3D geologic map of the Quilcene 7.5-minute quadrangle, Jefferson County, Washington

Disclaimer

Citation and link

This 3D geologic map is derived from previously published geologic mapping and analysis. Some of the borehole data are considered preliminary and have not been examined for accuracy of either location or lithologic identification. While lithologic identification for all wells was made by the author of the published geologic map, not all of the wells shown in this 3D product were necessarily used to construct the geologic cross section. The map, cross section, and the borehole data within the 3D model are not intended for analytical use. Instead, the published map and (or) pamphlet should be consulted for original data and interpretation.

Click anywhere within this box to dismiss this disclaimer and continue.

Layer001

Layer002

No Separation | 5% | 50% | 100%

5

Probe

1x Z-Scale | 10x Z-Scale | Default Scale | 10

Web tutorial

WASHINGTON STATE DEPARTMENT OF
Natural Resources
Peter Goldmark - Commissioner of Public Lands

3D PDF INSTRUCTIONS

NAVIGATION
(1 of 2)

- Click inside the window to manipulate the 3D view—the compass will rotate to point north
- Hold the left mouse button and move the mouse to tilt the view
- Use the mouse wheel to zoom
- Hold both the right and left mouse buttons to pan the view
- Toggle individual layers in the lower left corner
- Change the vertical scaling or layer separation in the lower toolbar
- Selecting an object will display its data below

OBJECT DATA

undefined

undefined

undefined

undefined

3D model creation: Daniel W. Eungard

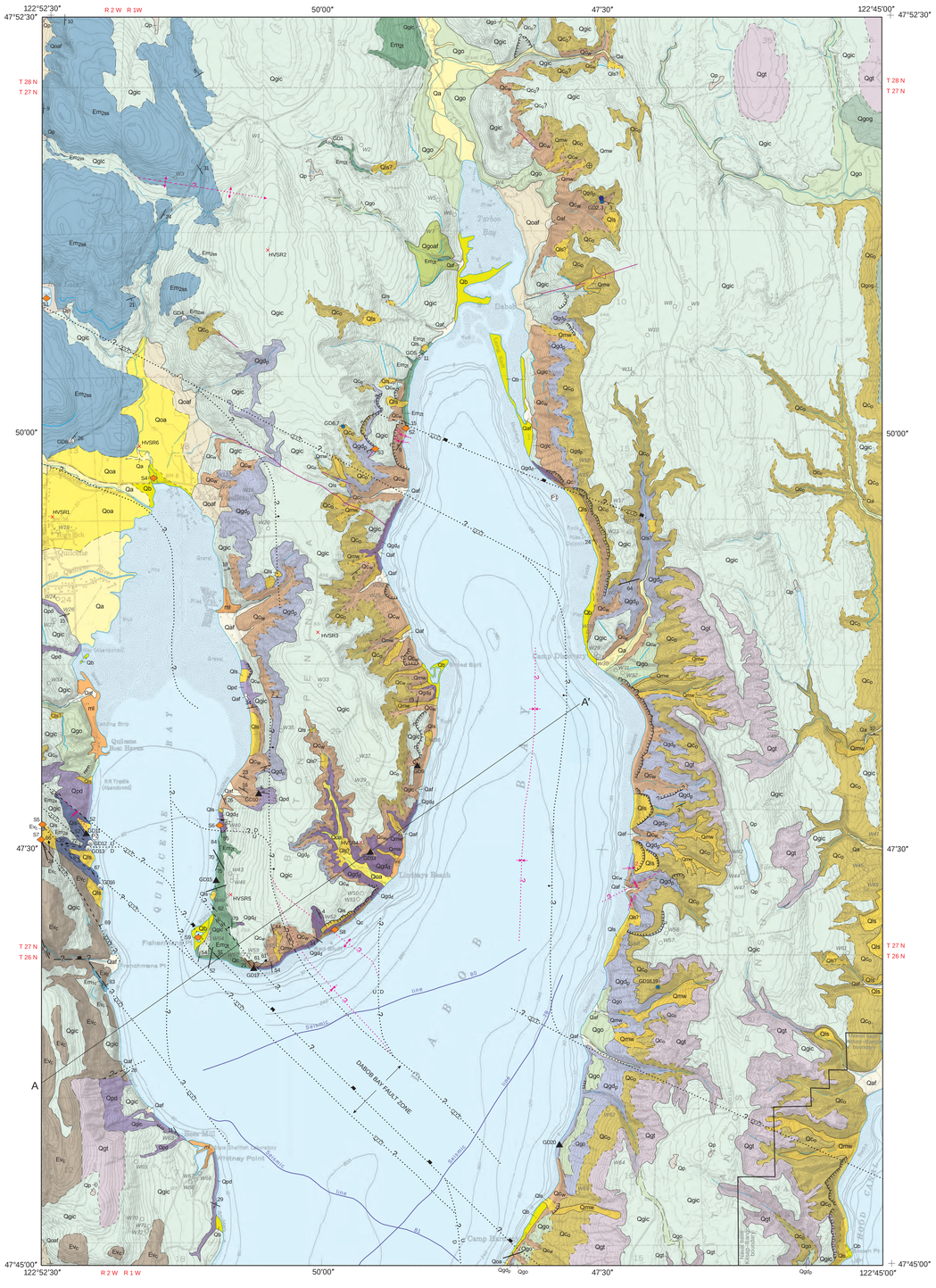
Editing and production: Alexander N. Steely

