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Gabriola's glacial drift—soils

Nick Doe

All of the soils on Gabriola have developed since the end of the ice age.[1] Their parent material is bedrock, glacial till, or a mix of the two.

Although there has been re-working of the till in recent times by creeks, this has been slight compared to the sorting that went on at the end of the ice age by almost unimaginably voluminous flows of meltwater. A few tills have been chemically weathered to smectite clay over the last ten-thousand years. In general, glaciers create a lot of sand and silt, including some very-fine-grained silt, but no clay minerals.

Because the focus in this series of articles is on geology rather than on pedology, the C-horizons of soil are of greater interest than the upper A- and B-horizons; however, in most pedological studies there is limited interest in soil below the plough zone, and often none at all in horizons more than a metre deep. This unfortunately restricts the usefulness of the available pedological studies for present purposes.

According to an Agriculture Canada survey,[2] there are 25 types of soil on Gabriola, each with variants.[3] Discarding near-bare bedrock types, a few speciality soils (organic and middens), and not counting mixed soils separately, reduces the count to 16 (the underlined ones in the footnote list), but that's still a lot. However, of these 16 soil types, 6 account for more than 90% of the coverage of the island, so I have consolidated the "minor" soils (those that account for less than 2.5% of the coverage) with the most similar "major" soil type, so the list then becomes:

Saturna plus Bellhouse;
Galiano;
Trincomali plus Mexicana and Suffolk;
Qualicum plus Baynes, Beddis, and Denman Island;
Brigantine and **Tolmie** plus Parksville; and
Cowichan plus Fairbridge and Chemainus.

Bedrock soils (61.2%)

The three bedrock types—sandstone, shale, and conglomerate—give rise to three soil types—Saturna, Galiano, and Salalakim.

Saturna plus Bellhouse (55.5%)

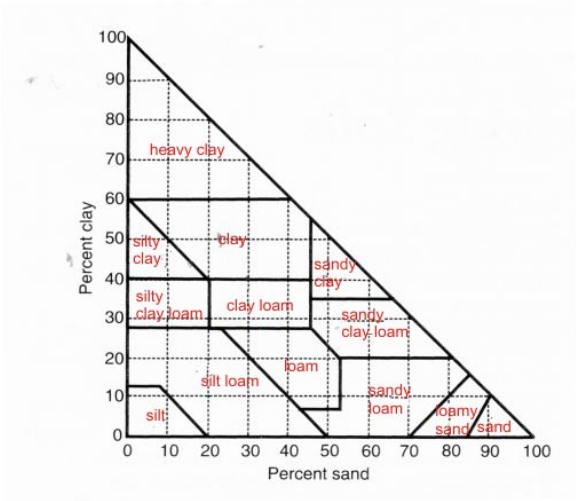
Saturna soil (ORTHIC DYSTRIC BRUNISOL) is a gravelly-covering of sandy loam and sandstone fragments. The *sl* (very shallow)

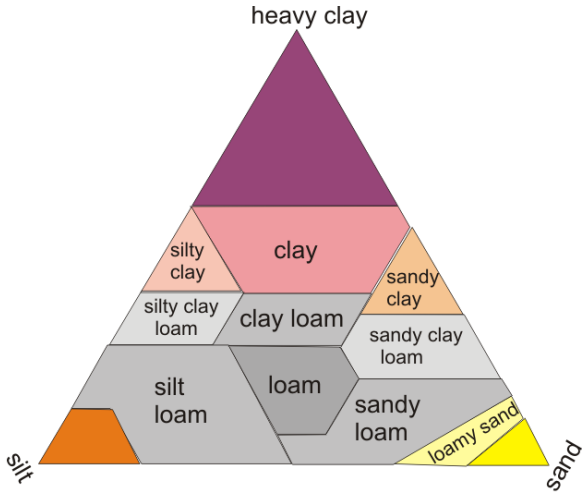
[1] Meaning there are no acknowledged deposits that are pre-Vashon; however, my strong suspicion is that Beddis soil contains some Quadra sand.

[2] E.A. Kenney et al., *Soils of the Gulf Islands of British Columbia*, 4, Soils of Gabriola and lesser islands, Agriculture Canada, 1990. A useful supplement for soil descriptions is J.R. Jungen et al., *Soils of Southeast Vancouver Island, Parksville, Qualicum Beach, Courtenay, and Port Alberni Areas*, MOE Technical Report 30, Ministry of Environment and Ministry of Agriculture and Fisheries, 1989.

