APPENDIX E - SOIL DESCRIPTIONS

As provided by the United States Department of Agriculture – National Cooperative Soil Survey

ALDERWOOD SERIES

The Alderwood series consists of moderately deep to a densic contact, moderately well drained soils formed in glacial drift. Alderwood soils are on glacially modified foothills and valleys and have slopes of 0 to 65 percent. The mean annual precipitation is about 1,000 mm and the mean annual temperature is about 10 degrees C.

TAXONOMIC CLASS: Loamy-skeletal, isotic, mesic Aquic Dystroxerepts

TYPICAL PEDON: Alderwood gravelly sandy loam - forested. (Colors are for moist soil unless otherwise noted.)

A--0 to 18 cm; very dark grayish brown (10YR 3/2) gravelly sandy loam, brown (10YR 5/3) dry; moderate fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; few fine irregular pores; 20 percent gravel; moderately acid (pH 5.8); abrupt smooth boundary. (7 to 18 cm thick)

Bw1--18 to 53 cm; dark yellowish brown (10YR 4/4) very gravelly sandy loam, yellowish brown (10YR 5/4) dry; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; many fine roots; many fine tubular and irregular pores; 35 percent gravel; gradual smooth boundary; moderately acid (pH 5.8).

Bw2--53 to 75 cm; brown (10YR 4/3) very gravelly sandy loam, pale brown (10YR 6/3); dry; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common fine roots; few very fine tubular pores; 40 percent gravel; moderately acid (pH 5.8); clear wavy boundary. (Combined Bw1 and Bw2 horizons is 35 to 67cm thick)

Bg--75 to 89 cm; 50 percent olive brown (2.5Y 4/4) very gravelly sandy loam, light yellowish brown (2.5Y 6/4) dry and 50 percent dark grayish brown (2.5Y 4/2) iron-manganese nodules with strong brown (7.5YR 5/6) coatings on fragments, light brownish gray (2.5Y 6/2) and reddish yellow (7.5YR 6/6) dry; massive; slightly hard, very friable, nonsticky and nonplastic; few fine roots; common fine tubular and interstitial pores; 45 percent gravel; moderately acid (pH 6.0); abrupt wavy boundary. (8 to 38 cm thick)

2Cd1--89 to 109 cm; dark grayish brown (2.5Y 4/2) very gravelly sandy loam, light brownish gray (2.5Y 6/2) dry; dark yellowish brown (10YR 4/4), olive (5Y 4/4), yellowish red (5YR 4/6) and strong brown (7.5YR 5/6) coatings in cracks; massive; extremely hard; extremely firm, nonsticky and nonplastic; few fine roots; few fine tubular pores; 40 percent gravel; moderately acid (pH 6.0); abrupt irregular boundary. (13 to 51 cm thick)

2Cd2--109 to 150 cm; grayish brown (2.5Y 5/2) dense glacial till that breaks to very gravelly sandy loam, light gray (2.5Y 7/2) dry; massive; extremely hard, extremely firm,

nonsticky and nonplastic; 40 percent gravel; moderately acid (pH 6.0).

TYPE LOCATION: Snohomish County, Washington; about 8 km east of Lynnwood on Maltby road; 61meters south and 122 meters east of the center of section 28, T. 27 N., R. 5 E.

RANGE IN CHARACTERISTICS:
Depth to densic contact - 50 to 100 cm
Mean annual soil temperature - 8 to 13 degrees C.
Moisture control section - dry 60 to 75 consecutive days following the summer solstice
Reaction - strongly acid to slightly acid above the 2Cd horizon
Particle-size control section - averages 35 to 50 percent total rock fragments and 5 to 15 percent clay
Depth to redox features with chroma of 2 or less - 45 to 75 cm

A horizon
Hue - 10YR or 7.5YR
Value - 2 or 3 moist, 3 to 5 dry
Chroma - 2 to 4 moist and dry
Rock fragments - 15 to 65 percent total, 15 to 65 percent gravel, 0 to 5 percent cobbles, and 0 to 5 percent stones

An E horizon less than 3 cm thick is sometimes present.

