VERMONT GEOLOGICAL SURVEY

DEPARTMENT OF WATER RESOURCES

SURFICIAL GEOLOGIC MAP OF VERMONT

Compiled and Edited under the Direction of
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Geology by
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Scale 1:250,000
Contour Interval 100 feet
Datum is mean sea level

1970

EXPLANATION

GLACIAL

TILL

TILL

Till mantling the bedrock and reflecting the topography of the underlying bedrock surface. Thicker in the valleys and thinner on the uplands. On many exposed uplands postglacial erosion has left only rubble and scattered boulders on the bedrock.

MORAINE

Ice marginal till accumulations with morainic topography.
m—frontal moraine assumed to be recessional.
tm—terminal moraine.

GLACIOFLUVIAL

KAME GRAVEL

Ice contact outwash gravel.
k—isolated kame.
kt—kame terrace.
km—kame moraine, kame complex with morainic topography.

OUTWASH

Horizontally bedded glaciofluvial gravel. Spillway or valley train gravel in stream valleys. May or may not have a thin veneer of postglacial alluvium.

ESKER

EOLIAN

EOLIAN SAND AND DUNES

GLACIOLACUSTRINE

LITTORAL SEDIMENT
PREDOMINANTLY GRAVEL

lg—horizontally bedded gravel deposited in a shoaling lake or topset beds of deltaic gravel where no foreset bedding is exposed.
bg—beach gravel.
dg—delta gravel showing foreset bedding.
d—small deltaic component of sand and gravel.

LITTORAL SEDIMENT PREDOMINANTLY SAND

ls—well sorted sand, no pebbles or boulders.
ps—pebbly sand.
bs—sand containing ice rafted boulders.
ds—delta sand.

LAKE BOTTOM SEDIMENTS

stc—silt, silty clay, and clay.
vc—varved clay.
bc—silt, silty clay, and/or clay containing ice rafted boulders.

WAVE-WASHED TILL

Till from the top of which the finer materials have been removed by wave action leaving boulder concentrations on the surface.

BEACH RIDGE

SHORELINE

POSTGLACIAL FLUVIAL

PLUVIAL GRAVEL

PLUVIAL SAND

RECENT ALLUVIUM

Fluvial sands and gravels were differentiated in areas where the deposits might have economic significance.

CHAMPLAIN SEA

MARINE BEACH GRAVEL

MARINE SAND

ms—marine sand without pebbles or boulders.
psm—pebbly marine sand.

MARINE CLAY

GRAVEL BAR

SEA CLIFF OR WAVE CUT TERRACE

PLUVIAL

SWAMP, PEAT and/or MUCK

BEDROCK

BEDROCK EXPOSURES

Significant exposures of bedrock with little or no cover that show the thickness of the drift, or where the drift has been removed by erosion. No effort was made to differentiate all outcrops in till areas of the uplands.

SAND OR GRAVEL PIT

SURFICIAL MAPPING

David P. Stewart	1956–1966
Paul MacClintock	1963–1966
William F. Cannon	1964
G. Gordon Connally	1965
Parker E. Calkin	1965
Robert E. Behling	1966
William W. Shilts	1966

NOTE: The mapping by Stewart from 1956 to 1961 was reported jointly by the Vermont Highway Department and the Vermont Geological Survey.

DRIFT SHEETS AND ICE DIRECTIONS

- BURLINGTON DRIFT
- SHELBURNE DRIFT
- BENNINGTON DRIFT
- FABRIC OF SURFACE TILL
- FABRIC OF SUBSURFACE TILL
- STRIATION

Scale 1:500,000

MAXIMUM EXTENT OF GLACIAL AND POST GLACIAL LAKES

- LAKE VERMONT
- CONNECTICUT VALLEY LAKE
- HIGH LEVEL LAKES DAMMED BY BURLINGTON ICE
- HIGH LEVEL LAKES DAMMED BY SHELBURNE ICE
- HIGH LEVEL LAKES PROBABLY DAMMED BY BENNINGTON ICE

SCALE

Williams & Heintz Map Corporation, Washington, D.C. 20007

APPENDIX D

USDA NRCS WEB SOIL SURVEY DATA

Soil Map—Windsor County, Vermont
(Jewell Brook Site No. 5)

Map Scale: 1:4,130 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Windsor County, Vermont
Survey Area Data: Version 23, Sep 16, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 10, 2011—Oct 8, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
11C	Marlow fine sandy loam, 8 to 15 percent slopes, very stony	1.6	2.7%
11E	Marlow fine sandy loam, 35 to 60 percent slopes, very stony	5.8	9.7%
18B	Peru, Skerry, and Colonel soils, 0 to 8 percent slopes, very stony	1.3	2.3%
18C	Peru, Skerry, and Colonel soils, 8 to 15 percent slopes, very stony	14.8	24.9%
28	Udorthents and Udipsamments	23.9	40.2%
63E	Monadnock and Berkshire soils, 35 to 60 percent slopes, very stony	6.1	10.3%
68C	Monadnock and Berkshire soils, 8 to 15 percent slopes	6.0	10.0%
Totals for Area of Interest		**59.6**	**100.0%**

Map Unit Description

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named, soils that are similar to the named components, and some minor components that differ in use and management from the major soils.

Most of the soils similar to the major components have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Some minor components, however, have properties and behavior characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. All the soils of a series have major horizons that are similar in composition, thickness, and arrangement. Soils of a given series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Additional information about the map units described in this report is available in other soil reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the soil reports define some of the properties included in the map unit descriptions.

Report—Map Unit Description

Windsor County, Vermont

11C—Marlow fine sandy loam, 8 to 15 percent slopes, very stony

Map Unit Setting

National map unit symbol: 2ty5p

Elevation: 520 to 1,900 feet
Mean annual precipitation: 31 to 95 inches
Mean annual air temperature: 27 to 55 degrees F
Frost-free period: 90 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Marlow, very stony, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Marlow, Very Stony

Setting

Landform: Hills, mountains
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountainbase, mountainflank, side slope, nose slope, interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy lodgment till derived from granite and/or loamy lodgment till derived from mica schist and/or loamy lodgment till derived from phyllite

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 5 inches: fine sandy loam
E - 5 to 8 inches: fine sandy loam
Bs1 - 8 to 15 inches: fine sandy loam
Bs2 - 15 to 19 inches: fine sandy loam
BC - 19 to 33 inches: gravelly fine sandy loam
Cd - 33 to 65 inches: fine sandy loam

Properties and qualities

Slope: 8 to 15 percent
Percent of area covered with surface fragments: 1.1 percent
Depth to restrictive feature: 20 to 41 inches to densic material
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.01 to 1.42 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 5.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Peru, very stony

Percent of map unit: 6 percent
Landform: Mountains, hills
Landform position (two-dimensional): Footslope, backslope
Landform position (three-dimensional): Mountainbase, mountainflank, interfluve, side slope, nose slope
Microfeatures of landform position: Open depressions, open depressions, closed depressions, closed depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: No

Berkshire, very stony

Percent of map unit: 4 percent
Landform: Hills, mountains
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Mountainbase, mountainflank, side slope, nose slope, interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Tunbridge, very stony

Percent of map unit: 3 percent
Landform: Hills, mountains
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Mountainbase, mountainflank, side slope, nose slope, interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Pillsbury, very stony

Percent of map unit: 2 percent
Landform: Hills, mountains
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Mountainbase, mountainflank, side slope, nose slope, interfluve
Microfeatures of landform position: Open depressions, open depressions, closed depressions, closed depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

11E—Marlow fine sandy loam, 35 to 60 percent slopes, very stony

Map Unit Setting

National map unit symbol: 2ty5v
Elevation: 660 to 2,100 feet

Mean annual precipitation: 31 to 95 inches
Mean annual air temperature: 27 to 48 degrees F
Frost-free period: 90 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Marlow, very stony, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Marlow, Very Stony

Setting

Landform: Hills, mountains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy lodgment till derived from granite and/or loamy lodgment till derived from mica schist and/or loamy lodgment till derived from phyllite

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 5 inches: fine sandy loam
E - 5 to 8 inches: fine sandy loam
Bs1 - 8 to 15 inches: fine sandy loam
Bs2 - 15 to 19 inches: fine sandy loam
BC - 19 to 33 inches: gravelly fine sandy loam
Cd - 33 to 65 inches: fine sandy loam

Properties and qualities

Slope: 35 to 60 percent
Percent of area covered with surface fragments: 1.1 percent
Depth to restrictive feature: 20 to 41 inches to densic material
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.01 to 1.42 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 5.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Peru, very stony

Percent of map unit: 5 percent
Landform: Hills, mountains
Landform position (two-dimensional): Footslope, backslope
Landform position (three-dimensional): Mountainflank, side slope
Microfeatures of landform position: Open depressions, open depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: No

Tunbridge, very stony

Percent of map unit: 4 percent
Landform: Mountains, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Berkshire, very stony

Percent of map unit: 4 percent
Landform: Mountains, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Pillsbury, very stony

Percent of map unit: 2 percent
Landform: Hills, mountains
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Mountainflank, side slope
Microfeatures of landform position: Open depressions, open depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

18B—Peru, Skerry, and Colonel soils, 0 to 8 percent slopes, very stony

Map Unit Setting

National map unit symbol: 2w9r0
Elevation: 820 to 2,160 feet
Mean annual precipitation: 31 to 65 inches
Mean annual air temperature: 36 to 52 degrees F
Frost-free period: 90 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Peru, very stony, and similar soils: 55 percent
Skerry, very stony, and similar soils: 20 percent
Colonel, very stony, and similar soils: 15 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Peru, Very Stony

Setting

Landform: Hills, mountains
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Mountainbase, interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Loamy lodgment till derived from granite and/or mica schist and/or phyllite

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 5 inches: fine sandy loam
E - 5 to 6 inches: fine sandy loam
Bs1 - 6 to 7 inches: fine sandy loam
Bs2 - 7 to 13 inches: fine sandy loam
Bs3 - 13 to 18 inches: fine sandy loam
BC - 18 to 21 inches: fine sandy loam
Cd1 - 21 to 37 inches: fine sandy loam
Cd2 - 37 to 65 inches: fine sandy loam

Properties and qualities

Slope: 0 to 8 percent
Percent of area covered with surface fragments: 1.1 percent
Depth to restrictive feature: 21 to 43 inches to densic material
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.01 to 1.42 in/hr)
Depth to water table: About 17 to 34 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C/D
Hydric soil rating: No

Description of Skerry, Very Stony

Setting

Landform: Mountains, hills

Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Mountainbase, interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Loamy lodgment till derived from granite and gneiss and/or schist over sandy lodgment till derived from granite and gneiss and/or schist

Typical profile

Oa - 0 to 2 inches: highly decomposed plant material
E - 2 to 4 inches: fine sandy loam
Bhs - 4 to 6 inches: fine sandy loam
Bs1 - 6 to 20 inches: gravelly fine sandy loam
Bs2 - 20 to 25 inches: gravelly fine sandy loam
Cd1 - 25 to 34 inches: gravelly loamy sand
Cd2 - 34 to 65 inches: gravelly loamy sand

Properties and qualities

Slope: 0 to 8 percent
Percent of area covered with surface fragments: 1.1 percent
Depth to restrictive feature: 21 to 43 inches to densic material
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.01 to 1.42 in/hr)
Depth to water table: About 17 to 34 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C/D
Hydric soil rating: No

Description of Colonel, Very Stony

Setting

Landform: Mountains, hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Mountainbase, interfluve
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Loamy lodgment till derived from granite and/or mica schist and/or phyllite

Typical profile

Oa - 0 to 1 inches: highly decomposed plant material
E - 1 to 2 inches: fine sandy loam
Bhs - 2 to 3 inches: fine sandy loam
Bs1 - 3 to 9 inches: fine sandy loam
Bs2 - 9 to 12 inches: fine sandy loam
BC - 12 to 18 inches: gravelly fine sandy loam

Cd - 18 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 0 to 8 percent
Percent of area covered with surface fragments: 1.1 percent
Depth to restrictive feature: 11 to 25 inches to densic material
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 1.42 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Marlow, very stony

Percent of map unit: 4 percent
Landform: Hills, mountains
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountainbase, interfluve
Microfeatures of landform position: Rises, rises
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Cabot, very stony

Percent of map unit: 3 percent
Landform: Hills, mountains
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Mountainbase, interfluve
Microfeatures of landform position: Closed depressions, closed depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Tunbridge, very stony

Percent of map unit: 3 percent
Landform: Mountains, hills
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Mountainbase, interfluve
Microfeatures of landform position: Rises, rises
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

18C—Peru, Skerry, and Colonel soils, 8 to 15 percent slopes, very stony

Map Unit Setting

National map unit symbol: 2w9r1
Elevation: 750 to 2,260 feet
Mean annual precipitation: 31 to 65 inches
Mean annual air temperature: 36 to 52 degrees F
Frost-free period: 90 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Peru, very stony, and similar soils: 55 percent
Skerry, very stony, and similar soils: 20 percent
Colonel, very stony, and similar soils: 15 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Peru, Very Stony

Setting

Landform: Hills, mountains
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Mountainbase, mountainflank, side slope, nose slope, interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Loamy lodgment till derived from granite and/or mica schist and/or phyllite

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 5 inches: fine sandy loam
E - 5 to 6 inches: fine sandy loam
Bs1 - 6 to 7 inches: fine sandy loam
Bs2 - 7 to 13 inches: fine sandy loam
Bs3 - 13 to 18 inches: fine sandy loam
BC - 18 to 21 inches: fine sandy loam
Cd1 - 21 to 37 inches: fine sandy loam
Cd2 - 37 to 65 inches: fine sandy loam

Properties and qualities

Slope: 8 to 15 percent
Percent of area covered with surface fragments: 1.1 percent
Depth to restrictive feature: 21 to 43 inches to densic material
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.01 to 1.42 in/hr)
Depth to water table: About 17 to 34 inches
Frequency of flooding: None

Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C/D
Hydric soil rating: No

Description of Skerry, Very Stony

Setting

Landform: Hills, mountains
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Mountainflank, mountainbase, side slope, nose slope, interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Loamy lodgment till derived from granite and gneiss and/or schist over sandy lodgment till derived from granite and gneiss and/or schist

Typical profile

Oa - 0 to 2 inches: highly decomposed plant material
E - 2 to 4 inches: fine sandy loam
Bhs - 4 to 6 inches: fine sandy loam
Bs1 - 6 to 20 inches: gravelly fine sandy loam
Bs2 - 20 to 25 inches: gravelly fine sandy loam
Cd1 - 25 to 34 inches: gravelly loamy sand
Cd2 - 34 to 65 inches: gravelly loamy sand

Properties and qualities

Slope: 8 to 15 percent
Percent of area covered with surface fragments: 1.1 percent
Depth to restrictive feature: 21 to 43 inches to densic material
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.01 to 1.42 in/hr)
Depth to water table: About 17 to 34 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C/D
Hydric soil rating: No

Description of Colonel, Very Stony

Setting

Landform: Hills, mountains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Mountainbase, mountainflank, nose slope, side slope, interfluve
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Loamy lodgment till derived from granite and/or mica schist and/or phyllite

Typical profile

Oa - 0 to 1 inches: highly decomposed plant material
E - 1 to 2 inches: fine sandy loam
Bhs - 2 to 3 inches: fine sandy loam
Bs1 - 3 to 9 inches: fine sandy loam
Bs2 - 9 to 12 inches: fine sandy loam
BC - 12 to 18 inches: gravelly fine sandy loam
Cd - 18 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 8 to 15 percent
Percent of area covered with surface fragments: 1.1 percent
Depth to restrictive feature: 11 to 25 inches to densic material
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 1.42 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Marlow, very stony

Percent of map unit: 4 percent
Landform: Hills, mountains
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountainbase, mountainflank, interfluve, side slope, nose slope
Microfeatures of landform position: Rises, rises
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Cabot, very stony

Percent of map unit: 3 percent
Landform: Hills, mountains
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Mountainflank, mountainbase, side slope, nose slope, interfluve
Microfeatures of landform position: Open depressions, closed depressions, closed depressions, open depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Tunbridge, very stony

Percent of map unit: 3 percent
Landform: Hills, mountains
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Mountainbase, mountainflank, side slope, nose slope, interfluve
Microfeatures of landform position: Rises, rises
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

28—Udorthents and Udipsamments

Map Unit Setting

National map unit symbol: 9hnn
Elevation: 280 to 2,000 feet
Mean annual precipitation: 35 to 55 inches
Mean annual air temperature: 37 to 52 degrees F
Frost-free period: 90 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents and similar soils: 43 percent
Udipsamments and similar soils: 42 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Setting

Down-slope shape: Convex, concave, linear
Across-slope shape: Convex, concave
Parent material: Human transported material

Typical profile

H1 - 0 to 65 inches: gravelly sandy loam

Properties and qualities

Depth to restrictive feature: More than 80 inches

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 6.00 in/hr)
Depth to water table: About 24 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydrologic Soil Group: A
Hydric soil rating: No

Description of Udipsamments

Setting

Down-slope shape: Convex, linear, concave
Across-slope shape: Convex, concave
Parent material: Human transported material

