SAND AND GRAVEL STUDY 1980
BRITISH COLUMBIA LOWER MAINLAND

by

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Finally, while acknowledging the contributions from staff, municipalities, and industry people, we accept full responsibility for the content and accuracy of the report. Furthermore, the views expressed herein are those of the authors and do not necessarily represent those of the Ministry or the Government of British Columbia.

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I. INTRODUCTION

1.1 CIRCUMSTANCES OF THE STUDY

A general shortage of construction aggregate is presently a common problem in most large urban areas in North America. The supply-demand relationship is becoming critical with accelerating urban growth, particularly near the big cities. Municipal encroachment into traditional source areas for gravel has caused increasing reliance on more distant deposits remote from city centres, and the problems of access and transport are being compounded by restrictive legislation and public concerns for protection of the environment, preservation of agricultural land, and aesthetics of the landscape.

The advent of tight supply in the lower mainland was recognized several years ago. To avoid future shortages the Government of British Columbia realized the need to prepare an integrated mineral aggregate resource management policy. This report represents the first of a three-phase examination leading to such a policy. The phases are:

Phase I – Inventory of the resource and definition of the magnitude of the supply-demand problem.
Phase II – Detailed examination and recommendations on a mineral aggregate resource management policy.
Phase III – Implementation through new procedures and possibly legislative action.

Implementation of Phase I is intended to focus specifically on the following areas:

(a) current proven and probable reserves of mineral aggregate;
(b) alternative sources of supply and substitutes;
(c) current and future aggregate distribution relative to population distribution and growth;
(d) current and future demand for mineral aggregate;
(e) supply-demand projections;
(f) economic aspects of the industry;
(g) restrictions that will reduce availability of supply;
(h) legal and jurisdictional problems and responsibilities.

This report summarizes the field work done during 1978, a physical inventory of gravel pits, and a survey of the operators with an analysis of the collected data during 1979.

1.2 COMMODITY DESCRIPTION AND USE

Sand and gravel deposits are the main source of fine and coarse aggregate. Mineral aggregate is used extensively in asphaltic pavement and portland cement concretes, as sub-base under pavings, for railroad ballast, and for various types of fill where good drainage is required. Large volumes of sand and gravel are used for road building and highway construction. Each of the final uses has special requirements with respect to grain size composition, particle shape and surface, petrographic character, and physical and chemical properties, in order to ensure good quality of the final product. To meet such requirements, screening and crushing are important for any large producer of mineral aggregate supplying a diversified market. In 1978, about 40

million tonnes of sand and gravel were consumed in British Columbia. The lower mainland's commercial share was 12 million tonnes and approximately 1 million tonnes of this came from Washington State. The value of sand and gravel used in the lower mainland in 1978 was some $23 500 000. This substantial production comes from commercial operators and does not include gravel produced by Government agencies for building and maintenance of roads and highways.

Wherever the term sand and/or gravel is used in this report, it refers to the natural deposits or unprocessed material. The term aggregate, on the other hand, refers to the product processed for industrial use, for instance, crushed, screened, and washed. Conversion factors used to prepare graphs and tables in metric units are:

m^3 = short tons ÷ 2.0
m^3 = cubic yards ÷ 1.3
m^3 = tonnes ÷ 1.8

II. GEOLOGY OF SAND AND GRAVEL

2.1 PREVIOUS GEOLOGICAL STUDIES

Studies on geology of sand and gravel deposits in the lower mainland date back to 1953 when J. E. Armstrong of the Geological Survey of Canada published a paper, *'Geology of Sand and Gravel Deposits in Lower Fraser Valley, British Columbia.'* This was followed in 1956, 1957, 1959, and 1960 by publication of surficial geology maps for Vancouver, New Westminster, Sumas, and Chilliwack map-areas. An updated set of these map sheets has recently been issued by the same author.

S. F. Leaming's (1966) paper entitled, *'Sand and Gravel in the Strait of Georgia Area,'* gives an excellent inventory of gravel producers and resources for all lower mainland municipalities. The geology of Quaternary deposits in the Coquitlam valley has been described by S. R. Hicock (1976) in his M.Sc. thesis at the University of British Columbia, *'Quaternary Geology: Coquitlam—Port Moody Area, British Columbia.'*

The offshore distribution of gravel deposits has been investigated by C. H. Pharo (1972) in his University of British Columbia thesis, *'Sediments of the Central and Southern Strait of Georgia, British Columbia,'* and J. J. Clague (1975) in *'Quaternary Geology, Northern Strait of Georgia, B.C.'*

Information compiled from numerous water well logs for that part of the lower mainland west of Sumas Mountain and south of Fraser River is portrayed in *'Hydrogeological Fence Diagrams, B.C. Lower Mainland'* by E. C. Halstead (in press). The diagrams provide information on subsurface distribution of granular deposits for most of the townships in the lower mainland at a scale of 1:25 000.

Data on surficial geology along the mainland coast are much less comprehensive. Part of the area of interest has been covered by J. W. McCammon (1979) in his publication, *'Surficial Geology and Sand and Gravel Deposits of Sunshine Coast, Powell River, and Campbell River Areas.'* Some very valuable information on the distribution of sand and gravel deposits can be derived from manuscript terrain maps for most of the coastline west and northwest of Howe Sound, available at the 1:50 000 scale from the Resource Analysis Branch, British Columbia Ministry of Environment.

There are many articles on the stratigraphy of Quaternary deposits of the area of interest; the most important authors on this subject are J. E. Armstrong (1977) and J. J. Clague (1975, 1976).

2.2 ORIGIN AND DISTRIBUTION OF DEPOSITS

Sand and gravel resources of the southern coastal region of British Columbia may be linked to various episodes of Wisconsin glaciation. To understand the distribution of sand and gravel deposits in the area of the Fraser lowland and along the coast, several major controlling factors may be considered. During the Wisconsin, and probably earlier stages, the area was subjected to repeated glaciations separated by nonglacial intervals. Each major glaciation was accompanied by isostatic and eustatic changes in the sea level up to approximately 200 metres or more. As a

TABLE 2.1 STRATIGRAPHY OF QUATERNARY DEPOSITS IN THE LOWER MAINLAND

Years B.P.	Time Units	Geologic Climate Units	Lithostratigraphic Units	Comments	Important Sources of Mineral Aggregate
	Holocene		Salish and Fraser River sediments	All post-glacial sediments	Alluvial gravels
10 000	Late Wisconsin	Post-glacial / Fraser glaciation	Capilano sediments; Sumas drift; Fort Langley Formation	Marine, deltaic, and fluvial deposits; Till, outwash, ice-contact deposits; Deltaic, ice-contact and outwash deposits, till	Deltaic and channel fill; raised beach; Outwash and ice-contact; Deltaic, outwash and ice-contact
13 000			Vashon drift	Till, outwash, ice-contact deposits	Outwash
18 000			Quadra sand; Coquitlam drift	Proglacial sand, silt, gravel; Till	Gravel locally
26 000	Middle Wisconsin	Olympia non-glacial interval	Cowichan Head Formation	Fluvial, organic, colluvial	Gravel locally*
62 000	Early Wisconsin and Pre-Wisconsin	Semiahmoo glacial	Semiahmoo drift	Fill, glaciofluvial, glaciomarine	Gravelly outwash locally*
		Highbury non-glacial	Highbury sediments	Fluvial gravel, sand, and silt	Gravel locally*
		Westlynn glacial	Westlynn drift		Gravel locally*
			Older sediments		

*Exposed and mined in Coquitlam Valley as a complex of units.

After J. E. Armstrong, 1977.

result, the lowland was covered by the sea during the majority of Quaternary time. Since the lowland is bounded on two sides by high mountain ranges, the glaciers terminated in the sea during their maximum advance and retreat. Therefore, the meltwaters released during deglaciation, together with retreating glacier ice, could produce widespread and extensive deposits of sand and gravel both along the coast and throughout the Fraser lowland and adjacent areas. Combination of wave action and changing sea levels left widespread gravelly beach deposits up to a few metres thick scattered between 0 and 200 metres above sea level in most of the coastal area.