Bw horizons
Fine earth texture - SL, L, or COSL
Hue - 10YR or 7.5YR
Value and chroma - 2 to 6 dry or moist
Rock fragments - 15 to 65 percent total, 15 to 65 percent gravel, 0 to 15 percent cobbles, and 0 to 5 percent stones

Bg horizon (2BC or 2CB horizon)
Fine-earth texture - SL, L, or COSL
Hue - 10YR or 2.5Y
Value - 5 to 7 dry
Chroma - 2 to 4 moist and dry
Redox concentrations - beginning within 75 cm of the surface
Rock fragments - 35 to 85 percent total, 35 to 60 percent gravel, 0 to 25 percent cobbles, and 0 to 5 percent stones

2Cd horizons
Fine-earth texture - SL, LS, COSL, or FSL
Hues - 10YR or 2.5Y
Value - 4 to 8 dry
Chroma - 1 to 3 moist and dry
Rock Fragments - 15 to 45 percent total, 0 to 45 percent gravel, 0 to 10 percent cobbles, and 0 to 5 percent stones.
Reaction - slightly to moderately acid

COMPETING SERIES: This is the Whidbey series. Whidbey soils are dry 75 to 90 consecutive days following the summer solstices.

GEOGRAPHIC SETTING: These soils are on till plains and moraines at elevations of 0 to about 245 meters. Slope is 0 to 65 percent. The soils formed in glacial till. Alderwood soils are in a cool marine climate. The summers are cool and dry, and the winters are mild and wet. Mean annual precipitation is 200 to 1500 cm, most of which falls as rain from November through March. Mean January temperature is 3 degrees C, mean July temperature is 16 degrees C, and mean annual temperature is 10 degrees C. The growing season (-2 degrees C) is about 200 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Beausite, Dick, Everett, Hoogdal, Indianola, Kitsap, Norma, Quilcene, Skipopa and Whidbey series. All of these soils except Whidbey soils lack a densic layer within 100 cm. In addition, the Beausite soils have a lithic contact at 50 to 100 cm. Dick, Hoogdal, Indianola, Kitsap, and Skipopa soils have less than 35 percent coarse fragments. Everett soils are sandy-skeletal. McKenna soils have an aquic moisture regime. Norma soils have an aquic moisture regime of less than 35 percent coarse fragments in the upper part of the control section. Quilcene soils are in a fine family.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Moderately well drained; high saturated hydraulic conductivity above the densic layer and low saturated hydraulic conductivity in the densic material. A perched water table is at its highest from January through March.

USE AND VEGETATION: Used mostly for woodland, field crops, hay and pasture, orchards, vineyards, wildlife habitat, watershed, and non-farm uses. The natural vegetation is Douglas-fir, western hemlock, western redcedar, and red alder with an understory of salal, Oregon-grape, western brackenfern, western swordfern, Pacific rhododendron, red huckleberry, evergreen huckleberry, and Orange honeysuckle.

DISTRIBUTION AND EXTENT: Northwestern Washington; MLRA 2. The series is extensive.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Portland, Oregon

SERIES ESTABLISHED: Snohomish County, Washington 1936.

REMARKS: Diagnostic horizons and features recognized in this soil:
Ochric epipedon
Cambic horizon - from 18 to 89 cm
Densic contact - from 89 to 150 cm
Aquic feature - redox depletions with chroma of 2 or less at 75cm.
Humic subgroup - meet color requirement from 0 to 18 cm
Particle-size control section - 25 to 89 cm.
The current typical pedon is borderline in meeting the Aquic subgroup criteria and is also borderline in meeting Humic subgroup criteria. Based on the range of characteristics, the

present classification is marginal to being Aquic subgroup and marginal to not meeting Humic subgroup criteria. It is recommended a new typical pedon be selected to represent the series concept and classification.

