



NEON Site-Level Plot Summary

Abby Road (ABBY)

Document Information

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Site Background

The Abby Road (ABBY) site is approximately 25 km northeast of Vancouver in Clark County, Washington. The ABBY site is in Major Land Resource Area (MLRA) 3 - Olympic and Cascade Mountains in southwestern Washington. ABBY consists of approximately 7380 acres (2987 hectares), and covers portions of Yacolt Burn State Forest, which is managed by the Washington Department of Natural Resources. The area is part of the 1972 Soil Survey of Clark County, Washington (McGee et al, 1972).

Site Information

The ABBY NEON (National Ecological Observatory Network) site has diverse relief, with an elevation range from a low of 275 meters up to 760 meters above MSL. Slope gradients range from 0 to 75 percent, as defined in the existing Soil Survey of Clark County. Mean annual precipitation ranges between 2400 and 3175 mm based on data obtained from the PRISM (Parameter-elevation Regression on Independent Slopes Model) Climate Group at Oregon State University. The dominant landscape setting is foothills, with landforms consisting of ridges and hillslopes of varying relief. The dominant geological material at the site are andesite flows of Oligocene age. The dominant vegetative cover includes recent clear cuts, dense recently planted tree stands, and older mature forested stands.

The major soils at the ABBY site, as defined in the Soil Survey, are formed in residuum, colluvium, and alluvium derived from a mixture of volcanic ash and igneous rock. There is also pre-Fraser age alpine glacial drift mapped in the vicinity of the NEON tower location. The drift presence was confirmed by soil description at the NEON tower soil pit in 2015. In addition, based on the landform setting of the tower pit location, the drift is likely larger in extent than what is currently recognized in the Soil Survey.

The soil mapping on the site shows 24 distinct map units, which are all consociations (map units dominated by a single major soil component). The map units consist of various slope and surface texture phases of 7 named soil series. The NEON provided pre-selected sampling plots occurred



in 10 map units covering approximately 6019 acres, or approximately 82 percent of the total ABBY site acreage. The 10 soil map units have one of five soil series (Cinebar, Kinney, Olympic, Larchmount, and Yacolt) as dominant components.

Analysis of Plots for Sampling

NEON provided 34 distributed plots that were reviewed for potential characterization sampling. The plots were within soil map units dominated by one of five soil series. The plots were grouped by the dominant of soil map unit components, consisting of a soil series and its surface texture (e.g. Kinney silt loam, Cinebar silt loam, Kinney cobbly silt loam, etc.). The plots selected for characterization were chosen based on the distribution and extent of these soil components, which provided greater detail than the soil map unit as defined by soil series name alone.

A total of 15 plots were sampled that targeted three dominant soil components: Cinebar silt loam, Kinney silt loam, and Olympic stony clay loam. The plots not selected for sampling occurred in non-typical landform settings, had limited access, presented difficulty for sampling due to rock fragment content or slope, or had soils similar to one of the selected plots. In addition, a few plots were rejected because they occurred within a soil of quite limited spatial extent within the site. These plots would contain soils not representative of site-wide conditions.

Table 1 provides soil map unit component phases, which are minor differences from the named soil series or component. A phase most commonly refers to the texture or coarse fragment content in the surface or near surface horizons.

Map Unit Component	Acres by Component	Number Plots in Component	Number Plots Sampled
Cinebar silt loam	2270	16	8
Kinney silt loam	2805	8	5
Kinney cobbly silt loam	313	3	0
Larchmount cobbly silt loam	184	1	0
Olympic stony clay loam	342	5	2
Yacolt loam	105	1	0
Totals	6019	34	15

Table 1. Areal coverages of soil map unit component phases at ABBY. The number of NEON plots located within a delineation dominated by that component and number of plots sampled are also listed.