Typical profile

H1 - 0 to 65 inches: sand

Properties and qualities

Depth to restrictive feature: More than 80 inches
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 99.90 in/hr)
Depth to water table: About 24 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Water

Percent of map unit: 4 percent
Landform: Depressions
Hydric soil rating: Unranked

Rock outcrop

Percent of map unit: 4 percent
Hydric soil rating: Unranked

Aquents

Percent of map unit: 4 percent
Landform: Depressions
Hydric soil rating: Yes

Udifluvents

Percent of map unit: 3 percent

Landform: Flood plains
Hydric soil rating: No

63E—Monadnock and Berkshire soils, 35 to 60 percent slopes, very stony

Map Unit Setting

National map unit symbol: 2wln2
Elevation: 620 to 1,740 feet
Mean annual precipitation: 31 to 95 inches
Mean annual air temperature: 27 to 52 degrees F
Frost-free period: 90 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Monadnock, very stony, and similar soils: 45 percent
Berkshire, very stony, and similar soils: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Monadnock, Very Stony

Setting

Landform: Hills, mountains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy supraglacial meltout till derived from phyllite and/or granite and gneiss and/or mica schist over sandy and gravelly supraglacial meltout till derived from phyllite and/or granite and gneiss and/or mica schist

Typical profile

Oe - 0 to 3 inches: moderately decomposed plant material
E - 3 to 8 inches: fine sandy loam
Bs1 - 8 to 10 inches: fine sandy loam
Bs2 - 10 to 12 inches: fine sandy loam
Bs3 - 12 to 22 inches: gravelly fine sandy loam
BC - 22 to 25 inches: gravelly fine sandy loam
2C1 - 25 to 45 inches: gravelly loamy sand
2C2 - 45 to 65 inches: gravelly loamy sand

Properties and qualities

Slope: 35 to 60 percent
Percent of area covered with surface fragments: 1.1 percent
Depth to restrictive feature: 18 to 36 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)

Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Hydric soil rating: No

Description of Berkshire, Very Stony

Setting

Landform: Hills, mountains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy supraglacial meltout till derived from phyllite and/or granite and gneiss and/or mica schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 4 inches: fine sandy loam
E - 4 to 5 inches: fine sandy loam
Bs1 - 5 to 7 inches: fine sandy loam
Bs2 - 7 to 13 inches: fine sandy loam
Bs3 - 13 to 21 inches: fine sandy loam
BC1 - 21 to 28 inches: fine sandy loam
BC2 - 28 to 33 inches: fine sandy loam
C - 33 to 65 inches: fine sandy loam

Properties and qualities

Slope: 35 to 60 percent
Percent of area covered with surface fragments: 1.1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: High (about 10.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Becket, very stony
Percent of map unit: 6 percent
Landform: Hills, mountains
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Mountainflank, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Lyman, very stony
Percent of map unit: 4 percent
Landform: Hills, mountains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank, side slope
Microfeatures of landform position: Rises, rises
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Sunapee, very stony
Percent of map unit: 3 percent
Landform: Hills, mountains
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Mountainflank, side slope
Microfeatures of landform position: Open depressions, open depressions
Down-slope shape: Convex, concave
Across-slope shape: Convex, concave
Hydric soil rating: No

Moosilauke, very stony
Percent of map unit: 2 percent
Landform: Hills, mountains
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Mountainflank, side slope
Microfeatures of landform position: Open depressions, open depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

68C—Monadnock and Berkshire soils, 8 to 15 percent slopes

Map Unit Setting
National map unit symbol: 2wlmt
Elevation: 390 to 1,770 feet
Mean annual precipitation: 31 to 95 inches
Mean annual air temperature: 27 to 52 degrees F
Frost-free period: 90 to 150 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Monadnock and similar soils: 45 percent
Berkshire and similar soils: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Monadnock

Setting

Landform: Hills, mountains
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Mountainflank, mountainbase, interfluve, side slope, nose slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy supraglacial meltout till derived from phyllite and/or granite and gneiss and/or mica schist over sandy and gravelly supraglacial meltout till derived from phyllite and/or granite and gneiss and/or mica schist

Typical profile

Ap - 0 to 7 inches: fine sandy loam
Bs1 - 7 to 9 inches: fine sandy loam
Bs2 - 9 to 19 inches: gravelly fine sandy loam
BC - 19 to 22 inches: gravelly fine sandy loam
2C1 - 22 to 42 inches: gravelly loamy sand
2C2 - 42 to 65 inches: gravelly loamy sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 15 to 30 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 3.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Hydric soil rating: No

Description of Berkshire

Setting

Landform: Hills, mountains
Landform position (two-dimensional): Backslope, summit, shoulder

Landform position (three-dimensional): Mountainflank, mountainbase, side slope, nose slope, interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy supraglacial meltout till derived from phyllite and/or granite and gneiss and/or mica schist

Typical profile

Ap - 0 to 7 inches: fine sandy loam
Bs1 - 7 to 13 inches: fine sandy loam
Bs2 - 13 to 21 inches: fine sandy loam
BC1 - 21 to 28 inches: fine sandy loam
BC2 - 28 to 33 inches: fine sandy loam
C - 33 to 65 inches: fine sandy loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: High (about 9.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Skerry

Percent of map unit: 5 percent
Landform: Hills, mountains
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Mountainbase, mountainflank, interfluve, side slope, nose slope
Microfeatures of landform position: Closed depressions, open depressions, open depressions, closed depressions
Down-slope shape: Convex, concave
Across-slope shape: Linear, concave
Hydric soil rating: No

Marlow

Percent of map unit: 4 percent
Landform: Hills, mountains
Landform position (two-dimensional): Shoulder, backslope, summit
Landform position (three-dimensional): Mountainflank, mountainbase, interfluve, nose slope, side slope
Down-slope shape: Convex

Across-slope shape: Convex
Hydric soil rating: No

Tunbridge

Percent of map unit: 4 percent
Landform: Hills, mountains
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Mountainflank, mountainbase, side slope, nose slope, interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Colonel

Percent of map unit: 2 percent
Landform: Hills, mountains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Mountainbase, mountainflank, interfluve, nose slope, side slope
Microfeatures of landform position: Open depressions, open depressions, closed depressions, closed depressions
Down-slope shape: Linear, concave
Across-slope shape: Concave
Hydric soil rating: No

Data Source Information

Soil Survey Area: Windsor County, Vermont
Survey Area Data: Version 23, Sep 16, 2019

Engineering Properties

This table gives the engineering classifications and the range of engineering properties for the layers of each soil in the survey area.

Hydrologic soil group is a group of soils having similar runoff potential under similar storm and cover conditions. The criteria for determining Hydrologic soil group is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba). Listing HSGs by soil map unit component and not by soil series is a new concept for the engineers. Past engineering references contained lists of HSGs by soil series. Soil series are continually being defined and redefined, and the list of soil series names changes so frequently as to make the task of maintaining a single national list virtually impossible. Therefore, the criteria is now used to calculate the HSG using the component soil properties and no such national series lists will be maintained. All such references are obsolete and their use should be discontinued. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. These properties are depth to a seasonal high water table, saturated hydraulic conductivity after prolonged wetting, and depth to a layer with a very slow water transmission rate. Changes in soil properties caused by land management or climate changes also cause the hydrologic soil group to change. The influence of ground cover is treated independently. There are four hydrologic soil groups, A, B, C, and D, and three dual groups, A/D, B/D, and C/D. In the dual groups, the first letter is for drained areas and the second letter is for undrained areas.

The four hydrologic soil groups are described in the following paragraphs:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Depth to the upper and lower boundaries of each layer is indicated.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, "gravelly."

Classification of the soils is determined according to the Unified soil classification system (ASTM, 2005) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 2004).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of particle-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Percentage of rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

References:

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Report—Engineering Properties

Absence of an entry indicates that the data were not estimated. The asterisk '*' denotes the representative texture; other possible textures follow the dash. The criteria for determining the hydrologic soil group for individual soil components is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba). Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Engineering Properties–Windsor County, Vermont														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
11C—Marlow fine sandy loam, 8 to 15 percent slopes, very stony														
Marlow, very stony	85	C	0-2	Slightly decomposed plant material	PT	A-8	0- 0- 0	0- 0- 0	—	—	—	—	—	—
			2-5	Fine sandy loam, loam, sandy loam, silt loam	SM	A-5	0- 0- 17	0- 0- 25	42-87-87	40-87-87	30-75-83	15-45-54	0-45 -76	NP-2 -5
			5-8	Fine sandy loam, silt loam, loam, sandy loam	SM	A-4	0- 0- 13	0- 0- 20	53-92-92	52-92-92	39-79-87	20-47-57	0-20 -30	NP-1 -6
			8-15	Fine sandy loam, loam, sandy loam, very fine sandy loam	SM	A-4	0- 0- 16	0- 0- 24	44-89-89	42-88-88	32-76-82	16-45-52	0-34 -47	NP-2 -5
			15-19	Sandy loam, fine sandy loam, very fine sandy loam, loam	SM	A-4	0- 0- 15	0- 0- 23	48-85-90	46-84-90	35-72-84	18-43-53	0-23 -38	NP-2 -5
			19-33	Gravelly fine sandy loam, very fine sandy loam, loam, sandy loam	SM	A-4	0- 0- 13	0- 0- 20	53-77-92	52-76-92	39-66-85	20-39-54	0-18 -25	NP-2 -6
			33-65	Fine sandy loam, loam, sandy loam	SM	A-4	0- 0- 12	0- 0- 18	55-83-93	53-83-93	40-72-86	20-43-55	0-18 -23	NP-3 -6

Engineering Properties–Windsor County, Vermont														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
11E—Marlow fine sandy loam, 35 to 60 percent slopes, very stony														
Marlow, very stony	85	C	0-2	Slightly decomposed plant material	PT	A-8	0- 0- 0	0- 0- 0	—	—	—	—	—	—
			2-5	Fine sandy loam, loam, sandy loam, silt loam	SM	A-5	0- 0- 17	0- 0- 25	42-87-87	40-87-87	30-75-83	15-45-54	0-45 -76	NP-2 -5
			5-8	Fine sandy loam, silt loam, loam, sandy loam	SM	A-4	0- 0- 13	0- 0- 20	53-92-92	52-92-92	39-79-87	20-47-57	0-20 -30	NP-1 -6
			8-15	Fine sandy loam, loam, sandy loam, very fine sandy loam	SM	A-4	0- 0- 16	0- 0- 24	44-89-89	42-88-88	32-76-82	16-45-52	0-34 -47	NP-2 -5
			15-19	Sandy loam, fine sandy loam, very fine sandy loam, loam	SM	A-4	0- 0- 15	0- 0- 23	48-85-90	46-84-90	35-72-84	18-43-53	0-23 -38	NP-2 -5
			19-33	Gravelly fine sandy loam, very fine sandy loam, loam, sandy loam	SM	A-4	0- 0- 13	0- 0- 20	53-77-92	52-76-92	39-66-85	20-39-54	0-18 -25	NP-2 -6
			33-65	Fine sandy loam, loam, sandy loam	SM	A-4	0- 0- 12	0- 0- 18	55-83-93	53-83-93	40-72-86	20-43-55	0-18 -23	NP-3 -6

Engineering Properties–Windsor County, Vermont														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
18B—Peru, Skerry, and Colonel soils, 0 to 8 percent slopes, very stony														
Peru, very stony	55	C/D	0-1	Moderately decomposed plant material	PT	A-8	0- 0- 0	0- 0- 0	—	—	—	—	—	—
			1-5	Fine sandy loam, loam, silt loam, sandy loam	OL	A-5	0- 2- 18	0- 2- 56	64-97-97	27-91-91	22-80-87	13-55-63	0-46 -76	NP-2 -5
			5-6	Very fine sandy loam, loam, sandy loam, fine sandy loam	ML	A-4	0- 1- 14	0- 1- 43	70-98-98	40-95-95	31-83-88	17-53-58	0-0 -36	NP-0 -6
			6-7	Loam, very fine sandy loam, sandy loam, fine sandy loam	ML	A-4	0- 2- 17	0- 4- 53	65-97-97	31-95-95	23-80-86	14-52-59	0-33 -43	NP-3 -5
			7-13	Fine sandy loam, sandy loam, very fine sandy loam, loam	ML	A-4	0- 2- 16	0- 4- 50	67-98-98	33-95-95	25-81-87	15-52-59	0-0 -34	NP-0 -6
			13-18	Fine sandy loam, sandy loam, very fine sandy loam, loam	ML	A-4	0- 2- 16	0- 4- 50	67-98-98	33-95-95	25-80-86	15-55-60	0-0 -34	NP-0 -6
			18-21	Sandy loam, very fine sandy loam, loam, fine sandy loam	ML	A-4	0- 1- 14	0- 3- 43	70-98-98	40-96-96	31-82-88	17-51-58	0-0 -25	NP-0 -6
			21-37	Sandy loam, loam, fine sandy loam, very fine sandy loam	ML	A-4	0- 1- 13	0- 2- 39	72-98-98	44-97-97	34-82-89	19-52-58	0-0 -23	NP-0 -6

Engineering Properties–Windsor County, Vermont														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
			37-65	Loam, sandy loam, fine sandy loam, very fine sandy loam	ML	A-4	0- 1- 13	0- 2- 39	72-98-98	44-97-97	34-82-89	19-52-58	0-0 -23	NP-0 -6
Skerry, very stony	20	C/D	0-2	Highly decomposed plant material, slightly decomposed plant material, moderately decomposed plant material	PT	A-8	0- 0- 0	0- 0- 0	—	—	—	—	—	—
			2-4	Loamy sand, fine sandy loam, sandy loam, gravelly fine sandy loam	ML	A-4	0- 1- 43	0- 4- 43	58-90-95	57-89-95	48-78-89	30-50-59	0-0 -36	NP-0 -6
			4-6	Fine sandy loam, sandy loam, gravelly fine sandy loam	SM	A-4	0- 2- 52	0- 6- 52	49-86-93	47-85-92	38-72-82	24-47-54	0-33 -43	NP-4 -5
			6-20	Sandy loam, gravelly fine sandy loam, fine sandy loam	SC-SM	A-4	0- 1- 50	0- 7- 50	52-79-93	50-78-92	40-66-82	25-43-54	0-26 -34	NP-5 -6
			20-25	Fine sandy loam, sandy loam, gravelly fine sandy loam	SM	A-4	0- 1- 50	0- 7- 50	52-71-92	50-69-91	41-59-84	26-38-57	0-0 -34	NP-0 -6
			25-34	Fine sandy loam, loamy fine sand, loamy coarse sand, sandy loam, gravelly loamy sand	SM	A-2-4	0- 1- 50	0- 5- 50	52-72-94	50-71-94	38-56-77	13-21-30	0-0 -18	NP-0 -2
			34-65	Fine sandy loam, sandy loam, gravelly loamy sand, loamy fine sand, loamy coarse sand	SM	A-2-4	0- 1- 50	0- 5- 50	52-72-94	50-71-94	38-56-77	13-21-30	0-0 -18	NP-0 -2

Engineering Properties–Windsor County, Vermont														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
Colonel, very stony	15	D	0-1	Highly decomposed plant material	PT	A-8	0- 0- 0	0- 5- 10	—	—	—	—	—	—
			1-2	Fine sandy loam, very fine sandy loam, sandy loam, loam	SM	A-4	0- 0- 0	0- 8- 43	59-91-96	57-91-96	44-79-88	25-48-58	0-0 -34	NP-0 -6
			2-3	Very fine sandy loam, loam, fine sandy loam, sandy loam	SM	A-4	0- 0- 0	0-11- 53	49-88-94	47-87-93	36-75-86	20-46-57	0-0 -60	NP-0 -5
			3-9	Loam, fine sandy loam, sandy loam, very fine sandy loam	SM	A-4	0- 0- 0	0-10- 50	51-89-94	49-88-94	38-76-87	21-46-57	0-0 -43	NP-0 -5
			9-12	Very fine sandy loam, sandy loam, loam, fine sandy loam	SM	A-4	0- 0- 0	0-10- 50	52-89-94	50-88-94	39-76-87	21-46-57	0-0 -34	NP-0 -6
			12-18	Loam, sandy loam, gravelly fine sandy loam, very fine sandy loam	SM	A-4	0- 0- 0	0- 7- 42	59-84-94	57-83-94	44-72-88	25-44-57	0-0 -25	NP-0 -6
			18-65	Loam, gravelly fine sandy loam, sandy loam, very fine sandy loam	SM	A-4	0- 0- 0	0- 6- 44	57-86-95	55-85-95	44-75-91	22-41-55	0-0 -23	NP-0 -6