The series has had a long history in classification, much of it involves the cementation or not of the upper part of the glacial till. The series in 1978 started as a loamy-skeletal, mixed, mesic Dystric Entic Durochrepts, then in 1988 to a loamy-skeletal, mixed, mesic, ortstein Aquic Haplorthods, then in 1994 to a loamy-skeletal, mixed, mesic Vitrandic Durochrepts, then in 2000 to a loamy-skeletal, isotic, mesic Vitrandic Dystroxerepts and in 2011 to a loamy-skeletal, isotic, mesic Aquic Dystroxerepts. The 89 to 109 cm horizon is the horizon in question as to cementation or not, and if cemented, what is the cementing agent. The material was studied in the late 1960's and early 1970's and it was though at that time to be cemented, but the cementing agent was not easily identifiable. The strength of Vitrandic properties in the upper part of the solum is very weak. Given all this change in classification the typical pedon has remained the same and the concept of a moderately deep and moderately well drained soil has remained the same.

An in depth study of the glacial till is needed throughout the Puget Sound foothills on several similar soil series.

ADDITIONAL DATA: Partial data available for this series. Sample # S71WA033002, 71WA033003, S04WA-061-002, and S09WA053098.

BEAUSITE SERIES

The Beausite series consists of moderately deep, well drained soils formed in sandstone and conglomerate. These soils are on foothills. Slopes are 0 to 90 percent. The average annual precipitation is about 40 inches and the mean annual temperature is about 50 degrees F.

TAXONOMIC CLASS: Loamy-skeletal, isotic, mesic Vitrandic Dystroxerepts

TYPICAL PEDON: Beausite gravelly sandy loam - forested. (Colors are for moist soil unless otherwise noted.)

Oi--0 to 2 inches; slightly decomposed needles, leaves, twigs, bark, moss, and wood fragments.

Oa--2 to 3 inches; highly decomposed; black (5YR 2/1) forest litter; moderately acid (pH 5.6).

A--3 to 5 inches; dark brown (7.5YR 3/2) gravelly sandy loam, brown (7.5YR 5/2) dry; weak fine and medium granular structure; slightly hard, very friable, nonsticky and nonplastic; many fine roots; 30 percent rounded pebbles; moderately acid (pH 5.9); clear wavy boundary. (2 to 5 inches thick)

Bw1--5 to 9 inches; dark brown (7.5YR 4/3) very gravelly sandy loam, light brown (7.5YR 6/3) dry; weak medium and coarse subangular blocky structure; slightly hard, very friable,

nonsticky and nonplastic; many fine and medium roots; 35 percent rounded pebbles; moderately acid (pH 6.0); gradual wavy boundary. (3 to 10 inches thick)

Bw2--9 to 17 inches; dark brown (10YR 4/3) very gravelly sandy loam, pale brown (10YR 6/3) dry; weak coarse subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; many fine and medium roots; common fine and medium tubular pores; 40 percent rounded pebbles; moderately acid (pH 6.0); gradual wavy boundary. (6 to 10 inches thick)

Bw3--17 to 25 inches; dark yellowish brown (10YR 4/4) very gravelly sandy loam, light yellowish brown (10YR 6/4) dry; massive; hard, firm, nonsticky and nonplastic; common small and medium roots; 35 percent rounded pebbles; slightly acid (pH 6.1); gradual irregular boundary. (6 to 10 inches thick)

C--25 to 36 inches; brown (10YR 5/3) and grayish brown (10YR 5/2) very gravelly sandy loam, very pale brown (10YR 7/4) dry; massive; very hard, very firm, nonsticky and nonplastic; few fine roots; 55 percent rounded pebbles; slightly acid (pH 6.1); clear irregular boundary. (3 to 12 inches thick)

R--36 inches; grayish brown (10YR 5/2) and brown (10YR 5/3); massive; very gravelly conglomerate.

TYPE LOCATION: Jefferson County, Washington. 900 feet south and 600 feet west of northeast corner of SW1/4SW1/4 sec. 36, T. 29 N., R. 2 W.

