GEOLOGICAL RECONNAISSANCE OF VANCOUVER ISLAND COAL AREAS - SUQUASH COAL BASIN AND OUTLIERS

NORTHERN VANCOUVER ISLAND

BRITISH COLUMBIA

Prepared For :

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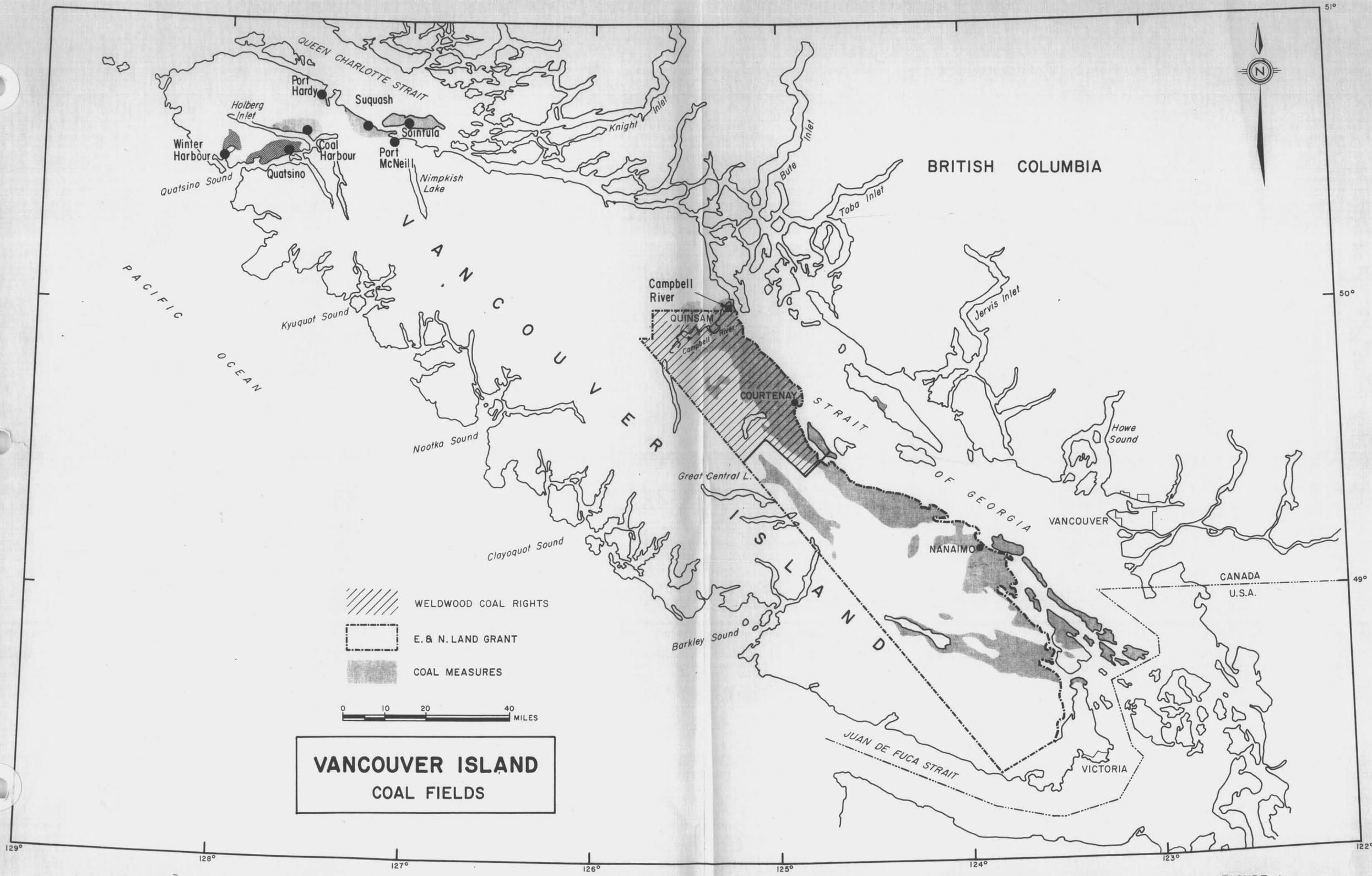


VANCOUVER ISLAND
COAL FIELDS

FIGURE 1

Chapter 1

INTRODUCTION

1.1 Location and Description of Study Area

The sedimentary deposits of the Suquash Basin and outlying areas are located in the northern part of Vancouver Island, British Columbia. Vancouver Island is the largest island on the Pacific Coast of North America, 290 km. long by an average 80 km. wide.

The Suquash area is located on the northeast coast of Vancouver Island (see Figure 1.), approximately 315 km and 440 km barge distance from deep sea ports at Neptune Terminals (Vancouver) and Ridley Island (Prince Rupert) respectively. Other outlying areas, such as the Coal Harbour, Winter Harbour, Quatsino and Holberg Inlet areas, are only accessible by water from the outer coast (west coast) of Vancouver Island. Barge distances from these areas to deep sea ports at Vancouver and Prince Rupert increase to 540 km and 520 km respectively. The north island area consists of rugged volcanic terrain: high ridges and

steep-sided valleys, interspersed with a few, low-lying, fairly flat areas along the coastlines and in major valleys. Fjoord-type inlets, such as Quatsino Sound, Holberg Inlet and Rupert Inlet afford navigable water access to large areas within the interior of the north island region.

The climate of northern Vancouver Island is typical of a wet coastal northern latitude area: rainfall averages 140 cm. to 165 cm. annually, with the majority of this precipitation occurring as rain between the months of October to March. A considerable winter snow pack develops at elevations greater than 750 metres, and snow sometimes occurs at sea level, however these lower level snowfalls seldom remain on the ground for more than a few days. The temperature ranges from -10 degrees to 32 degrees Centigrade.

The north island area is sparsely populated, with Port Hardy being the largest population centre (population 4,500). Other smaller communities include Port McNeill (population 2,500), Alert Bay (population 1,000), Sointula (population 400), Coal Harbour (population 500), Port Alice (population 500), and Holberg (population 250). In addition to these smaller population centres, fishing villages such as Winter Harbour and logging camps such as Mahatta River have a very small population base and are subject to seasonal fluctuations in activity (i.e. during the fishing season).

The chief industry of the north island area is forestry and lumber: the area is extensively logged for pulp logs, sawmill logs, and cedar shake and shingles. A pulp mill is located at Port Alice, several small sawmills and shake mills are located in the area, however, the bulk of the logs are dumped into the inlets, sorted, and boomed or barged to major mills on the lower mainland or lower coastal areas. Secondary industries are fishing and mining. Port Hardy, Alert Bay, and Winter Harbour have long been important bases for a fishing fleet, many boats of which come from larger centres in the south during the summer fishing season. During the last decade, the mining industry has established itself as an important industrial base in the area: Utah Mines Island Copper Mine on Rupert Inlet, approximately 15 km. southwest of Port Hardy, employs approximately 350 people. A relatively high level of mineral exploration activity in the area during the past two to three years indicates that mining will become increasingly important in the area in the future.

Since 1979, when the Island Highway was completed from Campbell River to Port Hardy, the north island area has seen a marked increase in tourism. Prior to 1979, the area area was only accessible by driving some 400 km. of rough gravel logging roads and few tourists would venture to the area. The new paved road has opened the area to tourist traffic, although the campsites and other tourist facilities are still quite limited.

1.2 Scope of Present Study

The present study is designed to provide general geological and other pertinent information such as land ownership, mineral title ownership, the general infrastructure and other details on the Northern Vancouver Island area and specifically those sedimentary areas which have the potential of containing economically recoverable reserves of coal. Field reconnaissance work, coupled with informational research, has resulted in the estimation of the amount of potential in-situ coal reserves in each of the basinal areas, however these are placed under the term "estimated resources" and are speculative in nature. Conclusions and recommendations as to where the client should apply for coal licences and where further exploration work should be carried out are contingent on management policies regarding the following:

1. Management's overall impression of coal marketability and the short term and long term predictions of world coal prices.

2. Management's policy on the scale of possible mining developments. The economies of scale that determine the viability of certain reserve areas are important when considering detailed exploration and evaluation work.

3. Management's policy with regards to the type of mining development, i.e. underground or surface operations. Certain areas, due to their physiographic and geologic setting, may lend themselves to underground rather than surface production.

4. Management's willingness or unwillingness to be exposed to potentially sensitive environmental issues that may arise from proposed mining developments on Vancouver Island.

It is hoped that a general study of this nature will provide the basis for an initial assessment of each of the areas in question, keeping in mind the above points.

Chapter 2

SUMMARY

This study consisted of regional field reconnaissance and historical research of the potential coal-bearing beds of the Lower and Upper Cretaceous on northern Vancouver Island. As a result of the work, a number of Cretaceous areas have been identified and evaluated :

1. The Suquash Basin - This is an area of Upper Cretaceous beds situated on the northeast coast of Vancouver Island, between the towns of Port Hardy and Port McNeill. It includes an area of roughly 128 sq. km. along the coastline, in a narrow strip approximately 32 km in length by 4 km in width. In addition, a large portion of the basin lies beneath the waters of Queen Charlotte Strait, Broughton Strait and the western part of Malcolm Island. Past exploration and development work has identified a number of coal seams, one of which was mined. However, the great amount of parting material (an average 50 % of the total seam section

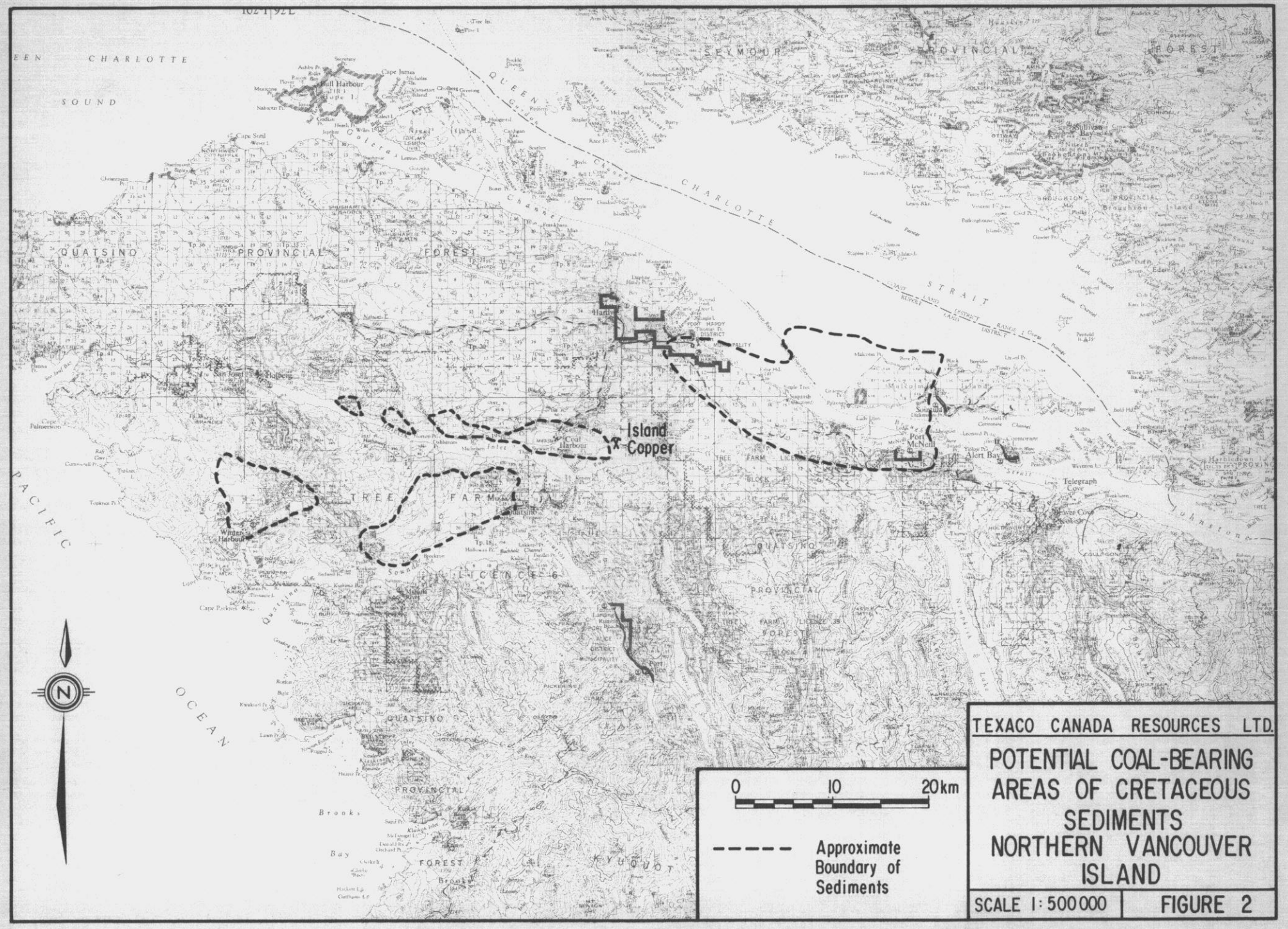
, discouraged development. While previous work has shown that there is no potential for economic development on the land-based portion of the basin, the absence of any work done on the offshore portion leads to the possibility of the seam partings diminishing, resulting in a workable, structurally favourable coal seam development. This large submarine area could contain a possible 20 - 50 million tonnes of in-situ coal resources. While off-shore exploration costs are very high, this offshore area could be controlled at no cost to the client, because of the current Federal-Provincial disagreement on offshore resource ownership (see Section 7.1).

The Coal Harbour Area - The Coal Harbour area refers to an area of Lower Cretaceous sediments covering approximately 2,227 ha on the north side of Rupert and Holberg Inlets, surrounding the village of Coal Harbour. Two coal horizons have been identified within the Lower Cretaceous strata, however, the current work and past mining indicate that both zones are extremely dirty. This fact, coupled with the steep dips, makes the area a poor exploration risk, even though a total possible resource of 27.5 million tonnes is indicated.

The Holberg Inlet Areas (Hushamu Creek and Cleskaugh Creek) - These areas, located on the north shore of Holberg Inlet west of Coal Harbour, are two small remnants of preserved sediments that are isolated from the main part of the sedimentary basin at Coal

Harbour. Turn of the century exploration located a 4.0 metre coal seam in one of the areas (probably Hushamu Creek). Current work shows an abundance of coal float in Hushamu Creek, and structural information indicates that the area may contain some surface recoverable coal resources, with underground mining above sea level also likely. Assuming 2.5 metres of clean coal, the total possible in-situ coal resource for the Hushamu Creek area is 11.9 million tonnes, and for the Cleskaugh Creek area is 6.0 million tonnes (combined total = 17.9 million tonnes).

The Winter Harbour Area - This area refers to widespread Lower Cretaceous sediments occurring northeast of Winter Harbour and also on the north shore of Quatsino Sound, from Koprino Harbour east to Quatsino, and extending inland to the north. Neither old exploration work nor the current study has revealed positive indications of significant coal seams occurring in these areas, however the lower member of the Lower Cretaceous has been identified in the low, wide valley, the northeastern portion of which is occupied by Denaad Creek. If the lower member contains the same coal zones as those found at Coal Harbour and the Holberg Inlet areas, this valley would represent the best exploration target, considering the regular and uniform structure.)