J. E. Armstrong (1977) divided Quaternary sediments of the lower mainland area into the lithostratigraphic units described in Table 2.1. The main units containing deposits of sand and gravel are Holocene Salish sediments of alluvial origin and Late Wisconsin Capilano raised alluvial fans deltaic deposits, Sumas outwash and ice-contact deposits, Fort Langley glaciomarine deltaic sediments, and Vashon outwash with ice-contact deposits. These units have, in the lower mainland, the following characteristics:

(1) Salish deposits are beach gravels and deltaic deposits up to 40 metres above sea level along the coast. They also comprise alluvial sediments of existing watershed of the lower mainland.
(2) Capilano deposits are between 40 metres and 200 metres above sea level.
(3) Sumas drift is not overlain by marine silts or younger till.
(4) Fort Langley Formation contains flow tills and is overlain by marine silts.
(5) Vashon gravels have been overridden by glacier ice and have till on top.

Economically, the most important deposits are those derived from the Fraser glaciation, namely, Sumas, Capilano, Fort Langley, and Vashon sediments.

2.3 LOCAL GEOLOGY

As shown on the map (Fig. 2-1) the gravel-bearing formations are distributed throughout most of the lower mainland in a variety of stratigraphical and lithological units. The following are brief descriptions of the local geology of gravel deposits in individual district municipalities and major producing centres in the Fraser lowland and adjacent areas.

KENT DISTRICT MUNICIPALITY

Gravel deposits in this area occur as a small erosional remnant of Sumas sediments as a relic outwash terrace. The deposit is from 10 to 20 metres thick, very sandy, and forms a low, irregular, up to a few-hundred-metre-wide terrace along the edge of the Fraser lowland.

CHILLIWACK DISTRICT MUNICIPALITY

The large alluvial fan of the Chilliwack River developed in an area where the river gradient changed suddenly after leaving the mountain range and entering the Fraser lowland. The deposited gravel is 5 to 10 metres thick and corresponds to Salish sediments.

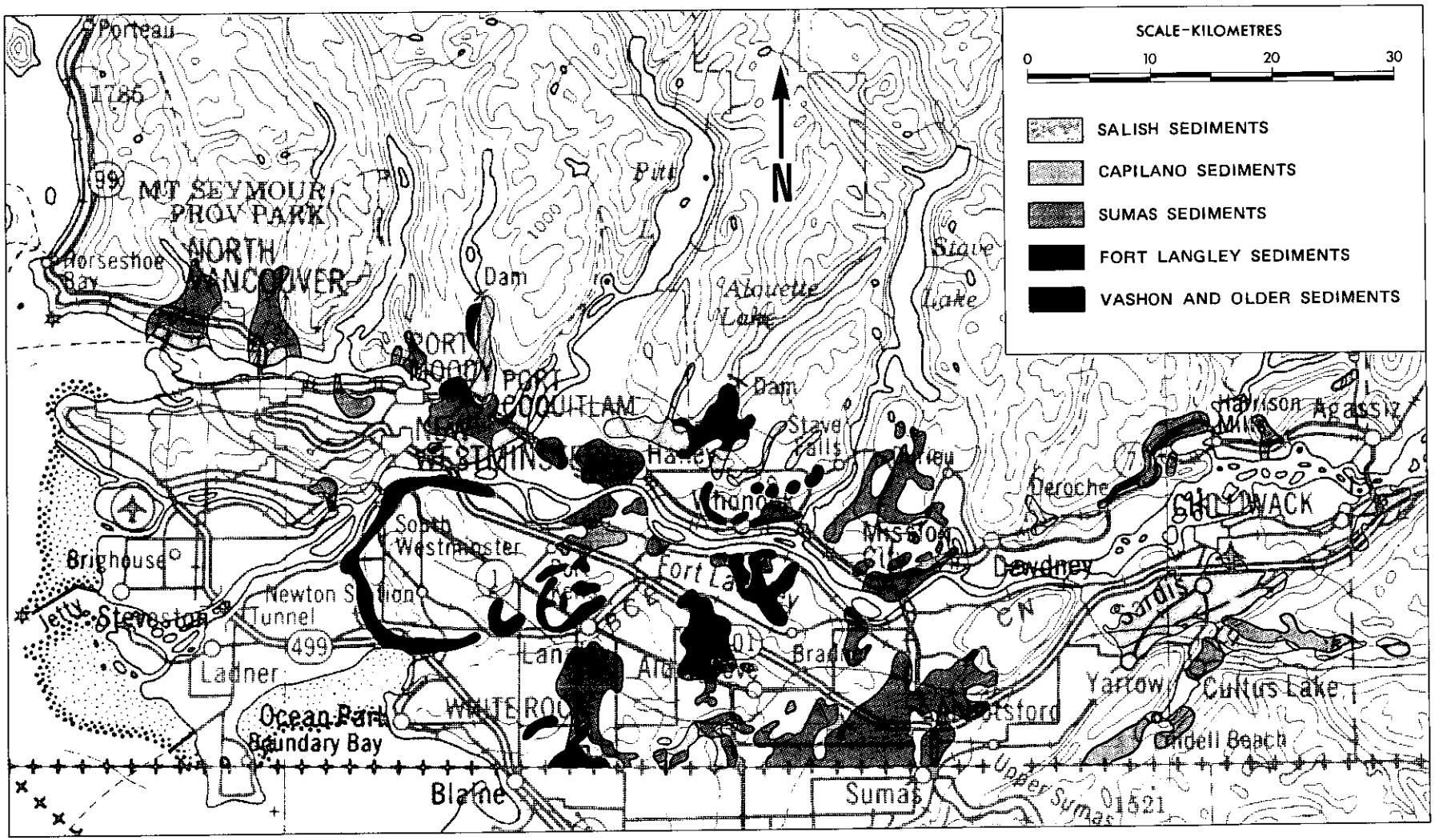


Figure 2-1. Gravel deposits of the lower mainland.

Gravelly outwash of Sumas drift, viewed along the slopes of the Chilliwack River valley, is as much as 20 metres thick in places and forms a continuous mantle along the lower part of the slopes. Exposures of Sumas drift in the Columbia Valley between Cultus Lake and the international border contain pockets of gravelly outwash locally up to 50 metres thick (Ministry of Transportation and Highways' pit).

ABBOTSFORD DISTRICT MUNICIPALITY

Gravel resources of this area consist of several small alluvial fans along the base of Sumas Mountain and deposits of Sumas drift immediately around and south of Abbotsford. The alluvial fans are only a few hundred metres across and are 10 to 15 metres thick. The deposits of Sumas drift are part of an area extending through the southern half of the Matsqui District Municipality. The exposed thickness of Sumas gravel observed within Abbotsford municipal boundaries is between 15 and 20 metres (Fig. 2-2).

MATSQUI DISTRICT MUNICIPALITY

Accumulations of gravel here are glaciofluvial and ice-contact deposits of Sumas drift. These deposits extend over considerable areas of the southern part of the municipality, into the western part of the Abbotsford District Municipality and, to a lesser degree, into the eastern part of the Langley District Municipality. Geologically, these deposits represent both advance and recessional outwash and are underlain by flat-lying marine sediments. The thickness of gravel ranges up to approximately 50 metres and part of the gravel is an important aquifer (Fig. 2-2).

MISSION DISTRICT MUNICIPALITY

This district's gravel deposits are also glaciofluvial and ice-contact deposits of Sumas drift. North of the Fraser River, however, the gravel forms an irregular, locally bouldery outwash mantle along the slopes of deeply cut valleys, and is frequently underlain by basal till. This type of deposit does not extend over large areas, but as a result of deposition along the slopes, the vertical thickness is as much as 50 metres.