Engineering Properties–Windsor County, Vermont														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
18C—Peru, Skerry, and Colonel soils, 8 to 15 percent slopes, very stony														
Peru, very stony	55	C/D	0-1	Moderately decomposed plant material	PT	A-8	0- 0- 0	0- 0- 0	—	—	—	—	—	—
			1-5	Silt loam, loam, sandy loam, fine sandy loam	OL	A-5	0- 2- 18	0- 2- 56	64-97-97	27-91-91	22-80-87	13-55-63	0-46 -76	NP-2 -5
			5-6	Fine sandy loam, loam, very fine sandy loam, sandy loam	ML	A-4	0- 1- 14	0- 1- 43	70-98-98	40-95-95	31-83-88	17-53-58	0-0 -36	NP-0 -6
			6-7	Fine sandy loam, very fine sandy loam, sandy loam, loam	ML	A-4	0- 2- 17	0- 4- 53	65-97-97	31-95-95	23-80-86	14-52-59	0-33 -43	NP-3 -5
			7-13	Loam, fine sandy loam, very fine sandy loam, sandy loam	ML	A-4	0- 2- 16	0- 4- 50	67-98-98	33-95-95	25-81-87	15-52-59	0-0 -34	NP-0 -6
			13-18	Sandy loam, very fine sandy loam, fine sandy loam, loam	ML	A-4	0- 2- 16	0- 4- 50	67-98-98	33-95-95	25-80-86	15-55-60	0-0 -34	NP-0 -6
			18-21	Very fine sandy loam, loam, fine sandy loam, sandy loam	ML	A-4	0- 1- 14	0- 3- 43	70-98-98	40-96-96	31-82-88	17-51-58	0-0 -25	NP-0 -6
			21-37	Loam, very fine sandy loam, fine sandy loam, sandy loam	ML	A-4	0- 1- 13	0- 2- 39	72-98-98	44-97-97	34-82-89	19-52-58	0-0 -23	NP-0 -6

Engineering Properties–Windsor County, Vermont														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
			37-65	Fine sandy loam, very fine sandy loam, loam, sandy loam	ML	A-4	0- 1- 13	0- 2- 39	72-98-98	44-97-97	34-82-89	19-52-58	0-0 -23	NP-0 -6
Skerry, very stony	20	C/D	0-2	Highly decomposed plant material, slightly decomposed plant material, moderately decomposed plant material	PT	A-8	0- 0- 0	0- 0- 0	—	—	—	—	—	—
			2-4	Fine sandy loam, sandy loam, gravelly fine sandy loam, loamy sand	ML	A-4	0- 1- 43	0- 4- 43	58-90-95	57-89-95	48-78-89	30-50-59	0-0 -36	NP-0 -6
			4-6	Fine sandy loam, sandy loam, gravelly fine sandy loam	SM	A-4	0- 2- 52	0- 6- 52	49-86-93	47-85-92	38-72-82	24-47-54	0-33 -43	NP-4 -5
			6-20	Gravelly fine sandy loam, fine sandy loam, sandy loam	SC-SM	A-4	0- 1- 50	0- 7- 50	52-79-93	50-78-92	40-66-82	25-43-54	0-26 -34	NP-5 -6
			20-25	Fine sandy loam, sandy loam, gravelly fine sandy loam	SM	A-4	0- 1- 50	0- 7- 50	52-71-92	50-69-91	41-59-84	26-38-57	0-0 -34	NP-0 -6
			25-34	Loamy fine sand, gravelly loamy sand, loamy coarse sand, fine sandy loam, sandy loam	SM	A-2-4	0- 1- 50	0- 5- 50	52-72-94	50-71-94	38-56-77	13-21-30	0-0 -18	NP-0 -2
			34-65	Gravelly loamy sand, loamy fine sand, loamy coarse sand, fine sandy loam, sandy loam	SM	A-2-4	0- 1- 50	0- 5- 50	52-72-94	50-71-94	38-56-77	13-21-30	0-0 -18	NP-0 -2

Engineering Properties–Windsor County, Vermont														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
Colonel, very stony	15	D	0-1	Highly decomposed plant material	PT	A-8	0- 0- 0	0- 5- 10	—	—	—	—	—	—
			1-2	Very fine sandy loam, sandy loam, loam, fine sandy loam	SM	A-4	0- 0- 0	0- 8- 43	59-91-96	57-91-96	44-79-88	25-48-58	0-0 -34	NP-0 -6
			2-3	Very fine sandy loam, loam, fine sandy loam, sandy loam	SM	A-4	0- 0- 0	0-11- 53	49-88-94	47-87-93	36-75-86	20-46-57	0-0 -60	NP-0 -5
			3-9	Fine sandy loam, sandy loam, very fine sandy loam, loam	SM	A-4	0- 0- 0	0-10- 50	51-89-94	49-88-94	38-76-87	21-46-57	0-0 -43	NP-0 -5
			9-12	Sandy loam, loam, fine sandy loam, very fine sandy loam	SM	A-4	0- 0- 0	0-10- 50	52-89-94	50-88-94	39-76-87	21-46-57	0-0 -34	NP-0 -6
			12-18	Sandy loam, gravelly fine sandy loam, very fine sandy loam, loam	SM	A-4	0- 0- 0	0- 7- 42	59-84-94	57-83-94	44-72-88	25-44-57	0-0 -25	NP-0 -6
			18-65	Loam, gravelly fine sandy loam, sandy loam, very fine sandy loam	SM	A-4	0- 0- 0	0- 6- 44	57-86-95	55-85-95	44-75-91	22-41-55	0-0 -23	NP-0 -6
28—Udorthents and Udipsamments														
Udorthents	43	A	0-65	Gravelly sandy loam	GM, GP, ML, SM	A-1, A-2-4, A-3, A-4	—	0-10- 30	25-80-100	20-60-100	10-50-90	2-41- 80	0-18 -35	NP-5 -10
Udipsamments	42	A	0-65	Sand, gravelly sand	SP	A-1, A-3	—	0- 1- 2	85-93-100	50-80-100	25-58-90	0- 3- 5	0-7 -14	NP

Engineering Properties–Windsor County, Vermont														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
63E—Monadnock and Berkshire soils, 35 to 60 percent slopes, very stony														
Monadnock, very stony	45	B	0-3	Moderately decomposed plant material, slightly decomposed plant material, highly decomposed plant material	PT	A-8	0- 0- 0	0- 0- 0	—	—	—	—	—	—
			3-8	Fine sandy loam, sandy loam, silt loam, gravelly fine sandy loam	SM	A-4	0- 1- 27	0- 4- 48	67-92-100	65-91-100	55-80-94	32-47-58	0-0 -30	NP-0 -6
			8-10	Gravelly fine sandy loam, coarse sandy loam, fine sandy loam, loam	SM	A-4	0- 2- 25	0- 6- 25	57-88-100	55-87-100	47-76-94	27-45-58	0-0 -65	NP-0 -5
			10-12	Coarse sandy loam, loam, fine sandy loam, gravelly fine sandy loam	SM	A-4	0- 0- 0	0- 6- 24	59-89-100	57-88-100	49-77-94	28-45-58	0-0 -43	NP-0 -5
			12-22	Coarse sandy loam, loam, gravelly fine sandy loam	SM	A-4	0- 0- 0	0- 5- 23	61-72-100	60-71-100	51-62-94	29-36-58	0-0 -34	NP-0 -6
			22-25	Loam, gravelly fine sandy loam, sandy loam, fine sandy loam	SM	A-2-4	0- 0- 0	0- 7- 20	67-70-100	65-68-100	55-60-94	32-35-58	0-0 -25	NP-0 -6
			25-45	Loamy coarse sand, loamy sand, loamy fine sand, gravelly loamy sand	SM	A-2-4	0- 0- 0	0- 7- 23	38-71-94	35-69-94	28-56-76	11-21-30	0-0 -14	NP

Engineering Properties–Windsor County, Vermont														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
			45-65	Gravelly loamy sand, loamy fine sand, loamy sand, loamy coarse sand	SM	A-2-4	0- 0- 0	0- 7- 23	38-71-94	35-69-94	28-56-76	11-21-30	0-0 -14	NP
Berkshire, very stony	40	B	0-2	Slightly decomposed plant material	PT	A-8	0- 0- 0	0- 0- 0	—	—	—	—	—	—
			2-4	Loam, fine sandy loam, gravelly fine sandy loam, sandy loam	SM	A-4	0- 0- 0	0- 0- 0	44-88-88	42-88-88	36-77-84	21-45-52	0-0 -54	NP-0 -5
			4-5	Fine sandy loam, loam, gravelly fine sandy loam, sandy loam	SM	A-4	0- 0- 0	0- 0- 0	53-92-92	51-91-91	44-80-87	26-47-54	0-0 -32	NP-0 -6
			5-7	Sandy loam, loam, fine sandy loam, gravelly fine sandy loam	SM	A-4	0- 0- 0	0- 0- 0	43-88-88	41-88-88	35-76-83	20-45-52	0-0 -65	NP-0 -5
			7-13	Loam, sandy loam, fine sandy loam, gravelly fine sandy loam	SM	A-4	0- 0- 0	0- 0- 0	45-89-89	43-89-89	37-77-84	22-45-52	0-0 -43	NP-0 -5
			13-21	Gravelly fine sandy loam, sandy loam, loam, fine sandy loam	SM	A-4	0- 0- 0	0- 0- 0	47-90-90	44-89-89	38-78-85	22-45-53	0-0 -34	NP-0 -6
			21-28	Sandy loam, loam, fine sandy loam, gravelly fine sandy loam	SM	A-4	0- 0- 0	0- 0- 0	53-92-92	51-91-91	44-80-87	26-47-54	0-0 -27	NP-0 -6
			28-33	Gravelly fine sandy loam, sandy loam, loam, fine sandy loam	SM	A-4	0- 0- 0	0- 0- 0	53-92-92	52-92-92	44-80-87	26-47-54	0-0 -25	NP-0 -6
			33-65	Sandy loam, loam, fine sandy loam, gravelly fine sandy loam	SM	A-4	0- 0- 0	0- 0- 0	54-85-92	52-84-92	45-73-87	26-43-54	0-0 -23	NP-0 -6

Engineering Properties–Windsor County, Vermont														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
68C—Monadnock and Berkshire soils, 8 to 15 percent slopes														
Monadnock	45	B	0-7	Fine sandy loam, sandy loam, gravelly fine sandy loam, silt loam	SM	A-4	0- 0- 0	0- 6- 48	66-91-100	65-91-100	55-79-94	32-46-58	0-0 -43	NP-0 -6
			7-9	Gravelly fine sandy loam, fine sandy loam, coarse sandy loam, loam	SM	A-4	0- 0- 0	0- 6- 24	59-89-100	57-88-100	49-77-94	28-45-58	0-0 -43	NP-0 -5
			9-19	Gravelly fine sandy loam, loam, coarse sandy loam	SM	A-4	0- 0- 0	0- 5- 23	61-72-100	60-71-100	51-62-94	29-36-58	0-0 -34	NP-0 -6
			19-22	Loam, fine sandy loam, gravelly fine sandy loam, sandy loam	SM	A-2-4	0- 0- 0	0- 7- 20	67-70-100	65-68-100	55-60-94	32-35-58	0-0 -25	NP-0 -6
			22-42	Loamy fine sand, gravelly loamy sand, loamy sand, loamy coarse sand	SM	A-2-4	0- 0- 0	0- 7- 23	38-71-94	35-69-94	28-56-76	11-21-30	0-0 -14	NP

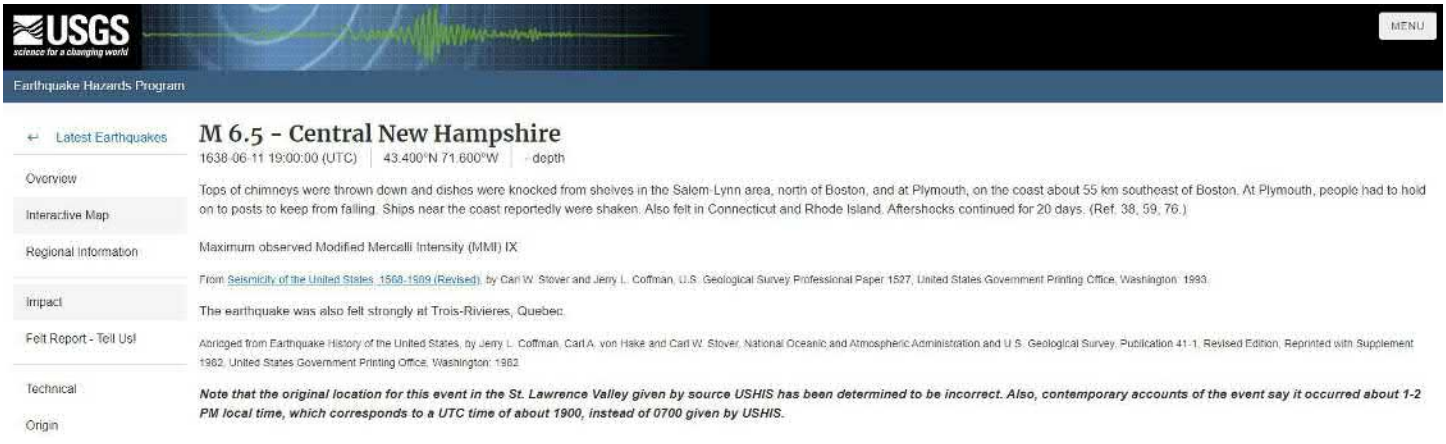
Engineering Properties–Windsor County, Vermont														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
			42-65	Loamy fine sand, gravelly loamy sand, loamy sand, loamy coarse sand	SM	A-2-4	0- 0- 0	0- 7- 23	38-71-94	35-69-94	28-56-76	11-21-30	0-0 -14	NP
Berkshire	40	B	0-7	Fine sandy loam, gravelly fine sandy loam, sandy loam, loam	SM	A-4	0- 0- 0	0- 0- 0	54-92-92	52-92-92	45-80-87	26-47-54	0-0 -43	NP-0 -5
			7-13	Gravelly fine sandy loam, fine sandy loam, sandy loam, loam	SM	A-4	0- 0- 0	0- 0- 0	45-89-89	43-89-89	37-77-84	22-45-52	0-0 -43	NP-0 -5
			13-21	Loam, gravelly fine sandy loam, fine sandy loam, sandy loam	SM	A-4	0- 0- 0	0- 0- 0	47-90-90	44-89-89	38-78-85	22-45-53	0-0 -34	NP-0 -6
			21-28	Gravelly fine sandy loam, fine sandy loam, sandy loam, loam	SM	A-4	0- 0- 0	0- 0- 0	53-92-92	51-91-91	44-80-87	26-47-54	0-0 -27	NP-0 -6
			28-33	Sandy loam, loam, gravelly fine sandy loam, fine sandy loam	SM	A-4	0- 0- 0	0- 0- 0	53-92-92	52-92-92	44-80-87	26-47-54	0-0 -25	NP-0 -6
			33-65	Gravelly fine sandy loam, sandy loam, loam, fine sandy loam	SM	A-4	0- 0- 0	0- 0- 0	54-85-92	52-84-92	45-73-87	26-43-54	0-0 -23	NP-0 -6

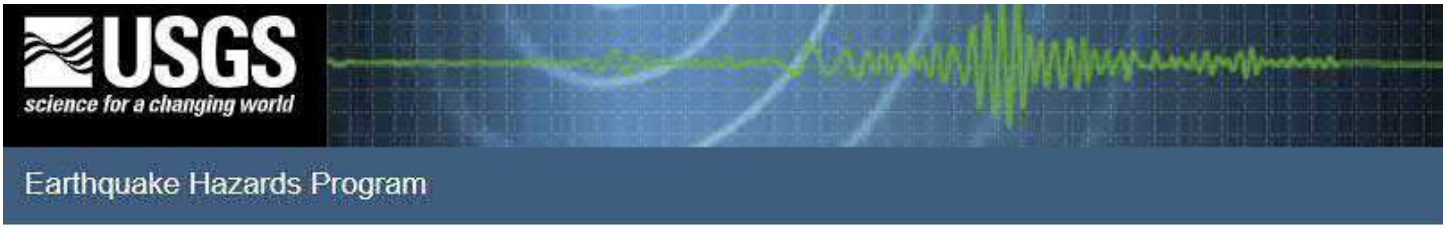
Data Source Information

Soil Survey Area: Windsor County, Vermont
Survey Area Data: Version 23, Sep 16, 2019

APPENDIX E

SEISMIC DATA


USGS
science for a changing world
MENU
Earthquake Hazards Program
Latest Earthquakes
Overview
Interactive Map
Regional Information
Impact
Felt Report - Tell Us!
Technical
Origin
M 6.5 - Central New Hampshire
1638-06-11 19:00:00 (UTC) | 43.400°N 71.600°W | depth
Tops of chimneys were thrown down and dishes were knocked from shelves in the Salem-Lynn area, north of Boston, and at Plymouth, on the coast about 55 km southeast of Boston. At Plymouth, people had to hold on to posts to keep from falling. Ships near the coast reportedly were shaken. Also felt in Connecticut and Rhode Island. Aftershocks continued for 20 days. (Ref. 38, 59, 76.)
Maximum observed Modified Mercalli Intensity (MMI) IX
From Seismicity of the United States, 1568-1989 (Revised), by Carl W. Stover and Jerry L. Coffman, U.S. Geological Survey Professional Paper 1527, United States Government Printing Office, Washington, 1993.
The earthquake was also felt strongly at Trois-Rivieres, Quebec.
Abridged from Earthquake History of the United States, by Jerry L. Coffman, Carl A. von Hake and Carl W. Stover, National Oceanic and Atmospheric Administration and U.S. Geological Survey, Publication 41-1, Revised Edition, Reprinted with Supplement 1982, United States Government Printing Office, Washington: 1982
Note that the original location for this event in the St. Lawrence Valley given by source USHIS has been determined to be incorrect. Also, contemporary accounts of the event say it occurred about 1-2 PM local time, which corresponds to a UTC time of about 1900, instead of 0700 given by USHIS.