Island Copper
0 10 20km
Approximate Boundary of Sediments
TEXACO CANADA RESOURCES LTD.
POTENTIAL COAL-BEARING AREAS OF CRETACEOUS SEDIMENTS NORTHERN VANCOUVER ISLAND
SCALE 1:500000
FIGURE 2

Chapter 3

GEOLOGIC SETTING

Because of its marginal continental location, the geologic history of Vancouver Island is chiefly related to plate tectonics and massive crustal movements on the Pacific margin of North America. Vancouver Island represents submarine and later terrestrial vulcanism associated with rifting along an ocean floor subduction zone, formed from the Pacific oceanic plate colliding with the western edge of the North American continent and being subducted beneath the continental margin. These crustal movements began in Paleozoic time and have continued to the present. Most of the vulcanism associated with rifting, however, took place in early Mesozoic time[1]. During the Jurassic and Triassic periods, massive outpourings of pillow and flow lavas, and aquagene tuffs formed volcanic island arcs which eventually formed the Insular Mountain Belt, which covers Vancouver Island, the Queen Charlotte Islands, the Alaska

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1. Muller, J. E., "Evolution of the Pacific Margin, Vancouver Island, and Adjacent Regions", Can. Journal of Earth Science, Vol. 14, 1977

panhandle and the Wrangell and St. Elias ranges of Alaska. These volcanic buildups are represented on northern Vancouver Island by the thick basalts of the Triassic Karmutsen Formation, and the major batholiths of the Bonanza Volcanics and the acidic Island Intrusions of Lower to Middle Jurassic. These volcanic complexes form the basement rock upon which later clastic sedimentary wedges of Lower and Upper Cretaceous Age were deposited.

3.1 Sedimentation

Muller[2] describes Upper Jurassic and Lower Cretaceous sedimentation in northwestern Vancouver Island as follows

> ...the eastward onlapping wedge of clastic sediments consists of upper Middle to Upper Jurassic, as yet unnamed sediments, the Lower Cretaceous Valanginian to Barremian Longarm Formation, and the Aptian to Cenomanian Queen Charlotte Group. The lower formations, mainly greywacke and siltstone, only occur in small areas along the west coast and are only a few hundred metres thick. Further east, the upper conglomerate is up to 1000 m. thick and contains cobbles of volcanic rocks and of porphyritic granitoid rocks, presumably derived from high level plutons. Clearly these beds are of a clastic wedge, shed westward from the extinct but still elevated Jurassic volcanic arc.

The general range of southwesterly dips measured in the Lower

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2. Muller, J. E., "Evolution of the Pacific Margin, Vancouver Island, and Adjacent Regions", Can. Journal of Earth Science, Vol. 14, 1977

TABLE OF FORMATIONS OF VANCOUVER ISLAND*

	PERIOD		STAGE	GROUP	FORMATION	SYM-BOL	AVERAGE THICKNESS IN m.±	LITHOLOGY
CENOZOIC					late Tert. volc's of Port McNeill	Tvs		
					SOOKE BAY	mpTsb		conglomerate, sandstone, shale
			EOCENE to		CARMANAH	eoTc	1,200	sandstone, siltstone, coglomerate
			OLIGOCENE		ESCALANTE	eTe	300	conglomerate, sandstone
			early EOCENE		METCHOSIN	eTm	3,000	basaltic lava, pillow lava, breccia, tuff
MESOZOIC		LATE	MAESTRICHTIAN	NANAIMO	GABRIOLA	uKGa	350	sandstone, conglomerate
					SPRAY	uKs	200	shale, siltstone
			CAMPANIAN		GEOFFREY	uKG	150	conglomerate, sandstone
					NORTHUMBERLAND	uKN	250	siltstone, shale, sandstone
					DE COURCY	uKDC	350	conglomerate, sandstone
					CEDAR DISTRICT	uKCD	300	shale, siltstone, sandstone
					EXTENSION - PROTECTION	uKEP	300	conglomerate, sandstone, shale, coal
			SANTONIAN		HASLAM	uKH	200	shale, siltstone, sandstone
					COMOX	uKC	350	sandstone, conglomerate, shale, coal
		EARLY	CENOMANIAN ALBIAN APTIAN?	QUEEN CHARLOTTE	conglomerate unit	lKQc	900	conglomerate, greywacke
					siltstone shale unit	lKQp	50	siltstone, shale
			VALANGINIAN BARREMIAN		LONGARM	lKL	250	greywacke, conglomerate, siltstone
	JURASSIC	MID to LATE	TITHONIAN CALLOVIAN		Upper Jurassic sediment unit	uJs	500	siltstone, argillite, conglomerate
		EARLY	TOARCIAN? PLIENSBACHIAN SINEMURIAN	BONANZA	volcanics	lJB	1,500	basaltic to rhyolitic lava, tuff, breccia, minor argillite, greywacke
					HARBLEDOWN	lJH	-	argillite, greywacke, tuff
	TRIASSIC	LATE	NORIAN	VANCOUVER	PARSON BAY	uTrPB	450	calcareous siltstone, greywacke, silty-limestone, minor conglomerate, breccia
			KARNIAN		QUATSINO	uTrQ	400	limestone
					KARMUTSEN	muTrK	4,500	basaltic lava, pillow lava, breccia, tuff
		MID	LADINIAN		sediment - sill unit	Trds	750	metasiltstone, diabase, limestone
PALEOZOIC	PENN. and ? PERM.			SICKER	BUTTLE LAKE	CPBL	300	limestone, chert
					sediments	CPSs	600	metagreywacke, argillite, schist, marble
					volcanics	CPSv	2,000	basaltic to rhyolitic metavolcanic flows, tuff, agglomerate
	DEV. or EARLIER							

* Courtesy: Muller, J.E., "Geology of Vancouver Island"
G.S.C. No. O.F. 463, 1977

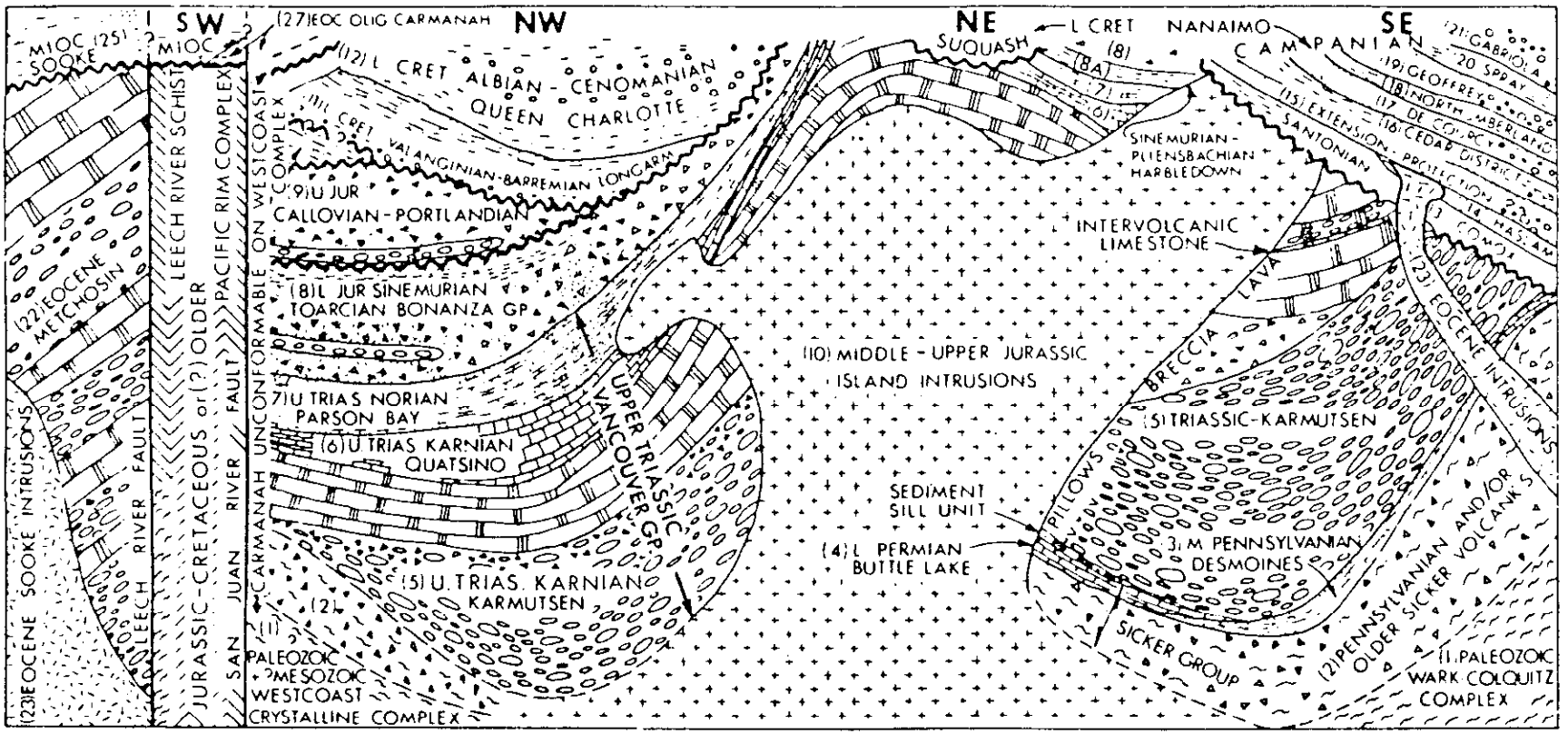
Cretaceous sedimentary sequences around Coal Harbour and the Quatsino Sound area during the current field reconnaissance reinforces Muller's theories of eastward onlap during Lower Cretaceous time. Muller continues:

> The Early Cretaceous shelf sequence of the west coast is succeeded by the Upper Cretaceous Nanaimo Group of eastern Vancouver Island. Only in one place in the central northern part of the island are the two sequences believed to be in stratigraphic contact. Elsewhere Upper Cretaceous sediments overlie with marked unconformity pre-Cretaceous rocks including Jurassic Island Intrusions. The molasse-type coal-bearing marine and deltaic deposits of sandstone, siltstone, shale, and conglomerate contain Santonian to Maestrichian fossils.....
>
> .....the Early Cretaceous basin was on a shelf sloping southwestward to the Pacific Rim trench. The Late Cretaceous "Georgia Basin" was inboard of emerging Vancouver Island ranges and deepened to the northeast.

This difference between Lower and Upper Cretaceous sedimentary buildups is clearly evident in the field: in the Late Cretaceous Suquash area, measured dips are predominantly to the northeast and east, as opposed to general southwesterly dips measured in the Lower Cretaceous sediments in the Coal Harbour area. The significance of this can be found in the differing characteristics of the rock types in each of the areas, and more importantly, the characteristics of the coal seams. It also means that observations and conclusions drawn from the Late Cretaceous area can not be inferred for the Lower Cretaceous areas, because the source areas for sedimentation are different.

FIGURE 4

RELATIONSHIPS OF FORMATIONS OF VANCOUVER ISLAND*



*Courtesy: Muller, J.E., "Geology of Vancouver Island", G.S.C. No. O.F. 463, 1977

3.2 Structure

Post-Cretaceous structural deformation in the northern Vancouver Island area is responsible for the preservation of a portion of both the Lower Cretaceous sediments around Coal Harbour, Quatsino and Holberg Inlet, and the Late Cretaceous sediments of the Suquash area on the northeast coast. This structural deformation manifests itself in the form of major normal (gravity) faults which, in many cases, are bounding features of sedimentary areas: the sediments of the Cretaceous are preserved on the downdropped structural blocks. In many cases, this faulting occurs as a number of related 'step' faults. This is best exemplified along the southwest edge of the Suquash area, where two or possibly more sub-parallel normal faults, trending in a northwesterly direction, represent the edge of the basin.

In addition to the predominant faulting, Post-Cretaceous movements have resulted in minor folding. This folding is not clearly evident in surface exposures because the folds are generally gentle and broad with shallow dips, however, drilling in the Suquash area has confirmed their presence (see Figure 5.).

3.3 Origins of Structural Deformation

The Post-Cretaceous structural deformation evident in the northern Vancouver Island area is chiefly the result of Tertiary Volcanic activity and uplift. However, many workers have attributed fault movements in Tertiary time as occurring along pre-existing fault and fracture planes that originated during the major rifting that occurred during the Triassic.

Muller[3] describes Late Tertiary volcanic rocks near Port McNeill:

> Late Tertiary volcanic rocks are exposed in small areas south of Port McNeill. They are basalt, almost unconsolidated tuff and breccia, volcanic boulder conglomerate and light-coloured dacite tuff.

These are exposed south of O'Connor Lake. Also, they are evident approximately 5.6km southwest of and 6.4 km west of the town of Port McNeill as two peaks, shown on Appendix Map I as Cluxewe Mountain and an unnamed, smaller hill approximately 2.4 km to the northwest. These Tertiary upwellings have decidedly affected the sediments, as a vertical volcanic dyke was observed on the beach south of the Suquash Mine striking at 30 degrees east of north, or directly in line with the smaller peak. This dyke intruded

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3. Muller, J. E.,"The Geology of Vancouver Island",1977

the sediments probably through a joint or fracture plane resulting from stress placed on the sediments as a result of the Tertiary uplift. Frequent parallell joint sets in adjacent sandstones also exhibited similar orientation. It is theorized that additional dykes not exposed occur in a radial fashion from the centres of these Tertiary volcanic occurrences.

3.4 Surficial Geology

The northern part of Vancouver Island has been subjected to glaciation during the Pleistocene and also some earlier period, when glaciation covered the Georgia Strait, the Queen Charlotte Strait and the entire island with a continuous ice sheet originating on the mainland and flowing southwest[4]. During the Pleistocene a number of glacial sequences originated from centres on Vancouver Island, and ice flowed in all directions from these centres, especially down the major valleys such as the Nimpkish Valley, south of Port McNeill.

Glacial erosion and scour occurred on the higher elevations, while varying thicknesses of glacial debris and outwash material were deposited on the lowland areas, in particular the relatively

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4. Muller, J. E.,"The Geology of Vancouver Island",1977

flat-lying sedimentary basins. This glacial deposition has masked the underlying sediments very effectively on northern Vancouver Island, especially in the Suquash area, where unconsolidated overburden is known to be up to 100 metres in thickness. Surface exposures of Cretaceous sediments are thus few in number, and occur along the tideline where the erosive action of the sea has uncovered the bedrock, or along major fault contacts, where scarp lines occur.

Chapter 4

THE SUQUASH BASIN

4.1 Location and Description of Area

The Suquash basin is located on the north end of Vancouver Island, at Latitude 50 Degrees 38 Minutes and Longitude 127 Degrees 15 Minutes. An extensive lowlying area underlain by coal-bearing sediments of Upper Cretaceous age occurs between the towns of Port Hardy and Port McNeill(see Figs. 1 & 2). This sedimentary area, known as the Suquash basin, is approximately 32 km. in length and 4 km. in width, parallelling the coastline. The abandoned Suquash coal mine is located approximately midway along the length of the sedimentary area on the coastline where Suquash Creek enters the Queen Charlotte Strait.

Port Hardy, the chief commercial and population centre in the area, is located at the northwestward extremity of the sedimentary basin. Approximately 4,500 people reside in Port Hardy, which is chiefly a service centre for the local logging industry and Utah Mines Island Copper Mine, located on the north

shore of Rupert Inlet. Secondary industries are commercial fishing and tourism. Port Hardy is served by regular daily jet service from Vancouver, as well as prop service from Vancouver to Campbell River. It is also served by the B. C. Ferry Corporation, which operates a large ferry from Vancouver to Port Hardy to the Queen Charlotte Islands and return. Port Hardy is accessible from southern Vancouver Island by a paved highway from Campbell River and points south. It is approximately a 5 hr. drive from Nanaimo.

The smaller town of Port McNeill is located approximately 35 km. southeast of Port Hardy. It contains approximately 2500 people and relies heavily on the local logging industry, with some fishing and tourism.

The western margins of the Suquash basin are accessible by the paved Island Highway which runs to Port Hardy, however the greatest majority of the area is inaccessible by road, except for a few private logging roads. Much of the area is low-lying, swampy and covered with dense vegetation, making walking difficult.