Plot ID	Map Unit Symbol	Map Unit Name	Soil Series Sampled	Named Map Unit Major or Minor Component
ABBY_001	CnD	Cinebar silt loam, 8 to 20 percent slopes	Cinebar	Yes
ABBY_002	CnG	Cinebar silt loam, 30 to 70 percent slopes	Aschoff	No
ABBY_007	KeF	Kinney silt loam, 30 to 50 percent slopes	Cinebar	No
ABBY_008	KeF	Kinney silt loam, 30 to 50 percent slopes	Cinebar	No
ABBY_009	CnD	Cinebar silt loam, 8 to 20 percent slopes	Kinney	No
ABBY_011	KeE	Kinney silt loam, 15 to 30 percent slopes	Kinney	Yes
ABBY_016	CnE	Cinebar silt loam, 20 to 30 percent slopes	Ferteg	No
ABBY_017	KeF	Kinney silt loam, 30 to 50 percent slopes	Kinney	Yes
ABBY_019	CnD	Cinebar silt loam, 8 to 20 percent slopes	Cinebar	Yes
ABBY_020	CnE	Cinebar silt loam, 20 to 30 percent slopes	Kinney	No
ABBY_021	CnE	Cinebar silt loam, 20 to 30 percent slopes	Cinebar	Yes
ABBY_023	OmE	Olympic stony clay loam, 3 to 30 percent slopes	Kinney	No
ABBY_026	OmE	Olympic stony clay loam, 3 to 30 percent slopes	Kinney	No
ABBY_028	KeC	Kinney silt loam, 3 to 15 percent slopes	Huss	No
ABBY_063	CnD	Cinebar silt loam, 8 to 20 percent slopes	Cinebar	Yes

Table 2. Map units and soil series within a map unit for each NEON plot sampled.

Plot Findings

Pedon and plot data were collected at all 15 plots, and included horizon designations, horizon depths, field texture including sand and clay estimates, moisture status, consistence, manner of failure, stickiness and plasticity, soil color, horizon fragment volume field estimates, redoximorphic features (if present), soil structure, and roots and pores quantity and size field estimates. Plot (site data in NASIS) data included location, parent material, geomorphic description, latitude and longitude coordinates, slope percent and shape, aspect, drainage class,



and area overlap. Sampled soils were classified based on field estimated soil properties, and current classification of existing series.

The 1972 Soil Survey of Clark County was published 46 years ago, and was completed without the aid of computers, high resolution aerial photography, and digital elevation models. At ABBY, it was expected that because of the age of the soil survey and lower intensity mapping methodology used at the time, some of the pedons sampled would correlate to a minor soil component that may have not been identified during the original mapping. In some cases, more recent concepts from neighboring soil survey areas were utilized to classify the minor components. These instances are noted in the Summary of Soils.

Andisols and Andic Soil Properties

The presence of volcanic ash in western WA including the ABBY site strongly influences soil formation, soil properties, and soil classification. Soils containing volcanic ash generally classify as Andisols, or within an Andic subgroup or great group in Soil Taxonomy. Two criteria are employed to define Andic Soil Properties. One is the presence of volcanic glass in the 0.02 to 2.0 mm size fraction. The second criterion is the amount of ammonium oxalate extractable Al plus $\frac{1}{2}$ amount of extractable Fe in a sample. The amount of oxalate extractable Al and Fe is a measure of the amount of amorphous or short-order range mineral (SORM) present. SORM is a weathering product of volcanic glass that has relatively high anion and cation exchange and a high water holding capacity. A soil with 30% or more volcanic glass and a total of 0.5% extractable Al and $\frac{1}{2}$ Fe is one end member for Andic Properties. A soil with minimum of 5% volcanic glass and 2% or more extractable Al and Fe is another end member. Given the influence of volcanic ash, it is reasonable to assume most soils on the ABBY site will qualify as Andisols or a closely related taxon. The quantity of oxalate extractable Al and Fe will determine the exact classification.

Summary of Soils

ABBY_001 – This pedon is within a Cinebar silt loam, 8 to 20 percent map unit delineation and was field classified as the Cinebar series (Medial, mixed, mesic Humic Haploxerands). These very deep soils have an umbric epipedon 33 cm thick, and field estimated andic soil properties between a depth of 9 and 55 cm from the soil surface. Textures were medial silt loams overlying silty clay loam at a depth of 55 cm. A surface organic horizon 9 cm in thickness consisted of slightly decomposed plant material. The pedon is in a forested stand of Douglas-fir (*Pseudotsuga menziesii*).