RANGE IN CHARACTERISTICS: The mean annual soil temperature is 47 to about 53 degrees F. These soils are usually moist but are dry in all parts between 8 and 24 inches for 60 to 75 consecutive days. Content of coarse fragments in the control section ranges from 35 to 75 percent. Content of clay in the control section is 5 to 15 percent. Depth to bedrock ranges from 24 to 40 inches. Thickness of solum ranges from 20 to 35 inches.

The A horizon has hue of 5YR, 7.5YR, or 10YR, value of 2 through 4 moist and dry, and chroma of 1 through 4 moist and dry.

The Bw horizon has hue of 5YR through 2.5Y, value of 2 through 4 moist, 4 through 6 dry, and chroma of 2 through 4 moist and dry. It is gravelly sandy loam, very gravelly loam, very gravelly sandy loam, or extremely gravelly sandy loam. Reaction is moderately acid or slightly acid.

The C horizon has hue of 7.5YR through 2.5Y, value of 2 through 5 moist, 4 through 6 dry, and chroma of 2 to 5 moist and dry. It is very gravelly sandy loam or extremely gravelly sandy loam. It is slightly acid or moderately acid.

COMPETING SERIES: These are the Ahl, Barnhardt, Blethen, Heisler, Kanasket, Ogarty, Pickett, Squire, Tunnel, and Vanzandt series. Ahl soils have very gravelly loam or very gravelly silt loam control sections and have solums thinner than 20 inches. Barnhardt, Blethen, Heisler, Kanasket, and Tunnel soils are deeper than 40 inches. Ogarty, Pickett,

and Squires soils are finer than sandy loam in the fine earth fraction. Vanzandt soils have a paralithic contact with dense glacial till at 20 to 40 inches.

GEOGRAPHIC SETTING: Beausite soils are on glaciated mountains and foothills at elevations of near sea level to about 1,500 feet. They formed in glacial till and colluvium and slope alluvium from sandstone and conglomerate. These soils occur in a mild cool marine climate having an average annual precipitation of 30 to 50 inches, most of which falls as rain during the fall, winter, and spring months; an average January temperature of 40 degrees F, an average July temperature of 60 degrees F, and a mean annual growing season (28 degrees F) of 200 to 300 days and (32 degrees F) 160 to 220 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These include Alderwood, Blethen, Chuckanut, Everett, and Hoodsport soils and the competing Ahl and Blethen soils. These soils are deeper than 40 inches.

DRAINAGE AND PERMEABILITY: Well drained; moderate permeability; and runoff is medium to rapid.

USE AND VEGETATION: Timber production. The native vegetation is Douglas-fir, western hemlock, western red cedar, and red alder, with an understory of salal, Oregon-grape, oceanspray, red huckleberry, blueleaved huckleberry, and western swordfern.

DISTRIBUTION AND EXTENT: Northwestern Washington. Series is of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Portland, Oregon

SERIES ESTABLISHED: Jefferson County, Washington, 1968.

REMARKS: Diagnostic horizons and features recognized in this pedon are an ochric epipedon.

EVERETT SERIES

The Everett series consists of very deep, somewhat excessively drained soils formed in glacial outwash or alluvium with an admixture of volcanic ash on terraces, moraines, and terrace escarpments. Slopes are 0 to 65 percent. The average annual precipitation is about 40 inches. The average annual temperature is about 50 degrees F.

TAXONOMIC CLASS: Sandy-skeletal, isotic, mesic Vitrandic Dystroxerepts

TYPICAL PEDON: Everett very gravelly sandy loam, forest. (Colors are for moist soil unless otherwise noted.)