The western portion of Malcolm Island, which is separated from Vancouver Island by Broughton Strait, also makes up part of the sedimentary area. This part of Malcolm Island is uninhabited, however parts of it are accessible by logging road from Sointula,

a small logging and fishing village located on the southern shore of Malcolm Island. In addition to the western part of Malcolm Island, a good portion of the Suquash sedimentary basin lies beneath Broughton Strait and the Queen Charlotte Strait.

4.2 Early Coal Mining Developments at Suquash

A. R. C. James describes early developments at Suquash:[5]

> 'Indians of the Beaver Harbour area brought specimens of coal to Dr. W. F. Tolmie at Ft. McLoughlin in the year 1835. In 1847 the Hudson's Bay Company decided to open up a mine in this area to supply steamships with bunker fuel. A party of miners arrived from England in 1849, and mining was carried out on a limited scale until 1852. It is believed that the workings were in outcrops at Suquash, and that about 10,000 tons of coal was mined. The workings were abandoned after the discovery of richer deposits at Nanaimo.'

While there is no evidence of these earliest workings, it is believed that they were located in a thin .5 to .8 meter coal seam which is evident at low tide near the mouth of Suquash Creek.

Boreholes drilled along the shore near the mouth of Suquash

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5. James, A. R. C.,"The Coalfields of Vancouver Island", 1969, pp. 34

Creek by Pacific Coast Coal Mines Ltd. in 1908 identified a coal seam at a depth of 173 ft. A. R. C. James goes on to document development work done by this company:

> A shaft was sunk 200 ft. from the shoreling to the No. 2 seam. This shaft was a twin-compartment shaft 6 by 10 feet in the clear. Between 1909 and 1914 about 12,000 ft. of development drivage was done in the seam. The workings extended 1,350 ft. south of the shaft. Two pairs of dips headings were driven east northeast, one for 1,200 ft., or 1080 ft. beyond the shoreline, and the other for 500 feet. A longwall face 800 ft. long was opened up to the south of the shaft on the landward side but was only worked on a very limited scale. A start was made on the sinking of a large new shaft 1,500 ft. southeast of the original one. All work was suspended on the outbreak of World War I and was not resumed again until 1920. The original shaft was then unwatered and a considerable amount of location work was done on the surface with a view to handling a large production. However, in 1922 all operations ceased. According to reports, 12,000 to 16,000 tons of coal was mined in the period from 1909 to 1914 by Pacific Coast Coal Mines Ltd.

It is interesting to note that the entire operations of Pacific Coast Coal Mines Ltd., including their Nanaimo coal mines, ceased and the company went out of business.

It was much later that some development was again attempted in the Suquash Area. In 1952 a small publicly-traded company named Suquash Collieries Ltd. was formed to develop the coal reserves in the area. The old shaft was pumped out and some sampling of the seam was undertaken, however actual mining operations never got underway and the leases were dropped.

4.3 Recent Exploration Work

British Columbia Hydro and Power Authority acquired an option on the Suquash area from Cobre Exploration Ltd. in 1974. A detailed diamond drilling program was carried out in the area northwest and southeast of the old Suquash Mine (see boreholes labelled S-74-01 to S-74-13 on Appendix Map I). Apparently the intent of B. C. Hydro was to identify a minimum of 70,000 million short tons of coal in this area in order to satisfy requirements for a coal-fired generating station on Vancouver Island. The results of this drilling were apparently not very encouraging, as shortly afterwards, Hydro dropped all of the coal licences in the Suquash area.

In 1979, a small Vancouver company named Ramm Ventures Ltd. took out 17 coal licences covering most of the sedimentary area adjacent to the old Suquash Mine. This property was then optioned to Filtrol Corporation of Los Angeles, California who were looking for a source of coal to supply their Columbia Cement Plant at Bellingham, Washington. Filtrol drilled 5 rotary drillholes in the area adjacent to the old Suquash minesite (see boreholes labelled SU-80-01 to SU-80-05 on Appendix Map I).

A

SU-80-04
Elevation: 38m. a.s.l.

m.
0
Overburden
casing bottom
50
shaly coal .7m
shaly coal .2m
100
150
200
250
basalt
T.D. 260 m

m
0
Overburden
casing bottom
coal 2m
50
shaly coal .2m
shaly coal .6m
coal 5m
coaly shale
shale + coal 2m
100
coal 2 m.
coal, trace
shaly coal .1m
150
shaly coal 2m
shaly coal 2 m
200
T.D. 201m

SU-80-03
Elevation: 82m. a.s.l.

DATUM : MEAN SEA LEVEL

S-74-05
Elevation: 56m. a.s.l.

m.
0
coal .3 m.
coal 3 m
50
coal, trace
100
coal 4 m
coal .12 m.
150
coal 4 m. & shaley coal 16 m.
coal 25 m. & coaly shale 1.3 m
coal, trace
coal 4 m
coaly shale 2.7 m.
200
T.D. 237 m.

S-74-06
Elevation: 50m. a.s.l.

m.
0
50
coal, trace
100
coal 25 m.
coal 15 m & shaly coal
coal 25m & shaly coal
coal 3 m.
coal .5 m. & coaly shale
150
coal 3 m
200
coaly shale
coal .15 m.
coal 9 m & coaly shale .8 m
T.D. 222 m

B

SU-80-01
Elevation: 40m. a.s.l.

m
0
Overburden
casing bottom
50
coal .7 m.
coal .4 m.
100
coal .6 m.
coal .4 m
150
coal .5 m.
coal 1 m.
200
coc. 5 m.
coal 3 m
coal .3 m
250
coal .6 m.
coal .5 m.
coal .5 m
300
coal 1.6 m. & coaly shale 1.7 m.
coal .6 m.
350
shaly coal .2 m.
T.D. 381m

LEGEND

- Overburden (unconsolidated)
- Sandstone
- Shale
- Sandstone, with Shaly beds
- Bentonitic Shale
- Volcanics

Horizontal Scale: **1 cm = 128 m**

Vertical Scale: 1 cm. = 5 m.

CORRELATION OF COAL SEAMS, 1974 & 1980 DRILLING, SUQUASH AREA

Section A-B* **Suquash Coal Property** – *RAMM VENTURE CORPORATION*

*For location refer to APPENDIX MAP I

FIGURE 5

Again this exploration work was not encouraging and this company subsequently dropped their option on the property. Ramm Ventures Ltd. let the licences lapse and since that time there has been no activity in the Suquash area. Currently there are no existing coal licences or freehold rights in the Suquash area.

4.4 Description of Current Work

Surface geology is difficult in the Suquash area because of an excessive amount of glacial overburden, a thick cover of vegetation, low, swampy conditions and limited access. Reconnaissance work consisted of dip and strike measurements along the shoreline southeast of the old mine, and an examination of the western part of Malcolm Island, which included driving all accessible logging roads in the area and a beach traverse along the shoreline on the northwest side as far as Graeme Point. Some road mapping was also undertaken along the Island Highway towards Port Hardy, as well as some of the secondary roads around Fort Rupert and the Port Hardy Airport. Because so much work has previously been undertaken in the area, little time was spent on surface geology.

4.5 Geology of the Coal Measures

Upper Cretaceous sediments of the Nanaimo Group outcrop along the coastline of Vancouver Island between the towns of Port McNeill and Port Hardy. The sedimentary area covers approximately 140 sq. km. along the coastline in a narrow strip 35 km. in length by an average 4 km. width. In general, these sediments dip gently to the northeast at less than 10 degrees, although surface readings indicate that south and southeasterly dips predominate in the southern one-half of this area. The sedimentary area is bounded on the southwest by a series of sub-parallel normal faults which are downthrown to the northeast. Minor cross-faults form the northwest and southeast limits of the sedimentary basin. Triassic Karmutsen Fm. basalts, with some minor occurrences of Jurassic Bonanza Group volcanics as well as some Tertiary intrusive activity near the southern end of the area(refer to Chapter 2.), form the highlands surrounding the basin. Drilling indicates that a minimum of 400 meters of sediment occurs near the coastline, with the base of the sedimentary pile not reached in any of the drillholes, except near the margins of the basin where some pinching out occurs. A large part of the basinal area occurs beneath the waters of Broughton Strait and Queen Charlotte Strait. It is also supposed

that the western one-half of Malcolm Island is underlain by sediment. The part of the basin lying beneath water and beneath Malcolm Island is estimated to cover approximately 120 sq. km. This estimate is arrived at by plotting the contour of the 50 fathom water depth, which appears to mark the edge of a fairly flat shelf which extends some distance under the water northwest of the northwest shore of Malcolm Island. This is further substantiated by aeromagnetic data which suggests that the sedimentary body extends seaward for a considerable distance.[6]

J. E. Muller[7] dates the sediments in the Suquash area as being of the Upper Cretaceous Nanaimo Group belonging to the Northumberland and DeCourcy Formations of Campanian age (see Fig. 3). These two formational divisions belong to the third depositional cycle in the Nanaimo Group sequence, occurring above the Extension-Protection and Comox Formations, which are the well-known and highly productive coal-bearing formations of the Nanaimo and Comox areas of east-central Vancouver Island. In the field the drab-coloured sandstones and buff-weathering pebble conglomerates of the Nanaimo Group are not easily relegated to their respective formational units. Earlier workers have correlated the coal-bearing sequence in this area to the

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6. James, A.R.C.,"The Coalfields of Vancouver Island",1969,pp.36

7. Muller, J. E.,"The Geology of Vancouver Island",1977

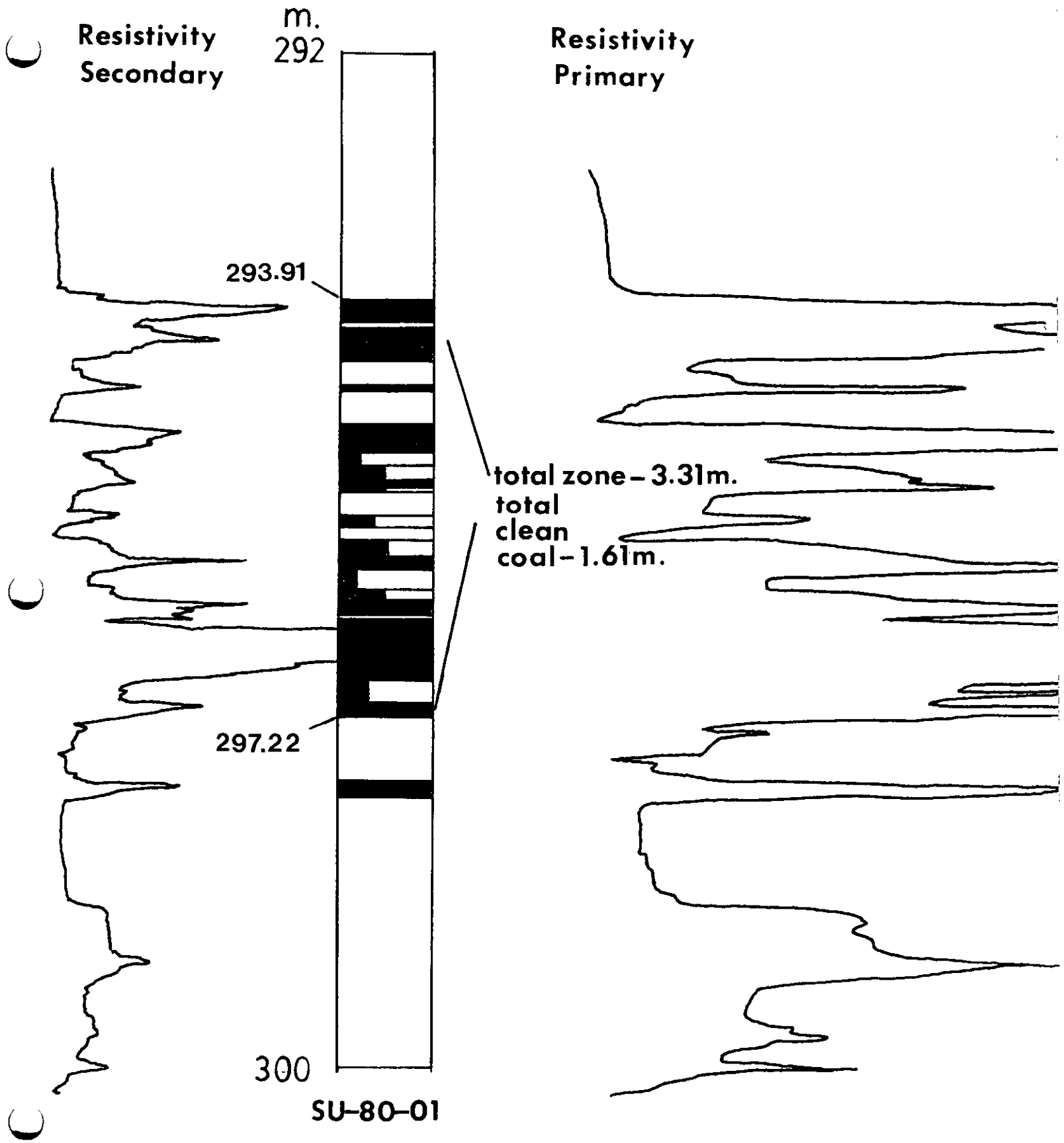
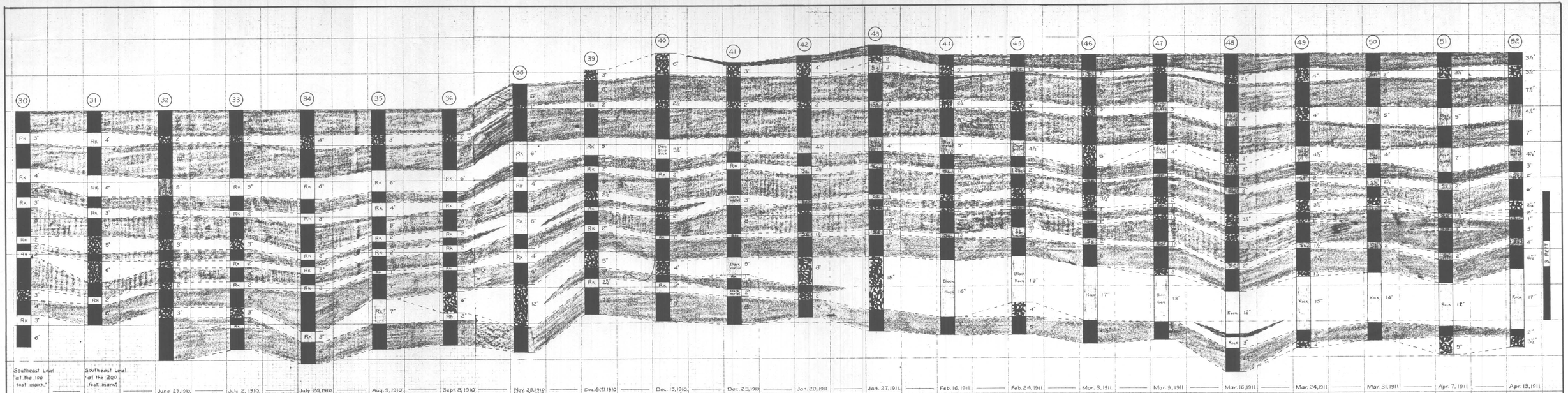


FIG. 6 – Best coal intersection – 1980 drilling

Extension-Protection Formation. It must be assumed that Muller relied on fossil dating to place the age of the Suquash coal-bearing sediments as slightly younger than Extension-Protection Formation. The quality of the coal at Suquash as documented by D. B. Dowling and others is that of slightly lower rank than the Comox and Extension-Protection Formations, which would tend to support Muller's conclusions.