WASHINGTON STATE DEPARTMENT OF
Natural Resources
Peter Goldmark - Commissioner of Public Lands
Division of Geology and Earth Resources
David K. Norman - State Geologist

Geologic Map of the Quilcene 7.5-minute Quadrangle, Jefferson County, Washington

by Trevor A. Contreras, Annette I. Patton, Gabriel Legorreta Paulín, Ian J. Hubert, Recep Cakir, and Robert J. Carson

2014



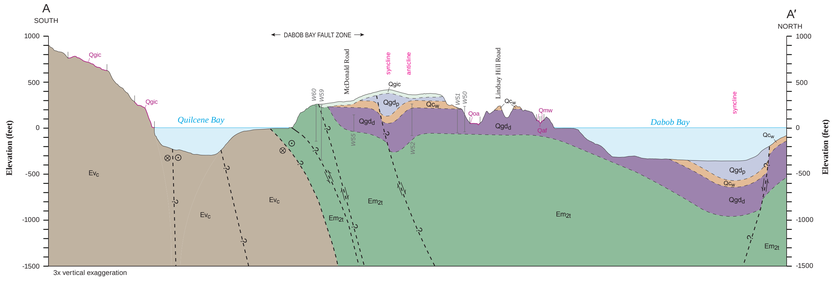
Lambert conformal conic projection
North American Datum of 1927; to place on North American Datum of 1983, move the projection lines approximately 20 meters north and 96 meters east as shown by crosshair corner ticks
Base map from scanned and rectified U.S. Geological Survey Quilcene 7.5-minute quadrangle, 1953
Shaded relief generated from a lidar bare-earth digital elevation model (available from Puget Sound Lidar Consortium, http://pugetsoundlidar.ess.washington.edu/); sun azimuth 340°; sun angle 60°; vertical exaggeration 0.8
GIS by Trevor A. Contreras and Annette I. Patton
Digital cartography by Ian J. Hubert and Anne C. Olson
Editing and production by Jaretta M. Roloff, Jessica L. Czajkowski, and Alexander N. Steely

SCALE 1:24,000
1 0.5 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 0.5 0 1 KILOMETER
contour interval 20 feet
depth contours in feet—datum is mean lower low water

This geologic map was funded in part by the U.S. Geological Survey National Cooperative Geologic Mapping Program.