[3] *The Canadian System of Soil Classification*, Agriculture and Agri-Food Canada, Third Edition, 1998. The Canadian System is different from the system used in the United States, and there is not always a simple means of translating a classification in one system to a classification in the other. The first thing to do when picking up a technical article or textbook on soils is to ascertain what system is being used. As much as anything these differences have arisen historically because of the far greater use of the soil for agriculture in the United States. In contrast, some 90% of the area of Canada is unlikely ever to be cultivated.

The identified soils are Baynes, Beddis, Bellhouse, Brigantine, Brigantine-Tolmie, Chemainus, Cowichan, Denman Island, Fairbridge, Galiano, Metchosin, Mexicana, Neptune, Parksville, Parksville-Tolmie, Qualicum, Rock, Rock-Bellhouse, Rock-Salalakim, Rock-Saturna, Saturna, Saturna-Qualicum, Suffolk, Tolmie, and Trincomali.





Wentworth scale			Φ
boulder	boulder	>256 mm	–8
	cobble	64–256 mm	–(6-8)
gravel	pebble (coarse)	32–64 mm	–(5-6)
	pebble (fine)	4–32 mm #5 sieve	–(2-5)
	granule	2–4 mm #10 sieve	–(1-2)
sand	very coarse	1–2 mm #18 sieve	–(0-1)
	coarse	500μm–1mm #35 sieve	+(0-1)
	medium	256μm–500μm #60 sieve	+(1-2)
	fine	128μm–256μm #120 sieve	+(2-3)
	very fine	64μm–128μm #230 sieve	+(3-4)
silt	coarse	32μm–64μm #400 sieve	+(4-5)
	medium	16μm–32μm	+(5-6)
	fine	8μm–16μm	+(6-7)
	very fine	4μm–8μm	+(7-8)
clay	clay	<4μm	>+8

sand	no ball
loamy sand	ball, no ribbon
sandy loam	ribbon < 1 inch; gritty & grinding noise
silt loam	ribbon < 1 inch; floury, no grinding noise
loam	ribbon < 1 inch; grittiness & grinding noise slight
sandy clay loam	ribbon 1–2 inches; prominent grittiness, grinding noise
silty clay loam	ribbon 1–2 inches; floury, no grinding noise
clay loam	ribbon 1–2 inches; grittiness & grinding noise slight
sandy clay	ribbon >2 inches; gritty, grinding noise
silty clay	ribbon >2 inches; floury, no grinding noise
clay	ribbon >2 inches; grittiness & grinding noise very slight
heavy clay	ribbon >2 inches; no grittiness or grinding noise, very smooth

variant is common and sometimes barely covers the sandstone bedrock. It is yellowish-brown, becoming darker nearer the surface. It is slightly-hard throughout.

Saturna soil is ubiquitous in the Gabriola uplands and the 707 Community Park where it occurs as the *vg* (very gravelly) variant. The soil often contains channery fragments (thin flat tablets) of sandstone, which are the result of modern weathering and spalling of the sandstone surface.

Saturna soil usually contains at least a smattering, and often a lot, of morainal rubble (ablation till)—up to 90%. In other locations, however; the top of the bluffs overlooking Lock Bay, for example, the soil appears to be entirely derived from the sandstone bedrock.

Bellhouse soil (ORTHIC SOMBRIC BRUNISOL) is a similar dark-brown more sandy loam, but also stony. It is soft throughout and is likely mostly weathered ablation till. Bellhouse soil is only found in small areas on Gabriola (0.5%).

Galiano (5.7%)

Galiano soil (ORTHIC DYSTRIC BRUNISOL) is the shale-bedrock equivalent of the sandstone-bedrock Saturna soil. It comes with substantial stony-till components (lodgement and ablation till) and is dark-brown as a result of the presence of shale weathering products. It is hard to slightly-hard at the surface.

Galiano soil usually occurs wherever the bedrock is shale; in the Whalebone area, False Narrows, and in the Descanso Valley, but not in the area of Somerset Farm where the soil is too deep. It is frequently one of the *l* (shallow lithic), *sl* (very shallow lithic), and *vg* (very gravelly) variants, though there is a *ng* (not gravelly) variant in the woodlands and fields below the bluffs at False Narrows.

