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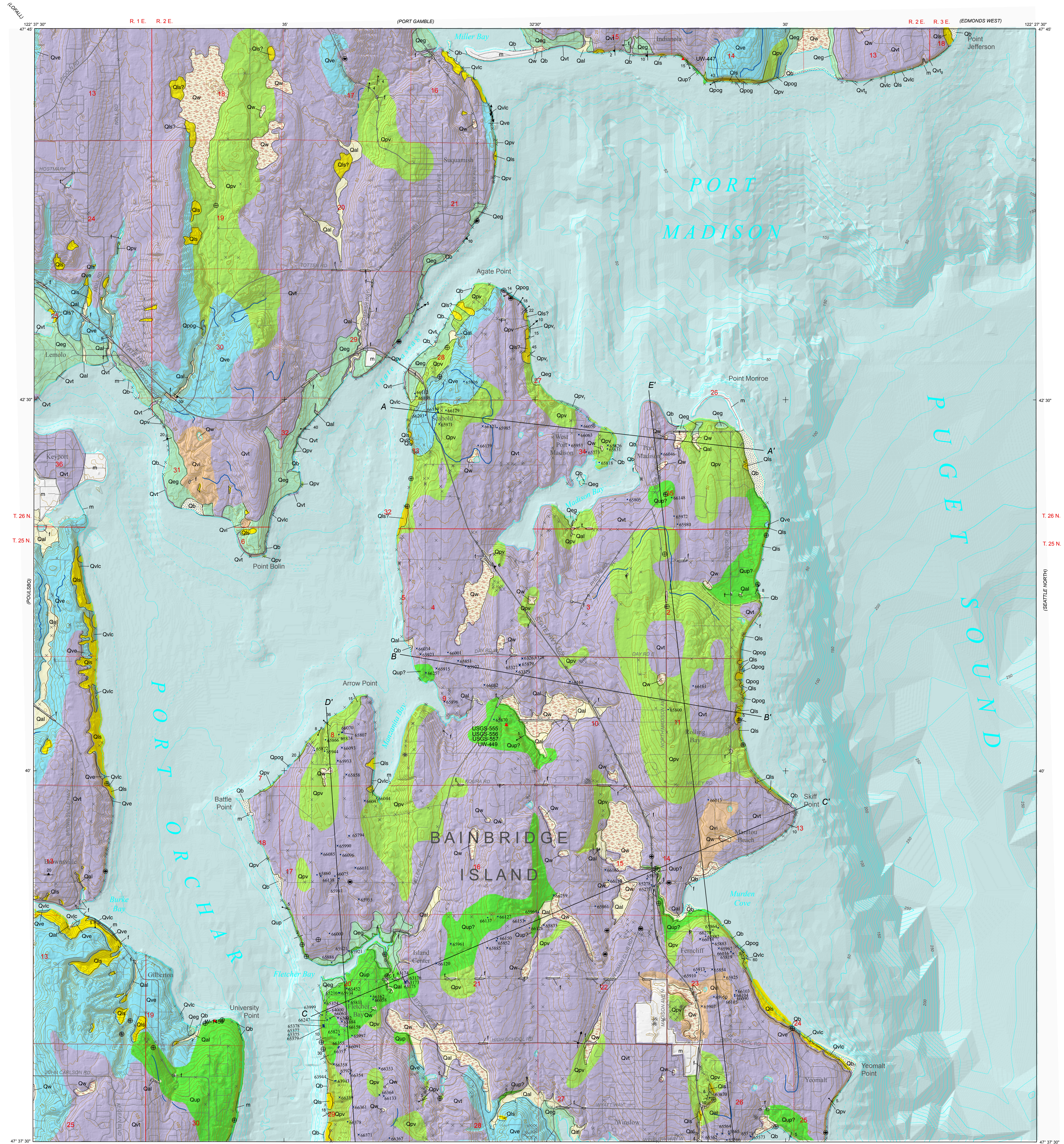
U.S. Department of the Interior
U.S. Geological Survey