Not all of the recent drilling records are available to this author, however, the most recent 1980 drillholes (see Appendix III.) indicate that a large number of very thin coal seams were intersected throughout the area on the landward side of the old Suquash Mine. Figure 5. illustrates the correlation of the various coal seams between holes. The No. 2 Seam horizon, which was previously mined, appears to thin and pinch out in a southerly direction. The most well-developed seam in hole SU-80-01 at 294 m and in S-74-06 at 215 m is interpreted as a lower seam than that mined in the 1920's. Figure 6. illustrates this seam intersection as interpreted from the geophysical log of hole SU-80-01. It is evident from the drill records and the underground seam sections from the old mine workings (see Figure 7.) that an inherent characteristic of coal seam generation in the southwestern part of the basinal area is that of a constantly changing depositional environment that caused numerous shale and dirt bands to appear throughout the seam section. The drilling



SEAM SECTIONS

TAKEN IN

SOUTHEAST LEVEL SUQUASH MINE

V. Scale – 1:10

FIGURE 7

shows that this characteristic was not a localized feature that was coincidental with the original mine location. However, the lack of information to the seaward side of the old mine does not allow this characteristic to be extrapolated in an easterly and northeasterly direction.

The conclusions resulting from the 1980 drilling are [8] :

> With the exception of that area to the north and west of the Keogh River mouth i.e. adjacent to the Port Hardy Airport, there is no potential for near-surface strippable reserves of coal. This is due to the thinness of existing coal seams and the extreme thickness of unconsolidated sands and gravels.
>
> With the exception of the north half of Lot 12, the northeast quarter of Lot 13, the southeast quarter of Lot 15, the south half of Lot 16 plus an undetermined area east and southeast under the sea, there is no potential for underground coal reserves that would be amenable to conventional underground methods. This is due to the thin and dirty nature of existing coal seams.
>
> Because of the increase in the number and thickness of coal bands from Hole S-74-06 to SU-80-01, it would appear that the basinal environment necessary for the generation of coal is enhanced to the south and east of the abandoned Suquash Mine. Most of this area is covered by sea, except for the 960 acre area mentioned in Point 2. If future exploration is contemplated, it is recommended that it be concentrated in this area.

An area of potential in-situ coal resources has been outlined on Appendix Map I which roughly corresponds to the above-mentioned area. The coal resources which may lie within this area are

---

8. Abcon Engineering Ltd.,"Geological Report on the Suquash Coal Project, Port McNeill, British Columbia",1980,pp 13.

discussed in Section 4.5.2. .

4.5.1 Coal Quality

Notwithstanding the abundance of shale and dirt bands within the coal seams at Suquash, the rank of the coal is that of High Volatile Bituminous "B" or "C" (ASTM), which is of slightly lower rank than coals of the Nanaimo and Comox basins.

The following documents sampling from the 52 metre (170 ft.) level of the Suquash Mine [9] :

A "grab sample" taken from the foot of the shaft:

Moisture..... 5.7%
Volatile Combustible Matter..... 36.2%
Fixed Carbon..... 47.1%
Ash..... 11.0%
Sulphur..... 0.98%

Calorific Value..... 11,580 BTU/lb.

From a channel sample of coal representing 47" in a total seam thickness of 78". All heavy partings discarded :

Capacity Moisture : 9.0%

PROXIMATE ANALYSIS :	As Received	Cap. Moisture	Dried
Moisture.....	8.7 %	9.0 %	- %
Ash.....	9.0	9.0	9.8
Volatile Matter...	36.0	35.9	39.4
Fixed Carbon.....	46.3	46.1	50.8
ULTIMATE ANALYSIS :			
Sulphur.....	0.4	0.4	0.4
CAL. VALUE BTU/LB....	11,200	11,160	12,260

FUEL RATIO F.C./V.M. = 1.3

COKING PROPERTIES : Agglomerating, Free Swelling Index = 1.5, Soft, weak coke.

CLASSIFICATION : High Volatile 'C' Bituminous
M.M. Free, Dry F.C. = 56.9%
M.M. Free, Moist BTU = 12,520
M.M. Free, Dry BTU = 13,760

---

9. "Report on Vancouver Island Coal Holdings of Suquash Collieries Limited", Hope Engineering Ltd., 1953, pp.26,27

Some early work is documented from D. B. Dowling's 1915 report: 10

> From small seam of coal on stream about three-quarters of a mile south of mouth of Kliksiwi [[Cluxewe]] River. This coal produces a coherent but tender coke, and is considerably acted on by a solution of caustic potash.

Hygroscopic Water	3.65
Volatile Combustible Matter	42.23
Fixed Carbon	39.84
Ash	14.28
	100.00

> From Suquash. This coal yields a moderately firm coke, and is considerably affected by a solution of caustic potash, yielding a brownish-yellow colour, like the last.

Hygroscopic Water	5.03
Volatile Combustible Matter	41.51
Fixed Carbon	46.52
Ash	6.94
	100.00

> From a thin seam at Kiuk River. This coal yields a firm coherent coke, and is scarcely affected by a solution of caustic potash.

Hygroscopic Water	3.68
Volatile Combustible Matter	39.29
Fixed Carbon	47.03
Ash	10.00
	100.00)

---

10. Dowling, D. B., "Coalfields of British Columbia", 1915, G. S. C. Memoir 69, pp. 123

These analyses indicate that other coal seams in the Suquash Basin may be of similar quality to the worked seam at the 52 m. level in the Suquash Mine.

It is difficult to arrive at a firm conclusion on the overall quality of coal in the Suquash area, considering the lack of data. However, the Suquash coal is most certainly in the High Volatile Bituminous category, and is probably High Volatile Bituminous "B" or "C".

4.5.2 Potential Coal Resources

The previous exploration programs have negated the possibilities of near-surface coal reserves, or underground mineable coal reserves beneath land, except for an area to the south and east of the old Suquash Mine. This 400 hectare area is possibly underlain by a dirty coal zone containing as much as 50% parting material and lying below a depth of 200 meters. The total thickness of the zone is shown by the drilling to be in excess of 3 meters, of which only about 1.5 meters can be expected to be clean coal. Using this 1.5 meter thickness, the in-situ reserve potential under the land portion would be in the order of 9.1 million tonnes (assume no dip on the coal, a factor of 22,861 tonnes/hectare, and R. D. of 1.5 for coal). Using a radius of

investigation equal to the distance between drillholes S-74-06 and SU-80-01 to project to the seaward side of SU-80-01, an additional 9 million tonnes is estimated as an in-situ reserve under the sea adjacent to borehole SU-80-01, bringing the total to 18.1 million tonnes. Given the depth to coal and the high percentage of waste material that would have to be mined with the coal, this drill target is not attractive. However, there are some indications that the thickness and number of individual coal bands is increasing in a southeasterly direction. Additional exploration work could conceivably identify an area of clean coal, which would enhance the economics. This exploration work would necessarily be offshore drilling, which is costly.

No total estimate of in-situ coal resources is calculated for the entire area of the Suquash Basin that has not been previously explored (i.e. that area beneath the Queen Charlotte Strait, Broughton Strait, and Malcolm Island). However, this area is quite extensive (see Appendix I) and could contain a large in-situ coal resource.

Chapter 5

THE COAL HARBOUR AREA

5.1 Location and Description of Area

The Coal Harbour area refers to an area of Lower Cretaceous sedimentary deposition containing coal measures, located approximately 16 km southwest of Port Hardy, immediately adjacent to the village of Coal Harbour. The area, located on the northeast coast of Holberg Inlet, is accessible by paved road from the Island Highway (Highway 19) near Port Hardy. It is also on tidewater, being accessible from the Pacific Ocean on the west coast of Vancouver Island via Forward Inlet and Quatsino Sound. However, the Quatsino Narrows, at the eastern end of Quatsino Sound, limits the size of shipping to 30,000 long tons (32 ft. draught) into Holberg and Rupert Inlets.

The village of Coal Harbour (population 500) is dependent on logging and fishing for its economy, however, many of the people working at the Island Copper Mine (Utah Mines Ltd.), located on the northeast side of Rupert Inlet, and 11 road km away, reside

in Coal Harbour.

The topography around Coal Harbour is undulatory. High ridges and hills to the southwest of the village are the expression of a massive and resistant conglomerate member. The remaining sedimentary area is relatively subdued as compared to the rugged volcanic areas bounding it.

The sediments cover approximately 2,227 hectares (5,600 acres), as shown on Appendix Map I. . Access is limited to private logging roads over most of the area. The area is uninhabited except for the village of Coal Harbour itself. The coal rights over the majority of the area are under the control of the Crown, except for a 334 hectare tract in the middle, which is held in fee simple by Mr. Frank Hole, a Coal Harbour resident. This tract covers the rights under and directly adjacent to the village, and probably stems from an old Crown grant during the pre-1900's coal mining period.

5.2 Early Coal Mining Developments in the Coal Harbour Area

The coal measures in the vicinity of Coal Harbour were known about since the 1870's :

Under "Coal Mining in the Province", by W. F. Robertson,

Ministry of Mines Annual Reports, 1898, pp. 1164,1165. :

"On the North-West Coast, near Quatsino Sound, coal has for years been known to exist, this area having been reported on by the Geological Survey in 1868, and again by Dr. G. M. Dawson, in the survey report for 1886.

Seams of coal, 4 feet thick, were then reported and some little development work done, but this was later discontinued.

In 1897, the West Vancouver Commercial Company began development of certain areas in this district and is reported as having met with considerable success, and to be now sinking a shaft on a 5 foot seam, with some hundreds of tons of coal on the dump. Some 12 men are employed in this development work, and a steam hoist and other machinery have been erected.

The coal measures also occur and have been somewhat prospected at Alert Bay on the North-East Coast,... ... but so far none of the discoveries have received development sufficient to show their value."

pp. 1165, by T. Morgan :

"At Quatsino, on the North-West Coast of Vancouver Island, the West Vancouver Commercial Company has opened up a number of coal seams, but has not, as yet, become a shipper."

From Ministry of Mines Annual Report for 1899, pp. 797 : "West Coast of Vancouver Island", by W. M. Brewer :

"Near the northwest end of the Island, in Quatsino Sound, there has been considerable activity in prospecting for both copper and coal during the past year. The Hallidie Syndicate, of San Francisco, has expended quite a considerable amount of capital in developing coal propositions, and it is reported that coal of a good grade is being mined from a five foot seam. If this proves to be a good coking coal, the West Coast of Vancouver Island will offer such advantageous opportunities for smelting (should the ore bodies prove of sufficient extent and grade) as can be found but very few localities on the American

Continent."

From Ministry of Mines Annual Report for 1900, pp. 720,: "General Developments of the Year" :

> "The coal fields on Quatsino Sound, West Coast of Vancouver Island, have this past summer received some systematic exploration -- with what results has not yet been learned. This coal is of good quality and in fair-sized bed, but the measures are suspected of being faulted and the extent of the field has not as yet been well-defined. Should these coal areas prove of consequence they will have an important bearing on the Pacific Ocean carrying trade."

From report of B. W. Leeson, Mining Recorder, Quatsino Mining Division, 1903, pp. 194, 195 :

> "On the West Arm iron and coal deposits have been discovered, ... On the north side of the main sound and on Forward Inlet, coal formation occurs, some small croppings of a fine quality of coal being known on Winter Harbour, although none of sufficient size to work."

From notes of a visit by the Provincial Ministry of Mines, (W. F. Robertson), 1907, pp. 150-151, 173. :

> The fact that coal measures, and probably workable seams exist on the West Arm of Quatsino Sound has been known for many years, as the coal seams at Coal Harbour were at least partially prospected some years ago by a California company, which acquired the land and did a little work, but not enough to prove or disprove whether the seams were sufficiently extensive to permit their being worked.

Historical research indicates that the early attempts at development near the village of Coal Harbour occurred in the pre-1900's period, and that exploration and development work

after 1900 moved to other areas, including further west along Holberg Inlet (see Section entitled : The Holberg Inlet area). This early work included the drilling of at least 6 boreholes and resulted in the construction of at least three shallow shafts, which were subsequently abandoned. Some of these old workings were found in the recent reconnaissance work (see Appendix II.: Plates VI and VII.). Although at least two different coal zones were mined to a limited extent during this early work, less than one thousand tonnes of coal were produced from this area. The reasons for this are not clear, but the relatively poor quality of the coal is the most obvious. Mr. Alfred Ilstad, an area resident for over sixty years, remembers a story about one of the coal burning ships coming in to Coal Harbour to bunker coal for the trip to Vancouver. Apparently the captain of the ship had to stop somewhere along the coast to procure firewood in order to assist the combustion of the coal. On the return trip up the Vancouver Island coast, he related this and said that he would never bunker at Coal Harbour again.

5.3 Recent Exploration in the Coal Harbour Area

There has only been one attempt at exploration work in the Coal Harbour area in recent years. This was by the same company that drilled in the Suquash area in 1980 : Filtrol Corporation of Los

ROKE OIL ENTERPRISES LTD. CALGARY, ALBERTA

GAMMA RAY
SIDEWALL DENSILOG
CALIPER

FILE NO.
LSD
SEC
TWP
RGE
W ___ M

COMPANY ABLON ENGINEERING LIMITED
WELL CH-80-01
LOCATION COAL HARBOUR
FIELD
PROVINCE BRITISH COLUMBIA

Other Services: 781-20 cm

Permanent Datum GROUND LEVEL Elev. ___ K.B. ___
Log Measured from GROUND LEVEL ___ Above Perm. Datum CSG ___
Well Depths Measured from GROUND LEVEL G.L. ___

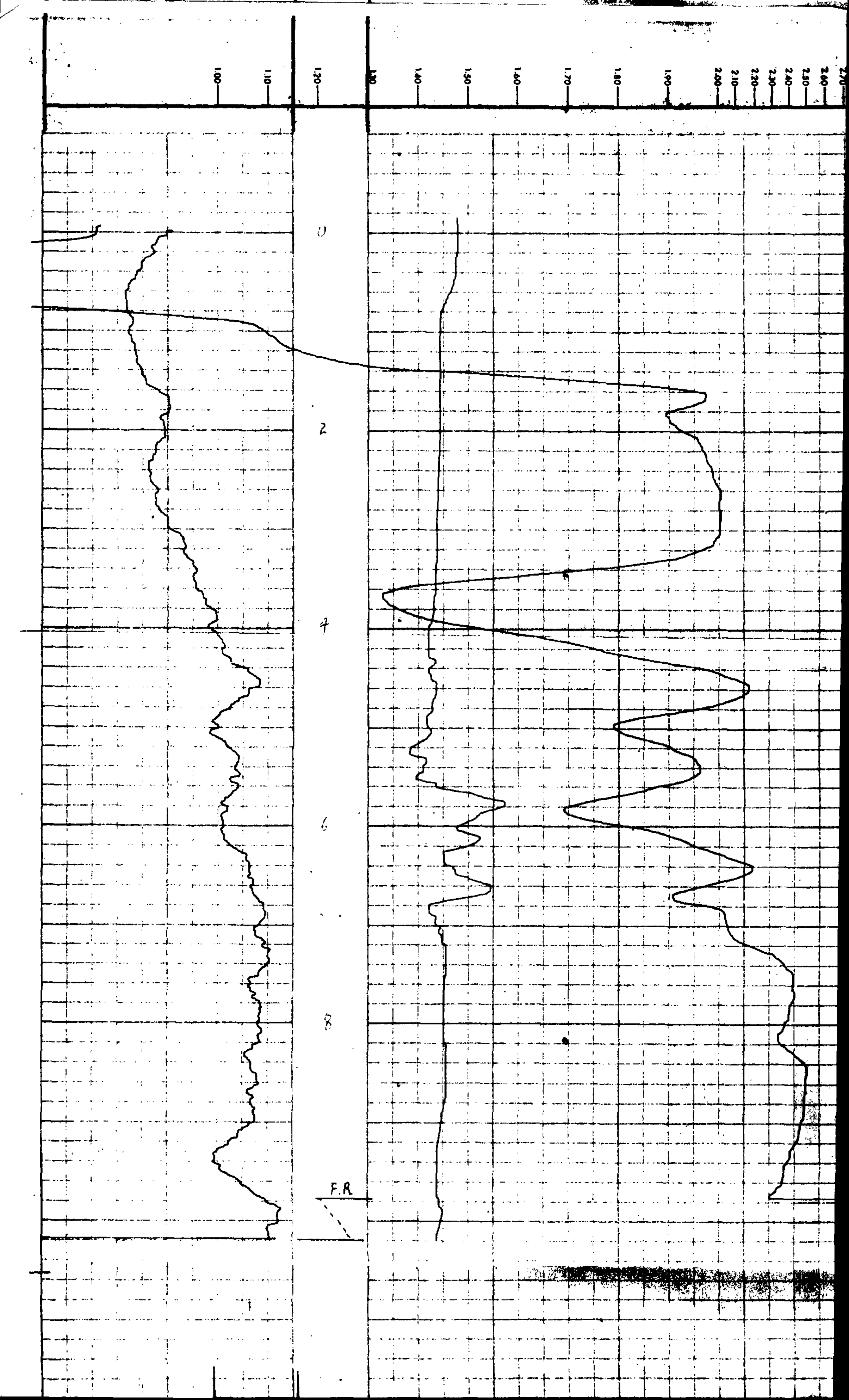
Run. No.	ONE			
Date	9 SEPTEMBER 1980			
First Reading	10.2 m			
Last Reading	0.0			
Footage Logged	10.2			
Depth Reached	12.0			
Depth Driller	12.0			
Casing Roke	4.3			
Casing Driller	4.3			
Fluid Type	WATER			
Liquid Level	3.9			
Min. Diam.	11.3 cm			
Operating Time	1 HOUR			
Truck No.	107			
Recorded By	JAQUES	Witnessed By	GARDNER	

