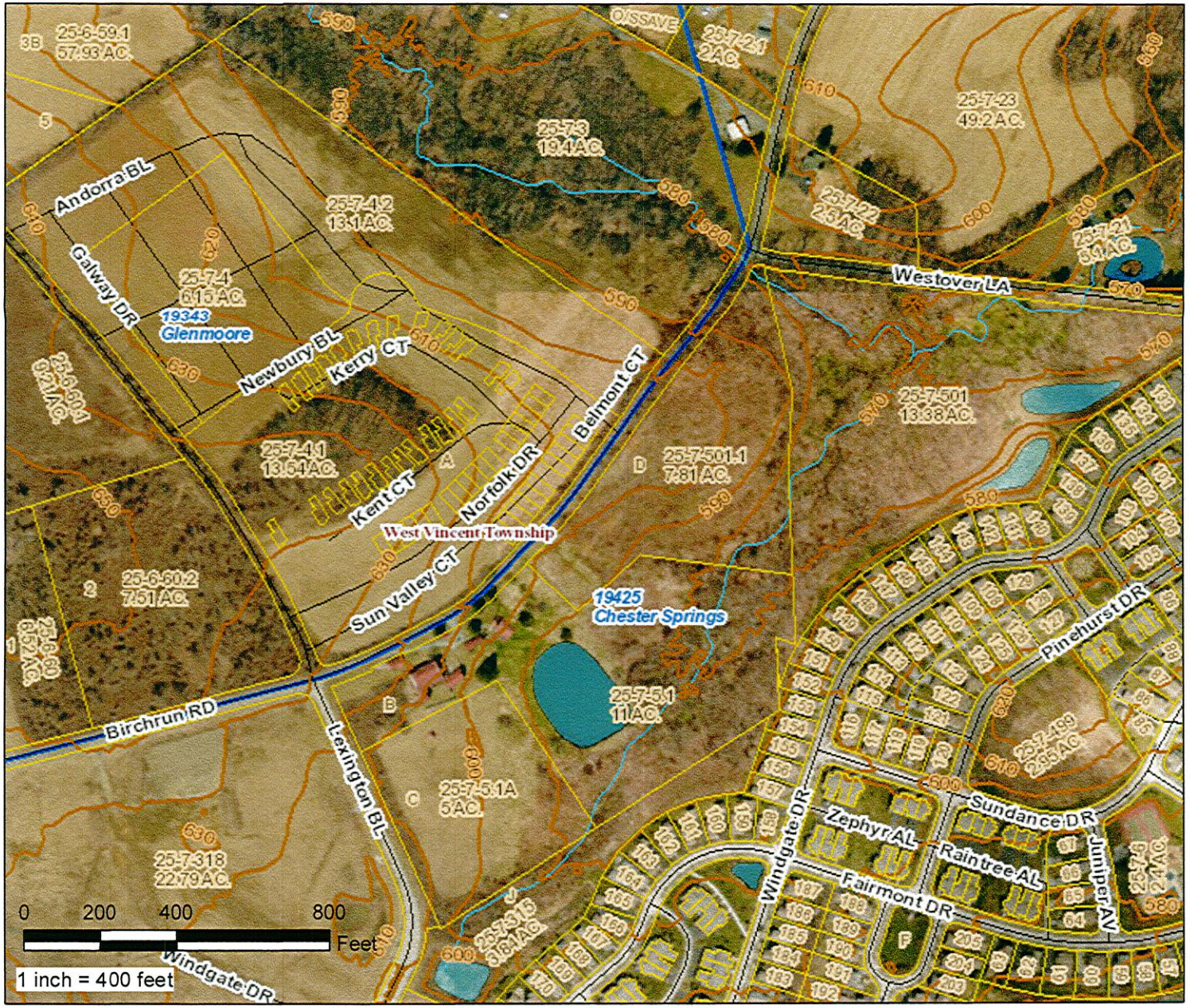
610-705-4500 | office

610-705-4900 | fax

www.cedarvilleeng.com

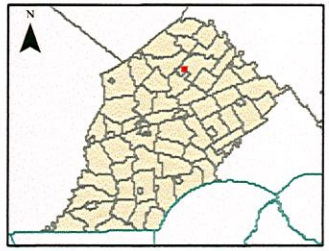
NOTES:

Pulte Development



COUNTY OF CHESTER

PENNSYLVANIA



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Sunday, June 04, 2017

County of Chester

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Amity Township Floodplain Site
Anthracite alluvium-Gibraltar series
Located on Old Philadelphia Rd. east of River Bridge Rd Amity Twp. Berks Co.
Parking lot: 40.253592 -75.727383

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NOTES:

Amity Township Scale: 1:100

The Gibraltar Soil Series: A Historical Record of Coal Mining in the Schuylkill River Basin

Matthew C. Ricker[1], Daniel J. Steinhauser[2], Joshua T. Prezkop[1]

1: Department of Environmental, Geographical, and Geological Sciences, Bloomsburg University
2: Department of Biology and Allied Health Sciences, Bloomsburg University

Introduction

The Gibraltar soil series (Coarse-loamy, mixed, active, nonacid, mesic Mollic Udifluvents) is an anthropogenic soil formed from alluvial anthracite coal silt and sand that has been transported great distances from its source. These soils are a result of past industrial activities that were carried out with minimal environmental regulations, thus these soils are a unique type of industrial legacy sediment deposit.

Legacy sediment is generically defined by the PA DEP (2006) as:

> *"Sediment that was eroded from upland areas after the arrival of early Pennsylvania settlers and during centuries of intensive land uses; that deposited in valley bottoms along stream corridors, burying pre-settlement streams, floodplains, wetlands, and valley bottoms; and that altered and continues to impair the hydrologic, biologic, aquatic, riparian, and water quality functions of pre-settlement and modern environments. Legacy sediment often accumulated behind ubiquitous low-head mill dams and in their slackwater environments, resulting in thick accumulations of fine-grained sediment that contain significant amounts of nutrients."*

Most research devoted to the study of legacy sediments has been in an agricultural context, with much of the post-colonial alluvium containing high concentrations of nitrogen and phosphorus that is remobilized via modern cut bank erosion. The Gibraltar series (and similar alluvial coal overwash soils) have a distinctly dissimilar alluvial parent material, which results in different potential environmental impacts.

Anthracite Mining and the Genesis of Alluvial Coal Soils

Industrial anthracite coal mining began in eastern Pennsylvania during the early 1800s. By the late 1800s anthracite coal was one of the largest industries in the region, employing well over 100,000 miners (PA DEP, 2015). Coal was extracted from subsurface mines and impurities such as slate and other non-marketable rock (including fine coal silts) were removed before shipping to market. Coal was mechanically crushed and separated by size in large above-ground facilities known as breakers. During the 1800s, sorting and separation was done manually by "red tips" or breaker boys. Coal operations greatly expanded during the early 1900s, and the amount of production exceeded the ability for manual separation. Therefore, breakers began to employ mechanical means of separation and washing, which produced greater amounts of non-marketable byproduct known as culm (Towne, 2012). Culm was discarded off-site in piles or washed directly back into local creeks near the breakers. Both situations produced vast amounts of mobilized coal silts that entered the local river systems (Schuylkill River Engineers, 1951). Most coal was eroded in this way from the late 1800s until the Great Depression significantly decreased the amount of anthracite coal production in this region (**Fig. 1**). The anthracite

economy collapsed following the Knox Mine Disaster of 1959, which essentially ended large-scale subsurface mining in the region (Stranahan, 1995).

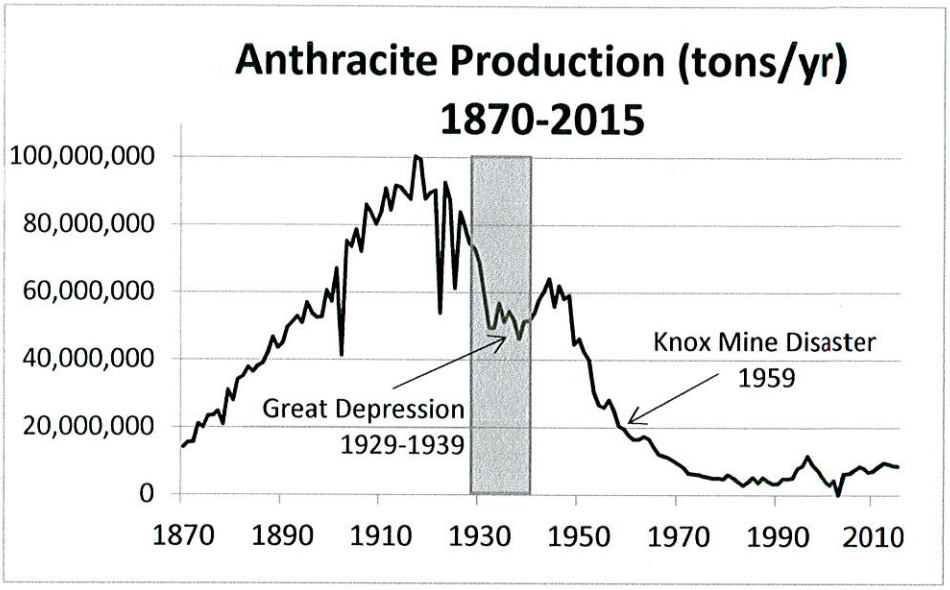

Fig. 1: Historical anthracite coal extraction from eastern Pennsylvania, 1870-2015 (data from PA DEP, 2015). Peak production rates occurred in the early 20th century, with a maximum in 1917. Rates of coal production steadily declined during the Great Depression with a small rebound occurring during the 1940s-1950s. In 1959 the Knox Mine Disaster occurred when mines beneath the Susquehanna River collapsed and flooded many deep subsurface shafts in the Lackawanna Syncline (northern anthracite fields). These events essentially lead to the end of large-scale subsurface mining in this region.

The Schuylkill River: America's Foulest River and Desilting Project

The Schuylkill River flows approximately 200 km within a watershed of 5,180 km^2 (**Fig. 2**). The river was of major importance from the late 1600s through the 1700s for providing the primary municipal water supply to the city of Philadelphia and later as a means of transport for goods via the Schuylkill Canal system (Towne, 2012). However, by the late 1800s anthracite coal mining and other industrial activities within the basin had severely degraded the water quality to the point where the channel periodically set fire (NY Times, 1892; Wolf, 1949). During the early 1900s it was estimated that 6-9 million tons of coal sediment was washed into the river per year, resulting in significant siltation of the floodplain, main channel, and constructed navigation canals (Schuylkill River Engineers, 1951). In response to lowered water quality and increased costs of dredging, the Schuylkill River Desilting Project was undertaken from 1947-1951. The project removed an estimated 20 million cubic yards of coal fines from the floodplain and channel of the river using a combination of heavy equipment and dredging (Towne, 2012). Desilting ponds were also created to capture sediments higher in the watershed, before they could reach the lower sections of the river (**Fig. 3**; Schuylkill River Engineers, 1951). The Schuylkill engineering program was the first of its kind in the United States and would be used as the blueprint for subsequent river cleanups after the formation of the EPA in 1970. The project was a major success; however, not all sections of alluvial coal fines were removed and these areas would later be mapped as the Gibraltar series we see today.

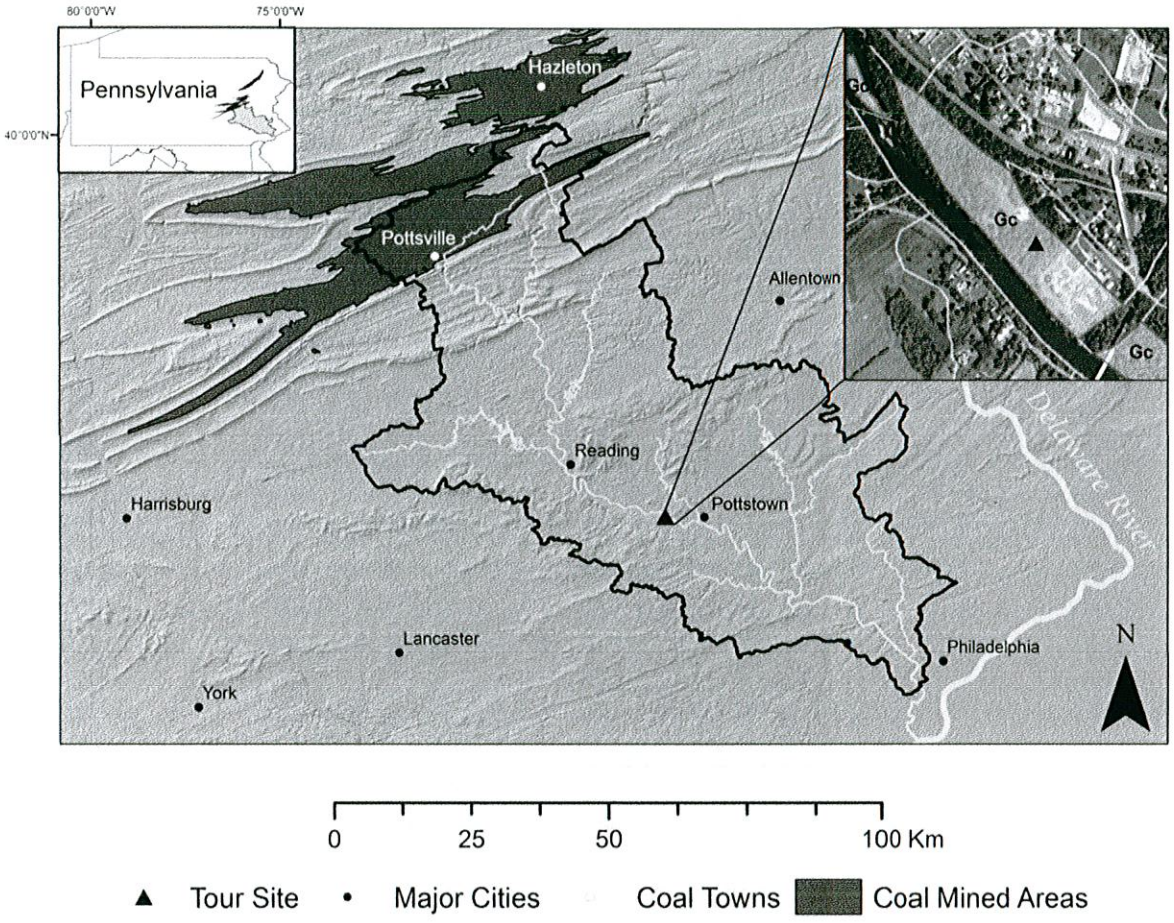

Fig. 2: Overview map of the Schuylkill River basin including the tour stop (black triangles). Note the distance (>100 river km) between the tour site and anthracite mined areas to the north near Pottsville, PA.

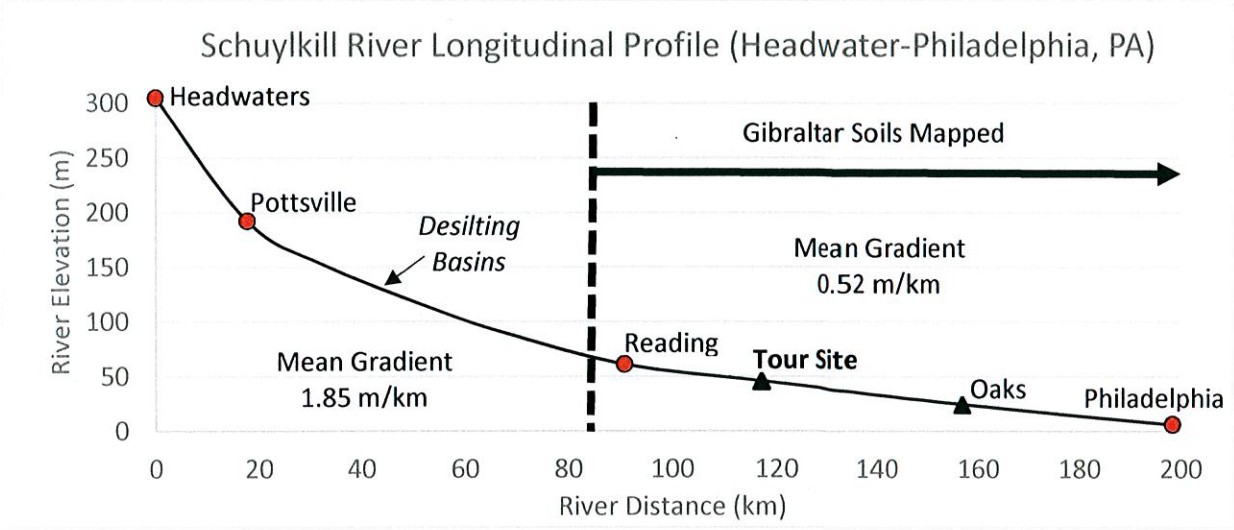

Fig. 3: Longitudinal profile of the Schuylkill showing the location of Gibraltar soils and constructed desilting basins designed to capture coal before being deposited in lower gradient sections of the river.

Gibraltar Series Spatial Extent

According to regional soil surveys, there are 1124 ha of Gibraltar series mapped in eastern Pennsylvania (Soil Survey Staff, 2017). Most of these areas are mapped along the Schuylkill and Lehigh Rivers in the Delaware Bay watershed. This soil series exists lower on the longitudinal gradient, in the Schuylkill basin it is mapped just upstream of Reading down to Philadelphia (**Fig. 3**). In addition to Gibraltar, there are many other alluvial soils with the potential for similar environmental interpretations. In our spatial analyses of the Susquehanna River floodplain we have found areas mapped as alluvial land, coal overwash, riverwash, Fluvaquents, and Udifluvents contain appreciable anthracite coal sediments within the upper 200 cm. These areas represent up to an additional 2400 ha of alluvial land that likely have similar properties to those of the Gibraltar series.

The major characteristic that distinguishes the Gibraltar series from other coal-contaminated alluvial soils is that the coal is present to the current floodplain surface. In many of the larger river systems of the region, coal sediments generated during the early 20th century can be buried by post-mining alluvium to depths of 1-5 meters (due to urban/agricultural land use), resulting in alternate map unit distinctions.

Tour Site Overview

Today we will look at two pedons within a Gibraltar soil map unit (**Fig. 2**). Additional data are presented in this field book from a Gibraltar soil site 40 km downstream at Oaks, Pennsylvania (sampled during the summer of 2015). The site today has two soil pits, #1 is closer to the active channel and #2 is situated further back laterally to show the underlying pre-colonial floodplain surface.

Gibraltar Soil Data: Unique Physical and Chemical Characteristics

Trace Metals

Trace metal concentrations were measured using x-ray fluorescence (XRF) in a benchtop configured Niton XL3t GOLDD. Prior to analysis, samples were over-dried to a constant weight at 105 °C and homogenized using mortar and pestle. Elemental concentrations from XRF were compared to acid digestion ICP analyses which showed a highly significant correlation among methods (R^2 = >0.95 for all metals). Trace metal depth distributions and calculated pools are displayed in Table 1.

Table 1: Average metal concentrations, bulk density, depths, and calculated metal pools (kg/ha) to 120 cm depth.

Sample	As mg/kg	Pb mg/kg	Cr mg/kg	Cu mg/kg	BD (g/cm^3)	Depth (cm)	As kg/ha	Pb kg/ha	Cr kg/ha	Cu kg/ha
G1 - 0-20	21.3	201.3	125.7	134.6	0.65	20.0	27.5	259.9	162.3	173.8
G1 - 20-40	10.7	66.7	80.5	67.8	0.64	20.0	13.7	85.5	103.1	86.8
G1 - 40-60	9.1	49.8	76.7	50.1	0.67	20.0	12.2	66.6	102.6	67.0
G1 - 60-80	10.6	42.3	80.6	45.3	0.73	20.0	15.3	61.5	117.1	65.9
G1 - 80-100	9.2	47.8	78.8	76.9	0.79	20.0	14.5	75.2	124.0	121.1
G1 - 100-120	11.2	48.8	125.7	71.8	0.77	20.0	17.2	75.5	194.4	111.0
					Total Storage (kg/ha)		*100.4*	*624.3*	*803.5*	*625.6*
G2 - 0-20	23.2	184.5	117.7	136.9	0.60	20.0	28.0	222.6	142.0	165.1
G2 - 20-40	15.8	81.5	82.1	80.7	0.70	20.0	22.2	114.4	115.3	113.3
G2 - 40-60	13.9	90.7	75.7	85.3	0.64	20.0	17.9	116.6	97.4	109.7
G2 - 60-80	12.8	44.1	65.3	67.3	0.87	20.0	22.4	76.8	113.8	117.2
G2 - 80-100	7.9	20.8	47.7	36.8	0.85	20.0	13.4	35.2	80.7	62.4
G2 - 100-120	3.8	13.1	48.5	23.7	0.92	20.0	7.0	24.0	89.4	43.7
					Total Storage (kg/ha)		*110.9*	*589.6*	*638.6*	*611.4*
Oaks - Au1	13.0	77.0	92.0	76.9	0.61	10.0	7.9	46.8	55.9	46.7
Oaks - Au2	6.0	102.7	111.0	89.2	0.77	22.0	10.2	174.8	188.9	151.8
Oaks - Cu	14.5	165.0	142.0	142.1	0.75	28.0	30.3	344.5	296.6	296.9
Oaks - C1	14.0	131.1	124.0	138.0	0.71	8.0	7.9	74.4	70.3	78.3
Oaks - C2	18.5	173.6	133.0	118.9	0.88	9.0	14.6	137.0	105.0	93.9
Oaks - C3	20.5	117.5	118.0	102.4	0.66	43.0	58.3	333.9	335.4	291.0
					Total Storage (kg/ha)		*129.2*	*1111*	*1052*	*958.6*
					Grand Mean (kg/ha)		**113.5**	**775.0**	**831.4**	**731.9**

Note: The Gibraltar series is mapped over 1124 ha in Pennsylvania. Using the grand mean values (kg/ha) from Table 1, this equals approximately 127,600 kg As, 871,100 kg Pb, 934,500 kg Cr, and 822,700 kg Cu stored to a depth of 120 cm in these soils.