MAPLE RIDGE DISTRICT MUNICIPALITY

The geology of gravel deposits of this district is fairly complex. There are gravels of Sumas drift similar to those in the Mission District Municipality, gravelly outwash deposits of Vashon drift, sandy gravels and sands of the Fort Langley Formation, and alluvial gravels of Salish sediments along the Alouette River. Vashon gravels of glaciofluvial origin about 15 to 20 metres thick are overlain by till or silty glaciomarine deposits of the Fort Langley Formation. Fort Langley gravels are glaciomarine deposits of deltaic type and are frequently interbedded with layers of silt and flow till, the silty layers occasionally containing shells. Where exposed, the thickness of Fort Langley gravels in this area is about 20 metres.

LANGLEY DISTRICT MUNICIPALITY

Gravel deposits here comprise two geological units, the Fort Langley Formation and Sumas drift. Fort Langley gravels are partly of glaciomarine and ice-contact origin and

partly a large pro-glacial fan delta. The gravels are up to 45 metres thick, commonly interbedded with layers of flow till, and frequently overlain by glaciomarine silts and silty clays.

Gravel deposits of Sumas drift are found mainly in the area south of Langley and closely resemble gravels in Matsqui District Municipality. The thickness is locally similar, up to about 50 metres, but generally less, and part of the gravel is below the groundwater table. Sumas gravels extend in the area south of Langley to the Surrey District Municipality (Fig. 2-2).

SURREY DISTRICT MUNICIPALITY

The only operating gravel pits are in Sumas drift, which extends from the Langley District Municipality (Fig. 2-3). Vashon glaciofluvial gravels, overlain by thick tills, are exposed along the lower slopes in the northern half of the municipality. Pits here were phased out several years ago as a result of urban encroachment.

COQUITLAM DISTRICT MUNICIPALITY

The gravel deposits of the Coquitlam valley and Mary Hill are geologically complex. They consist of sediments deposited during several major glacial advances and retreats as well as during nonglacial intervals in a glacier-carved bedrock valley. The gravels, which are up to 150 metres thick, are equivalents of Quadra, Highbury, and Pre-Highbury deposits, and are overlain by Vashon till (Fig. 2-3).

COASTAL AREAS

Capilano raised deltaic deposits are scattered along the mainland coast and, to a minor extent, on Vancouver Island. Capilano sediments are alluvial fans which were deposited when the shoreline levels were at least 15 metres above the present sea level. They are found up to about the 180-metre contour and, in contrast to the Fort Langley Formation, were not overridden by Sumas ice. The thickness observed in some exposures has reached 65 metres. Producing pits in Capilano deposits that supply the Vancouver market are along Howe Sound (partially depleted already), Jervis and Sechelt Inlets, and at Colwood, near Victoria, on Vancouver Island (Fig. 2-4). Two fairly large Capilano deltas in the North Vancouver District Municipality have been sterilized by residential development.

2.4 SIZE AND LOCAL PECULIARITIES OF DEPOSITS

Deposits of sand and gravel throughout the lower mainland are of many sizes, shapes, and granular compositions. As described in the preceding paragraphs, the producing deposits range from small fans and erosional remnants only a few hundred metres across and several metres thick, to areas having more than 50 square kilometres that are underlain by gravel up to 50 metres thick. Deposits south of the Fraser River are in generally flat terrain with gravel clasts of more regular size distribution, while many deposits north of the Fraser River and along the coast are on sloping terrain and contain very poorly sorted fragments mixed with many boulders. Many deposits are covered by only a few-centimetre-thick layer of topsoil. If there is any

till present, it is usually processed with underlying gravel, as in the Coquitlam valley, for example. Some deposits in the Fort Langley Formation, however, are overlain by laminated marine silts in a ratio of almost 1:1.

2.5 QUALITY OF SAND AND GRAVEL

Sand and gravel, or by industrial terminology 'fine and coarse aggregates', have many practical uses and each of them has certain specifications as to size, shape, petrographic composition, and other physical and chemical properties of the components. Petrographic composition with physical and chemical properties are fixed parameters and by the existing technology cannot be significantly improved. However, the required granulometric composition is easily controlled by crushing, screening, and washing of the product. Nature usually does not produce deposits of ideally sized and sorted particles suitable for industry requirements for optimum qualities of pavement, road base, concrete, or drainage fill, for example. Therefore, most of the aggregate that comes to the market in the study area is preprocessed to some degree. While smaller producers usually employ only simple screening, leaving boulders as a waste, and producing only a few types of construction aggregate or fill, all larger operators are capable of supplying many types of aggregate product for a variety of uses.

It is very fortunate that the lower mainland gravel deposits do not contain significant amounts of deleterious components like chert, glassy volcanic rock, and weathered rocks which in some other areas can severely limit the final use because of unfavourable impact on the quality of concrete. The only significant deleterious components of the sand and gravel deposits in the area of this study are silt and clay, both of which are easily removed by screening and washing.

TABLE 3.1 AVAILABILITY OF SAND AND GRAVEL IN THE LOWER MAINLAND

Municipality	1978 Production m^3	Remaining Reserves Within Existing Leases (1978 Estimate) m^3	Expected Life of Production at 1978 Level *years*	Geological Potential for Additional Reserves	Remarks and Potential Problems
Kent	40 000	3 000 000	100	poor	
Chilliwack	370 000	3 500 000	10	moderate	Agricultural land reserve, residential development
Abbotsford	25 000	240 000	10	good	Agricultural land reserve, residential and industrial development
Matsqui	1 380 000	9 000 000	6	excellent	Agricultural land reserve zoning
Mission	190 000	2 000 000	10	good	Residential development
Maple Ridge	240 000	1 300 000	5	moderate	Residential development
Langley	480 000	3 000 000	6	good	Agricultural land reserve, residential development
Surrey	320 000	1 000 000	2–3	moderate	Agricultural land reserve, residential development
Coquitlam	620 000	? (6 000 000+)	? (10+)	unknown*	Environmental concerns
Delta	170 000	-------	-----	----	Sand dredging from river bed
Richmond	115 000	-------	-----	------	Sand dredging from river bed
Pitt Meadows	-------	-------	-----	poor†	
Burnaby	-------	-------	-----	------†	
New Westminster	-------	-------	------	-----	
North Vancouver	-------	-------	------	moderate†	Along Indian Arm coast
West Vancouver	-------	-------	-----	-----†	

*Insufficient information on local geology.

†Available resource sterilized due to the residential and industrial development.

III. INVENTORY OF AGGREGATE RESOURCES AND RESERVES LIFE AT EXISTING PRODUCTION LEVELS

A physical inventory of sand and gravel deposits was undertaken in the following manner. First, the most recent available air photographs of the lower mainland were used to locate all excavations in the area. This information was transferred to 1:50 000 topographical maps, together with information on surficial geology compiled from available published and unpublished sources. Secondly, all located pits were visited to document the size of excavation, thickness of the deposit and mode of deposition, lithology and size of the particles, and overburden. Groundwater observations were included. Attention was given to the type of terrain and surrounding areas from the point of view of development or expansion potential. During the fall of 1978, a survey of operators and municipalities was conducted to provide descriptions of individual leases and maps of operations. Finally, these maps were used to calculate the approximate remaining reserves available for aggregate production.

One of the concerns of this study is the life expectancy of active pits and their expansion potential. In spite of the fact that large areas are underlain by gravel, only reserves within existing lease boundaries are available for mining. After studying locations of individual leases, and comparing the size of remaining areas with responses from individual producers, the conclusion reached is that many operators have not defined the shapes of the deposits and consequently the size of remaining reserves. The report by the Canadian Transport Commission, *'The Canadian Mineral Aggregate Industry,'* of December 1978, contains a table of estimated Vancouver-region reserves that was provided by the Greater Vancouver Regional District. It reports in total 325 million cubic yards and additional hundreds of millions of tons in pits located on tidewater. While these figures may represent resource they do not represent reserves. Only a small fraction of the resource is really available for production.

3.1 AVAILABILITY OF SAND AND GRAVEL IN INDIVIDUAL DISTRICT MUNICIPALITIES

Availability of the resource is influenced not only by the physical presence of deposits, and the economic viability of the product in the market area after production and transportation costs, but also by conflicting interests that may sterilize existing deposits. Residential development favours areas underlain by gravel because of good drainage and percolation. For example, the recent study for settlement suitability for the Regional District of North Okanagan ignores gravel deposits in the Vernon area as a source of construction aggregate and recommends, without exception, residential development of all the areas underlain by gravel.