778

GENERAL				GAMMA RAY				SIDEWALL DENSILOG			
RUN NO.	DEPTHS FROM	DEPTHS TO	SPEED m/MIN	T.C. SEC.	SENS SETTINGS	ZERO DIV.L OR R	API G.R. UNITS PER LOG DIV.	T.C. SEC.	SENS SETTINGS	ZERO DIV.L OR R	CPS/ DIV
1	0.0	10.2	4	3	100		12				
1	0.0	9.8	8					1	5K	2.35 R	111.39
1	0.0	10.2	8		CALIPER						

REMARKS GR # 175, CAL # 079, DENS # 663A

	DEPTHS	CALIPER (DIAMETER – cm)
GAMMA RAY API ←12→ 0 ... 120		10 15 20 25
		BULK DENSITY (GRAMS/CC)



ROKE

GAMMA RAY
SIDEWALL DENSILOG
CALIPER

OIL ENTERPRISES LTD. CALGARY, ALBERTA

FILE NO.	COMPANY: ABCON ENGINEERING LIMITED
LSD	WELL: CH-80-02
SEC	LOCATION: COAL HARBOUR
TWP	FIELD:
RGE	PROVINCE: BRITISH COLUMBIA
W___M	Other Services: FBL-20 cm

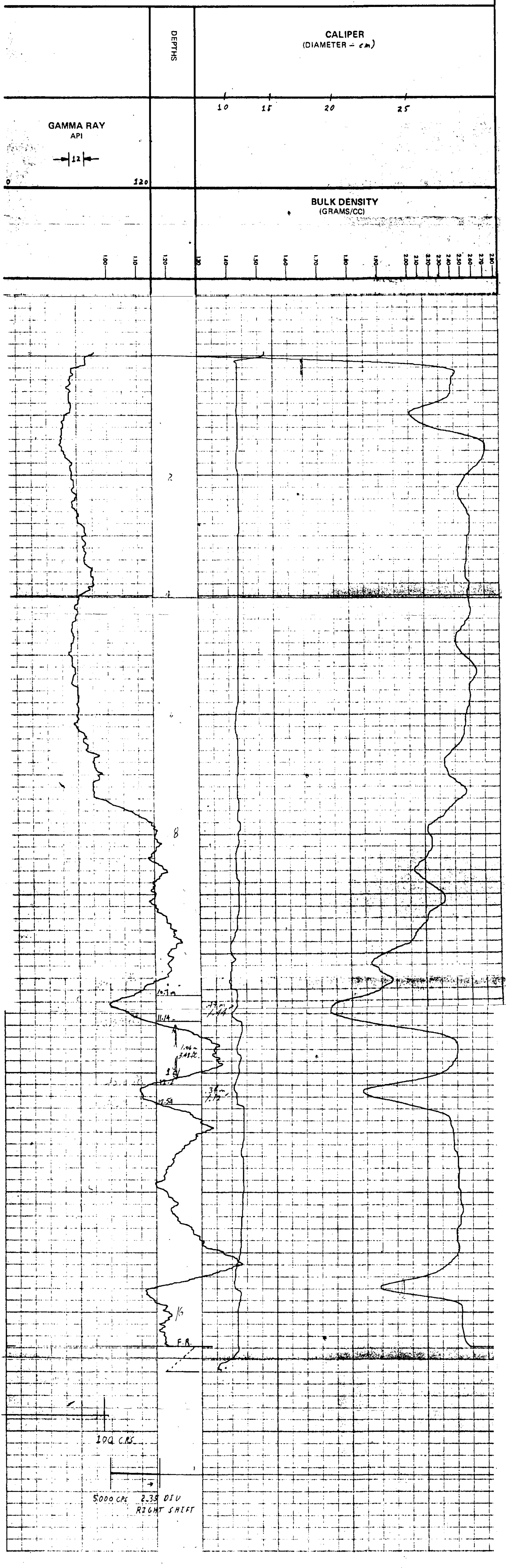
Permanent Datum: GROUND LEVEL Elev.
Log Measured from: GROUND LEVEL, Above Perm. Datum
Well Depths Measured from: GROUND LEVEL
K.B.
CSG
G.L.

Run. No.	ONE
Date	9 SEPTEMBER 1980
First Reading	17.0
Last Reading	0.0
Footage Logged	17.0
Depth Reached	18.5
Depth Driller	18.7
Casing Roke	
Casing Driller	
Fluid Type	WATER
Liquid Level	0.3
Min. Diam.	11.3 cm
Operating Time	0.5 HOUR
Truck No.	107

778

GENERAL				GAMMA RAY				SIDEWALL DENSILOG			
RUN NO.	DEPTHS FROM	DEPTHS TO	SPEED m/MIN	T.C. SEC.	SENS SETTINGS	ZERO DIV.L OR R	API G.R. UNITS PER LOG DIV.	T.C. SEC.	SENS SETTINGS	ZERO DIV.L OR R	CPS/DIV
1	0.0	26.6	4	3	100		12				
1	0.0	26.6	8					1	5K	2.35 R	191.19
1	0.0	27.0	8		CALIPER						

REMARKS: GR H 175, DENS 663A, CAL M879



Angeles, California. During the Suquash drilling, the drill rig was despatched to Coal Harbour to examine the near surface showing that occurs on the north side of the harbour. Two shallow rotary holes were drilled, with negative results. The geophysical logs showed one relatively clean coal band approximately .8 m thick, followed by a zone of shale and coaly shale approximately 2 m thick, at a depth of 3.4 m in the first hole. The second hole, located approximately 300 m Southwest of the first hole, showed the same zone at a depth of 10.7 m and a thickness of 1.8 m, however the entire zone was of inferior quality, with a 1 m coaly shale band within the zone.

5.4 Description of Current Work

Reconnaissance work in the Coal Harbour area consisted of geological mapping to determine the boundaries of the sedimentary area, examination of old mine workings, location and examination of coal outcrops, and dip and strike measurements of sedimentary exposures in order to interpret the general structure. Seven days were spent in the Coal Harbour area. Several of these days, however, were spent in the area west of Coal Harbour along the north shore of Holberg Inlet, where several isolated areas of sedimentary deposition were located. While these areas are essentially an extension of the Coal Harbour sedimentary

deposits, they are discussed in a separate section (see Section entitled : The Holberg Inlet Coal Areas).

5.5 Structure and Stratigraphy of the Coal Measures

Reconnaissance work has shown that the area covered by sedimentary deposits of the Lower Cretaceous in the Coal Harbour area covers an elongate east-west basin approximately 10 km long by 4 km wide, occupying an area from the Island Copper Mine on Rupert Inlet, west to Apple Bay on Holberg Inlet. The work identified four separate coal occurrences in the area, as shown on Appendix Map I. These occurrences are described as follows:

1. Located on the southeast side of Coal Harbour, approximately 200 m from tidewater up a small unnamed creek. Abundant coal float on the creek indicated a coal outcrop. This outcrop was not located, however an old shaft on the south side of the creek, approximately 8 m above the creek level, was found. Abundant coaly material and peices of coal on the spoil pile indicated that a seam had been reached. A wooden ladder running down the shaft plus the limited size of the spoil bank indicated that the workings were shallow and not extensive. Additional coal float farther up the creek pointed to an outcrop or coal exposure but this could not be located. It is believed that these workings were part of the work that was undertaken in the late 1800's, and that a 4 to 5 ft. seam was located in this area at a fairly shallow depth. A grab sample, labelled CH-84-01, was taken from the spoil bank and is analysed as follows:

		AIR DRY	DRY
Residual Moisture	%	3.55	-
Ash	%	31.02	32.16
Volatile Matter	%	28.13	29.17
Fixed Carbon	%	37.30	38.67
Sulphur	%	0.28	0.29
Free Swelling Index		1.5	-
CALORIFIC VALUE	BTU/lb.	9,284	9,626

2. Located on the west side of Coal Harbour, on a bank above the tideline, where a new paved road had been constructed and a sewer outfall into the inlet. Abundant large peices of coal were found within the till layer and along the new excavation, indicating that a seam lies at shallow depth in this area. This is probably correlative to the seam found in the 1980 drilling.

3. Located on the north side of Holberg Inlet, approximately one mile west of Apple Bay and the mouth of the Nuknimish River. This is a coal outcrop that is exposed at low tide and measures as follows:

Roof			covered interval
.10	m	SHALE,	dark grey to black, carbonaceous and coaly throughout
.18	m	COAL,	bright and dull banded, brown streak, very hard, poor quality
.08	m	SHALE,	as above, hard with thin coal laminae throughout.
.18	m	COAL,	softer, cleaner, blocky, partially covered
.30	m	COAL,	hard, resistant, blocky, dull, dirty, undulatory floor
.50	m	SANDSTONE,	buff, very hard, fine grained, quartzose
.30	m	COAL,	hard, resistant, somewhat cleaner, covered floor
1.64	m	TOTAL	

NOTE : Due to poorly exposed section contaminated with beach gravel and badly weathered nature of outcrop, a channel sample was not taken. However, a grab sample to give some indication of coal quality labelled CH-84-02 was taken and analysed as follows:

		AIR DRY	DRY
Residual Moisture	%	1.99	-
Ash	%	39.64	40.44
Volatile Matter	%	26.19	26.72
Fixed Carbon	%	32.18	32.84
Sulphur	%	0.32	0.32
Free Swelling Index		1	-
CALORIFIC VALUE	BTU/lb.	8,166	8,332

4. Located on the northwest side of Rupert Inlet, approximately 500 m southwest of mine buildings at Island Copper (Utah Mines). This is another coal exposure on the tide line, partially covered by beach gravel and boulders, so that accurate description is not possible. The total zone is approximately 2 metres thick, however, at least one metre in the middle is covered, so that the total clean coal section is not known. The floor of the zone consists of a conglomeratic sandstone, with a greenish grey medium-grained matrix, weathering to buff and brown. The zone strikes at 250 degrees, and dips to the south into the inlet at 30 degrees.

The above coal occurrences, coupled with the historical information, indicates that at least two coal zones occur within the lowermost 250 metres of sediment in the Coal Harbour area. The uppermost zone (Coal Occurrence Nos. 1 & 2) occurs within 50 stratigraphic metres below the contact of the massive conglomerate unit that forms the high ridges and hills on the southeast side of Coal Harbour (see Appendix II, Plate V.). The lower coal zone (Coal Occurrence Nos. 3 & 4) occurs near the base of the sedimentary section and could be expected to approach the surface near the margins of the sedimentary area. Both of these zones show thicknesses of 1.5 to 2 metres, however, there are strong indications that the ash content of the coal is high and significant rock bands occur within the section.

As previously stated, the Lower Cretaceous sediments in the Coal Harbour area are composed of two main units:

1. the upper unit- a thick-bedded massive pebble conglomerate, with interbeds of cross-bedded medium-grained sandstone containing clasts of coaly material. The total thickness of this unit is estimated by Muller[11] to be 900 metres, however, only the lowermost 200 metres occurs southeast of Coal Harbour.

2. the lower unit- a series of clay-shales, sandstones, minor conglomerates, siltstones and coaly beds up to 350 metres thick. Many of the clay-shales are light in colour, soft and plastic. Some of the sandstones contain a high clay content, which makes them soft and sticky when weathered.

In general, the area of sedimentary deposition is bounded by normal faulting, with the sediments preserved on the downdropped side of the bounding fault structures. Dips on the sediments are generally to the south. In most cases, observed dips were in the 20 to 30 degree range. The structure becomes more complex to the northwest, where numerous secondary fault structures can be inferred from the lineal depressions in the topography, and the presence of isolated volcanic exposures within the general

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11. Muller, J. E., "Geology of Vancouver Island", G. S. C. No. O.F. 463, 1977

confines of the basin (e.g. Coal Occurrence No. 3).

5.6 Potential Coal Resources

Due to uniformly steep dips, thinness of coal seam sections and lack of favourable structural complications such as anticlinal folds, the possibility of significant strippable coal resources in the Coal Harbour area is virtually nil. This conclusion is also reinforced by the massive, thick-bedded conglomerate unit found immediately above the uppermost coal zone, on the east side of Coal Harbour.

Potential underground coal resources can be inferred for the area, assuming the following:

1. That two coal zones occur within the basinal area, as shown by the reconnaissance work and previous mining operations.

2. The gross thickness of each of these two zones is 1.5 metres. However, this thickness includes a good proportion of non-coal and parting material, which has been shown to exist in some locations. Current information indicates a net, or clean coal thickness of 1 metre for each of the zones. This figure of 1 metre will be used for the purpose

of estimating inferred coal resources.

3. The two zones are uniform and continuous from their respective outcrop lines, downdip to a maximum cover depth of 600 metres. There is, however, some evidence in the form of old borehole records[12] that indicates that this might not be the case, especially when considering the lowermost coal zone.

4. The two zones dip uniformly at an angle of 20 degrees. Obviously there will be some structural complications which will affect the dip, however for the purpose of estimating resources, a 20 degree dip, which reconnaissance work has shown to be the average in the area, is sufficient.

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12. Dowling, D. B., "Coal Fields of British Columbia", G.S.C. Memoir #69, 1915, pp. 137 - 140

TABLE 1. - Estimated in-situ coal resources, Coal Harbour Area

COAL ZONE	STRIKE LENGTH m	DIP DISTANCE m	AREA ha	TONNAGE FACTOR t/ha	MILLIONS OF TONNES
UPPER	4,800	1,000	480	14,500	7.0
LOWER	8,850	1,600	1,416	14,500	20.5
TOTAL					27.5

As a result of the above calculations, it is concluded that 27.5 million tonnes of in-situ possible coal resources could occur in the Coal Harbour area, to a maximum cover depth of 600 metres.