When evaluating trace metals it is important to look at anthropogenic enrichment of metals beyond regional background levels. One way of doing this is to calculate enrichment factors (EFs). For this analysis we used EF calculations below (Sharma et al., 1999; Abrahim and Parker, 2008):

$$EF = [M_x \times (Fe, Al)_b] / [M_b \times (Fe, Al)_x]$$

Where M_x and Fe, Al_x are the sediment sample concentrations of the heavy metal and Fe/Al, while M_b and Fe, Al_b are these elemental concentrations in a suitable background material.

For this analysis background levels of soil Fe (2.5%) and Al (3.3%) were taken from the eastern United States reported by Shacklette and Boerngen, 1984. Regional values of soil trace metals As (7.4 mg/kg), Cr (17.5 mg/kg), Cu (21.2 mg/kg), Pb (31.3 mg/kg) were taken for Berks County, Pennsylvania as reported by Ciolkosz et al., 1998.

Table 2: Soil enrichment factors calculated using averaged Fe and Al concentrations.

Sample	As	Cr	Cu	Pb
G1 - 0-20	2.7	**6.7**	**5.9**	**6.0**
G1 - 20-40	2.1	**6.7**	4.6	3.1
G1 - 40-60	2.2	**7.9**	4.2	2.9
G1 - 60-80	2.5	**7.9**	3.7	2.3
G1 - 80-100	2.7	**9.6**	**7.7**	3.2
G1 - 100-120	2.8	**13.4**	**6.3**	2.9
G2 - 0-20	2.5	**5.3**	**5.1**	4.6
G2 - 20-40	2.2	4.8	3.9	2.7
G2 - 40-60	2.0	4.6	4.2	3.1
G2 - 60-80	1.5	3.2	2.7	1.2
G2 - 80-100	1.0	2.6	1.6	0.6
G2 - 100-120	0.5	2.6	1.0	0.4
Oaks - Au1	1.5	3.8	3.7	2.1
Oaks - Au2	0.8	4.6	4.1	2.2
Oaks - Cu	1.4	**6.8**	4.8	3.3
Oaks - C1	2.0	**7.9**	**6.2**	4.6
Oaks - C2	1.9	**7.5**	4.7	2.9
Oaks - C3	4.1	**9.9**	**8.1**	4.8
Grand Mean	2.0	**6.4**	4.6	2.9

Note:
EF < 2 = deficiently to minimal enrichment
2 ≤ EF < 5 = moderate enrichment
5 ≤ EF < 20 = significant enrichment

Total Sulfur and pH

Alluvial soils inherit properties from their eroded source materials. In the case of the Gibraltar soils, these geologic materials are dominated by coal fragments which contain elevated sulfur concentrations. Total S has been found to be negatively correlated to soil pH within coal alluvial horizons (**Fig. 4**), suggesting some portion of the total S is in a reduced form (sulfides, pyrite, etc.).

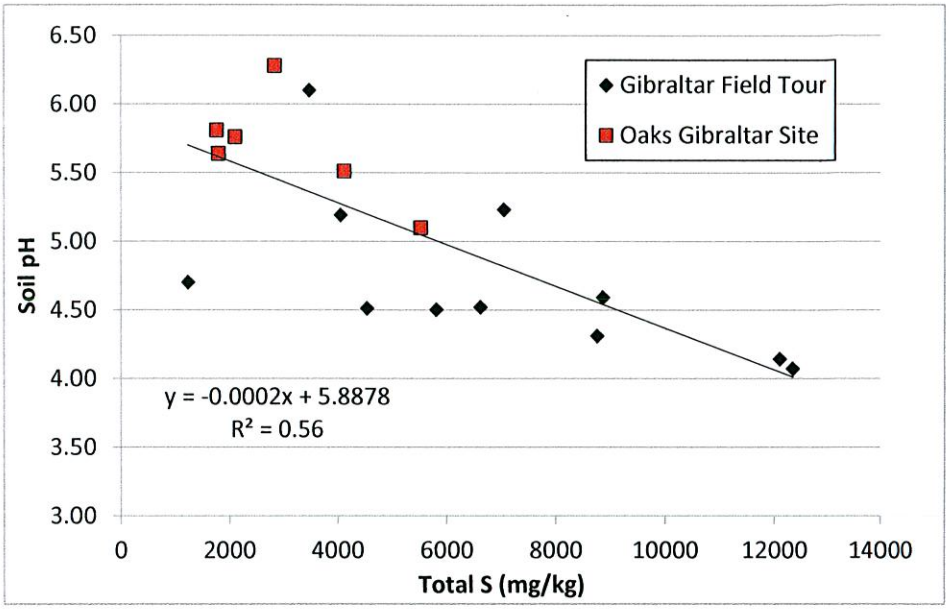

Fig. 4: Significant overall relationship between total elemental S concentration and soil pH for Gibraltar series samples. Some pH values are close to the definition of sulfuric horizons (pH 4.07, 4.14).

The anthracite region has extensive issues with acid mine drainage from abandoned mines, and it is likely that redeposited coal alluvium has the potential to generate acid sulfate conditions in an oxygenated environment. Incubation pH experiments on these soils have shown pH drops over time, but just one (G1 pit, 20-40 cm sample) to 4.00 over 16 weeks (**Figs. 5A and 5B**). So, are these acid sulfate soils? They typically are strongly acid (pH <5.5) and show drops in pH during aerobic incubation. However, only 1 sample out of 24 that have been used in incubation pH have dropped to pH 4.00 over a 16 week time frame. These data suggest some acid production can occur from these alluvial soils, but most horizons do not meet the definitions of sulfuric or sulfidic materials in U.S. Taxonomy. It is also possible that some of these coal-contaminated soils may be post-active, having sufficiently weathered and oxidized over the past 200 years as to not meet the definitions for active acid sulfate soils. Even so, the production of dilute acidity may continue to affect the biology of the river system into the future.

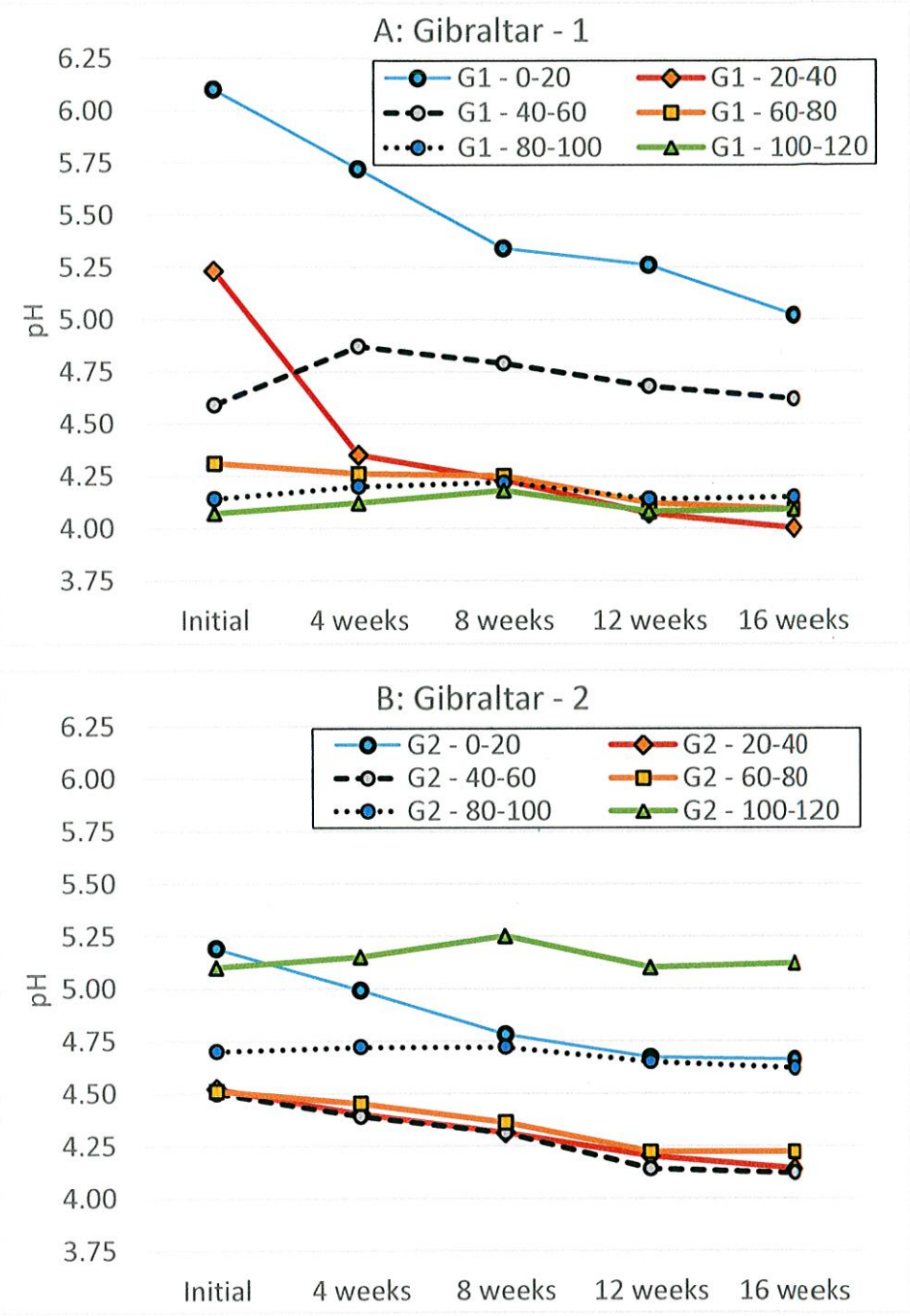

Fig. 5: A. Incubation pH for Gibraltar 1 pit soil materials, each sample represents a 20 cm increment, and average pH drop of all samples was 0.42. Note the 20-40 cm increment pH dropped from 5.23-4.00 over 16 weeks, **B.** Incubation pH for Gibraltar 2 pit soil materials, each sample represents a 20 cm increment, and average pH drop of all samples was 0.28. Note the difference in pH for the buried pre-industrial soil horizons (80-100 and 100-120 cm).

Other Issues

The Gibraltar series and other similar alluvial coal soils pose many problems for the evaluation of morphological, physical, and chemical properties. Examples of potential problems include:

- Problematic hydric soils, unable to identify depletions in black matrix.
- Accurate determination of soil carbon pools/sequestration. Separation of modern organic materials and coal-derived carbon is needed.
- Particle size distribution, low particle density of anthracite coal (~1.1-1.9 g/cm^3) changes settling time relative to other mineral grains. Difficult to account for in mixed lithology.
    - Coal more likely to break apart during physical disaggregation, sieving.
- Issues with horizonation, these soils are anthropogenic but deposited by rivers. Therefore no use of the ^ symbol, but morphological descriptions of A, C1, C2, C3, etc. are not telling of the origin of these deposits.
    - Lithologic discontinuity between coal and pre-industrial alluvium?
- Weak SBK structure in upper coal horizons, signs of pedogenesis? Thick A horizons (Umbric epipedon) or Bw horizons shift classification from Entisols to Inceptisols.

Environmental Considerations

Previous studies have noted the presence of thick coal alluvium in the region and have even suggested mapping these deposits as a stratigraphic "key bed" termed the Mammoth Coal Event (MCE). These deposits have also been used as evidence for establishment of the Anthropocene geologic epoch (Stinchcomb et al., 2013). This process is not confined to the Schuylkill River; there is evidence that many smaller tributary streams and the larger Susquehanna River have also undergone extensive aggradation with coal silt up to 6 m in depth. Our research in larger river systems like the Susquehanna has indicated that the historical coal alluvium is often buried >1 m deep and therefore overlooked or ignored.

Elevated metals in these soils warrant studies of the solubility and potential impacts to biological systems in the region. Research is needed to quantify how industrial legacy sediments impact contemporary hydrology, riparian plant growth, trace metal speciation, wildlife population health and breeding success, and floodplain susceptibility to invasion by non-native plant species (especially Japanese knotweed (*Fallopia japonica*) and *Phragmites australis).* Towards this goal, we have evaluated 12 alluvial sites in the Susquehanna River floodplain and are in the process of establishing 10 new sites during the summer of 2017. We have also begun to map the regional extent of anthracite alluvial soils and quantify the valuable water quality improvement functions provided by floodplains in coal mining regions throughout eastern Pennsylvania.

Conclusions

Historical coal mining drove expansion westward and was central to the industrial revolution in the United States. Coal made America great originally, but there are a number of long-lasting and unquantified off-site impacts of this industrial legacy. The Gibraltar soil series is one example of how unregulated industries can influence water quality and the overall fluvial landscape for future generations.

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LOCATION GIBRALTAR PA
Established Series
Rev. MS- MJ
02/2008

GIBRALTAR SERIES

The Gibraltar series consists of very deep, well-drained soils formed in recent alluvium derived from coal washings deposited over alluvium from reddish sandstone, siltstone and shale. They are nearly level soils on floodplains. Saturated hydraulic conductivity is moderately high. Mean annual precipitation is 43 inches. Mean annual temperature is 53 degrees F.

TAXONOMIC CLASS: Coarse-loamy, mixed, active, nonacid, mesic Mollic Udifluvents

TYPICAL PEDON: Gibraltar silt loam on a 1 percent slope in woodland (Colors are for moist soil unless otherwise noted.)

A-- 0 to 4 inches; very dark gray (10YR 3/1) silt loam; dark grayish brown (10YR 4/2) dry; very weak fine granular structure; friable, nonsticky and nonplastic; moderately acid; gradual wavy lower boundary. (3 to 10 inches thick)

C1-- 4 to 12 inches; very dark gray (10YR 3/1) silt loam; massive; friable; nonsticky and nonplastic; moderately acid; gradual wavy lower boundary.

C2-- 12 to 24 inches; black (N 2.5/0) silt loam; massive; friable; nonsticky and nonplastic; moderately acid; gradual wavy boundary.

C3-- 24 to 30 inches; black (N 2.5/0) sandy loam; massive; friable; nonsticky and nonplastic; moderately acid; gradual wavy boundary. (Combined thickness of C horizon 14 to 38 inches thick)

2Apb-- 30 to 38 inches; dark brown (7.5YR 3/2) silt loam; weak fine granular structure; friable; nonsticky and nonplastic; moderately acid; gradual wavy boundary. (0 to 10 inches thick)

2Bwb-- 38 to 62 inches; reddish brown (5YR 5/4) silt loam; weak medium granular structure; friable; nonsticky and nonplastic; moderately acid. (10 to 30 inches thick)

TYPE LOCATION: Berks County, Pennsylvania, Amity Township, 2000 feet southeast of Douglassville, 200 feet east of the road connecting US 422 and Pa. 724, 300 feet north-northeast of the edge of the Schuylkill River. Boyertown USGS topographic quadrangle, lat. 40 degrees 15 minutes, 01 seconds N, Long. 75 degrees, 43 minutes, 24 seconds W.

RANGE IN CHARACTERISTICS: Thickness of the solum ranges from 3 to 10 inches. Depth to the 2Apb horizon ranges from 20 to 70 inches. Depth to bedrock is greater than 60 inches.

Rock fragments range from 0 to 15 percent in the control section and 0 to 10 percent in the substratum. They are usually coal fragments or rounded gravels. Soil reaction: unlimed reaction is moderately acid to slightly acid throughout.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 0 to 2. It is silt loam, loam or sandy loam in the fine-earth fraction. Structure is weak or moderate granular and consistence is very friable or friable.

The C horizon has hue of 10YR to 5Y, value of 4 through 6, and chroma of 2 or less. It is silt loam, loam, or sandy loam in the fine-earth fraction. Structure is single grain or massive and consistence is friable to loose.

The 2Apb horizon has hue of 5YR to 10YR, value of 3 or 4, and chroma of 2 to 4. It is silt loam, loam or sandy loam in the fine-earth fraction. Structure is weak of moderate granular and consistence is friable or very friable. Reaction is moderately acid to slightly acid.

The 2Bwb horizon has hue of 2.5YR to 10YR, value of 3 to 5, and chroma of 3 or 4. It is silt loam, loam, or silty clay loam in the fine-earth fraction. Reaction is moderately acid to slightly acid. Some pedons have 2Bwgb horizons with similar characteristics to 2Bwb horizons but chromas ranges from 1 through 4 and occur at depths greater than 40 inches.

COMPETING SERIES: The Nelse series is the only member of the same family and these soils lack an upper horizon derived from alluvial coal.

GEOGRAPHIC SETTING: Gibraltar soils are on floodplains that extend from the Appalachian Plateau through the Valley and Ridge Province and the Northern Piedmont to the Mid-Atlantic Coastal Plain. Slopes range from 0 to 3 percent. The soils developed in recent alluvial coal deposits originating from mining operations upstream overlying older floodplain soils. Mean annual precipitation ranges from 40-50 inches, mean annual air temperature is 48 to 55 degrees F. and a growing season of 150 to 200 days.

GEOGRAPHICALLY ASSOCIATED SOILS: The moderately well drained Middlebury soils and the poorly drained Holly soils are associates on floodplains. Birdsboro, Raritan and Lamington are on adjacent terraces.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Well drained. Runoff is slow. Saturated hydraulic conductivity is moderately high.

USE AND VEGETATION: Most areas are in woodland and are used for timber production. Some areas are in cropland or hayland. Woodland vegetation is mixed hardwoods.

DISTRIBUTION AND EXTENT: Central and southeastern Pennsylvania. The series is of small extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Morgantown, West Virginia

SERIES ESTABLISHED: Berks County, Pennsylvania, 1995.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

a. Mollic feature: Although the soil has a thick dark surface, it is not considered a mollic epipedon because the dark color is derived from the coal, does not presumably meet the phosphate criterion and has an age of greater than holocene in the surface to 30 inches.

b. Fluvents - organic carbon decreases irregularly with depth and is greater than 0.2 percent at a depth of at least 50 inches below the surface.

2008 Revision was to update pedon description

Prior revision 7/2001 NJC-EAW-RP

National Cooperative Soil Survey
U.S.A.

