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INTRODUCTION

Due to the decline in available supplies of sand and gravel in the Vancouver area and increasing demand, recently there has been considerable interest in possible new sources of these materials. The Geological Survey of Canada has published various maps and bulletins that provide information on much of the Georgia Strait region but not for the Sunshine Coast from Howe Sound to Lund nor for the area north of Campbell River. Accordingly, a program to map these areas was initiated in 1974 and completed in 1975. The results of the survey are presented in this bulletin in three sections: Sunshine Coast Area, Powell River Area, and Campbell River Area.

Grateful acknowledgment is made for information and assistance provided by the Soils Survey Branch of the Ministry of Agriculture, the Geotechnical and Materials Branch of the Ministry of Highways, and the Groundwater Section of the Water Resources Service.

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SUNSHINE COAST AREA

INTRODUCTION

A reconnaissance survey of the surficial geology of the Sunshine Coast area from Port Mellon to Earls Cove was made during five weeks in 1974 and three weeks in 1975. The prime objective was to locate and study known sand and gravel deposits and to determine if others could be found. Study of topography and air photographs indicated it would be unlikely that commercial aggregate deposits would be found in the mountainous parts of the region, so the survey was restricted to the area below 300 metres elevation. The information obtained is shown on Figure 1.

In the following discussion the unconsolidated deposits have been grouped to conform with the general scheme that has normally been used for published surficial maps of the Strait of Georgia region.

GENERAL GEOLOGY

The mapped area lies mainly in the Georgia Lowland, the remainder being on the lower slopes of the Coast Mountains. Glacial ice moved over the entire area, southward down Howe Sound and southeast down the main coast. Above 300 metres elevation bedrock was left bare or covered with till and its disintegration products. Below that elevation the ground is mantled with a variety of unconsolidated materials of glacial, glaciomarine, marine, and fluvial origin. Frequent bedrock outcrops suggest that much of the overburden is shallow. Marine deposits and deltas indicate sea level in postglacial time was once at least 180 metres above that at present.

Only one till was recognized in most of the area, but drill logs record two in the Gower Point district. For this report the most widespread and younger one will be correlated with the normal Vashon ground moraine as the term is commonly used in the region.

Sub-till deposits were noted in the banks of Langdale Creek, on the slope on Lot 685A in south Gibsons, in the banks of Chaster Creek and gullies to the west, in Chapman Creek

valley, on the heights 3.5 kilometres west of Sechelt, and in bluffs around 'Redroofs' peninsula west of Sargeant Bay. Some corresponding deposits may be present in the Rainy River and Angus Creek valleys. At Langdale Creek the deposits consist mainly of fine sand and silt. By the powerline, sand and silt beds are flat-lying, but downstream they dip gently eastward. Very little gravel was seen in any of the exposures. On Lot 685A the exposures have sloughed and not much structural detail is visible. The beds are very sandy. Their dip is flat to low eastward and they are crossbedded. The area between Highway 101 and Gower Point is underlain by a complex of materials deposited at the junction of glaciers that moved south off the Coast Mountains and down Howe Sound, and southeast down Georgia Strait. Drill records indicate a general stratigraphic column consisting of a marine sand and gravel or clay veneer on up to 4 metres of till, over 12 to 18 metres of sand and gravel overlying more till which, in turn, overlies an undetermined thickness of silt and sand with some gravel. A slide in a bluff beside the road along the beach 600 metres west of Chaster Creek displays thin, flat beds of silt and silty clay which appear to be part of the sub-till sequence. Flat-lying interbeds of silt, sand, and gravel under till are exposed in cutbanks in Chapman Creek valley. In the gravel pits on Lots 4307 and 4310 west of Sechelt, a thin marine sand and gravel veneer overlies up to 3 metres of till which is on top of an undetermined thickness of crossbedded flat-lying sand and gravel. At 'Redroofs' peninsula drill logs and exposures in bluffs show a thin sandy marine veneer on up to 6 metres of till which overlies more than 75 metres of light-coloured and flat-lying interbeds of fine sand, silt, and silty clay with occasional small lenses of pea gravel. Some layers are crossbedded.

The Vashon ground moraine consists essentially of till with occasional lenses of sand and gravel. Exposures are abundant but usually too narrow to show on the map. They can be seen in ditches, roadcuts, building excavations, stream banks, and sea cliffs. Normal till is a tough concrete-like mixture of fairly well-rounded mixed pebbles in a sandy matrix with scattered boulders up to a metre or more in diameter. It is blue-grey when fresh and brown when weathered. The till lies on bedrock or sands and gravels. Contacts with the latter are irregular. Below 180 metres elevation the till is covered to variable depths by diverse marine deposits. The maximum thickness of till is not known but more than 30 metres has been recorded in drill holes.

Poorly exposed granular materials, thought to be of glaciofluvial origin, occur above deltas in the valleys of Chapman and Gray Creeks where the creeks debouch from the confines of the mountains. They form ridgelets and small kames in indistinctly defined areas shown on the map. Probably other similar deposits were not recognized. The materials consist of variable mixes of rounded pebbles and sand in poorly sorted, moderately dipping, irregular beds. Where seen, the underlying material was till.

The most widespread unconsolidated deposits comprise a variety of marine and glaciomarine sediments. Different types of sediments were not mapped separately during this project. The commonest type consists of a lag veneer, a metre or less thick, of brown sand, gravel, or sandy gravel lying directly on till. Isolated low ridges of similar materials appear to have formed as bars. Another common variety is stony clay. This consists of a

sandy-silty clay matrix containing scattered stones up to several centimetres in diameter. It is blue-grey when fresh but is usually oxidized to buff or light tan. In general appearance this clay is much like till and if the stone content is high the two are difficult to tell apart. Usually, however, diligent search will reveal moulds or casts of shellfish in the clay. Shell prints were found in beds of this material in most parts of the area but nowhere were any actual fossil shells discovered – all had been dissolved out to leave only a mould or cast. A third material is found in north and west Gibsons and on the flat heights 4 kilometres west of Sechelt. This is a silty, blue-grey, thin-bedded clay ranging up to at least 10 metres thick. No fossils were found in it but on some bedding planes markings that strongly resemble crab tracks were seen. Very fine sand or silt films separate individual clay layers. These clays may possibly be of freshwater origin but for convenience they are included with the marine sediments on Figure 1.

The Capilano fluvial deposits are composed of sands and gravels that form fans and deltas left by streams above present sea level up to about the 180-metre contour. The larger deltas extend downward in terraces or foreslopes to near sea level but numerous small ones have limited vertical range. The largest delta is the complex at the mouth of Chapman Creek. It coalesces with smaller ones along the side of Porpoise Bay to form an apron that extends to the north side of Angus Creek. These Capilano deposits are the sites of most of the aggregate pits in the area.

Salish sediments are materials now being deposited or that have been deposited since sea level became more or less stabilized at its present position. These include silt, sand, and gravel that are found in modern stream channels and deltas; sand and gravel on modern beaches; and bog deposits.

SAND AND GRAVEL DEPOSITS

During the survey 35 pits were examined. Of these, 17 were being used and another was being prepared for active production. Except for one in a glaciofluvial deposit and six in pre-Vashon beds, all are in Capilano fluvial sands and gravels.

Pit No. 1 is beside the Rainy River logging road in a small raised delta. It is 30 metres in diameter with a maximum face height of 3 metres. In the face 0.5 metre of rusty cobbly gravel overlies sandy gravel beds that dip 25 degrees southeast. Most pebbles are granitic and are well rounded with diameters less than 5 centimetres. Reserves are small.

On the north side of the mouth of Rainy River, a small delta with several terraces has been worked at two places. Just north of the logging road turn-off an abandoned pit, No. 2, is now used as a parking lot. Several houses built along the lip of the present excavation prevent further development there. However, the presence of three terraces northwest of the houses suggests gravel might be available from them once they have been logged. Between the logging road and the river, Canadian Forest Products operates pit 3. It is 50 metres in diameter with two levels, each having faces 10 metres high. A flat-lying, poorly

bedded, 2 to 3-metre-thick layer of bouldery coarse gravel covers beds of sandy fine gravel that dip 25 degrees southeast. The contact is irregular and shows sections of channel scour-and-fill. Boulders up to 2 metres in diameter occur in the topsets. A count indicated a composition of 71 per cent granitic, 8 per cent basic, 9 per cent volcanic, and 12 per cent miscellaneous pebbles in the pit face. The present pit could be worked upstream for at least 200 metres with an average width of 50 metres.

Two small pits have been operated for limited production on the hillside directly behind the Port Mellon pulp mill. One now serves as parking space and the other provides repair ballast for the road up river to the water-supply dam.

No. 4 is an abandoned pit beside an unused road on Indian Reserve 25 about 100 metres west of the Port Mellon road. The pit is overgrown and the walls have slumped. It is in the lower part of a large raised delta on the north bank of McNair Creek. There could be sizeable reserves of gravel still available round about this pit.

The Provincial Ministry of Highways operates pit No. 5 on Lot 1365 at 120 metres elevation on the front edge of the main terrace of the delta on the north bank of McNair Creek. The quarry is irregular in shape, about 250 metres long by 180 metres wide with 22 metres difference in elevation between the main floor and the terrace top. Topset beds 3 metres thick consist of coarse cobbly gravel with scattered boulders up to a metre in diameter. The underlying foresets are of sandy gravel, largely minus 2 centimetres in diameter, with occasional boulders up to half a metre in diameter. Low and to the southeast, silty beds are exposed. A pebble count showed the gravel composition to be 59 per cent granitic, 15 per cent basic, 17 per cent volcanic, and 9 per cent miscellaneous. The delta extends nearly 400 metres west from the lip of the present quarry to its apex at 200 metres elevation. Gravel reserves in this ground must be extensive. In June 1975 a plant was set up in the pit to provide hot asphalt mix to repave the Port Mellon highway.