A--0 to 2 inches; very dark brown (10YR 2/2) very gravelly sandy loam, dark grayish brown (10YR 4/2) dry; weak very fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many roots; 55 percent gravel; moderately acid (pH 5.6); clear smooth boundary. (1 to 3 inches thick)

Bw1--2 to 8 inches; dark yellowish brown (10YR 3/4) very gravelly sandy loam, yellowish brown (10YR 5/4) dry; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many roots; 55 percent gravel; moderately acid (pH 5.8); gradual wavy boundary. (5 to 7 inches thick)

Bw2--8 to 19 inches; dark brown (7.5YR 3/4) extremely gravelly coarse sandy loam, yellowish brown (10YR 5/4) dry; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic, many roots; 70 percent gravel; moderately acid (pH 6.0); clear wavy boundary. (0 to 15 inches thick)

2C--19 to 49 inches; olive brown (2.5Y 4/4) extremely gravelly sand, brown (10YR 5/3) dry; single grain; loose; 65 percent gravel; few roots; pale brown (10YR 6/3) manganese stains on underside of gravel; moderately acid (pH 5.8)

TYPE LOCATION: Pierce County, Washington; 200 feet west and 200 feet south of NE corner of sec.28, T. 19 N., R. 4 E.

RANGE IN CHARACTERISTICS: Depths to diagnostic horizons and features start from the mineral soil surface.

Average annual soil temperature - 48 to 54 degrees F.
Soil moisture control section - dry for 60 to 75 consecutive days
Reaction - slightly acid to very strongly acid
Particle-size control section:
Rock fragments - 35 to 80 percent.

A horizon
Hue - 10YR, 7.5YR, or 5YR
Value - 2 to 5 moist, and 4 to 6 dry
Chroma of 1 to 3 moist or dry.

Bw horizons
Hue - 10YR or 7.5YR
Value - 3 to 6 moist, and 3 to 6 dry
Chroma - 2 to 6 moist or dry.
Texture L or SL

BC horizon
Hue - 10YR or 7.5YR
Value - 3 or 4 moist, 4 to 6 dry
Chroma - 3 or 4 moist or dry
Texture - SL or LS

2C horizon
Hue of 7.5YR to 2.5Y
Value of 2 to 4 moist, and 5 to 7 dry

Chroma of 1 to 4.
Texture LS or COS

COMPETING SERIES: These are no competing series in this family.

GEOGRAPHIC SETTING: The Everett soils are on glacial outwash terraces and terrace escarpments at elevations of 30 to 700 feet. Slopes are 0 to 65 percent. These soils formed in alluvium or glacial outwash from granite, quartzite, shale, sandstone, schist, basalt, and andesite with an admixture of volcanic ash in the upper part. the climate is mild, summer is cool and dry, and winter is mild and wet. Mean annual precipitation ranges from 30 to 50 inches. Average January temperature is 36 degrees F., average July temperature is 63 degrees F., and the average annual temperature is 50 degrees F. The average frost-free season ranges from 145 to 240 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Alderwood, Baldhill, Indianola, and Kapowsin soils. Alderwood soils have a densic contact at a depth of 20 to 40 inches. Indianola soils are sandy throughout. Kapowsin soils are coarse-loamy. Baldhill soils are loamy-skeletal.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Somewhat excessively drained; high to very high saturated hydraulic conductivity.

USE AND VEGETATION: Some areas are used for pasture and others are cultivated and used for growing berries and small fruits. Some are used for homesites, sanitary landfills and as a source of sand and gravel. They now support second growth Douglas-fir and some red alder and western hemlock, with an understory of salal, Oregon-grape, vine maple, western brackenfern, red huckleberry, creambush oceanspray and trailing blackberry.

DISTRIBUTION AND EXTENT: Northwest Washington; MLRA A2, Northern part. Series is of large extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Portland, Oregon

SERIES ESTABLISHED: 1910 Reconnaissance Survey of Eastern Puget Sound Basin, Washington.

REMARKS: Classification changed 4/94 and 1/00 because of amendments to Soil Taxonomy. Estimated content of volcanic glass of >5 percent and >0.4 percent Al + 1/2 Fe by acid-oxalate. Diagnostic horizons and features recognized in this pedon are an ochric epipedon and a cambic horizon from 2 to 19 inches.