Route 663 Road Cut
Exposure of igneous Diabase
Contact metamorphic Hornfels
Sedimentary red Triassic shale
Location: 40.420719 -75.450489

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NOTES:

Tuskes Home Saratoga Farms - pre-Wisconsin till over carbonate-Washington series

4316 Saratoga Drive Nazareth, PA Location: 40.712072 -75.327847

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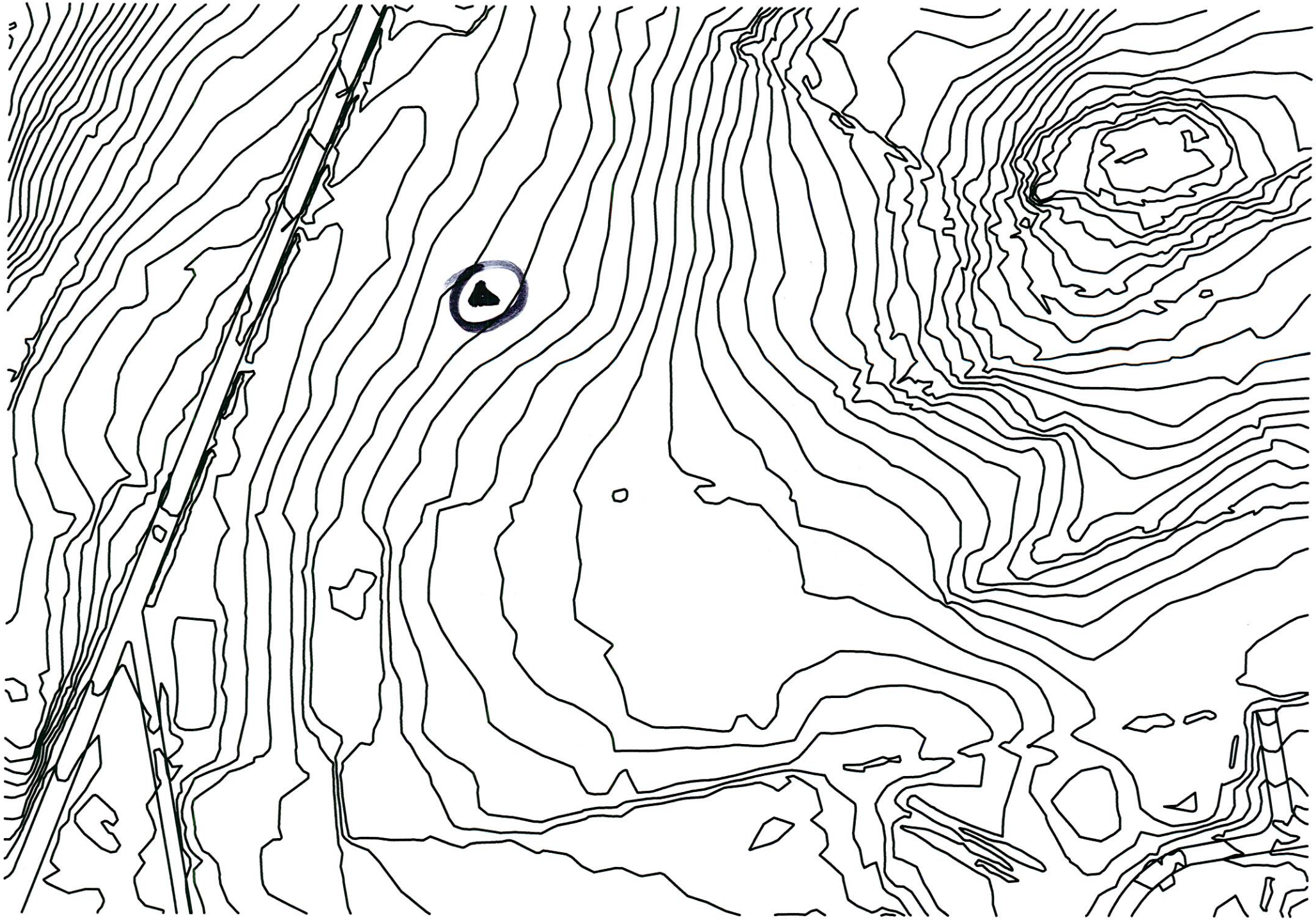
NOTES:



Tuskess Homes Scale: 1:200

PEDON DESCRIPTION

Print Date: Jun 12 2017
Description Date: Apr 10 1991
Describer: S. Anderson, R. Grossman, N. Churchill, A. Daughtry, J. Chibirka, M. Cortes, J. Castro
Site ID: S1991PA095006
Site Note:
Pedon ID: 91PA095006
Pedon Note: Original map unit WaB, soil map #34 in 1974 published survey.
Lab Source ID: SSL
Lab Pedon #: 91P0641
User Transect ID:
Soil Name as Described/Sampled: Washington
Classification:
Soil Name as Correlated:
Classification:
Pedon Type: within range of map unit
Pedon Purpose: full pedon description
Taxon Kind:
Associated Soils: Berks, Clarksburg, Duffield/Ryder
Physiographic Division:
Physiographic Province:
Physiographic Section:
State Physiographic Area:
Local Physiographic Area:
Geomorphic Setting: on summit of head slope of hillside on summit of head slope of karstland
Upslope Shape: convex
Cross Slope Shape: convex
Particle Size Control Section: 22 to 72 cm.
Description origin: Converted from PDP 3.x
Diagnostic Features: ochric epipedon 0 to 56 cm.
argillic horizon 56 to 353 cm.

Country:
State: Pennsylvania
County: Northampton
MLRA: 147 -- Northern Appalachian Ridges and Valleys
Soil Survey Area: PA095 -- Northampton County, Pennsylvania
Map Unit:
Quad Name:
Std Latitude: 40.7244453
Std Longitude: -75.2966690

Primary Earth Cover: Crop cover
Secondary Earth Cover:
Vegetation:
Parent Material:
Bedrock Kind:
Bedrock Depth:
Bedrock Hardness:
Bedrock Fracture Interval:
Surface Fragments:
Description database: KSSL

Cont. Site ID: S1991PA095006 **Pedon ID:** 91PA095006

Slope (%)	Elevation (meters)	Aspect (deg)	MAAT (C)	MSAT (C)	MWAT (C)	MAP (mm)	Frost-Free Days	Drainage Class	Slope Length (meters)	Upslope Length (meters)
4.0	128.0	315	11.1			1,092		well	55	24.4

Ap--0 to 23 centimeters (0.0 to 9.1 inches); brown (10YR 4/3) interior silt loam, pale brown (10YR 6/3) interior, dry; 18 percent clay; weak fine subangular blocky parts to moderate medium platy structure; friable, slightly sticky, slightly plastic; common fine roots throughout; few medium moderate-continuity discontinuous tubular pores; 2 percent angular 2 to 75-millimeter Cherty limestone fragments and 3 percent subrounded 2 to 75-millimeter Sandstone and siltstone fragments; moderately alkaline, pH 8.0, Hellige-Truog; abrupt smooth boundary. Lab sample # 91P03640. Other than spaces created by separation of peds from excavation, there were no observed pores.

Bt1--23 to 51 centimeters (9.1 to 20.1 inches); yellowish brown (10YR 5/6) interior silt loam; 25 percent clay; moderate fine and medium subangular blocky structure; friable, slightly sticky, slightly plastic; few fine roots throughout; few medium moderate-continuity discontinuous tubular pores; 10 percent prominent N 2/0) manganese or iron-manganese stains on faces of peds and in pores and 10 percent prominent N 2/0) manganese or iron-manganese stains on rock fragments and 30 percent prominent 7.5YR 5/4) clay films on faces of peds and in pores; 1 percent angular 2 to 75-millimeter Cherty limestone fragments and 1 percent subangular 2 to 75-millimeter Noncalcareous shale fragments and 2 percent subangular 2 to 75-millimeter Quartzite fragments; moderately alkaline, pH 8.0, Hellige-Truog; clear smooth boundary. Lab sample # 91P03641

Bt2--51 to 91 centimeters (20.1 to 35.8 inches); yellowish brown (10YR 5/6) interior silty clay loam; 33 percent clay; weak coarse prismatic parts to moderate fine and medium subangular blocky structure; firm, moderately sticky, moderately plastic; few very fine and fine roots throughout; few medium moderate-continuity interstitial and tubular pores; 10 percent prominent N 2/0) manganese or iron-manganese stains on faces of peds and in pores and 30 percent prominent 7.5YR 5/4) clay films on faces of peds and in pores and 30 percent prominent 7.5YR 5/4) clay films in root channels and/or pores; 2 percent subangular 2 to 75-millimeter Quartzite fragments and 2 percent subangular 2 to 75-millimeter Cherty limestone fragments and 4 percent subangular 2 to 75-millimeter Noncalcareous shale fragments; moderately alkaline, pH 8.0, Hellige-Truog; clear smooth boundary. Lab sample # 91P03642

Bt/C1--91 to 117 centimeters (35.8 to 46.1 inches); 10 percent strong brown (7.5YR 5/6) interior; gradual smooth boundary. Lab sample # 91P03643

Bt/C1--91 to 117 centimeters (35.8 to 46.1 inches); 90 percent yellowish brown (10YR 5/6) interior silty clay loam; 28 percent clay; weak coarse prismatic parts to weak medium subangular blocky structure; friable, moderately sticky, slightly plastic; few fine roots throughout; few coarse pores; 10 percent prominent N 2/0) manganese or iron-manganese stains on faces of peds and 10 percent prominent 7.5YR 5/4) clay films on faces of peds and in pores; moderately alkaline, pH 8.0, Hellige-Truog. Lab sample # 91P03643

Bt/C2--117 to 140 centimeters (46.1 to 55.1 inches); 10 percent strong brown (7.5YR 5/6) interior; gradual smooth boundary.

Bt/C2--117 to 140 centimeters (46.1 to 55.1 inches); 90 percent yellowish brown (10YR 5/6) interior silty clay loam; 25 percent clay; weak coarse prismatic parts to weak medium subangular blocky structure; friable, moderately sticky, slightly plastic; few medium moderate-continuity dendritic tubular and few fine low-continuity discontinuous tubular pores; 10 percent prominent N 2/0) manganese or iron-manganese stains on faces of peds and 10 percent prominent 7.5YR 5/4) clay films on faces of peds and in pores; moderately alkaline, pH 8.0, Hellige-Truog. Lab sample # 91P03644

C1--140 to 236 centimeters (55.1 to 92.9 inches); 50 percent strong brown (7.5YR 5/6) interior and 30 percent yellowish red (5YR 5/6) interior and 20 percent yellowish brown (10YR 5/4) interior silt loam; 25 percent clay; weak coarse prismatic parts to weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; few medium moderate-continuity dendritic tubular and few fine low-continuity discontinuous tubular pores; 10 percent faint 7.5YR 4/6) clay films on faces of peds; moderately alkaline, pH 8.0, Hellige-Truog; diffuse smooth boundary. Lab sample # 91P03645. In strata - colors and percentages of colors reflect various amounts and colors of each strata within this horizon. Strata is due to in-site weathering of parent material.

C2--236 to 264 centimeters (92.9 to 103.9 inches); 50 percent yellowish brown (10YR 5/4) interior and 30 percent yellowish brown (10YR 5/6) interior and 10 percent light olive brown (2.5Y 5/4) interior and 10 percent gray (10YR 5/1) interior silt loam; 26 percent clay; weak coarse platy structure; firm, nonsticky, slightly plastic; 10 percent faint 7.5YR 5/6) clay films on faces of peds; moderately alkaline, pH 8.0, Hellige-Truog. Lab sample # 91P03646. (10YR 5/1) color is relic limestone fragment color (ghost); average, maximum, and minimum thicknesses are disregarded because boundaries are smooth.

*** Primary Characterization Data ***

Pedon ID: 91PA095006 — (Northampton, Pennsylvania) — Print Date: Jun 12 2017 11:16AM

Sampled as on Apr 8, 1991 — Washington : Fine-loamy, mixed Typic Hapludalfs
Revised to :

SSL - Project CP91PA148 FRANKLIN-NORTHAMPTON
- Site ID S1991PA095006 Lat: 40° 43' 28.00" north Long: 75° 17' 48.01" west MLRA: 147
- Pedon No. 91P0641
- 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
91P03640	Ap	Ap	0-22				SIL	SIL
91P03641	Bt1	Bt1	22-50				SIL	SICL
91P03642	Bt2	Bt2	50-91				SICL	SICL
91P03643	Bt/C1	Bt/C1	91-116				SICL	C
91P03644	Bt/C2	Bt/C2	116-139				SICL	C
91P03645	C1	C1	139-235				SIL	SIC
91P03646	C2	C2	235-265				SIL	SIC

Pedon Calculations

Calculation Name	Result	Units of Measure
CEC Activity, CEC7/Clay, Weighted Average	0.21	(NA)
Clay, carbonate free, Weighted Average	35	% wt
Weighted Particles, 0.1-75mm, 75 mm Base	14	% wt
Volume, >2mm, Weighted Average	3	% vol
Clay, total, Weighted Average	35	% wt
LE, Whole Soil, Summed to 1m	2	cm/m

Weighted averages based on control section: 22-72 cm

PSDA & Rock Fragments

Layer	Depth (cm)	Horz	Prep	-1- Lab Texture	-2- Clay (Total) < .002	-3- Silt (Total) .002-.05	-4- Sand (Total) .05-2	-5- Clay (Fine) < .0002	-6- Clay (Fine) CO_3 < .002	-7- Silt (Fine) .002-.02	-8- Silt (Coarse) .02-.05	-9- Sand VF .05-.10	-10- Sand F .10-.25	-11- Sand M .25-.50	-12- Sand C .5-1	-13- Sand VC 1-2	-14- (Rock Fragments (mm)) Weight 2-5	-15- Weight 5-20	-16- Weight 20-75	-17- Weight .1-75	-18- >2 mm wt % whole soil
					(% of <2mm Mineral Soil)												(% of <75mm)				
				3A1a1a	3A1a1a	3A1a1a	3A1a1a	3A1a1a		3A1a1a	3A1a1a	3A1a1a	3A1a1a	3A1a1a	3A1a1a	3A1a1a	3B1	3B1	3B1		
91P03640	0-22	Ap	S	sil	23.3	59.5	17.2	5.2		39.0	20.5	5.4	4.0	3.6	2.6	1.6	3	4	–	18	7
91P03641	22-50	Bt1	S	sicl	31.1	52.6	16.3	12.1		35.1	17.5	4.9	3.5	3.4	2.8	1.7	3	3	–	17	6
91P03642	50-91	Bt2	S	sicl	39.3	44.5	16.2	17.0		28.3	16.2	9.2	2.1	1.9	1.5	1.5	2	2	–	11	4
91P03643	91-116	Bt/C1	S	c	41.9	38.0	20.1	21.8		21.9	16.1	10.5	3.3	2.2	1.9	2.2	3	4	–	16	7
91P03644	116-139	Bt/C2	S	c	40.5	39.2	20.3	19.8		22.1	17.1	10.5	3.8	2.1	1.9	2.0	4	4	–	17	8
91P03645	139-235	C1	S	sic	42.4	42.1	15.5	20.2		23.4	18.7	9.8	2.6	1.2	1.1	0.8	4	2	–	11	6
91P03646	235-265	C2	S	sic	40.3	43.9	15.8	19.4		26.1	17.8	10.8	2.1	1.4	1.0	0.5	1	tr	–	6	1

*** Primary Characterization Data ***

Pedon ID: 91PA095006 — (Northampton, Pennsylvania) — Print Date: Jun 12 2017 11:16AM

Sampled As : Washington — Fine-loamy, mixed Typic Hapludalfs
USDA-NRCS-NSSC-Soil Survey Laboratory ; Pedon No. 91P0641

Bulk Density & Moisture

Layer	Depth (cm)	Horz	Prep	-1- (Bulk Density) 33 kPa (g cm^{-3}) 4A1d	-2- Oven Dry (g cm^{-3}) 4A1h	-3- Cole Whole Soil	-4- (Water Content) 6 kPa (% of < 2mm)	-5- 10 kPa	-6- 33 kPa 4B1c	-7- 1500 kPa 3C2a1a	-8- 1500 kPa Ratio Moist	-9- AD/OD 3D1	-10- WRD Whole Soil (cm^3 cm^{-3}) 4C1	-11- Aggst Stabl 2-0.5mm % 3F1a1a	-12- (Ratio/Clay) CEC7 8D1	-13- 1500 kPa 8D1
91P03640	0-22	Ap	S	1.46	1.53	0.015			25.3	9.6		1.015	0.22	19	0.49	0.41
91P03641	22-50	Bt1	S	1.57	1.65	0.016			22.4	13.0		1.014	0.14		0.23	0.42
91P03642	50-91	Bt2	S	1.64	1.72	0.016			21.5	16.6		1.010	0.08		0.20	0.42
91P03643	91-116	Bt/C1	S	1.42	1.51	0.020			26.2	17.2		1.014	0.12		0.20	0.41
91P03644	116-139	Bt/C2	S	1.47	1.55	0.017			26.8	16.5		1.014	0.14		0.19	0.41
91P03645	139-235	C1	S	1.38	1.45	0.016			29.1	17.5		1.015	0.16		0.19	0.41
91P03646	235-265	C2	S	1.42	1.49	0.016			27.7	15.8		1.013	0.17		0.19	0.39

Water Content

Layer	Depth (cm)	Horz	Prep	-1- (Atterberg Limits) LL pct <0.4mm	PI	-2- (Bulk Density) Field (g cm^{-3})	-3- Recon 33 kPa	-4- Recon Oven Dry	-5- Field (Water Content)	-6- Recon 33 kPa (% of < 2mm)	-7- (Sieved Samples) 6 kPa	-8- 10 kPa	-9- 33 kPa	-10- 100 kPa	-11- 200 kPa	-12- 500 kPa 3C1e1a
91P03640	0-22	Ap	S													18.9
91P03641	22-50	Bt1	S													20.1
91P03642	50-91	Bt2	S													21.8
91P03643	91-116	Bt/C1	S													22.6
91P03644	116-139	Bt/C2	S													22.6
91P03645	139-235	C1	S													23.5
91P03646	235-265	C2	S													22.5

*** Primary Characterization Data ***

(Northampton, Pennsylvania)

Pedon ID: 91PA095006 — Print Date: Jun 12 2017 11:16AM

Sampled As : Washington — Fine-loamy, mixed Typic Hapludalfs

USDA-NRCS-NSSC-Soil Survey Laboratory — Pedon No. 91P0641

Carbon & Extractions

Layer	Depth (cm)	Horz	Prep	-1- Total C (% of <2 mm)	-2- Total N (% of <2 mm)	-3- Total S (% of <2 mm)	-4- Est OC (% of <2 mm)	-5- OC (WB) (% of <2mm)	-6- C/N Ratio	-7- Dith-Cit Ext Fe (% of <2mm)	-8- Dith-Cit Ext Al (% of <2mm)	-9- Dith-Cit Ext Mn (% of <2mm)	-10- Ammonium Oxalate Extraction Al+½Fe (% of <2mm)	-11- Ammonium Oxalate Extraction ODOE (% of <2mm)	-12- Na Pyro Phosphate Fe (% of <2mm)	-13- Na Pyro Phosphate Al (% of <2mm)	-14- Na Pyro Phosphate Si (% of <2mm)	-15- Na Pyro Phosphate Mn (% of <2mm)	-16- C (mg kg-1)	-17- Fe (% of <2mm)	-18- Al (% of <2mm)	-19- Mn (% of <2mm)
					6B3a		6A1c			6C2b	6G7a	6D2a										
91P03640	0-22	Ap	S		0.051		1.66			2.7	0.3	0.1										
91P03641	22-50	Bt1	S		0.036		0.21			3.7	0.4	0.1										
91P03642	50-91	Bt2	S		0.029		0.06			4.2	0.4	0.1										
91P03643	91-116	Bt/C1	S		0.152		0.07			4.4	0.4	0.1										
91P03644	116-139	Bt/C2	S				0.07			4.2	0.3	tr										
91P03645	139-235	C1	S				0.05			4.6	0.4	0.1										
91P03646	235-265	C2	S				0.03			3.9	0.3	tr										

CEC & Bases

Layer	Depth (cm)	Horz	Prep	-1- Ca (cmol(+) kg-1)	-2- Mg (cmol(+) kg-1)	-3- Na (cmol(+) kg-1)	-4- K (cmol(+) kg-1)	-5- Sum Bases (cmol(+) kg-1)	-6- Acidity (cmol(+) kg-1)	-7- Extr Al (cmol(+) kg-1)	-8- KCl Mn (mg kg-1)	-9- CEC8 Sum Cats (cmol(+) kg-1)	-10- CEC7 NH_4 OAC (cmol(+) kg-1)	-11- ECEC Bases +Al (cmol(+) kg-1)	-12- Al Sat (%)	-13- Base Saturation Sum (%)	-14- Base Saturation NH_4OAC (%)
				6N2e	6O2d	6P2b	6Q2b		6H5a			5A3a	5A8b			5C3	5C1
91P03640	0-22	Ap	S	37.2*	0.9	0.1	0.5		2.0				11.4			95	100
91P03641	22-50	Bt1	S	7.4*	0.6	0.1	0.2	8.3	1.9			10.2	7.0			81	100
91P03642	50-91	Bt2	S	6.9	0.5	0.1	0.1	7.6	2.0			9.6	7.7			79	99
91P03643	91-116	Bt/C1	S	7.5*	0.7	0.1	0.1	8.4	2.1			10.5	8.2			80	100
91P03644	116-139	Bt/C2	S	7.2*	0.8	0.1	0.1	8.2	4.9			13.1	7.7			63	100
91P03645	139-235	C1	S	7.0*	1.0	0.1	0.2	8.3	2.2			10.5	8.1			79	100
91P03646	235-265	C2	S	5.0	1.3	0.1	tr	6.4	3.4			9.8	7.7			65	83

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

*** Primary Characterization Data ***

(Northampton, Pennsylvania)

Pedon ID: 91PA095006 — Print Date: Jun 12 2017 11:16AM

Sampled As : Washington — Fine-loamy, mixed Typic Hapludalfs

USDA-NRCS-NSSC-Soil Survey Laboratory — Pedon No. 91P0641

Salt

Layer	Depth (cm)	Horz	Prep	-1- Ca (mmol(+) L-1)	-2- Mg (mmol(+) L-1)	-3- Na (mmol(+) L-1)	-4- K (mmol(+) L-1)	-5- CO_3 (mmol(-) L-1)	-6- HCO_3 (mmol(-) L-1)	-7- F (mmol(-) L-1)	-8- Cl (mmol(-) L-1)	-9- PO_4 (mmol(-) L-1)	-10- Br (mmol(-) L-1)	-11- OAC (mmol(-) L-1)	-12- SO_4 (mmol(-) L-1)	-13- NO_2 (mmol(-) L-1)	-14- NO_3 (mmol(-) L-1)	-15- H_2O (% Water Extracted From Saturated Paste)	-16- Total Salts (1:2 %)	-17- Elec Cond (1:2 dS m-1)	-18- Elec Cond (Sat Paste dS m-1)	-19- Exch Na (%)	-20- SAR
91P03640	0-22	Ap	S																			1	
91P03641	22-50	Bt1	S																			1	
91P03642	50-91	Bt2	S																			1	
91P03643	91-116	Bt/C1	S																			1	
91P03644	116-139	Bt/C2	S																			1	
91P03645	139-235	C1	S																			1	
91P03646	235-265	C2	S																			1	

pH & Carbonates

Layer	Depth (cm)	Horz	Prep	-1- pH KCl	-2- pH $CaCl_2$ 0.01M 1:2	-3- pH H_2O 1:1	-4- pH Sat Paste	-5- pH Oxid	-6- pH 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)
					4C1a2a	4C1a2a				6E1g				
91P03640	0-22	Ap	S		6.8	7.1				2				
91P03641	22-50	Bt1	S		6.7	7.2								
91P03642	50-91	Bt2	S		6.7	7.1								
91P03643	91-116	Bt/C1	S		6.5	7.0								
91P03644	116-139	Bt/C2	S		6.5	7.1								
91P03645	139-235	C1	S		6.5	6.9								
91P03646	235-265	C2	S		5.4	5.8								