Another limiting factor is public concern about noise, dust, water pollution, and heavy traffic resulting from aggregate extraction. Thus, it is fairly common practice by local residents to try to impose severe restrictions on aggregate operations and put them out of production. Locally, aesthetic aspects may play an important role in activating public pressure to eliminate existing production centres and to prevent development of new deposits. Another frequent problem is that municipal soil removal by-laws frequently permit gravel extraction above the groundwater table only.

A further problem facing the aggregate industry is that almost all of the gravel deposits south of the Fraser River and outside of the city limits lie within the agricultural land reserve. Appli-

cations for exemption to open a gravel pit come under the *Soil Conservation Act* and must be approved by local authorities and the Land Commission. In the end, access to seemingly abundant aggregate resources is dramatically reduced by these pressures and freeze most of the resource needed for residential, commercial, and industrial development.

In general terms, north of the Fraser River and along the coast the availability of gravel is influenced primarily by geological factors, and by the physical presence of deposits. Particle-size ratio and deposit distribution allows economical production of construction aggregate. South of the Fraser River, the main limiting factors are availability of land and permit procedure.

The following subsections review availability of the resource in the study region municipalities.

KENT DISTRICT MUNICIPALITY

This district has only one small deposit of sandy gravel outwash of Sumas age. This erosional remnant on the edge of Fraser lowland is covered by three leases that extend beyond the actual deposit, and there is a cemetery on top of this gravel terrace. There are approximately 3 000 000 m^3 of sandy gravel reserves, or sufficient for nearly 100 years at 1978 production levels if surface constraints were not present. There are no other potential deposits in this municipality except perhaps recent Fraser River sediments that are dredged locally on the Chilliwack side of the river (Fig. 3-1a).

CHILLIWACK DISTRICT MUNICIPALITY

Remaining reserves of gravel on existing leases are estimated at 3 500 000 m^3, which represents a little less than 10 years of production at 1978 levels. River leases have not been considered in this estimate, because there are no criteria to evaluate the volume of gravel in river bars without exploration drilling. There is still potential for new gravel pits in the Salish sediments of the Chilliwack River and in Sumas drift deposits east and southwest of Vedder Crossing, but preserving those aggregate resources for future production will require careful municipal planning. Most of the deposits are within the agricultural land reserve (ALR) (Figs. 3-1a and 3-1b).

ABBOTSFORD DISTRICT MUNICIPALITY

There is very limited production reported from this municipality. Three active pits at the foot of Sumas Mountain are mining small alluvial fans with limited reserves. At 1978 production levels of some 24 000 m^3, reserves may last for approximately 10 years. There are another two or three similar small deposits outside of the agricultural land reserve. Large deposits of gravel underlie the southwestern part of the municipality between Highway No. 1 and the international border, however, this area is protected by the *Soil Conservation Act* as agricultural land reserve (Fig. 3-1b).

MATSQUI DISTRICT MUNICIPALITY

Sand and gravel production from this district municipality is the largest in the lower mainland, with 1978 output near 1 500 000 m^3. Remaining reserves in areas covered by

existing leases are in the order of 9 000 000 m^3, which means only six years of production at existing levels. A significant proportion of gravel deposits in this municipality has already been lost as a result of residential and industrial development and the location of the Abbotsford airport. Although there still remains a large area in the southeastern corner of the municipality underlain by gravel, it is within the agricultural land reserve. In order to ensure continuous supply of construction aggregate at present production levels, two possibilities should be considered. Since there are still large tracts of land underlain by thick deposits of gravel, municipal planning should reserve them for multiple use which will include sequential mining of gravel and consequent rehabilitation for agriculture or other uses. Another possibility would be to consider dredging gravel from below the groundwater table, where a significant part of existing reserves remains unavailable due to current municipal regulations (Fig. 3-1b).

MISSION DISTRICT MUNICIPALITY

The gravel deposits of this municipality form an irregular mantle of Sumas outwash along the slopes of several hundred-metre-deep glacier-carved valleys. Despite a relatively large area underlain by gravel, the reserves estimate has to be done very cautiously because the deposits are extremely irregular in thickness. Moreover, the deposits are locally very bouldery and any larger scale operation would require a crushing plant in order to process all or most of the material available. Estimated reserves within existing leases are approximately 2 000 000 m^3, which represents some 10 years of production at 1978 levels (Fig. 3-1b).

MAPLE RIDGE DISTRICT MUNICIPALITY

In spite of the fact that several geological units with gravel are present in the area, the availability of this resource is rather limited. The principal reasons are that some of the deposits are almost depleted, major areas around Haney underlain by gravel were used for residential development, and part of a deposit is within Golden Ears Park. The only area with potential for new pits is along the lower part of the Blue Mountain slopes in the Alouette River valley. The reserves in existing leases are estimated at about 1 300 000 m^3, which represents approximately five years of production at 1978 levels (Figs. 3-1b and 3-1c).

LANGLEY DISTRICT MUNICIPALITY

Gravel deposits of Sumas drift and of Fort Langley glaciomarine sediments are principal sources of construction aggregate in this and, to some extent, the neighbouring municipality Surrey. The problems facing the Langley District Municipality are similar to those in Matsqui. The 3 000 000 m^3 of reserves within existing leases represent only six years of supply at 1978 levels, and the potential for new leases is limited by residential and industrial development, agricultural land reserve regulations, and a locally unfavourable stripping ratio because of thick overburden. In order to ensure continuous supply of construction aggregates in this fast-growing area, careful municipal planning, and perhaps larger scale production from below the water table, should be considered (Figs. 3-1b and 3-1c).

SURREY DISTRICT MUNICIPALITY

In addition to alluvial sand from the river, the only producing pits are located in the southeastern part of the municipality near Langley. The available reserves within existing leases are very small, some 700 000 to 1 000 000 m^3, and the 1978 production levels cannot be maintained for more than two or three years. Local industry is now trucking in gravel from deposits in Washington State (Fig. 3-1c).

COQUITLAM DISTRICT MUNICIPALITY

Annual production from the Coquitlam valley amounts to about 600 000 m^3 of gravel. The deposits are the product of several glacial and interglacial periods and are overlain by about a 10-metre-thick layer of till. The gravel exposed in the face of existing pits in this area is up to 150 metres thick. Due to the heavy till overburden, the limits of the gravel deposits are not known and no approximate reserves estimate can be made. The area has an excellent potential for more than 10 years of production at 1978 levels (Fig. 3-1c). Because this very important production centre supplies the north side of the Fraser River from Port Moody to Haney with aggregate products, it would be in the interest of all parties involved (industry, local and provincial governments) to have the limits of the deposits established. Then, in accord with the results, the areas which would be affected by future gravel operations could be outlined. These data would help to establish boundaries for the leases and prepare the grounds for good mining and reclamation plans.

The rest of the municipalities in the Vancouver area (Pitt Meadows, Burnaby, Delta, Richmond, Vancouver, North Vancouver, and West Vancouver) have no operating sand and gravel pits, although there is dredging of alluvial sand in the municipalities of Delta and Richmond. Large Capilano deposits along Lynn Creek and Seymour and Capilano Rivers were sterilized many years ago by residential development, but there is potential to locate and develop smaller deposits of this type along the shores of Indian Arm.

3.2 AVAILABILITY OF SAND AND GRAVEL FOR GREATER VANCOUVER MARKET

For many years Greater Vancouver construction activities have depended on gravel brought in from other areas. Because the major production centres in the Fraser lowland and adjacent areas are far away from the urban core and trucking costs are prohibitive, the industry has developed production units along the coast and is barging to Vancouver about 3 840 000 m^3 of aggregate per year to supply the construction industry. Some of the deposits in the Howe Sound area have already been depleted, but about 75 per cent of Capilano deltaic deposits located along the shores of Jervis and Sechelt Inlets have not been explored or developed. Other areas with aggregate potential lie along the shores of Indian Arm or eventually of Pitt Lake. The surficial geology of these areas has not been mapped and it is quite possible that significant deposits of gravel will eventually be located. A final possibility would be to consider dredging gravel from the bottom of the Strait of Georgia.