Research supported by the U.S. Geological Survey, National Cooperative Geologic Mapping Program, under USGS award number G13AC00173. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

APPROXIMATE MEAN DECLINATION, 2014



GEOLOGIC SYMBOLS IN CROSS SECTIONS

Fault—Solid where location accurate; dashed where inferred; queried where identity or existence questionable. Arrows indicate relative vertical motion. Arrow point (⊙) indicates motion toward the viewer, and arrow feathers (⊗) indicate motion away from the viewer.

Surficial geologic units too thin to show as polygons at the scale of the cross sections. Black tick marks separate units.

Water well

MAJOR FINDINGS

- The right-lateral Dabob Bay and Bon Jon Pass fault zones connect in a right step-over and create a pull-apart basin at Quilcene and the Bolton Peninsula. This step-over occurs near locations associated with the Olympic–Wallowa lineament.
- Deformed Quaternary deposits on the Bolton Peninsula suggest potentially active structures along or near the Olympic–Wallowa lineament where previous work by J Harlen Bretz and Robert J. Carson noted deformation.
- The Dabob Bay fault zone has deformed and juxtaposed portions of Crescent Formation, Aldwell Formation, and Townsend Shale between Fishermans Point on the Bolton Peninsula and Mount Walker. Seismicity in the area suggests these structures may be active.
- Native stories, as well as scarps and trees buried by landslide deposits near Frenchmans Point, may record a historic earthquake.
- Sedimentary bedrock at Fishermans Point contains evidence of fossil methane seeps in the Townsend Shale.

DESCRIPTION OF MAP UNITS

(See pamphlet for complete descriptions of map units)

Quaternary Unconsolidated Deposits

HOLOCENE NONGLACIAL DEPOSITS

ml — **Modified land**—Clay to boulder gravel and diamicton; locally derived but mixed and reworked by excavation and (or) redistribution that notably modifies topography.

Qa — **Alluvium**—Sand to cobble gravel; loose; gray, generally unweathered; clasts subrounded; moderately to well sorted.

Qoa — **Relict alluvium**—Sand to cobble gravel; loose; gray; clasts subrounded; moderately to well sorted; commonly found in abandoned terraces.

Qb — **Beach deposits**—Sand to boulder gravel with shells and driftwood; loose; gray to brown-gray; clasts moderately to well rounded; may be well sorted; derived from shore bluffs, streams, and underlying deposits.

HOLOCENE TO LATEST PLEISTOCENE NONGLACIAL DEPOSITS

Qp — **Peat**—Organic-rich sediment, including silt and clay; very soft to medium soft; dark brown to black; typically in closed depressions.

Qls — **Landslide deposits**—Diamicton; loose or soft; clasts subangular to subrounded; unsorted to moderately sorted; nonstratified. Not all landslides are shown, and absence of a mapped slide does not imply absence of hazard. Queried where there was some level of uncertainty about the identity of the landform.

Qmw — **Mass-wasting deposits**—Diamicton; loose; clasts subrounded; unsorted to poorly sorted; includes colluvium, debris fans, alluvial fans, and landslides; mapped where topography suggests mass-wasting deposits.

Qaf — **Alluvial fan deposits**—Debris-flow diamicton and alluvial sand and gravel; loose; gray; clasts subrounded to rounded; forms concentric lobes where streams emerge from confining valleys.

Qoaf — **Relict alluvial fan deposits**—Debris-flow diamicton and alluvial sand and gravel; loose; gray; clasts subrounded to rounded; found in inactive alluvial fans that lack evidence for recent sediment delivery.

PLEISTOCENE GLACIAL AND NONGLACIAL DEPOSITS

Vashon Drift of the Fraser Glaciation (MIS 2)

Qgo — **Vashon recessional outwash**—Sand and cobble to pebble gravel; loose; gray, weathering to tan; clasts subangular to rounded; moderately to well sorted; represents fluvial deposition by Vashon meltwater. Locally divided into:

Qgoaf — **Vashon alluvial fan deposits**—Sand and pebble gravel, silt, and cobbles; loose; subrounded; moderately to poorly sorted; stratified; forms concentric lobes where outwash streams emerged from confining valleys.