A large pit, No. 6, was operated previous to 1964 on Lots 1618 and 539 as part of the Hillside operation of Construction Aggregates Ltd. The excavation is irregular in shape, some 300 metres long by 240 metres wide, and extends from 54 metres to 120 metres elevation in five discontinuous benches. Parts are sloughed and overgrown. It is on the front edge of the main terrace of a raised delta between the mouths of McNair and Dakota Creeks. At least three other terraces exist higher up. Fossiliferous stony marine clay upon which the gravel lies is exposed near the centre of Lot 539 above the upper edge of the delta. In the pit a rusty, poorly bedded, flat-lying layer of cobbly to bouldery gravel overlies sandy gravel that forms well-bedded layers striking northeast and dipping 23 degrees southeast. A pebble count indicated a composition of 66 per cent granitic, 12 per cent basic, 12 per cent volcanic, and 10 per cent miscellaneous stones. Considerable gravel, perhaps several million tonnes, remains in the deposit. Drilling to determine the depths of the terraces west of the present pit face would be necessary to accurately estimate reserves.

Pit 7, on Lot 1432, was formerly operated by Construction Aggregates Ltd. as part of their Hillside operation. An old processing plant used until 1964 had been torn down and a new one under construction was nearly complete in June 1975. The pit is on the front escarpment of a deltaic deposit that extends from the beach to the highway at 76 metres elevation. The former pit is 300 metres long and about 200 metres wide reaching from sea level up to the 30-metre contour in irregular benches. The main exposure in the face consists of sandy gravel in foreset beds that strike northeast and dip 20 to 25 degrees southeast. Gravel composition is 58 per cent granitic, 20 per cent basic, 12 per cent volcanic, and 10 per cent miscellaneous as indicated by a pebble count. Several million tonnes of gravel remain in the deposit but development toward the north will be limited to only part of this because of highway allowance restrictions.

Two abandoned pits are situated in a small raised delta on Lot 1401, on the north bank of Langdale Creek just west of the highway at the ferry dock. Pit 8 is on the north side of the municipal pump house. It is about 30 metres in diameter with a maximum face height of 3 metres. The exposed beds are alternate layers of rusty sand and gravel that dip seaward. Pit 9 is west of the pump house. A dwelling has been built in the eastern part of the quarry. The excavation is about 30 by 60 metres with a maximum face 10 metres high. Alternate 0.25 to 0.5-metre-thick foreset beds of sand and gravel with lenses of cobbles dip 25 degrees eastward. A lens of marine stony clay containing numerous shell prints is exposed in the side of the quarry 2 to 3 metres from the top. Although gravel remains in the unmined part of the delta, further exploitation will not be likely because the ground is being subdivided for housing.

The town sewer plant and a rubbish dump occupy the site of an old sand pit at No. 10 on Lot 685 in south Gibsons. In the slumped face of the excavation the material exposed is mostly sand with some fine gravel. Beds are irregularly flat lying to easterly dipping and crossbedded.

Two pits are located in a raised delta on the south side of Langdale Creek at the north end of Stewart Road. No. 11 consists of several irregular excavations 1 to 2 metres deep from which a coarse surface layer of gravel has been removed. Sandy foreset beds are visible in one or two of the holes. No recent activity is evident. Gravel reserves are minimal. In the southeast corner of Lot 1507, Fiedler Bros. operate pit No. 12. It is 150 metres in diameter and is worked in several different areas on different benches 3 metres high. The main source of gravel is the 2 to 3-metre-thick cobbly top layer of the delta. This overlies foreset sand and silt beds containing small amounts of fine gravel. A count showed 44 per cent granitic, 18 per cent basic, 15 per cent volcanic, and 23 per cent miscellaneous pebbles. Reserves are limited. A third pit was once operated across the road east of the Fiedler pit but the land has now been reclaimed and subdivided for houses.

The Provincial Ministry of Highways operates pit 13 at the north end of Gilmour Road on the west side of Gibsons Creek. It is in an alluvial fan, possibly of ice-contact origin, that is underlain by till which is exposed in most of the floor. The pit is about 150 metres in diameter. The face shows a coarse bouldery surface layer of gravel over sand and fine

gravel beds that strike northeast and dip southeast. The sand and gravel is about 7 metres thick. Most has now been removed from the cleared area but more may be available in the bush to the north. However, the presence of two houses built between the pit and the creek to the northeast may limit further development.

Two abandoned pits and a third now operating are located in a deltaic deposit on the west side of Lots 691 and 1657 at the end of Cemetery Road. Pit 14, near the apex of the delta, is about 20 metres in diameter and 2 metres deep. It shows sandy gravel. Pit 15 is an excavation about 100 metres in diameter in beds of sand and fine sandy gravel. It is now occupied by a machine shop and trash dump. A new pit, No. 16, was being worked in 1975 by Shoal Development Ltd. The pit is at the base of the front scarp of the delta. It is 60 metres in diameter and is worked in two benches with a maximum face height of 8 metres in the centre. The aggregate is very sandy with most pebbles in lensy gravel beds having diameters of less than 3 centimetres. Reserves are limited.

Two pits have been opened up in a deltaic deposit near the municipal reservoir. At the west edge of Lot 1314, pit 17 is an opening 39 metres by 30 metres with a face 8 metres high. It shows south-dipping foreset beds of sand and fine gravel with some silty lenses. West of the reservoir, on Lot 1313, is a municipal pit, No. 18, about 20 metres in diameter with a 5-metre-high face. The material exposed is very sandy with not much good gravel. The beds are uneven and grain size varies rapidly in the beds laterally and vertically. Some irregular lenses of till-like material in the beds suggest this might be an ice-contact deposit. A drill hole beside the reservoir is reported to have passed through 30 metres of sand with some gravel.

An idle pit, No. 19, lies on the south side of Highway 101 east of Chaster Creek on Lot 908. The excavation is about 100 metres in diameter dug into the end of a rounded mound about 7 metres high. The mound consists of poorly sorted, well-rounded gravel and sand. Stones are mostly less than 10 centimetres in diameter but range up to 25 centimetres. Most are granitic with some volcanic and metamorphic varieties present. Beds dip to the north and to the west at low angles. In the floor and in a 3-metre-deep hole near the centre of the pit, till or stony marine clay is exposed. A few thousand tonnes of aggregate remain available.

On the east bank of Chaster Creek off Veterans Road on Lot 908, Gibsons Building Supplies Ltd. operates pit No. 20. The pit is 150 metres long, 60 metres wide, and 6 to 9 metres deep. The faces show a thin veneer of marine gravel, sand, and clay over a metre of till which lies on top of beds of sand and gravel. The contact between till and the underlying sand and gravel is uneven and appears to slope southward. The sand and gravel is very mixed and bedding is poor. The general attitude of the beds is flat but there is much crossbedding in various directions and channelling, particularly on the south side of the pit. The aggregate in the south and east faces is very sandy whereas on the northwest it is mainly gravelly, parts being cobbly to bouldery. A pebble count showed 51 per cent were granitic, 19 per cent basic, 22 per cent volcanic, and 8 per cent other. A road

extends down the bank from the quarry floor to Chaster Creek, 20 metres below. Down the road discontinuous outcrops show first till and then flat-bedded sand and silt with very little gravel for the rest of the way to the creek. There probably is a considerable amount of sand and gravel still in place in this area but how much can be quarried is not known. The ground adjoining the pit immediately to the east has been subdivided and is being rapidly built upon. To the south the ground slopes down and along the south boundary of Lot 908 a ditch exposes more than 3 metres of clay and silt -- beyond the ditch are houses. The pit can expand northward unhindered for some distance if the material there is useable. Logs of some holes more than 30 metres deep in the south part of Lot 909 east of Chaster Creek record till and sand but little or no gravel. The company operates a crushing, screening, and ready-mix plant in the pit.

The wall of the ravine directly behind the mobile home court on Lot 907 south of Highway 101 has been stripped off for a gravel pit at site 21. Exposed sediments consist of up to 3 metres of flat-lying thinly laminated silty blue-grey clay on top of 1 to 2 metres of till over sand and gravel. The contact below the till is irregular. The gravel is quite sandy and its pebbles average less than 10 centimetres in size with scattered boulders as large as 60 centimetres. Production to date has been small. Development to the north and east is limited by the mobile home court and to the west by a deep gully but to the south it is possible for at least a short distance. Drilling has indicated the presence of several million tonnes of sand and gravel underlying the area south of pit 21 on Lots 907 and 909 west of Chaster Creek. However, subdivision of the land is going on and this may prohibit the quarrying of much or any of the aggregate.

The Ministry of Highways operates pit No. 22 in a delta on the east bank of a creek at the end of Crowe Road. The excavation is approximately 150 metres in diameter and the present face, about 6 metres high. In the face beds dipping 15 degrees south consist of sand and fine gravel with scattered cobbles. These beds have a total thickness of 8 to 10 metres and overlie sandy stony marine clay that contains numerous shell prints. This latter material weathers rapidly to form sandy gravel that can be used for some purposes. Reserves in the delta are small.

About 300 metres south of pit 12, on the west side of Crowe Road, a building site now occupies a small former pit that provided gravel from marine veneer.