5.7 The Holberg Inlet Coal Areas

This section deals with a number of sedimentary occurrences along the north shore of Holberg Inlet, west from Coal Harbour. These areas are cut off from the main sedimentary area around Coal Harbour by volcanic rocks of the Jurassic Bonanza Group. They are dealt with separately in this section because they are detached from the main sedimentary area.

5.7.1 Early Coal Mining Developments

The area along the north shore of Holberg Inlet (or the West Arm, as it was earlier named) was prospected in the early 1900's. The following excerpts are from Ministry of Mines Annual Reports-

From report of B. W. Leeson, Mining Recorder, Quatsino Mining Division, 1903, pp. 194, 195 :

> "On the West Arm iron and coal deposits have been discovered, ... On the north side of the main sound and on Forward Inlet, coal formation occurs, some small croppings of a fine quality of coal being known on Winter Harbour, although none of sufficient size to work."

From Leeson's report of 1904 :

> "It is reported that a Mr. Pearson, of Vancouver, with three others, arrived by a recent steamer at the West Arm to bore for coal, but the extent of their intended operations has not been ascertained."

From Leeson's report of 1905 :

> "Mr. Pearson, of Vancouver, is steadily working on the West Arm, employing three to five men running tunnels and drilling for coal, but with what result is not yet known."

From notes of a visit by the Provincial Ministry of Mines, (W. F. Robertson), 1907, pp. 150-151, 173. :

> The fact that coal measures, and probably workable seams exist on the West Arm of Quatsino Sound has been known for many years, as the coal seams at Coal Harbour were at least partially prospected some years ago by a California company, which acquired the land and did a little work, but not enough to prove or disprove whether the seams were sufficiently extensive to permit their being worked.

About midway in the length of the West Arm, on the north side, the coal-bearing formation shows up on the beach, these measures extending to the west for pretty near the length of the Arm. For some years the Quatsino Coal Syndicate, under the manaagement of Mr. Thos. P. Pearson, has been prospecting for coal in this area, and, in 1905, put down three boreholes at what is known as Pearson's Lower Camp. The first hole was put down near the beach to a depth of 156 ft.; the second hole was sunk about one-third of a mile inland and was drilled to a depth of 218 ft., while the third hole was put about three-quarters of a mile inland and was drilled to a depth of 40 ft.. In none of these holes was any coal encountered of workable thickness, some three or four inch seams were encountered in the second hole and also some gas, but the workings were eventually abandoned.

Mr. Pearson then moved westward along the Arm to within three or four miles of its western extremity, where he established his 'Upper Camp', and in the vicinity took up ten prospecting areas. On one of these areas he was able to locate a very fair seam of coal, somewhat impure at the outcrop but containing great possibilities. The point at which the coal outcrops is about one mile from the Arm on the steep bank of Pearson Creek, 100 ft. above the bed of the creek and 175 ft. above sea level. The seam dips S. 30 degrees W., at a moderate angle, into the bank and towards the Arm.

The work so far done is not claimed to be more than prospecting work, but consists of an upper tunnel, a rock cross-cut adit tunnel, which at 80 ft. in cuts a coal seam, the outcrop of which is visible higher up in the hillside. At a somewhat lower level, the second tunnel, also a rock cross-cut adit tunnel, has been driven, reaching the coal at 110 ft. in. A slope in the coal connects the two levels and has been sunk about 30 ft. below the lower level, while in from the tunnel, a drive about 150 ft. long has been made in the coal and along its strike.

To prove the coal further to the dip, a borehole was being put down, which was then down 110 ft., and if the dip held true, should strike the seam at a depth of 120 ft..

The seam, as exposed, lay under a clay-shale and over

a sandstone, giving the following section in descending order:

1′ 8"	--	Coal
9"	--	Clay
2′ 7"	--	Coal
1′ 0"	--	Clay
4′ 3"	--	Coal
3′ 0"	--	Black Shale & Coal
13′ 3"	--	Total Seam Thickness

The various layers of coal seemed about the same quality and a sample was taken representing the average of the upper portion of the seam, which gave, at the Government laboratory, the following analysis :

Moisture	1.80%
Volatile Combustible Matter	30.67%
Fixed Carbon	19.63%
Ash	47.90%
	100.00 %

"It is premature, as yet, to predict what the future of the discovery may prove to be; it is a strong, well-defined coal seam, somewhat dirty where struck, but that trouble may disappear in a short distance. The area of the seam remains to be determined, which will require time, but as a prospect is such that a railway to the Arm and good shipping facilities could easily and cheaply obtained. The management is going ahead slowly but surely, and within a year should have some interesting data to present."

From O. A. Sherberg, Mining Recorder, Quatsino Mining Division,

Report for 1908, pp. 145,199 :

"The Quatsino Coal Syndicate, under the management of Thomas P. Pearson, has been working on its property on the West Arm during the summer and until the latter part of October, when the work was closed down for the winter. Mr. Pearson expressed himself satisfied with the results of the work so far done, and he expects to be back again to start work in the early spring."

pp. 199:

> On Vancouver Island, Mr. Pearson has been engaged in developing the coal seams described in the report of 1907, on the West Arm of Quatsino Sound, with results satisfactory as far as they go, but more work must be done before the ultimate value of the property will be known."

From Report of O. A. Sherberg, Mining Recorder, Quatsino Mining Division, 1909, pp. 148. :

> "The coal claims situated on the West Arm of Quatsino Sound and owned by the Quatsino Coal Syndicate, have been worked with a few men since the latter part of September."

From report of 1910, pp. 153 :

> "Development work has been carried on continuously during the past year by Thomas Pearson of Vancouver, on the coal property, situated on the West Arm of Quatsino Sound, owned by the Quatsino Coal Syndicate. The underground work has been extended to about 600 ft.. In the latter part of September a diamond drill was brought here and work started on a coal property consisting of twenty claims situated on the north side of the main channel of Quatsino Sound, opposite Limestone Island. The Manhattan Coal Company, which owns a few coal claims on the south side, will be ready in about a week to start work on its property near Monkey Creek with a diamond drill."

pp. 175 :

> "On Vancouver Island, in addition to the areas actually being worked, there is a Cretaceous coalfield in the Quatsino Mining Division on Quatsino Sound now being developed by Mr. Thomas Pearson and associates, which gives promise of containing extensive beds of workable coal; prospecting workings have been in progress here for about four or five years, with considerable success."

From O. A. Sherberg's Report for 1911, pp. 193, 223 :

> "Under the management of Thomas P. Pearson, development work has been carried on continuously on the coal property owned by the Quatsino Coal Syndicate. The property is situated on the West Arm of Quatsino Sound. The underground work has been extended 800 ft. On the several other claims on the Sound very little work has been done during the year."

The references to this early prospecting work abruptly cease in about 1911, and no further reference to the West Arm area could be found. There has been no further exploration activity for coal in this area since this early activity.

5.7.2 Description of Recent Work

Recent work consisted of a reconnaissance of the north shoreline of Holberg Inlet, west from Coal Harbour for a distance of approximately 18 km. Road traverses of all of the existing logging roads in the area provided some data for the inland areas, however, the absence of roads was a limiting factor. In areas along the coastline where sediments were found to exist, creek traverses were undertaken in order to define the boundaries of the sedimentary areas. These boundaries and other geologic information are shown on Appendix Map I.

The most important area in terms of favourable geology and positive indications of coal occurrence is the Hushamu Creek area (see Appendix Map I.). Sandstone outcrops on the beach just east

of Hushamu Creek, dipping to the south at approximately 30 degrees. A traverse up the creek indicated that an area of sedimentary deposition occurs on the southwest side of the creek. Large pieces of coal float up to 10 cm in thickness indicated that a significant coal seam occurred within the sedimentary section. The presence of numerous clayey beds along the steep sides of the creek valley, however, has caused almost continuous slumping of the banks, covering any exposures. A second traverse up an unnamed creek just southwest of Hushamu creek confirmed that the sediments are continuous, and one exposure of silty clay beds with coaly lenses measured a relatively flat dip of 4 degrees to the north, indicating that the structure is favourable.

It is conjectured that this area may be that which was prospected by Mr. Thomas Pearson in the early 1900's, although no evidence of any slopes or adits could be found. The presence of coal float in the creek is sufficient to indicate that a coal seam exists in the area, and it is reasonable to assume that the seam as documented in the Ministry of Mines Reports occurs here:

1' 8"	--	Coal
9"	--	Clay
2' 7"	--	Coal
1' 0"	--	Clay
4' 3"	--	Coal
3' 0"	--	Black Shale & Coal
13' 3"	--	Total Seam Thickness

An estimate of potential in-situ coal resources can be made for this area, using the above measured clean coal thickness of8.5 ft.(2.6 m) :

- Area of sedimentary deposition as defined by reconnaissance mapping: 306 ha (756 acres)
- Assume a flat seam, and an S.G. of 1.5 for the coal, which gives a figure of 15,734 tonnes/acre, or 38,863 tonnes/ha : Therefore,

38,863 t/ha X 306 ha = 11,892,078 tonnes
or, approximately 11.9 million tonnes
of possible in-situ coal resources.

An estimate of the amount of surface mineable coal present in this area can not be arrived at due to the scarcity of strike and dip measurements and lack of definite information as to the location of the seam, and its attitude.

5.8 The Cleskaugh Creek Area

Approximately 6.5 km west of the Hushamu Creek area is an additional area of potential coal-bearing sedimentary rocks, in the vicinity of Cleskaugh Creek. This area was observed from the waters of Holberg Inlet, however due to equipment malfunctions and time constraints, the area could not be examined on the ground. The topography indicates that the same type of sedimentary section occurs here as at Hushamu Creek, and when one

examines the excerpt from the 1907 Ministry of Mines Report (see above) detailing the location of the seam outcrop, this locality also fits the description. Using the same clean coal thickness of 8.5 ft.(2.5 m), an estimate of potential in-situ coal resources can be inferred for this area :

- Area of sedimentary deposition = 384 acres(155 ha)
- Assume a flat seam, and an S.G. of 1.5 for the coal, which gives a figure of 15,734 tonnes/acre, or 38,863 tonnes/ha :

Therefore, 155 ha X 38,863 t/ha = 6,023,765 tonnes
or, approximately 6.0 million tonnes of possible in-situ coal resources.

No grab samples were taken in either of these two potential coal areas, but some analytical data is available from the Ministry of Mines Annual Repts. (W. F. Robertson, 1907, see above) which indicates that, although the ash content is high due to the parting material which was included in the sample, the volatile matter is still above 30%.

5.8.1 Conclusions

It is difficult to arrive at a positive conclusion on these areas in light of the data furnished in this report, however, both of these areas are deserving of further work. This work should be fairly detailed mapping work, in preparation for determining a number of locations for diamond drilling, which is the only means to provide enough data on the structure and the thickness and

quality of the coal seams to properly evaluate the mineability of the areas. It is the author's opinion, however, that even detailed mapping will not furnish much data on the geology of the coal measures, given the heavy cover of vegetation and soft, clayey nature of some of the formations directly associated with the coal. In fact, it can be speculated that the soft nature of some of these overburden horizons, and probably in-seam partings, deterred the early developments to a great extent.

Chapter 6

The Winter Harbour Area

6.1 Location and Description of Area

The Winter Harbour Area refers to an area of Cretaceous sediments on the north and south shores of Winter Harbour, which also extends to the southeast to include a large area on the north shore of Quatsino Sound, around Koprino Harbour and the Indian village of Quatsino (see Appendix Map I.) The area covers approximately 30 sq. km. on the north shore of Winter Harbour, centering about a low wide valley through which Denaad Creek flows. On the north shore of Quatsino Sound from Koprino Harbour east to Quatsino, and north to almost the south shore of Holberg Inlet, the Cretaceous sediments cover an upland area of approximately 80 sq. km. in extent.

Access to the areas is confined to two private logging roads : the road to Winter Harbour from Holberg, and a branch road off this road which follows the south shore of Holberg Inlet for some distance, then swings south to Koprino Harbour. There are some

minor secondary logging roads off these main roads but these are very limited. The best access is by water from Coal Harbour, where small open boats can be rented.

The topography is extremely variable, with the volcanic rocks forming rugged, steep-sided ridges and hogsbacks. The sediments, for the most part, are preserved in the low valleys or at low elevations close to tidewater. The major exception to this is the area around Mt. Byng and most of the area between Koprino Harbour and Holberg Inlet to the north-north-east : here the massive, thick-bedded conglomerates have resisted erosion and formed uplands and high, elongate ridges up to 450 metres above sea level.

The area is virtually uninhabited except for Winter Harbour and Quatsino, which are tiny, isolated fishing villages. There are some Indians living on reserve areas close to tidewater, such as the reservation northeast of Winter Harbour at Denaad Creek and the one east of Quatsino.

The area has been heavily logged in recent years. The Bonanza Volcanics surrounding the Cretaceous sediments have received a great amount of exploration recently, and many mineral claims owned by companies such as Noranda Exploration and Cominco were observed in the field (see Appendix Map II.)

6.2 Early Coal Mining Developments

The Winter Harbour and Quatsino areas received varying amounts of exploration work in the early years. G. M. Dawson of the Geological Survey of Canada prospected the area and reported on it in 1886. Between 1886 and 1911, the areas were prospected to some extent by various companies, and some diamond drilling was undertaken, however, no records of this drilling occur in any of the government reports.

The area has not been examined in recent years, and there are no existing claims to the coal rights : the entire area being under the control of the Crown.

6.3 Description of Current Work

The current reconnaissance work consisted of road traverses over all of the existing roads, including the secondary logging roads, one creek traverse (Denaad Creek), and a beach reconnaissance along the north side of Quatsino Sound, from Quatsino west to Koprino Harbour.

No coal seams or coal float were found over the entire area.

At Winter Harbour, some sandstones, siltstones and shale beds are evident. These were traced for some miles to the northeast, where at Denaad Creek they assume a very regular, flat-lying structure which would appear to carry through the entire valley. The complete thickness of the Cretaceous section in this vicinity could not be determined, but it is estimated to be at least 300 metres.

Along the north shore of Quatsino Sound, and in the inland area northeast of Koprino Harbour, the entire Cretaceous area is covered by massive, thick-bedded conglomerates which are equivalent to the thick conglomerate beds in the Coal Harbour area (see Section 4.5). A much greater thickness of these conglomerates is preserved here, however, as some of the upland areas are formed entirely of conglomerate up to 450 metres in thickness. Along the north shore of Quatsino Sound, the lower member of the Lower Cretaceous series is exposed in a few limited sections, such as the area just east of the mouth of Bish Creek, and on Ilstad Island, where a medium-grained sandstone contains large blebs of shiny bitumen. Farther inland, however, the lower member is most likely absent entirely. This is supported by a rock quarry exposing the massive conglomerates of the upper member in unconformable contact with the dark green amygdaloidal basalts of the Triassic Karmutsen Formation, approximately 1 km northeast of Koprino Harbour.

While the presence of potentially mineable coal resources can not be ruled out in these areas, the current study has not furnished enough evidence to calculate in-situ resources. Further to this, the absence of observed coal occurrences in the present field work and the lack of references to any significant seams as a result of the early prospecting work indicates that the area may be a poor exploration target.

Chapter 7

CONCLUSIONS AND RECOMMENDATIONS

As a result of this study, the Upper and Lower Cretaceous sediments of Northern Vancouver Island have been shown to contain a number of coal horizons, which are of High Volatile Bituminous quality. A number of factors contribute to the attractiveness of coal-mining developments in the areas examined :

1. The areas are all proximal to navigable tidewater.

2. With the exception of the area immediately adjacent to the village of Coal Harbour, the areas are uninhabited.

3. With the exception of the 334 ha parcel of freehold coal rights directly beneath and immediately surrounding the village of Coal Harbour, the areas are all controlled by the Crown, with no coal licences current.