Salalakim (<0.1%)

Salalakim soil (ORTHIC DYSTRIC BRUNISOL) is a very gravelly loamy sand that is found over conglomerate bedrock, but on Gabriola, such soil is so shallow it is counted as a "rock-salalakim" soil type.

Till soils (38.8%)

Trincomali plus Mexicana and Suffolk (12.9%)

Trincomali soil (ORTHIC & GLEYED DYSTRIC BRUNISOL) has lodgement till (hard-pan) as its effective bedrock (C-horizon). The actual bedrock can be sandstone, shale, or conglomerate. The less consolidated sediments near the surface can be weathered lodgement till or ablation till. It is olive- or greyish-brown, becoming darker and yellowish and then darker and reddish nearer the surface. It is extremely-hard at the bottom becoming looser nearer the surface.

This gravelly-loam soil is common at the east end of the 707 Community Park, some of which is a *pd* (poorly drained) gleysolic variant. It is also found in the Crown land (Kensington lands) north of Lackhaven Drive, the area in the vicinity north of the United Church, and some of the slopes on Gray Farm.[4]

Mexicana soil (ORTHIC & GLEYED DYSTRIC BRUNISOL) is a similar gravelly sandy loam with weathered and sorted ablation till. This type of soil tends to contain more sand and sandstone fragments and less gravel than Trincomali soil, but is still fairly stony throughout. It is a dark-yellowish-brown

[4] Some soil east of False Narrows is classified as Galiano soil on account of the shale bedrock, but a substantial hard-pan till layer above the shale gives it, in my view, a Trincomali soil character.

and hard. Mexicana soil is confined to small areas on Gabriola (0.7%).

Suffolk soil (GLEYED DYSTRIC BRUNISOL & ORTHIC HUMIC GLEYSOL) has stone-free, firm, silty loam BC and C-horizons (undermelt till), but with some gravel close to the bedrock (weathered lodgement till). It also has an overlying gravelly morainal till B-horizon (weathered ablation till). It is generally olive- or yellowish-brown and dark. Suffolk soil is confined to small areas on Gabriola (0.4%).

Qualicum plus Beddis, Baynes, and Denman Island (11.1%)

Qualicum soil (ORTHIC DYSTRIC BRUNISOL) is outwash material—ablation till that has been well sorted by heavy flows of meltwater from glacial ice. Pockets of gravel and stone-free sand in otherwise very gravelly sand are common. It is generally olive-brown.

It occurs particularly on the north-facing slopes of the eastern end of the central highlands, but there are pockets, elsewhere, some associated with gravel pits.

Beddis soil (ORTHIC DYSTRIC & SOMBRIC BRUNISOL) is similar, but is stone-free, glaciofluvial sand with gravel only at the surface. It is not as well drained as Qualicum soil with which it is often associated, and is more intense in colour. It is friable throughout. Beddis soil is confined to small areas on Gabriola (0.7%) but it may be significant geologically as being remnants of pre-glacial Quadra Sand.

Baynes soil (GLEYED SOMBRIC & DYSTRIC BRUNISOL) is often associated with Beddis and Denman Island soils. It is well sorted, sandy, and gravel free except at the surface (glaciofluvial till). It is light-grey at the bottom (undermelt till?) becoming browner nearer the surface. It is slightly-hard throughout, not as well drained as either Qualicum or Beddis soil, and is uncommon on Gabriola (1.2%).

Denman Island soil (ORTHIC HUMIC GLEYSOL) is less well drained than any of the associated soils with less coarse fragments and more fine sand, silt, and clay. It occurs in modern drainage pathways and on flat landscapes. It too is confined to small areas on Gabriola (0.3%).

Brigantine and Tolmie plus Parksville (11.1%)

Brigantine soil (GLEYED DYSTRIC & SOMBRIC BRUNISOL) is almost stone free except at the surface. It is less firmly consolidated than Trincomali soil, and less well sorted than Qualicum soil. It has various shades of brown, is firm below becoming friable nearer the surface. Brigantine soil is confined to areas that were formerly below sea level and its associated landscapes are very gently to gentle slopes surrounding depressional basins and draws.

Tolmie soil (ORTHIC HUMIC GLEYSOL) is similar with a finer texture. It is almost stone free, is grey throughout, and is mostly undermelt till.[5] It is hard throughout except at the surface. Drainage is very poor to poor on account of the underlying clay. Often associated with wetlands.