USGS
science for a changing world
Earthquake Hazards Program


Latest Earthquakes
Overview
M 4.7 - New York
1931-04-20 19:54:30 (UTC) | 43.471°N 73.785°W | 5.0 km depth
Maximum observed Modified Mercalli Intensity (MMI) VII


USGS
science for a changing world
MENU
Earthquake Hazards Program
Latest Earthquakes
Overview
Interactive Map
Regional Information
Impact
Felt Report - Tell Us!
ShakeMap
M 4.5 - New Hampshire
1982-01-19 00:14:42 (UTC) | 43.500°N 71.600°W | 8.0 km depth
ShakeMap
Catalog
MMI
Source
Description
ATLAS
V
ATLAS 2
1 km NW of Sanbornton, New Hampshire
US
VI
ATLAS 2
ShakeMap Atlas v4
Slight damage (VI) at Bristol, Canaan, Danbury and Laconia, New Hampshire, also North Hartland and White River Junction, Vermont. Felt throughout most of New England, northeastern New York and as far as southern Quebec and northeastern Ontario.
Maximum observed Modified Mercalli Intensity (MMI) VI

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Input

Edition
Dynamic: Conterminous U.S. 2014 (update) (v4.2.0)

Spectral Period
Peak Ground Acceleration

Latitude
Decimal degrees
43.38

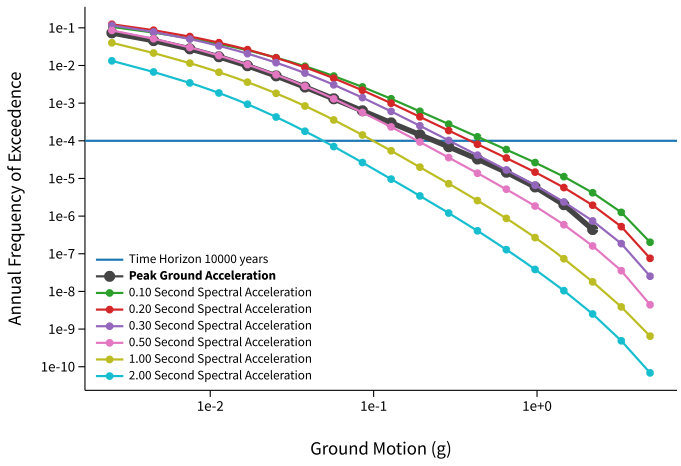
Time Horizon
Return period in years
10000

Longitude
Decimal degrees, negative values for western longitudes
-72.723

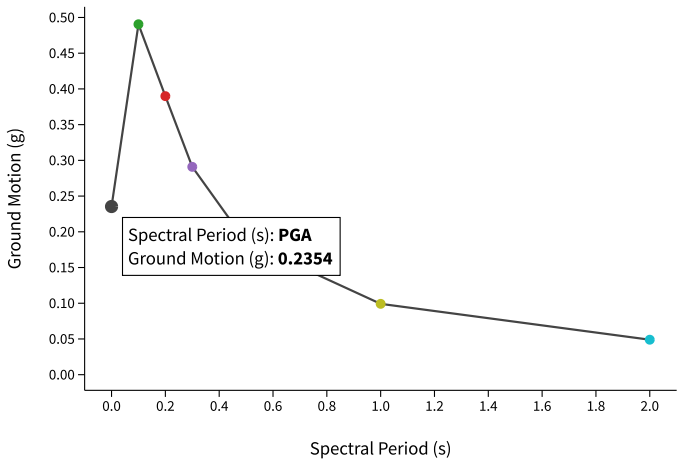
Site Class
760 m/s (B/C boundary)

Hazard Curve

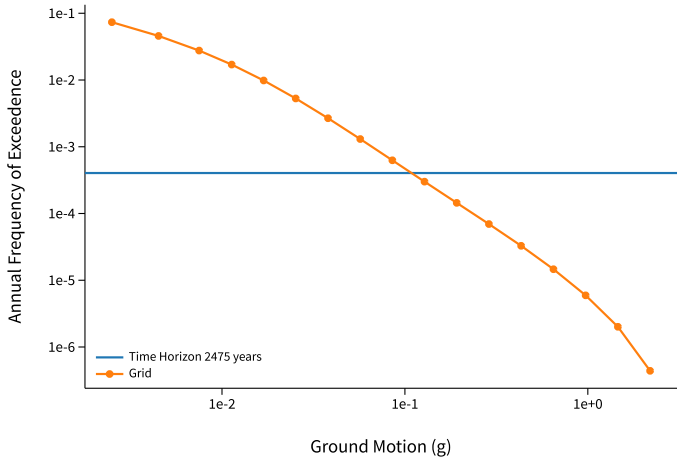
Hazard Curves



Uniform Hazard Response Spectrum



Component Curves for Peak Ground Acceleration

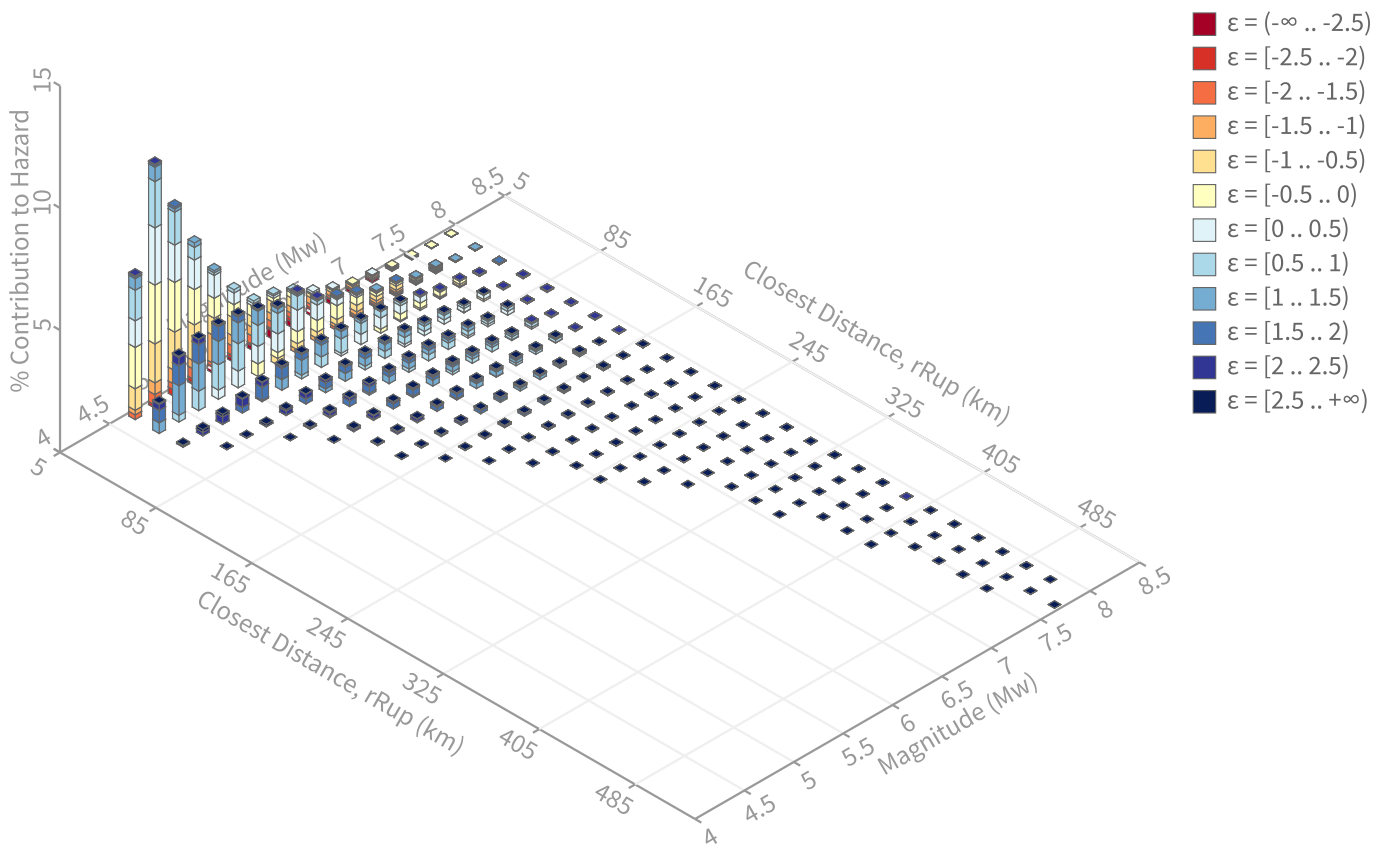


View Raw Data

Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 10000 yrs
Exceedance rate: 0.0001 yr^{-1}
PGA ground motion: 0.23537685 g

Recovered targets

Return period: 9992.3797 yrs
Exceedance rate: 0.00010007626 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.87 %

Mean (over all sources)

m: 5.77
r: 37.45 km
ε_0: 0.32 σ

Mode (largest m-r bin)

m: 4.9
r: 11.67 km
ε_0: -0.04 σ
Contribution: 9.98 %

Mode (largest m-r-ε_0 bin)

m: 4.9
r: 11.61 km
ε_0: -0.21 σ
Contribution: 2.41 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ϵ_0	lon	lat	az	%
USGS Fixed Smoothing Zone 2 (opt)	Grid							32.86
PointSourceFinite: -72.723, 43.492		13.12	5.29	-0.24	72.723°W	43.492°N	0.00	6.64
PointSourceFinite: -72.723, 43.582		22.11	5.54	0.37	72.723°W	43.582°N	0.00	3.24
PointSourceFinite: -72.723, 43.447		8.86	5.21	-0.74	72.723°W	43.447°N	0.00	3.18
PointSourceFinite: -72.723, 43.537		17.60	5.41	0.12	72.723°W	43.537°N	0.00	2.77
PointSourceFinite: -72.723, 43.627		26.59	5.67	0.53	72.723°W	43.627°N	0.00	2.29
PointSourceFinite: -72.723, 43.402		5.57	5.16	-1.26	72.723°W	43.402°N	0.00	2.18
PointSourceFinite: -72.723, 43.672		31.01	5.81	0.64	72.723°W	43.672°N	0.00	1.74
PointSourceFinite: -72.723, 43.717		35.41	5.93	0.73	72.723°W	43.717°N	0.00	1.71
PointSourceFinite: -72.723, 43.762		39.81	6.05	0.79	72.723°W	43.762°N	0.00	1.04
SSCn Fixed Smoothing Zone 4 (opt)	Grid							31.96
PointSourceFinite: -72.723, 43.492		13.12	5.29	-0.24	72.723°W	43.492°N	0.00	6.64
PointSourceFinite: -72.723, 43.582		22.11	5.54	0.37	72.723°W	43.582°N	0.00	3.24
PointSourceFinite: -72.723, 43.447		8.86	5.21	-0.74	72.723°W	43.447°N	0.00	3.18
PointSourceFinite: -72.723, 43.537		17.60	5.41	0.12	72.723°W	43.537°N	0.00	2.77
PointSourceFinite: -72.723, 43.627		26.59	5.67	0.53	72.723°W	43.627°N	0.00	2.29
PointSourceFinite: -72.723, 43.402		5.57	5.16	-1.26	72.723°W	43.402°N	0.00	2.18
PointSourceFinite: -72.723, 43.672		31.01	5.81	0.64	72.723°W	43.672°N	0.00	1.74
PointSourceFinite: -72.723, 43.717		35.41	5.93	0.73	72.723°W	43.717°N	0.00	1.71
USGS Adaptive Smoothing Zone 2 (opt)	Grid							17.16
PointSourceFinite: -72.723, 43.492		13.12	5.29	-0.24	72.723°W	43.492°N	0.00	2.99
PointSourceFinite: -72.723, 43.582		22.11	5.54	0.37	72.723°W	43.582°N	0.00	1.51
PointSourceFinite: -72.723, 43.447		8.86	5.21	-0.74	72.723°W	43.447°N	0.00	1.49
PointSourceFinite: -72.723, 43.537		17.60	5.41	0.12	72.723°W	43.537°N	0.00	1.23
SSCn Adaptive Smoothing Zone 4 (opt)	Grid							16.70
PointSourceFinite: -72.723, 43.492		13.12	5.29	-0.24	72.723°W	43.492°N	0.00	2.99
PointSourceFinite: -72.723, 43.582		22.11	5.54	0.37	72.723°W	43.582°N	0.00	1.51
PointSourceFinite: -72.723, 43.447		8.86	5.21	-0.74	72.723°W	43.447°N	0.00	1.49
PointSourceFinite: -72.723, 43.537		17.60	5.41	0.12	72.723°W	43.537°N	0.00	1.23

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Input

Edition
Dynamic: Conterminous U.S. 2014 (update) (v4.2.0)

Spectral Period
Peak Ground Acceleration

Latitude
Decimal degrees
43.38

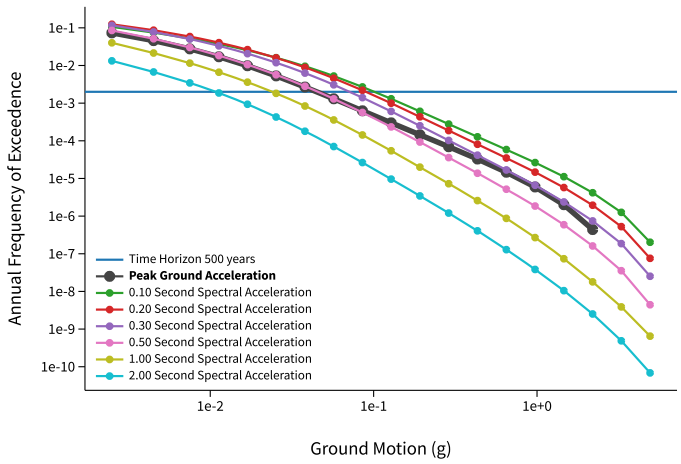
Time Horizon
Return period in years
500

Longitude
Decimal degrees, negative values for western longitudes
-72.723

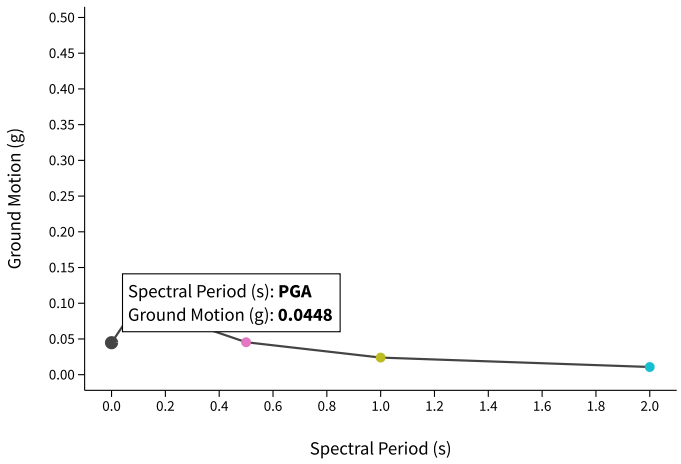
Site Class
760 m/s (B/C boundary)