Scientific Investigations Map 3181
Pamphlet accompanies map

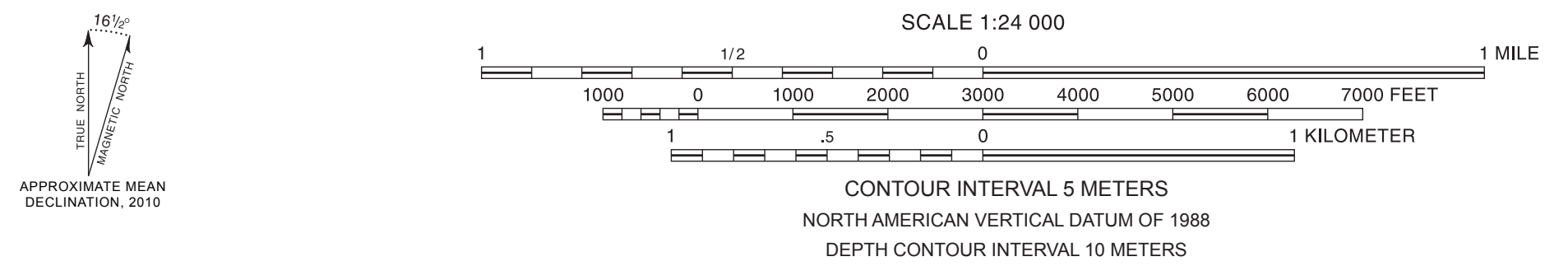

(LOFALL)
122° 37' 30"
47° 45'
R. 1 E.
R. 2 E.
(PORT GAMBLE)
35'
32'30"
30'
R. 2 E.
R. 3 E.
(EDMONDS WEST)
122° 27' 30"
47° 45'
Miller Bay
Indianola
Point Jefferson
Suquamish
Agate Point
Agate Passage
PORT MADISON
PUGET SOUND
Point Monroe
Lemolo
Keyport
Point Bolin
Seabold
West Port Madison
Port Madison
Madison Bay
T. 26 N.
T. 25 N.
(POULSBO)
(SEATTLE NORTH)
42' 30"
Arrow Point
Manzanita Bay
Battle Point
PORT ORCHARD
BAINBRIDGE ISLAND
Rolling Bay
Skiff Point
Manitou Beach
Murden Cove
Brownsville
Burke Bay
Gilberton
University Point
Fletcher Bay
Island Center
Ferncliff
Yeomalt
Yeomalt Point
Winslow
40'
A
A'
B
B'
C
C'
D
D'
E
E'
USGS-555
USGS-556
USGS-557
UW-449
UW-447
47° 37' 30"
122° 37' 30"
R. 1 E.
R. 2 E.
35'
(BREMERTON EAST)
32' 30"
30'
(SEATTLE SOUTH)
47° 37' 30"
122° 27' 30"
(BREMERTON WEST)

Geographic coordinates: North American Datum of 1927

Contours and shaded-relief-base image calculated from 6-ft lidar DEM, Puget Sound Lidar Consortium, and 30-ft DEM compiled by D.P. Finlayson (2005, Combined bathymetry and topography of the Puget Lowland, Washington State: University of Washington, *http://www.ocean.washington.edu/data/pugetsound/*, accessed on August 31, 2011). Triangular facets in submarine areas are artifacts from sparse bathymetric data

Public Land Survey System from Washington Department of Natural Resources

Roads from Kitsap County


16½°
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 2010
SCALE 1:24 000
1
1/2
0
1 MILE
1000
0
1000
2000
3000
4000
5000
6000
7000 FEET
1
.5
0
1 KILOMETER

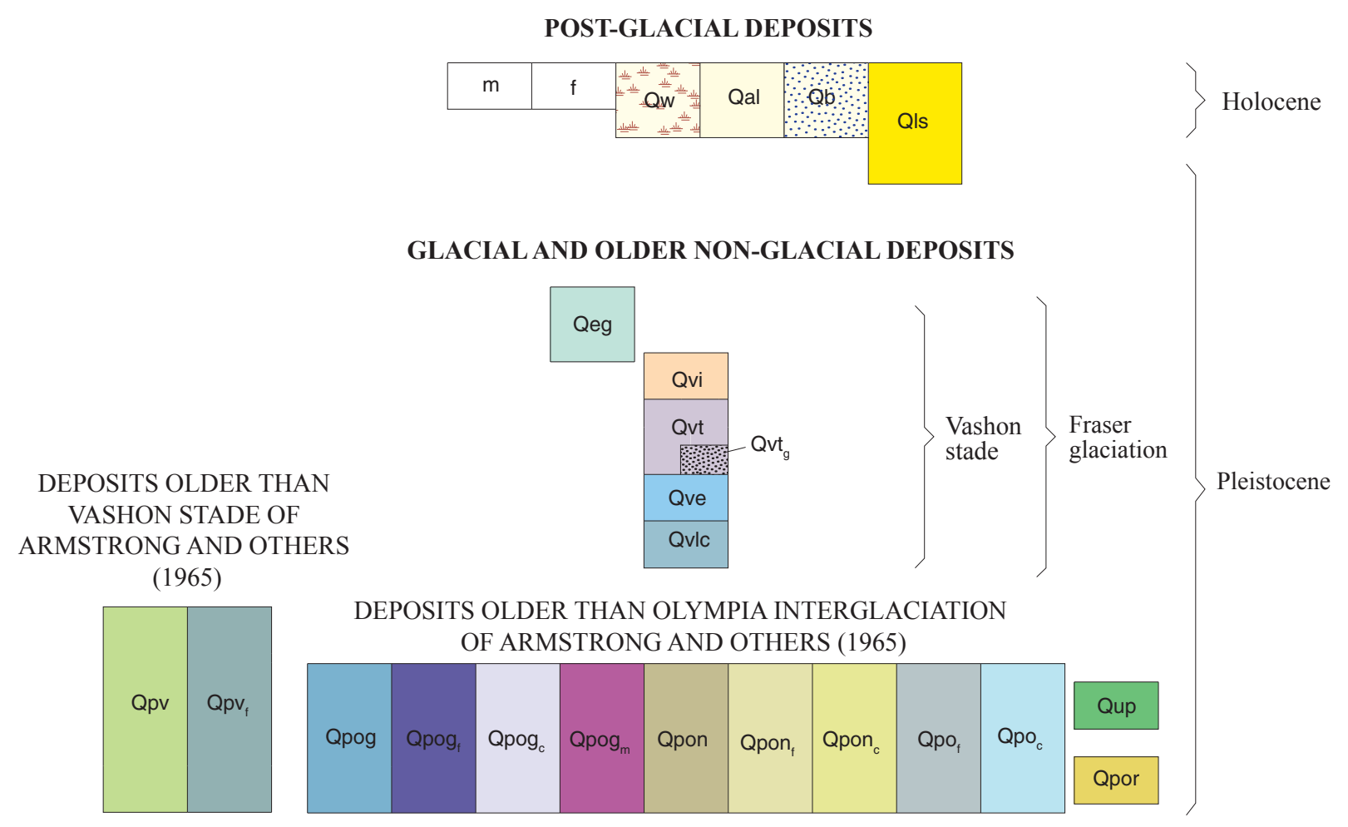
CONTOUR INTERVAL 5 METERS
NORTH AMERICAN VERTICAL DATUM OF 1988
DEPTH CONTOUR INTERVAL 10 METERS