ABBY_002 – This pedon, located in a young stand of planted Douglas-fir, is within a Cinebar silt loam, 30 to 70 percent slopes map unit delineation and was field classified as the Aschoff series (Loamy-skeletal, isotic, mesic Andic Humudepts). These very deep soils have an umbric epipedon to depth of 48 cm, and field estimated andic soil properties in the upper 30 cm of mineral soil. The weighted average of rock fragments within the particle size control section exceeded 35 percent, with field estimated rock fragment volumes ranging from 10 to 55 percent



in the top 100 cm of the soil. A thin (1 cm) organic horizon of slightly decomposed plant material was described at the soil surface. Aschoff soils were not originally described in the 1972 Soil Survey of Clark County, and the soil type was not expected to be found at this site. The very deep Aschoff soil pit had higher quantities of rock fragments and less volcanic ash than would be expected in the Cinebar soil that was mapped here. Modern mapping would more than likely identify this Aschoff pedon as a minor component (i.e. low composition), or soil, in the map unit.

ABBY_007 – This pedon, located in a recent clear-cut with a grass/herbaceous cover type, is within a Kinney silt loam 30 to 50 percent slopes map unit delineation and was sampled as the Cinebar series (Medial, mixed, mesic Humic Haploxerands). These very deep soils have a 50 cm thick umbric epipedon, and assumed andic soil properties extending below 100 cm from the soil surface. Field estimated rock fragment volumes ranged from 0 to 42 percent in the surface 100 cm. Textures were described as medial loams and medial silt loams, overlying very gravelly medial clay loam. A 3 cm thick organic horizon of slightly decomposed plant material was described at the soil surface. Cinebar and Kinney soils are commonly mapped adjacently to one another in the survey. Cinebar soils have lower quantities of rock fragments and more volcanic ash in the soil. Kinney soils quite often have restrictive paralithic contacts in the profile. Modern mapping would more than likely identify this Cinebar pedon as a minor component in the map unit.

ABBY_008 – This pedon, located in a forested stand of Douglas-fir, is within a Kinney silt loam, 30 to 50 percent slopes map unit delineation and was sampled as the Cinebar series (Medial, mixed, mesic Humic Haploxerands). These very deep soils have an umbric epipedon from 3 to 34 cm in depth, and estimated andic soil properties extending below 100 cm from the soil surface. Field textures ranged from medial loam to medial silty clay loam, with no observed rock fragments within the surface 100 cm of the profile. A 3 cm thick organic horizon of slightly decomposed plant material was described at the soil surface. Cinebar and Kinney soils are commonly mapped adjacently to one another in the survey. Cinebar soils have lower quantities of rock fragments and more volcanic ash in the soil. Kinney soils quite often have restrictive paralithic contacts in the profile. Modern mapping would more than likely identify this Cinebar pedon as a minor component in the map unit.

ABBY_009 – This pedon, located in a young, planted stand of Douglas-fir, is within a Cinebar silt loam, 8 to 20 percent slopes map unit delineation and was classified in the field as the Kinney series (Fine-loamy, isotic, mesic Andic Humudepts). These deep to very deep soils have an umbric epipedon 57 cm thick, estimated andic soil properties in the upper 25 cm, and a paralithic contact within 100 to over 150 cm from the soil surface. Field textures ranged from gravelly medial loams in the upper 25 cm, to very gravelly loams beneath. Rock fragments range from 20 to 40 percent by volume throughout the upper meter of the profile. No organic surface horizons were described. Cinebar and Kinney soils are commonly mapped adjacent to one another in the survey. Kinney soils have higher quantities of rock fragments, less volcanic ash, and quite often have restrictive paralithic contacts in the profile compared to the Cinebar series. Current soil survey practices would likely identify this Kinney pedon as a minor component in the named map unit.

ABBY_011 – This pedon is within a Kinney silt loam, 15 to 30 percent map unit delineation and was sampled as the Kinney series (Fine-loamy, isotic, mesic Andic Humudepts). These deep to



very deep soils have an umbric epipedon 49 cm thick, estimated andic soil properties in the upper 20 cm, and a paralithic contact within 100 to over 150 cm from the soil surface. Textures were described as medial silt loams in the surface horizon, overlying loams and silty clay loams to a depth of 100 cm. Rock fragments ranged from 0 to 10 percent throughout the upper meter. No organic surface horizons were described. The pedon is located in a forested stand of Douglas-fir.