The expected lifetime of major producers in the coastal area is estimated for one of the pits at 5 years, another two at 10 and 20 years, and the last three at approximately 30 years. Due to a relatively simple tenure procedure, not affected by municipal or agricultural land reserve regulations, it may be assumed that aggregate reserves for Greater Vancouver from the coastal pits

are available for well over 10 years. This is despite the fact that the demand is expected to double in approximately 20 years and the actual lifetime of the production centres, due to higher production volumes, will be accordingly shorter.

3.3 QUARRIED AND CRUSHED AGGREGATE

At the time of writing this report, there was no active quarry producing crushed aggregate in the study area. This type of production at Pitt Lake, near Port Coquitlam, was phased out several years ago and the quarry at Watts Point, in Howe Sound, became inactive in 1979.

The data published in '*Industrial Minerals and Rocks*' (Lefond, 1975) indicate that production costs of crushed quarried aggregate are 30 to 50 per cent higher than those of sand and gravel. This means that the two products cannot be competitive if they come from local sources. However, increased transportation costs as a result of moving to deposits more distant from the market, may make crushed quarried rock in the lower mainland competitive again in the future.

Yet another possibility is changing circumstances. Limestone quarries on Texada Island, for example, are producing large volumes of waste. Granitic dykes form a significant part of the limestone deposit, and, for the lime and cement industry, the dyke material is deleterious. Since mining of only limestone is frequently impractical, dykes are usually selectively mined out and dumped. If such waste were to be crushed and screened it could provide an economic source of mineral aggregate, because the barging distance to Vancouver is about the same as from Jervis or Sechelt Inlets.

TABLE 4.1 SAND AND GRAVEL PRODUCTION IN INDIVIDUAL MUNICIPALITIES

District Municipality	1978 Approximate Production Volume m^3	Geological Units	Remarks
Kent	40 000	Sumas drift — small scattered remnants.	
Chilliwack	370 000	Sumas drift in Chilliwack River valley. Alluvial fan of Chilliwack River. Alluvial deposits of Fraser River (dredging about 20%).	
Abbotsford	25 000	Small alluvial fans. Sumas drift.	Most of the local needs supplied from Matsqui District.
Matsqui	1 380 000	Sumas drift.	Supplies most of Abbotsford and part of Langley's needs.
Mission	190 000	Sumas drift — small and irregular deposits on mountain slopes and in valleys.	
Maple Ridge	240 000	Sumas and Vashon drifts — small and irregular deposits on valley slopes.	
Langley	480 000	Sumas drift and Fort Langley formation south of Langley.	
Surrey	320 000	Sumas drift and Fort Langley formation south of Langley.	
Coquitlam	620 000	Complex deposits of Sumas and Vashon drifts with products of earlier glaciations.	
Delta	170 000	Alluvial deposits of Fraser River.	Dredging.
Richmond	115 000	Alluvial deposits of Fraser River.	Dredging.
TOTAL	3 900 000		

Note: Does not include production data of Ministry of Transportation and Highways.

IV. AGGREGATE PRODUCTION AND USE

4.1 PRODUCTION CENTRES AND DISTRIBUTION PATTERNS

The distribution of production centres depends in general on the local market size and availability of the resource. As has been discovered during our survey, the market can bear transportation costs up to approximately 32 kilometres by truck and 112 kilometres by barge. Transportation cost, therefore, seems to be the main limiting factor in the lower mainland by dictating the size of production in quite a competitive market. Only large deposits with large markets within economic transportation distances can support several larger producers concentrated in a relatively small area. Availability of transportation corridors is also an extremely important factor for marketability of aggregates in the lower mainland. The lack of available crossings on the Fraser River further constrains marketing construction aggregate from one side to the other (Fig. 4-2).

There are more than 70 producing pits in the lower mainland with total output in the order of 2 700 000 m^3 per year. Table 4-1 provides annual production data for individual district municipalities with respect to the geological units in the area.

There is no aggregate production in Vancouver, West and North Vancouver, New Westminster, and Burnaby Municipal Districts. Only a small part of this approximately 3 000 000-m^3 market is from production in immediately adjacent municipalities (mainly Coquitlam), while the bulk of the needs for the Vancouver area are barged in from six main production centres along the coast of the Strait of Georgia and the Juan de Fuca Strait (Fig. 4-1). The following Table 4.2 lists the production centres supplying the Greater Vancouver market.

TABLE 4.2 PRODUCTION VOLUMES FROM COASTAL PITS

Location	1978 Approximate Production Volume m^3	Geological Units	Remarks
Jervis and Sechelt Inlets	1 160 000	Capilano delta	Some used on Vancouver Island
Howe Sound	580 000	Capilano delta	
Others	2 100 000	Capilano delta and Quadra sand	1 000 000 m^3 are net imports from U.S.A.
TOTAL	3 840 000		

Production and distribution patterns for the lower mainland (Fig. 4-2) and Greater Vancouver (Fig. 4-3) and adjacent municipalities have very little overlap. Transportation costs are prohibitive for marketing production from most of the lower mainland deposits in the Vancouver area. Only Coquitlam River valley is within economic reach of the Greater Vancouver market.

4.2 CURRENT BRITISH COLUMBIA AND LOWER MAINLAND USE CHARACTERISTICS

Past and current use characteristics for sand and gravel are shown in the following Tables 4.3 through 4.6. The results indicate that there is very little stability in the use characteristics over

TABLE 4.4 BRITISH COLUMBIA PUBLIC TRANSPORTATION SECTOR ESTIMATED AGGREGATE USE AND VALUE IN 1978 DOLLARS

Use Category	Highways *tonnes*	Railways *tonnes*	Municipalities *tonnes*
Road construction and maintenance	12 192 523	---	930 360
Ice control	945 677	---	---
Asphalt	2 485 436	---	---
Railroad ballast	---	699 630	---
Gravel fill	---	119 959	232 590
TOTAL	15 623 636*	819 589	1 162 950
Average value	$1.29/t	.70/t**	1.09/t

*From 75 pits; 184 782 tonnes in lower mainland from 68 pits.

**Values range from $0.53 per tonne to $2.29 per tonne; taken from 16 pits and 4 in lower mainland area.

TABLE 4.5 LOWER MAINLAND COMMERCIAL AGGREGATE USE, 1978

Use Category	Aggregate Sold and Used *tonnes*	Share
Road construction and maintenance	5 984 270	.49
Concrete production	2 126 280	.18
Asphalt production	1 999 988	.16
Railway ballast	122 860	.01
Mortar sand	6 973	.00
Back fill mines	141 534	.01
All other fill	1 614 413	.13
Special uses	143 497	.01
TOTAL	12 139 815	1.00

Source: Mineral Economics Division, 1978 Sand and Gravel (Statistics Canada) returns.

TABLE 4.6 CANADA AND BRITISH COLUMBIA SAND AND GRAVEL CONSUMPTION BY END USE, 1977

Use Category	Canada	Share	B.C.	Share
	(000's tonnes)			
Road construction and maintenance	141 984	.58	30 568	.69
Road ice control	3 780	.02	139	.00
Concrete	31 947	.13	3 553	.08
Asphalt	18 671	.08	4 187	.09
Rail ballast	3 570	.01	1 298	.03
Mine backfill	1 199	.00	183	.00
Mortar sand	2 100	.01	80	.00
Other fill	23 984	.10	3 665	.08
Special uses	18 985	.08	814	.02
TOTAL	246 220	1.00	44 487	1.00

Source: Statistics Canada.