WASHINGTON
MAP LOCATION

Geology mapped by R.A. Haugerud, 1999–2005; E.A. Thoms, 2004; and Brett Cox, 2005
Database and digital cartography by R.A. Haugerud
Edited by J.L. Zigler
Manuscript approved for publication September 29, 2011

CORRELATION OF MAP UNITS

[Note: Units $\mathrm{Qpog_f}$, $\mathrm{Qpog_c}$, $\mathrm{Qpog_m}$, Qpon, $\mathrm{Qpon_f}$, $\mathrm{Qpon_c}$, $\mathrm{Qpo_f}$, $\mathrm{Qpo_c}$, and Qpor are present in subsurface only]


POST-GLACIAL DEPOSITS
m
f
Qw
Qal
Qb
Qls
Holocene
GLACIAL AND OLDER NON-GLACIAL DEPOSITS
Qeg
Qvi
Qvt
Qvt$_g$
Qve
Qvlc
Vashon stade
Fraser glaciation
Pleistocene
DEPOSITS OLDER THAN VASHON STADE OF ARMSTRONG AND OTHERS (1965)
Qpv
Qpv$_f$
DEPOSITS OLDER THAN OLYMPIA INTERGLACIATION OF ARMSTRONG AND OTHERS (1965)
Qpog
Qpog$_f$
Qpog$_c$
Qpog$_m$
Qpon
Qpon$_f$
Qpon$_c$
Qpo$_f$
Qpo$_c$
Qup
Qpor

DESCRIPTION OF MAP UNITS

[Subsurface units and well-log data shown in cross sections. Some areas on the plotted map are too small to distinguish the color for unit identification. Most of these areas are labeled. All areas are attributed in the database]

POSTGLACIAL DEPOSITS

m **Modified land (Holocene)**—Sand and gravel as fill, or extensively graded natural deposits. Mapped only where modification is sufficiently extensive that the underlying deposit cannot be inferred. Locally mapped as artificial fill:

f **Artificial fill**—Sand, gravel, and wood waste placed as fill. Mapped especially in road prisms where compaction by seismic shaking is a predictable hazard

Qw **Wetland deposits (Holocene)**—Silt, sand, muck, and peat deposited in wetlands. Mapped on basis of surface morphology or presence of surface water and wetland vegetation

Qal **Alluvium (Holocene)**—Well-sorted, unconsolidated sand, gravel, and silt deposited by postglacial streams. Locally may contain intercalated, poorly sorted debris-flow deposits

Qb **Beach deposits (Holocene)**—Sand, gravel, and logs deposited by wave action. Underlies nearshore flats. Beach deposits are not mapped seaward of the high water line. Locally includes mud and peat deposited in wetlands developed inboard of the beach berm

Qls **Landslide deposits (Holocene and Pleistocene?)**—Diamict, sand, gravel, silt, and soil transported in deep-seated landslides. Deposits commonly less dense than parent materials. Commonly water saturated. Largely mapped on basis of morphology. Some landslide deposits may be latest Pleistocene in age

LATE-GLACIAL DEPOSITS

Qeg **Emergence gravels (Pleistocene)**—Moderately sorted gravel and sand, 1–3 m thick, that mantles till and older deposits at low elevations. Beach and stream deposits formed when late-glacial sea level was higher than at present or formed along shores of late-glacial ice-marginal lakes. Mapped from natural exposures in shoreline bluffs, local artificial exposures, and surface morphology

GLACIAL AND OLDER NONGLACIAL DEPOSITS

Vashon Drift (Pleistocene)

Qvi **Ice-contact deposits**—Gravel, sand, and diamict deposited against stationary ice. Commonly reworked by slumping. Mapped on basis of surface morphology

Qvt **Till**—Mostly dense sandy diamict. Pebbles are matrix supported; most are well-rounded. Rare clasts >10 cm are commonly subangular to angular. Lenses of bedded sand, silt, and gravel are common. Wave-etched exposures commonly show subhorizontal foliation in diamict and isoclinal folding of silt and sand lenses. In many upland locales, till is mapped on basis of clayey, pebbly subsoil, commonly with gray to green-gray hue indicative of minimal oxidation. Good shoreline bluff exposures indicate that most till of the Vashon Drift is subglacial lodgment till

$\mathrm{Qvt_g}$ **Gravel**—Coarse, crossbedded gravel that grades into overlying till

Qve **Esperance Sand Member**—Quartzofeldspathic medium-fine to medium sand, locally pebbly or with small amounts of gravel or silt. Not cemented, though locally supports vertical faces. In deep exposures, commonly not oxidized. Subsoils derived from this unit are mostly loose sand, light colored when dry. Advance outwash deposits. Local crossbeds and large foresets suggest deposition in fluvial or deltaic setting; elsewhere, pervasive decimeter-thick planar beds and low-angle crossbeds suggest deposition by prodelta turbidity currents