Qgog — **Vashon recessional outwash gravel**—Pebble and cobble gravel and sand; gray to tan, unweathered; loose; clasts moderately to well rounded; moderately to well sorted; mapped in outwash channels graded to a recessional lake.

Qgic — **Vashon ice-contact deposits**—Diamicton, cobbly pebble gravel, and subglacial melt-out till; yellow-tan to gray; loose to dense; clasts subangular to subrounded; variously sorted; massive to well stratified; till is friable and permeable.

Qgt — **Vashon lodgment till**—Mixture of clay, silt, sand, and gravel (diamicton); gray; compact; clasts subangular to rounded; unsorted and unstratified.

Pre-Fraser Glacial and Nonglacial Deposits

Qc_o — **Olympia nonglacial deposits**—Sand, silt, and pebble gravel; tan and gray; loose to moderately compact; clasts subangular to subrounded; well sorted; massive to well bedded and stratified; locally crossbedded. Represents distal Olympic and Cascade alpine outwash deposited in the Puget Lowland when it was ice free. Deposited during the Olympia nonglacial interval (MIS 3).

Qgd_p — **Possession Drift**—Diamicton and outwash; light brown to gray; very dense and massive; clasts subrounded to rounded; moderately to well sorted and unsorted; moderately stratified and medium to thickly bedded. Deposited during the Possession Glaciation (MIS 4).

Qc_w — **Whidbey Formation**—Silt, clay, and sand with minor sandy pebble gravel; light gray; dense and stiff; clasts subrounded; well stratified and well sorted; thinly laminated to very thickly bedded. Represents mostly calm-water deposition during the Whidbey Interglaciation (MIS 5).

Qgd_d — **Double Bluff Drift**—Diamicton; gray to blue gray; very dense. The few wells that penetrated this unit encountered diamicton suggestive of significant glacial strata. Deposited during the Double Bluff Glaciation (MIS 6).

Pre-Fraser deposits, undivided

Qc — **Pre-Fraser nonglacial deposits**—Predominantly silty clay, sand, and gravel of uncertain age; brown-gray and blue-gray; very dense and hard.

Qpd — **Pre-Fraser glacial drift**—Till and minor sandy pebble to cobble gravel of uncertain age; gray; compact; clasts subangular to subrounded; moderately sorted and stratified to unsorted and unstratified. The unit may reflect multiple glacial advances.

TERTIARY SEDIMENTARY AND VOLCANIC ROCKS

Em_{Tt} — **Townsend Shale (late Eocene)**—Marine siltstone and sandstone; gray to brown; calcareous concretions and nodules of siderite are locally abundant.

Em_{Tss} — **Sandstone of Snow Creek (late? Eocene)**—Micaceous sandstone and sandy siltstone; gray-brown. Previously identified as the Snow Creek Member of the Lyre Formation (Spencer (1983b, 1984).

Em_{Ta} — **Aldwell Formation (early to middle Eocene)**—Lithic sandstone and siltstone; gray to gray-green; interfingering contact with sedimentary beds of the Crescent Formation.

Ev_c — **Crescent Formation (early to middle Eocene)**—Basalt; dark gray to greenish black where fresh, weathers gray and yellow-brown; commonly fine-grained sills and flows; commonly includes amygdules of zeolite and chlorite-group minerals. Locally subdivided into:

Em_{Tc} — **Sedimentary rock of the Crescent Formation (early to middle Eocene)**—Lithic sandstone, basaltic conglomerate and basalt breccia; dark gray-black; interfingered with Crescent volcanics.