Several small pits have been opened up in a raised delta on the west bank at the mouth of Chapman Creek. The only one now in use is No. 23 which is worked by the Ministry of Highways. It is 60 metres long, 30 metres wide, and 4.5 metres deep. Up to a metre of cobbly gravel with some sand forms a flat layer over sandy foreset beds. Some of the foresets are very fine sand and silt only a centimetre or less thick. The topsets have provided the bulk of the gravel and these have been scraped off the surface for 60 to 90 metres north of the present pit face. Reserves are small. A second small pit supplied some aggregate from a farmyard 120 metres north of pit 23. The other two pits in this delta are at site 24 at the school. Geologically these show the same conditions as in No. 23. The school occupies most of one pit and rubbish litters the other. Ground to the north, which probably contains gravel, has been subdivided for building.

Pit 25 is on the west side of the main Chapman Creek logging road at a bend near the centre of Lot 1029 at the north end. The excavation is 60 metres long by 40 metres wide and 3 metres deep. About half a metre of flat gravel overlies sand and gravel beds that dip 7 degrees south. Stones in the gravel range up to 15 centimetres in diameter. Approximately a third of the material is gravel and the rest is sand. The pit supplies material to maintain the logging road. Although the depth of the gravel is not known and may not be great, the areal extent of the deposit suggests considerable reserves are present in the surrounding region.

No. 26 is the site of a former pit dug in southwest-dipping sand and sandy gravel beds. The area is now subdivided and much is occupied by houses.

The Sechelt Indian Band operates pit No. 27 on the north side of the highway just east of the hospital. The pit is 100 metres long by 50 metres wide with a maximum face 10 metres high. Material exposed is sand and sandy gravel. The lower beds are quite flat and almost all sand; the upper beds are lensy, crossbedded, and channelled and dip about 15 degrees southwesterly. Much of the gravel is loose and black coated or rusty. Near the top of the face a silty lens contains numerous shell prints. Plenty of sand reserves remain but the amount of good gravel available is limited.

Pit 28 is beside an old road on Lot 4081 about 60 metres east of the mainline logging road up Chapman Creek. It is only 7 metres in diameter in a mound of sand 3 metres high.

At 29 on Lot 2461, 300 metres north of the 4-mile post on Chapman Creek logging road, a pit 30 metres by 15 metres with a face 5 metres high has been dug in the side of a small kame. The exposure shows mainly sand with minus 3-centimetre diameter gravel overlying till. The granular materials display irregular slumped structures. Gravel reserves are small.

L & H Swanson Ltd. operates a pit to produce sized aggregate and ready-mix at site 30 on Lot 1556 on the south side of Burnet Creek at Porpoise Bay, 3 kilometres north of Sechelt. This is a large pit worked on several levels in a multi-terraced raised delta that extends from the Porpoise Bay road up to 180 metres elevation. The pit has a high gravel content. Pebbles from a large pile of crushed and sized rock on a bench at 90 metres elevation were 58 per cent granitic, 9 per cent basic, 21 per cent volcanic, and 12 per cent miscellaneous in composition. Reserves are considerable.

At site 31 on Lot 1557 on the north side of Angus Creek the Ministry of Highways periodically quarries gravel beside the road. The pit is being dug into the side of a raised delta that reaches from the highway to approximately 180 metres elevation in several terraces. On the other side of the delta at site 32, and still on Lot 1557, Pacific Rim Aggregates operates a quarry that supplies sized aggregate to the Vancouver area. The pit is 200 metres long and 100 metres wide. It is worked on two main levels. A flat surface layer of cobbly gravel overlies long straight foreset beds. These latter consist of sandy

gravel in which most pebbles are less than 5 centimetres in diameter but scattered cobbles reach 20 centimetres. During processing a large surplus of sand is separated out and much is stored in the unused part of the pit. A composition of 64 per cent granitic, 8 per cent basic, 22 per cent volcanic, and 6 per cent miscellaneous was found in a pebble count. A large volume of sand and gravel remains in this delta but recovery of much of it will be hampered or prevented by the presence of the hydro transmission line that traverses the ground immediately east of the present headwall of the quarry.

The Provincial Ministry of Highways operates pit 33 at 110 metres elevation on the logging road on the north side of Gray Creek. The pit is about 60 metres in diameter with a sloping floor and irregular face. The gravel is not as sandy as most pits in this area. It is well bedded but not well sorted and contains scattered boulders to 30 centimetres in diameter. No pebble count was made but the general appearance suggests a composition similar to other local pits. The pit is at the base of the front scarp of the widest of several terraces that make up a raised delta extending up the north bank of the creek to 200 metres elevation. Reserves are moderately large but exploitation may be hampered by land subdivision and residential building nearby.

A low mound on Lots 4310 and 4307 along the east side of Mason Road on the upland 3.5 kilometres northwest of Sechelt is the site of pits 34 and 35, operated by the Ministry of Highways and Coast Paving Ltd. respectively. The mound is formed of a veneer of marine lag sand and gravel over 1 to 3 metres of till which lies on an uneven top surface of relatively flat-bedded silty sand, sand, and gravel. There is considerable crossbedding and some channelling in the deposit. The gravel is dirty and rusty and contains scattered 'rotten' granite stones. A count showed 50 per cent granitic, 11 per cent basic, 28 per cent volcanic, and 11 per cent miscellaneous pebbles. Several large erratics up to 3 metres in diameter lie about on the ground surface. Drilling would be necessary to delimit the gravel in this deposit. A hot-mix plant was being operated in pit 35 in 1975.

Between Sechelt and Earls Cove, apart from two pits at a creek where the powerline crosses Highway 101 about 9 kilometres south of Earls Cove, the only pits found were insignificant ones in sand, thin gravel veneer, or till. No evidence was seen to suggest the possibility of finding large gravel sources. At the creek mentioned above, Harbour Concrete Ltd. works a small pit below the highway in a narrow fan that extends up the north side of the creek. The gravel is angular, poorly bedded, and bouldery. Reserves are small and restricted by the powerline and highway. The Ministry of Highways works a pit on the south side of the creek in a larger fan. The size range of the granular material is great and size changes are rapid vertically and horizontally. Some of the aggregate is loose and some lenses are compact and till-like. Bedding is irregular and variable, often being contorted. It is probably an ice-contact fan. Volcanic rocks are much more abundant than in pits near Sechelt. Reserves here are considerable but aggregate quality may be poor.

Sand and gravel occurs in recent stream and beach deposits throughout the area of this report. However, the stream deposits are small and most, if not all, of the beach deposits are along residentially developed seafront, so it is unlikely either type can offer

commercial possibilities. Beyond the limits of the area discussed, at the mouths of streams entering arms of the various inlets there are sand and gravel deposits which could be of commercial interest. A large one of these is now being worked on the east side of Jervis Inlet at Treat Creek, 14 kilometres northest of Earls Cove. Also, on Nelson Island a gravel deposit is reported to be under test for commercial value.

In summary, the survey indicates that most of the gravel sources in the area examined are being exploited. The major undeveloped source is the delta complex at the mouth of Chapman Creek. Small amounts of aggregate for local use can be obtained in many localities from the marine lag veneer. Future commercial sources should be sought at the mouths of streams flowing into the various arms of the inlets in the surrounding region.

3

POWELL RIVER AREA

INTRODUCTION

A week in 1974 and a week and a half in 1975 were spent in making a reconnaissance survey of the surficial geology of the Powell River coast from Saltery Bay to Lund. The prime objective was to locate and study known sand and gravel deposits and to see if others could be found. The information obtained is shown on Figure 2.

In the following discussion the unconsolidated deposits have been grouped to conform with the general scheme that has been used for published surficial maps of the Strait of Georgia region.

GENERAL GEOLOGY

The mapped area lies in the Georgia Lowland. Glacial ice moved south and southeastward over the entire region. Above the edge of the lowland, about 300 metres elevation, the ground surface is mostly bare rock or rock with small thin patches of overburden that is normally till. In the lowland itself, a variety of unconsolidated materials left by glaciers, streams, and the sea mantle the area. Marine deposits and deltas indicate that sea level in past glacial time was once at least 180 metres higher than now.

Exposures of till are common throughout the region. It is possible that tills of more than one age are present but no evidence for this was recognized and, since the general appearance of the materials in outcrops examined was similar, for this report all till will be considered to belong to the Vashon ground moraine.

Pre-Vashon sediments were seen at Myrtle Point village, in sea cliffs between Myrtle and Grief Points, in a gravel pit 2 kilometres northwest of Myrtle Point village, in pits west of Hammil Lake, in a pit beside Highway 101 just north of Westview, in pits northeast of Powell River, in pits on the east side of Cranberry Lake, and in a pit 3 kilometres north of Sliammon. At Myrtle Point village the exposures seen are of sand or sand with minor gravel. No good cross-sections were found. Logs of wells drilled in the area record as

much as 35 metres of sand, some gravel, and clay but no till. Wells just to the west and east record up to 36 metres of till over as much as 90 metres of sand and silt. Cliffs between the village and Grief Point expose up to 45 metres of flat-lying, clean, fine, light-coloured sand, with some silt, in beds 0.6 to 15 centimetres thick. Some layers are crossbedded and some contain concentrations of mica and black sand. An irregular thickness of till overlies the sand and a thin marine veneer covers the till. In the Ministry of Highways pit on Lot 1358 northwest of Myrtle Point more than 6 metres of well-bedded flat-lying sand and sandy gravel are exposed. Although no till was seen in contact overlying the deposit, their setting and nature suggest the granular materials are probably pre-Vashon in origin. Three pits beside the road west of Hammil Lake show patches of till and marine clay irregularly overlying relatively flat, partly crossbedded sand and sandy lenses of gravel. In the municipal pit beside Highway 101 a kilometre north of Westview, marine veneer covers an irregular layer of till which overlies an undetermined thickness of flat to irregularly bedded sand and gravel. Five pits east and southeast of Cranberry Lake reveal flat-lying beds of light-coloured fine sand and sandy gravel with some silt lying under till and marine veneer. Three pits and a cutbank just beyond the northeast corner of Powell River show till overlying beds of sand with some gravel. The lowest exposed beds are flat lying and consist of fine light grey sand. In the pit north of Sliammon marine veneer-covered till overlies sandy poorly bedded gravel, sand, and silt. Drill logs indicate that in the area between Kelly Point and Myrtle Point up to 36 metres of till veneered with marine sediments overlies as much as 90 metres of sand, gravel, and silt. It is likely that the same general geological conditions are present in the entire through valley from Kelly Point up Lang Creek to Haslam Lake. Similar conditions exist from Myrtle Point northwest to Powell Lake. A northwest-trending, partly exposed ridge of rock separates these two areas.