Parksville soil (ORTHIC HUMIC GLEYSOL) is relatively stone free and very-hard becoming slightly-hard nearer the surface. It is undermelt till with a thin overlay of glaciofluvial till. It is olive- or greyish-brown.

Parksville soil is less well drained than Brigantine soil. Parksville soil is confined to small areas on Gabriola (0.3%).

[5] Very often described as glaciomarine till, which most of it may be, but undermelt till, which contains glacial flour, also occurs at higher elevations on Gabriola, albeit, usually deeply buried below thick peat.

Cowichan plus Fairbridge and Chemainus (3.7%)

Cowichan soil (HUMIC LUVIC & ORTHIC HUMIC GLEYSOL) is a grey, firm, stone-free, silty clay loam, frequently found in wetlands together with the purely organic (peat) Metchosin soil. It was formerly below sea level.

Fairbridge soil (GLEYED DYSTRIC & SOMBRIC BRUNISOLIC) is not so poorly drained and sandier. It is stone-free silty clay with a few stones in the overlaying silt loam. It is grey and firm becoming yellowish-brown and friable nearer the surface. Fairbridge soil is confined to small areas on Gabriola (0.7%).

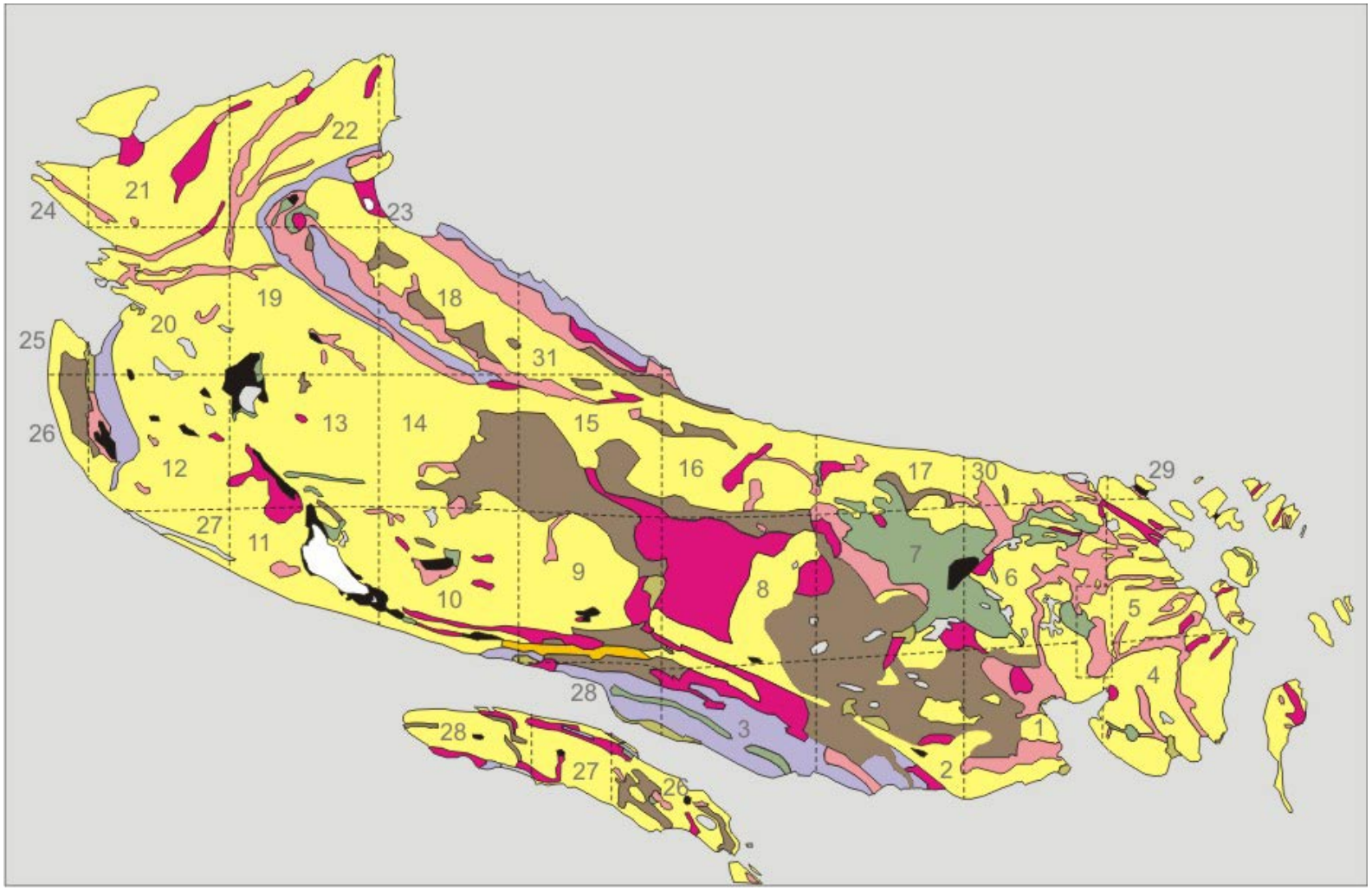
Chemainus soil (GLEYED SOMBRIC BRUNISOL & CUMULIC HUMIC REGOSOL) is a recently formed silty loam found in stream channels and on flood plains. It is confined to small areas on Gabriola (0.1%).