ADDITIONAL DATA: Laboratory data is available for this series. National Soil Survey Laboratory Pedon Numbers 71C0045, 71C0046, and 04N0759

RAGNAR SERIES

The Ragnar series consists of very deep, well drained soils that formed in glacial outwash. Ragnar soils are on rolling areas of esker and kame relief and have slopes of 0 to 70 percent. The average annual precipitation is about 47 inches and the mean annual temperature is about 50 degrees F.

TAXONOMIC CLASS: Coarse-loamy over sandy or sandy-skeletal, isotic over mixed, mesic Vitrandic Dystroxerepts

TYPICAL PEDON: Ragnar fine sandy loam, forested. (Colors are for moist soil unless otherwise noted.)

Oe--0 to 1 inch; black (10YR 2/1) partially decomposed leaves and twigs; many roots; abrupt smooth boundary. (1 to 2 inches thick)

A--1 to 5 inches; very dark grayish brown (10YR 3/2) and very dark gray (10YR 3/1) fine sandy loam, grayish brown (10YR 5/2) dry; massive; slightly hard, very friable, nonsticky, nonplastic; many roots; many very fine pores; NaF pH 10.5; moderately acid (pH 6.0); abrupt wavy boundary. (3 to 9 inches thick)

Bs--5 to 18 inches; dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) fine sandy loam, brown (10YR 5/3) dry; massive; slightly hard, very friable, nonsticky, nonplastic; many roots; many very fine pores; NaF pH 11.5; moderately acid (pH 6.0); clear smooth boundary. (5 to 13 inches thick)

2BC--18 to 28 inches; yellowish brown (10YR 5/4) loamy fine sand, brown (10YR 5/3) dry; massive; slightly hard, very friable, nonsticky, nonplastic; common roots; many very fine pores; NaF pH 10.5; slightly acid (pH 6.2); clear smooth boundary. (6 to 12 inches thick)

2C--28 to 41 inches; olive brown (2.5Y 4/4) loamy sand, yellowish brown (10YR 5/3) dry; massive; loose; few roots; many very fine pores; NaF pH 10.0; slightly acid (pH 6.2).

TYPE LOCATION: King County, Washington; 330 feet north, 230 feet east of center of section 3, T.21N., R.5E.

RANGE IN CHARACTERISTICS: The mean annual soil temperature is 47 to 53 degrees F. These soils are usually moist, but are dry in all parts between depths of 8 and 24 inches for 60 to 80 consecutive days in most years. The upper part of the 10 to 40 inch control section contains 2 to 10 percent clay. The lower part of the control section is loamy sand or sand. Depth to the 2C horizon ranges from 20 to 35 inches. Rock fragments in the control section range from 0 to 15 percent by volume. Reaction is moderately acid or slightly acid.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3 moist, 4 or 5 dry, and chroma of 1 through 3 moist or dry.

The Bs horizon has hue of 10YR or 7.5YR, value of 3 through 5 moist, 4 through 7 dry, and chroma of 4 through 6 moist or dry. It contains 0 to 5 percent iron concretions.

The 2C horizon has hue of 10YR through 5Y, value of 3 through 7 moist, 4 through 7 dry, and chroma of 1 through 4 moist or dry. It is loamy sand, sand, or fine sand.

COMPETING SERIES: These are the Birchbay, Lystair, and Winston series. Birchbay and Winston soils are sandy-skeletal in the lower part of the particle-size control section. Lystair soils are mottled in the C horizon.

GEOGRAPHIC SETTING: These soils are on esker and kame like relief along the edges of major valleys at elevations of 300 to 1,000 feet. Slopes are 0 to 70 percent. The soils formed in glacial outwash. They have cool, dry summers and mild, wet winters. The average annual precipitation ranges from 35 to 65 inches, most of which falls between October and April. Some snow falls in winter. The average January temperature is about 38 degrees F.; the average July temperature is 66 degree F.; and the frost free season ranges from 150 to 212 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Alderwood, Everett, Harstine, Indianola, and Kitsap soils. Alderwood and Harstine soils have dense glacial till at a depth of 20 to 40 inches. Everett soils average more than 35 percent rock fragments in the 10 to 40 inch control section. Indianola soils have a sandy control section. Kitsap soils are a fine-silty.

DRAINAGE AND PERMEABILITY: Well drained; medium to slow runoff; rapid permeability.

USE AND VEGETATION: Most of the Ragnar soils are used for growing timber. They are used to a small extent for growing hay, pasture, early berries and truck crops. Many areas are used for homesites. The dominant overstory is Douglas-fir, Pacific madrone. western hemlock, red alder, and western redcedar with an understory of salal, Oregon-grape, huckleberry, western brackenfern, western swordfern, trailing blackberry, and evergreen huckleberry.

DISTRIBUTION AND EXTENT: Northwestern Washington. This series is moderately extensive.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Portland, Oregon

SERIES ESTABLISHED: King County, Washington, 1943.

REMARKS: Classification updated 3/94 and 1/00 because of amendments to Soil Taxonomy. Estimate that the 0 to 17 inch zone has >5.0 percent volcanic glass and >0.4 percent by ammonium-oxalate extract. Diagnostic horizons and features recognized in this pedon are an ochric epipedon from 1 to 5 inches, a cambic horizon from 5 to 18 inches, and a lithologic change at 18 inches from coarse-loamy to sandy soil material.

Depths to diagnostic horizons and features are measured from the to of the first mineral horizon.

INDIANOLA SERIES

The Indianola series consists of very deep, somewhat excessively drained soils formed in sandy glacial drift. Indianola soils are on hills, terraces, terrace escarpments, eskers, and kames of drift or outwash plains at elevations of near sea level to 1,000 feet. Slopes are 0 to 70 percent. Mean annual precipitation ranges from 20 to 55 inches and the mean annual temperature is about 50 degrees F.

TAXONOMIC CLASS: Isotic, mesic Dystric Xeropsamments

TYPICAL PEDON: Indianola loamy sand-forested. (Colors are for moist soil unless otherwise stated.)

Oi--0 to 1 inch; slightly decomposed plant material; abrupt smooth boundary.

A--1 to 6 inches; very dark grayish brown (10YR 3/2) loamy sand, black (10YR 2/1) moist; single grain; loose, nonsticky, nonplastic; many very fine and fine roots; many very fine and fine interstitial pores; neutral (pH 6.8); clear wavy boundary.

Bw1--6 to 17 inches; yellowish brown (10YR 5/4) loamy sand, brown (10YR 4/3) moist; single grain; loose, nonsticky, nonplastic; common very fine, fine, and common medium roots; many very fine and fine interstitial pores; neutral (pH 6.8); clear wavy boundary.

Bw2--17 to 27 inches; yellowish brown (10YR 5/4) sand, brown (10YR 4/3) moist; single grain; loose, nonsticky, nonplastic; common very fine, fine, and medium roots; many very fine and fine interstitial pores; neutral (pH 6.6); clear wavy boundary.

BC--27 to 37 inches; pale brown (10YR 6/3) sand, brown (10YR 4/3) moist; single grain; loose, nonsticky, nonplastic; common fine roots; many very fine and fine interstitial pores; neutral (pH 6.8); gradual wavy boundary.

C--37 to 60 inches; pale brown (10YR 6/3) sand, brown (10YR 4/3) moist; single grain; loose, nonsticky, nonplastic; few very fine and fine roots; many very fine and fine interstitial pores; neutral (pH 6.6).

TYPE LOCATION: Thurston County, Washington; about 2 miles southeast of Tumwater, north end of Munn Lake near Department of Game boat launching site; 2,200 feet east and 2,550 feet north of the southwest corner sec. 1, T. 17 N., R. 2 W. Willamette Baseline Meridian; USGS Maytown NE quarter quadrangle; lat. 46 degrees 59 minutes 18 seconds N. and long. 122 degrees 52 minutes 40 seconds W., NAD83.