The Vashon ground moraine in Powell River area is similar to that in the Sechelt region. It consists essentially of till with scattered sand and gravel lenses. Although exposures are common in cutbanks, ditches, pits, stream banks, and on beaches, most are too small to show on Figure 2. The till lies on bedrock or unconformably on sand and gravel. Below about 180 metres elevation it is covered with marine veneer of variable composition and texture. Drill logs record thicknesses of till up to 36 metres.

Marine and glaciomarine deposits were not segregated in this survey and all are shown in the same colour on the map. They occur widespread, forming the surface layer of unconsolidated material over most of the area. In composition and texture they are the same as in the Sunshine Coast map-area. Most occurrences consist of sand or gravel but some are silty or stony clay. Fossil imprints were not found as frequently as in the area to the south but in one abandoned pit east of Grief Point some whole marine shells were discovered.

Capilano fluvial deposits are scarce and of limited size in this area. These are deltaic, fan, and channel occurrences of sand and gravel laid down by streams at some post-glacial stage when sea level was higher than at present. Lack of sizeable streams accounts for the few deposits of these materials.

Salish sediments, consisting of silt, sand, gravel, and peat laid down since sea level became stable at its present position, are found chiefly as beach deposits below the high tide mark.

SAND AND GRAVEL DEPOSITS

Most of the aggregate pits in the area are small and no large ones are in operation. During the survey 38 pits were seen and of these only nine appeared to be in use at the time. The sand content in most deposits is much greater than the gravel, and sand is the only product of several pits. In the eastern part of the district the aggregates are in Capilano fluvial deposits but in the west most are in pre-Vashon materials. It is unlikely that large undiscovered deposits of economically workable gravel are present in the area mapped.

Beside the logging road 1 kilometre north of Saltery Bay at pit site 1, an area approximately 100 metres in diameter has been cleared off on the surface of a small alluvial fan. The material composing the fan is chiefly coarse sand with a minor amount of poorly rounded and poorly sorted gravel containing scattered stones up to 25 centimetres in diameter. Underlying bedrock and till have been uncovered in the upper northwest corner of the clearing. The maximum depth of the deposit is not visible but is probably not great. Reserves are considered small.

Beside the west fork of the logging road at 2 a pit has been opened up across the base of the front of a small fan-like deposit. The fan is about 7 metres high, 60 metres wide, and extends 50 metres or more back from the road. The granular materials are similar to those at site 1.

On the powerline right-of-way about 500 metres northeast of the government picnic grounds a small pit has been worked at 3. It is in a tiny fan containing a few hundred cubic metres of sand and gravel.

The Provincial Ministry of Highways operates a pit at site 4, about 250 metres from Highway 101 directly north of the picnic grounds. This pit is in a fan about 150 metres wide and 150 metres long. The best gravel appears to be in the upper beds. Lowest exposures are mainly sand. Gravel reserves are not large.

Pit 5 is at the southeast corner of Lot 3495 at Lang Bay. It is an excavation 30 metres long by 10 metres wide and 3 metres deep in what appears to be a sand and gravel bar lying on marine clay. Little further development is possible.

Near the centre of Lot 4417 at Lang Bay there is an abandoned pit about 12 metres in diameter at site 6. Flat-lying sandy beds with a little fine gravel are exposed to a depth of 2 metres overlying till. This could be a beach terrace. Surrounding land is being built upon thus preventing much further use of the pit.

Pit No. 7 is beside the main logging road up Lois River about 45 metres west of the bridge. It is an opening 30 metres by 15 metres and 3 metres deep in flat-lying sand with some gravel. Reserves are minimal.

Pit 8 is beside the road on the east side of Lois River about 30 metres east of the bridge. It is a hole 15 metres in diameter about 4 metres deep in a small sand and gravel mound which appears to overlie fossiliferous marine clay. Reserves are negligible.

No. 9 is a sand pit in the front of a deltaic deposit. No gravel is exposed in the excavation. The sand is fine, very light coloured, and in thin beds. It is exposed for 200 metres along the logging road and extends northwestward uphill to the next road. Along both sides the sand seems to overlie till which rests on bedrock. There is a moderate amount of sand available at this deposit but no apparent gravel.

A bank of gravel is exposed by a cut along the logging road starting 200 metres north of the sand pit and continuing on to the road junction a further 250 metres. A pit 15 metres in diameter, No. 10, just southeast of the road junction has provided some gravel for road maintenance. The gravel is in beds that strike north and dip moderately east toward the lake. Reserves are small and excavation is limited by the presence of the two roads.

J. Hawkins, of Powell River, owns and operates a sand and gravel pit at location 11. The deposit in which the pit is situated has the form of a delta facing southeast but not the typical deltaic internal structure. The top is relatively flat and the surface layer, visible in spots where it has not been removed, is 1 to 3 metres of coarse cobbly gravel that lies flatly over the underlying material but does not show bedding. Towards the front, the next lower layer is an irregular thickness of silty sand that contains many fossil prints, mostly clam-type moulds and casts up to 10 centimetres in diameter. Below this material is a stony clay, again of irregular thickness and also fossiliferous. Below the stony clay the sediments are very mixed ranging from silt to gravel in irregular beds and lenses. Sand is much more abundant than gravel in the working pit, particularly toward the south end. Below the road at the base of the delta front till is visible overlying bedrock on the bank of Lois River. The delta is at least 30 metres thick at the front and covers an area as shown on Figure 2. Because of the irregular nature of the deposit, however, without drill-hole information and screen testing it is not possible to estimate how much gravel is actually available as a reserve. The pit is an irregularly shaped opening about 200 metres in diameter worked on several levels. The shape is the result of attempting to selectively remove gravel lenses and leave sand and silt.

Pit 12 is at the northwest corner of Lot 4411. This is an opening 100 metres long by 60 metres wide with several levels and having a maximum difference of 12 metres between the lowest floor and the top of the pit. Materials exposed are silt, sand, and gravel with an excess of the finer sizes. Bedding is poor, what can be seen being generally flat with gentle undulations. In places the changes of grain size are abrupt. At the west edge a metre or more of till-like stony clay forms the surface layer but elsewhere the topmost material

visible is about a metre of cobbly gravel. There are reserves still available at this site but the amount of good gravel is indefinite and housing developments in the vicinity will limit production possibilities.

On Lot 3510, about 250 metres east of the gate on the Lang Bay logging road, pit 13 has been excavated in a small delta of Capilano sediments. The pit is 100 metres long by 60 metres wide and has a face 3 metres high. It exposes 3 metres of gravel overlying more than 3 metres of fine sand. The gravel grades upward from cobbly to fine. Little gravel is visible in the deepest parts of the pit. The deposit shows good deltaic bedding that strikes north 65 degrees east and dips south. Some crossbedding is present. The pebbles are chiefly granitic and volcanic and are fairly well rounded. Visible reserves of gravel are small.

At 14, on the west side of the Lang Bay logging road about half a kilometre north of the gate, 1.5 metres of sand and gravel marine veneer has been scraped off the underlying till in a long shallow excavation. An unknown amount of similar material could probably be recovered from parts of the surrounding area.

On the east side of the logging road 350 metres north of pit 14, a small pit was opened up in a sandy gravel marine veneer deposit. It does not appear to have been used for a considerable time. Reserves are minimal.

Directly northeast of the major logging road junction near the centre of the north boundary of Lot 6149 is a Capilano delta front. Two pits have been worked in the deposit, one on each road fork. Pit 16 is on the east fork. It is 100 metres long, 35 metres wide, and has a face 6 metres high. Exposed in the face is well-bedded, well-rounded, clean gravel with a high sand content. Good foreset beds strike north 20 degrees west and dip west. A topset layer a metre thick consists of coarse gravel. The pebbles are mostly plutonic or volcanic. Pit 17 is on the north fork of the road and a few metres below 16 in elevation. It is 100 metres long, 60 metres wide, and has a face up to 15 metres high. Geologically it is like 16. The lowest exposed material in one corner of the pit is about 3 metres of silty clay. This pit has not been used for some time and much of the face has slumped. There could be considerable reserves in the whole deposit depending on how extensive the underlying silt is. Drilling would be necessary to obtain a reasonable estimate.

Pit 18 is in the northwest corner of Lot 6366, 1.5 kilometres east of Grief Point. This is a sand pit in glaciomarine sediments. About a metre of flat-lying cobbly gravel forms the uppermost part of the deposit. This is partly on sand and partly on fossiliferous stony clay. The sand is in beds that dip flat to 10 degrees west. One huge boulder is exposed in the face embedded in the sand. The boulder sits on a pile of shells and worm tubes. The pit has not been worked for some time and is now used as a skeet range. Gravel reserves are negligible.

The Provincial Ministry of Highways operates the pit at site 19, just south of the powerline near the northeast corner of Lot 1358, northeast of Grief Point. The pit is about 120 metres in diameter with an irregular depth. A maximum of approximately 6 metres of strata shows in the excavation. The strata consist of flat even beds of sand interbedded with gravel. Some crossbedding is present in thin sand beds. Pebbles in the gravel range from 0.6 to 10 centimetres in diameter, most being in the smaller range. They are not well sorted, some are rusty, and some consist of 'rotten' granite. A pebble count showed a content of 43 per cent granitic, 15 per cent basic, 36 per cent volcanic, and 6 per cent miscellaneous in origin. Toward the north limit of the pit sand is dominant with little visible gravel; toward the south and west the strata are lower in the sequence and contain more gravel. The topmost exposed material is a metre of rusty flat-lying gravel. There is a possibility of fairly extensive reserves in the surrounding area. This is still undeveloped land so excavation would not be restricted by housing. Although no till was seen, the general setting of the deposit suggests it probably consists of pre-Vashon sediments.

Three pits have been operated in what is apparently a pre-Vashon deposit beside the road just west of Hammil Lake. No. 20 is near the centre of Lot 5490. The pit is 45 metres long by 30 metres wide with a maximum face of 5 metres. Relatively flat layers of sand, some crossbedded, containing lenses of gravel with a few boulders are exposed in the face. A small irregular patch of till or stony clay lies on top of the sand on the lip of the pit. Some periodic use is made of this pit. Pit 21 is north along the road and adjacent to 20. It is 100 metres long by 60 metres wide and of variable depth. Slumping hides structural details but the geological setting looks similar to that in pit 20. Gravel in the upper layers and top has been skimmed off to leave sand exposed in the lower showings. Not much gravel remains visible. The pit does not seem to be in use. Pit 22 is 250 metres farther north along the road, near the centre of Lot 5489. It is 150 metres long by 120 metres wide and has a maximum face height of 7 metres. The exposed top surface is irregular and shows some till and fossiliferous marine sand. This overlies nearly flat sand and gravel. Sand is most abundant, with gravel present as small included lenses. Part of the pit is used as a dump but part is still used as a source of sand. Little gravel aggregate is available. The deposit exposed in these three pits probably extends for some distance east and southeast from the road. No doubt plenty of sand is available but the amount of gravel is likely to be quite limited.

Pit 23 is a small low excavation in flat-bedded sand at the curve in the road near the northeast corner of Lot 5114. It is now occupied by a building.

At 24 an abandoned pit shows that a layer of marine gravel veneer about 3 metres thick was scraped off the underlying till for some distance along the powerline right-of-way. House building prevents further exploitation laterally.

A municipal storage area now occupies the site of a former pit in marine veneer at 25. Development in the surrounding area prevents more removal of gravel.

One of the largest pits in the area is operated by Powell River Municipality at 26, near the south end of Lot 450 on the east side of Highway 101 at the bend in the road just north of the public park. Marine veneer forms the ground surface. This lies on an irregular bed of till which rests unconformably on sand and gravel beds. The beds are very irregular and the uppermost ones contorted, but they have a general flat attitude with gross and fine-scale crossbedding. The granular materials vary from fine sand to cobble size with scattered boulders to 2 metres in diameter. Size changes are frequently abrupt vertically and laterally. A pebble count showed a composition consisting of 53 per cent granitic, 13 per cent basic, 22 per cent volcanic, and 12 per cent miscellaneous stones. The pit is approximately 210 metres in diameter. It is being worked by means of five irregular benches with a total difference in elevation of 30 metres between the lip of the pit and the lowest floor. The city garbage incinerator occupies the southeast corner of the excavation. This deposit is an advance outwash deposit that probably underlies the area for 1 kilometre to the northeast and 1.5 to 2 kilometres to the north. How much of the land is open to exploitation and what the average gravel content would be is not known.

Near the centre of Lot 5187 about 0.8 kilometres south of Cranberry Lake is pit 27, now abandoned. It consists of an excavation 6 metres in diameter and 1.5 metres deep. The pit shows a thin sand veneer over 15 centimetres of till which lies on a thin layer of cobbly gravel overlying an unknown thickness of sand and silt. This closely resembles the pre-Vashon deposits exposed in the four pits to the north. Little further quarrying is possible because of housing.

Pit 28, on Lot 5446, 0.8 kilometre southeast of Cranberry Lake is operated by Coast Paving Ltd. The pit is 150 metres in diameter with a variable depth of up to 12 metres. In it a thin marine veneer surfaces up to 6 metres or more of till which lies on flat but crossbedded silt, sand, and gravel. There is a high sand content in the pit and the proportion of silt appears to increase toward the southwest. Most of the gravel is minus 15 centimetres in size but scattered larger boulders occur. A hot-mix plant was being operated in the pit in 1975. The formation continues an unknown distance to the east and probably extends some distance to the south.

Pit 29 is near the centre of Lot 5445 at the southeast corner of Cranberry Lake. This is the Yukon Gravel Pit, owned and operated by John Sarnowski. It is 100 metres in diameter with a maximum face 7 metres high. Material exposed is mostly sand with some gravel and one or two cobbly lenses containing boulders up to a metre in diameter. In the eastern part of the face about 5 metres of thin-layered black silt containing wood fragments has been uncovered. From this pit a more or less continuous narrow excavation extends west and north around a rock knob to pit 30. This latter is a small sand pit in Block A of Lot 5445. Fine white sand with a thin surface gravel veneer is exposed in the excavation. The sediments lie against bedrock, some of which has been quarried.

A sand pit that is used intermittently is located on Lot 4128 beside the road at the northeast corner of Cranberry Lake. This pit, No. 31, reaches from the road northeast to a bedrock bluff. It is 100 metres wide by 240 metres long and extends over a vertical

height of 25 metres. Material exposed is essentially fine light grey sand with a few grit and pebble layers. Bedding in the upper layers is folded and faulted whereas that in the lowest exposures is almost flat and very even. Some crossbedding and channelling is visible. Thin patches of till with scattered boulders up to 2 metres in diameter lie on the top surface.

Pits 28, 29, 30, and 31 are all similar in that they are pre-Vashon deposits that were protected from total glacial erosion by being situated in the lee of bedrock protuberances. In all of them the amount of sand present is much in excess of the amount of gravel.

Pit 32 is an abandoned one at the northeast corner of Powell River townsite. It is about 150 metres long and up to 50 metres wide with a sloping floor. Much of the pit is overgrown and the walls have slumped. Two large water tanks occupy the southern part of the excavation. In the face, marine veneer-covered till overlies bedded sand and gravel. The sand content is high. Although there are probably reserves to the north and east, the powerline located adjacent to the pit and the presence of the water tanks limit further exploitation.

Pit No. 33 is on the east side of the logging road 300 metres north of No. 32. It is a low excavation 75 metres long by 25 metres wide with a face 3 metres high in outwash consisting mainly of sand and silt. The pit is used as a rock dump.

At site 34 a cutbank has been opened up along the logging road for 400 metres. Near the north end the cut is 7 metres high. At this point some aggregate appears to have been quarried. In the exposure outwash sand and gravel underlie till which has a thin marine sediment cover. The granular material is mostly fine sand but contains some pea gravel and scattered lenses of boulders. Rapid grain size changes, channelling, and crossbedding are features visible in the face. The lowest exposed beds are flat-lying, fine, light grey sand. Not much gravel appears to be available for commercial exploitation.

Pit 35 is an abandoned excavation directly above the north abutment of the dam on Powell River. It is an overgrown opening about 60 metres in diameter with a sloping slumped face 4 metres high. Bedrock is exposed around the west and north edges of the pit. Gravel visible looks clean and well washed but poorly bedded. Reserves are minimal.

No. 36 is a pit on Lot 1901A about 250 metres south on a side road from Highway 101 at Wildwood Heights. In 1975 it was being used as a dump for waste from the pulp mill. In a 6-metre-high face on the west side the pit excavation shows a thin marine veneer overlying sandy gravel in beds that strike north 30 degrees west and dip 28 degrees east. Some large-scale crossbedding is visible. Directly to the west is a bedrock hillock.

Pit 37 is a small abandoned hole in sandy, poorly bedded gravel under a marine veneer. Reserves are negligible.

Pit 38 is on Lot 4747, 1.8 kilometres up the road that runs northeast from Scuttle Bay. It is 125 to 150 metres in diameter with a difference in elevation of 15 metres between the

lowest floor and top of the pit. The aggregate consists of poorly sized gravel with scattered boulders to 1.5 metres in diameter mixed with a high proportion of sand and considerable silt. Bedding is poor and disturbed. Pebbles are chiefly granitic though some are volcanic. The sand and gravel are overlain irregularly by till which has a marine veneer cover. The deposit forms a small ridge in the lee of a rock knob which protected it from complete removal by glaciation. Some gravel can still be won from this location but recovery will be hampered and limited by the large boulders and abundance of sand and silt. A hot-mix plant has been operated at the site.

In the area from Scuttle Bay north to Lund very little overburden covers bedrock. It consists essentially of thin patches of till and marine veneer. The only pits found were shallow and small with minimal reserves.

Summing up, this survey indicates that in the area examined good gravel deposits are scarce and limited in size, although plenty of sand is available. Small amounts of gravel sufficient for local use can be obtained in some places from surface marine lag veneer. Likely places to prospect for sand and gravel would be on the lee sides, that is, south and southeast, of rock hills and hummocks.

4

CAMPBELL RIVER AREA

INTRODUCTION

A reconnaissance survey of the surficial geology of the Campbell River area was made during part of July and August, 1975. The objective was to determine the nature and extent of possible sources of sand and gravel for aggregate. The information obtained is shown on Figure 3.

In the following discussion and on the accompanying map the deposits have been grouped to conform as near as possible with those shown on Map 49–1959, Surficial Geology Oyster River, by J. G. Fyles, Geological Survey of Canada, Ottawa, which covers the region adjoining to the south.