	lodgement till	marine compact	marine firm	marine friable	ablation till	glaciofluvial & weathered	A-horizons
saturna					60		20
bellhouse					45		30
galiano	85				65		65
trincomali	25				30	40	50
mexicana	15				5	25	15
suffolk	20		0		10	35	40
qualicum					40	30	55
beddis				0	15	5	0
baynes			1			20	15
brigantine			<5			<10	<10
tolmie		<2		<5			<5
st. mary*	30		0	15	40		
parksville		<5				<5	<5
cowichan			0				2
fairbridge			0			5	10

Figures are the typical percentage of coarse fragments (coarser than sand). Name colours correspond to the map. Soil colours are approximate and vary greatly with moisture content.

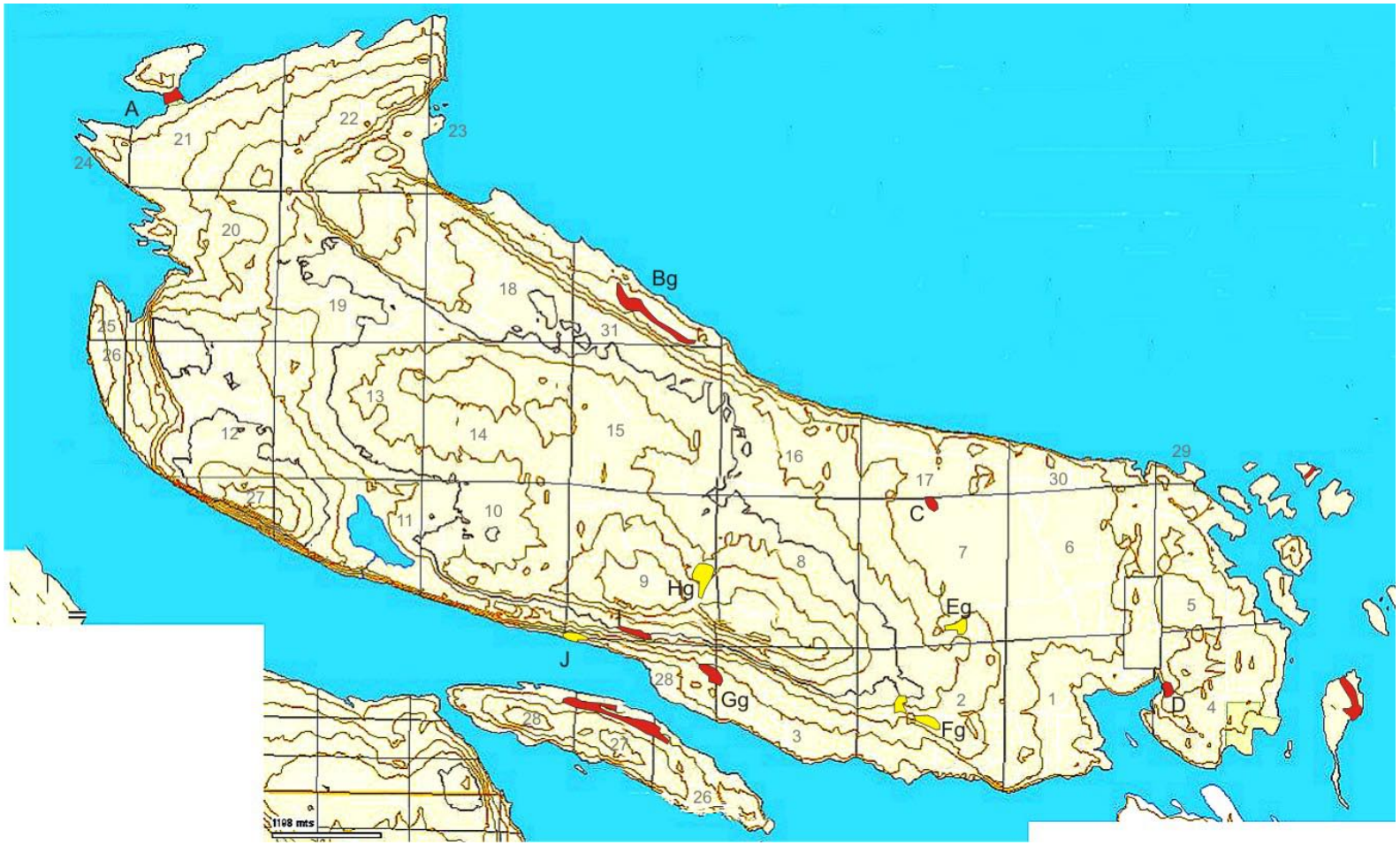
Not shown are: **metchosin** (organic); **neptune** (midden), & **salalakim** (same as saturna but over conglomerate, not sandstone).