GEOLOGIC SYMBOLS

Contact—Solid where location accurate; long dash where approximate; short dash where inferred; queried where existence or location uncertain

Normal fault—Location concealed

Reverse fault—Long dash where location approximate; short dash where inferred; dotted where concealed; queried where existence or location uncertain

Strike-slip fault, right-lateral offset—Solid where location accurate; long dash where location approximate; short dash where inferred; dotted where concealed; queried where existence or location uncertain

Oblique-slip fault, reverse right-lateral offset—Short dash where location inferred; dotted where concealed; queried where existence or location uncertain

Oblique-slip fault, normal right-lateral offset— Short dash where location inferred; dotted where concealed; queried where existence or location uncertain

High-angle dip-slip fault—Location concealed; queried where existence or location uncertain. relative movement shown by U and D

Anticline—Short dash where location inferred; dotted where concealed; queried where existence or location uncertain; arrow indicates plunge direction

Syncline—Short dash where location inferred; dotted where concealed; queried where existence or location uncertain

Topographic lineament—Solid where location accurate; long dash where approximate

A—A' Cross section line

Strand line (former shoreline)—Identity and existence certain

Seismic line 80 Geophysical data collection line—Location accurate

Landslide scarp—Solid where identity or existence certain; queried where identity or existence uncertain; hachures on downslope side

84 Bedding—showing strike and dip

16 Bedding in unconsolidated sedimentary deposits—showing strike and dip

51 Dip of fault—showing dip direction

21 Foreset bedding in unconsolidated sedimentary deposits—showing strike and dip

Horizontal bedding

62 Joint—showing strike and dip

Minor anticline—showing bearing and plunge

Minor syncline—showing bearing and plunge

52 Minor fault—showing strike and dip

Minor vertical fault—showing strike and dip

20 Slickenline—showing bearing and plunge

Qgd_p Geologic unit too small to show as a polygon at map scale

GD9 Age sample, radiocarbon (^{14}C)

GD2 Age sample, luminescence

GD13 Age sample, fossil

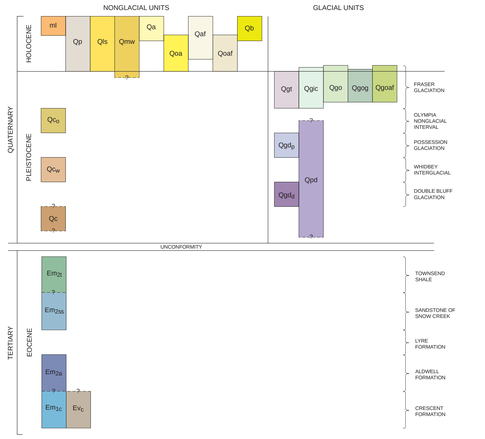
WS7 Water well

S8 Significant site

P Location of photograph

HVSR5 Geophysical data collection location

CORRELATION OF MAP UNITS



Central Puget Lowland Stratigraphic Column

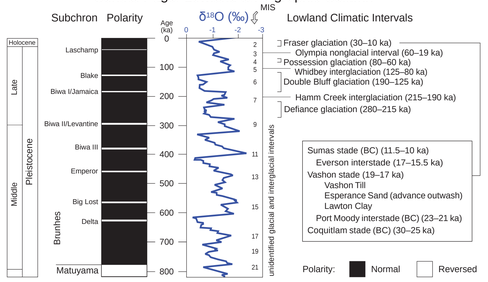


Figure M2. Comparison of geologic time scale, global magnetic polarity, Marine Oxygen Isotope Stages (MIS), and ages of climatic intervals in the Puget and Fraser Lowlands. Age ranges for the Olympia nonglacial interval, Vashon Stade, and Everson interstade were modified by Polenz and others (2013, 2012b). We note that the time boundaries between the Olympia nonglacial interval, Vashon Stade, and the Everson interstade in the Puget Lowland are time transgressive. Data sources are explained in Troost and Booth (2008). Figure modified from Troost and Booth (2008, fig. 6). BC, British Columbia.