GENERAL GEOLOGY

The area examined lies wholly within the northern part of the Nanaimo Lowland. The highest point is at the forest lookout, elevation 319 metres, between John Hart and McIvor Lakes. Glacial ice, moving in a southeasterly direction, traversed the entire region rounding off rock projections and leaving a mixed variety of debris, most of which was later modified or covered by other materials. Bedrock, generally basalt, with thin, small, scattered patches of overburden, normally till, is exposed in hills that occupy most of the western third of the map-area and form a sharp front diagonally across the country. Below 180 metres elevation and eastward from the bedrock front to the sea, the ground is covered with various glacial, glaciomarine, marine, and fluvial unconsolidated deposits.

Only one till was recognized in the mapping. This, a product of the most recent glaciation, is assumed to represent the Vashon ground moraine as described in areas to the south.

Sub-till deposits were noted in exposures along the waterfront south of the business section of Campbell River, in a roadcut on Spruce Street on the rise northwest of the business section, on the north side of Campbell River 1 kilometre upstream from the

Highway 19 bridge, on the east bank of Quinsam River at the bridge, on the west bank of Quinsam River below the power line crossing 300 metres upstream from the fish hatchery, and in the bank just northwest of the John Hart power house. The exposure south of the business section is the only one large enough to show on the map. At Yaculta Bank, the lowest outcrop, seen only at very low tide, consists of fossiliferous stony marine clay. This is overlain by 20 metres or more of flat-bedded, firmly compacted sand and gravel. Toward the north end of this exposure the beds show a deltaic structure that strikes west and dips 25 degrees north. In most places only a thin loose sand and gravel veneer is visible at the top surface but in one or two places till can be found. Sand and gravel are the major constituents exposed in the other sub-till deposits except for the one at the Quinsam River bridge where thin-bedded silts and sand are dominant. At most of these showings contacts between till and the underlying material are plainly visible.

Till is exposed in ditches, roadcuts, and banks in much of the map region but nowhere are surface areas large enough to show in plan on the map. Where till is exposed there is normally a veneer of marine sand or gravel or fossiliferous silty clay on top of the till and it forms the ground surface. The greatest thickness of till seen was about 4 metres but undoubtedly greater thicknesses occur. Dug wells on the heights in the southwest part of town passed through 3 to 8 metres of till or hardpan into sand or sand and gravel. Fresh till consists of a bluish grey, tough, concrete-like mixture of gravel in a sandy clay matrix. It weathers brownish.

A prominent delta, that appears to be a glaciofluvial component of the Vashon drift, extends for about 4 kilometres across the east end of Campbell Lake, east of the bay known as McIvor Lake, site of a separate small lake of that name before the power development flooding. The delta averages more than a kilometre wide and has a scarp front facing east that is over 30 metres high. The internal composition and structure of the delta is not well known. It exhibits gravel foreset beds of unknown total thickness overlain by 3 metres or more of horizontal gravel topsets which form the flat terraced surface of the delta. In some pits, especially well back from the front scarp, sand is dominant over gravel at a few metres depth. The delta was formed from glacial outwash poured eastward into the sea by a stream issuing from a wasting ice tongue when sea level was at its maximum, approximately 175 metres higher than at present.

The next younger deposits consist of the Capilano marine and glaciomarine sediments. These cover over half the surface of the map-area. They consist of material ranging from gravel to clay in variously proportioned mixes. For mapping purposes they have been grouped into three divisions. Within the division boundaries shown there are small local inclusions of other members of the group. Boundary lines are drawn where one material becomes visibly dominant over another in what are usually gradational contact zones. In hand specimens the silt and clay unit material (No. 4a on map) appears to be mainly silt with variable but minor amounts of clay. It is normally buff to yellowish when fresh and dry and weathers to light grey on the surface. Frequently it displays good bedding in

layers up to 10 centimetres thick but at times has a massive, structureless appearance. When dry it has a blocky fracture but it becomes slick when wet. Casts and moulds of molluscs are quite common in the deposits but normally require careful search to locate because they are usually small and concentrated in preferred horizons. Where the underlying formation was visible it was till. The thickness of the silt seen ranged from a few centimetres to several metres. The sand unit (No. 4b on map) consists of medium to fine-grained yellowish to red-brown sand containing scattered pebbles. Where underlying material was seen it was the silty clay of member 4a. Unit 4c designates a thin marine veneer of variable constitution. In most sections seen, the veneer was less than a metre thick and it rested on till. Commonly the constituent particles are sand or silty clay but in some patches they are pebbles or sand and pebbles. The silty clay frequently contains mollusc imprints.

The fluvial deposits of Capilano sediments occur chiefly around the ends of John Hart Lake and along Campbell River. They consist of sand and gravel with some silt. The deposits were laid down after the area was free of glacial ice and sea level had begun to drop from its maximum and they continued to accumulate as sea level continued to drop. At the west end of the lake terraces show 3 to 6 metres of flat-lying gravel over more than 30 metres of fairly well-bedded flat-lying sand with lenses of fine gravel and some silt. Large-scale crossbedding and channel scour-and-fill structures are displayed in the sand zone. At the east end of the lake is an irregular delta. Some gravel lies at the surface near the bedrock front but this does not extend more than a few hundred metres to the east where it grades out into sand. In the vicinity of the forest nursery northeast of Elk Falls Park, some gravel occurs at the surface or under a few centimetres of sand for about 1 kilometre along the MacMillan Bloedel logging road. A small area of flat-lying gravel up to 4 metres thick overlies marine silty clay and till in the area immediately northwest of the mouth of Campbell River.

The walls and bottom of the upper part of Quinsam River valley are covered with a mixture of materials derived from various sources. This is shown on the map simply as valley alluvium and colluvium.

The Salish sediments have been deposited most recently in the area, since sea level became more or less stabilized at its present position. Sand and gravel along the beaches, sand and gravel deltas at the mouths of rivers and streams, channel deposits along the rivers, and upland bog deposits make up these sediments.

SAND AND GRAVEL

During this survey the sites of 35 sand and gravel pits were examined within the area mapped and an additional one just south of the area was visited. Of these, only 10 were being worked or showed evidence of recent activity.

Twelve pits, including the largest active ones, are located in the large glaciofluvial delta east of McIvor Lake. This delta contains the largest and best gravel reserves in the area. The details of the structure and textural makeup of the deposit are not well known. From what was seen in the pits that have been opened up, in general the delta appears to consist of a thickness of up to 1 metre of brownish oxidized sand or pebbly sand at the surface overlying a thickness of 3 metres or more of oxidized flat-lying topset gravel, which, in turn, overlies an undetermined thickness of gravel, sand and gravel, and sand foreset beds. In three pits located on the lip of the delta front only gravel in foreset beds is exposed but in pits back from the scarp the material in the deepest excavations is mainly sand or silty sand. This would indicate the best sites for new pits would be along the top edge of the delta-front scarp. Since this delta forms the natural dam at the east end of Campbell Lake and since springs below the delta to the east indicate considerable seepage under the delta from the lake, there is a limit to how much sand and gravel can be safely removed from this area. These facts must be considered in the long-term planning for development of future pits in the delta.

Gravel pit No. 1, just across the road south of the town garbage dump and about 1 kilometre east of McIvor Lake, is operated by Antonelli Trucking Ltd. The pit opening is 250 metres long parallel to the road and 120 metres wide. It is worked from three irregular benches approximately 10, 5, and 10 metres high, one above the other. The exposure shows 1 to 2 metres of rusty gravel overlying clean-washed, well-rounded grey gravel and sandy gravel in foreset beds that strike north 20 degrees west and dip 12 to 15 degrees east. There is much crossbedding on a large scale and considerable lensing in the beds. Locally short open-work lenses of 15 to 25-centimetre diameter boulders occur and there is some small-scale faulting. No pebble count was made but the stone composition resembles that in pit 2 which contains about 30 per cent granitoid, 50 per cent volcanic, and 20 per cent mixed pebbles. A small screening plant is situated on the top bench floor. The pit was not in operation when examined. It is apparently used periodically.

Pit 2 is on the north side of the road 200 metres west of the Antonelli pit. It is 200 metres long by 120 metres wide and is worked from a single bench with a maximum face height of 9 metres. One metre or more of flat, oxidized, cobbly topset gravel overlies straight-bedded foreset beds of very sandy gravel. The pebbles are mostly less than 5 centimetres in diameter with scattered ones up to 20 centimetres in diameter. Two pits about 2 metres deep near the road showed mainly sand with some silt in the lowest beds exposed. A pebble count of gravel in the face showed the composition to be 21 per cent granitic, 9 per cent gabbroic, 50 per cent volcanic, and 20 per cent mixed stones. The pit was not operating when examined. A large pile of crushed and sized road metal occupied much of the quarry floor indicating that a portable crushing and screening plant is brought in when required.

The town dump is located in a conical depression about 30 metres deep at site No. 3 on the map. This depression and two or three others nearby are considered by some people to be kettle holes, however, the possibility that they might have been formed at least partly by piping due to the removal of fine-grained material by seepage along underlying

beds should be considered. Sloughing of the walls hides the nature of the beds at the dump. Some sand and gravel has been removed but whether for aggregate or just to cover compacted garbage was not determined.

At site 4, on the west side of Highway 28 about 1 kilometre southwest of the dump road junction, are two small abandoned gravel pits. At each a few cubic metres of poorly sorted mixed sand and gravel was removed, partly from bedrock. Neither has any further value as an aggregate source.