Qvlc **Lawton Clay Member**—Thin-bedded (5 mm to 15 cm) dark-gray silt and clay, locally with dropstones and (or) lenses of ice-rafted sand and gravel. Lacustrine advance outwash deposits. Primarily found in narrow areas along shorelines

DEPOSITS OLDER THAN VASHON STADE OF ARMSTRONG AND OTHERS (1965)

Qpv **Pre-Vashon-age deposits (Pleistocene)**—Sand, gravel, silt, peat, sandstone, mudstone, conglomerate, and diamict of fluvial, lacustrine, and glacial origin. May include marine deposits. Where outcrop is good, it is evident that much of material mapped as unit Qpv is interbedded sand and gravel of fluvial origin or thin-bedded fine sand and silt of indeterminate origin. Mostly mapped where poor outcrop (typically, brown, sandy, pebbly subsoil) does not permit a more detailed classification. Probably includes deposits elsewhere mapped as units $\mathrm{Qpv_f}$, Qup, and Qpog. May include minor amounts of units Qve and Qvlc

$\mathrm{Qpv_f}$ **Fine-grained deposits**

DEPOSITS OLDER THAN OLYMPIA INTERGLACIATION OF ARMSTRONG AND OTHERS (1965)

Qpog **Glacial deposits (Pleistocene)**—Till, pebbly mud, and tillite and associated silt, sand, gravel, and conglomerate. Subsurface deposits recognized as glacial on the basis of identifiable till fragments and (or) predominance of clasts suggestive of northern provenance: granitic and (or) metamorphic clasts in gravel; garnet, epidote, magnetite, and (or) metamorphic rock fragments in sand. Primarily identified in narrow areas along shorelines. Locally divided in subsurface

$\mathrm{Qpog_f}$ **Fine-grained glacial deposits**—Silt, clay, sandy silt, gravelly silt, gravelly sandy silt, clayey silt, and silty clay. Present in subsurface only

$\mathrm{Qpog_c}$ **Coarse-grained glacial deposits**—Diamict, gravel, sand, sandy gravel, silty gravel, clayey gravel, gravelly sand, gravelly silty sand, silty sand, gravelly clayey sand, and clayey sand. Present in subsurface only

$\mathrm{Qpog_m}$ **Glaciomarine deposits**—Fine-grained (silt, clay) deposits with minor sand and gravel and associated marine shells. Present in subsurface only

Qpon **Nonglacial deposits (Pleistocene)**—Sand, gravel, silt, clay, and peat. Identified as nonglacial by the presence of in-situ peat, paleosols, plant fragments, plant-fragment impressions, and (or) in-situ volcanic deposits (ash, pumice, mud flow). Locally, predominance of volcanic clasts suggests central Cascade Range provenance. Present in subsurface only. Locally subdivided

$\mathrm{Qpon_f}$ **Fine-grained nonglacial deposits**—Silt, clay, sandy silt, clayey silt, silty clay, and peat. Present in subsurface only

$\mathrm{Qpon_c}$ **Coarse-grained nonglacial deposits**—Sand, gravel, sandy gravel, gravelly sand, gravelly silty sand, silty sand, clayey sand, and peat. Present in subsurface only

$\mathrm{Qpo_f}$ **Fine-grained deposits (Pleistocene)**—Clay, silt, fine sand, and shale of indeterminate origin. Present in subsurface only

$\mathrm{Qpo_c}$ **Coarse-grained deposits (Pleistocene)**—Sand, gravel, and minor silt and clay of indeterminate origin. Present in subsurface only

Qup **Beds of University Point (Pleistocene)**—Variably lithified fluvial gravel and sand, locally crossbedded, with interbedded silt and peat. Gravel commonly oxidized. Gravel has high concentration of dark basaltic sandstone and basalt clasts that suggest an ultimate source in the Olympic Mountains. Gravel beaches below bluffs of University Point beds are noticeably darker than typical central Puget Sound beaches. Presence of a small fraction of granitoid pebbles in conglomerate and absence of pervasive clayey alteration of sandstone distinguish beds of University Point from the Blakely Harbor Formation (exposed 3 km south of map area), which they otherwise resemble. At University Point and north of Fletcher Bay, shoreline bluff exposures display 2- to 3-m-thick fining-upward sequences indicative of meandering stream deposits; silt and peat are overbank facies

Qpor **Sediment of Rockaway Beach (Pleistocene)**—Massive to disrupted silt, clay, and sand. Some silt is waxy textured. Most disruption appears to be nontectonic. Present in subsurface only

EXPLANATION OF MAP SYMBOLS

Fossil shoreline

Contact—Continuous where estimated location uncertainty <30 m; long dash where estimated location uncertainty 30–100 m; scratch boundary (no line) where estimated location uncertainty >100 m

Strike and dip of bedding

15 **Inclined**—Facing direction observed in outcrop, upright

6 **Inclined**—Facing direction not observed

11 **Inclined**—Facing direction not observed, approximate orientation

⊕ **Horizontal**

Strike and dip of foliation

27 **Inclined**

Horizontal

Minor fold axes—Showing plunge

10 **Inclined**

Horizontal

UW-449 ▲ **^{14}C sample location**—Showing sample number. See Table 1 in pamphlet for age data

• 65980 **Borehole location**—From GeomapNW (2007) database, used in construction of cross sections. Adjacent number is borehole identifier EXPLOID