Hazard Curve

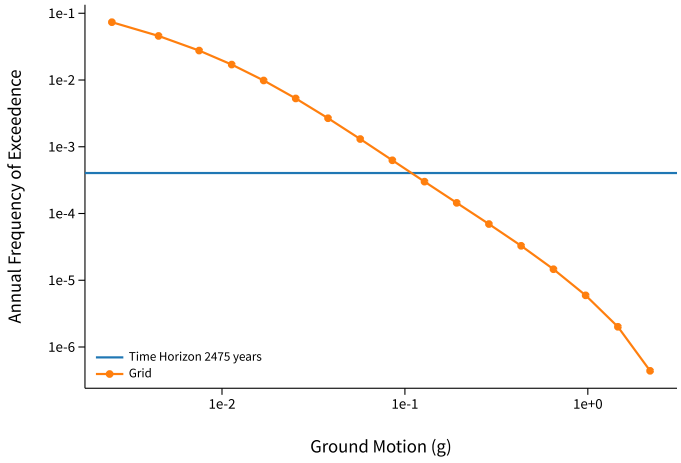
Hazard Curves



Uniform Hazard Response Spectrum



Component Curves for Peak Ground Acceleration

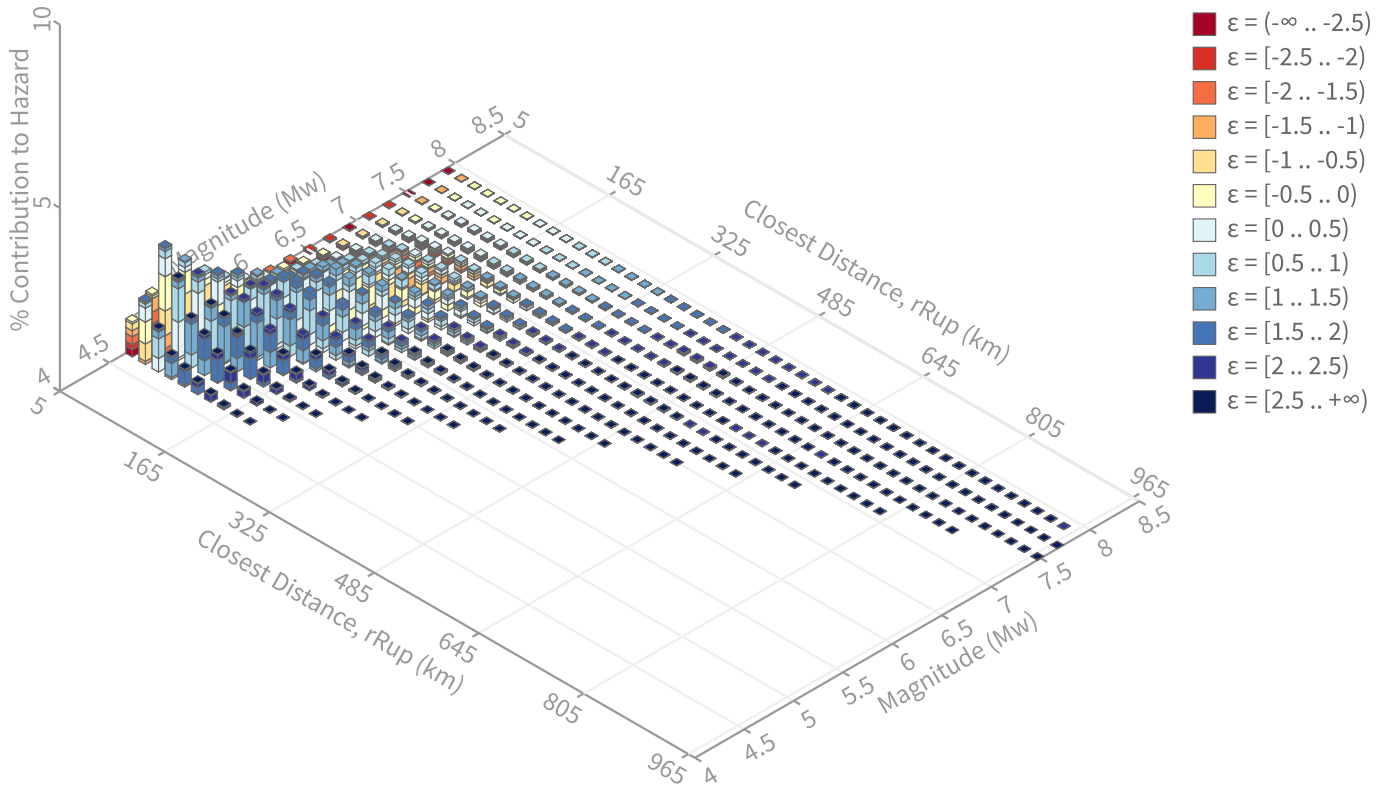


View Raw Data

Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 500 yrs
Exceedance rate: 0.002 yr^{-1}
PGA ground motion: 0.044782848 g

Recovered targets

Return period: 498.35013 yrs
Exceedance rate: 0.0020066213 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 1.81 %

Mean (over all sources)

m: 5.76
r: 106.74 km
ε_0: 0.23 σ

Mode (largest m-r bin)

m: 4.9
r: 30.59 km
ε_0: -0.35 σ
Contribution: 2.86 %

Mode (largest m-r-ε_0 bin)

m: 5.1
r: 51.48 km
ε_0: 0.26 σ
Contribution: 1.06 %

Discretization

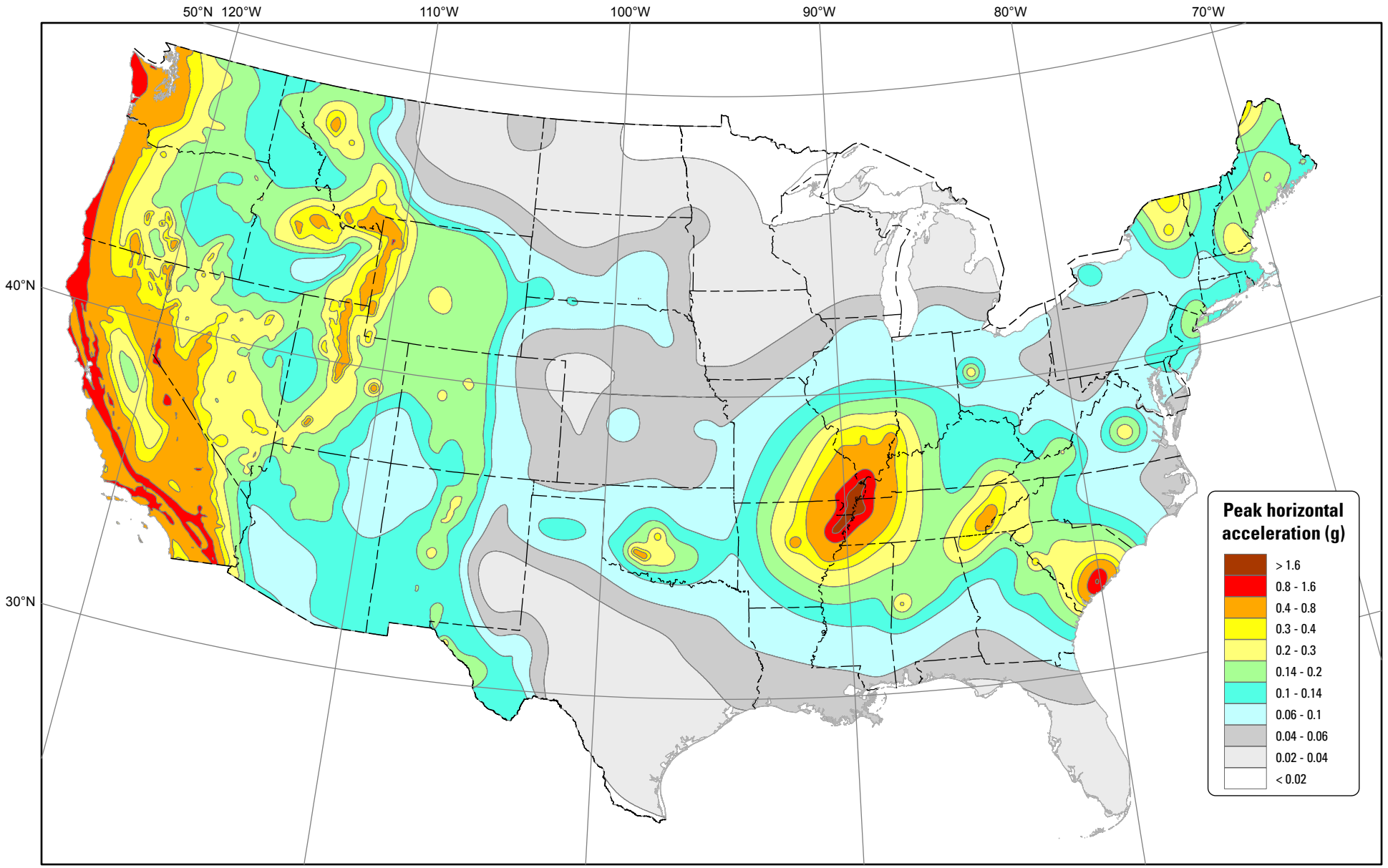
r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ϵ_0	lon	lat	az	%
USGS Fixed Smoothing Zone 2 (opt)	Grid							29.25
PointSourceFinite: -72.723, 43.717		37.40	5.29	-0.47	72.723°W	43.717°N	0.00	1.19
PointSourceFinite: -72.723, 43.897		56.89	5.45	0.08	72.723°W	43.897°N	0.00	1.08
SSCn Fixed Smoothing Zone 4 (opt)	Grid							27.17
PointSourceFinite: -72.723, 43.717		37.40	5.29	-0.47	72.723°W	43.717°N	0.00	1.19
USGS Adaptive Smoothing Zone 2 (opt)	Grid							20.18
SSCn Adaptive Smoothing Zone 4 (opt)	Grid							19.27
SSCn Fixed Smoothing Zone 7 (opt)	Grid							2.15
SSCn Adaptive Smoothing Zone 7 (opt)	Grid							1.00



2018 National Seismic Hazard Model for the conterminous United States

Peak horizontal acceleration
with a 2% probability of exceedance in 50 years
NEHRP site class B/C (V_{s30} = 760 m/s)

APPENDIX F

SPT N-VALUE CORRELATION

Characterization of Soil Strength Using SPT Correlation
Jewell Brook Watershed Site No. 5
Natural Resources Conservation Service
Ludlow, Windsor County, Vermont

Purpose

The purpose of this calculation is to estimate the effective shear strength (i.e. friction angle ø' and cohesion c') of soils within the embankment, foundation, and auxiliary spillway at Jewell Brook Watershed Site No. 5 in Ludlow, Windsor County, Vermont. The calculation uses three methods to correlate standard penetration tests (SPTs) blow counts to friction angle values. The calculation is based on SPT results from fifteen borings that were drilled by DDK.

References

1. Das, B. 2011. *Principles of Foundation Engineering.* Stamford, CT: Cengage Learning.
2. *Manual on Estimating Soil Properties for Foundation Design.* Cornell University, Ithaca, New York.
3. Tan, C.K., Et al. *Geotechnical Engineering: Engineering Manual for Shallow Foundations*. Virginia Tech, Blacksburg, Virginia.

   With information from: US Department of Navy (1982), *NAVFAC DM- 7.1-- Soil Mechanics* , Naval Facilities Engineering Command, VA, 348 pp. and Meyerhof G.G. (1956), *Penetration Tests and Bearing Capacity of Cohensionless Soils*, Proc., Journal of Soil Mechanics and Foundation Engineering, ASCE, Vol. 82, No. SM1, pp 1-11.

Correlation Between SPT Number and Friction Angle

Three methods were used to correlate the SPT number and friction angle and are outlined below.

Variables:

- N = measured penetration number
- N_{60} = standard penetration number corrected for field conditions
- $(N_1)_{60}$ = standardized value of N_{60}
- C_N = correction factor
- η_H = hammer efficiency (%)
- η_B = correction for borehole diameter
- η_S = sampler correction
- η_R = correction for rod length
- Ø' = friction angle
- σ'_{vo} = effective overburden pressure to the center of each layer (psf)
- p_a = atmospheric pressure (2000 psf)

$$N_{60} = \frac{N\eta_H\eta_B\eta_S\eta_R}{60}$$

$$C_N = \sqrt{\frac{1}{\frac{\sigma'_{vo}}{p_a}}}$$

$$(N_1)_{60} = C_N N_{60}$$

$$Ø'_1 = 27.1 + 0.3(N_1)_{60} - 0.00054[(N_1)_{60}]^2$$ Peck, Hanson, and Thornburn (1974)

$$Ø'_2 = \tan^{-1}\left[\frac{N_{60}}{12.2 + 20.3\left(\frac{\sigma'_{vo}}{p_a}\right)}\right]^{0.34}$$ Schmertmann (1975)

$$Ø'_3 = \sqrt{20(N_1)_{60}} + 20$$ Hatanaka and Uchida (1996)

DDK Engineering - JV

By: QDW Date: 03/27/20 Subject: Characterization of Soil Strength Sheet No.: of 18

Chkd By: ZSG Date: 05/01/20 Jewell Brook Watershed Site No. 5 Proj. No.: 172719-17

N:\2017\172719-17 - Jewell Pond Watershed Plan\Jewell Site 5\[SPT N-Value Correlation.xlsx]Purpose

JB5-19-1

Soil Properties

γ =	125	pcf	=	0.0625 tons/cf
γ_{sat} =	130	pcf	=	0.0650 tons/cf
γ_{H20} =	62.4	pcf	=	0.0312 tons/cf
γ' =	67.6	pcf	=	0.0338 tons/cf

Water Table Depth = Dry

Correction Factors (Reference 1)

η_H =	60
η_B =	1
η_S =	1
η_R =	Varies (see below)

Depth (feet)			**N**	σ'_{vo}/p_a	C_N	η_R	N_{60}	$(N_1)_{60}$	**Friction Angle** (°)		
Start	End	Center		(tsf)					$\emptyset'_1$	$\emptyset'_2$	$\emptyset'_3$
0.0	2.0	1.00	12	0.06	4.00	0.75	9.00	36.00	37.2	41.1	46.8
2.0	4.0	3.00	20	0.19	2.31	0.75	15.00	34.64	36.8	44.4	46.3
4.0	6.0	5.00	61	0.31	1.79	0.75	45.75	81.84	48.0	53.7	60.5
6.0	8.0	7.00	47	0.44	1.51	0.75	35.25	53.29	41.6	50.0	52.6
8.0	10.0	9.00	12	0.56	1.33	0.75	9.00	12.00	30.6	35.8	35.5
10.0	12.0	11.00	16	0.69	1.21	0.75	12.00	14.47	31.3	37.5	37.0
12.0	14.0	13.00	21	0.81	1.11	0.75	15.75	17.47	32.2	39.2	38.7
14.0	16.0	15.00	23	0.94	1.03	0.85	19.55	20.19	32.9	40.5	40.1
16.0	18.0	17.00	31	1.06	0.97	0.85	26.35	25.56	34.4	42.6	42.6
18.0	20.0	19.00	51	1.19	0.92	0.85	43.35	39.78	38.2	46.7	48.2
20.0	22.0	21.00	24	1.31	0.87	0.95	22.80	19.90	32.9	39.8	40.0
24.0	26.0	25.00	23	1.56	0.80	0.95	21.85	17.48	32.2	38.3	38.7
28.0	30.0	29.00	27	1.81	0.74	0.95	25.65	19.05	32.6	38.7	39.5
30.0	32.0	31.00	21	1.94	0.72	0.95	19.95	14.33	31.3	35.9	36.9
32.0	34.0	33.00	35	2.06	0.70	1.00	35.00	24.37	34.1	40.8	42.1
34.0	36.0	35.00	38	2.19	0.68	1.00	38.00	25.69	34.5	41.1	42.7
38.0	40.0	39.00	11	Excluded from calc since drilling rods fell through sample zone							
40.0	42.0	41.00	44	2.56	0.62	1.00	44.00	27.49	34.9	41.3	43.4
42.0	44.0	43.00	45	2.69	0.61	1.00	45.00	27.45	34.9	41.2	43.4
						Average =		28.4	35.0	41.6	43.1

DDK Engineering - JV

By: QDW Date: 03/27/20 Subject: Characterization of Soil Strength Sheet No.: of 18

Chkd By: ZSG Date: 05/01/20 Jewell Brook Watershed Site No. 5 Proj. No.: 172719-17

N:\2017\172719-17 - Jewell Pond Watershed Plan\Jewell Site 5\[SPT N-Value Correlation.xlsx]Purpose

JB5-19-2

Soil Properties

γ =	125	pcf	=	0.0625 tons/cf
γ_{sat} =	130	pcf	=	0.0650 tons/cf
γ_{H20} =	62.4	pcf	=	0.0312 tons/cf
γ' =	67.6	pcf	=	0.0338 tons/cf

Water Table Depth = Dry

Correction Factors (Reference 1)

η_H =	60
η_B =	1
η_S =	1
η_R =	Varies (see below)

Depth (feet)			N	σ'_{vo}/p_a	C_N	η_R	N_{60}	$(N_1)_{60}$	Friction Angle (°)		
Start	End	Center		(tsf)					$\emptyset'_1$	$\emptyset'_2$	$\emptyset'_3$
0.0	2.0	1.00	21	0.06	4.00	0.75	15.75	63.00	43.9	46.5	55.5
2.0	4.0	3.00	11	0.19	2.31	0.75	8.25	19.05	32.6	38.6	39.5
4.0	6.0	5.00	4	0.31	1.79	0.75	3.00	5.37	28.7	28.3	30.4
6.0	8.0	7.00	5	0.44	1.51	0.75	3.75	5.67	28.8	29.1	30.6
8.0	10.0	9.00	11	0.56	1.33	0.75	8.25	11.00	30.3	35.0	34.8
10.0	12.0	11.00	36	0.69	1.21	0.75	27.00	32.56	36.3	45.3	45.5
12.0	14.0	13.00	23	0.81	1.11	0.75	17.25	19.14	32.6	40.1	39.6
						Average =		22.3	33.3	37.5	39.4

DDK Engineering - JV

By:	QDW	Date:	03/27/20	Subject:	Characterization of Soil Strength	Sheet No.:	of 18
Chkd By:	ZSG	Date:	05/01/20		Jewell Brook Watershed Site No. 5	Proj. No.:	172719-17

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JB5-19-3

Soil Properties

γ =	125 pcf	=	0.0625	tons/cf
γ_{sat} =	130 pcf	=	0.0650	tons/cf
γ_{H20} =	62.4 pcf	=	0.0312	tons/cf
γ' =	67.6 pcf	=	0.0338	tons/cf

Water Table Depth = Dry

Correction Factors (Reference 1)

η_H =	60
η_B =	1
η_S =	1
η_R =	Varies (see below)