The following lists each of the areas examined, and discusses the potential of each area relative to the others :

7.0.1 The Suquash Area

The Suquash area has received the most intense exploration efforts in the past, both during the early history of coal mining on Vancouver Island and during recent years. None of this exploration work has been very encouraging. However, a large part of the total basinal area has not been explored to any degree because of its submarine nature. It is the author's opinion that, in view of the information compiled in this study, the Suquash area has the best potential for containing a large in-situ resource base i.e. in the order of 20 to 50 million tonnes. Exploration and mining to date has shown that the coal seams over the land-based portion of the basin are of an inherently dirty nature, containing numerous shale and rock bands, which make them uneconomic to mine. This characteristic was probably responsible for the cessation of mining activity in the 1920's, and deterred further exploration work in recent years. In order to make submarine mining at all attractive, this parting contamination would have to disappear or at least diminish to a minimum. This change can not be ruled out until offshore exploration proves otherwise. Of course, offshore exploration is expensive and places an onerous front-end charge on any coal reserves that may be proven.

The only plus factor that is in favour of pursuing further

investigations in the Suquash area is the fact that offshore coal exploration licences can be applied for in the normal way, but can not be granted at this time, due to a Federal-Provincial disagreement on offshore ownership. Instead, the Provincial Government refunds the application fees and grants the applicant company a first right of refusal on the licence areas until an eventual ruling on ownership rights comes to pass. In this way, a company can effectively tie up an offshore area at no cost for an indeterminate time period, until the ownership question is resolved.

7.0.2 The Coal Harbour Area

The Coal Harbour area has been demonstrated to contain some potential for containing reserves of coal, however, due to steep dips, the possibility of major complicating faults, and the thin, dirty nature of the seams, the chances of success for an exploration effort are slim. The parcel of freehold coal rights in the center of the area under the village of Coal Harbour adds a complicating factor, as does the proximity of the Island Copper Mine to the east portion of the area.

7.0.3 The Holberg Inlet Areas : Hushamu Creek and Cleskaugh Creek

It is the author's opinion that these areas furnish the best

chance for identifying a mineable reserve of coal, although the relatively small nature of the potential resource must be kept in mind (see Section 4.7). Historical research and current field work points to the following :

1. A relatively thick seam section of 4 metres, of which at least 2.5 metres is clean coal.

2. Uniform structure that may yield some surface mineable coal.

3. Underground potential above sea level, in an updip situation.

As a result, the author would recommend further field mapping, especially at Cleskaugh Creek. Both areas should be examined with a view to planning a limited diamond drill program. Prior to this, the areas should be taken under licence from the Provincial Government.

7.0.4 The Winter Harbour Area

In view of the absence of any coal exposures and the massive conglomerate sections occurring over much of the area, this must be categorized as an extreme exploration risk. If further work is at all contemplated, it should be in the area to the northwest of Winter Harbour, in the Denaad Creek area, where a flat-lying

and uniform valley contains an estimated 300 metres of the Lower Member sandstones, siltstones and shales.

REFERENCES

1. Abcon Engineering Ltd., (1980), "Report on the Suquash Coal Project"

2. Dowling, D. B., "Coalfields of British Columbia", (1915), Geological Survey of Canada Memoir 69

3. Hope Engineering Ltd., "Report on Vancouver Island Coal Holdings of Suquash Collieries Ltd.", (1953),

4. James, A. R. C., "The Coalfields of Vancouver Island", (1969), B.C. Dept. of Mines and Petroleum Resources

5. Muller, J. E., "Port McNeill and Nanaimo Basin", (1967), Geological Survey of Canada Paper 67-1

6. Muller, J. E., "The Geology of Vancouver Island", (1977), Geological Survey of Canada O.F. 463

7. Ministry of Mines Annual Reports for 1897 - 1915.

APPENDIX I. : MAPS

Appendix Map I. - Potential Coal-Bearing Sedimentary Deposits, Northern Vancouver Island

Appendix Map II.- Mineral Claim Status, Holberg Inlet (2 Sheets) March, 1984

ROKE

GAMMA RAY
SIDEWALL DENSILOG
CALIPER

OIL ENTERPRISES LTD. CALGARY, ALBERTA

FILE NO.
LSD
SEC
TWP
RGE
W ____ M

COMPANY ABCON ENGINEERING LIMITED
WELL CH-80-02
LOCATION COAL HARBOUR
FIELD
PROVINCE BRITISH COLUMBIA

Other Services:
FDL-20 cm

Permanent Datum GROUND LEVEL Elev. K.B.
Log Measured from GROUND LEVEL 4 Above Perm. Datum CSG
Well Depths Measured from GROUND LEVEL G.L.

Run. No.	ONE	
Date	9 SEPTEMBER 1980	
First Reading	170	
Last Reading	0.0	
Footage Logged	170	
Depth Reached	168.5	
Depth Driller	168.3	
Casing Roke		
Casing Driller		
Fluid Type	WATER	
Liquid Level	0.3	
Min. Diam.	11.2 cm	
Operating Time	0.5 HOUR	
Truck No.	107	

778 L01

RUN NO.	GENERAL DEPTHS FROM	TO	SPEED M/MIN	GAMMA RAY T.C. SEC.	GAMMA RAY SENS SETTINGS	GAMMA RAY ZERO DIVI. ON R.	GAMMA RAY API G.R. UNITS PER LOG DIV.	SIDEWALL DENSILOG T.C. SEC.	SIDEWALL DENSILOG SENS SETTINGS	SIDEWALL DENSILOG ZERO DIVI. ON R	SIDEWALL DENSILOG CPS/DIV
1	0.0	164	4	3	100		12	1	FK	2.35 R.	111.14
1	0.0	164	8		CALIPER						
1	0.0	170	8								

REMARKS GAMMA RAY, DENSILOG, CALIPER

CALIPER (DIAMETER - cm)
1.0 15 20 25

DEPTHS

GAMMA RAY API
0 120

BULK DENSITY (GRAMS/CC)
2.80 2.70 2.60 2.50 2.40 2.30 2.20 2.10 2.00 1.90 1.80 1.70 1.60 1.50 1.40 1.30 1.20 1.10 1.00

ROKE

GAMMA RAY
SIDEWALL DENSILOG
CALIPER

OIL ENTERPRISES LTD. CALGARY, ALBERTA

FILE NO.

LSD
SEC
TWP
RGE
W M

COMPANY ALTON ENGINEERING LIMITED
WELL CH-80-01
LOCATION COAL HARBOUR
FIELD
PROVINCE BRITISH COLUMBIA

Other Services:
FDL-20 cm

Permanent Datum GROUND LEVEL Elev.
Log Measured from GROUND LEVEL Above Perm. Datum
Well Depths Measured from GROUND LEVEL

K.B.
CSG
G.L.

Run. No.	ONE		
Date	1 SEPTEMBER 1980		
First Reading	10.2 m		
Last Reading	0.0		
Footage Logged	10 2		
Depth Reached	12 0		
Depth Driller	12.0		
Casing Roke	4.3		
Casing Driller	4.3		
Fluid Type	WATER		
Liquid Level	3.9		
Min. Diam.	11.3 cm		
Operating Time	1 HOUR		
Truck No.	107		
Recorded By	JAQUES	Witnessed By	GARDNER

GENERAL				GAMMA RAY				SIDEWALL DENSILOG			
RUN NO.	DEPTHS FROM	DEPTHS TO	SPEED m/MIN	T.C. SEC.	SENS SETTINGS	ZERO DIV.L OR R	API G.R. UNITS PER LOG DIV.	T.C. SEC.	SENS SETTINGS	ZERO DIV.L OR R	CPS/ DIV
1	0.0	10.2	4	3	100		12				
1	0.0	9.8	8					1	5K	2.35 R	171.14
1	0.0	10.2	8		CALIPER						

REMARKS GR # 175, CAL # 879, DENS # 663A

DEPTHS

CALIPER
(DIAMETER – cm)
10 15 20 25

GAMMA RAY
API
12
0 120

BULK DENSITY
(GRAMS/CC)
1.00 1.10 1.20 1.30 1.40 1.50 1.60 1.70 1.80 1.90 2.00 2.10 2.20 2.30 2.40 2.50 2.60 2.70

0
2
4
6
8

F.R

178 LOG

APPENDIX II. : PHOTOGRAPHIC PLATES

PLATES I AND II: Panoramic view of the Suquash Coal Basin, looking Northeast from Island Highway. Area of abandoned Suquash Mine at extreme left of Plate I. Queen Charlotte Strait and Coast Mountains of B. C. mainland visible in background of Plate I. Graeme Point, on western end of Malcolm Island, visible at extreme right of Plate I and extreme left of Plate II.

PLATES III AND IV : Panoramic view of the Coal Harbour area looking Northwest. Village of Coal Harbour visible at extreme right of Plate III, and extreme left of Plate IV. Holberg Inlet is visible in Plate III. Note rolling topography. Photo taken from top of massive conglomerate ridge which is recently logged off (foreground).

PLATE V : Rock quarry for logging road construction exposing beds of massive conglomerate with interbedded channel sands. Conglomeratic sandstone interbeds contain large coal clasts. This represents the upper part of the Queen Charlotte Fm.

PLATE VI : Coal occurrence #1, on the south side of Coal Harbour. Old vertical shaft on creek bank; remains of wooden ladder down shaft and lack of large amount of spoil material indicates shallow depth to coal.

PLATE VII : Small spoil bank below shaft opening at Coal Occurrence No. 1, Coal Harbour. Large amount of coal material indicates that seam was struck. Grab sample taken - CH-84-01.

PLATE VIII : Uniformly dipping calcareous siltstone and thin-bedded fine sandstones on Denad River, Northwest of Winter Harbour.

PLATE IX : Coal occurrence No. 3, approximately 1.2 km. west of mouth of Nukneemish River, north side of Holberg Inlet. Seam outcrop partially exposed at low tide, dipping into water at 20 degrees to the southwest.

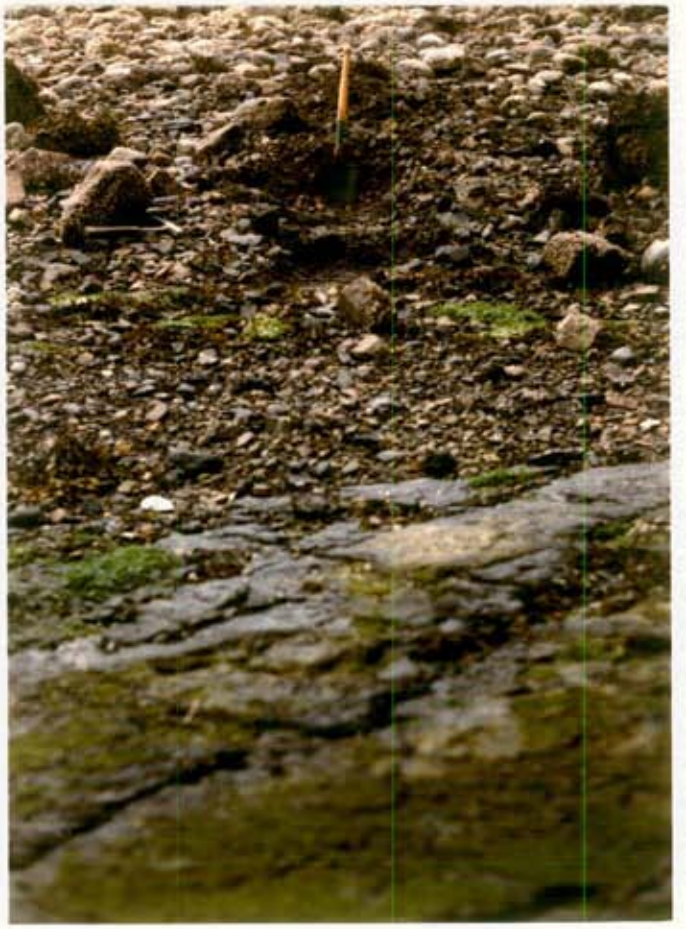


PLATE X : Coal occurrence No. 3, showing covered roof at low tide. Shovel position shows part of seam covered by beach gravel- unable to determine top of seam.

PLATE XI : Looking southwest across Hushamu River valley, approximately 1.2 km. from its confluence with Holberg Inlet. Photo taken from bluff of Bonanza Group volcanics, across to the potentially coal-bearing sedimentary area.