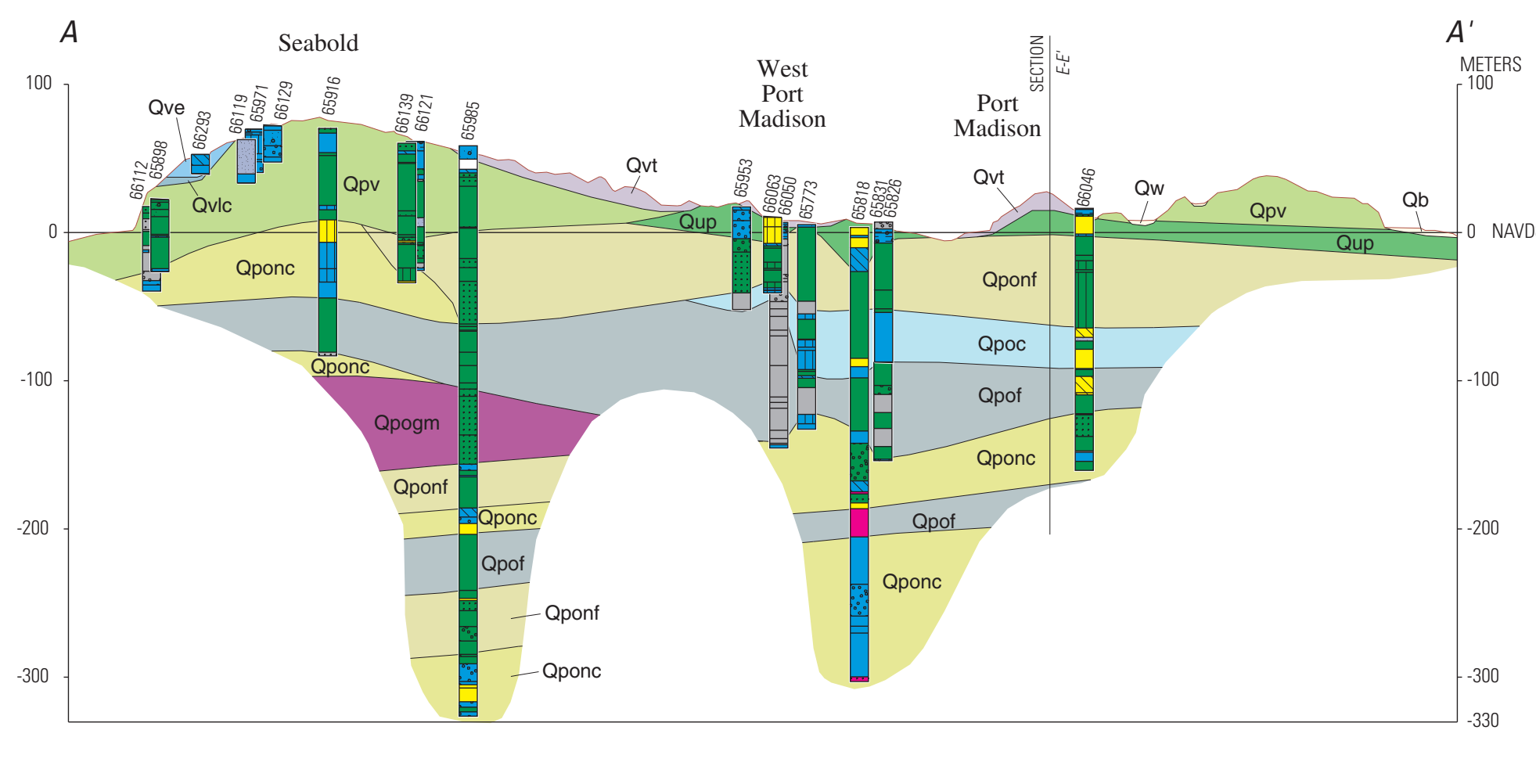
× **Observation point**—Outcrop, dug or augured hole, or borehole data from GeoMapNW (2007) database