ABBY_016 – This pedon was in a stand of western hemlock (*Tsuga heterophylla*) within a Cinebar silt loam, 20 to 30 percent slopes map unit delineation. The pedon was classified in the field as the Ferteg series (Medial over loamy-skeletal, amorphic over isotic, mesic Aquic Haploxerands). The site was in a concave slope form in proximity to a stream. These very deep, moderately well drained soils have an ochric epipedon, field estimated andic soil properties between 3 and 75 cm, and aquic conditions with redoximorphic features starting at 75 cm depth from the soil surface. Textures are medial silt loams and medial loams, overlying very gravelly loam. The subsoil had a field estimated rock fragment volume of 50 percent. A 3 cm thick organic horizon of slightly decomposed plant material was described at the soil surface. The Ferteg series was not originally described in the 1972 Clark County soil survey. Based on the slightly concave position of the landform, however, a soil profile with a seasonal high water table was expected; the Cinebar soil does not have a seasonal high water table described. Ferteg soils have a seasonal high water table 50 to 100 cm from the surface. Redoximorphic features were described in this Ferteg pedon (oxidized and reduced masses of water soluble iron in the soil), which do not occur in Cinebar soils. Modern mapping would more than likely identify this Ferteg pedon as a minor component in the map unit.

ABBY_017 – This pedon is within a Kinney silt loam, 30 to 50 percent map unit delineation and was sampled as the Kinney series (Fine-loamy, isotic, mesic Andic Humudepts). These deep to very deep soils have an umbric epipedon and andic soil properties from 7 to 36 cm in depth based on field estimates, and a paralithic contact within 100 to over 150 cm from the soil surface. Field described textures were medial loams over silty clay loams. Rock fragments were less than 10 percent by volume. A surface organic horizon 7 cm in thickness consisted of slightly decomposed plant material. The site was sampled in a forested stand of Douglas-fir.

ABBY_019 – This pedon is within a Cinebar silt loam, 8 to 20 percent slope map unit delineation and was classified in the field as the Cinebar series (Medial, mixed, mesic Humic Haploxerands). These very deep soils have an umbric epipedon from 0 to 25 cm, and assumed andic soil properties throughout. Textures were described as medial loam to medial silt loams in the upper meter. Rock fragments were less than 10 percent by volume. No organic surface horizons were described. The pedon is located in a forested stand of Douglas-fir.

ABBY_020 – This pedon, located in a forested stand of Douglas-fir, is within a Cinebar silt loam, 20 to 30 percent slopes map unit delineation and was sampled as the Kinney series (Fine-loamy, isotic, mesic Andic Humudepts). These deep to very deep soils have an umbric epipedon 3 to 46 cm in depth. The upper 18 cm of the soil after mixing, was estimated to have andic soil properties, and a paralithic contact within 100 to over 150 cm from the soil surface. Soil textures were described as gravelly medial loam at the surface overlying layers with textures ranging from loam to very cobbly loam. Rock fragment content by volume was estimated to range between 14 and 45 percent in the upper meter, but less than 35 percent by weighted average. A 3



cm thick organic horizon of slightly decomposed plant material was described at the soil surface. The site was sampled in a forested stand of Douglas-fir. Cinebar and Kinney soils are commonly mapped adjacently to one another in the survey. Cinebar soils have lower quantities of rock fragments and more volcanic ash in the soil. Kinney soils quite often have restrictive paralithic contacts in the profile. Modern mapping would more than likely identify this Kinney pedon as a minor component in the map unit.

ABBY_021 – This pedon is within a Cinebar silt loam, 20 to 30 percent slope map unit delineation and was classified in the field as the Cinebar series (Medial, mixed, mesic Humic Haploxerands). These very deep soils have an umbric epipedon from 4 to 35 cm, and assumed andic soil properties extending below 1 meter based on field estimates. Field estimated textures ranged from medial silt loam to medial clay loam, and rock fragment volumes were less than 10 percent. A surface organic horizon 4 cm in thickness consisted of slightly decomposed plant material. The site was sampled in a recent clear-cut dominated by grass/herbaceous species.