Depth (feet)			**N**	σ'_{vo}/p_a	C_N	η_R	N_{60}	$(N_1)_{60}$	**Friction Angle** (°)		
Start	End	Center		(tsf)					$\emptyset'_1$	$\emptyset'_2$	$\emptyset'_3$
0.0	2.0	1.00	19	0.06	4.00	0.75	14.25	57.00	42.4	45.5	53.8
2.0	4.0	3.00	25	0.19	2.31	0.75	18.75	43.30	39.1	46.5	49.4
4.0	6.0	5.00	14	0.31	1.79	0.75	10.50	18.78	32.5	39.5	39.4
6.0	8.0	7.00	14	0.44	1.51	0.75	10.50	15.87	31.7	38.3	37.8
8.0	10.0	9.00	9	0.56	1.33	0.75	6.75	9.00	29.8	33.2	33.4
10.0	12.0	11.00	26	0.69	1.21	0.75	19.50	23.52	33.9	42.1	41.7
12.0	14.0	13.00	39	0.81	1.11	0.75	29.25	32.45	36.3	45.2	45.5
						Average =		28.6	35.1	41.5	43.0

DDK Engineering - JV

By:	QDW	Date:	03/27/20	Subject:	Characterization of Soil Strength	Sheet No.:	of 18
Chkd By:	ZSG	Date:	05/01/20		Jewell Brook Watershed Site No. 5	Proj. No.:	172719-17

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JB1-19-4

Soil Properties

γ =	125 pcf	=	0.0625	tons/cf
γ_{sat} =	130 pcf	=	0.0650	tons/cf
γ_{H20} =	62.4 pcf	=	0.0312	tons/cf
γ' =	67.6 pcf	=	0.0338	tons/cf

Water Table Depth = Dry

Correction Factors (Reference 1)

η_H =	60
η_B =	1
η_S =	1
η_R =	Varies (see below)

Depth (feet)			**N**	σ'_{vo}/p_a	C_N	η_R	N_{60}	$(N_1)_{60}$	**Friction Angle** (°)		
Start	End	Center		(tsf)					$\emptyset'_1$	$\emptyset'_2$	$\emptyset'_3$
0.0	2.0	1.00	18	0.06	4.00	0.75	13.50	54.00	41.7	45.0	52.9
2.0	4.0	3.00	28	0.19	2.31	0.75	21.00	48.50	40.4	47.6	51.1
4.0	6.0	5.00	12	0.31	1.79	0.75	9.00	16.10	31.8	38.0	37.9
6.0	8.0	7.00	19	0.44	1.51	0.75	14.25	21.54	33.3	41.2	40.8
8.0	10.0	9.00	10	0.56	1.33	0.75	7.50	10.00	30.0	34.1	34.1
						Average =		30.0	35.5	41.2	43.4

DDK Engineering - JV

By:	QDW	Date:	03/27/20	Subject:	Characterization of Soil Strength	Sheet No.:	of 18
Chkd By:	ZSG	Date:	05/01/20		Jewell Brook Watershed Site No. 5	Proj. No.:	172719-17

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JB5-19-201N

Soil Properties

γ =	125 pcf	=	0.0625	tons/cf
γ_{sat} =	130 pcf	=	0.0650	tons/cf
γ_{H20} =	62.4 pcf	=	0.0312	tons/cf
γ' =	67.6 pcf	=	0.0338	tons/cf

Water Table Depth = Dry

Correction Factors (Reference 1)

η_H =	60
η_B =	1
η_S =	1
η_R =	Varies (see below)

Depth (feet)			**N**	σ'_{vo}/p_a	C_N	η_R	N_{60}	$(N_1)_{60}$	**Friction Angle** (^{o})		
Start	End	Center		(tsf)					$\emptyset'_1$	$\emptyset'_2$	$\emptyset'_3$
0.0	2.0	1.00	13	0.06	4.00	0.75	9.75	39.00	38.0	41.9	47.9
2.0	4.0	3.00	23	0.19	2.31	0.75	17.25	39.84	38.2	45.7	48.2
4.0	6.0	5.00	36	0.31	1.79	0.75	27.00	48.30	40.3	48.6	51.1
						Average =		42.4	38.8	45.4	49.1

DDK Engineering - JV

By:	QDW	Date:	03/27/20	Subject:	Characterization of Soil Strength	Sheet No.:	of 18
Chkd By:	ZSG	Date:	05/01/20		Jewell Brook Watershed Site No. 5	Proj. No.:	172719-17

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JB5-19-201NA

Soil Properties

γ =	125 pcf	=	0.0625	tons/cf
γ_{sat} =	130 pcf	=	0.0650	tons/cf
γ_{H20} =	62.4 pcf	=	0.0312	tons/cf
γ' =	67.6 pcf	=	0.0338	tons/cf

Water Table Depth = Dry

Correction Factors (Reference 1)

η_H =	60
η_B =	1
η_S =	1
η_R =	Varies (see below)

Depth (feet)			N	σ'_{vo}/p_a	C_N	η_R	N_{60}	$(N_1)_{60}$	Friction Angle (°)		
Start	End	Center		(tsf)					$\emptyset'_1$	$\emptyset'_2$	$\emptyset'_3$
8.0	10.0	9.00	51	0.56	1.33	0.75	38.25	51.00	41.0	49.7	51.9
12.0	14.0	13.00	56	0.81	1.11	0.75	42.00	46.59	39.9	48.7	50.5
14.0	16.0	15.00	63	0.94	1.03	0.85	53.55	55.31	42.0	50.2	53.3
18.0	20.0	19.00	65	1.19	0.92	0.85	55.25	50.70	40.9	49.1	51.8
						Average =		50.9	41.0	49.4	51.9

DDK Engineering - JV

By:	QDW	Date:	03/27/20	Subject:	Characterization of Soil Strength	Sheet No.:	of 18
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JB5-19-202N

Soil Properties

γ =	125	pcf	=	0.0625 tons/cf
γ_{sat} =	130	pcf	=	0.0650 tons/cf
γ_{H20} =	62.4	pcf	=	0.0312 tons/cf
γ' =	67.6	pcf	=	0.0338 tons/cf

Water Table Depth = 19.7 ft

Correction Factors (Reference 1)

η_H =	60
η_B =	1
η_S =	1
η_R =	Varies (see below)

Depth (feet)			N	σ'_{vo}/p_a	C_N	η_R	N_{60}	$(N_1)_{60}$	Friction Angle (°)		
Start	End	Center		(tsf)					$\emptyset'_1$	$\emptyset'_2$	$\emptyset'_3$
0.0	2.0	1.00	11	0.06	4.00	0.75	8.25	33.00	36.4	40.2	45.7
2.0	4.0	3.00	21	0.19	2.31	0.75	15.75	36.37	37.3	44.8	47.0
4.0	6.0	5.00	16	0.31	1.79	0.75	12.00	21.47	33.3	40.8	40.7
6.0	8.0	7.00	22	0.44	1.51	0.75	16.50	24.95	34.2	42.6	42.3
8.0	10.0	9.00	29	0.56	1.33	0.75	21.75	29.00	35.3	44.2	44.1
10.0	12.0	11.00	35	0.69	1.21	0.75	26.25	31.66	36.1	45.0	45.2
12.0	14.0	13.00	69	0.81	1.11	0.75	51.75	57.41	42.5	50.7	53.9
14.0	16.0	15.00	67	0.94	1.03	0.85	56.95	58.82	42.9	50.8	54.3
18.0	20.0	19.00	89	1.19	0.92	0.85	75.65	69.42	45.3	52.1	57.3
						Average =		40.2	38.2	45.7	47.8

DDK Engineering - JV

By:	QDW	Date:	03/27/20	Subject:	Characterization of Soil Strength	Sheet No.:	of 18
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JB5-19-203N

Soil Properties

γ =	125	pcf	=	0.0625 tons/cf
γ_{sat} =	130	pcf	=	0.0650 tons/cf
γ_{H20} =	62.4	pcf	=	0.0312 tons/cf
γ' =	67.6	pcf	=	0.0338 tons/cf

Water Table Depth = 14.4

Correction Factors (Reference 1)

η_H =	60
η_B =	1
η_S =	1
η_R =	Varies (see below)

Depth (feet)			N	σ'_{vo}/p_a	C_N	η_R	N_{60}	$(N_1)_{60}$	Friction Angle (°)		
Start	End	Center		(tsf)					$\emptyset'_1$	$\emptyset'_2$	$\emptyset'_3$
0.0	2.0	1.00	15	0.06	4.00	0.75	11.25	45.00	39.5	43.2	50.0
2.0	4.0	3.00	70	0.19	2.31	0.75	52.50	121.24	55.5	56.3	69.2
4.0	6.0	5.00	33	0.31	1.79	0.75	24.75	44.27	39.3	47.8	49.8
6.0	8.0	7.00	52	0.44	1.51	0.75	39.00	58.96	42.9	50.9	54.3
8.0	10.0	9.00	65	0.56	1.33	0.75	48.75	65.00	44.3	52.0	56.1
10.0	12.0	11.00	69	0.69	1.21	0.75	51.75	62.41	43.7	51.6	55.3
14.0	16.0	15.00	98	0.92	1.04	0.85	83.30	86.83	49.1	54.5	61.7
16.0	18.0	17.00	83	0.99	1.01	0.85	70.55	70.98	45.7	52.5	57.7
18.0	20.0	19.00	57	1.06	0.97	0.85	48.45	47.16	40.0	48.5	50.7
						Average =		66.9	44.5	50.8	56.1

DDK Engineering - JV

By:	QDW	Date:	03/27/20	Subject:	Characterization of Soil Strength	Sheet No.:	of 18
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JB5-19-204N

Soil Properties

γ =	125 pcf	=	0.0625	tons/cf
γ_{sat} =	130 pcf	=	0.0650	tons/cf
γ_{H20} =	62.4 pcf	=	0.0312	tons/cf
γ' =	67.6 pcf	=	0.0338	tons/cf

Water Table Depth = Dry

Correction Factors (Reference 1)

η_H =	60
η_B =	1
η_S =	1
η_R =	Varies (see below)

Depth (feet)			N	σ'_{vo}/p_a	C_N	η_R	N_{60}	$(N_1)_{60}$	Friction Angle (°)		
Start	End	Center		(tsf)					$\emptyset'_1$	$\emptyset'_2$	$\emptyset'_3$
0.0	2.0	1.00	16	0.06	4.00	0.75	12.00	48.00	40.3	43.9	51.0
2.0	4.0	3.00	51	0.19	2.31	0.75	38.25	88.33	49.4	53.4	62.0
4.0	6.0	5.00	41	0.31	1.79	0.75	30.75	55.01	42.0	49.9	53.2
6.0	8.0	7.00	69	0.44	1.51	0.75	51.75	78.24	47.3	53.6	59.6
8.0	10.0	9.00	58	0.56	1.33	0.75	43.50	58.00	42.7	50.9	54.1
10.0	12.0	11.00	50	0.69	1.21	0.75	37.50	45.23	39.6	48.5	50.1
14.0	16.0	15.00	43	0.94	1.03	0.85	36.55	37.75	37.7	46.5	47.5
16.0	17.8	16.90	71	1.06	0.97	0.85	60.35	58.72	42.9	50.7	54.3
20.0	22.0	21.00	77	1.31	0.87	0.95	73.15	63.85	44.1	51.1	55.7
24.0	26.0	25.00	57	1.56	0.80	0.95	54.15	43.32	39.1	47.0	49.4
28.0	29.8	28.90	45	1.81	0.74	0.95	42.75	31.81	36.1	43.7	45.2
30.5	32.0	31.25	42	1.95	0.72	0.95	39.90	28.55	35.2	42.5	43.9
38.0	40.0	39.00	58	2.44	0.64	1.00	58.00	37.15	37.5	44.4	47.3
						Average =		51.8	41.0	48.2	51.8

DDK Engineering - JV

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JB5-19-205S

Soil Properties

γ =	125 pcf	=	0.0625	tons/cf
γ_{sat} =	130 pcf	=	0.0650	tons/cf
γ_{H20} =	62.4 pcf	=	0.0312	tons/cf
γ' =	67.6 pcf	=	0.0338	tons/cf
Water Table Depth =			6.7	

Correction Factors (Reference 1)

η_H =	60
η_B =	1
η_S =	1
η_R =	Varies (see below)

Depth (feet)			**N**	σ'_{vo}/p_a	C_N	η_R	N_{60}	$(N_1)_{60}$	**Friction Angle** (^{o})		
Start	End	Center		(tsf)					$\emptyset'_1$	$\emptyset'_2$	$\emptyset'_3$
0.0	2.0	1.00	8	0.06	4.00	0.75	6.00	24.00	34.0	37.2	41.9
2.0	4.0	3.00	29	0.19	2.31	0.75	21.75	50.23	40.8	48.0	51.7
4.0	6.0	5.00	10	0.31	1.79	0.75	7.50	13.42	31.0	36.3	36.4
6.0	8.0	7.00	26	0.43	1.53	0.75	19.50	29.78	35.6	44.3	44.4
8.0	10.0	9.00	36	0.50	1.42	0.75	27.00	38.32	37.8	46.9	47.7
10.0	12.0	11.00	71	0.56	1.33	0.75	53.25	70.90	45.7	52.8	57.7
12.0	13.7	12.85	58	0.63	1.26	0.75	43.50	54.95	42.0	50.4	53.2
14.0	16.0	15.00	46	0.70	1.20	0.85	39.10	46.76	39.9	48.8	50.6
						Average =		41.0	38.3	45.6	47.9

DDK Engineering - JV

By:	QDW	Date:	03/27/20	Subject:	Characterization of Soil Strength	Sheet No.:	of 18
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JB5-19-206S

Soil Properties

γ =	125 pcf	=	0.0625	tons/cf
γ_{sat} =	130 pcf	=	0.0650	tons/cf
γ_{H20} =	62.4 pcf	=	0.0312	tons/cf
γ' =	67.6 pcf	=	0.0338	tons/cf

Water Table Depth = 12.0

Correction Factors (Reference 1)

η_H =	60
η_B =	1
η_S =	1
η_R =	Varies (see below)

Depth (feet)			**N**	σ'_{vo}/p_a	C_N	η_R	N_{60}	$(N_1)_{60}$	**Friction Angle** (°)		
Start	End	Center		(tsf)					$\emptyset'_1$	$\emptyset'_2$	$\emptyset'_3$
0.0	2.0	1.00	5	0.06	4.00	0.75	3.75	15.00	31.5	32.9	37.3
2.0	4.0	3.00	6	0.19	2.31	0.75	4.50	10.39	30.2	33.0	34.4
4.0	6.0	5.00	16	0.31	1.79	0.75	12.00	21.47	33.3	40.8	40.7
6.0	8.0	7.00	23	0.44	1.51	0.75	17.25	26.08	34.6	43.0	42.8
8.0	10.0	9.00	41	0.56	1.33	0.75	30.75	41.00	38.5	47.6	48.6
12.0	14.0	13.00	56	0.78	1.13	0.75	42.00	47.44	40.1	48.9	50.8
14.0	15.8	14.90	61	0.85	1.09	0.85	51.85	56.30	42.3	50.5	53.6
18.0	20.0	19.00	46	0.99	1.01	0.85	39.10	39.36	38.1	46.9	48.1
						Average =		32.1	36.1	42.9	44.5

DDK Engineering - JV

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JB5-19-207S

Soil Properties

γ =	125 pcf	=	0.0625	tons/cf
γ_{sat} =	130 pcf	=	0.0650	tons/cf
γ_{H20} =	62.4 pcf	=	0.0312	tons/cf
γ' =	67.6 pcf	=	0.0338	tons/cf

Water Table Depth = 13.8

Correction Factors (Reference 1)

η_H =	60
η_B =	1
η_S =	1
η_R =	Varies (see below)

Depth (feet)			N	σ'_{vo}/p_a	C_N	η_R	N_{60}	$(N_1)_{60}$	Friction Angle (°)		
Start	End	Center		(tsf)					$\emptyset'_1$	$\emptyset'_2$	$\emptyset'_3$
0.0	2.0	1.00	16	0.06	4.00	0.75	12.00	48.00	40.3	43.9	51.0
2.0	4.0	3.00	40	0.19	2.31	0.75	30.00	69.28	45.3	51.1	57.2
4.0	6.0	5.00	67	0.31	1.79	0.75	50.25	89.89	49.7	54.5	62.4
6.0	8.0	7.00	83	0.44	1.51	0.75	62.25	94.11	50.6	55.3	63.4
8.0	10.0	9.00	63	0.56	1.33	0.75	47.25	63.00	43.9	51.7	55.5
12.0	14.0	13.00	65	0.81	1.11	0.75	48.75	54.08	41.7	50.1	52.9
14.0	16.0	15.00	50	0.90	1.05	0.85	42.50	44.72	39.4	48.2	49.9
18.0	20.0	19.00	54	1.04	0.98	0.85	45.90	45.05	39.5	48.1	50.0
						Average =		63.5	43.8	50.4	55.3

DDK Engineering - JV

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JB5-19-208S

Soil Properties

γ =	125 pcf	=	0.0625	tons/cf
γ_{sat} =	130 pcf	=	0.0650	tons/cf
γ_{H20} =	62.4 pcf	=	0.0312	tons/cf
γ' =	67.6 pcf	=	0.0338	tons/cf

Water Table Depth = 0.0

Correction Factors (Reference 1)

η_H =	60
η_B =	1
η_S =	1
η_R =	Varies (see below)