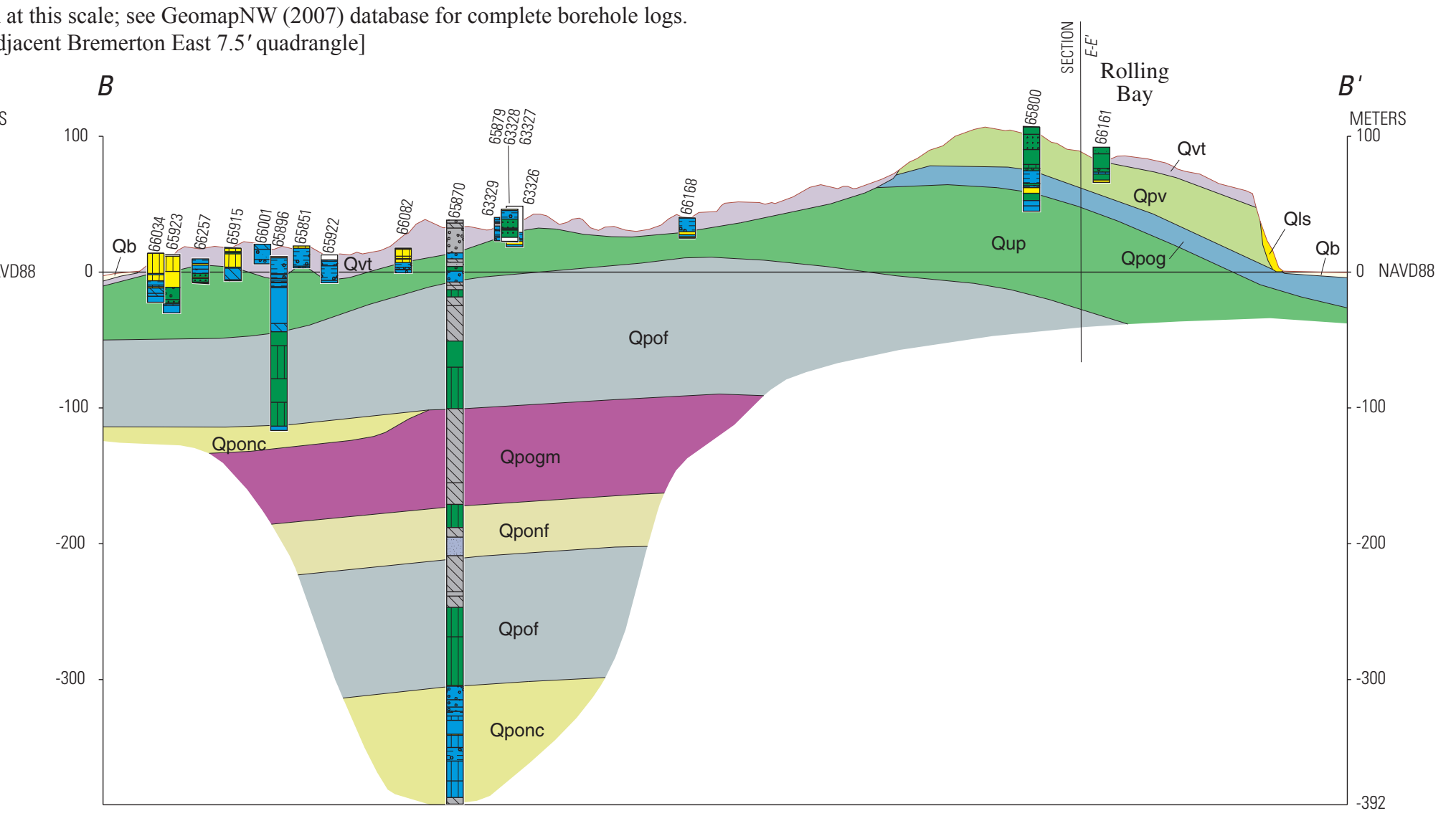
Figure 1. Chart showing correlation of Quaternary stratigraphies used on earlier maps of Suquamish quadrangle, recent standard Quaternary stratigraphy for Puget Lowland, and Quaternary stratigraphy of this report

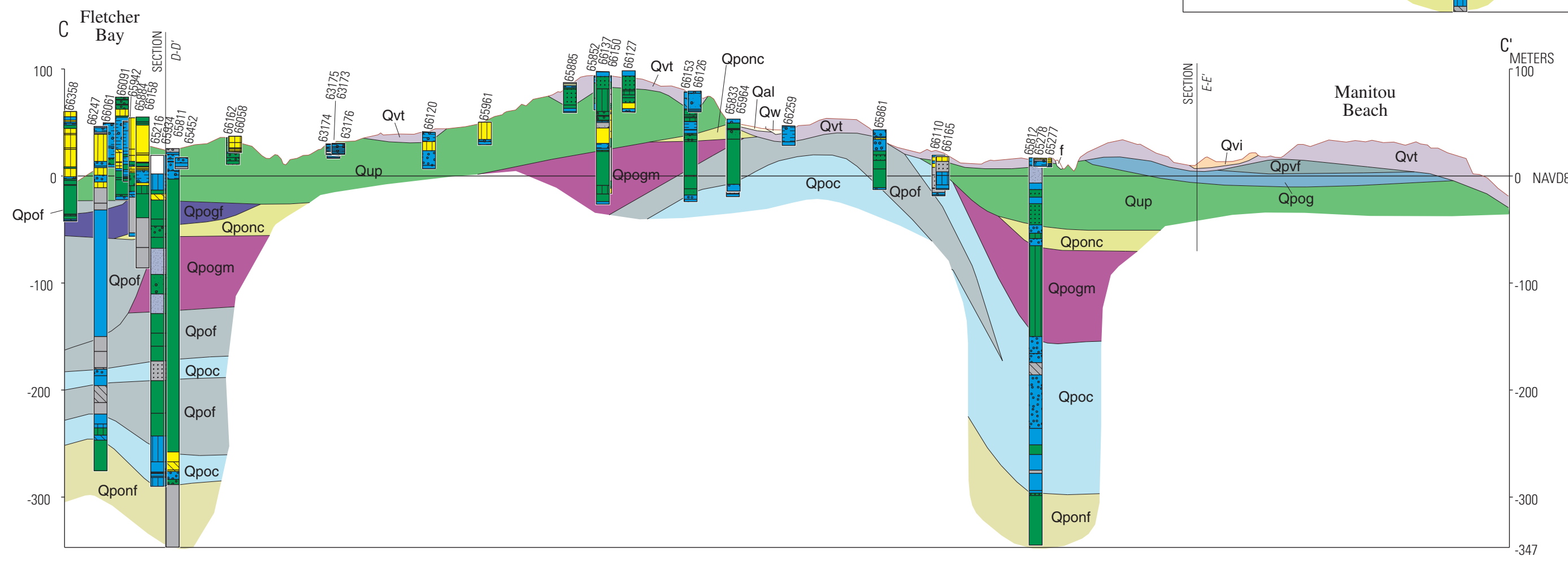
Sceva (1957)	Molenaar (*in* Garling and others, 1965)	Deeter (1979)	Booth and Waldron (2004) Booth and others (2004)	This report
Alluvium	Holocene alluvium	Holocene alluvium, beach deposits	Holocene *(many facies)*	Holocene *(many facies)*
Vashon Drift — Recessional outwash	Vashon Drift — Recessional outwash	Vashon Drift — Recessional outwash	Vashon Drift — Recessional outwash	Vashon Drift — Ice-contact deposits
Vashon Drift — Gorst Creek outwash	Vashon Drift — Till	Vashon Drift — Till	Vashon Drift — Till	Vashon Drift — Till
Vashon Drift — Till	Vashon Drift — Advance outwash *(gravel and coarse sand)*	Vashon Drift — Esperance Sand *(separated into sandy and gravelly phases)*	Vashon Drift — Advance outwash	Vashon Drift — Esperance Sand
Puyallup Sand *(as mapped includes advance outwash of the Vashon Drift)*	Vashon Drift — Colvos Sand *(bedded to massive sand, some clay and gravel, basal blue clay)*	Vashon Drift — Lacustrine deposits	Vashon Drift — Lawton Clay	Vashon Drift — Lawton Clay
Orting Gravel — Kitsap Clay member	Kitsap Formation *(bedded silt and clay, minor sand and gravel, peat)*	Kitsap Formation *(fine-grained nonglacial sediment deposited between 15,000 and 35,000 yr B.P.)*	Olympia beds	Qpv $\mathrm{Qpv_f}$
Orting Gravel — Lower member *(sand and gravel, slightly cemented, rusty colored)*	Salmon Springs (?) Drift *(gravel and coarse sand, local till)*	Possession Drift *(oxidized sand and gravel, local peat, silt, and clay)*	Possession Drift	Qpo *(many facies)* — Beds of University Point
Admiralty Drift *(blue-gray clay, sand, gravel, lignite, volcanic ash, minor lenses of glacial till)*		Whidbey Fm. *(sand, silt, clay, and peat; local coarser sand and gravel)*	Whidbey Formation	Qpo *(many facies)* — Sediment of Rockaway Beach
		Double Bluff Drift *(till, glaciomarine drift)*	Double Bluff Drift	
			--unknown interval--	
			Salmon Springs Drift	
			Deposits of Puyallup interglaciation	
			Stuck Drift	
			Deposits of Alderton interglaciation	
			Orting Drift	