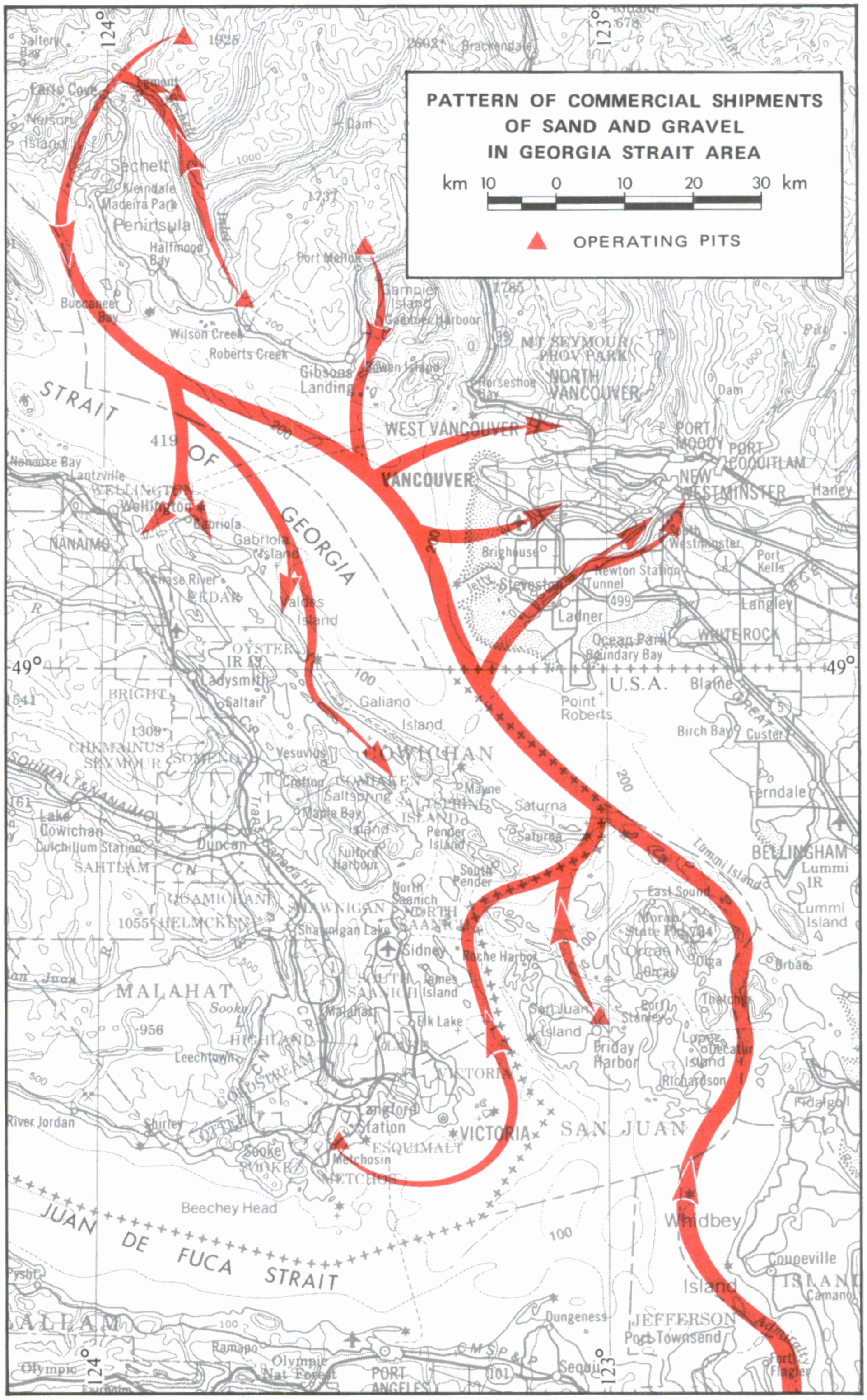


Figure 4-3. Pattern of commercial shipments of sand and gravel in Georgia Strait area.

time except that the road construction and maintenance category dominates as a share of total production. All categories fluctuate depending on the nature of construction undertaken in each year and large projects dominate the scene in any given year.

TABLE 4.3 END USES OF SAND AND GRAVEL, LOWER MAINLAND REGION
(thousands of tonnes)

Use Category	1964	*per cent*	1973	*per cent*	1978	*per cent*
Road construction and maintenance	1 592.0	28.2	5 092.0	42.3	19 107.0	66.4
Concrete aggregate	1 655.0	29.3	3 144.0	26.1	2 126.0	7.4
Asphalt aggregate	825.0	14.6	816.0	6.8	4 485.0	15.6
Railroad ballast	356.0	6.3	51.0	0.4	822.0	2.9
Mortar sand	46.0	0.8	144.0	1.2	7.0	0.02
Back fill mines	N/A	N/A	N/A	N/A	142.0	0.5
All other fill	585.0	10.4	2 381.0	19.8	1 967.0	6.8
Special uses	474.0	8.4	52.0	0.4	143.0	0.5
Unclassified	108.0	1.9	364.0	3.0	N/A	N/A
TOTAL	5 642.0	100.0	12 044.0	100.0	28 799.0	100.0

Source: 1964 and 1973 data from Siverston and Carson (1974). 1978 data from Mineral Economics Division.
Note: Includes noncommercial production for construction and maintenance of roads and highways.

Over time, it would be expected that the road construction and maintenance use category would gradually reduce in importance as a percentage of total use. This is due to a gradual maturation of infrastructure as municipalities grow to their optimum size and density. However, while this may be the case for Vancouver city, the region as a whole certainly does not display this pattern.

4.3 MARKET AREAS

The geographical features of the study area in relationship to the distribution of sand and gravel deposits and consequently aggregate production centres result in essentially five major market areas. There is very limited competition between each area. Transportation constraints, including long distances between areas and associated transport costs and the limited number of Fraser River crossings, are major obstacles for penetration from one area into another. Most of Greater Vancouver is within reach of docking facilities along the shoreline of Burrard Inlet and on the Fraser River and is supplied by barges from coastal pits. Gravel pits located in the Coquitlam valley supply the municipalities of Port Moody, Coquitlam, Port Coquitlam, and part of Surrey and Pitt Meadows. Central Fraser River valley municipalities south of the Fraser River from Abbotsford to Surrey obtain their aggregate from gravel pits near Aldergrove and Langley. Another two isolated markets have developed for the municipalities of Maple Ridge-Mission on the northern side of the Fraser River and for the Chilliwack-Kent area.

V. AGGREGATE DEMAND, PRICING, AND COSTS

Projected demands for British Columbia and the lower mainland are examined in this chapter. We have tested several demand models, which are described below, and attempted to fit these to the available consumption data. This chapter also examines demand price elasticity for the resource.

5.1. 1974 MODEL

Sivertson and Carson (1974) postulated that per capita sand and gravel consumption was related to real income, a proxy variable for economic activity in the Province. Using data from 1962 to 1973 they derived the following equation:

(1) $C/P = -77.74 + 11.62 \log Y/P$

$R^2 = .72$ $F = 25.26$

where

C/P = consumption per capita in short tons/person

log Y/P = log normalized form of real per capita personal income in constant 1961 dollars

R^2 = correlation coefficient

F = 'F' statistic for testing overall significance of regression.

The estimator equation implies that, per capita, consumption of sand and gravel in British Columbia tends to rise steeply at first with increases in income and then less steeply. Also, per capita consumption continually increases but less than proportionately with increases in real income.