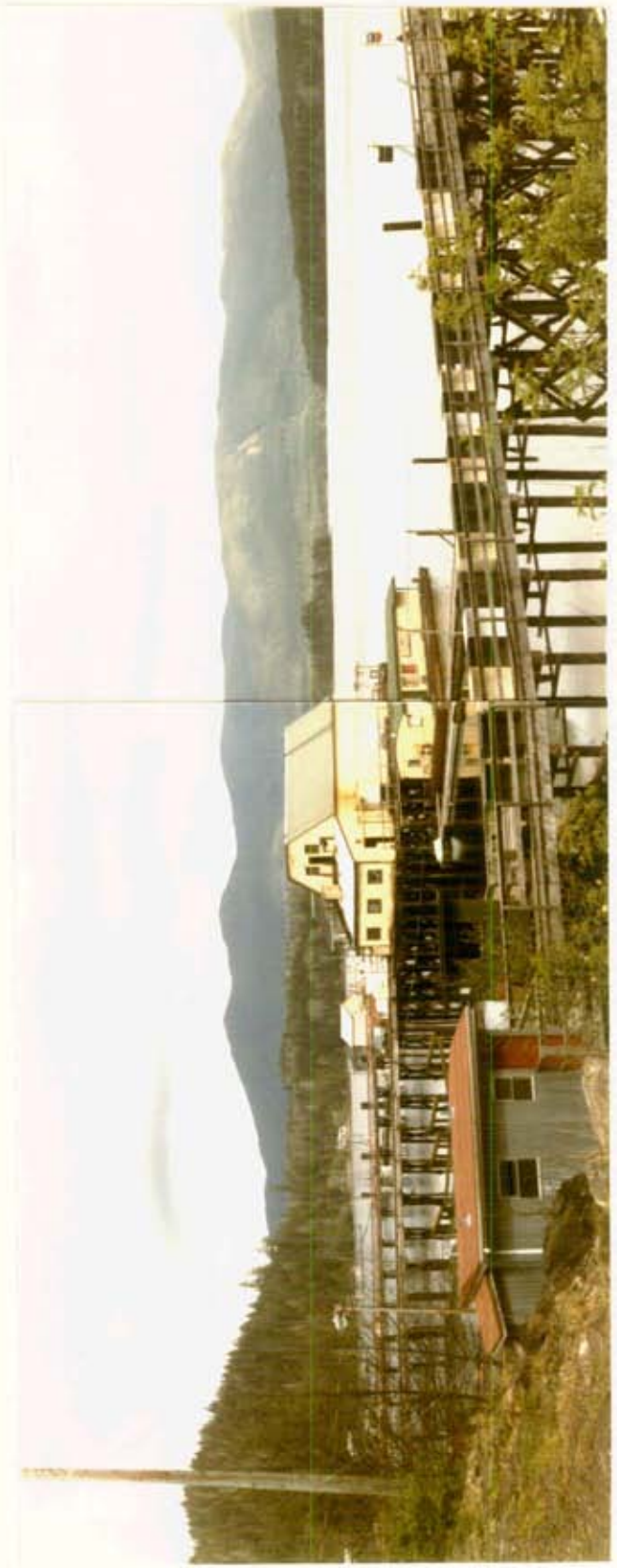
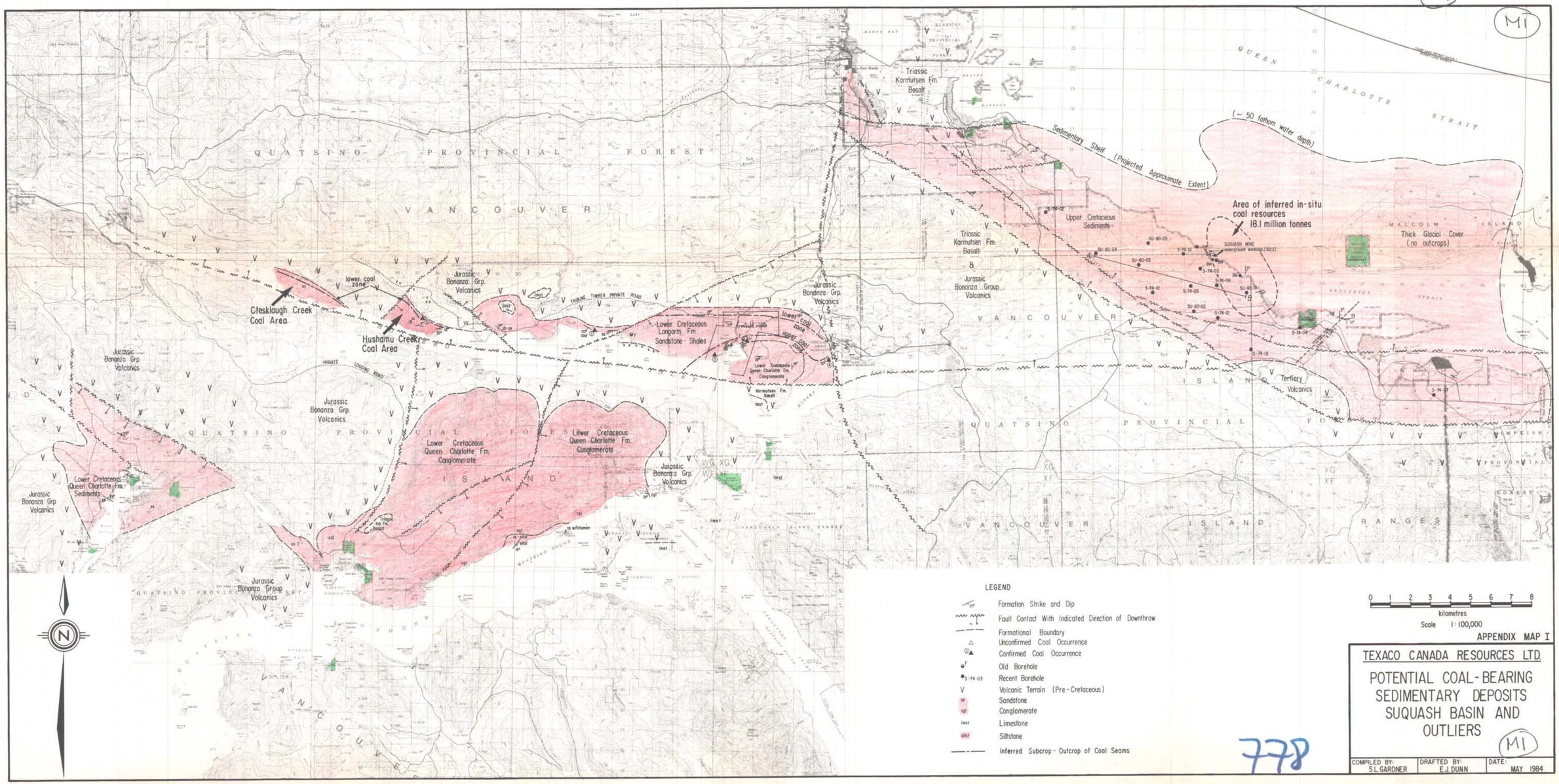


PLATE XII : Small fishing village of Winter Harbour on Forward Inlet, Quatsino Sound area. Photo looking North-north-east to lowlying Cretaceous sedimentary area. Faulted contact between sediments and Bonanza volcanics occurs along base of high range of hills in background.



LEGEND

- Formation Strike and Dip
- Fault Contact With Indicated Direction of Downthrow
- Formational Boundary
- Unconfirmed Coal Occurrence
- Confirmed Coal Occurrence
- Old Borehole
- S-74-03 Recent Borehole
- V Volcanic Terrain (Pre-Cretaceous)
- ss Sandstone
- cgl Conglomerate
- lmst Limestone
- slts/st Siltstone
- Inferred Subcrop - Outcrop of Coal Seams

0 1 2 3 4 5 6 7 8 kilometres

Scale 1:100,000

APPENDIX MAP I

TEXACO CANADA RESOURCES LTD.

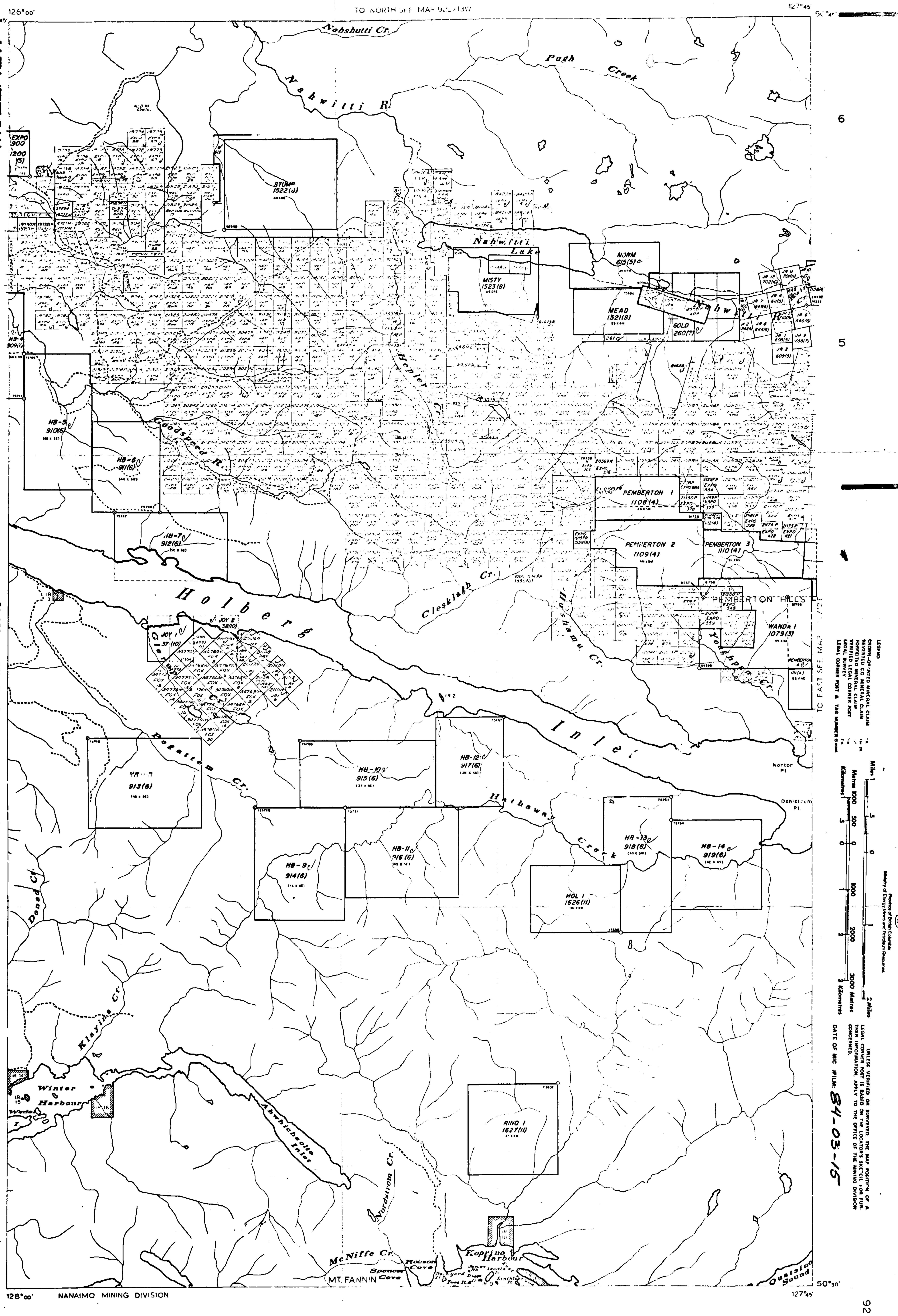
POTENTIAL COAL-BEARING SEDIMENTARY DEPOSITS SUQUASH BASIN AND OUTLIERS

M1

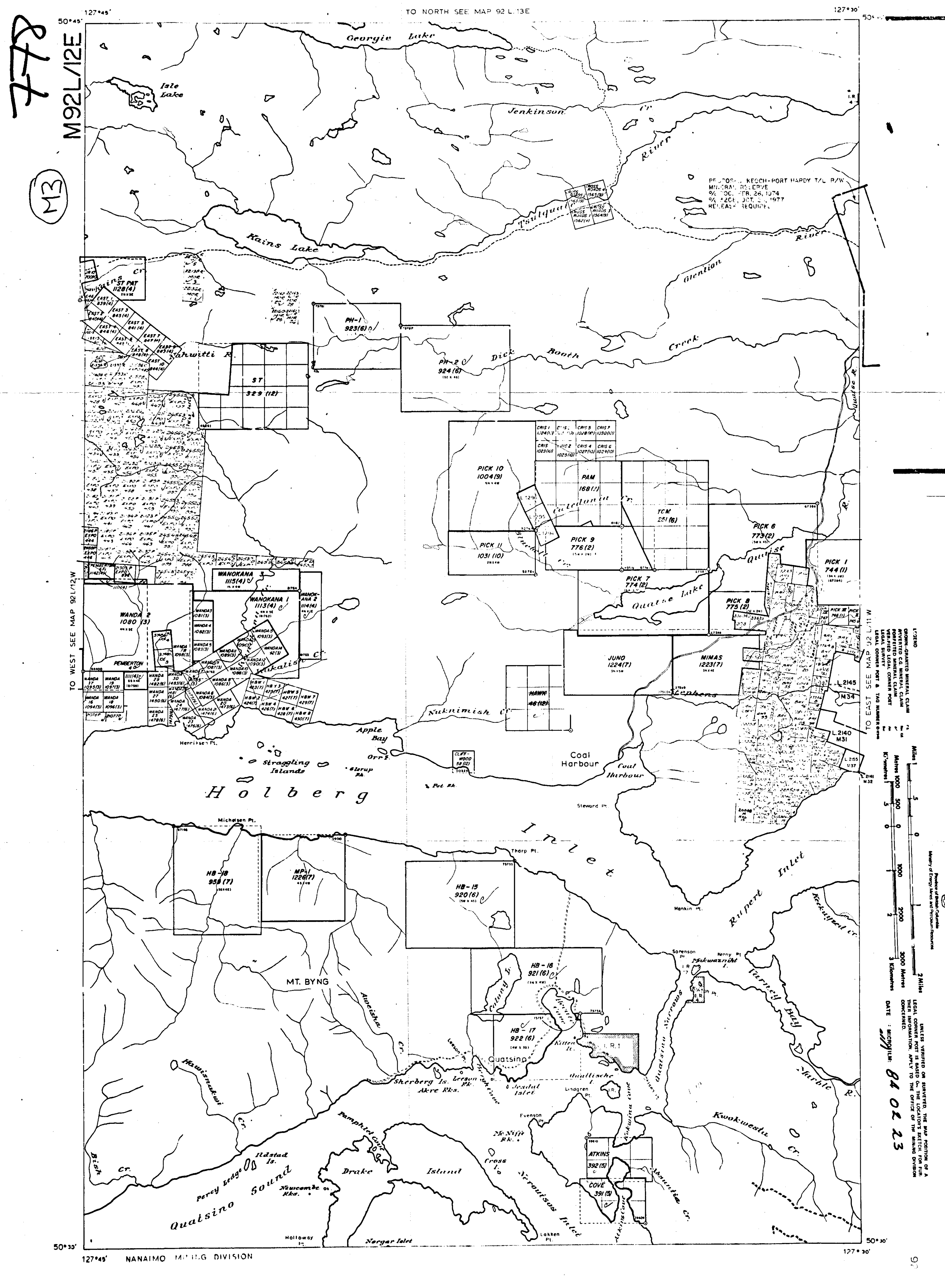
COMPILED BY:	DRAFTED BY:	DATE:
S.L. GARDNER	E.J. DUNN	MAY 1984

778

M2 778
M92L/12W



DEPARTMENT OF MINES AND PETROLEUM RESOURCES


778
M92L/12E
M13
TO NORTH SEE MAP 92 L 13E
127°45'
127°30'
50°45'
50°30'
Georgie Lake
Isle Lake
Jenkinson Cr.
Tsulquate River
Kains Lake
Glenlion River
Kains Cr.
ST PAT 1128(4)
Nahwitti R.
PH-1 923(6)
PH-2 924(6)
Dick Booth Creek
ST 329 (12)
PICK 10 1004(9)
PAM 168(1)
Caledonia Cr.
TCM 251(6)
PICK 9 776(2)
PICK 11 1031 (10)
PICK 6 773(2)
PICK 1 744(1)
PICK 7 774(2)
Quatse Lake
PICK 8 775(2)
Quatse R.
WANOKANA 1115(4)
WANOKANA 1 1113(4)
WANDA 2 1080 (3)
PEMBERTON 40
Makalish Cr.
JUNO 1224(7)
MIMAS 1223(7)
HAWK 48(12)
Stephens
Nuknimish Cr.
Apple Bay
Orr I.
Straggling Islands
Henriksen Pt.
CLIFF-WOOD 58(12)
Coal Harbour
Holberg Inlet
Pot Rk.
Steward Pt.
L.2145 M34
L.2140 M31
L.2155 M37
M32
Michelsen Pt.
HB-18 958 (7)
MP-1 1226(7)
Thorp Pt.
HB-15 920(6)
Rupert Inlet
Hankin Pt.
Kenny Pt.
Sorenson Pt.
Mahwaznuht I.
HB-16 921(6)
HB-17 922 (6)
Colony L.
Quatsino
I.R.1
Kitten Is.
MT. BYNG
Aurisha Cr.
Varney Bay
Quatsino Narrows
Marble R.
Hawinnakwi Cr.
Sherberg Is.
Akre Rks.
Evenson Pt.
Lindgren Pt.
Koprino Cove
Kwokwesta Cr.
Pamphlet Cove
McNiffe Rk.
Cross I.
ATKINS 392(5)
COVE 391(5)
Ildstad Is.
Percy Ledge
Drake Island
Newcombe Rks.
Quatsino Sound
Neroutsos Inlet
Bish Cr.
Holloway Pt.
Norgar Islet
Lokken Pt.
TO WEST SEE MAP 92 L/12 W
TO EAST SEE MAP 92 L/11 W
NANAIMO MINING DIVISION
PROPOSED KEOGH-PORT HARDY T/L R/W
MINERAL RESERVE
O/C 1100, FEB. 28, 1974
O/C 4206, OCT. 2, 1977
RELEASE REQUIRED
LEGEND
CROWN-GRANTED MINERAL CLAIM
REVERTED C.G. MINERAL CLAIM
RECORDED MINERAL CLAIM
VERIFIED LEGAL CORNER POST
LEGAL SURVEY
LEGAL CORNER POST & TAG NUMBER
Miles
Metres
Kilometres
UNLESS VERIFIED OR SURVEYED, THE MAP POSITION OF A LEGAL CORNER POST IS BASED ON THE LOCATOR'S SKETCH. FOR FURTHER INFORMATION, APPLY TO THE OFFICE OF THE MINING DIVISION CONCERNED.
DATE / MICROFILM: 84 02 23
Province of British Columbia
Ministry of Energy, Mines and Petroleum Resources