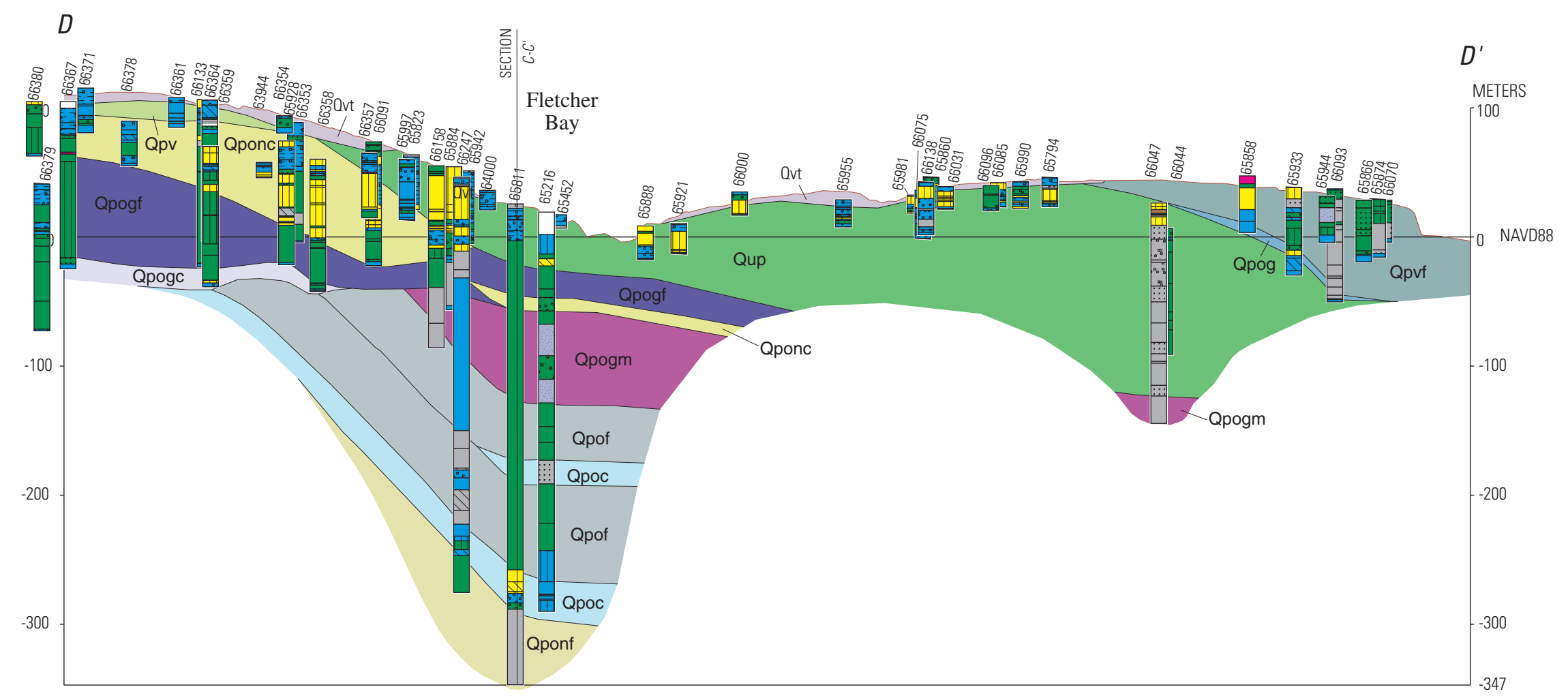
CROSS SECTIONS

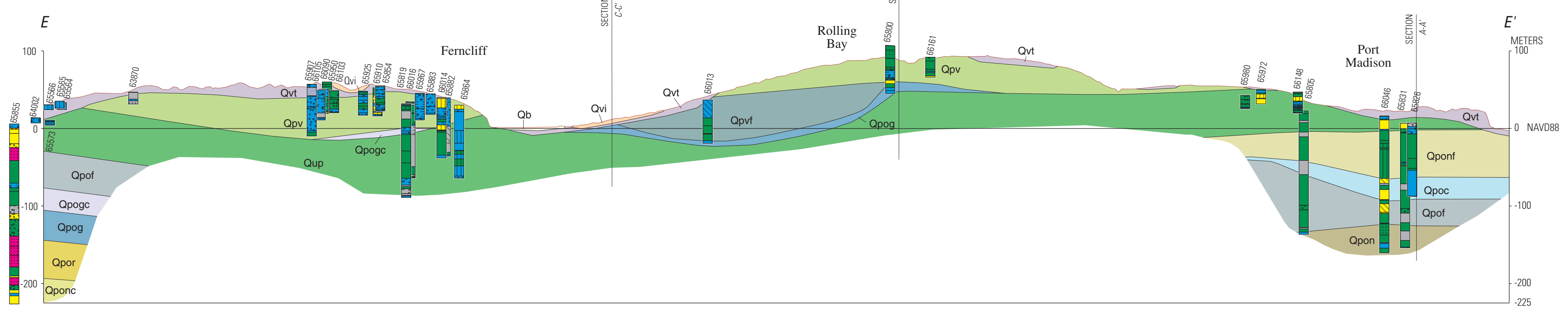
[Notes: Vertical exaggeration 5X in all cross sections. North America Vertical Datum of 1988 (NAVD88) is about 1 m lower than mean sea level in this area. Some intervals in some boreholes are too small to discern at this scale; see GeomapNW (2007) database for complete borehole logs. Boreholes beyond left (south) ends of sections *D-D'* and *E-E'* are in adjacent Bremerton East 7.5' quadrangle]


A
A'
Seabold
West Port Madison
Port Madison
SECTION E-E'
METERS
100
0
-100
-200
-300
-330
NAVD88
Qve
Qvlc
Qpv
Qvt
Qup
Qw
Qb
Qponc
Qpogm
Qponf
Qpof
Qpoc


B
B'
Rolling Bay
SECTION E-E'
METERS
100
0
-100
-200
-300
-392
NAVD88
Qb
Qvt
Qup
Qpv
Qpog
Qls
Qpof
Qponc
Qpogm
Qponf


C
Fletcher Bay
C'
SECTION D-D'
SECTION E-E'
Manitou Beach
METERS
100
0
-100
-200
-300
-347
NAVD88
Qvt
Qponc
Qal
Qw
Qvi
Qpvf
Qup
Qpog
Qpogf
Qpogm
Qpof
Qpoc
Qponf


D
D'
Fletcher Bay
SECTION C-C'
METERS
100
0
-100
-200
-300
-347
NAVD88
Qpv
Qponc
Qvt
Qup
Qpog
Qpvf
Qpogf
Qpogc
Qpogm
Qpof
Qpoc
Qponf


E
E'
Ferncliff
SECTION C-C'
Rolling Bay
SECTION B-B'
Port Madison
SECTION A-A'
METERS
100
0
-100
-200
-225
NAVD88
Qvt
Qpv
Qvi
Qb
Qpvf
Qpog
Qup
Qpogc
Qpof
Qponf
Qpoc
Qpon
Qpor
Qponc

EXPLANATION OF BOREHOLE LOGS

■	Asphalt and concrete	▨	Silt
■	Topsoil/vegetation	▨	Gravelly silt
■	Peat	▨	Gravelly sandy silt
▨	Cobbles	▨	Sandy silt
■	Gravel	▨	Clayey silt
▨	Silty gravel	■	Sandy clay/silt
▨	Clayey gravel	■	clay
■	Sand	▨	Gravelly clay
▨	Gravelly sand	▨	Gravelly sandy clay
▨	Gravelly silty sand	▨	Sandy clay
▨	Silty sand	▨	Silty clay
▨	Gravelly clayey sand	▨	Sedimentary bedrock
▨	Clayey sand	■	Undifferentiated rock
		☐	No Information or undefined

Geologic map of the Suquamish 7.5' Quadrangle and part of the Seattle North 7.5' x 15' Quadrangle, Kitsap County, Washington

By
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2011

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[2] University of Washington

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Digital files available at http://pubs.usgs.gov/sim/3181/

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