*** Primary Characterization Data ***

Pedon ID: 91PA095006
Sampled As : Washington
USDA-NRCS-NSSC-Soil Survey Laboratory

(Northampton, Pennsylvania)
Fine-loamy, mixed Typic Hapludalfs
Pedon No. 91P0641

Print Date: Jun 12 2017 11:16AM

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
						7A2i										7C3					tion
				(- - - - - - - - - peak size - - - - - - - - -)					(- - - - - - - - - % - - - - - - - - -)				(- - - - - - - - - - - - - - - - - - - % - - - - - - - - - - - - - - - - - - -)							$mg\ g^{-1}$	
91P03640	0.0-22.0	Ap	tcly	KK 3 QZ 1	MI 2	VR 2	GE 2	MT 1						21	10.4			1.6			

FRACTION INTERPRETATION:
tcly - Total Clay <0.002 mm

MINERAL INTERPRETATION:

GE Goethite | KK Kaolinite | MI Mica | MT Montmorillonite | QZ Quartz
VR Vermiculite

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

*** Primary Characterization Data ***

Pedon ID: 91PA095006
Sampled As : Washington
USDA-NRCS-NSSC-Soil Survey Laboratory

(Northampton, Pennsylvania)
Fine-loamy, mixed Typic Hapludalfs
; Pedon No. 91P0641

Print Date: Jun 12 2017 11:16AM

Sand - Silt Mineralogy (2.0-0.002 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					Optical				EGME	Inter
													Tot Re			Grain Count				Retn	preta
																7B1a2					tion
				(- - - - - - - - peak size - - - - - - - - -)					(- - - - - - - - % - - - - - - - - - -)				(- - - - - - - - - - - - - - - - - - % - - - - - - - - - - - - - - - - -)							$mg\ g^{-1}$	
91P03642	50.0-91.0	Bt2	csi										40	FD 44 OP 1	QZ 39 BT 1	OT 8 AM 1	MS 3 FK tr	FP 1	PR 1		

FRACTION INTERPRETATION:
csi - Coarse Silt 0.02-0.05 mm

MINERAL INTERPRETATION:

AM Amphibole | BT Biotite | FD Feldspar | FK Potassium Feldspar | FP Plagioclase Feldspar
MS Muscovite | OP Opaques | OT Other | PR Pyroxene | QZ Quartz

*** Method Codes ***

Code	Description
3A1a1a	PSDA, Routine, Pipet
3B1	Particles >2 mm, Weight Estimates
3C1e1a	Water Retention, 2 Bar, Pressure-Plate, <2mm
3C2a1a	Water Retention, 15 Bar, Pressure-Plate, <2mm
3D1	Water Retention, ADOD
3F1a1a	Aggregate Stability, 2-to 0 5-mm Aggregates Retained
4A1d	Bulk Density, 1/3-Bar Desorption I
4A1h	Bulk Density, Oven-Dry
4B1c	Water Retention, clod, 0.06, 0.1, 0.33, or 1 bar, pressure-plate extraction
4C1	derived WRD, 4C1
4C1a2a	pH, Routine, 1:1 Water and 1:2 0.01M CaCl2
5A3a	derived CEC_SUM, 5A3a
5A8b	CEC, NH4OAc, pH 7.0, automatic extractor, steam distillation I
5C1	derived BSESAT, 5C1
5C3	derived BSECAT, 5C3
5D2	derived NA_EXCH, 5D2
6A1c	Organic Carbon, acid dichromate digestion, FeSO4 titration, automatic titrator
6B3a	Total Nitrogen, Kjeldahl digestion II, ammonia steam distillation, automatic titrator
6C2b	Iron, Dithionite-Citrate Extraction, Atomic Absorption I
6D2a	Manganese, Dithionite-Citrate Extraction, Atomic Absorption I
6E1g	Calcium Carbonate Equivalent, HCl, <2mm, manometer, electronic (6E1g)
6G7a	Aluminum, Dithionite-Citrate Extraction, Atomic Absorption I
6H5a	Extractable Acidity, BaCl2-Triethanolamine IV, automatic extractor
6N2e	Calcium, NH4OAc Extraction, Atomic Absorption I
6O2d	Magnesium, NH4OAc Extraction, Atomic Absorption I
6P2b	Sodium, NH4OAc Extraction, Atomic Absorption I
6Q2b	Potassium, NHOAc Extraction, Atomic Absorption I
7A2i	X-ray Diffraction, Thin Film on Glass, Resin Pretreatment II
7B1a2	Optical Analysis, Full Grain Count
7C3	Total Analysis, HF Dissolution
8D1	Ratio, to Total Clay - 8D1

*** Preparation Codes ***

Code	Description / List of Methods
Caj	The moist soil clod used for bulk density determinations 4A1d, 4A1h, 4B1c
Sal	The air-dried whole soil passing a No. 10-mesh sieve and retained on a No. 18-mesh sieve 3F1a1a
Sjj	The air-dried soil passing a No. 10-mesh sieve 3A1a1a, 3C2a1a, 3D1, 3C1e1a, 6A1c, 6B3a, 6C2b, 6D2a, 6G7a, 5A8b, 6H5a, 6N2e, 6O2d, 6P2b, 6Q2b, 4C1a2a, 6E1g, 7A2i, 7B1a2, 7C3

*** Instrument Sets ***

Instrument Set Name	List of Methods
atomic adsorption spectrophotometer	6C2b, 6D2a, 6G7a, 6N2e, 6O2d, 6P2b, 6Q2b
distillation titirator	6B3a, 5A8b
Instrument Not Specified	3A1a1a, 3B1, 3C2a1a, 3D1, 3F1a1a, 4A1d, 4A1h, 4B1c, 3C1e1a, 7A2i, 7B1a2, 7C3
manometer	6E1g
pH meter	4C1a2a
titrator	6A1c, 6H5a

*** Analyzed Size Fractions ***

Size Fraction	List of Methods
<0.002 mm	7A2i, 7C3
<2 mm	3A1a1a, 3C2a1a, 3D1, 4A1d, 4A1h, 4B1c, 8D1, 3C1e1a, 6A1c, 6B3a, 6C2b, 6D2a, 6G7a, 5A3a, 5A8b, 5C1, 5C3, 6H5a, 6N2e, 6O2d, 6P2b, 6Q2b, 5D2, 4C1a2a, 6E1g

*** Glossary of Codes ***

Print Date: Jun 12 2017 11:16AM

Reports: Primary Characterization Report;
Pedons: 91P0641;

*** Analyzed Size Fractions ***

Size Fraction	List of Methods
<75 mm	3B1
0.02-0.05 mm	7B1a2
1-2 mm	3F1a1a
whole soil	4C1

LOCATION WASHINGTON NJ+PA
Established Series
KPW-CFJ-LEG; Rev. DHK
12/2005

WASHINGTON SERIES

The Washington series consists of deep, well drained soils formed in old glacial drift (pre-Wisconsin Age) or colluvium derived mainly from limestone and granitic gneiss. Washington soils occur on nearly level to steep glacial till plains in limestone valleys. Slope ranges from 0 to 40 percent. Mean annual air temperature ranges from 50 to 55 degrees F. and mean annual precipitation is about 40 to 48 inches.

TAXONOMIC CLASS: Fine-loamy, mixed, semiactive, mesic Ultic Hapludalfs

TYPICAL PEDON: Washington loam - pastured. (Colors are for moist soils.)

Ap--0 to 9 inches, dark yellowish brown (10YR 3/4) loam; moderate medium granular structure; friable; many fine roots; 10 percent subangular pebbles composed of granitic gneiss, sandstones, chert and leached limestone; neutral; clear smooth boundary. (7 to 12 inches thick)

Bt1--9 to 17 inches, strong brown (7.5YR 5/6) loam; moderate fine and medium subangular blocky structure; friable; many fine roots; few thin clay films on ped faces; 5 percent 3 mm to .25-inch granitic gneiss fragments; many worm channels filled with dark soil; neutral; diffuse wavy boundary.

Bt2--17 to 29 inches, strong brown (7.5YR 5/6) clay loam; strong medium and coarse subangular blocky structure, parting to moderate medium subangular and angular blocky; friable; few very fine roots; many thick clay films on ped faces and in the many worm channels; 5 percent thoroughly weathered and slightly weathered granitic gneiss fragments .25 to 1.25 inches in diameter; neutral; diffuse wavy boundary.

Bt3--29 to 42 inches, strong brown (7.5YR 5/6) clay loam; moderate medium subangular and angular blocky structure; friable; patchy maganese stains; thin patchy clay films on ped faces; 10 percent weathered gneiss, quartz and chert pebbles and few, soft, weathered, limestone pebbles; coarse sand and fine gravel impart gritty feel; neutral; gradual wavy boundary.

Bt4--42 to 52 inches, strong brown (7.5YR 5/6) clay loam; moderate, medium subangular and angular blocky structure; friable; thin, patchy clay films on ped faces; 10 percent gneiss, quartz, chert and limestone pebbles; coarse sand and fine gravel imparts a more gritty feel than in the Bt3 horizon; neutral; diffuse irregular boundary. (Combined thickness of the Bt horizons is 29 to 55 inches)

C--52 to 72 inches, brownish yellow (10YR 6/8) blotched with strong brown (7.5YR 5/6) loam grading toward gravelly silt loam with depth; massive; friable; coarse fragments increase from 10 percent to 35 percent with depth with increasing limestone or limey shale and less gneiss; neutral; abrupt irregular boundary. (0 to 140 inches thick)

2R--72 inches, massive and shaly dark gray limestone, with many large solution cavities.

TYPE LOCATION: Hunterdon County, New Jersey; 3 miles northeast of West Portal, DeBoor farm, in pasture, second field back from buildings, 100 feet in from fence corner on top of slope. Radioactive fallout sample site.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 40 to 60 inches. Depth to bedrock is 5 to 20 feet and variable within short distances. Weighted average clay content ranges from about 20 to 35 percent and sand is less than 40 percent in the control section. Subangular to rounded coarse fragments range from 2 to 35 percent, distributed throughout solum but usually increasing slightly with depth. Quartz, gneiss and chert fragments dominate in the solum, but soft, thoroughly weathered limestone and limey shale ghosts increase near the bottom of solum and limestone fragments increase in the substratum. Reaction ranges from moderately acid to neutral, generally becoming less acid with depth.

The Ap horizon has hue of 10YR or 7.5YR, with value of 3 or 4 and chroma of 2 through 4. Texture is loam, silt loam or clay loam and gravelly analogues. A horizons rarely occur, but when present have value of 3 and chroma of 1 through 3.

The B horizon has hue of 7.5YR or 10YR, with values of 5 or 6 and chroma of 4 through 8. Texture is dominantly clay loam or loam, but silt loam or silty clay loam textures occur in individual subhorizons. Structure ranges from moderate to strong, medium to coarse, subangular to angular blocky. The soil is typically friable throughout but some pedons may have some firmness in the lower B.

The C horizon dominantly has hue of 7.5YR or 10YR, but includes 5YR. Value is 4 through 6 and chroma is 4 through 8. Coarse lithochromic mottling may occur. Textures include clay loam, loam and silt loam. Where 2C horizons occur, texture may include silty clay loam, silty clay and clay. Structure is generally massive and consistence is friable.

COMPETING SERIES: These are the Bolton, Bookwood, Carpenter, Renox, and Ryder series. Bolton soils have 5YR and redder hues in the sola. Bookwood soils have interbedded limestone, shale and siltstone bedrock at 40 to 60 inches and have rock fragments consisting of primarily limestone, siltstone and shale throughout. Carpenter soils have rock fragments that are domantly sandstone, siltstone, shale, geodes, or chert throughout. Renox soils have rock fragments consisting of primarily of shale, siltstone, limestone, chert, geodes, and sandstone that are mostly gravel- or channer-sized. Ryder soils have interbedded limestone and limy shale bedrock at 20 to 40 inches.

GEOGRAPHIC SETTING: Washington soils occur on nearly level to steep till plains within limestone valleys, commonly with many shallow, closed depressions. The soils formed in old

glacial drift (pre-Wisconsin Age) or colluvium from these materials, typically overlying limestone bedrock. Mean annual air temperature ranges from 50 to 55 degrees F. and mean annual precipitation is about 40 to 48 inches.
Frost free period typically ranges from 163 to 188 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These include the Allenwood, Annandale, Bartley, Bedington, Berks, Edneyville, Elliber, Evendale, Kreamer, Lawrence, Melvin, Thorndale, Turbotville and Wiltshire soils. Allenwood, Annandale, Bedington and Edneyville soils have base saturation below 35 percent and Annandale also has a fragipan. Bartley, Lawrence, Thorndale, Turbotville and Wiltshire soils have fragipans and redox features above the fragipan. The Berks and Elliber soils have shallower sola, more rock fragments throughout, and lack argillic horizons. The Evendale, Kreamer and Melvin soils are poorly drained and have redox features in the upper part of the solum.

DRAINAGE AND PERMEABILITY: Well drained. Saturated hydraulic conductivity is moderately high. Permeability (obsolete) is moderate. Index surface runoff class is low to high (depending on slope).

USE AND VEGETATION: Nearly all of this soil is cropped for vegetables, general farming and pasture.

DISTRIBUTION AND EXTENT: Northwest New Jersey and east-central Pennsylvania. The series is of large extent with about 122,000 acres identified.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Morgantown, West Virginia

SERIES ESTABLISHED: Belvidere, New Jersey, 1917.

REMARKS: The 12/2005 revision places Washington soils in a semiactive family based on six characterization pedons. Control section CEC-7/clay ratios range from .19 to .37, with four semiactive and two subactive. The pedon description was updated to current horizon nomenclature and redoximorphic feature terminology. Competing series section was also updated. The "heavy" textural modifiers were removed from the Bt1 and C horizons and "light" textural modifier was removed from the Bt4 horizon.

Diagnostic horizons and features recognized in this pedon are:
a) Ochric epipedon - the zone from the surface of the soil to a depth of 9 inches (Ap horizon)
b) Argillic horizon - zone from 9 to 52 inches (Bt1, Bt2, Bt3 and Bt4 horizons)
c) Lithologic discontinuity at 72 inches (top of 2R horizon)
ADDITIONAL DATA: Characterization data are available for pedons 83NJ019002, 91NJ041001, 91NJ041002, 91NJ041003, 94NJ041001, 94NJ041002, from the National Soil Survey Laboratory, Lincoln, NE.
MLRA: 148, the northeast margin of 147, and the southern fringe of 144A
REVISED: 04/81-KPW-CFJ-LEG; 12/2005-DHK

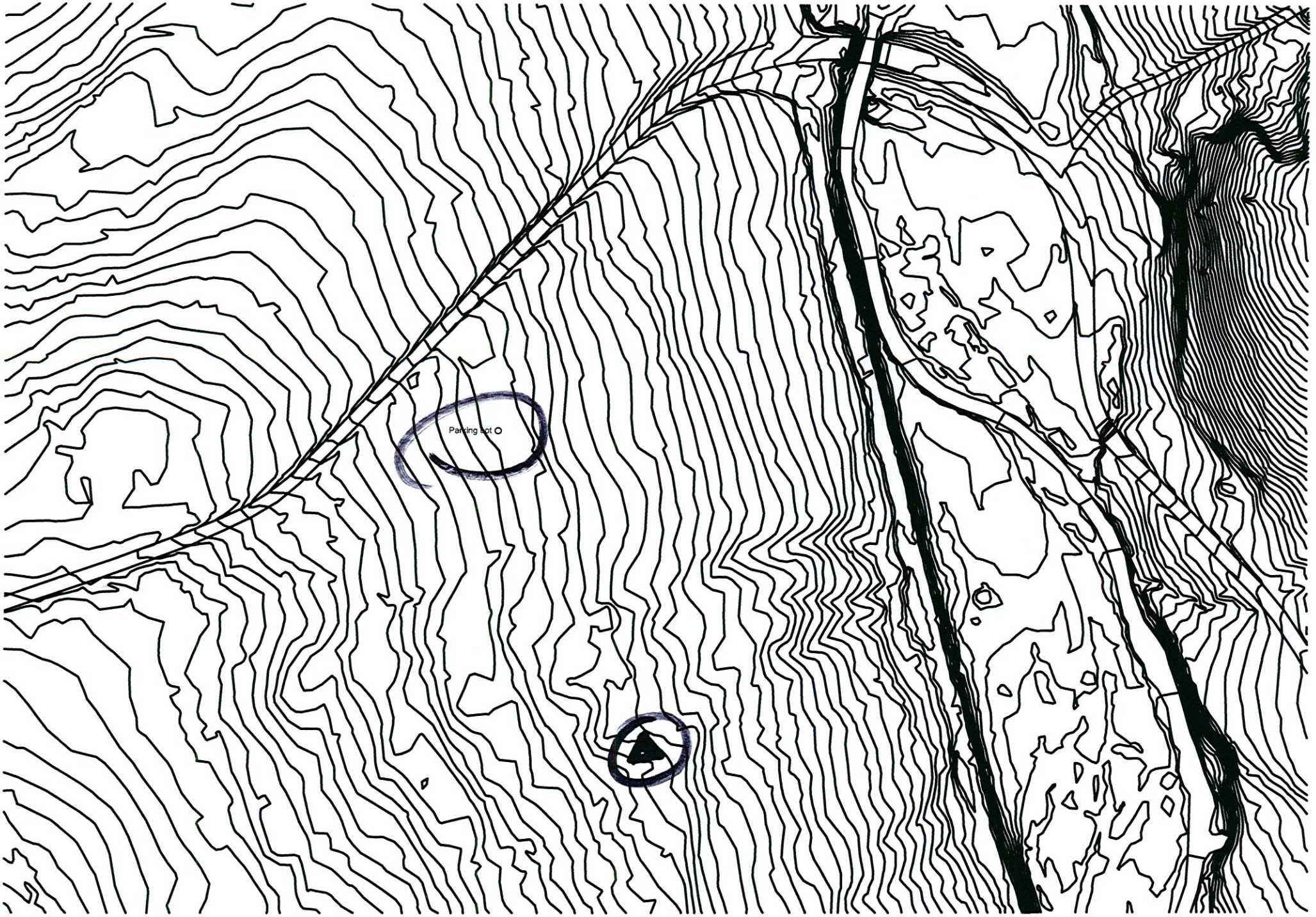
Jacobsburg State Park-mountain colluvium over old till- unnamed series
Meet at the horse Trailer parking lot on Belfast Rd near Keller Rd
Location: 40.796522 -75.311833

John D. Chibirka

Resource Soil Scientist

(610) 372-4655 X112

USDA Natural Resources Conservation Service



Jacobsburg State Park Scale: 1:200

PEDON DESCRIPTION

Print Date: Jun 12 2017
Description Date: Apr 9 1991
Describer: S. Anderson, E. White, N. Churchill, R. Grossman, A. Daughtry, M. Cortes, J. Chibirka, J. Castro
Site ID: S1991PA095005
Site Note:
Pedon ID: 91PA095005
Pedon Note: Original map unit BoB in 1974 published soil survey, soil map #19. Slope position - 2.
Lab Source ID: SSL
Lab Pedon #: 91P0640
User Transect ID:
Soil Name as Described/Sampled: Allenwood variant
Classification:
Soil Name as Correlated:
Classification:
Pedon Type: within range of map unit
Pedon Purpose: full pedon description
Taxon Kind:
Associated Soils: Berks, Brinkerton, Comly, Wiekert
Physiographic Division:
Physiographic Province:
Physiographic Section:
State Physiographic Area:
Local Physiographic Area:
Geomorphic Setting: on backslope of side slope of hillside on backslope of side slope of upland
Upslope Shape:
Cross Slope Shape: convex
Particle Size Control Section: 38 to 88 cm.
Description origin: Converted from PDP 3.x
Diagnostic Features: ochric epipedon 0 to 33 cm.
cambic horizon 33 to 97 cm.
argillic horizon 97 to 508 cm.