Depth (feet)			N	σ'_{vo}/p_a	C_N	η_R	N_{60}	$(N_1)_{60}$	Friction Angle (°)		
Start	End	Center		(tsf)					$\emptyset'_1$	$\emptyset'_2$	$\emptyset'_3$
0.0	2.0	1.00	9	0.03	5.44	0.75	6.75	36.72	37.4	38.8	47.1
2.0	4.0	3.00	35	0.10	3.14	0.75	26.25	82.43	48.2	50.9	60.6
4.0	6.0	5.00	55	0.17	2.43	0.75	41.25	100.34	51.8	54.3	64.8
6.0	8.0	7.00	66	0.24	2.06	0.75	49.50	101.76	52.0	55.2	65.1
8.0	10.0	9.00	50	0.30	1.81	0.75	37.50	67.99	45.0	51.9	56.9
10.0	12.0	11.00	69	0.37	1.64	0.75	51.75	84.87	48.7	54.2	61.2
12.0	14.0	13.00	75	0.44	1.51	0.75	56.25	84.86	48.7	54.4	61.2
16.0	18.0	17.00	42	0.57	1.32	0.85	35.70	47.10	40.0	48.9	50.7
18.0	20.0	19.00	42	0.64	1.25	0.85	35.70	44.55	39.4	48.4	49.8
20.0	22.0	21.00	50	0.71	1.19	0.95	47.50	56.38	42.3	50.6	53.6
24.0	26.0	25.00	75	0.85	1.09	0.95	71.25	77.51	47.1	53.5	59.4
28.0	30.0	29.00	79	0.98	1.01	0.95	75.05	75.80	46.7	53.2	58.9
30.0	32.0	31.00	70	1.05	0.98	0.95	66.50	64.97	44.3	51.6	56.0
32.0	33.9	32.95	96	1.11	0.95	1.00	96.00	90.97	49.9	54.7	62.7
34.0	36.0	35.00	70	1.18	0.92	1.00	70.00	64.36	44.2	51.4	55.9
42.0	44.0	43.00	44	1.45	0.83	1.00	44.00	36.50	37.3	45.5	47.0
						Average =		69.8	45.2	51.1	56.9

DDK Engineering - JV

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JB5-19-209S

Soil Properties

γ =	125 pcf	=	0.0625	tons/cf
γ_{sat} =	130 pcf	=	0.0650	tons/cf
γ_{H20} =	62.4 pcf	=	0.0312	tons/cf
γ' =	67.6 pcf	=	0.0338	tons/cf
Water Table Depth =			0.0	

Correction Factors (Reference 1)

η_H =	60
η_B =	1
η_S =	1
η_R =	Varies (see below)

Depth (feet)			**N**	σ'_{vo}/p_a	C_N	η_R	N_{60}	$(N_1)_{60}$	**Friction Angle** (^{o})		
Start	End	Center		(tsf)					$\emptyset'_1$	$\emptyset'_2$	$\emptyset'_3$
0.0	2.0	1.00	5	0.03	5.44	0.75	3.75	20.40	33.0	33.3	40.2
2.0	4.0	3.00	41	0.10	3.14	0.75	30.75	96.57	51.0	52.4	63.9
4.0	6.0	5.00	35	0.17	2.43	0.75	26.25	63.85	44.1	50.0	55.7
6.0	8.0	7.00	55	0.24	2.06	0.75	41.25	84.80	48.7	53.5	61.2
8.0	10.0	9.00	48	0.30	1.81	0.75	36.00	65.27	44.4	51.5	56.1
12.2	14.0	13.10	87	0.44	1.50	0.75	65.25	98.06	51.3	55.7	64.3
14.0	16.0	15.00	59	0.51	1.40	0.85	50.15	70.43	45.6	52.7	57.5
18.0	20.0	19.00	59	0.64	1.25	0.85	50.15	62.58	43.8	51.6	55.4
20.0	22.0	21.00	77	0.71	1.19	0.95	73.15	86.83	49.1	54.7	61.7
						Average =		72.1	45.6	50.6	57.3

DDK Engineering - JV

By:	QDW	Date:	03/27/20	Subject:	Characterization of Soil Strength	Sheet No.:	of 18
Chkd By:	ZSG	Date:	05/01/20		Jewell Brook Watershed Site No. 5	Proj. No.:	172719-17

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JB5-19-210S

Soil Properties

γ =	125	pcf	=	0.0625 tons/cf
γ_{sat} =	130	pcf	=	0.0650 tons/cf
γ_{H20} =	62.4	pcf	=	0.0312 tons/cf
γ' =	67.6	pcf	=	0.0338 tons/cf

Water Table Depth = 4.6

Correction Factors (Reference 1)

η_H =	60
η_B =	1
η_S =	1
η_R =	Varies (see below)

Depth (feet)			N	σ'_{vo}/p_a	C_N	η_R	N_{60}	$(N_1)_{60}$	Friction Angle (°)		
Start	End	Center		(tsf)					$\emptyset'_1$	$\emptyset'_2$	$\emptyset'_3$
0.0	2.0	1.00	25	0.06	4.00	0.75	18.75	75.00	46.6	48.2	58.7
2.0	4.0	3.00	18	0.19	2.31	0.75	13.50	31.18	35.9	43.3	45.0
4.0	6.0	5.00	28	0.30	1.82	0.75	21.00	38.28	37.8	46.3	47.7
6.0	8.0	7.00	58	0.37	1.65	0.75	43.50	71.65	45.8	52.6	57.9
8.0	9.8	8.90	64	0.43	1.52	0.75	48.00	72.96	46.1	53.0	58.2
						Average =		57.8	42.4	48.7	53.5

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By:	QDW	Date:	03/27/20	Subject:	Characterization of Soil Strength
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Summary of Results

Calculation of Friction Angle - Correlation to Standard Penetration Tests (SPTs)							
				Estimated Friction Angle From SPTs[2]			
Boring No.	G.S. Elevation[1]	Depth Range (ft)	Average $(N_1)_{60}$	$ø'_1$	$ø'_2$	$ø'_3$	Average
JB5-19-1	1496.8	0.0-44.0	28.4	35.0	41.6	43.1	39.9
JB5-19-2	1496.8	0.0-14.0	22.3	33.3	37.5	39.4	36.8
JB5-19-3	1496.3	0.0-14.0	28.6	35.1	41.5	43.0	39.9
JB5-19-4	1496.9	0.0-10.0	30.0	35.5	41.2	43.4	40.0
JB5-19-201N	1476.5	0.0-6.0	42.4	38.8	45.4	49.1	44.4
JB5-19-201NA	1476.5	8.0-20.0	50.9	41.0	49.4	51.9	47.4
JB5-19-202N	1485.5	0.0-20.0	40.2	38.2	45.7	47.8	43.9
JB5-19-203N	1489.1	0.0-20.0	66.9	44.5	50.8	56.1	50.5
JB5-19-204N	1487.7	0.0-40.0	51.8	41.0	48.2	51.8	47.0
JB5-19-205S	1479.5	0.0-16.0	41.0	38.3	45.6	47.9	44.0
JB5-19-206S	1481.6	0.0-20.0	32.1	36.1	42.9	44.5	41.2
JB5-19-207S	1485.7	0.0-20.0	63.5	43.8	50.4	55.3	49.8
JB5-19-208S	1488.7	0.0-44.0	69.8	45.2	51.1	56.9	51.1
JB5-19-209S	1486.3	0.0-22.0	72.1	45.6	50.6	57.3	51.2
JB5-19-210S	1483.2	0.0-9.8	57.8	42.4	48.7	53.5	48.2

Notes:

[1] Represents the approx. elev. at the time the boring was advanced.

[2] Friction angles estimated using 3 different methods:

- $ø'_1$ Peck, Hanson, and Thornburn (1974)
- $ø'_2$ Schmertmann (1975)
- $ø'_3$ Hatanaka and Uchida (1996)

Max	57.3
Min	33.3
Average	45.0
Std. Dev.	6.2

APPENDIX G

SITES MATERIAL INPUT PARAMETERS CALCULATION

SITES Material Input Parameters
Supplemental Watershed Plan and Environmental Document
Jewell Brook Watershed Site No. 5
Ludlow, Windsor County, Vermont

INTRODUCTION

The purpose of this calculation is to estimate the material input parameters to be used in the SITES analyses for the Jewell Brook Watershed Site No. 5 (Jewell Brook #5) located in Ludlow, Windsor County, Vermont. The material parameters are estimated based on empirical and historical data, subsurface exploration data, and results of laboratory tests performed on soil samples retrieved during the subsurface exploration performed by DDK Engineering - JV (DDK) in October and November 2019.

Borings JB5-19-201N through JB5-19-210SA were performed in the auxiliary spillways at Jewell Brook #5. Borings ending with "N" denote boring performed within the limits of the northern (left) auxillary spillway and borings ending with "S" denote borings performed within the southern (right) auxillary spillway. Borings were advanced to collect in-situ samples of spillway material for laboratory testing and classification. Borings JB5-19-1 through JB5-19-4 will not be considered in this calculation since they are outside of the auxiliary spillway area. Due to the topsoil layer being very thin or nonexistent, no estimation of material parameters for topsoil was

REFERENCES

1) Carter, Michael and Bentley, Stephen P., "Correlations of Soil Properties", John Wiley & Sons, Ltd., 2016

2) Das, Braja M., "Principles of Geotechnical Engineering (8th Ed.)", Cengage, 2010.

3) NRCS National Engineering Handbook Part 628, Chapter 52 "Field Procedures Guide for the Headcut Erodibility Index", (2001).

4) "SITES 2005 Water Resource Site Analysis Computer Program: User Guide", NRCS, October 2007.

5) "SPT Average N-Value Correlation", D'Appolonia, March 2020.

SITES Input Parameters

Unit Weights of Soils

The unit weight of existing auxiliary spillway soils at Jewell Brook #5 were estimated using laboratory testing of disturbed (SpT) samples, as well as assumed void ratios for each soil type (Ref. 1 & 2). The approximated dry unit weight is used for all layers.

		Approximated		
Layer	USCS Class.	Avg. G_S [1]	Void Ratio (e) [2]	Dry Unit Weight (lb./cu. Ft.)
1N	SM	2.68	0.5	111.5
2N	SM	2.70	0.4	120.2
3N	ML	2.70 [3]	0.4	120.3
1S	SM	2.67	0.5	111.2
2S	SM	2.69	0.4	120.0

[1] From Laboratory Index Testing Data

[2] Based on values presented in Reference No. 2, Table 3.2

[3] Assumed equal to layer 2N

Plasticity Index - North Spillway

The plasticity index of each soil type was estimated using average values from laboratory index testing data.

Layer	Boring	Sample ID	Atterberg Limits		
			USCS Symbol[1]	LL (%)	PI (%)
1N	JB5-19-201N	SpT-1	Non-Plastic		
		SpT-2/3	Non-Plastic		
	JB5-19-202N	SpT-1/3	Non-Plastic		
		SpT-4/5	Non-Plastic		
	JB5-19-203N	SpT-1/2	Non-Plastic		
	JB5-19-204N	SpT-1	Non-Plastic		
		SpT-2/3/4	Non-Plastic		
2N	JB5-19-201NA	SpT-1/2	Non-Plastic		
		SpT-6	Non-Plastic		
	JB5-19-202N	SpT-7/8	Non-Plastic		
		SpT-10	Non-Plastic		
	JB5-19-203N	SpT-4/5	Non-Plastic		
		SpT-6/7	Non-Plastic		
		SpT-9/10	Non-Plastic		
	JB5-19-204N	SpT-6/7	Non-Plastic		
		SpT-8/9	Non-Plastic		
		SpT-11/12	Non-Plastic		
		SpT-15	Non-Plastic		
3N	JB5-19-204N	SpT-20	Non-Plastic		
		SpT-22	Non-Plastic		
		SpT-23	Non-Plastic		

[1] This denotes the USCS symbol for the fines portion of each sample.

Layer	Avg. PI (%)
1N	N.P.
2N	N.P.
3N	N.P.

Plasticity Index - South Spillway

The plasticity index of each soil type was estimated using average values from laboratory index testing data.

Layer	Boring	Sample ID	Atterberg Limits		
			USCS Symbol[(1)]	LL (%)	PI (%)
1S	JB5-19-205S	SpT-4/5	Non-Plastic		
	JB5-19-206S	SpT-1	Non-Plastic		
		SpT-4/5	Non-Plastic		
	JB5-19-207S	SpT-1/2	Non-Plastic		
	JB5-19-209S	SpT-1	Non-Plastic		
		SpT-3/4	Non-Plastic		
	JB5-19-210S	SpT-1	Non-Plastic		
		SpT-3/4	Non-Plastic		
2S	JB5-19-205S	SpT-6/7	Non-Plastic		
		SpT-9	Non-Plastic		
	JB5-19-206S	SpT-7/8	Non-Plastic		
		SpT-10	Non-Plastic		
	JB5-19-207S	SpT-4	Non-Plastic		
		SpT-7/8	Non-Plastic		
		SpT-9/10	Non-Plastic		
	JB5-19-208S	SpT-4/5	Non-Plastic		
		SpT-6/7	Non-Plastic		
		SpT-10	Non-Plastic		
		SpT-11	Non-Plastic		
		SpT-15/16	Non-Plastic		
		SpT-17/18	Non-Plastic		
		SpT-21	Non-Plastic		
		SpT-22	Non-Plastic		
		SpT-24	Non-Plastic		
	JB5-19-209S	SpT-7/8	Non-Plastic		
	JB5-19-210SA	SpT-2/3	Non-Plastic		
		SpT-6	Non-Plastic		

Layer	Avg. PI (%)
1S	N.P.
2S	N.P.

Clay Content (%)

The clay content of each soil type was determined using the average sieve and hydrometer results of each soil type from the laboratory index testing data.

Layer	Boring	Sample No.	USCS Class.	Clay Content (%)
1N	JB5-19-201N	SpT-2/3	SM	6.59
	JB5-19-201NA	SpT-1/2	SM	5.73
	JB5-19-204N	SpT-2/3/4	SM	9.15
2N	JB5-19-201NA	SpT-1/2	SM	11.27
	JB5-19-202N	SpT-7/8	SM	11.37
	JB5-19-203N	SpT-4/5	SM	6.92
	JB5-19-203N	SpT-9/10	SM	6.02
	JB5-19-204N	SpT-8/9	SM	13.63
1S	JB5-19-205S	SpT-4/5	SM	12.30
	JB5-19-206S	SpT-4/5	SM	13.88
	JB5-19-207S	SpT-1/2	SM	9.71
	JB5-19-209S	SpT-1	SM	1.72
	JB5-19-209S	SpT-3/4	SM	12.45
	JB5-19-210S	SpT-1	SM	0.70
	JB5-19-210S	SpT-3/4	SM	8.91
2S	JB5-19-205S	SpT-9	SM	11.88
	JB5-19-206S	SpT-7/8	SM	10.05
	JB5-19-207S	SpT-9/10	SM	9.96
	JB5-19-208S	SpT-4/5	GM	10.30
	JB5-19-208S	SpT-15/16	SM	11.52

Layer	Avg.Clay Content (%)
1N	7.16
2N	9.84
3N	9.84[(1)]
1S	8.52
2S	10.74

[(1)] Since no samples in Layer 3N underwent hydrometer testing, it was assumed that the clay content for Layer 3N was equivalent to that of Layer 2N.

Headcut Erodibility Index

The headcut erodibility index was estimated using the procedures and typical values described in NRCS Part 628, Chapter 52 of the National Engineering Handbook. For factors which use soil characteristics (IDM, UCS, LL), this calculation uses the average value for each layer. (Ref. 3)

The equation given for the headcut erodibility index is:

$$K_h = M_s \times K_b \times K_d \times J_s \qquad [52\text{–}1]$$

where:
- M_s = material strength number of the earth material
- K_b = block or particle size number
- K_d = discontinuity or interparticle bond shear strength number
- J_s = relative ground structure number

For cohesionless soil:

$M_S = 1.7(IDM)^{0.832}$ (MPa)

$K_b = 1$ Using cohesionless soil with D<0.1m

$K_d = \tan(\Phi'_r)$ where:

$\Phi'_r = 169.58(LL)^{-0.4925}$ For soils with clay content <20%

$J_S = 1$ Intact soil

Table 52–2 Material strength number, M_s, for cohesionless soil 1/

Relative density	Field identification tests	SPT 2/ 5/ (blows/0.3 m) 4/ 5/	In situ deformation modulus (IDM) (MPa) 5/	M_s 3/
Very loose	Particles loosely packed. High percentage of voids. Very easily dislodged by hand. Matrix crumbles easily when scraped with point of geologic pick. Raveling often occurs on excavated faces.	< 5	< 0.005	< 0.02
Loose	Particles loosely packed. Some resistance to being dislodged by hand. Large number of voids. Matrix shows low resistance to penetration by point of geologic pick.	5 - 10	0.005 - 0.01	0.02 - 0.05
Medium dense	Particles closely packed. Difficult to dislodge individual particles by hand. Voids less apparent. Matrix has considerable resistance to penetration by point of geologic pick.	10 - 30	0.01 - 0.03	0.05 - 0.10
Dense	Particles very closely packed and occasionally very weakly cemented. Cannot dislodge individual particles by hand. The mass has very high resistance to penetration by point of geologic pick. Requires many blows of geologic pick to dislodge particles.	30 - 50	0.03 - 0.08	0.10 - 0.20
Very dense	Particles very densely packed and usually cemented together. Mass has high resistance to repeated blows of geologic pick. Requires power tools for excavation.	> 50	0.08 - 0.2	0.20 - 0.45

1/ Cohesionless soil is a material with a plasticity index (PI) less than or equal to 10. Use table 52–3 for cohesive soils.
2/ Standard Penetration Test, SPT (ASTM D 1586) used for most sandy-type cohesionless soils. In situ deformation modulus (IDM) (ASTM D 1194) used for most gravel-type soils and coarse detritus.
3/ M_s of a cohesionless soil is approximately determined from results of IDM testing by the following relationship:

$$M_s = 1.7\ (IDM)^{0.832} \text{ for IDM in MPa}$$

4/ Cohesionless soils in which blow counts are greater than 50 or IDM is greater than 200 kPa to be taken as rock, for which the hardness may be obtained from table 52–4.
5/ Correlation between SPT and IDM should be used as a guide only as results may vary in different geologic areas. Lab strength tests are recommended on soil materials to support SPT or field assessment tests.