Uplands Excavating Ltd. operates a pit off the map sheet on the lip of the delta-front 1.5 kilometres south of pit No. 1. When visited the excavation consisted of one bench 150 metres in diameter with a face 8 metres high. In the face one-half to 1 metre of brown topset gravel overlies grey, well-bedded foreset material that consists mainly of gravel or gravelly sand interbedded with some sand layers as much as half a metre thick. Large-scale crossbedding, lensing of beds, and open-work layers are present. The main foreset beds strike north 45 degrees east and dip southeast. A mobile crushing and screening plant is set up in the pit when needed.

Pit 5 is 300 metres northwest of the junction of the McIvor Lake road and Highway 28. It is operated by Gord Noren Trucking Ltd. Tayco Paving have a hot-mix plant set up in the quarry. The excavation is 300 metres long by 225 metres wide with a maximum face height of 8 metres. The west edge is against the bedrock front. In the southwest corner a rock quarry 15 metres in diameter with a 4-metre-high face has been worked in amygdaloidal basalt. About 1 metre of flat-bedded cobbly gravel overlies grey interbedded sandy gravel and sand. The pebbles in the gravel average less than 2.5 centimetres in diameter with scattered ones up to 20 centimetres wide. Beds display crossbedding, lensing, faulting, and open-work structures and strike north 25 degrees west with a 28-degree northeast dip. In the lowest exposed beds the composition is mostly sand. The rock mix is predominantly volcanic, similar to that in other nearby pits.

Uplands Excavating Ltd. cleared a large area and opened up a small pit at site 6, across the highway from the Noren pit. The opening, when seen, was about 17 metres in diameter and 3 metres deep. It showed up to 1 metre of brown sand over 1.5 metres of flat-bedded and poorly sorted sand and gravel which overlay more than 1.5 metres of sand and pebbly sand in beds striking north 30 degrees west and dipping 25 degrees northeast. The gravel content of the deposit uncovered is very small.

A pit was once operated at site 7, south of John Hart Road about 500 metres west of the Highway 28 junction. The working is irregular in shape, about 100 metres in diameter with a maximum face 4 metres high. It has been unused for some time and the banks are all sloughed so exposures are poor. About 1 to 1.5 metres of flat gravel overlies foreset beds. The material is very sandy and little gravel is evident in the floor. Apparently the aggregate source was the top layer with the upper part of the foreset beds.

At site 8, across the road north from pit 7, a shallow, irregular pit about 30 metres in diameter was opened up. Mostly sand with very little gravel is exposed. Not much material was removed from the excavation — it may have only been an exploratory hole.

Gary Chadsey Trucking operates a small gravel pit at site 9, east of Highway 28 opposite the John Hart Road junction. The pit is about 100 metres long parallel to the highway and 50 metres wide. It is on the front scarp of the delta and extends down the slope over a vertical drop of approximately 15 metres. The beds exposed consist of less than 1 metre of brown silty sand over 1 to 1.5 metres of brown flat-lying gravel, with pebbles averaging 5 centimetres in diameter, over more than 8 metres of grey gravel in foreset beds. These latter beds strike north and dip 20 degrees east. They are 0.5 to 1 metre thick and display major crossbedding, some slumping, some lensing, and some open-work structures. A few contain stones 5 to 7.5 centimetres in diameter but most contain stones less than 2 centimetres in diameter and sand. Many pebbles have a rusty bluish tarnish and most are volcanic porphyry or amygdaloid, or granitic.

The Provincial Ministry of Highways operates a gravel pit at site 10, on the west side of Highway 28 just north of the John Hart Road junction. The excavation is irregular in shape, extends 310 metres along the highway, is 170 metres wide, and has a maximum difference in elevation of 15 metres between the lowest part of the floor and the top of the pit. Up to 1 metre of coarse rusty gravel overlies grey deltaic foreset beds. There is much sand in the central to western part of the pit, most gravel being near the surface and toward the east, near the highway. The lower beds exposed toward the west are contorted and consist mainly of sand with silty interbeds. In this section the gravel foreset beds overlie the sand with an uneven contact. A pebble count across the best exposure of gravel showed 20 per cent granitoid, 57 per cent volcanic, and 23 per cent mixed, mainly sedimentary, stones. Portable machinery is brought to the quarry when necessary to process aggregate.

Just east of the bedrock front, at the extreme northern tip of the area mapped as glaciofluvial delta, a small pit was once worked at site 11. The opening is 65 metres long by 30 metres wide and has a maximum face height of 3 metres. The banks are sloughed but the nature of the deposit seems similar to those already described. Apparently the pit bottomed in sand.

Eight pit sites were found within the area mapped as Capilano fluvial and deltaic sediments that occur around the ends of John Hart Lake. Of these, all were inactive except No. 14, from which small quantities of sand and gravel were being removed periodically.

Pit 12 is on flat land below the glaciofluvial delta, about 300 metres east of the Ministry of Highways pit (No. 10). It has been abandoned for some time and is now largely overgrown with alder and the walls have slumped. The shape is irregular, about 150 metres long by 100 metres wide with a maximum face height of 3 metres. Little could be

seen of the geology. The floor is mostly sand so it would appear a gravel surface layer of about 3 metres thickness was removed and activity ceased when underlying sand was reached.

Pit 13 is just south of John Hart Lake about 1 kilometre west of the east end. This is a large pit that does not seem to have been used for sometime. Near the centre of the west side a small stone quarry has been worked. The gravel workings extend eastward from the bedrock front into fluvial materials. Sand and gravel has been removed from an opening 300 metres long, 180 metres wide, and 4 metres deep. Most faces are slumped and exposures are poor. The geological setting appears similar to that of other pits in the same formation, consisting of a flat layer of well-washed gravel about 3 metres thick overlying flat-lying sand, much of which is crossbedded. Little gravel is left in the pit, the floor of which is mostly sand. In the northeast corner one exposure reveals fine, crossbedded sand with some centimetre-thick silt beds that contain twig impressions and carbonized bits of wood. Surface gravel extends 100 to 200 metres east of the pit where it grades into sand.

Bruce Luoma Trucking periodically quarries small amounts of sand and gravel from pit 14, on the south side of the west end of John Hart Lake near the end of John Hart Road. Here 3 to 5 metres of well-bedded gravel overlies more than 30 metres of relatively flat-bedded light-coloured sand and silty sand containing lenses of fine gravel. The top metre of gravel is rusty brown. The sand beds display large-scale crossbedding and some scour-and-fill structures. The present quarry is approximately 200 metres in diameter and of irregular depth. Most of the opening is now in sand, the top-lying gravel having been removed. To the south and east bedrock is exposed. To the west the ground slopes down to the lake and seems to be underlain by sand. To the northeast a narrow terrace, surfaced with gravel but underlain by sand, extends along the lake for more than 1 kilometre.

The large alluvial flat between the west end of John Hart Lake and Campbell Lake is surfaced with gravel that overlies rather flat-lying light-coloured sand and silt. The gravel is at least 2 metres thick and the sand, more than 30 metres at its maximum. Only one small pit, No. 15, was seen on this flat. It is 30 metres in diameter and 1.5 metres deep. In it a thin layer of rusty gravel lies over grey gravel. The pit probably is just used as a gravel source for patching local roads.

Pit 16 is on the north side of John Hart Lake near the edge of a flat terrace that is a continuation of the deposit between the lakes. It was inactive in 1975. The pit is 120 metres in diameter and has faces up to 3 metres high. The floor is mostly sand. In the faces this sand is overlain by 1.5 to 2 metres of grey sandy gravel which, in turn, is overlain by up to 1 metre of flat, rusty, coarse gravel. The grey gravel is crossbedded in part.

Beside the road 1 kilometre northeast of pit 16, surface gravel has been quarried to a depth of 1.5 metres from an area 25 metres wide and 100 metres long at site 17. The pit is floored with sand. It has evidently not been used for some time.

At site 18, on the north side near the east end of John Hart Lake, a long abandoned pit lies just south of the road. It is 60 metres long, 20 metres wide, and has a maximum depth of 6 metres. The sloughed banks consist essentially of sand with very little fine gravel.

A gravel pit was once operated at site 19, on the south side of the MacMillan Bloedel logging road near the west boundary of Lot 151 and about 1.25 kilometres north of John Hart power house. This is on the top surface of a delta, 200 to 300 metres back from the frontal scarp. The pit has evidently not been operated recently and is now partly used as a dump. The excavation is 200 metres long, 120 metres wide, and 1.5 to 2 metres deep. A thin veneer of brown sand forms the ground surface layer. Under it is up to 2 metres of minus 2.5-centimetre diameter gravel with some sand which overlies sand. The floor is in sand. Bedding is generally well developed, in places showing some lensing and small-scale crossbedding. The bedding planes are quite flat, the maximum attitude observed being a strike of north with a dip of 8 degrees to the east. The gravel layer extends well beyond the pit in all directions but the limits were not determined.

A sand and gravel deposit just west of the arena on the hill in the southern part of the town of Campbell River is the site of four pits, two of which are worked periodically. These are in a blunt, westerly protruding, spit-like structure formed by marine veneer sediments washed out of and off the top of the till ridge to the east and south when it was below sea level. Till is exposed in the floor of the highest pit and in road ditches adjacent to the others. Pit No. 20 is used by the Municipal Department of Public Works as a source of run-of-pit sand and gravel. It is on relatively flat ground on the west edge of the hill. The shape is irregular, being 150 metres long and from 50 to 120 metres wide. It is worked from two benches with 3-metre-high faces. About 3 metres of rusty coarse gravel lies flatly on till on the east side of the pit and on foreset beds of sandy gravel and sand on the west side. The sand content of the deposit increases at depth to the west. Mollusc shell prints are abundant in the upper part of some foreset beds. Pit 21 adjoins No. 20 slightly downslope to the west. It is approximately 100 metres in diameter with two benches 3 metres high. Thin sand and gravel topset beds overlie and grade westward into foresets that strike north and dip 25 degrees west. Shell prints are abundant in the higher foreset beds. Sand is more plentiful than gravel in this pit. Pit 22 is at the foot of the front slope of the spit, about 9 metres below No. 21. It is 60 metres by 30 metres with a 6-metre-high face. The ratio of sand to gravel exposed is high. The pit was inactive in 1975. Pit 23 is at the same level as No. 22 and is located a couple of hundred metres to the south. A sloping area 150 metres long and 75 metres wide has had the surface layer stripped off. Mainly sand is now visible in the excavation. There was no evidence of recent activity at this pit. Taking the deposit as a whole, a considerable amount of sand is still available but the amount of gravel is relatively limited.