Country:
State: Pennsylvania
County: Northampton
MLRA: 147 -- Northern Appalachian Ridges and Valleys
Soil Survey Area: PA095 -- Northampton County, Pennsylvania
Map Unit:
Quad Name:
Std Latitude: 40.7944450
Std Longitude: -75.3108368

Primary Earth Cover: Tree cover
Secondary Earth Cover: Intermixed conifers and hardwoods
Vegetation: longleaf pine, oak
Parent Material:
Bedrock Kind:
Bedrock Depth:
Bedrock Hardness:
Bedrock Fracture Interval:
Surface Fragments: 3.0 percent
Description database: KSSL

Cont. Site ID: S1991PA095005 **Pedon ID:** 91PA095005

Slope (%)	Elevation (meters)	Aspect (deg)	MAAT (C)	MSAT (C)	MWAT (C)	MAP (mm)	Frost-Free Days	Drainage Class	Slope Length (meters)	Upslope Length (meters)
3.0	180.0		11.1			1,092		moderately well		

O--0 to 5 centimeters (0.0 to 2.0 inches); 2""""" of slightly decomposed oak, tulip, poplar, and white pine leaf litter on the surface. Lab sample # 91P03629

A--5 to 18 centimeters (2.0 to 7.1 inches); very dark gray (10YR 3/1) interior silt loam; 18 percent clay; weak fine granular structure; very friable, nonsticky, nonplastic; many very fine and fine roots throughout and common medium and coarse roots throughout; common fine and medium moderate-continuity discontinuous tubular pores; 1 percent subrounded 2 to 75-millimeter Sandstone fragments and 2 percent subangular 2 to 150-millimeter Sandstone fragments; neutral, pH 6.8, Hellige-Truog; abrupt smooth boundary. Lab sample # 91P03630

Bw--18 to 43 centimeters (7.1 to 16.9 inches); brown (7.5YR 5/4) interior silt loam; 18 percent clay; weak fine subangular blocky structure; friable, slightly sticky, nonplastic; common fine to coarse roots throughout; common fine moderate-continuity discontinuous tubular pores; 1 percent angular 2 to 75-millimeter Quartzite fragments and 2 percent subangular 2 to 150-millimeter Sandstone fragments and 2 percent angular 250 to 600-millimeter Sandstone fragments; slightly acid, pH 6.5, Hellige-Truog; clear wavy boundary. Lab sample # 91P03631

Bt1--43 to 83 centimeters (16.9 to 32.7 inches); strong brown (7.5YR 5/6) interior silt loam; 22 percent clay; moderate medium subangular blocky structure; friable, slightly sticky, slightly plastic; few fine and medium roots throughout; common fine moderate-continuity discontinuous tubular pores; 30 percent faint 7.5YR 5/6) clay films on faces of peds and in pores; 1 percent angular 2 to 150-millimeter Shale-siltstone fragments and 2 percent subrounded 2 to 75-millimeter Sandstone fragments and 3 percent subangular 2 to 150-millimeter Sandstone fragments; very strongly acid, pH 5.0, Hellige-Truog; clear wavy boundary. Lab sample # 91P03632

Bt2--83 to 112 centimeters (32.7 to 44.1 inches); strong brown (7.5YR 5/6) interior silt loam; 24 percent clay; 3 percent medium prominent (5Y 6/1) mottles; weak fine and medium subangular blocky structure; friable, nonsticky, slightly plastic; few fine and medium roots throughout; few fine moderate-continuity discontinuous tubular pores; 1 percent subrounded 2 to 75-millimeter Sandstone fragments and 2 percent subangular 2 to 150-millimeter Sandstone fragments and 5 percent angular 2 to 150-millimeter Shale-siltstone fragments; very strongly acid, pH 5.0, Hellige-Truog; clear wavy boundary. Lab sample # 91P03633

2Bt3--112 to 132 centimeters (44.1 to 52.0 inches); 20 percent strong brown (7.5YR 4/6) interior and 80 percent strong brown (7.5YR 5/6) exterior silty clay loam; 30 percent clay; weak fine and medium subangular blocky structure; friable, nonsticky, slightly plastic; few fine moderate-continuity discontinuous tubular pores; 30 percent prominent N 2/0) manganese or iron-manganese stains on rock fragments; 3 percent subrounded 2 to 75-millimeter Sandstone fragments and 5 percent subrounded 75 to 250-millimeter Sandstone fragments; very strongly acid, pH 5.0, Hellige-Truog; abrupt wavy boundary. Lab sample # 91P03634

3Bt4--132 to 155 centimeters (52.0 to 61.0 inches); yellowish red (5YR 5/6) interior silty clay loam; 37 percent clay; moderate medium subangular blocky structure; firm, moderately sticky, moderately plastic; few fine moderate-continuity discontinuous tubular pores; 30 percent faint 5YR 5/6) clay films on faces of peds and in pores; 5 percent subrounded 75 to 250-millimeter Sandstone fragments and 5 percent subrounded 2 to 75-millimeter Sandstone fragments; very strongly acid, pH 4.5, Hellige-Truog; clear wavy boundary. Lab sample # 91P03635. split for sampling purposes

3Bt5--155 to 205 centimeters (61.0 to 80.7 inches); yellowish red (5YR 5/6) interior cobbly silty clay loam; moderate medium subangular blocky structure; firm, moderately sticky, moderately plastic; few fine moderate-continuity discontinuous tubular pores; 30 percent faint 5YR 5/6) clay films on faces of peds and in pores; 10 percent subrounded 75 to 250-millimeter Sandstone fragments and 10 percent subrounded 2 to 75-millimeter Sandstone fragments; very strongly acid, pH 4.5, Hellige-Truog. Lab sample # 91P03636. split for sampling purposes

*** Primary Characterization Data ***

(Northampton, Pennsylvania)

Pedon ID: 91PA095005

Print Date: Jun 12 2017 11:15AM

Sampled as on Apr 7, 1991: Allenwood variant ; Fine-loamy, mixed Aquic Hapludults
Revised to :

SSL - Project CP91PA148 FRANKLIN-NORTHAMPTON
- Site ID S1991PA095005 Lat: 40° 47' 40.00" north Long: 75° 18' 39.01" west MLRA: 147
- Pedon No. 91P0640
- 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
91P03629	O	O	5-0					
91P03630	A	A	0-13				SIL	L
91P03631	Bw	Bw	13-38				SIL	L
91P03632	Bt1	Bt1	38-78				SIL	SIL
91P03633	Bt2	Bt2	78-107				SIL	L
91P03634	Bt3	Bt3	107-127				SICL	L
91P03635	Bt4	Bt4	127-150				SICL	CL
91P03636	Bt5	Bt5	150-200				SICL	CL
91P03637	Bt3	Bt3	107-127				SICL	COSL
91P03638	Bt4	Bt4	127-150				SICL	COSL
91P03639	Bt5	Bt5	150-200				SICL	COSL

Pedon Calculations

Calculation Name	Result	Units of Measure
CEC Activity, CEC7/Clay, Weighted Average	0.31	(NA)
Clay, carbonate free, Weighted Average	19	% wt
Weighted Particles, 0.1-75mm, 75 mm Base	40	% wt
Volume, >2mm, Weighted Average	14	% vol
Clay, total, Weighted Average	19	% wt

Weighted averages based on control section: 38-88 cm

*** Primary Characterization Data ***

(Northampton, Pennsylvania)

Pedon ID: 91PA095005

Print Date: Jun 12 2017 11:15AM

Sampled As : Allenwood variant

Fine-loamy, mixed Aquic Hapludults

USDA-NRCS-NSSC-Soil Survey Laboratory ; Pedon No. 91P0640

PSDA & Rock Fragments

Layer	Depth (cm)	Horz	Prep	-1- Lab Texture	-2- Total Clay < .002	-3- Total Silt .002 -.05	-4- Total Sand .05 -2	-5- Clay Fine < .0002	-6- Clay CO_3 < .002	-7- Silt Fine .002 -.02	-8- Silt Coarse .02 -.05	-9- Sand VF .05 -.10	-10- Sand F .10 -.25	-11- Sand M .25 -.50	-12- Sand C .5 -1	-13- Sand VC 1 -2	-14- Rock Fragments (mm) Weight 2 -5	-15- Weight 5 -20	-16- Weight 20 -75	-17- Weight .1- 75	-18- >2 mm wt % whole soil
					(- - - - % of <2mm Mineral Soil											- - - -)	(- - - % of <75mm			- - -)	
				3A1a1a	3A1a1a	3A1a1a	3A1a1a	3A1a1a		3A1a1a	3A1a1a	3A1a1a	3A1a1a	3A1a1a	3A1a1a	3A1a1a	3B1	3B1	3B1		
91P03629	5-0	O	S														--	--	--		
91P03630	0-13	A	S	l	21.1	49.3	29.6	6.2		33.7	15.6	7.1	9.4	7.4	3.9	1.8	9	--	--	29	9
91P03631	13-38	Bw	S	l	22.5	47.3	30.2	7.8		32.1	15.2	7.0	8.3	7.4	4.1	3.4	9	11	2	40	22
91P03632	38-78	Bt1	S	sil	20.4	51.3	28.3	7.6		32.8	18.5	7.1	7.7	6.6	3.7	3.2	7	9	7	39	23
91P03633	78-107	Bt2	S	l	15.8	48.2	36.0	4.7		28.9	19.3	6.9	10.5	9.0	6.1	3.5	9	7	3	43	19
91P03634	107-127	Bt3	S	l	20.1	47.7	32.2	6.4		30.2	17.5	7.2	9.5	7.8	4.6	3.1	5	9	18	49	32
91P03635	127-150	Bt4	S	cl	36.4	35.1	28.5	15.7		25.1	10.0	7.4	7.4	6.6	4.0	3.1	5	7	1	31	13
91P03636	150-200	Bt5	S	cl	37.9	33.3	28.8	16.0		23.3	10.0	6.3	8.9	7.6	3.5	2.5	6	9	--	34	15
91P03637	107-127	Bt3	S														6	12	--	--	
91P03637	107-127	Bt3	GP	cosl	10.8	21.4	67.8			13.8	7.6	6.5	11.8	12.3	15.9	21.3					
91P03638	127-150	Bt4	S														4	7	--	--	
91P03638	127-150	Bt4	GP	cosl	12.1	19.1	68.8			12.2	6.9	7.3	13.2	13.0	16.2	19.1					
91P03639	150-200	Bt5	S														5	6	--	--	
91P03639	150-200	Bt5	GP	cosl	12.8	18.6	68.5			12.7	6.0	8.7	13.1	13.5	18.7	14.5					

*** Primary Characterization Data ***

Pedon ID: 91PA095005 (Northampton, Pennsylvania) Print Date: Jun 12 2017 11:15AM

Sampled As : Allenwood variant Fine-loamy, mixed Aquic Hapludults

USDA-NRCS-NSSC-Soil Survey Laboratory ; Pedon No. 91P0640

Bulk Density & Moisture

Layer	Depth (cm)	Horz	Prep	-1- (Bulk Density) 33 kPa (g cm^{-3}) 4A1d	-2- Oven Dry 4A1h	-3- Cole Whole Soil	-4- Water Content 6 kPa (% of < 2mm)	-5- 10 kPa	-6- 33 kPa 4B1c	-7- 1500 kPa 3C2a1a	-8- 1500 kPa Moist	-9- Ratio AD/OD 3D1	-10- WRD Whole Soil cm^3 cm^{-3} 4C1	-11- Aggst Stabl 2-0.5mm % 3F1a1a	-12- (Ratio/Clay) CEC7 8D1	-13- 1500 kPa 8D1
91P03629	5-0	O	S							66.9		1.090				
91P03630	0-13	A	S	0.95	1.14	0.060			39.9	11.3		1.023	0.26	91	0.97	0.54
91P03631	13-38	Bw	S	1.59	1.85	0.044			21.1	8.9		1.010	0.17		0.30	0.40
91P03632	38-78	Bt1	S	1.65	1.69	0.007			20.3	9.0		1.009	0.16		0.31	0.44
91P03633	78-107	Bt2	S	1.43	1.44	0.002			18.5	7.2		1.010	0.14		0.32	0.46
91P03634	107-127	Bt3	S	1.71	1.73	0.003			18.0	8.0		1.010	0.13		0.35	0.40
91P03635	127-150	Bt4	S							13.7		1.015			0.29	0.38
91P03636	150-200	Bt5	S							14.3		1.013			0.36	0.38
91P03637	107-127	Bt3	S												0.24	0.45
91P03637	107-127	Bt3	GP							4.9		1.004				
91P03638	127-150	Bt4	S												0.20	0.33
91P03638	127-150	Bt4	GP							4.0		1.003				
91P03639	150-200	Bt5	S												0.21	0.36
91P03639	150-200	Bt5	GP							4.6		1.004				

Water Content

Layer	Depth (cm)	Horz	Prep	-1- (Atterberg Limits) LL pct <0.4mm	PI	-2- (Bulk Density) Field (g cm^{-3})	-3- Recon 33 kPa	-4- Oven Dry	-5- (Water Content) Field (% of < 2mm)	-6- Recon 33 kPa	-7- (Sieved Samples) 6 kPa	-8- 10 kPa	-9- 33 kPa	-10- 100 kPa	-11- 200 kPa	-12- 500 kPa 3C1e1a
91P03630	0-13	A	S													23.0
91P03631	13-38	Bw	S													15.9
91P03632	38-78	Bt1	S													16.2
91P03633	78-107	Bt2	S													13.6
91P03634	107-127	Bt3	S													14.6
91P03635	127-150	Bt4	S													20.4

*** Primary Characterization Data ***

Pedon ID: 91PA095005 (Northampton, Pennsylvania) Print Date: Jun 12 2017 11:15AM

Sampled As : Allenwood variant Fine-loamy, mixed Aquic Hapludults

USDA-NRCS-NSSC-Soil Survey Laboratory ; Pedon No. 91P0640

Carbon & Extractions

Layer	Depth (cm)	Horz	Prep	-1- (Total) C (% of <2 mm) 6B3a	-2- N 6R3b	-3- S	-4- Est OC	-5- OC (WB) 6A1c	-6- C/N Ratio	-7- (Dith-Cit Ext) Fe (% of < 2mm) 6C2b	-8- Al 6G7a	-9- Mn 6D2a	-10- (Ammonium Oxalate Extraction) Al+½Fe	-11- ODOE Fe	-12- Al	-13- Si	-14- Mn	-15- (Na Pyro-Phosphate) C (mg kg^{-1})	-16- Fe (% of < 2mm)	-17- Al	-18-	-19- Mn
91P03629	5-0	O	S		0.11			33.46														
91P03630	0-13	A	S	0.234				5.83		1.9	0.4	tr										
91P03631	13-38	Bw	S	0.057				0.82		2.4	0.4	tr										
91P03632	38-78	Bt1	S	0.026				0.16		2.7	0.3	tr										
91P03633	78-107	Bt2	S	0.165				0.09		2.3	0.2	tr										
91P03634	107-127	Bt3	S					0.06		2.6	0.3	tr										
91P03635	127-150	Bt4	S					0.09		3.7	0.4	tr										
91P03636	150-200	Bt5	S					0.09		3.8	0.2	tr										
91P03637	107-127	Bt3	GP					0.04														
91P03638	127-150	Bt4	GP					0.03														
91P03639	150-200	Bt5	GP					0.04														

CEC & Bases

Layer	Depth (cm)	Horz	Prep	-1- (NH_4OAC Extractable Bases) Ca (cmol(+) kg^{-1}) 6N2e	-2- Mg 6O2d	-3- Na 6P2b	-4- K 6Q2b	-5- Sum Bases	-6- Acidity 6H5a	-7- Extr Al 6G9c	-8- KCl Mn (mg kg^{-1}) 6D3b	-9- CEC8 Sum Cats (cmol(+) kg^{-1}) 5A3a	-10- CEC7 NH_4OAC 5A8b	-11- ECEC Bases +Al 5A3b	-12- Al Sat 5G1	-13- (Base Saturation) Sum (%) 5C3	-14- NH_4OAC 5C1
91P03629	5-0	O	S	51.8	5.1	0.4	1.5						65.2				
91P03630	0-13	A	S	16.3	0.6	0.1	0.3	17.3	11.5			28.8	20.4			60	85
91P03631	13-38	Bw	S	3.0	0.2	tr	0.2	3.4	5.7	0.3	0.1	9.1	6.8	3.7	8	37	50
91P03632	38-78	Bt1	S	0.8	tr	0.1	0.1	1.0	7.4	2.1	--	8.4	6.3	3.1	68	12	16
91P03633	78-107	Bt2	S	1.1	0.1	0.1	0.1	1.4	6.2	1.4	0.3	7.6	5.1	2.8	50	18	27
91P03634	107-127	Bt3	S	1.1	0.1	0.2	0.1	1.5	6.1	1.1	0.7	7.6	7.0	2.6	42	20	21
91P03635	127-150	Bt4	S	1.5	0.3	tr	0.2	2.0	9.5	1.4	tr	11.5	10.7	3.4	41	17	19
91P03636	150-200	Bt5	S	1.3	0.4	0.2	0.2	2.1	8.9	1.3	--	11.0	13.5	3.4	38	19	16
91P03637	107-127	Bt3	GP	0.7	0.1	0.1	0.1	1.0	3.0			4.0	2.6			25	38
91P03638	127-150	Bt4	GP	0.7	0.1	0.1	0.1	1.0	3.3			4.3	2.4			23	42
91P03639	150-200	Bt5	GP	0.7	0.2	0.2	0.1	1.2	3.4			4.6	2.7			26	44

*** Primary Characterization Data ***

Pedon ID: 91PA095005 (Northampton, Pennsylvania) Print Date: Jun 12 2017 11:15AM

Sampled As : Allenwood variant Fine-loamy, mixed Aquic Hapludults

USDA-NRCS-NSSC-Soil Survey Laboratory ; Pedon No. 91P0640

Salt

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	Total Salts	Elec Cond	Elec Cond	Exch Na	SAR
				-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 - - - - - -) 1:2																			
				(- - - - - mmol(+) L^{-1} - - - - -)				(- mmol(-) L^{-1} -)										(- - - - % - - - -)	(- - dS m^{-1} - -)		%	
91P03630	0-13	A	S																			tr	
91P03631	13-38	Bw	S																			--	
91P03632	38-78	Bt1	S																			2	
91P03633	78-107	Bt2	S																			2	
91P03634	107-127	Bt3	S																			3	
91P03635	127-150	Bt4	S																			--	
91P03636	150-200	Bt5	S																			1	
91P03637	107-127	Bt3	GP																			4	
91P03638	127-150	Bt4	GP																			4	
91P03639	150-200	Bt5	GP																			7	

pH & Carbonates

Layer	Depth (cm)	Horz	Prep	KCl	$CaCl_2$ 0.01M 1:2 4C1a2a	H_2O 1:1 4C1a2a	Sat Paste	Oxid	NaF	Carbonate As $CaCO_3$ <2mm	Carbonate As $CaCO_3$ <20mm	Gypsum As $CaSO_4*2H_2O$ <2mm	Gypsum As $CaSO_4*2H_2O$ <20mm	Resist ohms
				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-
				(- - - - - - - - - - - - - - - - - - pH - - - - - - - - - - - - - - - - -)						(- - Carbonate - -)		(- - Gypsum - - -)		
										(- - - - - - - - - - - - % - - - - - - - - - - -)				cm^{-1}
91P03629	5-0	O	S		5.1	5.4								
91P03630	0-13	A	S		5.5	5.9								
91P03631	13-38	Bw	S		5.0	5.6								
91P03632	38-78	Bt1	S		4.3	4.8								
91P03633	78-107	Bt2	S		4.4	4.8								
91P03634	107-127	Bt3	S		4.4	4.9								
91P03635	127-150	Bt4	S		4.3	4.9								
91P03636	150-200	Bt5	S		4.3	4.8								
91P03637	107-127	Bt3	GP		4.6	5.0								
91P03638	127-150	Bt4	GP		4.6	4.9								
91P03639	150-200	Bt5	GP		4.6	5.1								

*** Primary Characterization Data ***

Pedon ID: 91PA095005 (Northampton, Pennsylvania) Print Date: Jun 12 2017 11:15AM

Sampled As : Allenwood variant Fine-loamy, mixed Aquic Hapludults

USDA-NRCS-NSSC-Soil Survey Laboratory ; Pedon No. 91P0640

Clay Mineralogy (<.002 mm)

Layer	Depth (cm)	Horz	Fract	X-Ray 7A2i (peak size)	Thermal (%)	Elemental SiO_2	Al_2O_3	Fe_2O_3	MgO 7C3	CaO	K_2O	Na_2O (%)	EGME Retn ($mg\ g^{-1}$)	Interpretation
				-1- -2- -3- -4-	-5- -6- -7- -8- -9-	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-
91P03630	0.0-13.0	A	tcly	KK 2 VR 2 MI 2 GE 1			16	9.0			1.5			

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

*** Primary Characterization Data ***

Pedon ID: 91PA095005 (Northampton, Pennsylvania) Print Date: Jun 12 2017 11:15AM

Sampled As : Allenwood variant Fine-loamy, mixed Aquic Hapludults

USDA-NRCS-NSSC-Soil Survey Laboratory ; Pedon No. 91P0640

Sand - Silt Mineralogy (2.0-0.002 mm)

Layer	Depth (cm)	Horz	Fract	X-Ray (peak size)	Thermal (%)	Optical Tot Re (%)	Optical Grain Count 7B1a2 (%)	EGME Retn ($mg\ g^{-1}$)	Interpretation
				-1- -2- -3- -4-	-5- -6- -7- -8- -9-	-10-	-11- -12- -13- -14- -15- -16-	-17-	-18-
91P03632	38.0-78.0	Bt1	csi			68	QZ 67 FD 20 OT 7 MS 3 OP 1 PR 1 BT 1 HN tr TM tr ZR tr FK tr FP tr		

FRACTION INTERPRETATION
csi - Coarse Silt 0.02-0.05 mm

MINERAL INTERPRETATION:

BT Biotite FD Feldspar FK Potassium Feldspar FP Plagioclase Feldspar HN Hornblende

MS Muscovite OP Opaques OT Other PR Pyroxene QZ Quartz

TM Tourmaline ZR Zircon

*** Method Codes ***

Code	Description
3A1a1a	PSDA, Routine, Pipet
3B1	Particles >2 mm, Weight Estimates
3C1e1a	Water Retention, 2 Bar, Pressure-Plate, <2mm
3C2a1a	Water Retention, 15 Bar, Pressure-Plate, <2mm
3D1	Water Retention, ADOD
3F1a1a	Aggregate Stability, 2- to 0.5-mm Aggregates Retained
4A1d	Bulk Density, 1/3-Bar Desorption I
4A1h	Bulk Density, Oven-Dry
4B1c	Water Retention, clod, 0.06, 0.1, 0.33, or 1 bar, pressure-plate extraction
4C1	derived WRD, 4C1
4C1a2a	pH, Routine, 1:1 Water and 1:2 0.01M CaCl2
5A3a	derived CEC_SUM, 5A3a
5A3b	derived ECEC, 5A3b
5A8b	CEC, NH4OAc, pH 7.0, automatic extractor, steam distillation I
5C1	derived BSESAT, 5C1
5C3	derived BSECAT, 5C3
5D2	derived NA_EXCH, 5D2
5G1	derived AL_SAT, 5G1
6A1c	Organic Carbon, acid dichromate digestion, FeSO4 titration, automatic titrator
6B3a	Total Nitrogen, Kjeldahl digestion II, ammonia steam distillation, automatic titrator
6C2b	Iron, Dithionite-Citrate Extraction, Atomic Absorption I
6D2a	Manganese, Dithionite-Citrate Extraction, Atomic Absorption I
6D3b	Manganese, 1 N KCl Extractable, Automatic Extractor, Inductively Coupled Plasma Spectrometry II
6G7a	Aluminum, Dithionite-Citrate Extraction, Atomic Absorption I
6G9c	Cations, Potassium Chloride Extractable, 1 N, automatic extractor, ICP II (6G9c)
6H5a	Extractable Acidity, BaCl2-Triethanolamine IV, automatic extractor
6N2e	Calcium, NH4OAc Extraction, Atomic Absorption I
6O2d	Magnesium, NH4OAc Extraction, Atomic Absorption I
6P2b	Sodium, NH4OAc Extraction, Atomic Absorption I
6Q2b	Potassium, NHOAc Extraction, Atomic Absorption I
6R3b	Sulfur, Total, SO2 evolution, infrared I
7A2i	X-ray Diffraction, Thin Film on Glass, Resin Pretreatment II
7B1a2	Optical Analysis, Full Grain Count
7C3	Total Analysis, HF Dissolution
8D1	Ratio, to Total Clay - 8D1

*** Preparation Codes ***

Code	Description / List of Methods
Caj	The moist soil clod used for bulk density determinations 4A1d, 4A1h, 4B1c
Gaj	The air-dried whole soil including all coarse fragments ground to pass a No. 10-mesh sieve 3A1a1a, 3C2a1a, 3D1, 6A1c, 5A8b, 6H5a, 6N2e, 6O2d, 6P2b, 6Q2b, 4C1a2a
Sal	The air-dried whole soil passing a No. 10-mesh sieve and retained on a No. 18-mesh sieve 3F1a1a
Sjj	The air-dried soil passing a No. 10-mesh sieve 3A1a1a, 3C2a1a, 3D1, 3C1e1a, 6A1c, 6B3a, 6C2b, 6D2a, 6G7a, 6R3b, 5A8b, 6D3b, 6G9c, 6H5a, 6N2e, 6O2d, 6P2b, 6Q2b, 4C1a2a, 7A2i, 7B1a2, 7C3

*** Instrument Sets ***

Instrument Set Name	List of Methods
atomic adsorption spectrophotometer	6C2b, 6D2a, 6G7a, 6G9c, 6N2e, 6O2d, 6P2b, 6Q2b
distillation titirator	6B3a, 5A8b
elemental analyzer	6R3b
inductively coupled plasma spectrophotometer	6D3b
Instrument Not Specified	3A1a1a, 3B1, 3C2a1a, 3D1, 3F1a1a, 4A1d, 4A1h, 4B1c, 3C1e1a, 7A2i, 7B1a2, 7C3
pH meter	4C1a2a

*** Glossary of Codes ***

Print Date: Jun 12 2017 11:15AM

Reports: Primary Characterization Report;
Pedons: 91P0640;

*** Instrument Sets ***

Instrument Set Name	List of Methods
titrator	6A1c, 6H5a

*** Analyzed Size Fractions ***

Size Fraction	List of Methods
<0.002 mm	7A2i, 7C3
<2 mm	3A1a1a, 3C2a1a, 3D1, 4A1d, 4A1h, 4B1c, 8D1, 3C1e1a, 6A1c, 6B3a, 6C2b, 6D2a, 6G7a, 6R3b, 5A3a, 5A3b, 5A8b, 5C1, 5C3, 5G1, 6D3b, 6G9c, 6H5a, 6N2e, 6O2d, 6P2b, 6Q2b, 5D2, 4C1a2a
<75 mm	3B1
0.02-0.05 mm	7B1a2
1-2 mm	3F1a1a
whole soil	4C1

Torre Site- Wisconsin till- Wurtsboro and Volusia series
535 Institute Drive Bangor, PA 18013
Gate to field at 40.928739 -75.171942

John D. Chibirka

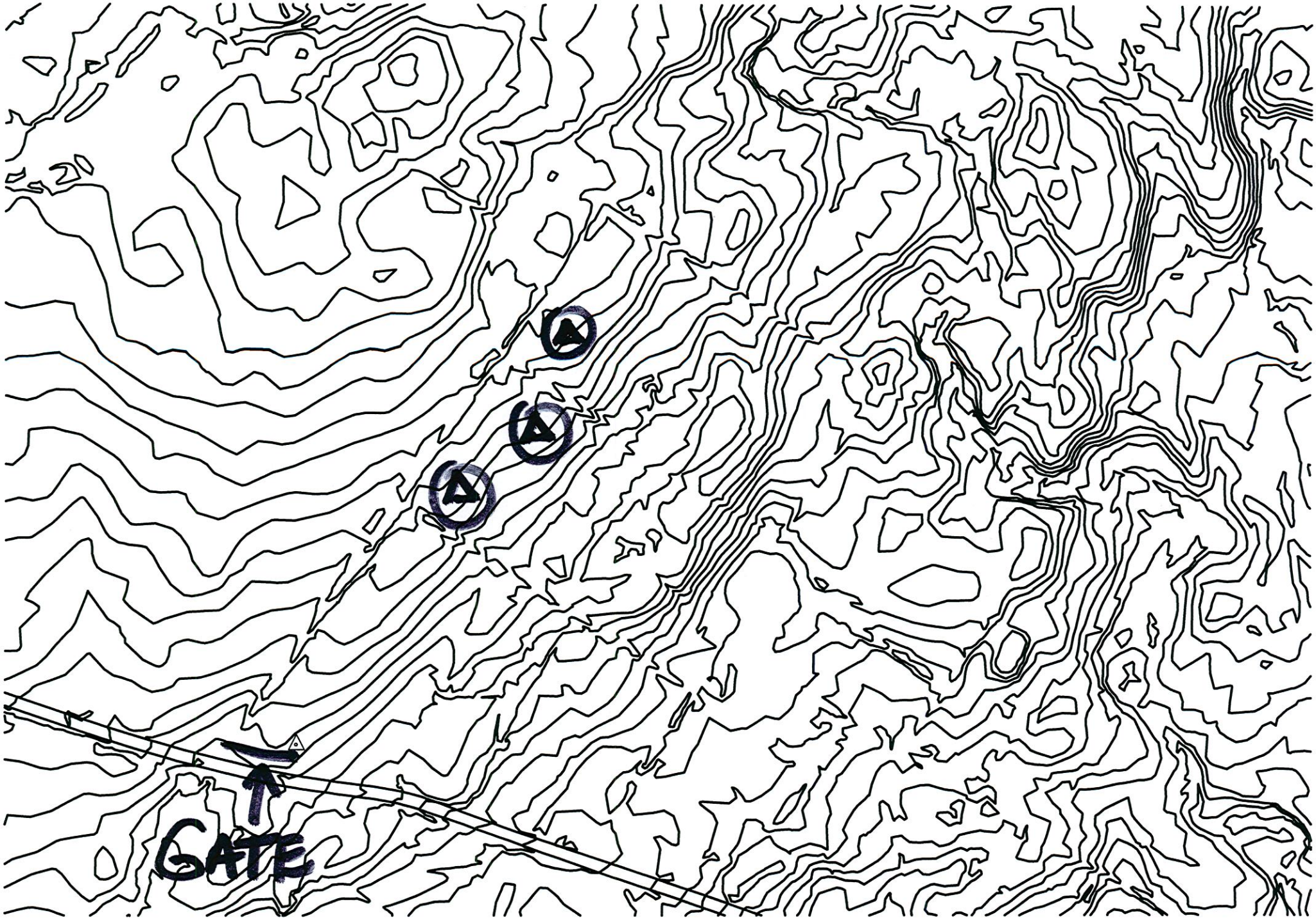
Resource Soil Scientist

USDA-NRCS

(610) 372-4655 X112

john.chibirka@pa.usda.gov

NOTES:



535 Institute Drive- Torre Scale: 1:200

LOCATION SWARTSWOOD PA NJ NY
Established Series
Rev. GDM-JRH-JDC
01/2008

SWARTSWOOD SERIES

The Swartswood series consists of deep and very deep, well drained and moderately well drained soils formed in till derived primarily from gray and brown quartzite, conglomerate, and sandstone. Slope ranges from 0 to 35 percent. Saturated hydraulic conductivity is moderately high or high in the mineral soil above the fragipan and moderately low or moderately high in the fragipan. Mean annual precipitation is 40 inches. Mean annual temperature is 49 degrees F.

TAXONOMIC CLASS: Coarse-loamy, mixed, active, mesic Typic Fragiudepts

TYPICAL PEDON: Swartswood gravelly fine sandy loam - woodland. (Colors are for moist soil unless otherwise noted.)

Oi-- 0 to 1 inches; brown (7.5YR 4/2) hardwood leaf litter; extremely acid; abrupt smooth boundary. (1 to 2 inches thick.)

Oe-- 1 to 2 inches; black (10YR 2/1) leaf mold; roots and fungus mycelia in fibrous mat; extremely acid; abrupt smooth boundary. (0 to 1 inch thick.)

E-- 2 to 4 inches; grayish brown (10YR 5/2) fine sandy loam; weak fine granular structure; very friable; 10 percent sandstone and quartzite pebbles; common stones; extremely acid; abrupt irregular boundary. (0 to 3 inches thick.)

Bs-- 4 to 7 inches; strong brown (7.5YR 5/6) gravelly fine sandy loam; weak fine granular structure; very friable; 15 percent rock fragments; common stones; extremely acid; clear wavy boundary. (0 to 5 inches thick.)

Bw1-- 7 to 20 inches; yellowish brown (10YR 5/4) gravelly fine sandy loam; weak fine subangular blocky structure; friable, slightly sticky; 25 percent rock fragments; extremely acid; clear wavy boundary. (10 to 15 inches thick.)

Bw2-- 20 to 32 inches; brown (10YR 5/3) gravelly sandy loam; some weak plates parting to weak medium subangular blocky structure; firm; 30 percent rock fragments; very strongly acid; clear wavy boundary. (6 to 14 inches thick.)

Bx-- 32 to 62 inches; dark yellowish brown (10YR 4/4) gravelly fine sandy loam; weak very thick platy structure; brittle; very firm; 30 percent rock fragments; few faint clay films in pores; very strongly acid.

TYPE LOCATION: Pike County, Pennsylvania; Porter Township, Delaware State Forest (originally Edgemere State Forest), 4 miles south on Fivemile Meadow Road from intersection with Dingman Pike and 50 feet southwest in woods. USGS Pecks Pond, PA topographic quadrangle; Latitude 41 degrees, 17 minutes, 18 seconds N. and Longitude 75 degrees, 0 minutes, 25 seconds W., NAD 1927.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 40 to 70 inches. Depth to the fragipan ranges from 20 to 36 inches. Depth to bedrock ranges from 3 1/2 to 20 feet, or more. Low chroma redoximorphic features are usually present within the fragipan or deeper than 26 inches. The particle-size control section averages more than 60 percent silt plus very fine sand. Rock fragments are angular or subrounded sandstone, conglomerate or quartzite usually less than 4 inches in size but range through boulder size. Rock fragment content in individual horizons ranges from 3 to 40 percent by volume above the fragipan and from 15 to 60 percent in the Bx and C horizons. The soil ranges from extremely acid through strongly acid throughout, where unlimed.

The Ap horizon has hue of 5YR through 10YR, value of 4 or 5, and chroma of 2 or 3. Undisturbed pedons typically have a thin A horizon with hue of 10YR, value of 2 or 3, and chroma of 1 through 3. Texture is fine sandy loam, sandy loam or loam in the fine-earth fraction.

The E horizon has hue of 7.5YR or 10YR, value of 4 through 6, and chroma of 1 through 3. Texture is fine sandy loam, sandy loam or loam in the fine-earth fraction. Some pedons do not have an E horizon.

The Bw horizon has hue of 5YR through 10YR, value of 4 through 6, and chroma of 3 through 6. Some pedons are redoximorphic concentrations below 26 inches. The Bw horizon has 5 to 18 percent clay in the fine-earth fraction.

The Bx horizon has hue of 5YR through 2.5Y, value of 4 or 5, and chroma of 2 through 6. It usually contains both high and low chroma redoximorphic features. The Bx horizon has platy or very coarse prismatic structure with subangular blocky, platy or massive interiors. Faces of prisms have chroma of 2 through 4. Texture is fine sandy loam, sandy loam or loam in the fine-earth fraction.

Some pedons have friable or firm, gravelly sandy loam C horizons.

COMPETING SERIES: The Bath, Braceville, Broadalbin, Ira, Lackawanna, Mardin, Rushford, Sodus, Wellsboro, and Wurtsboro series are in the same family. Bath, Lackawanna, Mardin, and Wellsboro soils have more than 60 percent silt plus very fine sand in the particle-size control section. Braceville soils have stratified sand and gravel in the series control section. Broadalbin soils have rock fragments primarily of granite, gneiss, and dark shale. Ira and Sodus soils are moderately acid to neutral in the fragipan. Rushford soils have less than 15 percent rock fragmnts in the lower subsoil and substratum. Wurtsboro soils have low chroma mottles between 12 inches and the top of the fragipan or within a depth of 26 inches.

GEOGRAPHIC SETTING: Swartswood soils are nearly level to very steep. Slope ranges from about 0 to 35 percent in gradient. The soils developed in till derived largely from gray and brown quartzite, conglomerate and sandstone. Stones and boulders are common surface features in wooded areas. The climate is temperate and humid; mean annual precipitation ranges from 34 to 46 inches, mean annual temperature ranges from 45 to 52 degrees F., and the frost-free season ranges from 130 to 150 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Arnot, Bath, Chippewa, Lackawanna, Lordstown, Mardin, Morris, Volusia, Wellsboro and Wurtsboro series. Arnot and Lordstown soils have thinner sola and do not have fragipans. Bath, Lackawanna, Mardin, and Wellsboro soils have more than 60 percent silt plus very fine sand in the particle-size control section. Chippewa and Volusia soils have more than 18 percent clay and dominant colors of 2 or lower chroma in the cambic horizon. Morris soils have reddish hues. Wurtsboro soils have low chroma mottles between 12 inches and the top of the fragipan or within a depth of 26 inches.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Well drained and moderately well drained. Surface runoff is slow to rapid. Saturated hydraulic conductivity is moderately high or high in the mineral soil above the fragipan and moderately low or moderately high in the fragipan.

USE AND VEGETATION: Largely in woodland. Nonstony areas are partly cleared and cultivated. Forested areas are in northern hardwoods of maple, beech and birch.

DISTRIBUTION AND EXTENT: Northeastern Pennsylvania, southeastern New York and northwestern New Jersey. The series is of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Amherst, Massachusetts

SERIES ESTABLISHED: Warren County, New Jersey, 1951.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
1. Ochric epipedon - the zone from the surface of the soil to a depth of about 4 inches (E horizon).
2. Cambic horizon - the zone from 4 inches to a depth of about 32 inches (Bs, Bw1 and Bw2 horizons).
3. Fragipan - the zone from 32 inches to a depth of about 60 inches (Bx horizon).

ADDITIONAL DATA: Laboratory data is available on four pedons in Pike County, Pennsylvania, S64Pa-52-1, S64Pa-52-11 and S64Pa-52-12; and tow pedons in Northamption County, Pennsylvania, S67Pa-48-32 and S67Pa-48-33.

National Cooperative Soil Survey
U.S.A.

LOCATION WURTSBORO PA NJ NY
Established Series
Rev. GDM-JRH-JDC
12/2009

WURTSBORO SERIES

The Wurtsboro series consists of very deep, moderately well drained and somewhat poorly drained soils formed in till derived from quarzite, conglomerate and sandstone. Slope dominantly ranges from 0 to 35 percent. The saturated hydraulic conductivity is moderately low to high in the mineral soil above the fragipan and moderately high to low in the fragipan. Mean annual precipitation is 41 inches. Mean annual temperature is 49 degrees F.

TAXONOMIC CLASS: Coarse-loamy, mixed, active, mesic Typic Fragiudepts

TYPICAL PEDON: Wurtsboro gravelly fine sandy loam - wooded. (Colors are for moist soil.)

Oi-- 0 to 2 inches; fibrous leaf material; extremely acid; abrupt wavy boundary. (1 to 3 inches thick.)

E-- 2 to 4 inches; gray (10YR 5/1) gravelly fine sandy loam; weak fine granular structure; very friable, nonsticky, nonplastic; 20 percent rock fragments; extremely acid; abrupt wavy boundary. (1 to 3 inches thick.)

Bs-- 4 to 10 inches; strong brown (7.5YR 5/6) gravelly fine sandy loam; weak fine granular structure; friable, nonsticky, nonplastic; 20 percent rock fragments; extremely acid; clear wavy boundary. (0 to 8 inches thick.)

Bw1-- 10 to 16 inches; yellowish brown (10YR 5/4) gravelly fine sandy loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; 30 percent rock fragments; very strongly acid; gradual wavy boundary.

Bw2-- 16 to 24 inches; yellowish brown (10YR 5/4) gravelly fine sandy loam; moderate medium subangular blocky structure; friable, nonsticky, slightly plastic; common medium distinct grayish brown (10YR 5/2) areas of iron depletion and strong brown (7.5YR 5/6) masses of iron accumulation; 20 percent rock fragments; very strongly acid; clear wavy boundary. (The combined thickness of the Bw horizon is 8 to 20 inches thick.)

Bx1-- 24 to 46 inches; brown (7.5YR 4/4) gravelly fine sandy loam; moderate very coarse prismatic structure parting to moderate thin and medium platy; very firm, brittle, slightly sticky, slightly plastic; common distinct clay films in pores; common faint black coatings on faces of peds; common medium distinct grayish brown (10YR 5/2) areas of iron depletion on faces of prisms; 20 percent rock fragments; very strongly acid; gradual wavy boundary.

Bx2-- 46 to 67 inches; brown (10YR 4/3) gravelly loam; grayish brown; weak very coarse prismatic structure parting to moderate thick platy; very firm, brittle, slightly sticky, slightly plastic; common distinct clay films in pores; continuous grayish brown (10YR 5/2) areas of iron depletion on faces of prisms; common medium distinct grayish brown (10YR 5/2) areas of iron depletion and strong brown (7.5YR 5/6) masses of iron accumulation within prisms; 25 percent rock fragments; very strongly acid. (The combined thickness of the Bx horizon is 20 to 70 inches thick.)
TYPE LOCATION: Pike County, Pennsylvania; Edgemere State Forest, 2.5 miles south on Flat Ridge road from its intersection with Porters Lake road, 160 feet northwest. USGS Twelvemile Pond, PA topographic quadrangle; Latitude 41 degrees, 13 minutes, 16 seconds N. and Longitude 75 degrees, 2 minutes, 4 seconds W. NAD 1927.

RANGE IN CHARACTERISTICS: The thickness of the solum ranges from 40 to 70 inches. Depth to the fragipan ranges from 17 to 28 inches and depth to bedrock is 4 to 20 feet or more. Rock fragments of subrounded or angular sandstone, conglomerate or quartzite range from 0 to 40 percent in individual layers above the fragipan and from 10 to 60 percent in the fragipan and C horizon. Illite is the dominant clay mineral with significant amounts of vermiculite and some kaolimite. Reaction of the mineral solum ranges from extremely acid to strongly acid where unlimed.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. Some pedons have A horizons with hue of 10YR, value of 2 to 4, and chroma of 1 to 3. Texture of the fine-earth is sandy loam, fine sandy loam, loam, or silt loam.