*St. Mary soil is not recorded on Gabriola, but occurs on near-by islands.



yellow: saturna, bellhouse; **brown**: trincomali, mexicana, suffolk; **magenta**: qualicum, beddis, baynes; **green**: cowichan, fairbridge
pink: brigantine, tolmie, parksville; **blue**: galiano; **black:** metchosin; **banana yellow**: disturbed, neptune; **grey**: rock; **white**: water

Adapted from Kenney et al.



TRIM Contours 20m. The black lines are 100m AMSL, approximately the high stand at the end of the ice age.

The red and yellow areas A-J are Beddis soil (red) or gravel pits where there often is stone-free sand (yellow). g indicates gravelly.

A: Gabriola Sands Provincial Park (10m AMSL) ; B: Whalebone Drive (30m AMSL); C: North Road, 700m east of Degnen Rd (53m AMSL); D: Degnen Bay, Martin Road (25m AMSL); E: Somerset Pit (56m AMSL); F: MOTI Pit (96m AMSL); G: Ferne Road (40m AMSL); H: Pit at the end of Pit Road (120m AMSL); I Stoneyridge Pit (112m AMSL); J Wharf Road Pit (20m AMSL).

Quadra Sand

Quadra Sand is the name given to an extraordinary band of well-sorted sand with minor silt and gravel that is common throughout the Georgia Depression and Puget Sound.[6] It pre-dates the peak of the Fraser Glaciation and is underlain by sediments deposited in a non-glacial environment. The consensus is that it dates from a time when glaciers were commencing their advance down and into what is now the Strait of Georgia, and numerous rivers and creeks were pouring glacial sediment into the Georgia Depression, probably seasonally, and creating vast sandy, ice-free lowlands and tidal flats (sandurs).

Map showing the distribution of Quadra Sand (black areas). The inset map shows the maximum extent of the Cordilleran ice sheet during the Fraser Glaciation.

from Clague et al., *Early growth of the last Cordilleran ice sheet deduced from glacio-isostatic depression in southwest British Columbia, Canada*, Quaternary Research 63, pp. 53– 59, 2005.

It is clear from the map (*right*) that Quadra Sand is, or must have been, present on Gabriola, but it has not been recorded here. This is because of lack of evidence for non-glacial sediments below the glacial drift on the island. However, there is a good chance that much of the island's sand came from Quadra Sand. This sand, Quadra sand (lower case) was probably transported by meltwater at the end of the ice age from higher ground to lower ground, thereby being re-deposited on younger glaciomarine deposits, and breaking the geological law of superposition (young strata overlie older strata).

Locating Quadra sand on Gabriola would be interesting because of the possibility of finding ice-age fossils in it, but distinguishing late-Pleistocene Quadra sand from the sand that is the product of the weathering of late-Cretaceous Nanaimo Group sandstone will be a challenge, given that their sources in the Coast Mountains are likely similar. ◊

[6] Clague, J.J., *Quadra Sand: A study of the late Pleistocene geology and geomorphic history of coastal southwest British Columbia*, Geological Survey of Canada, Paper 77-17, 1977.

Articles: