Mountain Valley Pipeline Project

Docket No. CP16-10-000

Mountain Valley Pipeline
Soil Profile Descriptions Report for
Jefferson National Forest

April 2016

TABLE OF CONTENTS

FIGURES

ATTACHMENTS

LIST OF ACRONYMS

JNF	Jefferson National Forest
MVP	Mountain Valley Pipeline
SCS	Soil Conservation Service
NASIS	National Soil Information System

1.0 OVERVIEW

The Mountain Valley Pipeline (MVP) corridor route is located through portions of the United States Department of Agriculture (USDA)-Jefferson National Forest (JNF). The pipeline corridor intersects the northern and southern portions of the JNF Eastern Divide Ranger District north of Blacksburg, Virginia. In this report the pipeline corridors that are located in the northern and southern portions of the JNF Eastern Divide Ranger District are hereafter defined as Crossing 1 and Crossing 2, respectively (Figure 1). Soil profiles were described in the field by Tetra Tech along Crossing 1 and Crossing 2 from selected locations using USDA soil classification terminology (National Soil Information System [NASIS]). The soil profile description that was obtained for each field location along the pipeline corridor was compared to the corresponding spatial soil map unit and associated description that was available from the USDA Natural Resource Conservation Service (NRCS), formerly defined as Soil Conservation Service (SCS). The purpose of the work was to characterize soils along the pipeline corridor route and determine if field soil characterizations are similar to the soil map units that are delineated and described from previously completed USDA-SCS county soil survey reports and recent updates. The methods used to obtain the recent field soil profile descriptions are described in this report. Comparisons between the recent field soil profile descriptions and those available from the USDA-NRCS for corresponding locations are discussed.

2.0 METHODS

2.1 SOIL DESCRIPTION (SOIL PROFILE PIT) LOCATIONS

The MVP corridor intersects the northern and southern portions of the JNF Eastern Divide Ranger District. The pipeline corridor is within both West Virginia (Monroe County) and Virginia (Giles and Montgomery Counties). The pipeline corridor Crossing 1 extends in a north-south direction through the northern portion of the Eastern Divide Ranger District that is on the border of Virginia and West Virginia (Figure 2A). Crossing 2 is southeast of Crossing 1 and also extends in a north-south direction through a portion of the JNF Eastern Divide Ranger District that is located north of Blacksburg, Virginia (Figure 2B).

Soil pits were excavated and soil profiles were described at a total of 13 locations based on the number of soil types identified within JNF from November 3 through November 6, 2015. Soil pits were excavated with a narrow blade shovel at six locations along Crossing 1 (Figure 2A, SP-1 through SP-6) and seven locations along Crossing 2 (Figure 2B, SP-8 through SP-14). The pre-selected soil pit location SP-7 was not excavated or described because the location was not on JNF property and therefore not accessible. The soil pits were excavated to vertical depths ranging from 14 inches to 40 inches from the soil surface depending on site conditions (e.g. bedrock). The soil profiles were described at each location based on USDA soil classification terminology (National Soil Information System [NASIS]) using the reference *Field Book for Describing and Sampling Soils, Version 3.0* (NRCS, 2012). Soil profile descriptions included the depth interval and classification for each soil horizon (e.g. A, B, C). Soil horizon color was obtained using Munsell Soil Color Charts. Soil horizon pH was determined in the field using a Hellige-Troug Soil pH Tester. Other soil horizon parameters that were characterized included texture, % by volume coarse fragment (gravel, cobble, stone, and boulder), % clay composition, reaction to dilute HCL (e.g. effervescence reaction to carbonates), and root density. Soil profile and landscape overview photos were taken at each soil pit location.

Physical characteristics of each soil profile location were described and included parent material type, slope, aspect, permeability, drainage, topographic position, and vegetation type. Physical and soil profile parameters for each soil profile location were documented on field forms.

2.2 REVIEW USDA-SCS SOIL MAP UNITS FOR COMPARISONS TO SOIL PIT DESCRIPTIONS

Following field investigations, soil profile descriptions for each soil pit were classified to their Family level using Keys to Soil Taxonomy (USDA, 2014). The soil pit locations were then correlated to USDA-NRCS soil map units which are provided (color coded) in Figure 2A for Crossing 1 and Figure 2B for Crossing 2. The soil descriptions for the soil map units were obtained from the USDA-NRCS Website that provides official soil series descriptions. (https://soilseries.sc.egov.usda.gov). Information from the USDA-SCS county soil survey reports were also reviewed and include the following:

- Soil Survey of Giles County, Virginia, Southern and Central Parts, USDA-SCS, December 1985.
- Soil Survey of Monroe County, West Virginia, USDA, Series 1960, No. 23, 1965.
- Soil Survey of Montgomery County, Virginia, H. Hudson and H. Porter, USDA, 1985.

3.0 RESULTS

3.1 USDA-SCS MAPPED UNIT AND SOIL PIT COMPARISONS

A summary of the soil profile, site location, and taxonomic classification description for soil map units described by Tetra Tech and corresponding NRCS Soil Series for each soil pit location is provided in Attachment 1. The USDA-NRCS Official Map Unit Soil Series Descriptions for soil pit locations are provided in Attachment 2. The completed field forms with soil profile, taxonomic, and site descriptions are provided in Attachment 3. Photographs of soil profiles and landscape overviews at soil pit location are provided in Attachment 4.

The comparisons between NRCS soil map units/taxonomic classification and soil profiles classified by Tetra Tech at 13 locations in the JNF are provided below. NRCS mapped soils that correlate with soil classified by Tetra Tech in the field bolded.

Soil Pit #	NRCS Map Unit Name	NRSC Taxonomic Name	Tetra Tech Taxonomic Name
1	DeKalb Channery Loam, 55-70% slope	Loamy-skeletal, Typic Dystrudepts	Fine-loamy, Lithic Hapludults
2	Lehew and Wallen Soils, Very Stony, 35-65% slopes	Loamy-skeletal, Typic Dystrudepts	Loamy-skeletal, Lithic or Inceptic, Hapludults
3	Lily-Bailegap Complex, Very Stony, 35-65% slopes	Fine-loamy, Typic Hapludults	Fine-loamy, Typic Paleudults
4	Lily-Bailegap Complex, Very Stony, 15-35% slopes	Fine-loamy, Typic Hapludults	Loamy-skeletal, Lithic Hapludults
5	Nolichucky Very Stony Sandy Loam, 15-30% slopes	Fine-loamy, Typic Paleudults	Clayey-skeletal, Lithic Dystrudepts
6	Nolichucky Very Stony Very Stony Sandy Loam, 15-30% slopes	**Fine-loamy, Typic Paleudults**	**Fine-loamy, Typic Paleudults**
7	Outside JNF	Outside JNF	Outside JNF

Soil Pit #	NRCS Map Unit Name	NRSC Taxonomic Name	Tetra Tech Taxonomic Name
8	Berks-Rock Outcrop Complex, 25-70% slopes 7-25%	**Loamy-skeletal, Typic Dystrudepts**	**Loamy-skeletal, Typic Dystrudepts**
9	Jefferson Extremely Stony Soils,	**Fine-loamy, Typic Hapludults**	**Fine-loamy, Typic Hapludults**
10	Jefferson Very Stony Soils, 7-15% slopes	**Fine-loamy, Typic Hapludults**	**Fine-loamy, Typic Hapludults**
11	Craigsville Soils	**Loamy-skeletal, Fluventic Dystrudepts**	**Loamy-skeletal, Fluventic Dystrudepts**
12	Berks-Weikert Complex, 15-25% slopes	Loamy-skeletal, Typic Dystrudepts	Loamy-skeletal, Lithic Hapludults
13	Berks-Weikert Soils, 25-65% slopes	**Loamy-skeletal, Typic Dystrudepts**	**Loamy-skeletal, Lithic Dystrudepts**
14	Berks-Weikert Very Stony Soils, 15-35% slopes	Loamy-skeletal, Typic Dystrudepts	Fine-loamy, Lithic Hapludults

The soil descriptions for 6 soil pit locations (SP-6, SP-8, SP-9, SP-10, SP-11, and SP-13) were consistent with the map unit descriptions. Two soil descriptions of pit locations were similar to that of the corresponding soil map unit. The SP-3 Typic Paleudults are similar to Hapludults (map unit) since Paleudults are basically freely-drained Udults on stable surfaces. Paleudults and Hapludults both have ochric and argillic diagnostic horizons. The SP-4 Lithic Hapludults are similar to the Typic Hapludalfs (map unit) since the primary difference is a shallow lithic contact.

More detailed comparisons of the USDA-NRCS map unit and Tetra Tech soil profile descriptions at soil pit locations are provided in the Attachment 1 table.

In addition to the soils investigation the bedrock along the alignment was evaluated between November 9 and 10, 2016 for consistency of mapped bedrock type, landslide evidence and evidence of groundwater seeps. This investigation indicated that the bedrock underlying the soils in the JNF consists of limestones interbedded with shales and siltstone. The shales are often calcareous. No indication of significant landslides or groundwater seepage was observed.

Detailed discussions of landslide potential is discussed in the Landslide Potential Report and the Karst-Specific Erosion and Sediment Control Plan. Near surface groundwater is discussed in Resource Report 2.

3.2 DISCUSSION

Soil surveys and associated map unit delineations are conducted over extensive areas and require interpretation and extrapolation. Soil map units may include areas of other taxonomic classes other than the dominant class that was described for the mapped unit. Every map unit consists of the soil for which it was named and also some soils that belong to other taxonomic classes. These other taxonomic classes are called soil map unit inclusions. The discrepancy between the USDA-NRCS map unit descriptions and the Tetra Tech soil descriptions at pit locations are presumably related to the detail at which the soil survey was conducted on the JNF and the occurrence of inclusions in the soil map unit.

Based on the reported soil descriptions the use of the USDA-NRCS data to analyze this project seems appropriate.

FIGURES
USDA-NRCS Soil Maps and Test Pit Location

Docket No. CP16-10-000

Greenville
Waiteville
Kire
Lindside
Pembroke
Pearisburg
Eggleston
McCoy
Parrott
Fairlawn
Blacksburg
Merrimac
Christiansburg
Jefferson National Forest
Peters Mountain Wilderness
Brush Mountain Wilderness
JNF Crossing 1
JNF Crossing 2
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Mountain Valley Pipeline Project

NAD 1983 UTM 17N

1:126,720

0 1 2 4 Miles

Mountain Valley PIPELINE

Figure 1
Jefferson National Forest
Crossing Areas Overview

April 2016

Data Sources: ESRI Streaming Data, 2014,
USDA National Forest Service

Legend

- Milepost
- Proposed Route
- Appalachian Trail
- Brush Mountain Wilderness
- Peters Mountain Wilderness
- US National Forest Service Boundary

N W E S

West Virginia
Virginia

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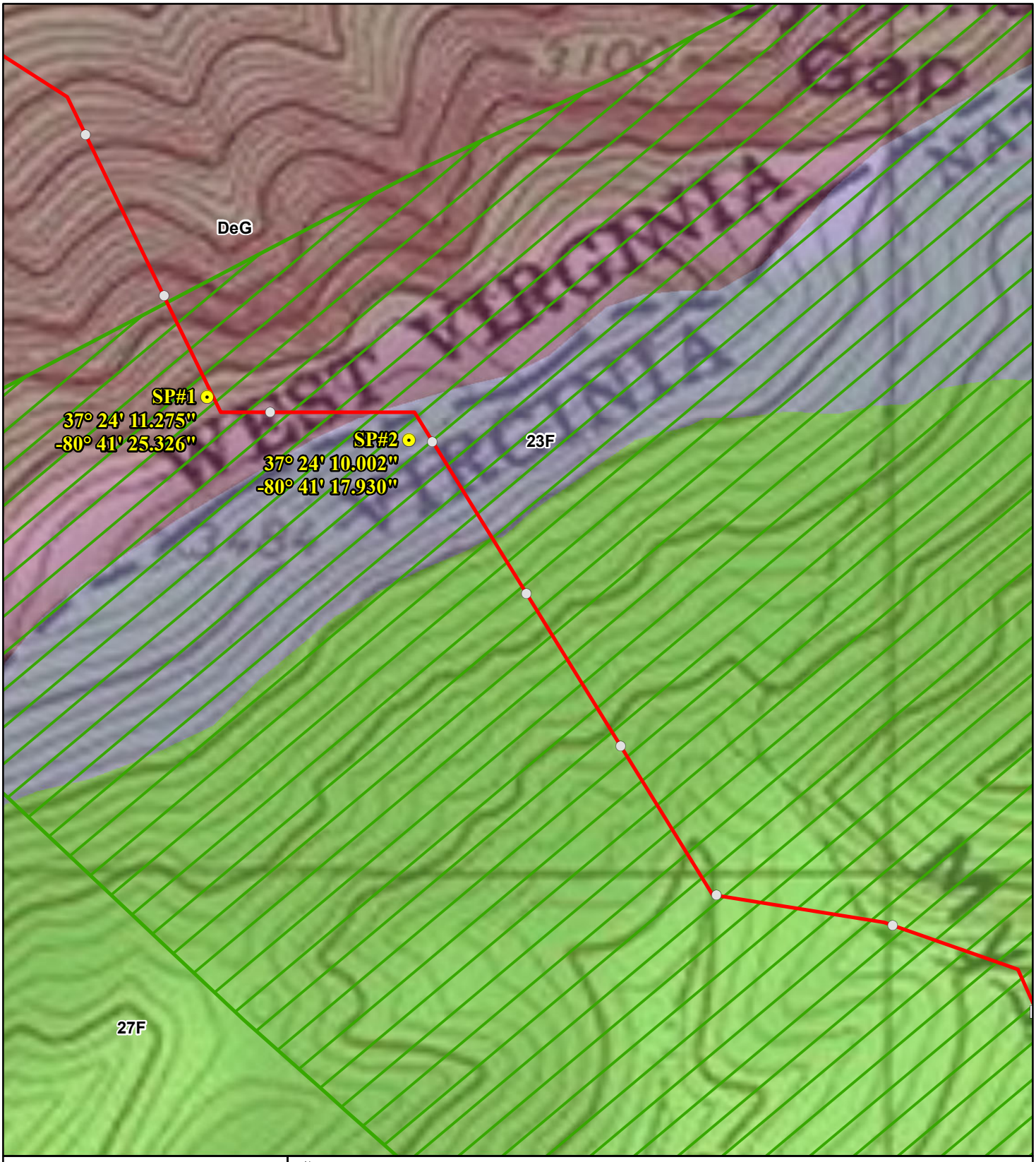

Mountain Valley Pipeline Project

N

NAD 1983 UTM 17N

0 100 200 400 600 800 Feet

Mountain Valley PIPELINE

Figure 2A
Jefferson National Forest
USDA - NRCS Soilmaps
and Test Pit Locations
(Crossing 1)

Page 1

April 2016

Data Sources: ESRI Streaming Data, 2014, SSURGO Soils, 2015

Legend

- Test Pit Location (ID-# and Coordinates Shown on Map)
- Milepost
- Tenth-Mile
- Proposed Route
- National Forest Boundary

Mapunit Symbol, Mapunit Name

- 23F, Lehew and Wallen soils, very stony, 35 to 65 percent slopes
- 27F, Lily-Bailegap complex, very stony, 35 to 65 percent slopes
- DeG, Dekalb channery loam, 55 to 70 percent slopes, very stony

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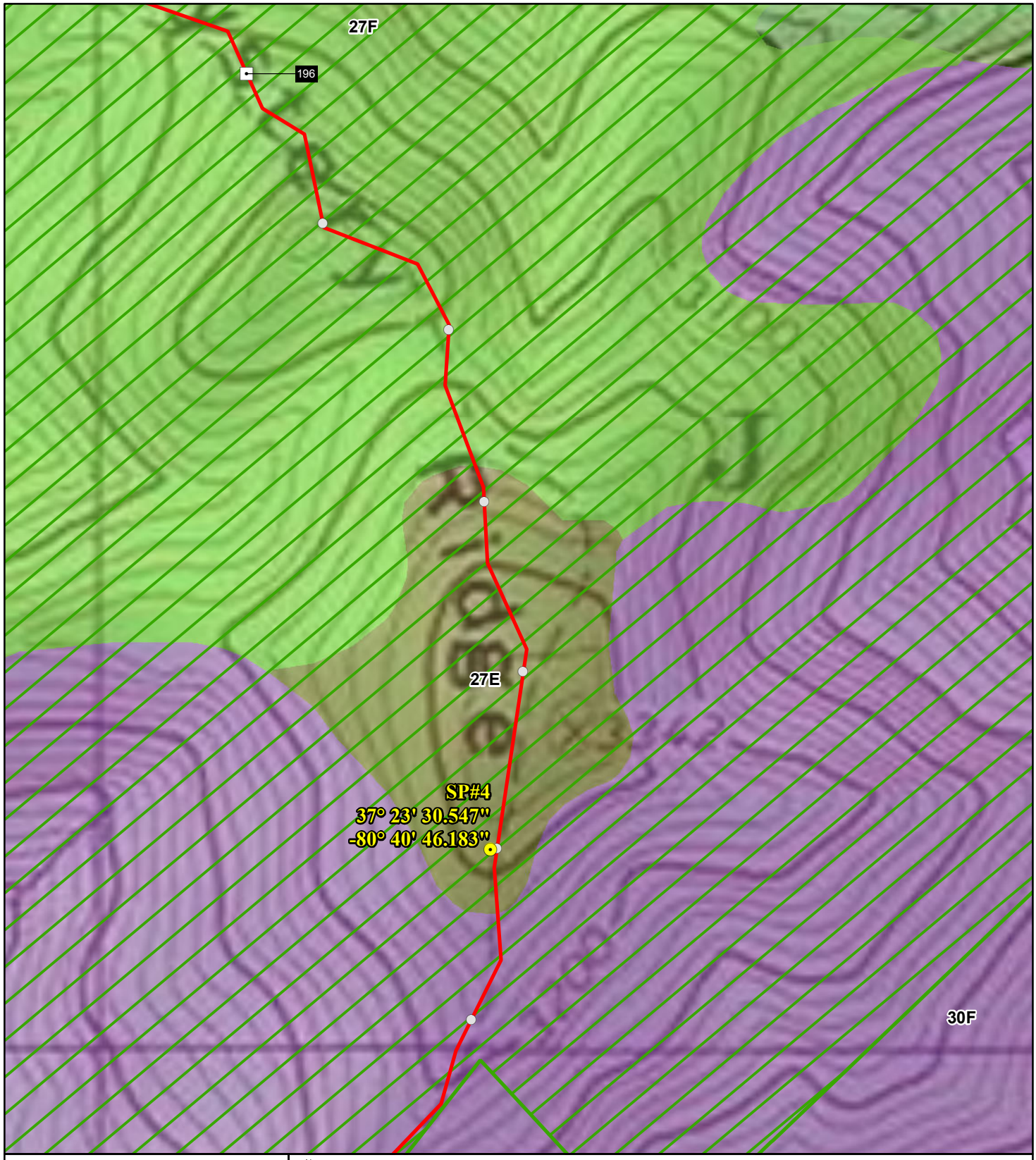

Mountain Valley Pipeline Project

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NAD 1983 UTM 17N

0 100 200 400 600 800 Feet

Mountain Valley PIPELINE

Figure 2A
Jefferson National Forest
USDA - NRCS Soilmaps
and Test Pit Locations
(Crossing 1)

Page 2

April 2016

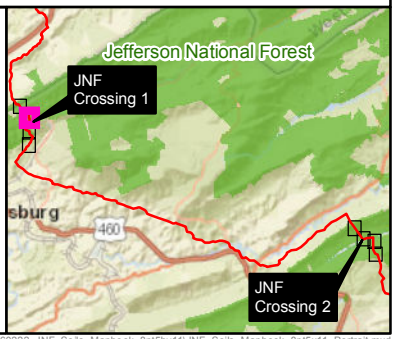
Data Sources: ESRI Streaming Data, 2014, SSURGO Soils, 2015

Legend

- Test Pit Location (ID-# and Coordinates Shown on Map)
- Milepost
- Tenth-Mile
- Proposed Route
- National Forest Boundary

Mapunit Symbol, Mapunit Name

- 27E, Lily-Bailegap complex, very stony, 15 to 35 percent slopes
- 27F, Lily-Bailegap complex, very stony, 35 to 65 percent slopes
- 30F, Nolichucky very stony sandy loam, 30 to 65 percent slopes



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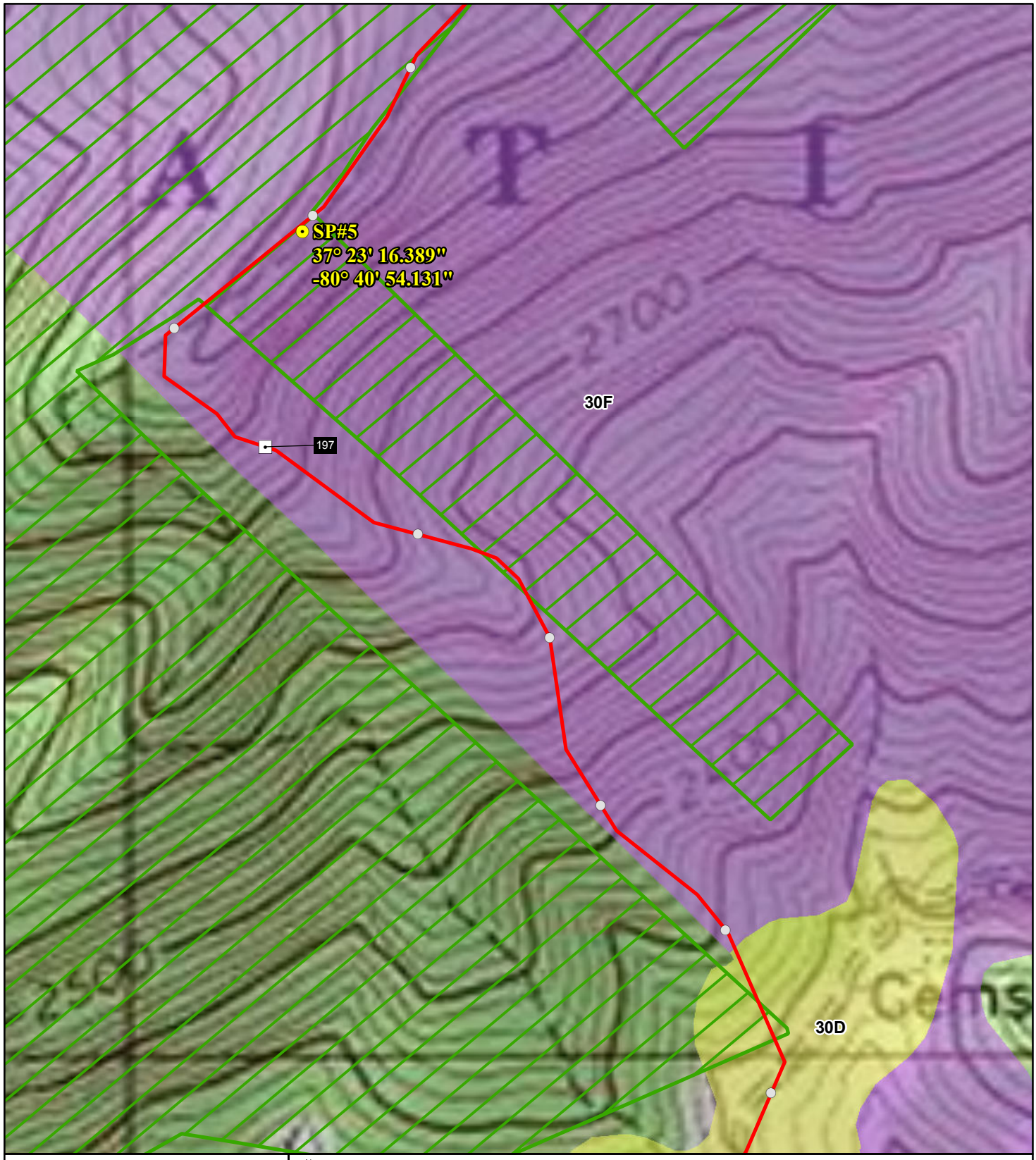

Mountain Valley Pipeline Project

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NAD 1983 UTM 17N

0 100 200 400 600 800 Feet

Mountain Valley PIPELINE

Figure 2A
Jefferson National Forest
USDA - NRCS Soilmaps
and Test Pit Locations
(Crossing 1)

Page 3

April 2016

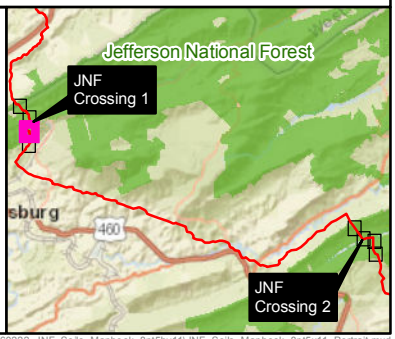
Data Sources: ESRI Streaming Data, 2014, SSURGO Soils, 2015

Legend

- Test Pit Location (ID-# and Coordinates Shown on Map)
- Milepost
- Tenth-Mile
- Proposed Route
- National Forest Boundary

Mapunit Symbol, Mapunit Name

- 30D, Nolichucky very stony sandy loam, 15 to 30 percent slopes
- 30F, Nolichucky very stony sandy loam, 30 to 65 percent slopes



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Mountain Valley Pipeline Project

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NAD 1983 UTM 17N

0 100 200 400 600 800 Feet

Mountain Valley PIPELINE

Figure 2A
Jefferson National Forest
USDA - NRCS Soilmaps
and Test Pit Locations
(Crossing 1)

Page 4

April 2016

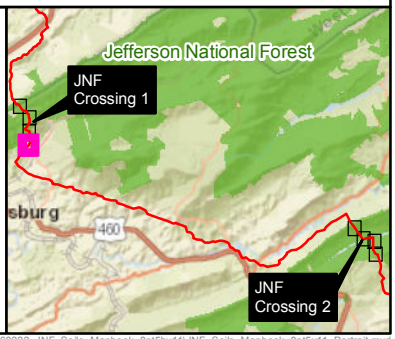
Data Sources: ESRI Streaming Data, 2014, SSURGO Soils, 2015

Legend

- Test Pit Location (ID-# and Coordinates Shown on Map)
- Milepost
- Tenth-Mile
- Proposed Route
- National Forest Boundary

Mapunit Symbol, Mapunit Name

- 30D, Nolichucky very stony sandy loam, 15 to 30 percent slopes
- 30F, Nolichucky very stony sandy loam, 30 to 65 percent slopes



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Mountain Valley Pipeline Project

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NAD 1983 UTM 17N

0 100 200 400 600 800 Feet

Mountain Valley PIPELINE

Figure 2B
Jefferson National Forest
USDA - NRCS Soilmaps
and Test Pit Locations
(Crossing 2)

Page 1

April 2016

Data Sources: ESRI Streaming Data, 2014, SSURGO Soils, 2015

Legend

- Test Pit Location (ID-# and Coordinates Shown on Map)
- Tenth-Mile
- Proposed Route
- National Forest Boundary

Mapunit Symbol, Mapunit Name

- 10G, Calvin-Rough complex, 35 to 70 percent slopes, very stony
- 23C, Jefferson very stony soils, 7 to 15 percent slopes
- 24D, Jefferson extremely stony soils, 7 to 25 percent slopes
- 4E, Berks-Rock outcrop complex, 25 to 70 percent slopes

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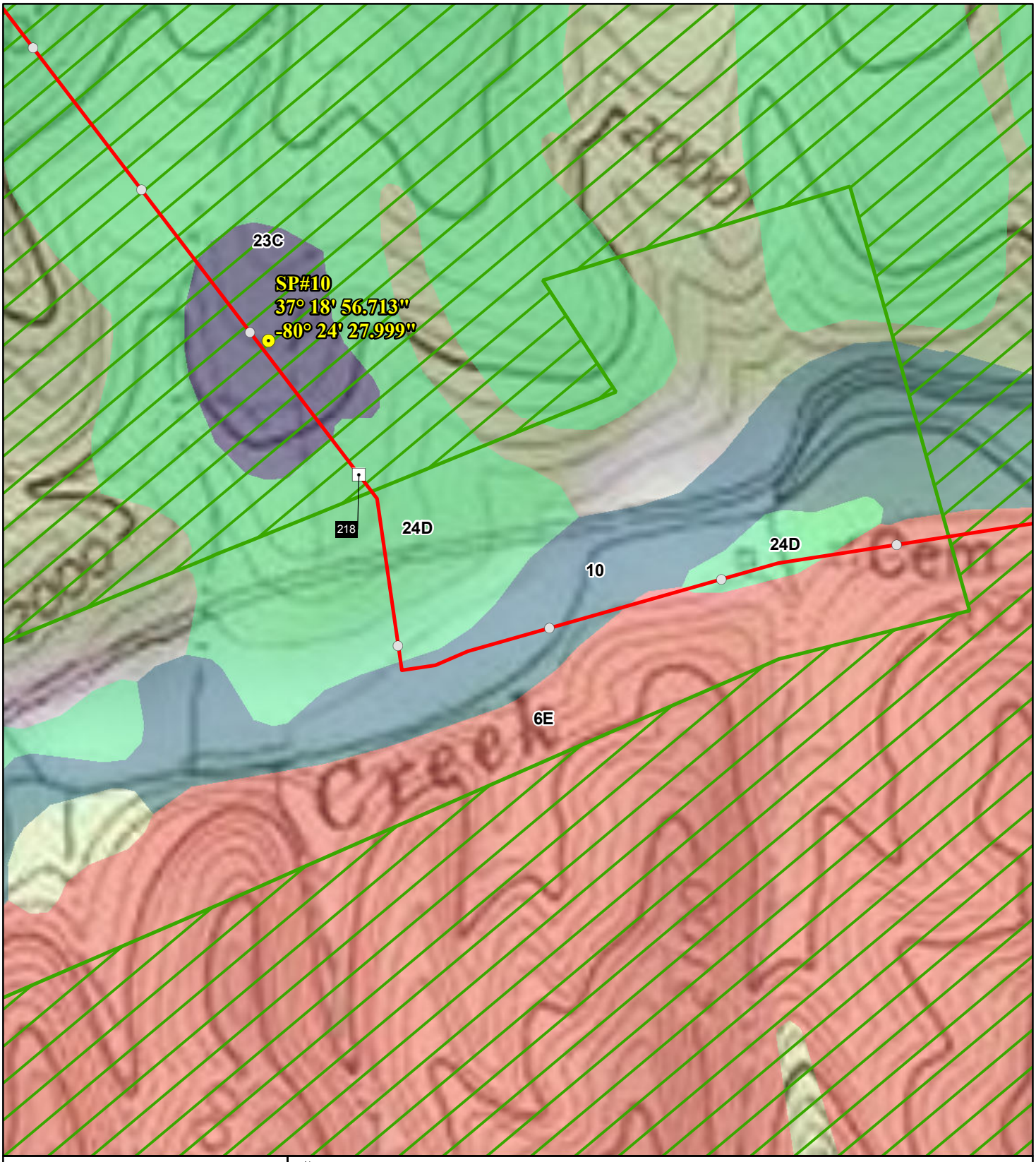

Mountain Valley Pipeline Project

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NAD 1983 UTM 17N

0 100 200 400 600 800 Feet

Mountain Valley PIPELINE

Figure 2B
Jefferson National Forest
USDA - NRCS Soilmaps
and Test Pit Locations
(Crossing 2)

Page 2

April 2016

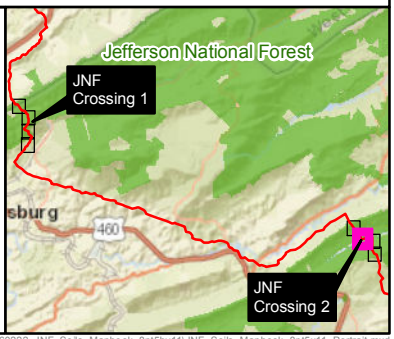
Data Sources: ESRI Streaming Data, 2014, SSURGO Soils, 2015

Legend

- Test Pit Location (ID-# and Coordinates Shown on Map)
- Milepost
- Tenth-Mile
- Proposed Route
- National Forest Boundary

Mapunit Symbol, Mapunit Name

- 10, Craigsville soils
- 23C, Jefferson very stony soils, 7 to 15 percent slopes
- 24D, Jefferson extremely stony soils, 7 to 25 percent slopes
- 6E, Berks and Weikert soils, 25 to 65 percent slopes



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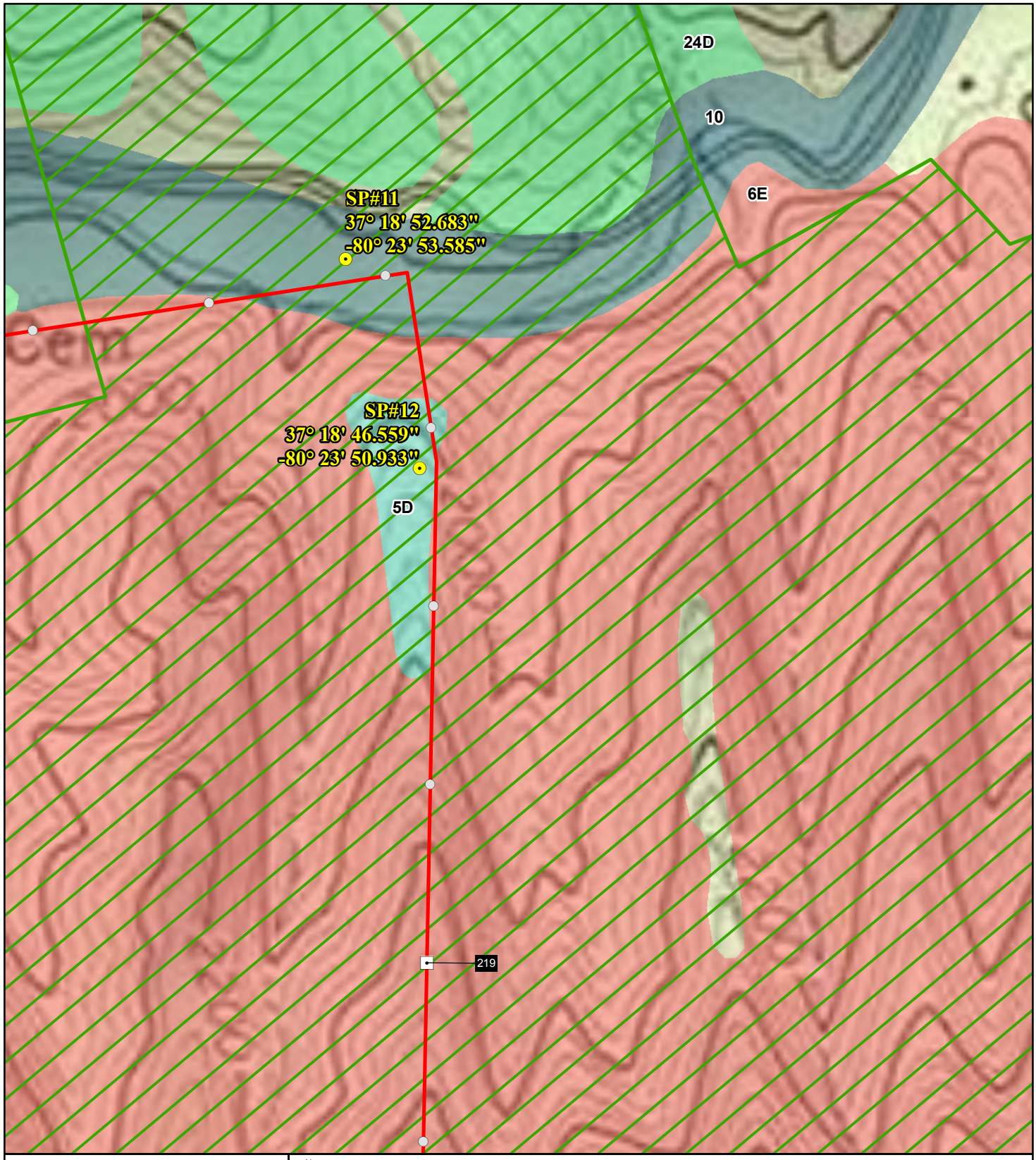

Mountain Valley Pipeline Project

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0 100 200 400 600 800 Feet

Mountain Valley PIPELINE

Figure 2B
Jefferson National Forest
USDA - NRCS Soilmaps
and Test Pit Locations
(Crossing 2)

Page 3

April 2016

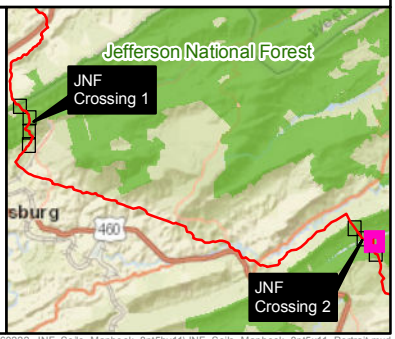
Data Sources: ESRI Streaming Data, 2014, SSURGO Soils, 2015

Legend

- Test Pit Location (ID-# and Coordinates Shown on Map)
- Milepost
- Tenth-Mile
- Proposed Route
- National Forest Boundary

Mapunit Symbol, Mapunit Name

- 10, Craigsville soils
- 24D, Jefferson extremely stony soils, 7 to 25 percent slopes
- 5D, Berks-Weikert complex, 15 to 25 percent slopes
- 6E, Berks and Weikert soils, 25 to 65 percent slopes



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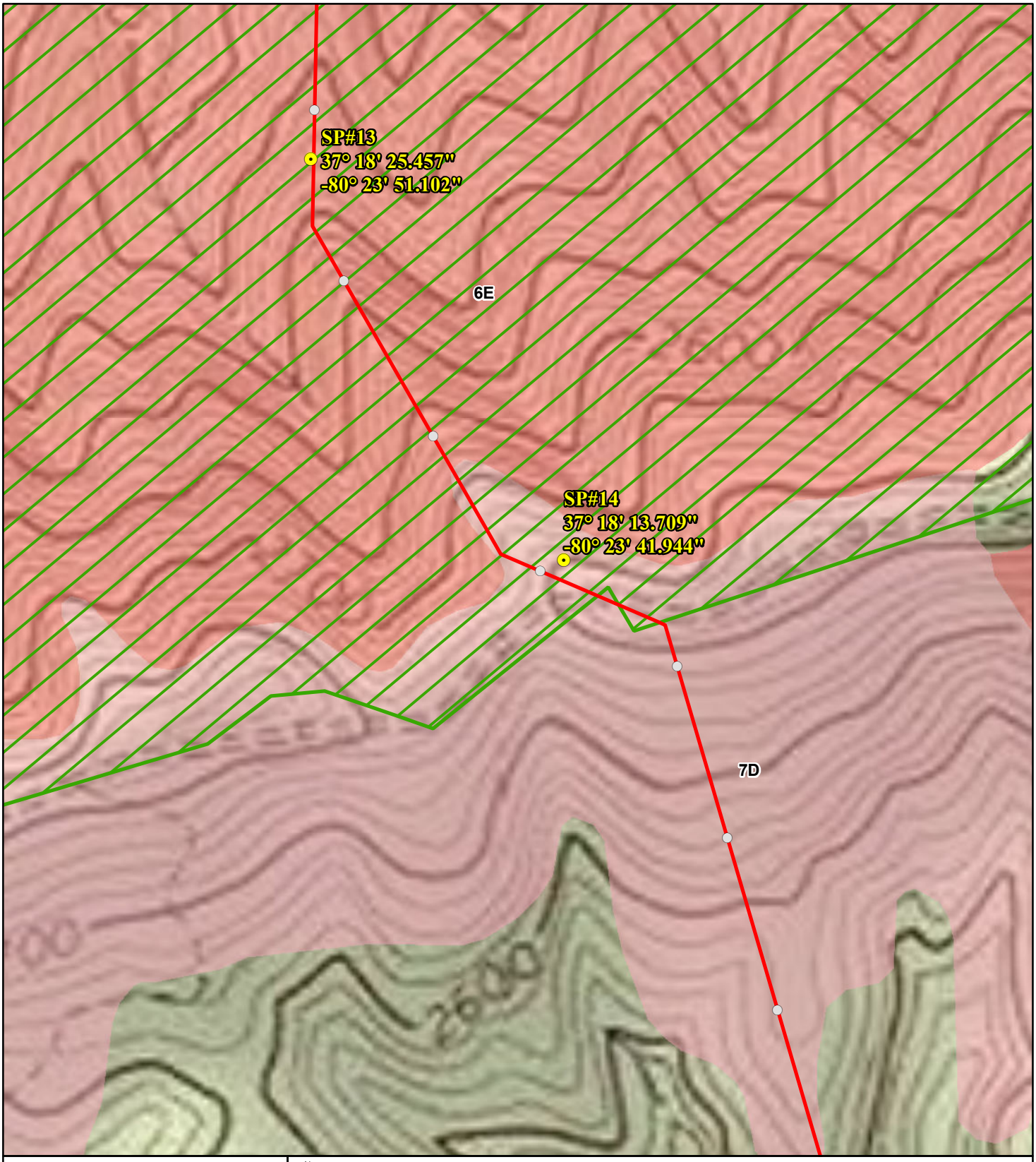

Mountain Valley Pipeline Project

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NAD 1983 UTM 17N

0 100 200 400 600 800 Feet

Mountain Valley PIPELINE

Figure 2B
Jefferson National Forest
USDA - NRCS Soilmaps
and Test Pit Locations
(Crossing 2)

Page 4

April 2016

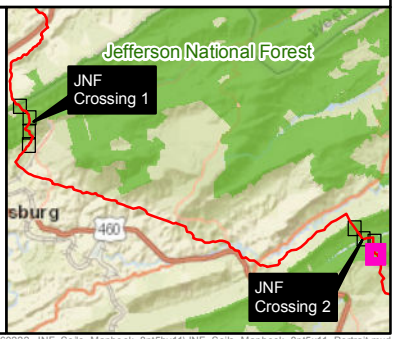
Data Sources: ESRI Streaming Data, 2014, SSURGO Soils, 2015

Legend

- Test Pit Location (ID-# and Coordinates Shown on Map)
- Tenth-Mile
- Proposed Route
- National Forest Boundary

Mapunit Symbol, Mapunit Name

- 6E, Berks and Weikert soils, 25 to 65 percent slopes
- 7D, Berks and Weikert very stony soils, 15 to 35 percent slopes



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ATTACHMENT 1
Summary of Soil Profile, Taxonomic, and Site Descriptions for Soil Map Units and Soil Pits

Docket No. CP16-10-000

USDA-NRCS SOIL MAP UNIT and SOIL PIT DESCRIPTION for EACH SOIL PIT LOCATION

NRCS SOIL MAP UNIT									TETRA TECH FIELD MAPPED SOIL PITS						
Soil Pit #	Map Unit	Topographic Position	Slope	Vegetation	Horizon/Color		Texture	Diagnostic Horizon(s)	Taxonomy	Topographic Position	Slope	Vegetation	Horizon/Color	Texture	Diagnostic Horizon(s)	Taxonomy
SP-1																
	Dekalb Channery Loam, 55-70 % slope	Level to steep upland and ridges	0-80%	Forests	O A E BW1&BW2 C R	 10YR 3/1 10YR 6/3 10YR 5/5 10YR 5/4	 cobbly to extremely cobbly sandy loam	Ochric Cambic	Loamy-skeletal, Typic Dystrudepts	Summit	10-40%	Forest	O A Bt BC C R	 10YR 2/2 10YR 4/4 10YR 4/6 7.5YR 4/6	 channery loam channery clay loam channery clay channery clay	Ochric Argillic	Fine-loamy, Lithic Hapludults
SP-2 (Lehew Series described for map unit,see Attachment 2 for Wallen Series description)																
	Lehew and Wallen Soils, Very Stony, 35-65 % slope	Level to very steep ridges	0-80%	Forests	A E BW1&BW2 C R	10YR 4/1 5YR 5/3 5 to 2.5YR 4/4 2.5YR 4/4	channery to extremely channery fine sandy loam	Ochric Cambic	Loamy-skeletal, Typic Dystrudepts	Summit	25-55%	Forest	O A Bw Bt Cr	 7.5YR 2.5/2 5YR 3/3 5YR 3/3 5YR 3/3	 channery sandy loam channery sandy loam stony sandy loam sandy loam (in bedrock cracks)	Ochric Argillic	Loamy-skeletal, Lithic or Inceptic, Hapludults
SP-3 (Lily Series described for map unit, see Attachment 2 for Bailgap Series description)																
	Lily-Bailegap Complex, very stony, 35-65% slopes	Upland ridges and hillsides	0-65%	Forest or agricultural crops	Ap Bt1 Bt2 R	10YR 4/3 7.5YR 5/6 7.5YR 5/6	loam clay loam sandy clay loam	Ochric Argillic	Fine-loamy, Typic Hapludults	Sideslope	25-50%	Forest	O A AB Bt Bt1 Bt2 Bt3	 2.5Y 4/4 10YR 5/6 10YR 5/6 10YR 5/8 10YR 5/8 7.5YR 5/8	 fine sandy clay loam fine sandy loam fine sandy loam sandy clay loam clay loam sandy clay loam	Ochric Argillic	Fine-loamy, Typic Paleudults
SP-4 (Lily Series described for map unit, see Attachment 2 for Bailgap Series description)																
	Lily-Bailegap Complex, Very Stony, 15-35% slopes	Same as SP-3	15-35%	Same as SP-3	Same as SP-3	Same as SP-3	Same as SP-3	Same as SP-3	Fine-loamy, Typic Hapludults	Summit	5-25%		O A E Bt Cr	 7.5YR 3/4 7.5YR 4/6 7.5YR 4/6 7.5YR 4/6	 cobbly sandy loam cobbly sandy loam very cobbly sandy loam very stony sandy loam	Ochric Argillic	Loamy-skeletal, Lithic or Inceptic, Hapludults
SP-5																
	Nolichucky Very Stony Sandy Loam, 30-65% slopes	Gently sloping to steep high terraces	2-30%	Mostly cropland and some forest	Ap BA Bt1 Bt2 Bt3 Bt4	10YR 5/4 7.5YR 5/8 5YR 5/8 2.5YR 4/8 2.5YR 4/6 2.5YR 4/6	loam loam clay loam clay loam clay loam clay	Ochric Argillic	Fine-loamy, Typic Paleudults	Summit	25-50%		O A BC R	 10YR 2/2 10YR 6/4	 cobbly loam very cobbly clay	Ochric Cambic	Clayey-skeletal, Lithic Dystrudepts
SP-6																
	Nolichucky Very Stony Sandy Loam, 15-30% slopes	Same as SP-5	15-30%	Same as SP-5	Same as SP-5	Same as SP-5	Same as SP-5	Same as SP-5	**Fine-loamy, Typic Paleudults**	Backslope	20-45%		O A E Bt1 Bt2 Cr/R	 10YR 5/4 10YR 5/6 7.5YR 5/6 5YR 5/8	 sandy loam sandy loam sandy clay loam cobbly clay	Ochric Argillic	**Fine-loamy, Typic Paleudults**
SP-8																
	Berks-Rock Outcrop Complex, 25-70% slopes	Summits & backslopes	0-80%	Cropland & forest	Ap Bw1 Bw2 CB C R	10YR 4/3 10YR 5/6 10YR 5/6 7.5YR 5/6 10YR 5/6	channery loam very channery loam very channery silt loam extremely channery loam	Ochric Cambic	**Loamy-skeletal, Typic Dystrudepts**	Backslope	40-60%		O A Bw C R	 10YR 3/3 10YR 3/4 10YR 4/6	 loam cobbly loam cobbly fine sandy loam	Ochrich Cambic	**Loamy-skeletal, Typic Dystrudepts**

Bold Text indicates similar soil type

USDA-NRCS SOIL MAP UNIT and SOIL PIT DESCRIPTION for EACH SOIL PIT LOCATION

NRCS SOIL MAP UNIT									TETRA TECH FIELD MAPPED SOIL PITS						
Soil Pit #	Map Unit	Topographic Position	Slope	Vegetation	Horizon/Color		Texture	Diagnostic Horizon(s)	Taxonomy	Topographic Position	Slope	Vegetation	Horizon/Color	Texture	Diagnostic Horizon(s)	Taxonomy
SP-9																
	Jefferson Extremely Stony Soils, 7-25% slopes	Steep mountain sides	2-75%	Forest	A E BE Bt BC	10YR 4/2 10YR 5/4 10YR 5/6 10YR 5/6 10YR 5/6	gravelly silt loam gravelly silt loam silt loam gravelly loam very gravelly loam	Ochric Argillic	**Fine-loamy, Typic Hapludults**	Backslope	15-30%		O A AB B+ BC C	 10YR 3/4 7.5YR 4/4 7.5YR 4/6 7.5YR 4/6	 sandy loam cobbly sandy loam cobbly sandy clay loam cobbly sandy clay loam extremely cobbly sandy loam	Ochric Argillic	**Fine-loamy, Typic Hapludults**
SP-10																
	Jefferson Very Stony soils, 7-15% slopes	Same as SP-9	7-15%		Same as SP-9	Same as SP-9	Same as SP-9	Same as SP-9	**Fine-loamy, Typic Hapludults**	Toe slope	7-15%		O A E BE Bt BC Cr	 10YR 4/2 2.5Y 5/4 10YR 5/6 10YR 5/6 10YR 5/6 10YR 5/6	 sandy loam sandy loam sandy loam cobbly sandy clay loam sandy loam cobbly sandy loam	Ochric Argillic	**Fine-loamy, Typic Hapludults**
SP-11																
	Craigsville Soils	Streams & tributaries			Ap Bw1 Bw2 2C	10YR 4/2 7.5YR 4/4 5YR 4/4 5YR 4/4	cobbly sandy loam gravelly sandy loam gravelly sandy loam extremely gravelly loamy sand	Ochric Cambic	**Loamy-skeletal, Fluventic Dystrudepts**	Floodplain	0-5%		O A Bw1 Bw2 C	 10YR 4/4 7.5YR 4/6 7.5YR 5/6 10YR 4/6	 sandy loam sandy loam sandy loam cobbly sandy loam	Ochric Cambic	**Loamy-skeletal, Fluventic Dystrudepts**
SP-12 (Berks Series described for map unit, see Attachment 2 for Weikert Series description)																
	Berks-Weikert Complex, 15-25% slopes	Same as SP-8	Same as SP-8		Same as SP-8	Same as SP-8	Same as SP-8	Same as SP-8	Loamy-skeletal, Typic Dystrudepts	Crest	20-25%		O A Bt C R	 10YR 4/4 10YR 6/6 10YR 6/8	 gravelly loam cobbly clay loam cobbly clay loam	Ochric Argillic	Loamy-skeletal, Lithic Hapludults
SP-13 (Berks Series described for map unit, see Attachment 2 for Weikert Series description)																
	Berks & Weikert Soils, 25-65% slopes	Same as SP-8	Same as SP-8		Same as SP-8	Same as SP-8	Same as SP-8	Same as SP-8	**Loamy-skeletal, Typic Dystrudepts**	Backslope	25-40%		O A Bw B/C R	 10YR 4/3 10YR 5/4 10YR 5/6	 loam channery loam very channery loam	Ochric Cambic	**Loamy-skeletal, Lithic Dystrudepts**
SP-14 (Berks Series described for map unit, see Attachment 2 for Weikert Series description)																
	Berks & Weikert Very Stony Soils, 15-35% slopes	Same as SP-8	Same as SP-8		Same as SP-8	Same as SP-8	Same as SP-8	Same as SP-8	Loamy-skeletal, Typic Dystrudepts	Summit	15-65%		O Oe A E Bt Bw Cr	 10YR 4/4 10YR 6/4 10YR 5/4 2.5Y 5/4 10YR 6/8	 channery clay loam loam gravelly clay loam gravelly silty clay loam extremely channery loam (soil in fractures)	Ochric Argillic	Fine-loamy, Lithic Hapludults

Bold Text indicates similar soil type

ATTACHMENT 2
USDA-NRCS Official Map Unit Soil Series Descriptions for Soil Pit Locations

Docket No. CP16-10-000

LOCATION BAILEGAP VA

Established Series
Rev. PLS-DDR-EPE-RP
09/2002

BAILEGAP SERIES

Soils of the Bailegap series are deep and well drained. They are on rounded hills, side slopes or ridge tops and formed in residuum weathered from sandstone, siltstone and interbedded shale in the Appalachian Ridge and Valley area. Permeability is moderate. Slope ranges from 2 to 65 percent. Mean annual precipitation is about 38 to 40 inches and mean annual temperature is about 51 degrees F.

TAXONOMIC CLASS: Fine-loamy, siliceous, semiactive, mesic Typic Hapludults

TYPICAL PEDON: Bailegap flaggy loam, 35 percent slope in a wooded area. (Colors are for moist soil unless otherwise stated.)

0i--0 to 0.5 inches; loose leaves, twigs and partially decomposed organic material.

A--0.5 to 2 inches; brown (7.5YR 4/2) flaggy loam; weak fine granular structure; friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine vesicular pores; 12 percent gravel and 20 percent flagstones; very strongly acid; abrupt smooth boundary. (1 to 4 thick)

E--2 to 8 inches; reddish brown (5YR 5/3) channery silt loam; weak fine granular structure; friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine vesicular pores; 10 percent gravel and 20 percent channers; very strongly acid; clear wavy boundary. (4 to 12 inches thick)

Bt1--8 to 20 inches; reddish brown (2.5YR 4/4) gravelly silt loam; weak fine subangular blocky structure; friable, slightly sticky and slightly plastic; common fine and medium roots; common very fine and fine vesicular pores; 30 percent gravel; few faint clay films on faces of peds; very strongly acid; clear wavy boundary.

Bt2--20 to 29 inches; reddish brown (2.5YR 4/4) angular cobbly silt loam; moderate fine subangular blocky structure; firm, sticky and plastic; few fine and medium roots; few very fine and fine vesicular pores; 15 percent gravel; and 20 percent angular cobblestones; few distinct clay films on faces of peds; very strongly acid; clear wavy boundary.

Bt3--29 to 37 inches; reddish brown (2.5YR 4/4) angular very cobbly silt loam; moderate fine subangular blocky structure; firm, sticky and plastic; few fine and medium roots; few very fine and fine vesicular pores; 30 percent gravel and 30 percent angular cobblestones; few distinct clay films on ped faces; very strongly acid; gradual irregular boundary.

Bt4--37 to 42 inches; reddish brown (2.5YR 4/4) angular very cobbly silt loam; weak fine angular blocky structure; firm, slightly sticky and slightly plastic; few fine and medium roots; few very fine and fine vesicular pores; 40 percent gravel and 40 percent angular cobblestones few distinct clay films on ped faces; very strongly acid; abrupt irregular boundary. (Combine thickness of the Bt horizon range from 20 to 50 inches)

Cr--42 to 58 inches; fractured red sandstone bedrock that crushes to sandy loam; weak fine granular structure in cracks; very strongly acid.

R-- 58 inches; Red sandstone bedrock.

TYPE LOCATION: Giles County, Virginia; on the north side of Big Mountain on Va. Route 804, 2.5 miles South of Va. Route 635.

RANGE IN CHARACTERISTICS: Solum thickness and depth to bedrock ranges from 40 to 60 inches. Rock fragments of sandstone range from 0 to 35 percent in the A, E and upper B horizons. Individual subhorizons in the lower B horizon and the C horizon ranges up to 80 percent. The soil is very strongly acid or strongly acid unless limed.

The A horizon has hue of 10YR to 5YR, value of 3 to 5, and chroma of 2 or 3. It is loam, silt loam, fine sandy loam or sandy loam in the fine earth fraction.

The E horizon has hue of 10YR to 5YR, value of 4 to 6, and chroma of 3 to 6. It is loam, silt loam, fine sandy loam or sandy loam in the fine earth fraction.

The Bt horizon has hue of 7.5YR to 10R, value of 4 to 6, and chroma of 3 to 8. It is silt loam, loam, clay loam, or sandy clay loam in the fine earth fraction.

The C horizon (where present) has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 3 or 4. It is loam, sandy loam, or loamy sand, in the fine earth fraction.

The Cr has hue of 2.5YR or 5YR, value of 4 to 6 and chroma of 3 or 4. It is saprolite that crushes to loam, sandy loam or loamy sand.

COMPETING SERIES: These are the Jefferson, Lily, Lonewood, Marr, Riney, Sassafras, and Sunnyside series in the same family. Jefferson soils has bedrock deeper than 60 inches. Lonewood soils lack coarse fragments in the solum. Lily and Marr soils have a solum thickness of less than 40 inches. Riney soils do not have hard sandstone rock fragments throughout the solum. Sassafras soils have rock fragments dominated by smooth quartz gravel. Sunnyside soils do not have flagstones or cobblestones in the solum. Apison, Cahaba, Granville, Hartsells and Linker soils have a thermic temperature regime. Brevard, Clymer, Meadowville, Shelocta, Tate and Thurmont soils have mixed mineralogy.

GEOGRAPHIC SETTING: The Bailegap soils are on rounded hills, side slopes, or ridge tops above 1500 feet elevation in the Appalachian Ridge and Valley area. Slope gradient range from 2 to 65 percent. The soils formed in residuum weathered from sandstone, siltstone and interbedded shale. The average annual temperature ranges from 47 to 56 degrees F. Average annual precipitation ranges from 34 to 40 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Clymer and Jefferson series and the Lehew, Nolichucky, Tumbling and Wallen soils. Lehew and Wallen soils have bedrock at depths between 20 and 40 inches and lack argillic horizons. Nolichucky soils have a sola greater than 60 inches thick. Tumbling soils have clayey particle size control sections. Clymer, Lehew and Wallen soils occupy similar landscape positions. The Jefferson, Nolichucky and Tumbling soils occupy side slopes and footslopes at relatively lower landscape positions.

DRAINAGE AND PERMEABILITY: Well drained. The potential for surface runoff is low to very high. Permeability is moderate.

USE AND VEGETATION: Nearly all areas of these soils are in woodland. Native vegetation consists of dominantly mixed hardwood species.

DISTRIBUTION AND EXTENT: Ridge and Valley and Appalachian Plateau areas of Virginia, Kentucky, Maryland, Pennsylvania, Tennessee, and West Virginia. The series is of small extent.

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

SERIES ESTABLISHED: Giles County, Virginia; 1980. Name is from Baileys Gap, Virginia.

REMARKS: These soils formerly were included in the Lehew series in Giles County but lab data show that these soils have an argillic horizon and have siliceous mineralogy.

Diagnostic horizons and features recognized in this pedon are:
1. Ochric Epipedon - The zone from 0 to 2 inches (The A horizon). 2. Argillic horizon - The zone from 8 to 42 inches (Bt horizon)

National Cooperative Soil Survey
U.S.A.

LOCATION BERKS PA IL IN KY MD NJ OH TN VA WV

Established Series
Rev. GHL-EAW-REP
09/1999

BERKS SERIES

The Berks series consists of moderately deep, well drained soils formed in residuum weathered from shale, siltstone and fine grained sandstone on rounded and dissected uplands. Slope ranges from 0 to 80 percent. Permeability is moderate or moderately rapid. Mean annual precipitation is 42 inches. Mean annual temperature is 52 degrees F.

TAXONOMIC CLASS: Loamy-skeletal, mixed, active, mesic Typic Dystrudepts

TYPICAL PEDON: Berks channery loam, on a south-facing slope of 3 to 8 percent in a cultivated field. (Colors are for moist soil unless otherwise noted.)

Ap--0 to 10 inches; brown (10YR 4/3) channery loam; weak fine granular structure; friable; 30 percent rock fragments; moderately acid; abrupt smooth boundary (6 to 12 inches thick).

Bw1--10 to 17 inches; yellowish brown (10YR 5/6) very channery loam; weak fine subangular blocky structure; friable, slightly sticky and slightly plastic; 35 percent rock fragments; slightly acid; gradual wavy boundary (4 to 12 inches thick).

Bw2--17 to 21 inches; yellowish brown (10YR 5/6) very channery silt loam; weak fine subangular blocky structure modified by rock fragments; slightly sticky and nonplastic; very few faint clay films on rock fragments; 50 percent rock fragments; slightly acid; abrupt wavy boundary (2 to 10 inches thick).

CB--21 to 26 inches; strong brown (7.5YR 5/6) extremely channery loam; structure obscured by rock fragments; friable; 60 percent rock fragments; slightly acid; clear irregular boundary (0 to 10 inches thick).

C--26 to 33 inches; yellowish brown (10YR 5/6) extremely channery loam; fines are concentrated in pockets between and as coatings on rock fragments; massive; friable; 75 percent rock fragments; moderately acid; clear wavy boundary (0 to 14 inches thick).

R-- 33 inches; very dark grayish brown (10YR 3/2) and light olive brown (2.5Y 5/6) fractured shale bedrock.

TYPE LOCATION: Lehigh County, Pennsylvania, Weisenberg Township, 1 mile south and east on T624 from New Smithville and 200 feet north of road.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 12 to 40 inches. Depth to bedrock is 20 to 40 inches. Depth to the top of the cambic horizon range from 3 to 12 inches. Rock fragments range from 10 to 50 percent in the Ap and A horizons, from 15 to 75 percent in individual horizons of the B, and from 35 to 90 percent in the C horizon. The average volume of rock fragments in the particle-size control section is more than 35 percent. In unlimed soils reaction ranges from extremely acid to slightly acid throughout. The dominant clay minerals are illite, vermiculite and interstratified vermiculite chlorite. Small amounts of kaolinite are present.

The Ap or A horizons have hue of 10YR, value of 3 to 5, and chroma of 2 to 4. Texture is loam or silt loam in the fine earth fraction.

The B horizon has hue of 5YR to 2.5Y, value of 4 to 6, and chroma of 3 to 8. Hue of 5YR is restricted to the lower part of the soil. Texture is loam, silt loam or silty clay loam in the fine earth fraction. It contains 5 to 32 percent clay and 40 to 60 percent silt. Structure is weak or moderate, fine or medium subangular blocky structure in the Bw horizon and is usually obscured by the rock fragments in the CB horizon.

The C horizon, where present, has hue of 5YR to 2.5Y, value of 4 to 6, and chroma of 2 to 8. Texture in the fine earth fraction is loam or silt loam.

COMPETING SERIES: These are the Greenlee, Handshoe, and Northcove series in the same family and the Brownsville, Calvin, Cardiff, Centralpark (T), Chamate, Highsplint, Konnarock (T), Lippitt, Parker, Remote, Sylco, Watt, and Wyoming series that are currently in older classification slots. Brownsville, Greenlee, Handshoe and Northcove soils do not have a lithic contact within a depth of 40 inches. Calvin soils have hue of 7.5YR or redder throughout the B horizon. Cardiff, Highsplint, Parker, Sylco, and Wyoming soils do not have a lithic contact within a depth of 40 inches. Centralpark (T) soils have rock fragments of concrete and asphalt. Chamate and Remote soils are formed in a more moist climate. Konnarock soils have ryhythmite and tillite rock fragments. Lippitt soils have till over Gneiss, schist or gravel. Watt soils have colors with chroma of 3 or less in the B horizon.

GEOGRAPHIC SETTING: Berks soils are on summits, shoulders, and backslopes of dissected uplands formed in residuum weathered from shale interbedded with fine grained sandstone and siltstone. Slope gradient range from 0 to 80 percent. Climate is humid and temperate. Mean annual precipitation ranges from 40 to 44 inches, mean annual temperature ranges from 50 to 55 degrees F and the growing season is 170 to 214 days.

GEOGRAPHICALLY ASSOCIATED SOILS: Bedington, Blairton, Brinkerton, Comly, Ernest, Gilpin, Muskingum, Rushtown, Shelocta, Tarhollow and Weikert soils are on nearby landscapes. Bedington, Brownsville, Rushtown, Shelocta and Tarhollow soils all have bedrock at a depth of more than 40 inches and are on similar landscape positions. Blairton and Comly soils are moderately well drained. Brinkerton soils are poorly drained. Gilpin soils have fewer rock fragments and are on similar landscapes. Weikert soils have bedrock at a depth of less than 20 inches and are on similar landscape positions.

DRAINAGE AND PERMEABILITY: Well drained. The potential for surface runoff is negligible to high. Permeability is moderate or moderately rapid. Depth to a seasonal high water table is more than 6 feet.

USE AND VEGETATION: Approximately 60 percent of Berks soils are in cropland and pasture, the remainder are in woodland or other uses. Principal crops are corn, wheat, oats, barley, Christmas trees and hay. Native vegetation is mixed, deciduous hardwood forest.

DISTRIBUTION AND EXTENT: Kentucky, Maryland, New Jersey, New York, Ohio, Pennsylvania, Virginia, West Virginia, Indiana, and Southern Illinois. MLRA's 115, 120, 121, 124, 125, 126, 127, 128, 130, 139, 147 and 148. The series is of large extent.

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

SERIES ESTABLISHED: Berks County, Pennsylvania, 1909.

REMARKS: The Ashby, Kistler and Trexler soils, which were moderately shallow in some Pennsylvania published surveys are now included in the Berks Series.

Diagnostic horizons recognized in this pedon are:

Ochric epipedon - from a depth of 0 to 10 inches (Ap horizon).
Cambic horizon - from a depth of 10 to 21 inches (Bw, Bt horizons).
Lithic contact - at a depth of 33 inches (R horizon).
CEC class - active, but includes semiactive and subactive
R - some pedons have very few thin clay films and silt coats on upper surfaces of rock fragments.
ADDITIONAL DATA: Laboratory data is available for this pedon,
S59-PA-039-7(1-5), and for pedon S59-PA-039-2(1-4). Other pedons from areas mapped Berks are available that show weak argillic horizons:
S65-PA-028-5(1-4), S65-PA-028-7(1-3), S62-PA-029-17(1-4),
S62-PA-020-18(1-4).

National Cooperative Soil Survey
U.S.A.

LOCATION CRAIGSVILLE VA+KY NC PA TN WV

Established Series
Rev. DDR-ART
05/2004

CRAIGSVILLE SERIES

Soils of the Craigsville series are very deep and well drained to somewhat excessively drained. They formed in moderately coarse and coarse textured sediments. Permeability is moderately rapid or rapid. They are nearly level to gently sloping soils on flood plains. Slopes range from 0 to 5 percent. Mean annual temperature is about 50 degrees F., and mean annual precipitation is about 40 inches.

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive, mesic Fluventic Dystrudepts

TYPICAL PEDON: Craigsville cobbly sandy loam - forested area in George Washington National Forest. (Colors are for moist soil.)

Oi--0 to 2 inches; fresh and partially decomposed leaves, pine needles, and twigs,extremely acid.

Ap--2 to 7 inches; dark grayish brown (10YR 4/2) cobbly sandy loam; moderate medium granular structure; very friable; many fine and medium roots; 35 percent cobbles and gravel; very strongly acid; clear smooth boundary. (0 to 10 inches thick)

Bw1--7 to 23 inches; brown (7.5YR 4/4) gravelly sandy loam; weak medium and fine subangular blocky structure; common fine and medium roots; 45 percent gravel and cobbles; very strongly acid; clear smooth boundary.

Bw2--23 to 30 inches; reddish brown (5YR 4/4) gravelly sandy loam; weak medium subangular blocky structure; friable; few fine roots; 35 percent gravel and cobbles; very strongly acid; gradual wavy boundary. (Combined thickness of the Bw horizon is 15 to 36 inches.)

2C--30 to 67 inches; reddish brown (5YR 4/4) extremely gravelly loamy sand; massive; very friable; few roots; 65 percent gravel and cobbles; very strongly acid.

TYPE LOCATION: Augusta County, Virginia; 60 yards west of intersection of U. S. Forest Service Roads 95 and 96; 20 yards south of Road 96, 5 miles northwest of West Augusta Post Office.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 20 to 40 inches. Depth to bedrock is more than 60 inches. Average content of rock fragments ranges from 5 to 60 percent in the A horizon and 35 to 70 percent in the B and C horizons. These consist of gravel and cobbles. A lithologic discontinuity is not present in all pedons. The soil is very strongly acid or strongly acid, unless limed.

The A horizon has hue of 7.5YR or 1OYR, value of 3 or 4, and chroma of 2 to 4. It is sandy loam to silt loam in the fine-earth fraction.

The B horizon has hue of 5YR to 1OYR, value of 4 or 5, and chroma of 4 or 6. It is loam or sandy loam in the fine-earth fraction.

The BC horizon, where present, has hue of 5YR to 10YR, value of 4 or 5, and chroma of 4 or 6. It is loam, sandy loam, or loamy sand in the fine-earth fraction.

The C or 2C horizon has hue of 5YR to 10YR, value of 4 or 5, and chroma of 3 to 6. They are loamy sand or sandy loam in the fine-earth fraction. Thin unconforming horizons may have less than 15 percent gravel or cobbles.

COMPETING SERIES: There are no other known series in this family.

GEOGRAPHIC SETTING: Craigsville soils are nearly level to gently sloping soils on first bottoms along the major streams and their tributaries. Slope gradients are commonly 1 to 3 percent and range from 0 to 5 percent. Craigsville soils formed in alluvium washed from sandy and gravelly upland soils that weathered from acid sandstone and quartzite. Mean annual temperature ranges from 48 to 56 degrees F., and mean annual precipitation ranges from 36 to 46 inches near the type location.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Allegheny, Berks, Laidig, and Rushtown soils. Allegheny soils have an argillic horizon and are on stream terraces. Berks soils are on uplands and are less than 40 inches deep to fractured shale bedrock. Laidig soils have a fragipan. Rushtown soils are silty and contain many fine shale fragments.

DRAINAGE AND PERMEABILITY: Well drained to somewhat excessively drained; The potential for surface runoff is neglegible to very low. Permeability is moderately rapid or rapid.

USE AND VEGETATION: More than one-half of these soils are in forest and the remainder is used for growing pasture and crops. Crops are mixed hay, small grain, and corn. Native vegetation is yellow-poplar, white pine, northern red oak, and white oak.

DISTRIBUTION AND EXTENT: Virginia and West Virginia. The series is of moderate extent.

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

SERIES ESTABLISHED: Augusta County, Virginia, 1976.

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

a. Ochric epipedon - the zone from 2 to 7 inches (Ap horizon).

b. Cambic horizon - the zone from 7 to 30 inches (Bw horizon).

c. Fluventic feature - organic carbon decreases irregularly with depth.

ADDITIONAL DATA: Mechanical analysis by hydrometer method (U.S. Forest Service, Profile No. 241) and chemical analysis (V.P.I. Soil Testing Laboratory, Profile No. 241) available for samples from typical pedon.

SIR = VA0072, VA0265 (GRAVELLY)

MLRA = 125, 127, 128, 147

REVISED =1/23/92, MHC

National Cooperative Soil Survey
U.S.A.

LOCATION DEKALB PA+GA KY MD NY OH VA WV

Established Series
Rev. WRK-ART
05/2004

DEKALB SERIES

The Dekalb series consists of moderately deep, excessively drained soils formed in material weathered from gray and brown acid sandstone in places interbedded with shale and graywacke. Slope ranges from 0 to 80 percent. Permeability is rapid. Mean annual precipitation is about 48 inches and mean annual air temperature is about 53 degrees F.

TAXONOMIC CLASS: Loamy-skeletal, siliceous, active, mesic Typic Dystrudepts

TYPICAL PEDON: Dekalb cobbly sandy loam in a wooded area of Hazleton and Dekalb soils, 25 to 75 percent slopes, extremely stony on an east facing slope at 1700 feet elevation. (Colors are for moist soil unless otherwise noted.)

Oi--0 to 1 inches; slightly decomposed leaves and twigs.

Oe--1 to 3 inches; moderately decomposed mat of roots and leaves.

A--3 to 5 inches; very dark gray (10YR 3/1) very cobbly sandy loam; weak fine granular structure; loose, nonsticky, nonplastic; many fine and medium roots; 40 percent angular sandstone cobbles and channers; very strongly acid; clear smooth boundary.(1 to 8 inches thick)

E--5 to 9 inches; pale brown (10YR 6/3) cobbly sandy loam; weak fine granular structure; friable, nonsticky, nonplastic; many medium and fine roots; 30 percent angular sandstone cobbles and channers; very strongly acid; clear smooth boundary.(0 to 7 inches thick)

Bw1--9 to 20 inches; yellowish brown (10YR 5/4) cobbly sandy loam; weak fine and medium subangular blocky structure; friable, nonsticky, nonplastic; common medium and fine roots; 35 percent angular sandstone cobbles and channers; very strongly acid; gradual smooth boundary.

Bw2--20 to 30 inches; yellowish brown (10YR 5/6) very cobbly sandy loam; weak medium subangular blocky structure; friable, nonsticky, nonplastic; common fine roots; 50 percent angular sandstone cobbles and channers; strongly acid; gradual wavy boundary. (15 to 30 inches thick)

C--30 to 34 inches; yellowish brown (10YR 5/4) extremely cobbly sandy loam; single grained; loose, nonsticky, nonplastic; few fine roots; 90 percent angular sandstone cobbles and channers; strongly acid; clear wavy boundary. (0 to 10 inches thick)

R--34 inches; light yellowish brown (10YR 6/4) and gray (10YR 5/1) slightly weathered sandstone bedrock; 4 to 40 inches between fractures with

minimal displacement; bedrock inclination 5 to 30 degrees. Excavation difficulty, extremely high. Excavation via pick is nearly impossible. Backhoe excavation by a 50-80 hp tractor cannot be made in a reasonable time.

TYPE LOCATION: Fulton County, Pennsylvania; in Licking Creek Township, 0.9 miles north of the intersection of US 30 and Pennsylvania Township route T428, 1000 feet west of T428; USGS Hustontown topographic quadrangle; lat. 40 degrees 1 minutes 32 seconds N. and long. 78 degrees 6 minutes 47 seconds W.

RANGE IN CHARACTERISTICS: Solum thickness and depth to bedrock range from 20 to 40 inches. Flat, subangular or angular, sandstone fragments, 1 to 10 inches across increase with depth and range from 10 to 60 percent in individual horizons of the solum and from 50 to 90 percent or more in the C horizon. The amount of rock fragments typically increases with depth. Weighted average rock fragment content ranges from 35 to 75 percent in the particle-size control section. Cobbly, channery, and very stony phases are common. Reaction ranges from extremely through strongly acid where unlimed. Illite, kaolinite, and vermiculite are common clay minerals.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. If cultivated, an Ap horizon has hue of 10YR, value of 4, and chroma of 2 to 4. It is loam fine sandy loam or sandy loam. Structure is weak very fine or fine granular.

The E horizon has hue of 10YR, value of 5 or 6, and chroma of 1 to 4. Texture and structure are similar to the A horizon.

Some pedons have a BA horizon with hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is loam, sandy loam, or fine sandy loam.

The B horizon has hue of 7.5YR or 10YR, value of 4 to 8, and chroma of 4 to 8. It is loam, fine sandy loam, or sandy loam. Average clay content typically is between 6 to 15 percent but ranges up to 18 percent in the particle-size control section. Structure is weak to moderate, fine or coarse subangular blocky.

The BC horizon, where present, has hue of 7.5YR or 10YR, value of 5 to 8 and chroma of 4 to 8. It is sandy loam, fine sandy loam, or loam in the fine- earth fraction.

The C horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 4 to 8. Texture is sandy loam or loamy sand in the fine-earth fraction. Bedrock is gray to brown sandstone of varying hardness and is commonly fractured without displacement.

COMPETING SERIES: The Hazleton and Wallen soils are in the same family. Hazleton soils are deeper than 40 inches to bedrock. Wallen soils allow more silt textures in the solum.

The Hailey, Lehew and soils are in related families. Hailey soils formed in residuum from cherty limestone. Lehew soils have hue of 5YR or redder in the B horizon. Marbleyard soils have rock fragments dominantly of quartzite and metasandstone.

GEOGRAPHIC SETTING: Dekalb soils are on nearly level to very steep, uplands and ridges. Slopes are usually convex with gradients of 0 to 80 percent. The regolith weathered from gray and brown acid sandstone in places interbedded with shale and graywacke. The climate is humid temperate with mean annual rainfall of 36 to 60 inches and mean annual air temperature of 47 to 59 degrees F. The growing season ranges from 110 to 180 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Hazleton along with the Buchanan, Clymer, Cookport, Ernest, Gilpin, Laidig, and Ramsey series. Buchanan, Cookport, Ernest, and Laidig soils have fragipans. Clymer and Gilpin soils have argillic horizons. Ramsey soils have bedrock within 20 inches.

DRAINAGE AND PERMEABILITY: Well drained to somewhat excessively drained. The potential for surface runoff is negligible to high. Permeability is rapid.

USE AND VEGETATION: Most Dekalb soils are in forests of mixed oaks, maple, and some white pine and hemlock. Smaller areas have been cleared for cultivation and pasture.

DISTRIBUTION AND EXTENT: Southern New York, Pennsylvania, Maryland, Ohio, West Virginia, Virginia, Kentucky, Tennessee, and Georgia. The series is of large extent.

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

SERIES ESTABLISHED: Fort Payne Area, Alabama, 1903.

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 9 inches (A and E horizon).
2. Cambic horizon - the zone from 9 to 30 inches (Bw horizon).

The Type location was changed from Clinton County, Pennsylvania to Fulton County, Pennsylvania.

ADDITIONAL DATA: Data from characterization sample S58Pa-18-6 were used as a basis for this description.

National Cooperative Soil Survey
U.S.A.

LOCATION JEFFERSON KY+TN VA WV

Established Series
Rev. JMR-HCD
02/2010

JEFFERSON SERIES

The Jefferson series consists of deep and very deep, well-drained soils on mountain sides and foot slopes. They formed in colluvium from soils formed in residuum of acid sandstone, shale, and siltstone. Permeability is moderately rapid. The average annual precipitation is about 49 inches, and the average annual temperature is about 57 degrees F. Slopes range from 2 to 75 percent.

TAXONOMIC CLASS: Fine-loamy, siliceous, semiactive, mesic Typic Hapludults

TYPICAL PEDON: Jefferson gravelly silt loam--on a convex 20 percent slope on the lower part of a steep mountain side in woods. (Colors are for moist soils.)

A--0 to 3 inches; dark grayish brown (10YR 4/2) gravelly silt loam; moderate fine granular structure; friable; many very fine roots; 20 percent pebbles; strongly acid; clear wavy boundary.

E--3 to 9 inches; yellowish brown (10YR 5/4) gravelly silt loam; weak fine granular structure; friable; common fine roots; 20 percent pebbles; strongly acid; clear wavy boundary. (4 to 9 inches thick)

BE--9 to 23 inches; yellowish brown (10YR 5/6) silt loam; weak very fine subangular blocky structure; friable; common medium roots; 10 percent pebbles; very strongly acid; gradual wavy boundary. (0 to 14 inches thick)

Bt--23 to 40 inches; yellowish brown (10YR 5/6) gravelly loam; moderate fine subangular blocky structure; friable; few fine roots; many thin clay films on faces of peds; 25 percent pebbles; 25 percent pebbles; strongly acid; gradual wavy boundary. (10 to 30 inches thick)

BC--40 to 75 inches; yellowish brown (10YR 5/6) very gravelly loam; many medium distinct light yellowish brown (10YR 6/4) mottles; weak medium subangular blocky structure; friable; few clay films on faces of peds; few fine roots; 40 percent pebbles; strongly acid; gradual smooth boundary. (24 to 40 inches thick)

TYPE LOCATION: Harlan County, Kentucky; 150 feet north of U.S. Highway 119, near borrow pit, 3 1/2 miles northeast of Harlan, about 1 mile east of Rosspoint.

RANGE IN CHARACTERISTICS: Thickness of the solum is more than 40 inches. Depth to bedrock ranges from 50 to more than 80 inches. Content of rock fragments of sandstone range from 5 to 35 percent to a depth of about 40 inches, and below 40 inches from 20 to 80 percent. Some areas are stony to extremely stony. The soil ranges from strongly to very strongly acid, excep the A horizons which range from very strongly acid to neutral.

The A horizon has hue of 10YR, value of 3 to 5, and chroma of 1 to 3. The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. They are silt loam, loam, fine sandy loam, or sandy loam, or gravelly or cobbly analogs.

The E horizon has hue of 10YR, value of 4 to 6, and chroma of 3 or 4. Texture is similar to the A horizon.

The BE horizon has hue of 10YR, value of 4 to 6, and chroma of 4 to 8. They are silt loam, loam, or sandy loam, or the gravelly or cobbly analogues.

Some pedons have BA horizons similar to the BE horizon.

The Bt horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 4 to 8. Some pedons have mottles in shades of brown, yellow, red, and the lower part shades of gray. It is loam, sandy loam, sandy clay loam, or clay loam, or the gravelly or cobbly analogues.

The BC horizon is in shades of brown, red, or gray, and are usually mottled. It is very gravelly, very channery, extremely gravelly, or extremely channery analogs of sandy loam, fine sandy loam, sandy clay loam, loam, or clay loam.

The C horizon, where present, has color and texture ranges like the BC horizon. Some pedons have a 2C horizon, below a depth of about 50 inches, that are from shaly material with a higher content of clay.

COMPETING SERIES: These are Lily, Lonewood, Marr, Riney, Sassafras, and Sunnyside series. Lily soils have bedrock at less than 40 inches. Lonewood, Marr, and Sassafras soils lack coarse fragments in the solum. Riney and Sunnyside soils have hue redder than 7.5YR in some part of the Bt horizon.

GEOGRAPHIC SETTING: Jefferson soils are on steep mountain sides and foot slopes, often below sandstone escarpments, with slopes ranging from 2 to 75 percent. These soils formed in colluvium from soils formed in residuum of acid sandstone, shale, and siltstone. Near the type location the average annual precipitation is about 49 inches and the average annual temperature is about 57 degrees F.

GEOGRAPHICALLY ASSOCIATED SOILS: These are Clymer, Dekalb, Gilpin, Muse, Ramsey, Shelocta, and Whitley series. Clymer soils have mixed mineralogy. Dekalb and Ramsey soils lack argillic horizons. Gilpin soils have bedrock at depths of less than 40 inches. Muse soils are clayey, and Whitley soils are fine-silty. Shelocta soils have mixed mineralogy.

DRAINAGE AND PERMEABILITY: Well drained with rapid or medium runoff, depending on slope. Permeability is moderately rapid.

USE AND VEGETATION: Most areas are in forest but less steep areas are used mainly for pasture and crops. The forest vegetation is chiefly yellow-poplar, upland oaks, Virginia and shortleaf pine, hickory, and laurel.

DISTRIBUTION AND EXTENT: Eastern Kentucky, Tennessee, West Virginia, Georgia, and Virginia. The series is extensive.

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

SERIES ESTABLISHED: Reconnaissance Survey of Southwestern Pennslyvania; 1909.

REMARKS: Jefferson series formerly included Paleudults. Lab data of representative pedon reveal silt loam texture in the A and E horizons.

Diagnostic horizons and features recognized in this pedon are:

Ochric epipedon: 0 to 9 inches (A,E)

Argillic horizon: 9 to 40 inches (BE, Bt)

ADDITIONAL DATA: Characterization sample S84KY-095-001

National Cooperative Soil Survey
U.S.A.

LOCATION LEHEW WV+MD PA TN VA

Established Series
Rev. MEC-RRD
05/2003

LEHEW SERIES

The Lehew series consists of moderately deep, well drained to excessively drained soils formed in material weathered from reddish sandstone, siltstone, and shale. They are nearly level to very steep soils on uplands. Slopes range from 0 to 80 percent. Permeability is moderately rapid to rapid.

TAXONOMIC CLASS: Loamy-skeletal, siliceous, semiactive, mesic Typic Dystrudepts

TYPICAL PEDON: Lehew channery fine sandy loam, wooded. (Colors are for moist soil.)

A--0 to 1 inches; dark gray (10YR 4/1) channery fine sandy loam; weak fine granular structure; very friable; nonsticky; many roots; 20 percent rock fragments; strongly acid; clear smooth boundary. (1 to 3 inches thick)

E--1 to 6 inches; reddish brown (5YR 5/3) channery fine sandy loam; weak fine and medium granular structure; friable, nonsticky; common roots; 20 percent rock fragments; strongly acid; gradual wavy boundary. (0 to 7 inches thick)

Bw1--6 to 9 inches; reddish brown (5YR 4/4) channery fine sandy loam; weak fine subangular blocky structure; friable, slightly sticky; common roots; 25 percent rock fragments; strongly acid; gradual wavy boundary. (2 to 7 inches thick)

Bw2--9 to 20 inches; reddish brown (2.5YR 4/4) very channery fine sandy loam; moderate medium subangular blocky structure; friable, slightly sticky; few faint clay films on faces of peds; few fine roots; 35 percent rock fragments; strongly acid; gradual wavy boundary. (6 to 18 inches thick)

C--20 to 32 inches; reddish brown (2.5YR 4/4) extremely channery fine sandy loam; massive with some tendency to platy cleavage; friable, slightly sticky; 60 percent rock fragments; strongly acid. (6 to 18 inches thick)

R--32 inches; slightly weathered reddish sandstone.

TYPE LOCATION: Hampshire County, West Virginia; about 3-3/4 air miles northeast of Augusta, along secondary road 45/13, 3/4 mile southeast of intersection with State Road 45.

RANGE IN CHARACTERISTICS: Thickness of the solum ranges from 15 to 30 inches. Depth to bedrock ranges from 20 to 40 inches. The

particle-size control section averages 35 to 80 percent rock fragments and 5 to 18 percent clay. Rock fragments consist of sandstone, siltstone, and shale. Rock fragments range from 0 to 40 percent in A, Ap, and E horizons and include channers, cobbles, flagstones, and stones; 20 to 40 percent in individual subhorizons of the Bw horizon; and 35 to 90 percent in the C horizon. Base saturation is less than 60 percent between a depth of 10 to 30 inches. The unlimed soil is extremely acid or strongly acid.

The A horizon has hue of 7.5YR or 10YR, value of 2 through 4, and chroma of 1 or 2. Some pedons have an Ap horizon that has hue of 5YR through 10YR, value of 4 or 5, and chroma of 2 through 4. Texture is sandy loam, fine sandy loam, or loam in the fine-earth fraction. Structure is weak very fine granular or weak fine and medium granular. Consistence is very friable or friable.

The E horizon has hue of 7.5YR or 5YR, value of 5 through 7, and chroma of 1 through 4. Texture of the fine-earth fraction is fine sandy loam, sandy loam, or loam. It has weak fine or medium granular structure and very friable or friable consistence.

The B horizon has hue of 2.5YR or 5YR, value of 3 through 5, and chroma of 3 through 6. It is sandy loam, fine sandy loam, or loam in the fine-earth fraction with a weighted average clay content of 5 to 18 percent. Structure is weak or moderate very fine to medium subangular blocky. Consistence is very friable or friable.

The C horizon has hue of 2.5YR or 5YR, value of 3 through 5, and chroma of 2 through 4. It is loamy sand, sandy loam, fine sandy loam, or loam in the fine-earth fraction. Consistence is loose to firm.

COMPETING SERIES: These are the Marbleyard(T) and Varilla series in the same family. Marbleyard soils have hues of 7.5YR and yellower in the Bw horizon and have rock fragment lithologies of quartzite and metasandstone. Varilla soils are more than 60 inches deep to bedrock and have hues of 7.5YR or yellower in the Bw horizon.

The Dekalb, Hazleton, Sherando, and Wallen series are in closely related families. Dekalb and Wallen soils have hues of 7.5YR or yellower Bw horizon. Hazleton and Sherando soils are deeper than 40 inches to bedrock and have yellower hues in the Bw horizon.

The Berks, Calvin, Dekalb, and Hazleton soils are similar soils in related families. The Berks, Calvin, Dekalb, and Hazleton soils have mixed mineralogy.

GEOGRAPHIC SETTING: Lehew soils are on nearly level to very steep ridges and side slopes of mountains. Slopes range from 0 to 80 percent. Lehew soils formed in materials weathered from interbedded red sandstone, siltstone, and shale. The climate is humid and temperate with an average rainfall of 36 to 50 inches and average annual temperature of 47 to 59 degrees F, and a growing season of 130 to 200 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Berks, Calvin, Dekalb, Klinesville, and Laidig soils. The Berks, Calvin, Dekalb, and Klinesville soils are on similar landscape positions. Berks soils have finer textures in the particle-size control section. Dekalb soils have hues yellower than 5YR in the B and C horizons. Klinesville soils have bedrock at depths less than 20 inches. Laidig soils are on footslopes and have a fragipan.

DRAINAGE AND PERMEABILITY: Well to excessively drained; slow to very rapid runoff; moderately rapid to rapid permeability.

USE AND VEGETATION: Steeper slopes are mainly mixed hardwood forests. Row crops, small grain, and orchards are on gentle slopes. Virginia pine is common on abandoned fields.

DISTRIBUTION AND EXTENT: South central Pennsylvania, western Maryland, eastern West Virginia, and western Virginia. The series is of large extent.

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

SERIES ESTABLISHED: Hampshire County, West Virginia, 1927.

REMARKS:
1. These soils were originally included in a mixed mineralogy family.
2. Diagnostic horizons and features recognized in this pedon are:
a. Ochric epipedon - the zone from 0 to 6 inches (A and E horizons).
b. Cambic horizon - the zone from 6 to 20 inches (Bw horizon).
c. Lithic contact at 32 inches.

National Cooperative Soil Survey
U.S.A.

LOCATION LILY KY+AR GA MO NC OH TN VA WV

Established Series
Rev. JDM-JMR
01/2006

LILY SERIES

The Lily series consists of moderately deep, well drained soils formed in residuum weathered primarily from sandstone. Permeability is moderately rapid. These nearly level to very steep soils are on ridge tops and hill sides. Slopes range from 0 to 65 percent.

TAXONOMIC CLASS: Fine-loamy, siliceous, semiactive, mesic Typic Hapludults

TYPICAL PEDON: Lily loam on a 4 percent slope in a cultivated field (colors are for moist soil unless otherwise stated).

Ap--0 to 8 inches; brown (10YR 4/3) loam; weak fine granular structure; very friable; common fine roots; slightly acid; clear smooth boundary. (5 to 10 inches thick)

Bt1--8 to 24 inches; strong brown (7.5YR 5/6) clay loam; moderate fine and medium subangular blocky structure; friable; common fine roots; many faint clay films on all surfaces of peds; extremely acid; gradual smooth boundary.

Bt2--24 to 30 inches; strong brown (7.5YR 5/6) sandy clay loam; common fine distinct red (2.5YR 4/6) lithochromic mottles; moderate medium subangular blocky structure; common faint clay films on all surfaces of peds; extremely acid; abrupt smooth boundary. (Combined thickness of Bt horizon is 10 to 30 inches)

R--30 inches; hard sandstone bedrock.

TYPE LOCATION: Laurel County, Kentucky; on a narrow ridgetop in an area of Lily loam, 2 to 6 percent slopes; 50 feet south west of the intersection of Dan Westerfield Road and Kentucky Highway 229; about 12.2 miles southeast of London; 37 degrees, 0 minutes, 48 seconds N. Latitude and 83 degrees, 56 minutes, 50 seconds W. Longitude; USGS Blackwater Quadrangle; NAD 1927.

RANGE IN CHARACTERISTICS: Solum thickness and depth to sandstone range from 20 to 40 inches. Coarse fragments, mostly sandstone channers, range from 0 to 30 percent to a depth of about 24 inches and from 0 to 35 percent below 24 inches. Reaction ranges from extremely acid to strongly acid, unless limed.

The Ap and E horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. Some pedons have an A horizon up to 4 inches thick with hue of 10YR or 7.5YR, value of 2 to 5, and chroma of 1 to 3. Texture is loam, silt loam, fine sandy loam or sandy loam.

The AB, BA, or BE horizon (where present) is 3 to 10 inches thick, has hue of 10YR or 7.5YR, value of 4 to 6 and chroma of 1 to 8. Testure is loam, fine sandy loam or sandy loam.

The Bt horizon has hue of 10YR to 5YR, value of 4 to 6 and chroma of 4 to 8. Texture is loam, sandy clay loam or clay loam. Subhorizons of fine sandy loam are in the lower part of some pedons. Lithochromic mottles in shades of red, brown, or yellow become more common with depth.

The BC or C horizon (where present) is 5 to 15 inches thick, has hue of 10YR to 2.5YR, value of 4 to 6 and chroma of 4 to 8. Texture is loamy sand, sandy loam, fine sandy loam, loam, sandy clay loam, or clay loam.

The R horizon is hard sandstone bedrock.

COMPETING SERIES: These are the Alonzville, Bailegap, Hambrook, Harmiller, Jefferson, Keener, Lonewood, Marr, McCamy, Raftville, Riney, Sassafras and Sunnyside series of the same family. The Alonzville, Bailegap, Hambrook, Jefferson, Keener, Lonewood, Marr, Raftville, Riney, Sassafras and Sunnyside soils are deeper than 40 inches to hard bedrock. The Harmiller and McCamy soils formed in residuum affected by soil creep in the upper part that weathered from low-grade metasedimentary rocks such as arkose, arkosic sandstone, quartzite, graywacke, metasiltstone or metasandstone.

GEOGRAPHIC SETTING: Lily soils are on upland ridges and hillsides and formed in residuum weathered from acid sandstone. Near the type location the mean annual precipitation is about 46 inches and the mean annual air temperature is about 56 degrees fahrenheit.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Jefferson and Lonewood soils and the Alticrest, Gilpin, Helechawa, Latham, Marrowbone, Ramsey, Rayne, Rigley, Sequoia and Shelocta series. Alticrest, Helechawa and Marrowbone soils lack argillic horizons. Gilpin soils are less sandy and have mixed mineralogy. Jefferson, Lonewood, Rayne, Rigley and Shelocta soils are deeper than 40 inches to hard bedrock. Latham and Sequoia soils are fine. Ramsey soils lack argillic horizons and are shallow.

DRAINAGE AND PERMEABILITY: Well drained with moderately rapid permeability. Runoff is very low on slopes of 2 to 5 percent, low on slopes of 5 to 20 percent and medium on slopes greater than 20 percent.

USE AND VEGETATION: Used for growing corn, tobacco, small grains and hay and as pasture. Native forest is oak, hickory, dogwood, elm, beech, and Virginia, shortleaf or white pine.

DISTRIBUTION AND EXTENT: Kentucky, Arkansas, Georgia, Missouri, Ohio, Tennessee and West Virginia. Extent is large.

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

SERIES ESTABLISHED: Laurel County, Kentucky; 1973.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Ochric epipedon: 0 to 8 inches, Ap
Argillic horizon: 8 to 30 inches, Bt1, Bt2

Lithic contact at 30 inches
The 2006 revision better defined the location; updated the competing series and associated soils and revised drainage and permeability statements.

National Cooperative Soil Survey
U.S.A.

LOCATION NOLICHUCKY TN+AL KY VA

Established Series
Rev. JCJ:DEL
04/2001

NOLICHUCKY SERIES

The Nolichucky series consists of very deep, well drained soils on high stream terraces. They formed in moderately fine textured alluvium derived from sandstone, shale, quartzite, and limestone rocks. Slopes range from 2 to 30 percent.

TAXONOMIC CLASS: Fine-loamy, siliceous, semiactive, mesic Typic Paleudults

TYPICAL PEDON: Nolichucky loam - cultivated. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 7 inches; yellowish brown (10YR 5/4) loam; weak medium granular structure; very friable; many fine roots; slightly acid; clear smooth boundary. (4 to 10 inches thick)

BA--7 to 15 inches; strong brown (7.5YR 5/8) loam; weak medium subangular blocky structure; friable; common fine roots; few small quartzite pebbles; medium acid; clear smooth boundary. (0 to 10 inches thick)

Bt1-15 to 21 inches; yellowish red (5YR 5/8) clay loam; weak medium subangular blocky structure; friable; few fine roots; few faint clay films on faces of peds; few small quartzite pebbles; strongly acid; clear smooth boundary.

Bt2--21 to 32 inches; red (2.5YR 4/8) clay loam; few fine and medium faint strong brown (7.5YR 5/6) and yellowish red (5YR 4/6) mottles on edges of peds; moderate medium subangular and angular blocky structure; friable; common distinct clay films on faces of peds; strongly acid; gradual smooth boundary.

Bt3--32 to 56 inches; red (2.5YR 4/6) clay loam; moderate medium angular blocky structure; friable; many distinct clay films on faces of peds; strongly acid; gradual smooth boundary.

Bt4--56 to 75 inches; red (2.5YR 4/6) clay; few medium and fine distinct yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; weak coarse subangular blocky structure; friable; many distinct clay films on faces of peds; very strongly acid. (Thickness of the Bt horizon ranges from 50 to more than 80 inches)

TYPE LOCATION: Washington County, Tennessee; 8 miles southwest of Jonesboro to Limestone, 3.65 miles southeast across the Nolichucky River to New Salem Church, 330 feet southwest of New Salem Church.

RANGE IN CHARACTERISTICS: Thickness of the solum exceeds 60 inches. Reaction in each horizon is strongly acid or very strongly acid except the surface layer where limed. Rock fragment rage from 0 to 30 percent in each horizon. The fragments are mostly rounded sandstone and quartzite pebbles and cobbles.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. Severely eroded areas also have hue of 7.5YR or 5YR, and chroma of 6 or 8. Some pedons have A horizons less than 4 inches thick with hue of 10YR, value of 3 or 4, and chroma of 2 to 4. The fine earth fraction of the A and Ap horizons is sandy loam, loam or silt loam. Severely eroded areas are also sandy clay loam.

E horizons, where present, have hue of 10YR, value of 5 or 6, and chroma of 3 or 4. Texture of the fine earth is sandy loam, or loam.

Some pedons have a transitional horizon between the A or E horizon and the Bt horizon.

The Bt horizons have hue of 2.5YR and 5YR, value of 3 to 5, and chroma of 6 to 8. Texture of the fine earth fraction is clay loam, sandy clay loam, or clay.

COMPETING SERIES: These are the Brocket, Claiborne and Trimble series in the same family and the Allen, Brandon, Etowah, Holston, Jefferson, Minvale and Shouns soils. Brocket soils have a clay decrease in the lower part of the Bt horizon and have pockets of uncoated sand grains. Claiborne soils have fragments of chert in the series control section. Trimble soils have hue of 10YR and lack sandstone and quartzite pebbles or cobbles. Allen, Brandon, Etowah, Holston and Minvale soils are thermic. Jefferson soils have hue of 10YR in the B horizon and the solum is less than 60 inches. Shouns soils have less clay in the lower part of the Bt horizon and have mixed mineralogy.

GEOGRAPHIC SETTING: Nolichucky soils are on gently sloping to steep high terraces. Slope ranges from about 2 to 30 percent. These soils formed in moderately fine textured alluvium from watersheds dominated by sandstone, quartzite, limestone and shale. Mean annual air temperature is 56.6 degrees F., and mean annual precipitation is 44.4 inches near the type location.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Jefferson and Dunmore soils. Dunmore soils are clayey.

DRAINAGE AND PERMEABILITY: Well drained. Runoff is medium on gentle slopes and rapid on steeper slopes. Moderate permeability.

USE AND VEGETATION: Most areas are cleared and used for pasture, hay crops or tobacco. A small acreage is in forests of oak, hickory, elm, maple, and dogwood.

DISTRIBUTION AND EXTENT: The Appalachian Ridges and Valleys of Tennessee and possibly Kentucky, Missouri and the southwestern part of Virginia. The series is of moderate extent.

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

SERIES ESTABLISHED: Jefferson County, Tennessee; 1935.

REMARKS: Diagnostic horizons recognized in this pedon are:

Ochric epipedon - 0 to 7 inches (Ap horizon).

Argillic horizon - 15 to 75 inches (Bt horizon).

National Cooperative Soil Survey
U.S.A.

LOCATION WALLEN TN+AR KY PA MD VA WV

Established Series
Rev. DFW, RRD
10/2005

WALLEN SERIES

The Wallen series consists of moderately deep, somewhat excessively drained soils that formed in residuum or colluvial creep over residuum weathered from fine-grained sandstone, siltstone, and shale. They are on mountain tops and on mountain sides with warm aspect. Slopes range from 2 to 85 percent.

TAXONOMIC CLASS: Loamy-skeletal, siliceous, active, mesic Typic Dystrudepts

TYPICAL PEDON: Wallen gravelly loam--forest. (Colors are for moist soil unless otherwise stated.)

Oi--1 to 0 inch; very dark gray (10YR 3/1) organic mat of mixed hardwood leaves and pine needles.

E--0 to 6 inches; pale brown (10YR 6/3) gravelly loam; weak fine and medium granular structure; very friable; many roots; 25 percent angular sandstone fragments mostly between 1 inch and 4 inches across, a few up to 10 inches across; very strongly acid; gradual smooth boundary. (0 to 10 inches thick)

Bw1--6 to 18 inches; light yellowish brown (10YR 6/4) gravelly loam; weak medium and fine subangular blocky structure; very friable; common roots; 35 percent angular sandstone fragments mostly 1 inch to 4 inches across, a few up to 10 inches across; very strongly acid; gradual smooth boundary.

Bw2--18 to 28 inches; light yellowish brown (10YR 6/4) very cobbly loam; weak medium and fine subangular blocky structure; very friable; common roots; 45 percent angular sandstone fragments 2 to 10 inches across; very strongly acid; clear irregular boundary. (Combined thickness of Bw horizons range from 18 to 35 inches).

R--28 inches; hard fractured sandstone with light yellowish brown (10YR 6/4) loam extending into cracks.

TYPE LOCATION: Hawkins County, Tennessee on south facing mountainside north of Poor Valley; 100 feet east of intersection of gravel roads; 2 miles northeast of the community of Spruce Pine.

RANGE IN CHARACTERISTICS: Thickness of solum and depth to bedrock ranges from 20 to 40 inches. Rock fragments, ranging from gravel to stones, make up 15 to 35 percent by volume of the surface layer and 35 to 70 percent of the B subsoil. Stony and rubbly phases are allowed in this

soil. Reaction is extremely to moderately acid.

The A horizon or Ap horizons, where present, have hue of 10YR, value of 2 to 6 and chroma of 1 to 4. Fine-earth texture is loam, silt loam, fine sandy loam, or sandy loam. Surface horizons with values of 2 or 3 are less than 6 inches thick.

The E horizon, where present, has hue of 10YR, value of 4 to 6 and chroma of 3 or 4. Fine-earth texture is loam, silt loam, fine sandy loam, or sandy loam.

The Bw horizon has hue of 10YR or 7.5YR, value of 4 to 6 and chroma of 4 or 6. Some pedons have lithochromic mottles in shades of brown and red in the lower part. Fine-earth texture is loam, silt loam, fine sandy loam, sandy loam or loamy sand. Some pedons have a thin BC or C horizon with colors and textures similar to the lower part of the Bw horizon. Other pedons have thin Cr horizons overlying bedrock.

The R horizon is commonly unweathered sandstone, but grades to siltstone or shale in some areas.

COMPETING SERIES: These are the Dekalb and Hazleton series in the same family. Dekalb soils do not allow silt loam textures in the solum. Hazleton soils are deep.

GEOGRAPHIC SETTING: Wallen soils are on mountain tops and mountain sides with warm aspect. Slopes range from 2 to 85 percent. These soils formed in residuum or colluvial creep over residuum weathered from Pennsylvanian aged fine-grained sandstone, siltstone and shale. At a weather station about 25 miles from the type location and at approximately the same elevation, average annual air temperature is 55 degrees F, and average annual precipitation is 50 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Alticrest, Gilpin, Helechawa, Jefferson, Ramsey and Varilla series. Alticrest and Helechawa soils are coarse-loamy. Gilpin and Jefferson soils are fine-loamy. Ramsey soils are loamy. Gilpin and Jefferson soils have argillic horizons. Helechawa, Jefferson and Varilla soils are deeper than 40 inches to bedrock. Ramsey soils have bedrock within 20 inches.

DRAINAGE AND PERMEABILITY: Somewhat excessively drained with moderately rapid permeability. Runoff is very low on slopes less than 5 percent; low on slopes between 5 and 20 percent; and medium on slopes greater than 20 percent.

USE AND VEGETATION: Practically all areas are in mixed secondary growth hardwood forest consisting of oaks, hickories, sourwood and Virginia pine. Huckleberry and Mountain Laurel are common understory species.

DISTRIBUTION AND EXTENT: The Great Valley and Cumberland Mountain provinces of Tennessee and Pine Mountain in Kentucky and possibly Alabama, Arkansas, Georgia, Virginia and West Virginia. The series is of moderate extent.

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

SERIES ESTABLISHED: Hawkins County, Tennessee; 1973.

REMARKS: Diagnostic horizons recognized in this pedon are:

Ochric epipedon - 0 to 6 inches (E horizon).
Cambic horizon - 6 to 28 inches (Bw1, Bw2 horizons).
REV. RRD
MLRAs: 125, 128
SIR numbers: TN0117, TN0152, TN0231

National Cooperative Soil Survey
U.S.A.

LOCATION WEIKERT PA+IL IN KY MD OH VA WV

Established Series
Rev. AWD-WRK-REP-ART
04/2009

WEIKERT SERIES

The Weikert series consist of shallow, well drained soils formed in material that weathered from interbedded gray and brown acid shale, siltstone, and fine-grained sandstone on gently sloping to very steep areas on uplands. Slope ranges from 0 to 100 percent. Permeability is moderately rapid. Mean annual precipitation is about 42 inches, and the mean annual air temperature is about 52 degrees F.

TAXONOMIC CLASS: Loamy-skeletal, mixed, active, mesic Lithic Dystrudepts

TYPICAL PEDON: Weikert channery silt loam, in a cultivated field on 8 to 15 percent slopes. (Colors are for moist soil unless otherwise noted.)

Ap--0 to 7 inches; brown (10YR 4/3) channery silt loam; weak fine granular structure; friable, nonsticky and nonplastic; many fine and medium roots; 30 percent angular and subangular shale channers; strongly acid, clear smooth boundary. (5 to 9 inches thick)

Bw--7 to 14 inches; yellowish brown (10YR 5/4) very channery silt loam; weak fine subangular blocky structure; friable, nonsticky and nonplastic; common fine roots; 50 percent angular and subangular shale channers; strongly acid; gradual wavy boundary. (3 to 12 inches thick)

C--14 to 18 inches; yellowish brown (10YR 5/4) extremely channery silt loam; massive; friable; nonsticky and nonplastic; few fine roots; common distinct sily and clay deposits on channers; 70 percent angular and subangular shale channers; very strongly acid; clear wavy boundary. (0 to 8 inches thick)

R--18 inches; dark gray (10YR 4/1) fractured acid shale and siltstone bedrock.

TYPE LOCATION: Franklin County, Pennsylvania; Hamilton Township, 3 miles west of Chambersburg, 2000 feet west of the intersection of Pennsylvania routes 4008 and 4010, 1000 feet south of route 4008; Chambersburg, PA topographic quadrangle; Latitude 39 degrees, 57 minutes, and 46 seconds N. and Longitude 77 degrees, 44 minutes, and 3 seconds W. NAD 27

RANGE IN CHARACTERISTICS: Solum thickness ranges from 8 to 20 inches. Depth to bedrock ranges from 10 to 20 inches. Rock fragments range from 5 to 50 percent in the A or Ap horizon, from 35 to 60 percent in the Bw horizon, and from 60 to 85 percent in the C horizon. The sand fraction and rock fragments have a low content of feldspars, hydrobiotite, and chlorite. Unlimed reaction ranges from moderately acid to very strongly acid in the A or Ap horizon and moderately acid to extremely acid in the Bw and C horizons.

The A or Ap horizon has hue of 7.5YR or 10YR, value of 3 through 5, and chroma of 2 through 4. Texture is silt loam, or channery or very channery silt loam. Undisturbed pedons have a thin dark A horizon underlain by a 2 to 5 inch thick yellowish brown E horizon.

The Bw horizon has hue of 7.5YR or 10YR, value of 4 through 6, and chroma of 3 through 6. Texture is very channery silt loam or very channery loam. The fine-earth fraction has about 10 to 25 percent clay, 40 to 60 percent silt, and 20 to 40 percent sand. Structure of the Bw is weak or moderate, fine or medium subangular blocky. Moist consistence is friable or very friable, nonsticky or slightly sticky, and nonplastic or slightly plastic.

The C horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 4 through 6, and chroma of 3 through 8. Texture is extremely channery silt loam or extremely channery loam with common interstitial pores. The fine-earth fraction is much like the horizon above but has massive or platy bedrock controlled structure.

Some pedons have a Cr horizon beginning at depths of less than 20 inches. Fractures are less than 4 inches apart but displacement of the pieces is rare. Some of the fragments are coated with silt films.

The R consists of shale, siltstone, fine-grained sandstone, or alternate beds of such material. The bedrock is sometimes fractured.

COMPETING SERIES: These are the Arnot, Klinesville, Nassau, and Sylvatus series in the same family. Arnot and Nassau soils are formed in a thin mantle of glacial till or congeliturbate. Arnot and Nassau soils appear similar in the field but analytical data show 10 to 40 percent of the clay fraction of Weikert is kaolinite, whereas this mineral is lacking in the Arnot and Nassau soils. Sylvatus soils contain fragments of metasediments, primarily phyllite and slate. Klinesville soils have inherited hues redder than 7.5YR.

Bugley, Rohan, and Unicoi are a related family. They are all semiactive. In addition, Bugley soils have rock fragments of schist in the solum. Rohan soils have carbonaceous bedrock. Unicoi soils have a much higher content of feldspar, hydrobiotite, and chlorite in the sand fraction.

GEOGRAPHIC SETTING: Weikert soils are on gently sloping to very steep convex dissected uplands formed in weathered residuum from interbedded gray and brown acid shale, siltstone, and fine-grained sandstone. Slope gradients range from 0 to 100 percent. The climate is humid and temperate with an mean annual precipitation of 36 to 50 inches, mean annual air temperatures of 46 to 57 degrees F., and a growing season of 120 to 200 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These include Allenwood, Bedington, Berks, Cavode, Ernest, Gilpin, Hartleton, Muskingum, Rayne, Westmoreland, and Wharton series. All these soils are deeper than 20 inches to bedrock. In addition, Allenwood, Bedington, Gilpin, Rayne, and Westmoreland soils have argillic horizons and are nonskeletal. The subsoils of Cavode, Ernest, and Wharton soils have low chroma redoximorphic features.

DRAINAGE AND PERMEABILITY: Well drained. The potential for surface runoff is neglegible to high. Permeability is moderately rapid to rapid.

USE AND VEGETATION: Most is cleared and used for cropland and pasture or is idle. Forested areas are mixed, deciduous hardwoods.

DISTRIBUTION AND EXTENT: Pennsylvania, Maryland, Ohio, Indiana, West Virginia, Virginia, and Kentucky. The series is of large extent. MLRA's 120, 124, 125, 126, 127, 128, 130, 140, 147, 148.

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

SERIES ESTABLISHED: Union County, Pennsylvania, 1939.

REMARKS: In 1994 the Type Location was visited and redescribed as part of the MLRA 147 update in Pennsylvania, West Virginia, and Maryland.

Some pedons sampled as Weikert have a CEC class of semiactive.

In some areas the Weikert series may include somewhat excessively drained soils.

Soils that are now within the range of the Weikert series were correlated as Montevallo (thermic) in several published soil surveys.

Diagnostic horizons and features recognized in this pedon are:
Ochric epipedon - from a depth of 0 to 7 inches (Ap horizon).
Cambic horizon - from a depth of 7 to 14 inches (Bw horizon).
Lithic contact at a depth of 18 inches (R horizon)

ADDITIONAL DATA: Lab samples number S93PA-055-039 and S93PA-055-040, taken from the same county as the type location, were used as the basis for placing this series into the active CEC activity class.

National Cooperative Soil Survey
U.S.A.

ATTACHMENT 3
Completed Field Forms with Soil Profile, Taxonomic, and Soil Pit Site Descriptions

Docket No. CP16-10-000

EQT-MVP Jefferson National Forest

Site ID: SP-1
Parent Material: Residuum
Slope: 10-40%
Aspect: North
Permeability: Moderate-Rapid
Drainage: Well Drained
Topographic Position: Summit/Shoulder
Vegetation: Forested

Date: 05 Nov 2015
Time: 12:00
Latitude/Northing 37.40310
Longtitude/Easting: -80.69030

Epipedon: Ochric Diagnostic Subsurface = Argillic
Control Texture: Fine loamy SMR: UDIC STR: Mesic
Series: Lithic Hapludults

NOTES: (Soil Map Unit — DeG Dekalb Channery Loam 55-70% slopes) Bedrock outcroppings throughout Survey area. Sandstone, 60 channers/Flagstone on surface. soil is moist throughout

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

Horizon		Depth (inches)			Color (Moist)		Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	pH	Clay Films (Y/N)	C.F. % by Vol (note size)	Notes
1	O	2	-	0	—	—	—	—	—	—	—	—	—	1 inch leaf litter, 1 inch decomposed
2	A	0	-	2.5	10YR	2/2	L	15%	2VFSBK	NE	5.0	N	25% CN	Roots: 2UF, 2F, 1M, 1C
3	B_t	2.5	-	6	10YR	4/4	CL	30%	2FABK	NE	4.5	Y	25% CN	Roots: 1VF, 1F, 1M, 1VC
4	BC	6	-	10	10YR	4/6	C	45%	2FABK/M	NE	4.5	N	25% CN	Roots: 1F, 1C
5	C	10	-	15	7.5YR	6/6	C	55%	M	NE	4.5	N	25% CN 5% GR	Roots: 1VF, 1F, 1VC
6	R	15	-	R	—	—	—	—	—	—	—	—	—	Fractured sandstone and bedrock

EQT-MVP Jefferson National Forest

Site ID: SP-2
Parent Material: Residuum / colluvium
Slope: 25-55%
Aspect: South
Permeability: Mod-Rapid
Drainage: Moderate-Well
Topographic Position: Summit / shoulders
Vegetation: Forested

Date: 05 Nov 2015
Time: 13:30
Latitude/Northing 37.40276
Longtitude/Easting: -80.68933

Epipedon: Ochric
Diagnostic Subsurface: Argillic
Control Texture: Loamy skeletal
SMR: Udic STR: Mesic
Series: Inceptic Hapludult

NOTES (Soil Map Unit: 23F- Lehew-Wallen Soils, Very Stony, 35-65% slopes) 25% CN/FL on surface
Soil is moist throughout profile.

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

Horizon		Depth (inches)			Color (Moist)		Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	pH	Clay Films (Y/N)	C.F. % by Vol (note size)	Notes
1	O	3	-	0	—	—	—	—	—	—	—	—	—	1 inch leaf, 2 inch decomposed
2	A	0	-	4	7.5YR	2.5/2	SL	12%	2VFGR	NE	4.5	N	20% CN 10% GR	Roots: 3VF, 3F, 2M, 2C, 1VC
3	Bw	4	-	10	5YR	3/3	SL	15%	2FSBK	NE	4.5	N	30% CN	Roots: 2VF, 2F, 1C, 1M
4	Bt	10	-	17	5YR	3/3	SCL	22%	1VFGR	NE	4.5	N	30% CN 35% ST	Roots: 1VF, F, 1M
5	Cr	17	-	+	5YR	3/3	SL	15%	SG	NE	4.5	N	→	85% Fragmented bedrock with soil in cracks
6			-											

EQT-MVP Jefferson National Forest

Site ID: SP-3
Parent Material: Residuum
Slope: 25-50%
Aspect: NE
Permeability: Mod - rapid
Drainage: well drained
Topographic Position: Shoulder / side slope
Vegetation: Forested

Date: 05 Nov 2015
Time: 15:00
Latitude/Northing 37.39882
Longtitude/Easting: -80.68296

Epipedon: Ochric Diagnostic Subsurface: Argillic
Control Texture: Fine-Loamy SMR=Udic STR=Mesic
Series: Typic Paleudult

NOTES (Soil Map Unit: 27F - Lily Bailegap Complex, very stony, 35-65% slopes)

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon	Depth (inches)			Color (Moist)		Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	pH	Clay Films (Y/N)	C.F. % by Vol (note size)	Notes
1	O	3	-	0	—	—	—	—	—	—	—	—	—	1inch leaf litter 2inch decomposed
2	A	0	-	3	2.5Y	4/4	Fine SCL	21%	3FSBK	NE	4.5	N	15% CN 5% GR	Roots: 2VF, 2F, 1M, 1C
3	AB	3	-	7	10YR	5/6	Fine SL	24%	2FABK	NE	4.5	N	15% CN 5% GR	Roots: 2VF, 2F, 1M, 2C
4	B+	7	-	12	10YR	5/6	Fine SL	32%	2VFSBK	NE	4.5	N	10% CN 10% GR	Roots: 2VF, 1F, 1M, 1C, 1VC
5	B+1	12	-	21	10YR	5/4	SCL	30%	2FABK	NE	4.5	N	15% CB 15% GR	Roots: 1VF, 1F,
6	B+2	21	-	31	7.5YR	5/4	CL	30%	2FABK	NE	4.5	N	5% CB 5% GR	Roots: 1VF, 1F, 1C
	B+3	31	-	40	7.5YR	5/4	SCL	30%	2FABK	NE	4.5	N	10% CB 10% GR	Roots: 1VF, 1F

EQT-MVP Jefferson National Forest

Site ID: SP-4
Parent Material: Residuum
Slope: 5-25%
Aspect: South
Permeability: Well - rapid
Drainage: well drained
Topographic Position: Summit / Slope
Vegetation: Forest

Date: 05 Nov 2015
Time: 11:00
Latitude/Northing 37.39184
Longtitude/Easting: -80.67949

Epipedon: Ochric Diagnostic Sub Surface = Argillic
Control Texture: Loamy - Skeletal SMR = Udic STR = Mesic
Series: Inceptic Hapludult

NOTES: Soil Map Unit: 27E - Lily Bailegap Complex, very stony, 15-35% Slopes
5.5% cobbles, stones, boulders on surface

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

Horizon		Depth (inches)			Color (Moist)		Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	pH	Clay Films (Y/N)	C.F. % by Vol (note size)	Notes
1	O	3	-	0	—	—	—	—	—	—	—	—	—	1" leaf/litter, 2" decomp
2	A	0	-	5	7.5YR	3/4	SL	15%	2VFGR	NE	6.0	N	20% CB	Roots: 2VF, 2F, 1M, 1C
3	E	5	-	14	7.5YR	4/6	SL	17%	2VFGR	NE	4.5	N	25% CB 10% ST	Roots: 1VF, 1F, 1M
4	Bt	14	-	22	7.5YR	4/6	SL	18%	2FSBK	NE	4.5	Y	40% CB 20% ST	Roots: 1VF, 1F
5	Cr	22	-	34	7.5YR	4/6	SL	15%	2FGR	NE	4.5	N	35% CB 35% ST	Roots: 1VF, 1F
6			-											

EQT-MVP Jefferson National Forest

Site ID: SP-5
Parent Material: Residuum
Slope: 25% – 50%
Aspect: NNW
Permeability: Moderate
Drainage: well Drained
Topographic Position: Summit / Crest
Vegetation: Forested

Date: 11-5-2015
Time: 10:00
Latitude/Northing 37.38790
Longtitude/Easting: -80.68169

Epipedon: Ochric Diagnostic subsurface: Cambic
Control Texture: Clayey Skeletal SMR=UDic STR=Mesic
Series: Lithic Dystrudept

NOTES (Soil Map Unit: 30F- Nolichucky very stony sandy loam, 30-65% slopes) 50% CB, ST Boulder on surface bedrock outcrops present

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

Horizon		Depth (inches)			Color (Moist)		Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	pH	Clay Films (Y/N)	C.F. % by Vol (note size)	Notes
1	O	4	-	0	—	—	—	—	—	—	—	—	—	2 inches leaf litter. 2 inches decomposed Organic
2	A	0	-	3	10YR	2/2	L	20%	2VFGR	NE	6.5-7	N	20% CB 15% ST	Roots: 2VF, 2F, 1C
3	BC	3	-	14	10YR	6/4	C	45%	2FGR / M	NE	4.5	Y	45% CB 15% ST	Roots: 1VF, 1F, 1C
4	R	14	-	+	—	—	—	—	—	—	—	—	—	unable to dig further due to high % of CFs. Fractured Sandstone
5			-											
6			-											

EQT-MVP Jefferson National Forest

Site ID: SP-6
Parent Material: Colluvium
Slope: 20-45%
Aspect: South
Permeability: Mod-rapid
Drainage: well drained
Topographic Position: Back slope
Vegetation: Forest

Date: 06 Nov 2015
Time: 1600
Latitude/Northing 37.57816
Longtitude/Easting: -80.67849

Epipedon: Ochric Subsurface: Argillic
Control Texture: Fine loamy SMR=udic STR=Mesic
Series: Typic Paleudults

NOTES: (Soil Map Unit: 30D - Nolichucky very stony sandy loam, 15-30% slopes)

SOIL PROFILE DESCRIPTION ***(Use NASIS Abbreviations)***

Horizon		Depth (inches)			Color (Moist)		Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	pH	Clay Films (Y/N)	C.F % by Vol (note size)	Notes
1	O	3	-	0	—	—	—	—	—	—	—	—	—	1 inch leaf, 2 decomposed organic
2	A	0	-	5	10YR	5/4	SL	13%	2VFGR	NE	6.5	N	5% CB 5% GR	Roots: 3VF, 3F, 2M, 1C
3	E	5	-	12	10YR	5/6	SL	13%	2VFSBK	NE	6.5	N	5% CB 5% GR	Roots: 2VF, 2F, 1M, 1VC
4	Bt1	12	-	20	7.5YR	5/6	SCL	30%	2MABK	NE	6.5	Y	10% CB 10% GR	Roots: 1VF, 1VC, 1F
5	Bt2	20	-	32	5YR	5/8	C	45%	2FABK	NE	4.5	Y	15% CB 15% GR	Roots: 1VF, 1F
6	Cr/R	32	-		—	—	—	—	—	—	—	—	—	High course fragment content, unable to dig further

EQT-MVP Jefferson National Forest

Site ID: SP-7
Parent Material: _____
Slope: _____
Aspect: _____
Permeability: _____
Drainage: _____
Topographic Position: _____
Vegetation: _____

Epipedon: _____
Control Texture: _____
Series: _____

Date: _____
Time: _____
Latitude/Northing _____
Longtitude/Easting: _____

This location/Map unit is outside of NF And no access to property. Did not survey.

NOTES (Soil Map Unit: 10G- Calvin Rough Complex, 35-70% slopes very stony)

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

Horizon	Depth (inches)	Color (Moist)	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	pH	Clay Films (Y/N)	C.F. % by Vol (note size)	Notes
1	-									
2	-									
3	-									
4	-									
5	-									
6	-									

EQT-MVP Jefferson National Forest

Site ID: SP-8
Parent Material: Colluvium / Residuum
Slope: 40-60%
Aspect: South
Permeability:
Drainage:
Topographic Position: Shoulder / Backslope
Vegetation: Forested

Date: November 4 2015
Time: 1100
Latitude/Northing 37.32332
Longtitude/Easting: -80.41528

Epipedon: Ochric Subsurface: CAMBIC
Control Texture: Loamy skeletal SMR=UDIC STR: Mesic
Series: Typic Dystrudepts

NOTES: (Soil Map Unit: 4E- Berks-Rock outcrop Complex 25-70% slopes). 15-25% stones/boulders on surface, Bedrock outcrops throughout map unit. soil is moist throughout profile.

SOIL PROFILE DESCRIPTION ***(Use NASIS Abbreviations)***

Horizon		Depth (inches)			Color (Moist)		Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	pH	Clay Films (Y/N)	C.F. % by Vol (note size)	Notes
1	O	0	-	3	—	—	—	—	—	—	—	—	—	1" leaf/litter, 2" decomp.
2	A	1	-	4	10YR	3/3	L	20%	2VFGR	NE	5.5	N	10% CB 5% GR	Roots: 3VF, 2F, 1M, 1VC
3	Bw	4	-	15	10YR	3/4	L	15%	1VFSBK	NE	5.5	N	30% CB	Roots: 2VF, 2F, 1M, 1VC
4	C	15	-	30	10YR	4/6	Fine SL	15%	1VFGR/M	NE	5.0	N	35% CB 5% GR	Roots: 1VF, 1F, 1C
5	R	30	-	+	—	—	—	—	—	—	—	—	—	Sandstone/Shale
6			-											

EQT-MVP Jefferson National Forest

Site ID: SP-9
Parent Material: Colluvium
Slope: 15-30%
Aspect: South
Permeability: Mod-rapid
Drainage: well drained
Topographic Position: Backslope
Vegetation: Forested

Date: 04 Nov 2015
Time: 13:30
Latitude/Northing 37.32152
Longtitude/Easting: -80.41357

Epipedon: Ochric Subsurface=Argillic
Control Texture: Fine-loamy udic, Mesic
Series: Typic Hapludult

NOTES (Soil MapUnit: 24D - Jefferson extremely stony soils, 7-25% slopes), 15-25% cobbles/boulders on surface. Moist throughout profile

SOIL PROFILE DESCRIPTION ***(Use NASIS Abbreviations)***

Horizon		Depth (inches)			Color (Moist)		Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	pH	Clay Films (Y/N)	C.F. % by Vol (note size)	Notes
1	O	3	-	0	—	—	—	—	—	—	—	—	—	1" leaf/litter, 2" decomp.
2	A	0	-	4	10YR	3/4	SL	12%	2FABK	NE	4.5	N	5% GR 10% CB	Roots: 2VF, 2F, 3M, 2C, 1VC
3	AB	4	-	10	7.5YR	4/4	SL	15%	2FABK	NE	5.0	N	5% GR 15% CB	Roots: 1VF, 1F, 1C
4	B_t	10	-	19	7.5YR	4/6	SCL	22%	2VFGR	NE	4.5	N	5% GR 15% CB	Roots: 1VF, 1F, 1M, 1C
5	BC	19	-	28	7.5YR	4/6	SCL	22%	2FABK/M	NE	4.5	N	25% CB 10% GR	Roots: 1VF, 1F, 1M, 1C
6	C	28	-	+	7.5YR	4/6	SL	15%	M	NE	4.5	N	75% CB	C's Fractured sandstone with thin vains of soil

EQT-MVP Jefferson National Forest

Site ID: SP-10
Parent Material: Colluvium
Slope: 7-15%
Aspect: South
Permeability: Mod-rapid
Drainage: Well Drained
Topographic Position: Toe Slope
Vegetation: Forested

Date: 04 Nov 2015
Time: 15:00
Latitude/Northing 37.31580
Longtitude/Easting: -80.40789

Epipedon: Ochric Subsurface diagnostic= Argillic
Control Texture: Fine loamy
Series: Typic Hapludult

NOTES (Soil Map Unit: 23C - Jefferson very stony soils, 7-15% slopes) 10% stones and boulders on surface.

SOIL PROFILE DESCRIPTION ***(Use NASIS Abbreviations)***

Horizon		Depth (inches)			Color (Moist)		Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	pH	Clay Films (Y/N)	C.F. % by Vol (note size)	Notes
1	O	3	-	0	—	—	—	—	—	—	—	—	—	1" leaf/litter 2" Decomp
2	A	0	-	4	10YR	4/2	SL	12%	2VFGR	NE	4.5	N	5GR, 5ST, 10CB	Roots: 2VF, 2F, 1M, 1C, 1VC
3	E	4	-	7	2.5Y	5/4	SL	12%	2VFGR	NE	5.5	N	10CB, 10ST	Roots: 1VF, 1F, 1M, 1C
4	BE	7	-	13	10YR	5/6	SL	16%	2FABK	NE	5.0	N	15CB	Roots: 1VF, 1C
5	B+	13	-	21	10YR	5/6	SCL	22%	2FSBK	NE	4.5	N	15CB	Roots: 1VF, 1F
6	BC	21	-	33	10YR	5/6	SL	18%	2FABK 1M	NE	4.5	N	10GR	Roots: 1VF, 1F
	C	33	+		10YR	5/6	SL	15%	M	NE	4.5	N	15CB	Roots: 1VF, 1F. Fractured sandstone with C between cracks

EQT-MVP Jefferson National Forest

Site ID: SP-11
Parent Material: Colluvium
Slope: 0-5%
Aspect: East
Permeability: Rapid
Drainage: Somewhat excessive
Topographic Position: Flood plain
Vegetation: Forested

Date: 06 Nov 2015
Time: 12:00
Latitude/Northing 37.31461
Longtitude/Easting: -80.39811

Epipedon: Ochric Subsurface diagnostic: Cambic
Control Texture: loamy Skeletal Udic, Mesic
Series: Fluventic Dystrudepts

NOTES: (Soil Mapunit: 10 Craigsville soils)

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color (Moist)		Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	pH	Clay Films (Y/N)	C.F. % by Vol (note size)	Notes
1	O	2	-	0	—	—	—	—	—	—	—	—	—	—	1 inch leaf litter, 1 inch decomposed
2	A	0	-	2	10YR	4/4	SL	10%	1VFGR	NE	4.5	N	10% CB 10% GR	Roots: 3VF, 2F, 1C
3	Bw_1	2	-	15	7.5YR	4/6	SL	12%	1FSBK	NE	4.5	N	10% CB 10% GR	Roots: 2VF, 2F, 1M, 1C
4	Bw_2	15	-	29	7.5YR	5/6	SL	18%	2FSBK	NE	4.5	N	10% CB 10% GR	Roots: 1VF, 1F, 1M, 1C
5	C	19	-	36	10YR	4/6	SL	15%	1FSBK/ 5GR	NE	4.5	N	30% GR 30% CB	Roots: 1VF, 1F, 1M
6			-												

EQT-MVP Jefferson National Forest

Site ID: SP-12
Parent Material: residuum
Slope: 20-25%
Aspect: West
Permeability: _____
Drainage: _____
Topographic Position: crest/side slope
Vegetation: _____

Date: 06 NOV 2015
Time: 1500
Latitude/Northing 37.31289
Longtitude/Easting: -80.39753

Epipedon: Ochric subsurface diagnostic. Argillic
Control Texture: loamy-skeletal udic, Mesic
Series: Lithic Hapludult

NOTES: Soil Map Unit: 5D · Berks Weikert soils, 15-25% slopes

SOIL PROFILE DESCRIPTION ***(Use NASIS Abbreviations)***

Horizon		Depth (inches)			Color (Moist)		Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	pH	Clay Films (Y/N)	C.F. % by Vol (note size)	Notes
1	O	2	-	0	—	—	—	—	—	—	—	—	—	1 inch leaf, 1 inch decomposed organic
2	A	0	-	3	10YR	4/4	L	25%	2VFGR	NE	4.5	N	15% GR 10% CB	Roots: 3VF, 3F, 1M
3	B+	3	-	12	10YR	6/6	CL	35%	2FABK	NE	4.5	Y	20% GR 25% CB	Roots: 2VF, 2F, 1M, 1C, 1VC
4	C	12	-	19	10YR	6/8	CL	30	M	NE	4.5	Y	30% GR 30% CB	Roots: 1VF, 1F, 1VC
5	R	19	-	+	—	—	—	—	—	—	—	—	—	weathered/fractured bedrock. Shale
6			-											

EQT-MVP Jefferson National Forest

Site ID: SP-13
Parent Material: Residuum/colluvium
Slope: 25-40%
Aspect: North
Permeability: Mod - rapid
Drainage: well drained
Topographic Position: Backslope
Vegetation: Forest

Date: 03 Nov 2015
Time: 4:30pm
Latitude/Northing 37.30705
Longtitude/Easting: -80.39763

Epipedon: Ochric subsurface diagnostic=Cambic
Control Texture: loamy-skeletal udic, mesic
Series: lithic Dystrudept

NOTES: Soil Map Unit: GE-Berks and Weikert Soils, 25-65% slopes
Soil is moist throughout profile

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

Horizon		Depth (inches)			Color (Moist)		Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	pH	Clay Films (Y/N)	C.F. % by Vol (note size)	Notes
1	O	2.5	-	0	—	—	—	—	—	—	—	—	—	1" leaf, 1.5" decomp.
2	A	0	-	4	10YR	4/3	L	20%	2MABK	NE	4.5	N	10% CN	Roots: 3VF, 1M
3	Bw	4	-	14	10YR	5/4	L	18%	2FSBK	NE	4.5	N	15% CN	Roots: 2VF, 2F, 1M, 1C
4	B/C	14	-	15	10YR	5/6	L	25%	2FABK/M	NE	4.5	N	50% CN	Roots: 1VF, 1F, 1M, 1C
5	R	15	-	+	—	—	—	—	—	NE	—	—	—	Redish/Pink Silt Stone
6			-											

EQT-MVP Jefferson National Forest

Site ID: SP-14
Parent Material: RESIDUUM
Slope: 15-65%
Aspect: NORTH
Permeability: M
Drainage: SE
Topographic Position: SUMMIT
Vegetation: Forested

Date: 03NOV2015
Time: 3:00 PM
Latitude/Northing 37.30381
Longtitude/Easting: -80.39501

Epipedon: Ochric subsurface Diagnostic = Argillic
Control Texture: Fine loamy
Series: Lithic Hapludult

NOTES: (Soil Map Unit: 7D-Berks and Weikert Very Stony Soils, 25-65% slopes) unable to dig past 16 inches due to CF content

SOIL PROFILE DESCRIPTION ***(Use NASIS Abbreviations)***

Horizon		Depth (inches)			Color (Moist)		Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	pH	Clay Films (Y/N)	C.F. % by Vol (note size)	Notes
1	O	2.5	-	1	—	—	—	—	—	—	—	—	—	LEAF/LITTER
2	Oe	1	-	0	—	—	—	—	—	—	—	—	—	—
3	A	0	-	6	10YR	4/4	CL	30%	3MABK	NE	4.5	NO	15% CN	ROOTS: 3VF, 3F, 2M, 1C
4	E	6	-	9	10YR	6/4	L	20%	2FSBK / 2FGR	NE	4.0	NO	10% GR 10% CN	ROOTS: 2VF, 2F, 2M, 1C, 1VC
5	Bt	9	-	12	10YR	5/4	CL	35%	2FABK	NE	4.5	Y	15% GR 10% CN	ROOTS: 1VF, 1F, 1M, 1VC
6	Bw	12	-	16	2.5Y	5/4	SiCL	30%	2FABK / M	NE	4.0	Y	15% GR 15% CN	ROOTS: 1VF, 1F, 1VC
7	Cr	16+			10YR	6/8	L	25%	M	NE	4.5	N	70% CN	Highly fractured bedrock, soil between cracks

ATTACHMENT 4
Photographs of Soil Profiles at Soil Pit Locations

Docket No. CP16-10-000

Photographic Documentation
Jefferson National Forest Soil Investigation; MVP

Soil Pedon ID: SP-1
Soil Series: Lithic Hapludult

Soil Pedon ID: SP-1, Looking North

Soil Pedon ID: SP-1, Looking South

Soil Pedon ID: SP-1, Filled-in

	
Soil Pedon ID: SP-2 Soil Series: Lithic Hapludult	Soil Pedon ID: SP-2, Looking North
	
Soil Pedon ID: SP-2, Looking South	Soil Pedon ID: SP-2, Filled-in

	
Soil Pedon ID: SP-3 Soil Series: Typic Paleudult	Soil Pedon ID: SP-3, Looking North
	
Soil Pedon ID: SP-3, Looking South	Soil Pedon ID: SP-3, Filled-in

	
Soil Pedon ID: SP-4 Soil Series: Inceptic Hapludult	Soil Pedon ID: SP-4, Looking North
	
Soil Pedon ID: SP-4, Looking South	Soil Pedon ID: SP-4, Filled-in

	
Soil Pedon ID: SP-5 Soil Series: Lithic Dystrudept	Soil Pedon ID: SP-5, Looking North
	
Soil Pedon ID: SP-5, Looking South	Soil Pedon ID: SP-5, Filled-in

	
Soil Pedon ID: SP-6 Soil Series: Typic Paleudult	Soil Pedon ID: SP-6, Looking North
	
Soil Pedon ID: SP-6, Looking South	Soil Pedon ID: SP-6, Filled-in

	
Soil Pedon ID: SP-8 Soil Series: Typic Dystrudept	Soil Pedon ID: SP-8, Looking North
	
Soil Pedon ID: SP-8, Looking South	Soil Pedon ID: SP-8, Filled-in

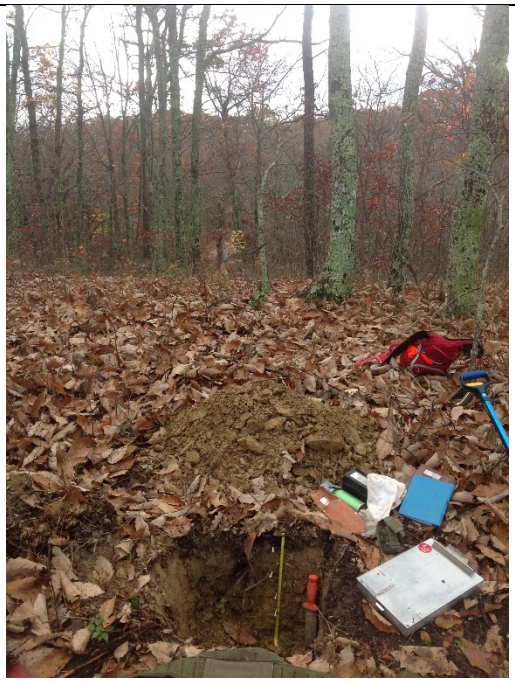
	
Soil Pedon ID: SP-9 Soil Series: Typic Hapludult	Soil Pedon ID: SP-9, Looking North
	
Soil Pedon ID: SP-9, Looking South	Soil Pedon ID: SP-9, Filled-in

	
Soil Pedon ID: SP-10 Soil Series: Typic Hapludult	Soil Pedon ID: SP-10, Looking North
	
Soil Pedon ID: SP-10, Looking South	Soil Pedon ID: SP-10, Filled-in

	
Soil Pedon ID: SP-11 Soil Series: Fluventic Dystrudept	Soil Pedon ID: SP-11, Looking North
	
Soil Pedon ID: SP-11, Looking South	Soil Pedon ID: SP-11, Filled-in

	
Soil Pedon ID: SP-12 Soil Series: Lithic Hapludult	Soil Pedon ID: SP-12, Looking North
	
Soil Pedon ID: SP-12, Looking South	Soil Pedon ID: SP-12, Filled-in

	
Soil Pedon ID: SP-13 Soil Series: Lithic Dystrudept	Soil Pedon ID: SP-13, Looking North
	
Soil Pedon ID: SP-13, Looking South	Soil Pedon ID: SP-13, Filled-in

	
Soil Pedon ID: SP-14 Soil Series: Lithic Hapludult	Soil Pedon ID: SP-14, Looking North
	
Soil Pedon ID: SP-14, Looking South	Soil Pedon ID: SP-14, Filled-in

ATTACHMENT 5
Resumes of Field Staff and Report Compilers

Docket No. CP16-10-000

Experience Summary

Dr. McGuire is a Tetra Tech CES senior scientist in Sheboygan, Wisconsin with 30+ years experience as a soil scientist and hydrologist working for public natural resource agencies (11 yr) or private sector engineering/environmental consulting firms (23 yr). Roles have included project manager, technical staff supervisor, project technical lead, technical staff trainer, technical writer/publisher, expert witness, and third party technical reviewer.

Project work experience includes sediment/soil characterization and hydrology support for fluvial geomorphology contaminant investigations, soil erosion and bank stability modeling, hydrogeology characterization, groundwater flow and contaminant transport assessment , design of unsaturated zone/groundwater and/or surface water monitoring systems, surface and groundwater contamination assessment, soil survey and fertility analysis, design of reclamation plans for disturbed land, wetland delineation, watershed characterization, design and monitoring of evapotranspiration waste covers, nonpoint source watershed pollution assessment, numerical modeling (unsaturated zone, groundwater, surface water), and statistical analysis.

Dr. McGuire was the lead soil scientist for fluvial geomorphic investigations in Wisconsin (Fox River PCB remediation) and Michigan (Tittabawassee River dioxin and furan contamination). He was the lead soil scientist/hydrologist for a project that resulted in the first permitted and constructed RCRA regulated alternative (evapotranspiration) cover for a landfill at the US Army Fort Carson Facility, Colorado. He was also the lead soil science/hydrologist for the reclamation of a 300+ acre abandoned, acid producing strip-mine site in Southern Illinois. He was the field hydrologist for the first field demonstration project in Wisconsin to assess sediment and other watershed pollutant loads from agricultural and urban land use.

Dr. McGuire has published in peer reviewed journals on soil science and hydrology topics including the Soil Science Journal, Groundwater, and the Journal of Geotechnical and Geoenvironmental Engineering. He has presented at numerous professional conferences and published in Inland Ports Magazine. He also served as a governor appointee to the State of Wisconsin Regulation and Licensing Examining Board of Professional Geologists, Hydrologists, and Soil Scientists from 1999-2003.

Education

PhD (Doctor of Philosophy), Soil Science (Soil Physics; Geology/Civil Engineering minor), University of Wisconsin-Madison, 1990
MS (Master of Science), Soil Science (Soil Chemistry), University of Wisconsin-Madison, 1975
MS (Master of Science), Water Resources Management, University of Wisconsin-Madison, 1975
BS (Bachelor of Science), Natural Resources, University of Wisconsin-Madison, 1970

Corporation Project Experience

Senior Soil Scientist, December 2012 to Present
Enbridge Energy Pipeline Integrity Group, Superior and Chicago Regions

The project began by developing a process to evaluate pipeline stability at corridor water and slope crossings in the Superior and Chicago Regions. The process included background data collection, an extensive background review, field survey to evaluate the erosion potential and depth of cover (DOC) of the pipeline, data analysis, database input, and final report. The process was implemented in January 2013. Approximately 1100 water and slope crossings were evaluated using background data and field surveys. Site water crossing erosion potential, slope stability, routine monitoring schedule, and single

event inspection level are the results of the evaluation. This project will provide Enbridge with a systematic way to inspect their water and slope crossing sites based on the potential for water crossing erosion/exposure and slope movement.

Fluvial Geomorphic Investigations

Soil Scientist/Hydrologist
Kalamazoo River Petroleum Spill Investigation, Marshall, Michigan

Provide soil science/hydrology support for an emergency response investigation to locate and remove submerged oil associated with a crude oil spill into the Kalamazoo River. The work included characterization of sediment core samples, a flow frequency evaluation of the Kalamazoo River using the Log Pearson Type III Method, and report writing to describe methods used to characterize the extent and degree of submerged oil occurrence.

Soil Scientist/Hydrologist
Fox River Sediment Remediation Action and OU3-OU4 Infill Sampling, DePere, Wisconsin

Lead soil scientist for a project that requires remedial action to mitigate sediment PCB contamination in the OU3 and OU4 Fox River reaches. Responsible for the development of sediment sampling plans, sediment characterization/interpretation procedures, measures to evaluate sampling methods, and standard operating procedures for sampling. Responsible for developing reports and providing written response to client, agency, and oversight comments on reports relating to sampling procedures. Also served as a task manager responsible for coordinating senior scientist review/report of engineering and hydrology work on the Fox River that was completed by previous consultants.

Soil Scientist
Ann Arbor Technical Services, Fox River Contaminated Sediment Investigation, Appleton and Green Bay, Wisconsin

Lead soil scientist for a confidential client. Responsible for sediment characterization of Fox River sediment samples. Provided assessment of past PCB discharge load from a former pulp waste landfill located adjacent to the Fox River, using the USDA Revised Universal Soil Loss Equation.

Previous Experience

Fluvial Geomorphic Investigations

Soil Scientist/Hydrologist
Ann Arbor Technical Services, Tittabawassee River Remedial Investigation, Midland, Michigan

Lead soil scientist for a 3 year soil and sediment investigation to characterize deposition and erosion patterns of contaminated sediment in the overbank and river. Responsible for defining soil/sediment description and classification parameters, characterizing soil/sediment samples, predicting mass soil loss from banks based on model applications and measured bank erosion data, conducting statistical analysis of data, and report writing. The investigation was completed for 24 miles of river from Midland, MI to the confluence with the Saginaw River.

Soil Scientist
Ann Arbor Technical Services, Jordan Creek, Pine Creek and Hayton Mill Pond PCB Investigation, New Holstein, Wisconsin

Responsible for report development and writing for a field investigation to evaluate PCB contamination deposited in two stream channels and a lake.

Soil Survey, Classification, Erosion Control

Soil Scientist
Minn-Dak Farmers Co-operative, Wahpeton, North Dakota
Responsible for application of the Revised Universal Soil Loss equation to assist with the design of a landfill cover for a food processing facility.

Soil Scientist /Hydrologist
US Army Corps of Engineers, Fort Carson, Colorado
Technical lead for development of soil suitability and vegetation plan for the design of an alternative landfill cover. The hydrologic performance of the cover was dependent on the establishment of a native grass community on a disturbed site (landfill) that was located in a semiarid climate. A soil and vegetation management plan was completed. The plan included descriptions for the selective placement of borrow area soils based on soil physical and chemical characteristics, the target bulk density of soils so plant productivity is not affected by compaction, the application rates for soil amendments including biosolids and fertilizers, the practices required for establishment of a cover crop, the practices required for establishment of a permanent native grass community, the erosion control measures required prior to development of final cover, the plant maintenance and monitoring, and the implementation schedule for critical practices.

Forest Soil Scientist
USDA-Forest Service, Challis, Idaho
Conducted a soil resource inventory of a 200,000-acre forest area and developed an interpretive report. The inventory included descriptions of forestland types and associated environmental conditions including soil profiles, soil erosion potential, soil and plant associations, and soil productivity. The data from the inventory was used to define suitable land use and management practices for forestland types. Assisted with the preparation of an environmental impact statement for a proposed major molybdenum surface mine in Idaho (Thompson Creek Mine) that described potential hydrologic/water quality impacts and alternatives related to the proposed construction and operation of the mine adjacent to the Salmon River.

Hydrology (surface & groundwater) and Contamination Evaluations, Flow and Transport Modeling

Hydrologist
Former Maine Electronics Facility, Lisbon, Maine
Developed a numerical groundwater model (GFLOW) in support of a water balance assessment for the installation of a permeable reactive barrier at the RCRA regulated industrial site.

Soil Scientist/Hydrologist
Isplat Inland Inc. East Chicago, Indiana
Technical lead for development of an analytical element groundwater flow model (GFLOW) that was used to assess groundwater flow and potential transport pathways from a steel production facility.

Soil Scientist/Hydrologist
Kohler Company-Whistling Straights Golf Club, Haven, Wisconsin
Member of a team responsible for providing wetland impact assessment and design for routing stream to reduce channel erosion. Provided channel design (cross-section, profile, vegetation flow retardance) using Manning's Equation to insure that the channel design would contain the 10-year storm peak flow at velocities that would not result in scouring.

Soil Scientist/Hydrologist
Tyco Ansul Facility, Marinette, Wisconsin
Technical lead for groundwater investigation to assess remediation alternatives for arsenic clean-up. Work included application of GFLOW groundwater flow model to evaluate influence of trench collection system on arsenic plume.

Soil Scientist/Hydrologist
Golden Eagle Refinery, Martinez, California
Technical lead for project that required MODFLOW and SESOIL groundwater flow/ transport modeling to assess the potential impact on groundwater from past refinery activities that resulted in organic compound and metals contamination. The evaluation required an assessment of site geochemistry and the environmental chemistry of metals including arsenic to assess potential metals mobility.

Soil Scientist/Hydrologist
Lockheed Martin Corporation, Burbank, California
Technical lead for unsaturated zone flow and transport modeling to assess potential long term groundwater impacts. The site is characterized by a thick unsaturated soil that was contaminated with tetrachloroethylene (PCE). A vapor extraction system was used to remove the source PCE. SESOIL, an unsaturated zone water balance and fate and transport model was used to predict potential impacts on groundwater following the source removal.

Soil Scientist /Hydrologist
Wisconsin Department of Transportation, Lost River Wetland Restoration, Stevens Point, Wisconsin
Provided technical support for a project that required a plan to convert more than 300 acres of drained agricultural land into a wetland ecosystem. Tasks included interpretation of data (soils, surface water, and groundwater) to determine if project goals were feasible based on site hydrology and to define practical water management options. Worked with the University of Wisconsin towards the development of a 3-dimensional groundwater flow model (MODFLOW) to predict groundwater elevations associated with management options.

Groundwater Hydrologist
City of Two Rivers, Landfill Monitoring Plan, Two Rivers, Wisconsin
Developed groundwater monitoring plan for existing landfill site. Work included evaluation of existing ground and surface water monitoring network and sampling program. Recommendations for a revised monitoring and sampling program were proposed to satisfy regulatory requirements and insure the protection of public health and environment.

Groundwater Hydrologist
Wisconsin Department of Natural Resources, Madison Well No. 3
Performed as technical reviewer for a hydrogeologic investigation that was conducted to determine the source of contamination that was impacting a municipal water supply well.

Groundwater Hydrologist
Waste Management Inc., Independent Landfill Manganese Assessment, Muskegon, Michigan
Conducted a hydrogeologic and water quality assessment to assess relationship between an existing landfill and water quality parameters including iron and manganese concentrations within an adjacent wetland environment. The study included a statistical analysis of iron and manganese surface and groundwater quality data to assess the distribution of the data (normal), the central tendency of the data, and the data variability.

Groundwater Hydrologist
City of Plymouth-Wisconsin, Landfill Site Investigation
Lead Groundwater hydrologist for a hydrogeologic site investigation that included a soil gas analysis, advancement of borings, and installation and sampling of monitoring wells, data analysis, and completion of a Wisconsin Administrative Code, Chapter NR716 Site Investigation Report. The Site Investigation Report characterizes the source contamination, defines the nature and extent of contamination, assesses water quality trends, predicts transport rates, and assesses impacts of contamination on the environment and potential receptors. Participated in meetings with client, regulatory agencies, and public to describe project objectives, methods, and progress.

Groundwater Hydrologist
Waste Management, Inc, Oregon, Wisconsin
Lead groundwater hydrologist for hydrogeologic investigation that required an analysis of groundwater aquifer characteristics to provide data for the design of a groundwater extraction system. The work included design of aquifer test program, analysis of draw down data, and completion of report that described methods and results.

Groundwater Hydrologist and Project Manager
Oneida County Landfill, Rhinelander, Wisconsin
Lead groundwater hydrologist and project manager for hydrogeologic and environmental contamination investigation at an active landfill. Investigation included drilling and logging of boreholes, installation of groundwater monitoring wells, well abandonments, analysis of leachate and groundwater data, and development of report describing approach for conducting an Environmental Contamination Assessment (ECA) that complies with Wisconsin Department of Natural Resources requirements and completion of the ECA report. The work included communication with county officials and state regulators to define project objectives, methods, and progress.

Groundwater Hydrologist and Project Manager
Waste Management, Inc., Landfill Investigation, Dekalb, Illinois
Lead groundwater hydrologist and project manager for hydrogeologic evaluations at an active landfill. Investigations were conducted to provide information necessary for application to the State of Illinois for a permit to expand the landfill and to conduct groundwater impact assessments. The project included drilling and logging of boreholes, borehole geophysical analysis, and packer tests to determine bedrock permeability, installation of groundwater monitoring wells, groundwater flow/transport model simulations, soil gas analysis, analysis of groundwater and leachate isotopes, and report development.

Sample Custodian/Chemist
US Army Corps of Engineers, Groundwater Contamination Investigation, Old Bethpage, New York
Sample custodian/chemist for an environmental contamination project. Responsibilities included preparation of sample containers and preservatives, sample logging, sample packaging, and completion of chain of custody forms.

Groundwater Hydrologist
US Army Corps of Engineers, Groundwater Contamination Investigation, Marine, Illinois
Lead groundwater hydrologist, project manager, and field manager for hydrogeologic and contamination evaluation at a former Nike missile installation. Project included drilling and logging boreholes, installation of groundwater monitoring wells, collection of soil and water samples for chemical analysis, hydrogeologic evaluation, and completion of report.

Groundwater Hydrologist and Project Manager
Waste Management, Inc., DeKalb, Illinois
Technical lead and project manager for several landfill hydrogeologic evaluations. The work included applications of POLLUTE, a one-dimensional flow and transport model to assess landfill leachate contaminant concentrations below the landfill liner and Visual Modflow, a two- or three-dimensional flow model that was used to assess the affects of surface and groundwater control measures on groundwater flow patterns.

Hydrologist
Minn-Dak Farmers Co-operative, Wahpeton, North Dakota
Developed statistical approach for evaluation of groundwater quality data at a food processing waste facility.

Hydrologist
Charter Steel, Grafton, Wisconsin
Conducted a site water balance assessment to determine if existing climatic, surface runoff, and groundwater conditions would sustain a wetland environment at the site. The assessment report was based on a review of existing data. The report was approved and supported by the Wisconsin Department of Natural Resources.

Hydrologist
Dewitt, Ross, and Stevens, Madison, Wisconsin
Conducted hydrologic assessment to determine potential lake elevation fluctuations based on climatic conditions, flow control structures, and hydrogeology. Performed as an expert witness in a legal proceeding regarding a navigable water dispute and public access to a northern Wisconsin lake.

Hydrologist
Wisconsin Department of Transportation, Wisconsin Rapids
Technical lead for project to assess the potential impacts from proposed transportation routes (State Highway 10) on groundwater quantity and quality of community drinking water supplies. The work included an evaluation of available soil and hydrogeologic data to characterize conditions within wellhead protection areas, review of wellhead protection regulations and plans (community, county, state), and presentations at local communities to describe proposed transportation routes and potential impacts on water supply.

Groundwater Hydrologist and Project Manager
Blackhawk County Landfill, Waterloo, Iowa
Technical and project manager for development of an automated method to evaluate statistics for a complex groundwater monitoring system at an EPA RCRA regulated landfill. The project required quarterly statistical analysis of groundwater data from more than 50 groundwater monitoring wells. The statistical analysis required both interwell and intrawell evaluations using both parametric and nonparametric statistical methods. The Statistical Analysis System (SAS) was used to develop a SAS code to conduct statistical tests and graphics for completion of quarterly and annual reports for submittal to EPA.

Hydrologist
Waste Management, Inc., DeKalb, Illinois
Technical lead for several landfill hydrogeologic evaluations. The work included applications of POLLUTE, a one-dimensional flow and transport model to assess landfill leachate contaminant concentrations below the landfill liner and Visual Modflow, a two- or three-dimensional flow model that

was used to assess the affects of surface and groundwater control measures on groundwater flow patterns.

Hydrologist
USEPA, Alternate Remedial Contracting Strategy Sites, Region 5, Chicago Illinois
Developed summary of contaminant fate and transport mechanisms for Superfund remedial investigation projects. A literature review was conducted to obtain information that described the chemical and biological reactions that affect common organic and metal contaminants that impact soil and groundwater. A summary of the fate and transport mechanisms included a discussion of contaminant attenuation mechanisms in the environment, contaminant degradation pathways, environmental conditions required for degradation, and rates of degradation.

Forest Hydrologist
USDA - Forest Service, Harrisburg, Illinois
Responsible for forest watershed management program that included inventory of watershed condition, surface water quality monitoring to assess baseline conditions and impacts of forest management practices, statistical analysis of water quality data, and development of watershed restoration plans. Managed forest water quality monitoring program that included groundwater quality sampling associated with strip mine reclamation project and potable watery monitoring at recreational sites to ensure compliance with the Safe Drinking Water Act. Responsible for establishing riparian management guidelines for silvicultural practices. Participant in a multidisciplinary team to develop long term forest management plan.

Soil Scientist/Hydrologist
University of Wisconsin Water Resources Center and Wisconsin Department of Natural Resources, Madison
Hydrologist responsible for design of watershed surface water quality monitoring program to assess nonpoint source pollution loads from urban and agricultural watersheds before and after implementation of best management practices. Responsible for establishment of flow control structures and automated water sampling equipment to assess nonpoint source pollutant loads, processing flow and water quality data, data interpretation, development of reports and publications, and transfer of information to project team that was developing guidelines for county nonpoint source pollution control. Coordinated activities with Washington County Land Management Department, USDA Soil Conservation Service, Wisconsin Department of Natural Resources, US Geological Survey, and the University of Wisconsin. Participated in public informational meetings to describe project objectives, methods, and progress.

Unsaturated Zone Hydrology, Soil Physics, Mining/Land Reclamation

Soil Scientist /Hydrologist
Waste Management, Inc., Columbia Ridge Landfill, Arlington, Oregon
Technical lead for design of an evapotranspiration landfill cover that resulted in an approved construction permit from the State of Oregon. The work includes development of design and construction protocols that insure satisfactory hydrologic performance of the cover. Tasks include soil characterization, selection of soil types based on analysis, numerical water balance modeling (UNSAT-H) to demonstrate performance, and development of vegetation plan.

Soil Scientist /Hydrologist
US Department of Defense (Flour Daniel), Bagdad, Iraq
Responsible for design of evapotranspiration covers for landfills in Ba' qubah and Baghdad, Iraq. The work included an evaluation of climatic conditions and numerical water balance model simulations (UNSAT-H).

Soil Scientist/Hydrologist
US Department of Defense, Bagdad, Iraq
Responsible for providing hydraulic inputs for the design of a wastewater effluent drainage field near Baghdad, Iraq. The work included estimates of potential maximum effluent loading capacity based on soil hydraulic properties.

Soil Scientist/Unsaturated Zone Hydrologist
Interstate Technology Regulatory Council (ITRC), Alternative Landfill Cover Design Guidelines, Washington, D.C.
Participated as a voluntary member of the ITRC in support of the Alternative Landfill Cover Technology Team. The team was tasked with the development of an alternative landfill cover technical guidance document to provide guidance for the assessment, design, construction, and monitoring of evapotranspiration landfill covers.

Soil Scientist/Hydrologist
Department of Energy (Kaiser Hill), Rocky Flats Environmental Technology Site, Evapotranspiration Landfill Cover Pre-Design Investigation, Golden, Colorado
Technical manager for a preliminary assessment to determine the feasibility for an evapotranspiration cover for the landfill site. The work included engineering design, water balance model simulations to assess potential hydrologic performance of an evapotranspiration cover, and characterization of potential borrow area soils.

Soil Scientist/Hydrologist
US Navy Former Marine Corps Air Station, El Toro, California
Technical lead for UNSAT-H water balance modeling that was used to assess evapotranspiration cover performance and design parameters.

Project Manager
State of New Mexico-3rd Party Reviewer, Molycorp, Questa, New Mexico
Project manager and soil science/hydrologist technical lead for project that required a 3rd party review of mining reclamation work at the Molycorp Tailings Facility. The review included work plans and assessments related to revegetation studies, design of an evapotranspiration cover over tailings, site hydrogeology, site geochemistry, erosion and stability analysis, toxicology analysis, and tailings impoundment design.

Soil Scientist/Hydrologist
Indiana Department of Environmental Management
Conducted flow and transport model simulations using SESOIL, a vadose zone contaminant transport model, to assess the exposure prevention remedy for an automotive facility.

Hydrologist
Phillips Petroleum Company, Houston Texas
Project required reclamation plan to stabilize 20 acre gypsum stack that resulted from the past production of phosphate fertilizer. Responsibilities included an assessment of methods to stabilize gypsum stack and minimize impacts on surface and groundwater quality. Technical lead responsible for the evaluation of hydrology controls to limit infiltration and stack leachate production due to rainfall. Field work was conducted to evaluate control measures and their affect on the system water balance and to assess the feasibility for the establishment of a vegetative cover on the stack to reduce erosion, promote evapotranspiration, limit infiltration, and reduce the volume of stack leachate production. Conducted hydrologic model simulations using USDA-NRCS Technical Release No. 55 procedures and the USDA-ARS EPIC model.

Soil Scientist/Hydrologist (Modeling)
City of Glendale, Arizona
Technical lead for numerical modeling aspects of a demonstration project that required unsaturated zone soil moisture monitoring and use of numerical model (UNSAT-H) to compare the hydrologic performance of a solid waste landfill cover that included a geomembrane liner with alternative landfill covers including monolithic and capillary barrier cover types. The project was a joint University of Wisconsin-Environmental Engineering Department and Earth Tech effort that resulted in a permit from the State of Arizona for the design and construction of an alternative landfill cover at the facility.

Soil Scientist/Hydrologist (modeling)
Waste Management Inc., Stoughton, Wisconsin
Technical lead for project that used SESOIL, an unsaturated zone transport model, to predict waste/soil cleanup levels for an EPA Superfund Site. The model was used to assess the groundwater contaminant concentration that corresponds to a given mass of contaminant in the surface soil considering environmental conditions and the transport characteristics of the contaminant.

Soil Scientist/Hydrologist (modeling and field investigation)
US Army Corps of Engineers, Fort Carson, Colorado
Technical lead for project that required assessment of the potential hydrologic performance of a waste barrier cover that was an alternative to the RCRA, Subtitle C landfill cover. The project required numerical model simulations (UNSAT-H) to assess the cover hydrologic performance. A soil survey of soil borrow areas was conducted to assess the suitability of soil horizon materials that included field descriptions of soil horizons, laboratory analysis of soil physical characteristics, laboratory analysis of soil fertility and salinity, and field measurement of soil hydraulic characteristics. Plans were developed to define soil management practices, plant cover establishment/maintenance practices, and the monitoring of the landfill cover hydrologic performance Meetings and communication with the State of Colorado regulators were required to obtain approval of this cover, which was the first Subtitle C alternative cover to be approved in Colorado. Responsible for installation of soil water monitoring equipment, field assessment of cover water storage capacity, and evaluation of soil water monitoring data to assess cover hydrologic performance, and communication with regulators.

Soil Scientist/Hydrologist (Reviewer)
US Army Corps of Engineers, FE Warren AFB, Wyoming
Invited by the USACE to participate as a member of a technical panel to review the proposed alternative landfill cover design that was developed for the US Air Force. As a panel member presented assessment to a committee that included staff from the Air Force, the USEPA, and the State of Wyoming.

Soil Scientist/Hydrologist
Waste Management Inc., Stoughton, Wisconsin
Technical lead for pilot study to assess the feasibility of using a surface infiltration basin to recharge treated groundwater. Study included assessment of potential groundwater mounding based on a unsaturated flow model, field characterization of soils, soil pit percolation tests, design of a pilot scale infiltration test, and an evaluation of pilot scale infiltration test data..

Soil Scientist/Hydrologist
Olin Corporation, Baraboo, Wisconsin
Technical lead for project that required unsaturated soil monitoring to determine if lead is transported from drainage within the soil following rainfall. Project included installation of porous collection plates to collect soil solution samples, gypsum blocks to assess soil profile moisture conditions, and

tensiometers to monitor soil profile moisture tensions at monitoring stations. Developed protocols for sampling and interpretation of data.

Forest Hydrologist
USDA-Forest Service, Harrisburg, Illinois

Coordinated reclamation project for a 312-acre abandoned acid strip mine site in southern Illinois. The project required a remediation plan based on a soil survey that included physical and chemical characterization of soils, an assessment of potential soil amendments including municipal waste sludge and lime, and an evaluation of vegetative cover alternatives. The data from a long-term surface and groundwater monitoring plan was evaluated to assess water quality conditions before and after the reclamation work was completed. The project required coordination with several agencies including USDA Forest Service, Job Corps, Illinois Abandoned Mined Land Reclamation Council, Southern Illinois University.

Publications & Presentations

Conference Proceedings:

McGuire, P., D. Richardson, and C. McGuire. Core Sampling: Influence on Sediment Profile Interpretation. Battelle 6th International Conference on Remediation of Contaminated Sediments, New Orleans-Louisiana, February 7-10, 2011.

Richardson, D., and P. McGuire. Stokes' Law Application to Assess Sediment Residuals Battelle 6th International Conference on Remediation of Contaminated Sediments, New Orleans-Louisiana, February 7-10, 2011.

Richardson, D., J. Holmstadt, B. Schrotenboer, and P. McGuire. Geomorphology: A Practical Application for Contamination Assessment in River Systems. Battelle 6th International Conference on Remediation of Contaminated Sediments, New Orleans-Louisiana, February 7-10, 2011.

McGuire, P.E., T. Blackmar, and S. McGee. Methods Used to Delineate PCB Contamination in Sediment on the Fox River Remediation Project. The 26th Annual International Conference on Soils, Sediments, Water and Energy, University of Massachusetts, October 18-21, 2010.

D. Moses, and B. Andraski. 2004. An Evapotranspiration Cover for Containment at the US Army Fort Carson Landfill Site. NDIA 30th Environmental & Energy Symposium & Exhibition. April 5-8, San Diego, California.

McGuire, P.E. 2004. A Case Study of the US Army-Fort Carson Evapotranspiration Cap: Borrow Characterization, Design & Construction Considerations. Invited Speaker, EPA (Remediation Technologies Development Forum) Conference, Designing, Building, and Regulating Evapotranspiration Landfill Covers, March 9-10. Denver, Colorado.

McGuire, P.E. and S. duPont. 2001. The Assessment of A Phosphogypsum Stack In Texas. National Meeting of the American Society for Surface Mining and Reclamation, June 3-7, 2001. Albuquerque, New Mexico.

G. Foose, C. Benson, P. McGuire, and R. Boehm. 1998. Earthen Final Cover In An Arid Climate Proceedings of the Twenty-First International Madison Waste Conference. Madison, Wisconsin.

McGuire, P.E. 1997. An Evaluation of Landfill Cover Configurations in a Semiarid Climate Using An Unsaturated Flow Model. WASTETECH 97, February 3-5, Tempe, Arizona. pp.123-152.

McGuire, P.E. and S. Otterson. 1995. An Assessment of Remediation Measures and Effects on Groundwater Quality at the Oneida County Sanitary Landfill. Proceedings of the Eighteenth International Madison Waste Conference. Madison, Wisconsin, pp. 110-139.

McGuire, P.E., B. Lowery, and P.A. Helmke. 1989. Potential Sampling Error from Trace Metal Adsorption on Vacuum Pore Water Samplers. American Society of Agronomy Annual Meetings, Las Vegas, Nevada. Oct. 15-20.

McGuire, P.E., and M. Spivey. 1983. The Palzo Project-Water Quality Trends within a Sludge Amended Strip Mine Site. 1983 National Symposium on Surface Mining, Hydrology, Sedimentology, and Reclamation. University of Kentucky, Lexington.

Peer Reviewed Journal Publications:

McGuire, P.E., B.J. Andraski, R.E. Archibald. 2009. Case Study of a Full-Scale Evapotranspiration Cover. J. Geotech. Geoenviron. Eng. Vol. 135, No. 3, March 1, 2009.

McGuire, P.E. and B. Lowery. 1994. Monitoring Solute Flux In Unsaturated Soil With A Porous Cup Sampler And Soil Moisture Sensors. Ground Water Journal. 32:356-362.

McGuire, P.E., B. Lowery, P.A. Helmke. 1992. Potential Sampling Error: Trace Metal Adsorption on Vacuum Porous Cup Samplers. Soil Sci. Soc. Am. J. 56:74-82.

McGuire, P.E. and B. Lowery, 1991. Evaluation of Vacuum Solution Sampler Types in Sand and Silt at Several Water Potentials. Ground Water Monitoring Review. Fall Issue. 12:151-160.

McGuire, P.E., T.C. Daniel, D. Stoffel, and B. Andraski. 1980. Sample Intake Position and Loading Rates from Non-Point Source Pollution. Journal of Environmental Management, 4:73-77.

Daniel, T.C., P.E. McGuire, D. Stoffel, and B. Miller. and J. Konrad. 1979. Assessing the Pollutional Load from Non-Point Sources; Planning Considerations and a Description of an Automated Water Quality Monitoring Program. Journal of Environmental Management, 2:55-65.

Daniel, T.C., P.E. McGuire, D. Stoffel, and B. Miller. 1979. Sediment and Nutrient Yield from Residential Construction Sites. Journal of Environmental Quality, 8:304-308.

Professional Accomplishments

Wisconsin Association of Consulting Engineers, 1998 Engineering Honor Award, Alternative Final Cover Test Program, Glendale Landfill, Arizona, Project Soil Scientist/Hydrologist.

State of Wisconsin Regulation and Licensing Examining Board of Professional Geologists, Hydrologists, and Soil Scientists. Governor Appointment from 1999-2003.

US Army Corps of Engineers, Environmental Honorable Mention Award in 2000 for Fort Carson Environmental Restoration Project, Colorado Springs, Colorado, Project Soil Scientist/Hydrologist.

Professional Affiliations

Member, Soil Science Society of America

Discipline Codes

Environmental Scientist, N
Hydrologist, Y
Project Manager, N
30 Geologist, N

Skill Set

Biological Sciences

Computer Programming
Environmental Chemistry
Environmental Monitoring
Erosion Control
Fluvial Geomorphology
Project Management
Sediment Chemistry
Sediment Control
Sediment Transport
Slope Stability
Soil Survey
Soil/Sediment Quality
Soils
Statistical Analysis
Statistical Data Analysis
Surface Water Sampling
Investigations
Groundwater Sampling
Hydrology
Water Quality
Water Quality Evaluations
Watershed Analysis
Wetlands Delineation
Task Leader

Chemical Sciences

Fate and Transport Modeling
Feasibility Study
Field Sampling and Analysis Plan
Geotechnical Sampling
Groundwater/Surface Water Sampling
RCRA Facility Investigation/RCRA Facility
Remedial Action
Remedial Investigation
Remedial Investigation/Feasibility Study
Resource Conservation Recovery Act
Soil Gas Analysis
Soil/Sediment Sampling

Geosciences

Borings and Wells - Geotechnical Borings
Borings and Wells - Monitoring Well Installation
Borings and Wells - Soil Classification / Logging
Dense Non Aqueous Phase Liquids (DNAPL)
Exploration - Mine Tailings Piles
Geochemistry - Metal / Trace Metal
Geophysics - Neutron / Gamma
Geostatistics
Hydraulics / Design - Dewatering
Hydraulics / Design - Extraction Well Design
Hydraulics / Design - Slurry Walls / Cut Off
Hydraulics/ Design - Injection Well Design
Hydrogeology - Groundwater Hydraulics
Hydrogeology - Pump Test Analysis
Hydrogeology - Slug Test Analysis
Hydrogeology - Water Quality
Hydrology - Wetland Hydrology
Light Non Aqueous Phase Liquids (LNAPL)
Modeling - Contaminant Transport
Modeling - Groundwater Flow
Modeling - Surface Water / Runoff
Non Aqueous Phase Liquids (NAPL)
On-Site Analysis
RCRA / CERCLA
Sampling - Groundwater
Sampling - Sediment
Sampling - Soil
Sampling - Water Level Measurements

Technical Expertise

Experience in soil physics and unsaturated zone hydrology particularly as related to design and evaluation of waste isolation barriers.

Experience with many hydrologic model applications including UNSATH, MODFLOW, GFLOW, POLLUTE, RUSLE, AT123D, SESOIL, and USDA Bank Stability Model.

Familiar with Statistical Analysis System (SAS) applications and algorithm development.

Language Skills

Knowledge Level:

Professional References

Related Company Information

Payroll Number: 525979
Employment Status: Full
Preferred First Name: Pat
Office Location:
Hire Date: 2/28/09
Years with Other Firms: 28
Years with Current Firm: 2
Total Years Experience: 30
Supervisor: David B. Richardson, Senior Fluvial Geomorphologist
Office Phone: (920) 452-7962
Cell Phone: (920) 224-2484
Fax: (920) 452-7974
E-mail Address: pat.mcguire@tetratech.com
Other E-mail Address (if any):
Resume Last Revised: 5/4/11

RYAN N. SPARHAWK

Environmental Scientist | ryan.sparhawk@tetratech.com | 970.309.9536

EDUCATION

BS, Environmental Science, Rocky Mountain College, 2004
MS, Soil Science, North Carolina State University, 2014 to present

EXPERIENCE SUMMARY

Mr. Sparhawk has over ten years of experience as an Environmental Scientist conducting environmental compliance assessments, groundwater monitoring, soil sampling/mapping, wetland delineations, vegetation identification, avian surveys, biological evaluations, remediation, environmental sampling, and field investigations. Projects have been completed in assistance for petroleum refineries and pipelines, several wind energy developments, active and potential mines, abandoned mine sites, power transmission lines. Additionally, he is skilled in use and maintenance of various survey equipment, GPS units, data collection, archiving, and report writing. Currently, Mr. Sparhawk is working as a member of Tetra Tech Tech-Services and is working towards a Master of Science degree in in Soil Science from North Carolina State University. Mr. Sparhawk resides in Carbondale, Colorado.

PROJECT EXPERIENCE

Wetland Delineations/Assessment

- ***NextEra Energy, Brady Windfarm, Dickinson, North Dakota.*** Project scientist assisting with wetland delineations for proposed windfarm, responsible for determining wetland soils occurring within project area. (2015)

- ***EQT Midstream – Mountain Valley Pipeline, Virginia, West Virginia.*** Project Scientist responsible for leading wetland delineation crew for proposed 300 mile natural gas pipeline. Provided oversite of collected wetland delineation data and GIS review and technical expertise on wetland soils. (2015)

- ***Rocky Mtn Power, Wyoming.*** Project Scientist, conducted wetland delineations and provided GIS mapping and analysis support for approximately 400 miles of a proposed transmission line corridor reaching from Casper, Wyoming to Kemmerer, Wyoming. (2007, 2012-2013)

- ***Wetland Delineations/Wetland Protection/Construction Oversite, NextEra Energy, Barnes County, North Dakota.*** Project Scientist responsible for onsite wetland delineations, protection and monitoring during construction of first, second, and third phases of the 250 megawatt wind facility. Worked with client, subcontractors, U.S. Army Corp of Engineers, and United States Fish and Wildlife Services to prevent impacts to wetlands within project site. (2008 to 2010)

- ***NextEra Energy, Dickey County, North Dakota.*** Project Scientist responsible for identifying potential wetlands and conducting wetland delineations for a proposed 150 megawatt (MW) wind energy facility in Dickey County, North Dakota. Project included mapping wetlands, collecting GPS data and compiling data into a final report and recommendations to the client. This information was used by the client for micrositing access roads and wind turbine generators prior to construction to ensure protection of sensitive wetland areas. (2008)

- ***Bureau of Indian Affairs, Lodge Pole, Montana.*** Project Scientist responsible for wetland delineation of a proposed multi-use path along Lodge Pole Creek, Lodge Pole, Montana, in accordance with U.S. Army Corps of Engineers Field Guide for Wetland Delineation. (2008)

- ***Wetland, Soils, and Vegetation Studies, Basin Electric, Ward County, North Dakota.*** Staff Biologist responsible for assisting in the identification of potential wetlands, sensitive vegetation, and soils for a 99 megawatt wind power facility in Ward County, North Dakota. Project included writing the soils section of a critical environmental issues analysis for submittal to the client for use in procuring government funding for project construction. (2007)

- ***Wetland Delineations, Horizon Wind Energy, Howard and Mitchell Counties, Iowa.*** Staff biologist responsible for assisting in the delineation of wetlands for a continually expanding wind energy center

located in Howard and Mitchell Counties, Iowa. Project required review of existing environmental data, identification of permitting requirements, and wetland identification/delineation. (2007)

Soil Surveys

- ***EQT Midstream – Mountain Valley Pipeline, Virginia.*** Soil Scientist responsible for conducting soil survey for portions of proposed natural gas pipeline routed through Jefferson National Forrest, Virginia. Work was done by request of Forest Service Soil Scientist to confirm mapped soil units occurring on Forest Service land. (2015)

- ***Proposed Black Butte Copper Mine, Tintina Resources, White Sulphur Springs, MT***. Soil Scientist for Order II soil survey responsible for mapping representative soils at for post-mining site restoration. Included review of soil physical and chemical lab data interpretation, salvage volume calculations and report preparation. (2015)

- ***Graymont Dolomite Quarries, Millard County, Utah.*** Soil Scientist for Order II soil survey of 1,700 acres of private and federal land for proposed open pit mine expansion. Objectives included classifying soils, evaluation of soil suitability for revegetation and fill material, preparation of soil maps and report writing. (2014)

- ***Agrium-Conda Phosphate Operations, Soda Springs, Idaho.*** Soil Scientist for Order II soil survey to evaluate baseline soil conditions and suitability for use as a growth media for post-mining vegetation. Survey includes collection of soil samples to evaluate soil agronomic properties, total metals, and plant-available selenium concentrations throughout the soil profile. (2012, 2013)

- ***Proposed Otter Creek Coal Mine, Powder River County, Montana.*** Soil Scientist for proposed 7,000 acre coal mine. Responsible for identifying and mapping representative soil units and collecting soil samples to develop soil salvage recommendations for mine planning and permit applications. (2011, 2012)

- ***Proposed Rosemont Copper Mine, Pima County, Arizona.*** Soil Scientist for 3,000 acre pre-mine topsoil salvage suitability survey. Responsible for oversight of all laboratory analyses and assisted in development of suitability criteria and preparation and presentation of all field data. In addition, responsible for identifying the representative pedon locations and completing full pedon descriptions. (2007, 2010)

- ***Crow Abandoned Mine Land Reclamation Program, Bureau of Indian Affairs, Bighorn County, Montana***. Staff Scientist responsible for soils and vegetation resource evaluation for several small abandoned coal mine sites in south central Montana. Projects include delineation of abandoned mine sites and identification of suitable soil borrow and topsoil materials. Assists with preparation of reclamation plan and Environmental Assessment (EA). Assists in obtaining threatened and endangered species clearances. (2005 to 2009)

- ***Soil Compaction Investigations, Helena National Forest, Montana.*** As Biological Technician for the Helena National Forest, conducted field investigations on soil compaction resulting from post-fire timber harvesting. (2005)

- ***Custer National Forest, Carbon County, Montana.*** Soils Technician for the Custer National Forest, conducted Order III soil survey including vegetation and landform descriptions for high elevation forestland in the Beartooth Mountains of the Custer National Forest. This project required identification of representative locations for map unit soils descriptions and appropriate access routes. Assisted with development of map unit descriptions including discussion of soils, vegetation, and landforms. (2002, 2004)

Biological Services

- ***Lesser Prairie Chicken Surveys, Enervest, Fourpoints Energy, Elk City Oklahoma, Canadian Texas***. Biologist responsible for conducting habitat evaluations and aerial surveys for Lesser Prairie Chickens in support of potential gas drilling sites throughout northeastern Texas and northwestern Oklahoma. Tasks included evaluating the potential habitat at and near possible drilling locations by determining habitat and vegetation characteristics of each area. Aerial surveys were also conducted to

locate and verify lek locations. (2014, 2015)

- ***Flammulated Owl Surveys, Agrium-Conda Phosphate Operations, Soda Springs, Idaho***. As Staff Scientist, assisted conducting Flammulated Owl surveys at proposed phosphate mine expansion. (2014)

- ***Terrestrial Visual Encounter Survey (TVES), Idaho Power, Hemingway, Idaho to Boardman, Oregon.*** Staff Scientist responsible for identification of unique vegetation habitats, verification of vegetation cover, species dominance, and percent cover along proposed 300 mile electrical transmission line. (2011 to 2013)

- ***Vegetation, Weeds, Wetlands, Soils, and Threatened and Endangered Species Survey, Crow Indian Reservation, Big Horn County, Montana.*** Staff Scientist responsible for conducting biological field studies for the first and second phases of a coal resource drilling program for an international mining corporation. Assisted with the preparation of the resulting EA for the Bureau of Indian Affairs following each phase of the project. (2006 to 2007)

- ***Vegetation Production Survey, Black Butte Coal Mine, Wyoming.*** Staff Technician responsible for conducting vegetation production laboratory data analyses and data report preparation for a coal mine bond release study. This project required the handling of hundreds of clipping samples and precise data collection and reporting. (2006)

Environmental Assessments

- ***Environmental Site Assessment, Bureau of Reclamation, Fruitdale Gravel Pit, Butte County, South Dakota.*** Staff scientist responsible for Phase I site assessment of 27 acre gravel pit that was constructed in 1907. Site has been used as unauthorized dump. (2015)

- ***Environmental Site Assessment, Delta Petroleum Group, Henderson, Colorado.*** Project Scientist responsible for conducting Phase I and II Environmental Site Assessments at petroleum blending and glycol mixing facility. Oversaw drilling and collection of soil and water sampling to determine subsurface contamination and extents of impacts. (2013)

- ***Environmental Site Assessment, Hertz Rental Car, Williston, North Dakota.*** Project Scientist responsible for conducting environmental site assessment (ESA) to assess for any current or past environmental issues regarding the subject property. (2013)

- ***Environmental Compliance Assessments, United States Customs and Border Protection (CBP) Facilities Management and Engineering, Environmental and Energy Division (EED).*** *Project Scientist responsible for conducting environmental compliance assessments to assist CBP facilities to come into and maintain compliance with Federal and State environmental laws and regulations. (2012)*

Petroleum Release Investigations, Water Sampling

- ***TAQA North USA, In., Rival Lake Field 22R Injection Line Release Site, North Dakota.*** Environmental Scientist responsible for conducting a screening level ecological assessment as part of an emergency response to a produced water pipeline spill in North Dakota. Tasks included collecting soil and water samples to measure extents and concentrations of spill release in impacted wetland. Also mapped areas where the vegetation was observed to be dead or show signs of impacts from the released salt process water and crude oil. (2014)

- ***Quarterly Storm-Water Sampling, Aspen/Pitkin County Airport, Aspen, Colorado.*** Staff Scientist responsible for collecting storm-water samples for compliance monitoring. (2013-present)

- ***Petroleum Pipeline Release, Dayton, Wyoming***. Project Scientist responsible for emergency response, site investigation, and remediation/mitigation of a 31,500-gallon release from a refined products pipeline. Interacted with client, federal regulators, and landowner; remediated impacted soil; investigated impacted soils; and mapped release to determine extents. (2009)

- ***Tanker Truck Rollovers Emergency Response and Corrective Action, Montana.*** Project Scientist assisted with emergency response/corrective actions at gasoline and diesel fuel tanker truck roll-over

releases. Designed re-vegetation corrective measures for remediation following soil excavation. (2006 to 2009)

- ***Semi-annual Groundwater Monitoring, Cenex Harvest States Refinery, Laurel, Montana.*** As Environmental Technician, conducted quarterly and semi-annual groundwater levels and groundwater sampling. Additionally, responsible for assisting and overseeing remediation activities including groundwater remediation system operation and removal of petroleum hydrocarbon-impacted soil. (2005 to 2009)

- ***Groundwater Monitoring, Recovery Well Maintenance, ConocoPhillips Refinery, Billings, Montana.*** As Environmental Technician, conduct bi-monthly groundwater level measurements of over 100 monitoring wells for a major oil company. Conduct weekly checks and maintenance of groundwater product recovery wells. (2005 to 2009)

- ***Quarterly groundwater monitoring, Western Sugar, Billings, Montana.*** Environmental Scientist responsible for water level measurements, groundwater sampling, sample handling, and reporting. (2005 to 2009)

- ***Yearly water monitoring, Lockwood Solvent Groundwater Plume Site, Montana DEQ, Lockwood, Montana.*** Environmental Technician, responsible for collection of tap water, surface water, and groundwater samples. This site was a State Superfund regulated project requiring special sample documentation and waste-water management. (Spring 2007)

- ***Surface Water monitoring, New World Mine, Cooke City, Montana***. Environmental Technician responsible for the monitoring of numerous streams and springs in a remote location which had formerly been a large precious metals mining district. This work included gauging of streams, gathering parameters for determination of water quality, and the collection of samples for laboratory analysis. (2006 to 2008)

CONTINUING EDUCATION

ArcGIS I: Introduction to GIS; ArcGIS II: Essential Workflows 2013
8-hr HAZWOPER Refresher 2006 - 2011
Project Management Training, 2008
Lorman Seminars, Current Issues in Stormwater and Wetland Regulations, 2008
Wetlands Training Institute, Wetland Delineation with Emphasis on Soils and Hydrology, 2007
40-hr OSHA HAZWOPER, 2005

PROFESSIONAL EMPLOYMENT HISTORY

Environmental Scientist, Tetra Tech, 2007 to present
Environmental Technician, Tetra Tech, 2005 to 2006
Biological Technician (soils), USDA-Forest Service, 2002, 2004 to 2005