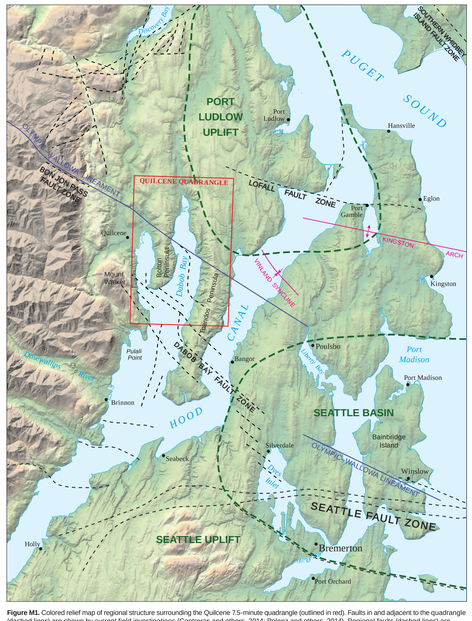


Figure M1. Colored relief map of regional structure surrounding the Quilcene 7.5-minute quadrangle (outlined in red). Faults in and adjacent to the quadrangle (dashed lines) are shown by current field investigations (Contreras and others, 2014; Polenz and others, 2014). Regional faults (dashed lines) are redrawn from previous investigations (Blakely and others, 2009; Tabor and others, 2011; Lamb and others, 2012; Bowman and Czajkowski, 2013; Contreras and others, 2013; Polenz and others, 2013). Segments of the Olympic–Wallowa lineament (blue line) are drawn from descriptions by Raisz (1945) and faulting noted by Tabor and others (2011). Geophysical studies (Pratt and others, 1997) provided the information on the uplifts and basins (outlined by green dashes).

Table M1. Age–control data within the Quilcene 7.5-minute quadrangle. Analytical methods used are ^{14}C, radiocarbon analysis; AMS, radiocarbon analysis by atomic mass spectrometry; and IRSL, infrared stimulated luminescence. Radiocarbon age estimates are presented as 'conventional radiocarbon age' with quoted errors representing one relative standard deviation (68% probability). Age estimates stated in ka are in calendar years before 1950 divided by 1,000 and are reported with two standard deviations of uncertainty (2σ = 95% confidence interval) as calculated using Calib online (http://calib.qub.ac.uk/calib/). Uncertainty estimates reflect random and lab errors; errors from unrecognized sample characteristics or flawed methodological assumptions are unknown. Elevations are estimated using Puget Sound Lidar Consortium lidar grid elevations projected to State Plane South, NAD 83 HARN, supplemented by elevation estimates of sites.