ABBY_023 – This pedon, located in a mixed stand of Douglas-fir and western hemlock, is within an Olympic stony clay loam, 3 to 30 percent slopes map unit delineation and was classified in the field as the Kinney series (Fine-loamy, isotic, mesic Andic Humudepts). These deep to very deep soils have an umbric epipedon from 0 to 46 cm, estimated andic soil properties in the upper 21 cm, and a paralithic contact within 100 to over 150 cm from the soil surface. Textures were described as medial silt loam over loam, with a very stony silty clay loam starting at 46 cm. Rock fragment content ranged from 0 to 45 percent, but had a weighted average of less than 35 percent in the particle size control section based on field estimates. No organic surface horizons were described. Olympic and Kinney soils are commonly mapped adjacently to one another in the survey. Olympic soils have lower quantities of rock fragments and occur on more stable positions such ridges and summits. Kinney soils are typically found on more active erosional slopes. Olympic soils therefore have more advanced soil development. Kinney soils quite often have restrictive paralithic contact (“soft” bedrock) in the profile. Modern mapping would more than likely identify this Kinney pedon as a minor component in the map unit.

ABBY_026 – This pedon, located in a mixed stand of Douglas-fir and western hemlock, is within an Olympic stony clay loam, 3 to 30 percent slopes map unit delineation and was classified as the Kinney series (Fine-loamy, isotic, mesic Andic Humudepts). These deep to very deep soils have an umbric epipedon from 0 to 51 cm, estimated andic soil properties in the upper 21 cm, and a paralithic contact within 100 to over 150 cm from the soil surface. Ten percent paralithic materials as fine paragravels were noted starting at a depth of 71 cm from the soil surface. Textures were described as medial loams and silt loams overlying clay loams and loams to a depth of 1 meter. No organic surface horizons were described. Olympic and Kinney soils are commonly mapped adjacently to one another in the survey. Olympic soils have lower quantities of rock fragments and occur on more stable positions such ridges and summits. Kinney soils are typically found on more active erosional slopes. Olympic soils therefore have more advanced soil development. Kinney soils quite often have restrictive paralithic contact in the profile. Modern mapping would more than likely identify this Kinney pedon as a minor component in the map unit.

ABBY_028 – This pedon, located within a mixed stand of conifer and hardwoods, is within a Kinney silt loam, 3 to 15 percent slopes map unit delineation and was classified as a Huss



taxadjunct (Medial-skeletal, amorphous, mesic Typic Hapludands). Although Huss soils are classified with a frigid soil temperature regime, the pedon was identified as a warm phase taxadjunct of the Huss component based on surrounding mapping and vegetation observed at the site. The soils identified within the ABBY site are typical of the Huss series physical properties and would likely manage similarly. These moderately deep soils have an umbric epipedon and estimated andic soil properties to a depth of 51 cm. Bedrock was observed at a depth of 85 cm. Textures above the lithic contact were described as gravelly medial loams and very gravelly medial loams over extremely gravelly silt loam. Estimated rock fragment volume content ranged from 30 to 70 percent throughout the profile. No organic surface horizons were described. Huss, taxadjunct soils were not originally described in the 1972 Soil Survey of Clark County, and the soil type was not expected to be found at this site. The moderately deep to igneous bedrock soil had much higher quantities of rock fragments and volcanic ash than would be expected in the Kinney soil that was mapped here. Modern mapping would more than likely identify this Huss taxadjunct pedon as a minor component in the map unit.

ABBY_063 – This pedon is within a Cinebar silt loam, 8 to 20 percent map unit delineation and classified in the field as the Cinebar series, Medial, mixed, mesic Humic Haploxerands. These very deep soils have an umbric epipedon from 2 to 48 cm in depth, and assumed andic soil properties extending below 1 meter. Textures were described as medial loams over medial clay loams, and rock fragment volume contents are 10 percent or less throughout the upper meter. A thin (2 cm) organic horizon of slightly decomposed plant material was described at the soil surface. The pedon was sampled in a forested stand of Douglas-fir.

References

McGee DA, McGee SS, Mayko RW, Call WA, McMurphy CJ. 1972. Soil Survey of Clark County, Washington. US Department of Agriculture, Soil Conservation Service. United States Government Printing Office. Washington DC.