RANGE IN CHARACTERISTICS: Depths to diagnostic horizons and features start from the mineral soil surface.

Mean annual soil temperature - 47 to 52 degrees F.
Moisture control section - dry for 60 to 75 consecutive days following summer solstice
Reaction - neutral to strongly acid

Particle-size control section:
Rock fragments - 0 to 15 percent

A horizon
Hue - 10YR, 7.5YR or 5YR
Value - 2 to 4 moist, 3 to 6 dry
Chroma - 1 to 6 moist and dry

Bw horizon
Hue - 10YR, 7.5YR or 5YR
Value - 2 to 4 moist, 4 to 6 dry
Chroma - 1 to 4 moist and dry
Texture - LS or LFS

BC horizon
Hue - 10YR or 2.5Y
Value - 4 or 5 moist, 6 or 7 dry
Chroma - 3 or 4 moist and dry
Texture - LS, LFS, S, or FS

C horizon
Hue - 10YR, 2.5Y or 5Y
Value - 4 through 6 moist, 5 through 7 dry
Chroma - 2 through 4 moist and dry
Texture - LS, LFS, S, or FS

COMPETING SERIES: This is the Keystone series. Keystone soils are dry in the moisture control section for 75 to 90 consecutive days following the summer solstice. Similar series classified in a mixed mineralogy family but are likely isotic as well are Birdsview, Greenwater, and Pilchuck series. Birdsview soils are dry in the moisture control section for 45 to 60 consecutive days following the summer solstice. Greenwater soils have 5 to 25 percent volcanic ash, cinders, and pumice in the control section. Pilchuck soils have chroma of 2 or less throughout the control section, and have an irregular decrease in organic carbon with depth.

GEOGRAPHIC SETTING: Indianola soils are on hills, terraces, terrace escarpments, eskers, or kames of drift or outwash plains at elevations of near sea level to 1,000 feet. Slopes are 0 to 70 percent. These soils formed in sandy glacial drift and minor amounts of volcanic ash. They are in a maritime climate of cool dry summers and mild wet winters. Mean annual precipitation ranges from 30 to 55 inches most of which falls between October and April. Mean January temperature is 36 degrees F., the average July temperature is 62 degrees F., and mean annual temperature is 50 degrees F. The frost-free season ranges from 180 to 240 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Alderwood, Cassolary, Everett, Hoypus, Kitsap, Nisqually, Quilcene, Sinclair, Spanaway, and Tokul soils. Alderwood, Sinclair, and Tokul soils have dense glacial till at a depth of 20 to 40 inches.

Cassolary soils are fine-loamy. Everett, Hoypus and Spanaway soils are sandy-skeletal. Kitsap soils are fine- silty. Nisqually soils have an umbric epipedon. Quilcene soils have a fine control section and are underlain by weathered shale at depths of 20 to 40 inches.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Somewhat excessively drained. Saturated hydraulic conductivity is very high.

USE AND VEGETATION: Timber production, forage production, and pasture. Potential natural vegetation is Douglas-fir, western redcedar, western hemlock, red alder and bigleaf maple, with an understory of salal, Oregongrape, red huckleberry, western brackenfern, western swordfern, trailing blackberry, evergreen huckleberry, and vine maple.

DISTRIBUTION AND EXTENT: Puget lowlands in Northwestern Washington, MLRA 2, northern part. The series is of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Portland, Oregon

SERIES ESTABLISHED: Kitsap County, Washington, 1935.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Ochric epipedon
Particle-size control section - 10 to 40 inches

This revision (7/2009) reflects a new description of the type location which adds an Oi horizon to this soil which is naturally forested.

Previous revision (5/2006) reflects a change in the mineralogy class from mixed to isotic, based on laboratory data

ADDITIONAL DATA: Laboratory data is available for this series. National Soil Survey Laboratory Pedon Numbers 74C0046 and 04N0755.