Site no.	Analytical method	Age estimate (^{14}C yr BP or ka)	$^{13}C/^{12}C$ (‰)	Material dated	Geologic unit	Lab no.	Elev. (ft)	Site location	Notes
GD1	fossils[6]	sample yielded no stratigraphic constraint	– –	microfossils	Em_{Tt}	8-A-696	365	sec. 5, T27N R1W	bedrock sample for biostratigraphic analysis
GD2	OSL[3]	72.980 ±3.51 ka	– –	quartz sand	Qc_w	Quilcene-2	295	sec. 3, T27N R1W	OSL sample of quartz grains from unit Qc_w
GD3	IRSL[3]	113.590 ±6.91 ka	– –	feldspar grains	Qc_w	Quilcene-2	295	sec. 3, T27N R1W	IRSL sample of feldspar grains from unit Qc_w
GD4	fossils[6]	sample yielded no stratigraphic constraint	– –	microfossils	Em_{Tss}	18-A-865-B	340	sec. 7, T27N R1W	bedrock sample for biostratigraphic analysis
GD5	fossils[6]	sample yielded no stratigraphic constraint	– –	microfossils	Em_{Tt}	38-A-1128	320	sec. 9, T27N R1W	bedrock sample for biostratigraphic analysis
GD6	OSL[3]	27.960 ±1.74 ka	– –	quartz sand	Qc_o	Quilcene-3	455	sec. 17, T27N R1W	OSL sample of quartz grains from unit Qc_o
GD7	IRSL[3]	36.640 ±2.98 ka	– –	feldspar grains	Qc_o	Quilcene-3	455	sec. 17, T27N R1W	IRSL sample of feldspar grains from unit Qc_o
GD8	fossils[6]	sample yielded no stratigraphic constraint	– –	microfossils	Em_{Tss}	8-A-702	570	sec. 13, T27N R2W	bedrock sample for biostratigraphic analysis
GD9	AMS[1]	>45 ka[4]	-25.2	organics	Qc_w	D-AMS 003731	176	sec. 28, T27N R1W	organics in paleosol
GD10	AMS[1]	49,053 ±470 yr BP[5]	-47.6	peat	Qc_o	D-AMS 003733	160	sec. 30, T27N R1W	peat layer in non-glacial gravel deposit
GD11	AMS[1]	113 ±31 yr BP 0.269–0.012 ka	-18.0	wood	Qls	D-AMS 004467	11	sec. 36, T27N R2W	tilted stump, partially buried by landslide
GD12	fossils[6]	sample yielded no stratigraphic constraint	– –	microfossils	Em_{Ta}	29-A-992	20	sec. 36, T27N R2W	bedrock sample for biostratigraphic analysis
GD13	fossils[6]	late Eocene–early Miocene	– –	fossil	Em_{Ta}	29-A-993	20	sec. 36, T27N R2W	late Eocene-early Miocene nautilus fossil *Aturia angustata*
GD14	tephra[2]	100–200 ka	– –	tephra	Qc_w	9-660-C	240	sec. 32, T27N R1W	Lindsays Beach tephra (Birdseye 1976b), correlated with the Carp Lake tephras. See Appendix E for microprobe data
GD15	AMS[1]	370 ±24 yr BP 0.500–0.319 ka	-25.9	wood	Qls	D-AMS 003734	8	sec. 31, T27N R1W	cedar roots in growth position, partially buried by possible landslide
GD16	fossils[6]	sample yielded no stratigraphic constraint	– –	microfossils	Em_{Ta}	26-A-955-A	20	sec. 36, T27N R2W	bedrock sample for biostratigraphic analysis
GD17	AMS[1]	>45 ka[4]	-30.3	organics	Qc_w	D-AMS 003732	25	sec. 6, T26N R1W	organics from silt and sand in beach bluff
GD18	OSL[3]	22.000 ±2.30 ka	– –	quartz sand	Qc_o	Quilcene-1	420	sec. 3, T26N R1W	OSL sample of quartz grains from unit Qc_o
GD19	IRSL[3]	26.420 ±2.13 ka	– –	feldspar grains	Qc_o	Quilcene-1	420	sec. 3, T26N R1W	IRSL sample of feldspar grains from unit Qc_o
GD20	AMS[1]	>45 ka[4]	-28.5	organics	Qc_w	D-AMS 004601	10	sec. 10, T26N R1W	organics in non-glacial silt deposit

[1] Analysis by DirectAMS
[2] Geochemical tephra analysis by Franklin Foit, Washington State University
[3] Analysis by Shannon Mahan, USGS
[4] Fraction of modern carbon was not discernible from background; samples are assumed to be older than 45 ka.
[5] Radiocarbon calibrations for samples greater than 45 ka are not supported by the Calib program.
[6] Analysis by Elizabeth Nesbitt, Burke Museum of Natural History

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Table M2. List of well sites for the Quilcene 7.5-minute quadrangle. Washington State Department of Ecology well tags shown when available; otherwise Ecology's internal tracking number shown. This unique identifier is assigned to each well log as it is recorded into their database. These data were obtained at: https://fortress.wa.gov/ecy/waterresources/map/WCLSWebMap/default.aspx