The E horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 or 3. Texture of the fine-earth is sandy loam, fine sandy loam, loam, or silt loam.

The Bw horizon has hue of 5YR to 2.5Y, value of 4 or 5 and chroma of 3 to 6. Low chroma redoximorphic features are between 12 and 26 inches. Texture of the fine-earth is fine sandy loam, sandy loam, loam, or silt loam.

The Bx horizon has hue of 5YR through 2.5Y, value of 4 or 5, and chroma of 2 through 6 and typically have both low and high chroma redoximorphic features and grayish prism faces. Texture of the fine-earth is fine sandy loam, sandy loam, loam, or silt loam.

Some pedons have firm, gravelly sandy loam C horizon.

COMPETING SERIES: The Bath, Braceville, Broadalbin, Ira, Lackawanna, Mardin, Rushford, Sodus, Swartswood and Wellsboro series are in the same family. Bath, Lackawanna, Mardin, and Wellsboro soils have more than 60 percent silt plus very fine sand in the particle-size control section. Braceville soils have stratified sand and gravel in the series control section. Broadalbin soils have rock fragments dominanted by granite, gneiss, and dark shale. Ira and Sodus soils have fragipans which are moderately acid to neutral. Rushville soils have a rock fragment content of less than 10 percent in the fragipan and C horizon. Swartswood soils do not have redoximorphic features above the fragipan or within a depth of 26 inches.

GEOGRAPHIC SETTING: Wurtsboro soils are nearly level to moderately steep soils of glaciated uplands. Slope ranges from 0 to 35 percent. The soils developed in till derived primarily from acid gray and brown quartzite, conglomerate, and sandstone. The climate is humid temperate; mean annual precipitation ranges from 36 to 46 inches, mean annual temperature ranges from 45 to 52 degrees F., and the frost free season ranges from 130 to 150 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Chippewa, Lordstown, Mardin, Morris, Swartswood, Volusia, and Wellsboro series. Chippewa and Morris soils have low chroma matrix within 20 inches of the surface and are on landscapes of lower drainage. Lordstown soils have bedrock within 40 inches. Mardin and Wellsboro soils have more than 60 percent silt plus very fine sand in the particle-size control section and are on similar landscapes. Swartswood soils do not have redoximorphic features above the fragipan or within a depth of 26 inches and are on landscapes of better drainage. Volusia soils have between 18 and 34 percent clay in the fine-earth fraction and are on landscapes of lower drainage.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Moderately well drained and somewhat poorly drained. The potential for surface runoff is medium to very high. The saturated hydraulic conductivity is moderately low to high in the mineral soil above the fragipan and moderately high to low in the fragipan.

USE AND VEGETATION: Almost entirely in woodland. Native vegetation is northern hardwoods of maple, beech and birch.

DISTRIBUTION AND EXTENT: Northeastern Pennsylvania, southeastern New York and northwestern New Jersey. MLRA 140 and 144A. The series is of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Amherst, Massachusetts

SERIES ESTABLISHED: Sullivan County, New York, 1938.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
a. Ochric horizon - the zone from 0 to 4 inches (O1 and E horizon).
b. Cambic horizon - the zone from 4 to 24 inches (Bs, Bw1 and Bw2 horizons).
c. Fragipan - the zone from 22 to 65 inches (Bx1 and Bx2 horizons).

ADDITIONAL DATA: Laboratory data available on two pedons sampled in Pike County, Pennsylvania, S64Pa-52-2 and S64Pa-52-9 and on two pedons sampled in Northampton County, Pennsylvania, S67Pa-48-8 and S67Pa-48-9.

National Cooperative Soil Survey
U.S.A.

LOCATION VOLUSIA NY+PA

Established Series
Rev. JEW-SEA-SAF
11/2013

VOLUSIA SERIES

The Volusia series consists of very deep, somewhat poorly drained soils formed in loamy till. These soils are on concave to planer landscape positions in glaciated upland areas. A dense fragipan is at a depth of 25 to 56 cm (10 to 22 inches) below the soil surface. Slope ranges from 0 to 35 percent. Saturated hydraulic conductivity in the mineral soil above the fragipan is moderately high or high and in the fragipan and substratum it is low to moderately high. Mean annual temperature is about 8 degrees C (46 degrees F), and the mean annual precipitation is about 1080 mm (42.5 inches).

TAXONOMIC CLASS: Fine-loamy, mixed, active, mesic Aeric Fragiaquepts

TYPICAL PEDON: Volusia channery silt loam, on a 5 percent slope in a cultivated field. (Colors are for moist soil unless otherwise noted.)

Ap--0 to 23 cm (0 to 9 inches); very dark grayish brown (10YR 3/2) channery silt loam, light brownish gray (10YR 6/2) dry; weak medium and coarse granular structure; friable; common fine and medium roots throughout and few coarse roots throughout; 15 percent rock fragments; neutral; abrupt wavy boundary. (15 to 30 cm thick) (6 to 12 inches thick)

Bw--23 to 38 cm (9 to 15 inches); 60 percent olive brown (2.5Y 4/3) and 40 percent brown (10YR 4/3) channery silt loam; weak fine and medium subangular blocky structure, friable; common fine and medium roots throughout; 5 percent fine and medium distinct light brownish gray (10YR 6/2), moist, masses of reduced iron and 5 percent fine and medium distinct strong brown (7.5YR 4/6), moist, masses of oxidized iron; 20 percent rock fragments; moderately acid; clear wavy boundary. (0 to 25 cm thick) (0 to 10 inches thick)

Eg--38 to 43 cm (15 to 17 inches); light brownish gray (2.5Y 6/2) channery silt loam; weak fine and medium subangular blocky structure; friable; few fine and medium roots throughout; 5 percent fine and medium distinct strong brown (7.5YR 4/6), moist, masses of oxidized iron; 20 percent rock fragments; moderately acid; clear wavy boundary. (0 to 30 cm thick) (0 to 12 inches thick)

Bx1--43 to 74 cm (17 to 29 inches); light olive brown (2.5Y 5/3) channery loam; moderate very coarse prismatic structure; prisms are 20 to 36 cm (8 to 14 inches) across; prism faces are gray (10YR 6/1) with strong brown (7.5YR 4/6) borders; very firm; brittle; few fine roots along prism faces; 1 percent medium distinct light brownish gray (10YR 6/2), moist, masses of reduced iron and 1 percent medium prominent strong brown (7.5YR 5/8), moist, masses of oxidized iron; 25

percent rock fragments; strongly acid; clear wavy boundary.

Bx2--74 to 137 cm (29 to 54 inches); olive brown (2.5Y 4/4) very channery loam; moderate coarse prismatic structure; prisms are 20 to 36 cm (8 to 14 inches) across; prism faces are gray (10YR 6/1) with strong brown (7.5YR 4/6) borders; very firm; brittle; 1 percent fine distinct light brownish gray (10YR 6/2), moist, masses of reduced iron and 1 percent fine prominent strong brown (7.5YR 5/8), moist, masses of oxidized iron; 60 percent rock fragments; moderately acid; clear wavy boundary. (Combined thickness of the Bx horizon is 51 to 163 cm (20 to 64 inches))

C--137 to 183 cm (54 to 72 inches); olive (5Y 5/3) channery silt loam; massive; firm; 34 percent rock fragments; moderately acid.

TYPE LOCATION: Cortland County, New York; Town of Georgetown; North of Willet Creek. 2,060 feet north of Morey Hill and German road intersection, and 540 feet east of Morey Hill road. USGS Willet, NY topographic quadrangle; Latitude 42 degrees, 28 minutes, 30.1 seconds N. and Longitude 75 degrees, 53 minutes, 31.4 seconds W. NAD 1983.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 102 to 183 cm (40 to 72 inches). Depth to bedrock is greater than 152 cm (60 inches). Depth to the fragipan ranges from 25 to 56 cm (10 to 22 inches). Rock fragments, mainly channers, gravel and flagstones, range from 5 to 30 percent by volume in the solum above the Bx horizon, and from 5 to 60 percent in the Bx horizon. Rock fragments in the C horizon commonly range from 10 to 60 percent.

The Ap horizon has hue of 10YR or 2.5Y, value of 3 through 5, and chroma of 2 or 3. Dry color value is 6 or more. It is loam or silt loam in the fine-earth fraction. Some pedons have a thin A horizon 5 to 13 cm (2 to 5 inches) thick. Reaction ranges from very strongly acid through moderately acid, unless limed.

The Bw horizon, where present, has hue of 10YR through 5Y, value of 3 through 5, and chroma of 2 through 4. Some pedons have a Bg horizon with hue of 10YR through 5Y, value of 3 or 4 and chroma of 2. Texture is loam or silt loam in the fine-earth fraction. Reaction ranges from very strongly acid through slightly acid.

The E or Eg horizon has hue of 10YR through 5Y, value of 4 through 6, and chroma of 1 or 2. It has common or many, distinct or prominent redoximorphic features in chroma higher than the matrix. Texture is loam or silt loam in the fine-earth fraction. ^delete?-with clay content between 18 and 27 percent- family texture class and allowable textures listed above, addresses this; no need for this statement^. It has platy or blocky structure or is massive, and is friable or firm. Reaction ranges from very strongly acid through slightly acid.

The Bx horizon has hue of 10YR through 5Y, value of 3 through 6, and chroma of 1 through 4. It is dominantly loam or silt loam in the fine-earth fraction but ranges to clay loam or silty clay loam. It has weak to strong coarse or very coarse prismatic structure with blocky, platy, subangular blocky, or massive prism interiors. Clay films coat most pore walls and can be in some depressions on vertical cleavage faces. Consistence is firm through extremely firm. It has few or common and faint to prominent redoximorphic features. Reaction ranges from very

strongly acid through slightly acid.

The C horizon has hue of 10YR through 5Y, value of 3 through 5, and chroma of 2 through 4. It is loam to silty clay loam in the fine-earth fraction. It is massive or has lenticular plate-like divisions. Consistence is firm or very firm. Reaction ranges from strongly acid through slightly alkaline.

COMPETING SERIES: These are the Erie and Wiscoy series. The Erie soils are neutral or mildly alkaline in the lower part of the solum. Wiscoy soils have silty lacustrine materials with less than 5 percent rock fragments within depths of 51 to 102 cm (20 to 40 inches).

Related series in other families are the Dalton, Fremont, Morris, Norchip, Ontusia, Platea, Scriba, Stissing and Venango soils. Platea and Venango soils have argillic horizons in the fragipan. Dalton soils have coarse-silty particle-size control sections. Fremont soils do not have a fragipan. Morris, Scriba, and Stissing soils have coarse-loamy particle-size control sections. Norchip and Ontusia soils have frigid temperature regimes.

GEOGRAPHIC SETTING: Volusia soils occupy long uniform slopes. Slope ranges from 0 to 35 percent. They are on lower valley sides and on broad divides of maturely dissected glaciated plateaus. The Volusia soils developed in firm basal till derived from siltstone, sandstone and brittle shale or slate. They are underlain by lacustrine materials in some areas. Mean annual precipitation typically ranges from 795 to 1725 mm (31 to 68 inches), but in some higher elevations it can range as high as 1790 mm (70 inches). Mean annual temperature typically ranges from 6 to 11 degrees C (43 to 52 degrees F), but in some higher elevations it can range as low as 4 degrees C (39 degrees F). Mean annual frost-free days ranges from 105 to 180 days. These soils generally occur at elevations between 100 and 670 meters (328 and 2,198 feet), but have been mapped as high as 750 meters (2,460 feet) in some areas.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Alden, Bath, Chenango, Chippewa, Dalton, Fremont, Halsey, Lordstown, Mardin, Wiscoy, and Wurtsboro series on nearby landscapes. Alden soils are wetter drainage associates on toeslopes and in depressions. Well drained Bath soils and moderately well drained Mardin soils are better drained associates on higher convex landscapes. Chenango and Halsey are on nearby glacial outwash terraces. Chippewa soils lack a fragipan and are wetter and lower on the landscape. Dalton soils are associated where coarse silty deposits overlie the till. Fremont soils do not have a fragipan. Wiscoy soils have silty lacustrine materials with less than 5 percent rock fragments within depths of 51 to 102 cm (20 to 40 inches). Lordstown soils are common associates that are moderately deep to bedrock.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Somewhat poorly drained. Internal drainage is slow or very slow. The potential for surface runoff is low to very high. Saturated hydraulic conductivity in the mineral soil above the fragipan is moderately high or high and in the fragipan and substratum it is low to moderately high.

USE AND VEGETATION: Most areas of this soil have been cleared but some are now growing up with a cover of brush and forbes. Cleared areas are used for pasture or for growing

hay, oats and corn for silage. Woodlots contain sugar maple, red maple, American beech, hemlock and associated species.

DISTRIBUTION AND EXTENT: Glaciated Allegheny Plateau of New York and northern Pennsylvania. MLRA 101, 139, 140, and 144A. The soil is extensive.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Amherst, Massachusetts

SERIES ESTABLISHED: Chautauqua County, New York; Westfield area, 1901.

REMARKS: Volusia is a Hall of Fame series and a benchmark soil. There are plans for future project work to separate out frigid soil areas from areas previously mapped as the mesic Volusia. After these spatial edits are completed, the Volusia OSD will be edited to remove statements in the Geographic Setting section referring to the higher elevation areas.

The separation between Volusia and Venango (Fragiaqualfs) can overlap on the landscape in some places. Future MLRA work refining the difference between the two would be beneficial.

Diagnostic horizons and features recognized in the typical pedon include:
1. Ochric epipedon - the zone from 0 to 23 cm (0 to 9 inches) (Ap horizon).
2. Fragipan - the zone from 43 to 137 cm (17 to 54 inches) (Bx horizons).
3. Aquepts suborder - aquic moisture regime, and matrix or ped faces of 2 chroma or less and redoximorphic features within 51 cm (20 inches) of the soil surface (Eg horizon).
4. Aeric subgroup - a zone within 76 cm (30 inches) of the surface that has dominant chroma higher than 2 in 40 percent or more of the matrix (Bw horizon).
5. Udic soil moisture regime (a humid, temperate climate).

National Cooperative Soil Survey
U.S.A.

PEDON DESCRIPTION

Print Date: Jun 12 2017
Description Date: Jul 18 1967
Describer: E. Sautter, J. Noll, R. Cunningham, G. Latshaw, L. Staley
Site ID: 629
Site Note:
Pedon ID: 1967PA095032
Pedon Note:
Lab Source ID: PSU
Lab Pedon #: 67PA095032
User Transect ID:
Soil Name as Described/Sampled: Wooster
Classification:
Soil Name as Correlated: Swartswood
Classification: none listed
Pedon Type:
Pedon Purpose: full pedon description
Taxon Kind:
Associated Soils:
Physiographic Division:
Physiographic Province:
Physiographic Section:

State Physiographic Area:
Local Physiographic Area:
Geomorphic Setting: plateau
ground moraine
Upslope Shape:
Cross Slope Shape:
Particle Size Control Section:
Description origin: PSU
Diagnostic Features: ? to ? cm.

Country: United States
State: Pennsylvania
County: Northampton
MLRA: 140 -- Glaciated Allegheny Plateau and Catskill Mountains
Soil Survey Area:
Map Unit:
Quad Name: Portland Mills, Pennsylvania
Std Latitude: 40.9330556
Std Longitude: -75.1122222

Primary Earth Cover: Tree cover
Secondary Earth Cover: Other tree cover
Vegetation: American hornbeam, red maple, sassafras, sweet birch, tuliptree, white ash
Parent Material:
Bedrock Kind:
Bedrock Depth:
Bedrock Hardness:
Bedrock Fracture Interval:
Surface Fragments: 1.0 percent
Description database: KSSL

Cont. Site ID: 629 **Pedon ID:** 1967PA095032

Slope (%)	Elevation (meters)	Aspect (deg)	MAAT (C)	MSAT (C)	MWAT (C)	MAP (mm)	Frost-Free Days	Drainage Class	Slope Length (meters)	Upslope Length (meters)
4.0	165.0	315				1,200		well		

Oa--0 to 3 centimeters (0.0 to 1.2 inches); black (10YR 2/1) interior; very strongly acid, pH 5.0, Unspecified; abrupt smooth boundary. Lab sample # PSU04842. Color is black.

A--3 to 8 centimeters (1.2 to 3.1 inches); dark brown (10YR 3/3) interior gravelly silt loam; weak fine granular structure; very friable; 20 percent Sandstone and shale fragments; moderately acid, pH 6.0, Unspecified; abrupt smooth boundary. Lab sample # PSU04843. Color is dark brown. 20% fragments.

BA--8 to 26 centimeters (3.1 to 10.2 inches); brownish yellow (10YR 6/6) interior gravelly loam; weak fine subangular blocky structure; friable, slightly sticky, slightly plastic; 14 percent clay films; 20 percent Sandstone and shale fragments; moderately acid, pH 5.8, Unspecified; clear wavy boundary. Lab sample # PSU04844. 20% fragments. Color is brownish yellow.

Bw--26 to 54 centimeters (10.2 to 21.3 inches); light yellowish brown (10YR 6/4) interior and brownish yellow (10YR 6/6) interior gravelly loam; moderate fine and medium subangular blocky structure; friable, slightly sticky, slightly plastic; 14 percent clay films; 10 percent unspecified fragments and 20 percent unspecified fragments; moderately acid, pH 5.6, Unspecified; clear wavy boundary. Lab sample # PSU04845. 30% fragments. Color is light yellowish brown.

Bx1--54 to 69 centimeters (21.3 to 27.2 inches); yellowish brown (10YR 5/4) interior gravelly sandy loam; weak coarse prismatic, and weak medium platy structure; firm, slightly sticky, slightly plastic; brittle; 14 percent prominent clay films; 10 percent unspecified fragments and 20 percent unspecified fragments; moderately acid, pH 5.6, Unspecified; gradual wavy boundary. Lab sample # PSU04846. Color is yellowish brown. 30% fragments.

Bx2--69 to 110 centimeters (27.2 to 43.3 inches); yellowish brown (10YR 5/4) interior and brown (7.5YR 5/4) exterior gravelly sandy loam; weak coarse prismatic, and weak medium platy structure; very firm, slightly sticky, slightly plastic; brittle; 14 percent prominent clay films; 10 percent unspecified fragments and 25 percent unspecified fragments; moderately acid, pH 5.7, Unspecified; gradual wavy boundary. Lab sample # PSU04847. 35% fragments. Color is yellowish brown.

Bx3--110 to 135 centimeters (43.3 to 53.1 inches); brown (7.5YR 5/4) interior very gravelly sandy loam; moderate very coarse prismatic structure; very firm, slightly sticky, slightly plastic; brittle; 14 percent prominent clay films; 1 percent medium distinct 10YR 5/4) and 1 percent medium distinct 7.5YR 5/6); 15 percent unspecified fragments and 35 percent unspecified fragments; moderately acid, pH 5.9, Unspecified; gradual wavy boundary. Lab sample # PSU04848. 50% fragments. Color is brown with light gray and strong brown mottels.

Bx4--135 to 166 centimeters (53.1 to 65.4 inches); yellowish brown (10YR 5/4) interior and light brown (7.5YR 6/4) broken face and light yellowish brown (10YR 6/4) broken face very gravelly sandy loam; moderate very coarse prismatic, and weak medium platy structure; very firm, slightly sticky, slightly plastic; brittle; 14 percent prominent clay films; 1 percent medium distinct 10YR 7/2) and 1 percent medium distinct 7.5YR 5/6); 20 percent unspecified fragments and 40 percent unspecified fragments; moderately acid, pH 6.0, Unspecified; gradual wavy boundary. Lab sample # PSU04849. 60% fragments. Color is yellowish brown with light gray and strong brown mottles.

Bx5--166 to 193 centimeters (65.4 to 76.0 inches); yellowish brown (10YR 5/4) interior very gravelly sandy loam; moderate very coarse prismatic, and weak medium platy structure; very firm, slightly sticky, slightly plastic; brittle; 14 percent prominent clay films; 1 percent medium distinct 10YR 7/2) and 1 percent medium distinct 7.5YR 5/6); 25 percent unspecified fragments and 50 percent unspecified fragments; moderately acid, pH 6.0, Unspecified; gradual wavy boundary. Lab sample # PSU04850. 75% fragments. Color is yellowish brown with light gray and strong brown mottles.

Bx6--193 to 227 centimeters (76.0 to 89.4 inches); yellowish brown (10YR 5/4) interior very gravelly sandy loam; moderate very coarse prismatic, and weak medium platy structure; very firm, slightly sticky, slightly plastic; brittle; 1 percent medium distinct 10YR 7/2) and 1 percent medium distinct 7.5YR 5/6); 35 percent unspecified fragments and 60 percent unspecified fragments; slightly acid, pH 6.1, Unspecified. Lab sample # PSU04851. 85% fragments. Color is light yellowish brown with light gray and strong brown mottles.