Half a kilometre north of the arena and pit No. 20, gravel was removed from three former pits in a shallow beach bar or spit-like deposit. At site 24 the banks show 1 to 3 metres of coarse, flat-lying gravel over fine sand beds that strike north and dip 25 degrees west.

There appear to have been more gravelly beds along the west side of the pit but these have all been removed. The area is being levelled off for a building site. Pit 25 is a small excavation now mostly occupied by the town curling rink. A maximum thickness of about 3 metres of sand and sandy gravel is exposed. At pit 26, on the west side of the road northwest of the rink, 1 to 2 metres of marine veneer gravel was scraped off the ground surface. It is now a building site. Building development prevents further removal of gravel in this area.

A roadcut on Spruce Street, halfway up the hill near the centre of Lot 1392 in the western part of town, site 27 on the map, was enlarged to provide a small amount of sand and gravel. Further expansion is unlikely because of housing built upslope. Here 3 metres of flat, fossiliferous, buff, clayey silt overlies up to 3 metres of till which, in turn, irregularly overlies an unknown thickness of well-bedded, firmly compacted sand and gravel. The beds strike north 15 degrees east and dip 18 degrees south.

At site 28, about a third of a kilometre northwest of pit 27, in a small area at the north edge of a flat, about 1 metre thickness of fine gravel has been removed from underlying flat-lying but crossbedded sand that is exposed to a depth of 6 metres. South of the excavation all surface exposures are silt.

A former pit (No. 29), now used as a machine shop site, once supplied some sand and gravel from the east side of a low mound near the northeast corner of Lot 1476 on Highway 28 on the western outskirts of Campbell River. The light grey sand and gravel lies on top of till and fossiliferous marine silty clay. The sand and gravel strikes north 60 degrees east and dips southeast. A mobile home development on top of the mound prevents further exploitation of sand and gravel.

Three small pits, Nos. 30, 31, and 32, have supplied a little sand and gravel from Capilano fluvial deposits in North Campbell River. A small amount more aggregate could be produced here but industrial and housing development prevents much future use of the pits.

Island Ready-Mix Ltd. has removed sand and gravel from the river bed at site 33, on the west side of the spit at the mouth of Campbell River. It is doubtful that this procedure can be used much longer because of ecological considerations.

A small amount of gravel was quarried from a shallow pit north of a logging road 120 metres west of Highway 19 in the north part of Lot 194, about 2 kilometres northwest of the head of Menzies Bay. The gravel forms a veneer less than 1 metre thick over till in this area.

In summary, the largest apparent concentration of gravel in the area mapped is in the glaciofluvial delta across the east end of Campbell Lake. Lesser amounts are available in

the surface layer of the Capilano fluvial deposits at the west end of John Hart Lake and in the same deposits northeast of the forest nursery around site 19. Small amounts of gravel occur in Capilano sediments within Campbell River townsite but their further exploitation is limited by industrial and housing development. Although much gravel is present in the bed of lower Campbell River and in deposits at and around the river mouth, it is unlikely this could be quarried because of environmental complications.

123°45′

123°30′

49°30′

SECHELT PENINSULA

SECHELT INLET

SARGEANT BAY

TRAIL BAY

TRAIL ISLANDS

THORNBROUGH CHANNEL

WOOLRIDGE ISLAND

GAMBIER ISLAND

SHOAL CHANNEL

KEATS ISLAND

BARFLEUR PASSAGE

1000

500

1500

Figure 1

SURFICIAL GEOLOGY SUNSHINE COAST AREA

0 1 2 3 4

SCALE-KILOMETRES

LEGEND

SALISH SEDIMENTS

SHORE, DELTAIC, FLUVIAL, AND SWAMP DEPOSITS: GRAVEL, SAND, CLAY, PEAT

CAPILANO SEDIMENTS

FLUVIAL DELTAIC, FAN, AND CHANNEL DEPOSITS: COBBLES, GRAVEL, SAND, AND SILT

MARINE AND GLACIO-MARINE DEPOSITS: VARIED GRAVELLY, SANDY, STONEY, CLAY, AND CLAY VENEER (NORMALLY OVER TILL)

VASHON DRIFT

GLACIO-FLUVIAL DEPOSITS: GRAVEL AND SAND

GROUND MORAINE DEPOSITS: MAINLY TILL

PRE-VASHON SEDIMENTS

GRAVEL, SAND AND SILT

BEDROCK OUTCROPS

MOSTLY BARE ROCK WITH THIN PATCHES OF OVERBURDEN, USUALLY TILL OR MARINE VENEER

SYMBOLS

GLACIAL STRIAE, GROOVES AND STOSS AND LEE SURFACES INDICATING DIRECTION OF ICE MOVEMENT

FOSSIL LOCALITY (F)

GRAVEL PIT

ROAD

CONTOURS (100 FOOT INTERVALS)

To accompany bulletin 65

Province of British Columbia
Ministry of Mines and Petroleum Resources

124°30′ 124°15′

49°55′ 49°55′

INLAND LAKE

SLIAMMON LAKE

POWELL LAKE

HASLAM LAKE

HORSESHOE LAKE

LOIS LAKE

POWELL RIVER

HARWOOD ISLAND

ALGERINE PASSAGE

HAMMIL LAKE

MALASPINA STRAIT

JERVIS INLET

49°45′ 49°45′

124°30′ 124°15′

Province of
British Columbia
Ministry of Mines and
Petroleum Resources

Figure 2

SURFICIAL GEOLOGY POWELL RIVER AREA

0 1 2 3 4

SCALE - KILOMETRES

LEGEND

SALISH SEDIMENTS

SHORE, DELTAIC, FLUVIAL, AND SWAMP DEPOSITS: GRAVEL, SAND, CLAY, PEAT

CAPILANO SEDIMENTS

FLUVIAL DELTAIC, FAN AND CHANNEL DEPOSITS: COBBLES, GRAVEL, SAND AND SILT

MARINE AND GLACIO-MARINE DEPOSITS: VARIED GRAVELLY, SANDY, STONEY, CLAY AND CLAY VENEER (NORMALLY OVER TILL)

VASHON DRIFT

GROUND MORAINE DEPOSITS: MAINLY TILL

PRE-VASHON SEDIMENTS

GRAVEL, SAND AND SILT

BEDROCK OUTCROPS

MOSTLY BARE ROCK WITH THIN PATCHES OF OVERBURDEN, USUALLY TILL OR MARINE VENEER

SYMBOLS

GLACIAL STRIAE, GROOVES AND STOSS AND LEE SURFACES INDICATING DIRECTION OF ICE MOVEMENT

FOSSIL LOCALITY

GRAVEL PIT

ROAD

CONTOURS (100 FOOT INTERVALS)

To accompany bulletin 65

125°27′
50°09′

125°08′
50°09′

Figure 3

SURFICIAL GEOLOGY CAMPBELL RIVER AREA

0 1 2 3 4
SCALE - KILOMETRES

LEGEND

SALISH SEDIMENTS

7 **SHORE, DELTAIC, FLUVIAL AND SWAMP DEPOSITS:** GRAVEL, SAND, CLAY, PEAT

6 **VALLEY ALLUVIUM AND COLLUVIUM:** BOULDERS, GRAVEL, SAND, SILT, LOAM

CAPILANO SEDIMENTS

5 **FLUVIAL DELTAIC, FLOODPLAN AND CHANNEL DEPOSITS:** COBBLES, GRAVEL, SAND AND SILT

MARINE AND GLACIO–MARINE DEPOSITS:

4a SILT AND CLAY

4b SAND, GENERALLY OVER CLAY

4c VARIED GRAVELLY, SANDY, OR CLAYEY VENEER, NORMALLY OVER TILL (UNIT 2)

VASHON DRIFT

3 **GLACIO–FLUVIAL DEPOSITS:** GRAVEL AND SAND

2 **GROUND MORAINE DEPOSITS:** MAINLY TILL (EXPOSURES TOO NARROW TO SHOW IN PLAN)

PRE–VASHON SEDIMENTS

1 GRAVEL, SAND AND STONY MARINE CLAY

BEDROCK OUTCROPS

R BARE ROCK WITH THIN PATCHES OF OVERBURDEN, USUALLY TILL (UNIT 2)

SYMBOLS

GLACIAL STRIAE, GROOVES, AND STOSS AND LEE SURFACES INDICATING DIRECTION OF ICE MOVEMENT

FOSSIL LOCALITY Ⓕ

GRAVEL PIT

ROAD

CONTOURS (100 FOOT INTERVALS)

To accompany bulletin 65

Maude Island
Morte Lake
Mary Lake
DISCOVERY PASSAGE
Hart Lake
John Campbell River
Campbell Lake
McIvor Lake
Cortland Island
QUADRA ISLAND
CAMPBELL RIVER

Province of British Columbia
Ministry of Mines and Petroleum Resources

(3)

50°00′
125°27′

50°00′
125°08′