For cohesive soil:

$M_S = 0.78(UCS)^{1.09}$ (MPa) For UCS (<= 10)

$M_S = UCS$ (MPa) For UCS (>10)

$K_b = 1$ Massed cohesive soil

$K_d = \tan(\Phi'_r)$ where:

$\Phi'_r = 169.58(LL)^{-0.4925}$ For soils with clay content <20%

$J_S = 1$ Intact soil

Table 52–3 Material strength number, M_n, for cohesive soil

Consistency	Field identification tests	SPT (blows/0.3 m)	Unconfined compressive strength (UCS) (kPa)	M_s
Very soft	Exudes between fingers when squeezed in hand.	< 2	< 40	< 0.02
Soft	Easily molded with fingers. Point of geologic pick easily pushed into shaft of handle.	2 - 4	40 - 80	0.02 - 0.05
Firm	Penetrated several centimeters by thumb with moderate pressure. Molded by fingers with some pressure.	4 - 8	80 - 150	0.05 - 0.10
Stiff	Indented by thumb with great effort. Point of geologic pick can be pushed in up to 1 centimeter. Very difficult to mold with fingers. Just penetrated with hand spade.	8 - 15	150 - 300	0.10 - 0.20
Very stiff	Indented only by thumbnail. Slight indentation by pushing point of geologic pick. Requires hand pick for excavation.	15 - 30	300 - 625	0.20 - 0.45

Notes:
1. Cohesive soil is material with a plasticity index (PI) greater than 10. Use table 52–2 for cohesionless soils.
2. 1 kPa equals 1 kN/m^2.
3. Vane shear strength (ASTM D 2573, field; ASTM D 4648, lab) also may be used for unconfined compressive strength (ASTM D 2166).
4. Cohesive soils in which blow counts are greater than 30 or strengths greater than 625 kPa are to be taken as rock, for which the hardness can be obtained from table 52–4.
5. Cohesive soils must be evaluated for hardness in the saturated condition.
6. M_s of a cohesive soil also can be determined as the product of unconfined compressive strength (in MPa) times its coefficient of relative density. For most cohesive soils, M_s is approximately determined by:

   $M_s = 0.78\ (UCS)^{1.09}$ for UCS ≤ 10 MPa, and M_s = UCS for UCS > 10 MPa.
7. Correlation between SPT and UCS should only be used as a guide, as results may vary in geologic areas. Lab strength tests are recommended on soil materials to support SPT or field assessment tests. Vane shear strength values also are applicable in the lower strength ranges.

For Rock:

$M_S = 0.78(UCS)^{1.09}$ (MPa) For UCS (<= 10)

$M_S = UCS$ (MPa) For UCS (>10)

Table 52–4 Material strength number, M_s, for rock

Rock material hardness 1/	Uniaxial compressive strength (MPa) 2/	Field identification tests	M_s 3/
Very soft rock or Hard, soil-like material	0.6 - 1.25	Scratched with fingernail. Slight indentation produced by light blow of point of geologic pick. Requires power tools for excavation. Peels with pocket knife.	0.45 - 1.0
Soft rock	1.25 - 5.0	Hand-held specimen crumbles under firm blows with point of geologic pick.	1.0 - 4.5
Moderately soft rock	5.0 - 12.5	Shallow indentations (1 to 3 mm) produced by light blows with point of geologic pick. Peels with pocket knife with difficulty.	4.5 - 12.5
Moderately hard rock	12.5 - 50.0	Cannot be scraped or peeled with pocket knife. Intact hand-held specimen breaks with single blow of geologic hammer. Can be distinctly scratched with 20d common steel nail.	12.5 - 50
Hard rock	50.0 - 100.0	Intact hand-held specimen requires more than one hammer blow to break it. Can be faintly scratched with 20d common steel nail.	50 - 100
Very hard rock	100.0 - 250.0	Intact specimen breaks only by repeated, heavy blows with geologic hammer. Cannot be scratched with 20d common steel nail.	100 - 250
Extremely hard rock	> 250.0	Intact specimen can only be chipped, not broken, by repeated, heavy blows of geologic hammer.	> 250

1/ Hardness categories are based solely on hardness characteristics, not geologic origin. For example, a highly weathered shale may classify as firm cohesive soil, and a partially lithified recent soil may classify as moderately soft rock. The transition, however, generally occurs within the 0.60 to 1.25 MPa range.
2/ 1.0 MPa approximately equals 145 pounds per square inch, or 10.4 tons per square foot.
3/ M_s is equal to the product of uniaxial compressive strength, UCS (ASTM D 2938), and coefficient of relative density. For most rock or rock-like materials, M_s is approximately determined by:

$M_s = 0.78\ (UCS)^{1.09}$ for UCS ≤ 10 MPa, and M_s = UCS for UCS > 10 MPa.

Layer	M_S (1)	K_b	K_d (2)	J_S	Headcut Erodibility Index
1N	0.076	1	0.577	1	0.044
2N	0.450	1	0.675	1	0.304
3N	0.450	1	0.625	1	0.281
1S	0.073	1	0.577	1	0.042
2S	0.450	1	0.675	1	0.304

(1) Layers 2N, 3N, and 2S were taken as rock and values for M_s were found using Table 52-4 (In accordance with Note 4 of Table 52-2).

(2) K_d was calculated using friction angle values from Table 6.3, 6.4, and 6.5 of Ref. 1.

Representative Diameter

The representative diameter was taken as the average diameter in which 75% of soil particles are equal to or smaller in diameter (D_{75}) for each soil layer. *(Ref. 4)*

Layer	Average D_{75} (in.)
1N	0.181
2N	0.070
3N	0.036
1S	0.162
2S	0.175

SITES Material Input Parameters
Jewell Brook Watershed Site No. 5
Natural Resources Conservation Service
Ludlow, Windsor County, Vermont

Project No. 172719-17

Layer	Avg. USCS	Dry Density (lb/cu.ft.)	Plasticity Index	Clay Content (%)	Head Cut Index	Representative Diameter (in.)
1N	SM	111.5	N.P.	7.16	0.044	0.181
2N	SM	120.2	N.P.	9.84	0.304	0.070
3N	ML	120.3	N.P.	9.84	0.281	0.036
1S	SM	111.2	N.P.	8.52	0.042	0.162
2S	SM	120.0	N.P.	10.74	0.304	0.175

Sample Information														
Layer	Boring	Sample ID	Blows				N-Value[1]	Avg. N-Value	Avg. IDM (Mpa)	Avg. UCS (Mpa)	PI	Φ'_r [2] (deg)	Use Φ'_r [3] (deg)	D75 (in)	Avg. D75 (in)
			1	2	3	4									
1N	201N	SpT-1	2	5	8	10	13	23.9	0.023923	N/A	0	44.4	30	0.7874	0.181
		SpT-2	12	10	13	11	23				0			0.0709	
		SpT-3	12	15	21	17	36								
	202N	SpT-1	3	6	5	10	11				0	40.9		0.0551	
		SpT-2	10	10	11	11	21				-			-	
		SpT-3	4	9	7	8	16				-			-	
		SpT-4	8	8	14	17	22				0			0.0157	
		SpT-5	8	12	17	20	29								
		SpT-6	12	17	18	18	35				-			-	
	203N	SpT-1	1	5	10	22	15				0	50.1		0.2835	
		SpT-2	20	33	37	46	70								
		SpT-3	21	16	17	18	33				-			-	
	204N	SpT-1	1	6	10	11	16				0	49.4		0.0161	
		SpT-2	9	25	26	22	51				0			0.0354	
		SpT-3	11	18	23	23	41								

Sample Information															
Layer	Boring	Sample ID	Blows				N-Value[1]	Avg. N-Value	Avg. IDM (Mpa)	Avg. UCS (Mpa)	PI	Φ'_r [2] (deg)	Use Φ'_r [3] (deg)	D75 (in)	Avg. D75 (in)
			1	2	3	4									
2N	201N	SpT-4	50/0.3				-	45.0	0.0675	N/A	-	-	34	-	0.070
	201NA	SpT-1	13	18	33	24	51				0	47.4		0.0307	
		SpT-2	12	19	50/0.4		-								
		SpT-3	10	32	24	31	56				-			-	
		SpT-4	48	28	35	36	63				-			-	
		SpT-5	50	50/0.2			-				-			-	
		SpT-6	15	34	31	31	65				0			0.0709	
	202N	SpT-7	47	31	38	40	69				0	50		0.0169	
		SpT-8	24	31	36	46	67								
		SpT-9	38	50	50/0.3		-				-			-	
		SpT-10	32	44	45	59	89				0			0.0236	
	203N	SpT-4	20	23	29	34	52				-	50.6		0.3740	
		SpT-5	21	31	34	41	65				-				
		SpT-6	25	32	37	35	69				-			0.0157	
		SpT-7	41	44	50/0.4		-				-				
		SpT-8	22	48	50	45	98				-			-	
		SpT-9	28	42	41	41	83				-			0.1575	
		SpT-10	11	24	33	33	57				-				
	204N	SpT-4	26	34	35	40	69				-	46.6		-	
		SpT-5	15	30	28	22	58				-			-	
		SpT-6	12	21	29	46	50				0			0.0472	
		SpT-7	39	50/0.4			-								
		SpT-8	16	22	21	23	43				0			0.0197	
		SpT-9	25	36	35	50/0.3	71								
		SpT-10	19	25	50/0.4		-				-			-	
		SpT-11	22	41	36	36	77				0			0.0787	
		SpT-12	29	50/0.4			-								
		SpT-13	17	28	29	47	57				-			-	
		SpT-14	50/0.4				-				-			-	
		SpT-15	27	21	24	50/0.3	45				0			0.0024	
		SpT-16	14	20	22		42				0			0.0051	
		SpT-17	19	25	50/0.4		-								
3N	204N	SpT-18	26	27	50/0.4		-	N/A	N/A	N/A	-	43.1	32	-	0.036
		SpT-19	62	50/0.3			-				-			-	
		SpT-20	27	23	35	50	58				0			0.0827	
		SpT-21	30	50/0.2			-				-			-	
		SpT-22	16	45	50/0.4		-				0			0.0098	
		SpT-23	24	45	50/0.1		-				0			0.0161	

Sample Information															
Layer	Boring	Sample ID	Blows				N-Value[1]	Avg. N-Value	Avg. IDM (Mpa)	Avg. UCS (Mpa)	PI	Φ'_r [2] (deg)	Use Φ'_r [3] (deg)	D75 (in)	Avg. D75 (in)
			1	2	3	4									
1S	205S	SpT-1	2	2	6	10	8	22.6	0.0226	N/A	-	40.9	30	0.3071	0.162
		SpT-2	8	14	15	18	29				-				
		SpT-3	4	5	5	8	10				-				
		SpT-4	8	12	14	15	26				0			0.0386	
		SpT-5	10	14	22	35	36								
	206S	SpT-1	1	2	3	2	5				0	37.9		0.0138	
		SpT-2	2	2	4	5	6				-			-	
		SpT-3	3	11	5	8	16				-			-	
		SpT-4	9	9	14	20	23				0			0.0157	
		SpT-5	13	20	21	47	41								
	207S	SpT-1	2	5	11	20	16				0	48.1		0.3150	
		SpT-2	24	17	23	29	40								
	208S	SpT-1	1	2	7	7	9				0	47.2		0.3543	
		SpT-2	11	18	17	29	35				-			-	
	209S	SpT-1	1	2	3	4	5				0	47.1		0.0252	
		SpT-2	5	18	23	20	41				-			-	
		SpT-3	12	16	19	22	35				0			0.0307	
	210S	SpT-1	1	5	20	6	25				0	45.5		0.0106	
		SpT-2	6	7	11	7	18				-			-	
		SpT-3	5	11	17	28	28				0			0.5118	
2S	205S	SpT-6	23	38	33	49	71	46.4	0.0711	N/A	0	49	34	0.0173	0.175
		SpT-7	38	38	20	50/0.2	58								
		SpT-8	15	22	24	30	46				-			-	
		SpT-9	34	36	50/0.3		-				0			0.0315	
		SpT-10	50/0.1				-				-			-	
	206S	SpT-6	50/0.3				-				-	46.6		-	
		SpT-7	14	26	30	38	56				0			0.1890	
		SpT-8	19	25	36	50/0.3	61								
		SpT-9	50/0.1				-				-			-	
		SpT-10	17	19	27	38	46				0			0.0236	
	207S	SpT-3	15	38	29	20	67				-	50.4		-	
		SpT-4	40	42	41	37	83				0			0.0472	
		SpT-5	12	26	37	36	63				-			-	
		SpT-6	22	50/0.4			-				-			-	
		SpT-7	13	27	38	39	65				0			0.0394	
		SpT-8	8	23	27	50	50								
		SpT-9	38	36	50/0.4		-				0			0.3543	
		SpT-10	15	20	34	41	54								

Sample Information															
Layer	Boring	Sample ID	Blows				N-Value[1]	Avg. N-Value	Avg. IDM (Mpa)	Avg. UCS (Mpa)	PI	Φ'_r [2] (deg)	Use Φ'_r [3] (deg)	D75 (in)	Avg. D75 (in)
			1	2	3	4									
2S	208S	SpT-3	15	31	24	75	55	46.4	0.0711	N/A	-	51.6	34	-	0.175
		SpT-4	22	21	45	22	66				0			0.5118	
		SpT-5	14	25	25	24	50								
		SpT-6	12	21	48	49	69				0			0.7874	
		SpT-7	27	30	45	44	75								
		SpT-8	50/0.1				-				-			-	
		SpT-9	10	20	22	29	42				-			-	
		SpT-10	25	23	19	20	42				0			0.0591	
		SpT-11	7	22	28	32	50				0			0.1063	
		SpT-12	50/0.4				-				-			-	
		SpT-13	11	26	49	56	75				-			-	
		SpT-14	50/0.4				-				-			-	
		SpT-15	14	32	47	50	79				0			0.0866	
		SpT-16	18	37	33	38	70								
		SpT-17	26	46	50	50/0.4	96				0			0.0472	
		SpT-18	38	29	41	45	70								
		SpT-19	38	50/0.3			-				-			-	
		SpT-20	50/0.4				-				-			-	
		SpT-21	18	50/0.4			-				0			0.7480	
		SpT-22	12	22	22	36	44				0			0.0134	
		SpT-23	16	50/0.2			-				-			-	
		SpT-24	25	46	50/0.4		-				0			0.0256	
		SpT-25	46	50/0.2			-				-			-	

Sample Information														
Layer	Boring	Sample ID	Blows				N-Value[1]	Avg. N-Value	Avg. IDM (Mpa)	Avg. UCS (Mpa)	PI	Φ'_r [2] (deg)	Use Φ'_r [3] (deg)	D75 (in)	Avg. D75 (in)
			1	2	3	4									
2S	209S	SpT-4	24	23	32	26	55	46.4	0.0711	N/A	-	53.3	34	-	0.175
		SpT-5	21	20	28	35	48				-			-	
		SpT-6	50/0.1				-				-			-	
		SpT-7	6	58	29	21/0.3	87				0			0.1575	
		SpT-8	6	19	40	57	59								
		SpT-9	50/0.3				-				-			-	
		SpT-10	19	30	29	41	59				0			0.0748	
		SpT-11	25	37	40	45	77								
	210S	SpT-4	49	26	32	34	58				-	52.3		-	
		SpT-5	9	27	37	50/0.3	64				-			-	
	210SA	SpT-1	50/0.3				-				-	-		-	
		SpT-2	20	30	50/0.4		-				0			0.1654	
		SpT-3	24	50/0.4			-								
		SpT-4	10	50/0.3			-				-			-	
		SpT-5	50/0.3				-				-			-	
		SpT-6	35	50/0.3			-				0			0.0205	

[1] N-Values over 50 taken as refusal and not used in calculation of average N-value.

[2] Φ'_r calculated using SpT N-Value Correlation from Reference 5.

[3] Assumed value for friction angle from table 6.3, 6.4, and 6.5 of Reference 1.