*** Primary Characterization Data ***

(Northampton, Pennsylvania)

Pedon ID: 1967PA095032

Print Date: Jun 12 2017 11:33AM

Sampled as on Jul 16, 1967: Wooster
Revised to correlated: Swartswood ; Coarse-loamy, mixed Typic Fragiochrepts

SSL Project PSU201101 The Pennsylvania State University Data
- Site ID 629 Lat: 40° 55' 59.00" north Long: 75° 6' 44.00" west MLRA: 140
- Pedon No. 67PA095032
- General Methods 1B1A, 2A1, 2B

State of Pennsylvania
The Pennsylvania State University
Department of Crop and Soil Sciences
452 ASI Building
University Park, PA 16802-3504

Layer	Horizon	Orig Hzn	Depth (cm)	Field Label 1	Field Label 2	Field Label 3	Field Texture	Lab Texture
PSU04842	Oa	Oa	0-3	PSU04842		1829699		L
PSU04843	A	A	3-8	PSU04843		1829700	GR-SIL	L
PSU04844	BA	BA	8-26	PSU04844		1829701	GR-L	L
PSU04845	Bw	Bw	26-54	PSU04845		1829702	GR-L	L
PSU04846	Bx1	Bx1	54-69	PSU04846		1829703	GR-SL	FSL
PSU04847	Bx2	Bx2	69-110	PSU04847		1829704	GR-SL	SL
PSU04848	Bx3	Bx3	110-135	PSU04848		1829705	GRV-SL	SL
PSU04849	Bx4	Bx4	135-166	PSU04849		1829706	GRV-SL	SL
PSU04850	Bx5	Bx5	166-193	PSU04850		1829707	GRV-SL	SL
PSU04851	Bx6	Bx6	193-227	PSU04851		1829708	GRV-SL	SL

PSDA & Rock Fragments

Layer	Depth (cm)	Horz	Prep	Lab Texture	Clay (<.002)	Silt (.002-.05)	Sand (.05-2)	Fine Clay (<.0002)	CO_3 Clay (<.002)	Fine Silt (.002-.02)	Coarse Silt (.02-.05)	VF Sand (.05-.10)	F Sand (.10-.25)	M Sand (.25-.50)	C Sand (.5-1)	VC Sand (1-2)	Rock Fragments (2-5)	Rock Fragments (5-20)	Rock Fragments (20-75)	Rock Fragments (.1-75)	>2 mm wt % whole soil
					Total			Clay		Silt		Sand					Weight				
					% of <2mm Mineral Soil												% of <75mm				
					3A1a1a					3A1a1a		3A1a1a	3A1a1a	3A1a1a	3A1a1a	3A1a1a					
PSU04842	0-3	Oa	S	L	12.7	48.2	39.1			25.7	22.5	11.6	10.5	7.6	6.0	3.4					
PSU04843	3-8	A	S	L	12.0	47.3	40.7			28.3	19.0	11.9	6.5	7.8	10.5	4.0					
PSU04844	8-26	BA	S	L	13.2	41.2	45.6			22.8	18.4	16.7	3.9	8.3	7.6	9.1					
PSU04845	26-54	Bw	S	L	14.0	34.9	51.1			20.0	14.9	9.9	11.4	9.4	8.8	11.6					
PSU04846	54-69	Bx1	S	FSL	12.1	34.3	53.6			19.6	14.7	11.7	14.2	12.0	9.4	6.3					
PSU04847	69-110	Bx2	S	SL	14.3	28.2	57.5			16.4	11.8	11.0	15.2	12.4	10.4	8.5					
PSU04848	110-135	Bx3	S	SL	13.5	27.6	58.9			15.6	12.0	11.8	15.7	13.2	10.2	8.0					
PSU04849	135-166	Bx4	S	SL	11.8	27.7	60.5			16.3	11.4	10.7	15.0	13.2	12.4	9.2					
PSU04850	166-193	Bx5	S	SL	11.2	23.7	65.1			11.4	12.3	12.7	19.1	13.8	11.3	8.2					
PSU04851	193-227	Bx6	S	SL	9.7	26.0	64.3			14.0	12.0	11.7	17.2	13.9	10.7	10.8					

*** Primary Characterization Data ***

(Northampton, Pennsylvania)

Pedon ID: 1967PA095032

Print Date: Jun 12 2017 11:33AM

Sampled As : Wooster

PSU Soil Characterization Laboratory ; Pedon No. 67PA095032

Bulk Density & Moisture

Layer	Depth (cm)	Horz	Prep	Bulk Density 33 kPa	Bulk Density Oven Dry	Cole Whole Soil	Water Content 6 kPa	Water Content 10 kPa	Water Content 33 kPa	Water Content 1500 kPa	1500 kPa Ratio Moist	1500 kPa Ratio AD/OD	WRD Whole Soil	Aggst Stabl 2-0.5mm	Ratio/Clay CEC7	Ratio/Clay 1500 kPa
				(Bulk Density)			(Water Content								(Ratio/Clay	
				(g cm^{-3}			% of < 2mm						cm^3 cm^{-3}		%	
				DbWR1	4A1h				DbWR1	3C2a1a						
PSU04842	0-3	Oa	S							35.4						2.79
PSU04843	3-8	A	S	0.78	1.00				46.5	14.8			0.21			1.23
PSU04844	8-26	BA	S	1.44	1.56				20.9	4.8			0.19			0.36
PSU04845	26-54	Bw	S							4.7						0.34
PSU04846	54-69	Bx1	S	1.59	1.71				16.4	4.1			0.13			0.34
PSU04847	69-110	Bx2	S	1.72	1.75				12.4	4.9			0.04			0.34
PSU04848	110-135	Bx3	S	1.70	1.74				12.0	4.7			0.05			0.35
PSU04849	135-166	Bx4	S	1.78	1.88				10.9	4.5			0.03			0.38
PSU04850	166-193	Bx5	S							3.5						0.31
PSU04851	193-227	Bx6	S	1.82	1.84				11.8	3.3			0.09			0.34

Water Content

Layer	Depth (cm)	Horz	Prep	Atterberg Limits LL	Atterberg Limits PI	Bulk Density Field	Bulk Density Recon 33 kPa	Bulk Density Recon Oven Dry	Water Content Field	Water Content Recon 33 kPa	Water Content Recon 6 kPa	Water Content Recon 10 kPa	Water Content Sieved Samples 33 kPa	Water Content Sieved Samples 100 kPa	Water Content Sieved Samples 200 kPa	Water Content Sieved Samples 500 kPa
				(Atterberg Limits)		(Bulk Density			(Water Content				(Sieved Samples			
				pct <0.4mm		(g cm^{-3}			% of < 2mm							
													3B6			
PSU04843	3-8	A	S										44.3			
PSU04844	8-26	BA	S										16.6			
PSU04846	54-69	Bx1	S										12.5			
PSU04847	69-110	Bx2	S										10.8			
PSU04848	110-135	Bx3	S										10.9			
PSU04849	135-166	Bx4	S										10.9			
PSU04851	193-227	Bx6	S										10.4			

*** Primary Characterization Data ***
(Northampton, Pennsylvania)

Pedon ID: 1967PA095032   Print Date: Jun 12 2017 11:33AM
Sampled As : Wooster
PSU Soil Characterization Laboratory ; Pedon No. 67PA095032

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 -----)			
					6B1a					6C2a												
PSU04842	0-3	Oa	S		0.790			11.99	15													
PSU04843	3-8	A	S		0.240			3.49	15	1.3												
PSU04844	8-26	BA	S		0.050			0.45	9	1.5												
PSU04845	26-54	Bw	S					0.20		1.7												
PSU04846	54-69	Bx1	S					0.11		1.6												
PSU04847	69-110	Bx2	S					0.07		1.7												
PSU04848	110-135	Bx3	S					0.08		1.7												
PSU04849	135-166	Bx4	S					0.08		1.5												
PSU04850	166-193	Bx5	S					0.07		1.3												
PSU04851	193-227	Bx6	S					0.07		1.3												

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} ---)			(-------- % --------)		
				4B1a1	4B1a1	4B1a1	4B1a1		4B2a1a1	NK							
PSU04842	0-3	Oa	S	25.3	2.6	0.1	1.1	29.1	29.3	0.1		58.4				50	
PSU04843	3-8	A	S	1.8	0.3		0.4	2.5	27.1	1.2		29.6				8	
PSU04844	8-26	BA	S	0.2			0.1	0.3	8.6	1.3		8.9				3	
PSU04845	26-54	Bw	S	0.1			0.1	0.2	8.0	1.3		8.2				2	
PSU04846	54-69	Bx1	S				0.1	0.1	8.0	0.6		8.1				1	
PSU04847	69-110	Bx2	S	0.1	0.1		0.2	0.4	6.9	0.6		7.3				6	
PSU04848	110-135	Bx3	S	0.2	0.1		0.1	0.4	5.8	0.6		6.2				7	
PSU04849	135-166	Bx4	S	0.3	0.1		0.1	0.5	6.9	0.4		7.4				7	
PSU04850	166-193	Bx5	S	0.1	0.1		0.1	0.3	7.4	0.4		7.7				4	
PSU04851	193-227	Bx6	S	0.1	0.1		0.1	0.3	6.3	0.4		6.6				5	

*** Primary Characterization Data ***
(Northampton, Pennsylvania)

Pedon ID: 1967PA095032   Print Date: Jun 12 2017 11:33AM
Sampled As : Wooster
PSU Soil Characterization Laboratory ; Pedon No. 67PA095032

pH & Carbonates

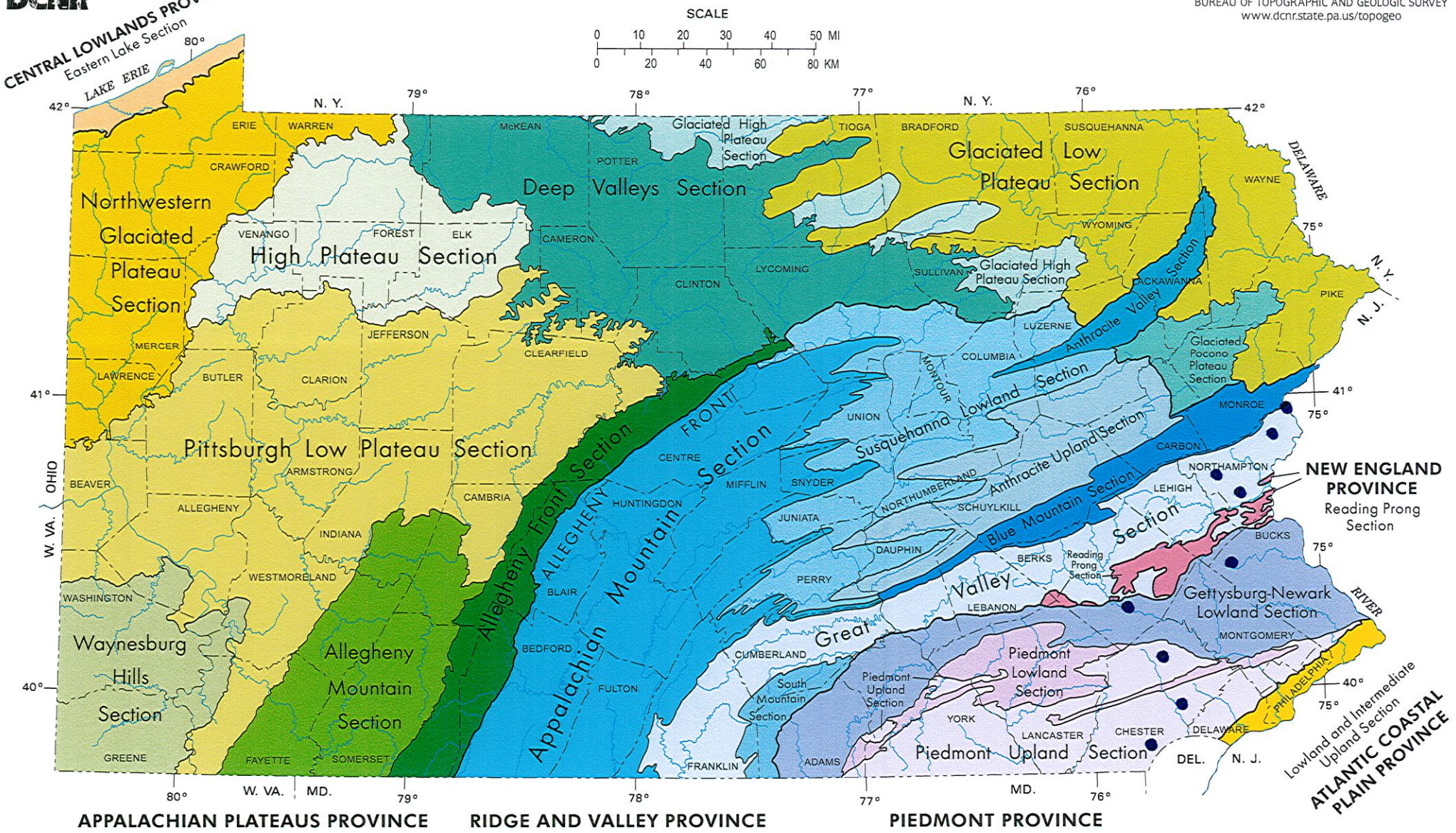
				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-
				(------------------ pH ------------------)						(-- Carbonate --)		(-- Gypsum ---)		
					$CaCl_2$					As $CaCO_3$		As $CaSO_4 \cdot 2H_2O$		Resist
	Depth				0.01M	H_2O	Sat			<2mm	<20mm	<2mm	<20mm	ohms
Layer	(cm)	Horz	Prep	KCl	1:2	1:1	Paste	Oxid	NaF	(------------ % ------------)				cm^{-1}
				8C1c	8C1e	8C1a								
PSU04842	0-3	Oa	S	4.7	5.3	5.7								
PSU04843	3-8	A	S	3.9	4.4	5.0								
PSU04844	8-26	BA	S	4.0	4.3	5.0								
PSU04845	26-54	Bw	S	3.9	4.2	4.9								
PSU04846	54-69	Bx1	S	3.9	4.2	4.8								
PSU04847	69-110	Bx2	S	3.9	4.1	4.9								
PSU04848	110-135	Bx3	S	4.0	4.2	5.1								
PSU04849	135-166	Bx4	S	4.0	4.6	5.1								
PSU04850	166-193	Bx5	S	4.1	4.2	5.1								
PSU04851	193-227	Bx6	S	4.0	4.2	5.1								

MAP 13

DCNR

PHYSIOGRAPHIC PROVINCES OF PENNSYLVANIA

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF
CONSERVATION AND NATURAL RESOURCES
BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY
www.dcnr.state.pa.us/topogeo



EXPLANATION

CENTRAL LOWLANDS PROVINCE
- Eastern Lake Section

APPALACHIAN PLATEAUS PROVINCE
- Northwestern Glaciated Plateau Section
- High Plateau Section
- Pittsburgh Low Plateau Section
- Waynesburg Hills Section
- Allegheny Mountain Section
- Allegheny Front Section
- Deep Valleys Section
- Glaciated High Plateau Section
- Glaciated Low Plateau Section
- Glaciated Pocono Plateau Section

RIDGE AND VALLEY PROVINCE
- Appalachian Mountain Section
- Susquehanna Lowland Section
- Anthracite Valley Section
- Anthracite Upland Section
- Blue Mountain Section
- Great Valley Section
- South Mountain Section

NEW ENGLAND PROVINCE
- Reading Prong Section

PIEDMONT PROVINCE
- Gettysburg-Newark Lowland Section
- Piedmont Lowland Section
- Piedmont Upland Section

ATLANTIC COASTAL PLAIN PROVINCE
- Lowland and Intermediate Upland Section

SYMBOLS
- Approximate boundary between physiographic provinces
- Approximate boundary between physiographic sections

Compiled by W. D. Sevon. Fourth Edition, 2000.

MAP 59

DCNR

GLACIAL DEPOSITS OF PENNSYLVANIA

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF
CONSERVATION AND NATURAL RESOURCES
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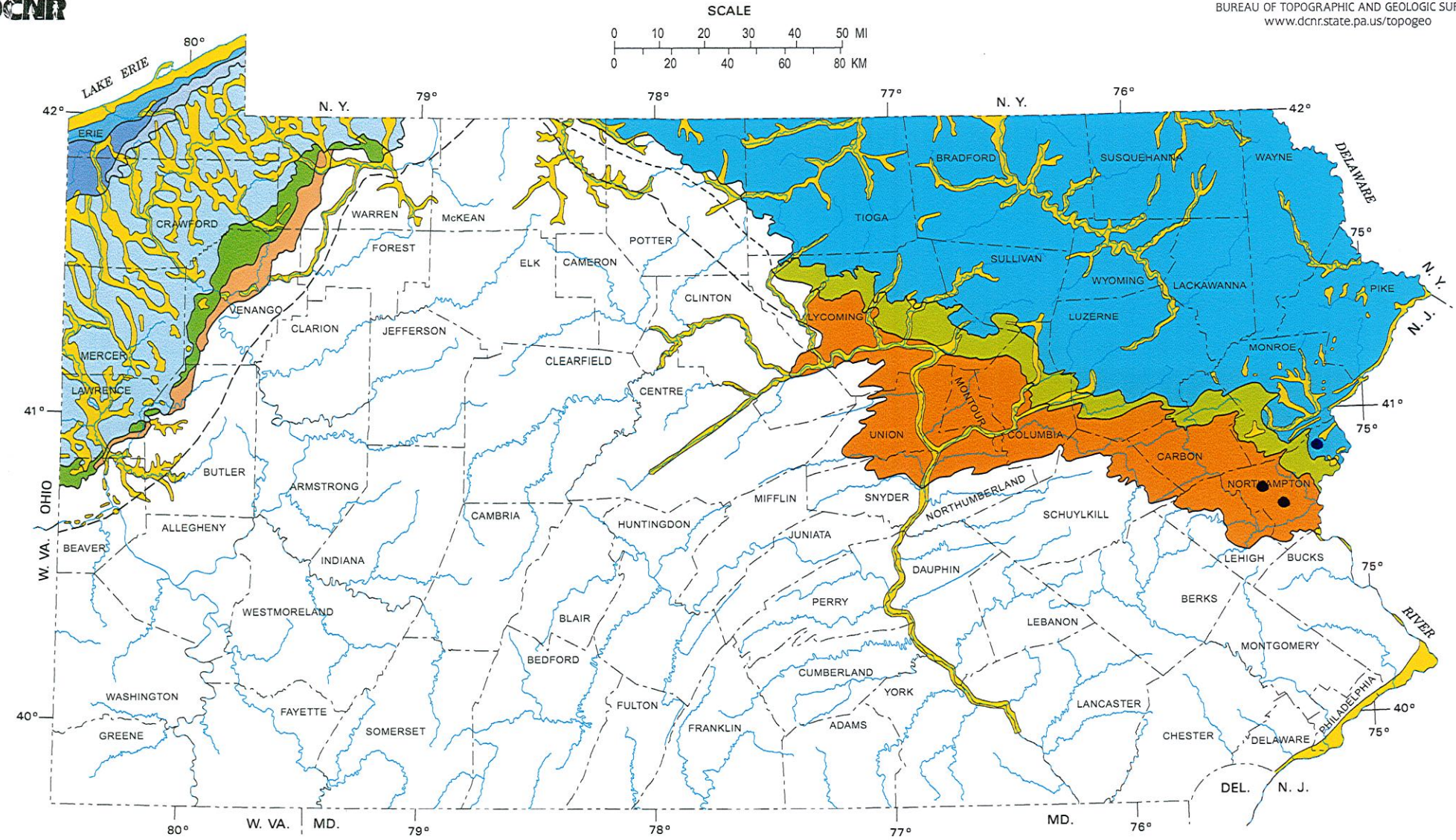

EXPLANATION

RECENT TO LATE ILLINOIAN (0–198,000 yrs.)

STRATIFIED DRIFT

Sand and gravel in eskers, kames, kame terraces, and outwash, principally in valleys; silt and clay in lake deposits in formerly ice-dammed valleys; lake clays and beach sands and gravels along Lake Erie; thin (Recent) to thick (late Illinoian) soils.

WISCONSINAN (17,000–22,000 yrs.)

ASHTABULA TILL
HIRAM TILL
LAVERY TILL
KENT TILL

Thick, gray, clayey to silty to sandy till covering over 75 percent of the ground; topography is mainly gently undulating, but there is also some knob-and-kettle topography; thin soil.

OLEAN TILL

Moderately thick, gray to grayish-red, sandy till covering 25 to 50 percent of the ground; very thin till covers an additional 25 percent of the ground; topography reflects the underlying bedrock; thin soil.

LATE ILLINOIAN (132,000–198,000 yrs.)

TITUSVILLE TILL
UNNAMED TILLS

Thin, gray (Titusville) to brown and grayish-red (unnamed), clayey to sandy till covering 10 to 25 percent of the ground; topography reflects the underlying bedrock; moderately thick, well-developed soil.

PRE-ILLINOIAN (>770,000 yrs.)

MAPLEDALE TILL
UNNAMED TILLS

Thin, gray, clayey to silty till in patches covering up to 10 percent of the ground; topography reflects the underlying bedrock; thick, well-developed soil, commonly having a yellowish-red color.

SYMBOLS

Southern limit of glacial advance

Approximate limit of Illinoian advance

Approximate limit of pre-Illinoian advance

By W. D. Sevon and D. D. Braun.
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