In our current analysis, we have extended the time frame by five years so that the period covered is 1962 to 1978 and re-estimated the equation using 1971 constant dollar observations on real personal income. Thus, equation (1) above is generalized as:

(2) $C/P = f(\log Y/P)$

and estimated using generalized least squares regression as:

(3) $C/P = -37.51 + 12.95 \log Y/P$

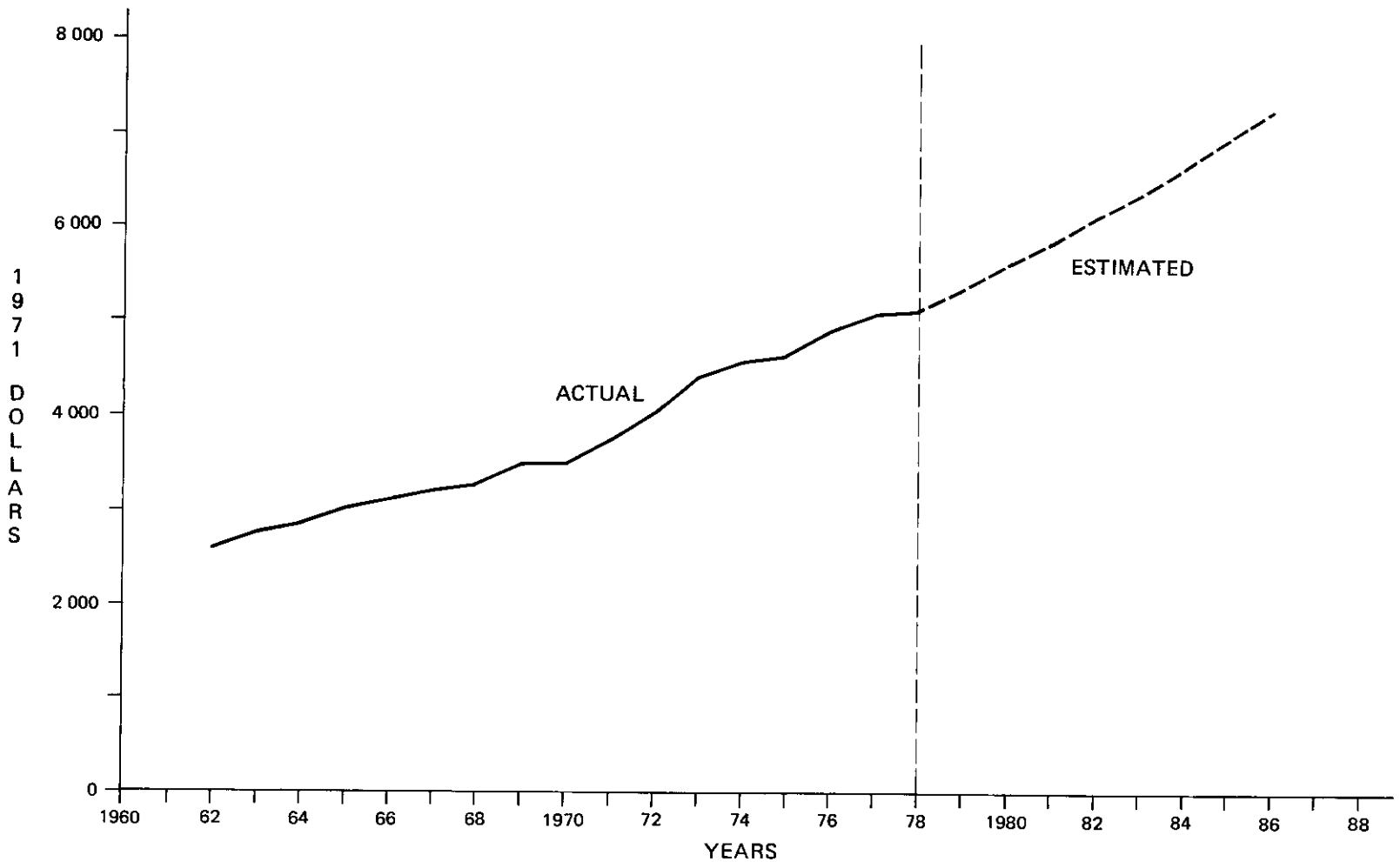
where

C/P = per capita consumption of sand and gravel in tonnes

log Y/P = decimal log of real personal income per capita in 1971 constant dollars

$R^2 = .59$ $F = 21.9$

This model (equation 3) is rejected for purposes of estimating one possible demand scenario due to a poor correlation.



Source: Mineral Economics Division, 1980.

Figure 5-1. Real per capita income in British Columbia (1971 dollars).

5.2. ONTARIO MODEL

The Ontario study (1977) postulated that the demand for mineral aggregate is a derived demand from the construction sector of the economy. The model is summarized as follows:

(4) $C = f(GPP, Y/P, \Delta POP)$

(5) $D = \sum_{i=1} \omega_i \phi_i(G_i)$

where

f and ϕ, stand for 'function of'

C = dollar value of construction activity

GPP = gross provincial product

Y/P = real per capita income

ΔPOP = year to year population growth

D = demand for mineral aggregates in short tons

ω_i = weights or input coefficients measuring tons of aggregate per $1 000 value of construction (residential, nonresidential, engineering)

C_i = value of construction in residential (C_1), nonresidential (C_2), and engineering (C_3) categories

Our data base does not enable full estimation of this equation for British Columbia primarily due to the paucity of data on input coefficients. However, the theoretical approach taken is more appealing than conventional extrapolation of past consumption. While the Ontario model is somewhat more complex than the Sivertson-Carson model, it was ultimately rejected by Ontario in favour of a simple straight line extrapolation of historical data. The latter, for Ontario, embodied an assumption of declining per capita consumption and declining value of material inputs in construction.

5.3. BRITISH COLUMBIA MODEL (1980)

Using multiple nonlinear (as well as linear) regression techniques, we have compared several models to obtain forecasts of the lower mainland consumption (in tonnes) of sand and gravel for the 1979 to 1986 period.

Based on data for the 1962 to 1978 period, we selected the best model as the following:

(6) $C = f(\ln Y/P)$

$C = -99\,910.7 + 13\,355.33 \ln Y/P$

T = values: for constant term = −7.3, for ln Y/P = 8.0

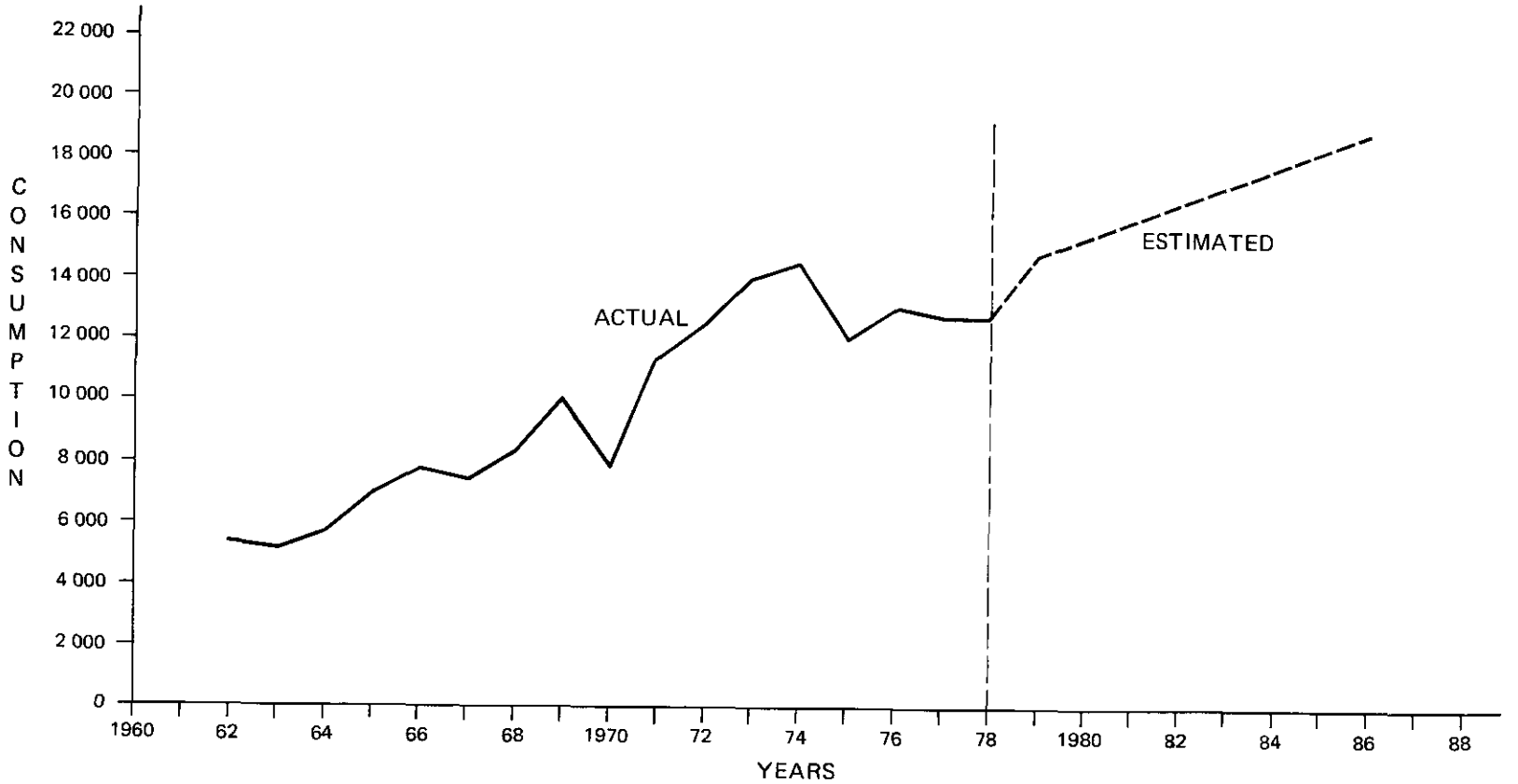
$R^2 = .81$, $F(1,15) = 63.6$, DW = 1.84