Well site	Site location	Site information
W1	sec. 6, T27N R1W	well tag BBN266
W2	sec. 5, T27N R1W	well tag APM087
W3	sec. 6, T27N R1W	internal no. 47658
W4	sec. 4, T27N R1W	internal no. 49684
W5	sec. 4, T27N R1W	well tag AKA942
W6	sec. 4, T27N R1W	well tag ABC600
W7	sec. 4, T27N R1W	well tag AKA941
W8	sec. 10, T27N R1W	well tag ALS030
W9	sec. 10, T27N R1W	well tag AAC142
W10	sec. 10, T27N R1W	well tag ACD378
W11	sec. 10, T27N R1W	well tag AEK724
W12	sec. 15, T27N R1W	well tag ABW243
W13	sec. 18, T27N R1W	well tag AKA906
W14	sec. 18, T27N R1W	well tag BCS267
W15	sec. 15, T27N R1W	well tag ABC395
W16	sec. 18, T27N R1W	well tag ABR981
W17	sec. 15, T27N R1W	internal no. 45796
W18	sec. 15, T27N R1W	well tag AFC250
W19	sec. 24, T27N R2W	internal no. 276825
W20	sec. 20, T27N R1W	well tag AES388
W21	sec. 22, T27N R1W	well tag AHB457
W22	sec. 20, T27N R1W	internal no. 52421
W23	sec. 22, T27N R1W	well tag BBB314
W24	sec. 24, T27N R2W	internal number 44634
W25	sec. 20, T27N R1W	well tag AHB477
W26	sec. 24, T27N R2W	well tag AKA933
W27	sec. 24, T27N R2W	well tag AKA981
W28	sec. 22, T27N R1W	well tag AL5046
W29	sec. 22, T27N R1W	well tag ACW035
W30	sec. 22, T27N R1W	well tag AS3820
W31	sec. 27, T27N R1W	well tag AAB949
W32	sec. 27, T27N R1W	internal no. 44389
W33	sec. 29, T27N R1W	well tag BBR671
W34	sec. 25, T27N R2W	internal no. 276393
W35	sec. 29, T27N R1W	internal no. 48970
W36	sec. 28, T27N R1W	internal no. 49864
W37	sec. 29, T27N R1W	internal no. 48451
W38	sec. 25, T27N R2W	well tag AAB848
W39	sec. 29, T27N R1W	well tag ABE811
W40	sec. 31, T27N R1W	internal no. 52223
W41	sec. 36, T27N R1W	well tag AHH178
W42	sec. 35, T27N R1W	well tag AGS203
W43	sec. 31, T27N R1W	well tag ABP913
W44	sec. 35, T27N R1W	well tag AHL410
W45	sec. 36, T27N R1W	well tag ABZ693
W46	sec. 31, T27N R1W	well tag AKA937
W47	sec. 35, T27N R1W	internal no. 583881
W48	sec. 36, T27N R1W	well tag ABP935
W49	sec. 31, T27N R1W	well tag AEJ752
W50	sec. 32, T27N R1W	well tag ABC155
W51	sec. 32, T27N R1W	well tag AFB553
W52	sec. 32, T27N R1W	well tag AEE041
W53	sec. 34, T27N R1W	well tag ACQ531
W54	sec. 31, T27N R1W	internal no. 52306
W55	sec. 32, T27N R1W	well tag AAC526
W56	sec. 34, T27N R1W	well tag ACQ532
W57	sec. 34, T27N R1W	well tag ALK367
W58	sec. 34, T27N R1W	well tag AGS268
W59	sec. 6, T26N R1W	well tag APQ292
W60	sec. 6, T26N R1W	well tag ABP738
W61	sec. 36, T27N R1W	internal no. 48805
W62	sec. 10, T26N R1W	well tag ABC313
W63	sec. 7, T26N R1W	well tag ABZ593
W64	sec. 10, T26N R1W	internal no. 51542
W65	sec. 7, T26N R1W	well tag ABC169
W66	sec. 7, T26N R1W	internal no. 277062
W67	sec. 7, T26N R1W	internal no. 28813
W68	sec. 7, T26N R1W	well tag AAB798
W69	sec. 10, T26N R1W	well tag AKS804
W70	sec. 7, T26N R1W	internal no. 46271
W71	sec. 7, T26N R1W	internal no. 43840
W72	sec. 7, T26N R1W	internal no. 45097

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