where

C = lower mainland consumption of sand and gravel in thousands of tonnes

ln Y/P = natural log of British Columbia real per capita income in dollars (base year = 1971).

DW = Durbin-Watson statistic for testing presence for autocorrelation.



Source: Mineral Economics Division, 1980.

Figure 5-2. Lower mainland sand and gravel consumption – actual and projected (10^3 tonnes).

On Figure 5-2, we show graphically the values of the lower mainland consumption from 1962 to 1986 inclusive, where 1962 to 1978 values are observed. The values for 1979 to 1986 are estimated by applying the above equation to estimated values of real per capita income in 1979 to 1986 (in 1971 dollars). The estimated values of real per capita income have been obtained from 1962 to 1978 observed values by applying the average annual historical growth rate during the 1962 to 1978 period to the 1978 to 1986 period in each year (*see* Fig. 5-1).

On Figure 5-3, we show the estimated values of consumption for 1962 to 1978. These estimates are obtained from equation 6 and illustrate the variance between the estimate derived from the regression and actual values for the period.

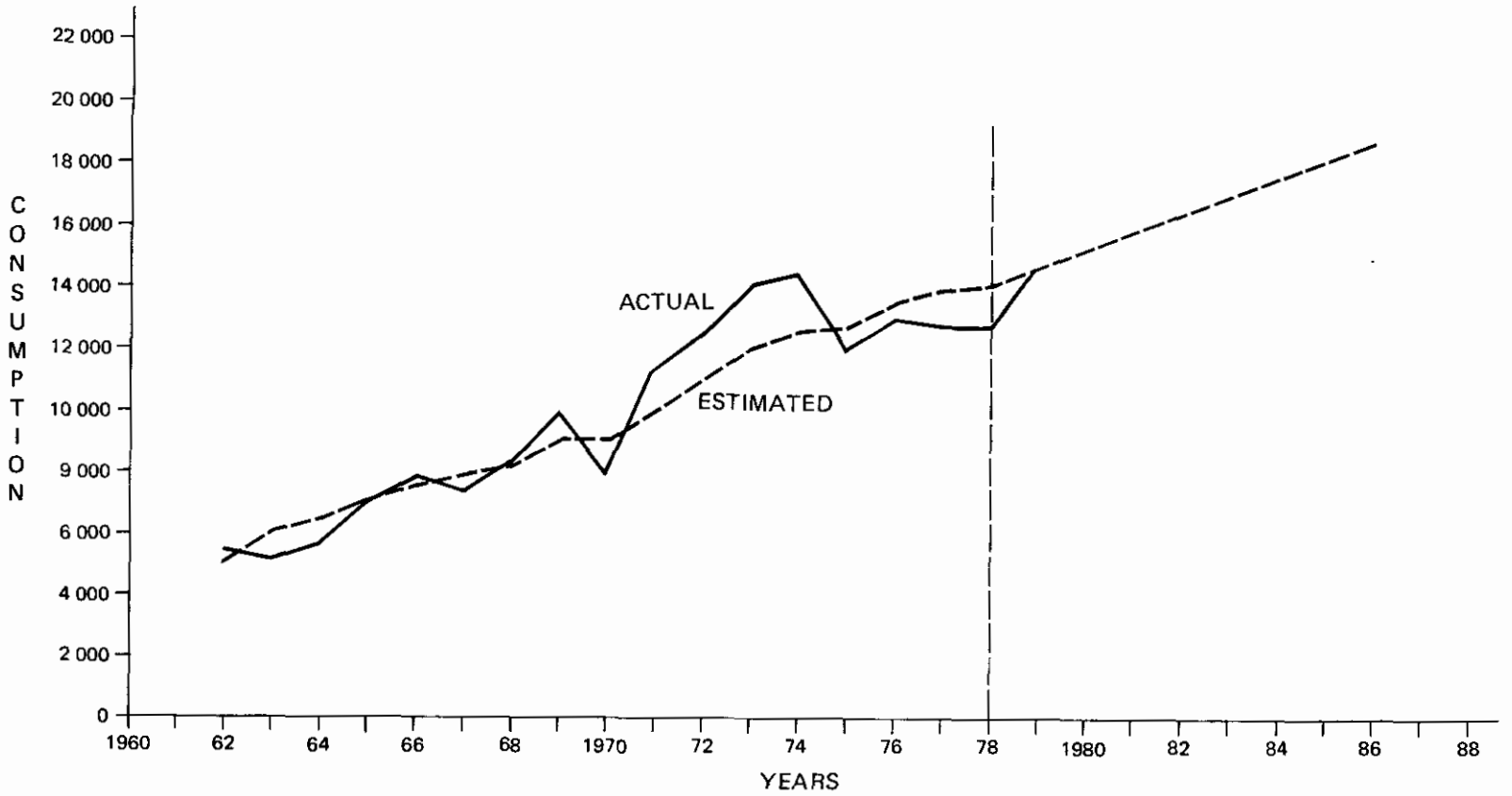
On Figure 5-4, we show estimated values of consumption for 1979 to 1986 based on the continuation of the average annual growth rate observed in the lower mainland over the 1962 to 1978 period.

Both estimates are equal somewhere during 1981 to 1982. The forecast based on C = f (ln Y/P) is higher in the short term (1979 to 1981) but lower after, than the estimation based on average growth rate. Due to the high significance of the linear equation C = f (ln Y/P), we have chosen C = f (ln Y/P) as the best forecasting model of lower mainland consumption for 1979 to 1986.

The model indicates that lower mainland sand and gravel consumption would grow from some 12.8 million tonnes in 1978 to about 18.7 million tonnes annually by 1986 (*see* Table 5.1) or 26.6 million tonnes by the year 2000. Projections for noncommercial sectors are more difficult to make because this use is strongly influenced by large projects spread unevenly over the years. The general trend, however, would be expected to follow the commercial use pattern.

TABLE 5.1 TABLE OF ACTUAL AND ESTIMATED VALUES FOR COMMERCIAL AGGREGATE USE

Year	Lower Mainland Consumption in Thousands of Tonnes	Real Per Capita Income in $ (1971 Basis)	
1962	5 254	2 583	Actual
1963	5 073	2 763	
1964	5 611	2 858	
1965	6 907	3 007	
1966	7 684	3 111	
1967	7 377	3 203	
1968	8 259	3 288	
1969	9 980	3 491	
1970	7 833	3 489	
1971	11 321	3 745	
1972	12 494	4 018	
1973	13 969	4 377	
1974	14 468	4 553	
1975	12 043	4 631	
1976	12 919	4 886	
1977	12 727	5 059	
1978	12 819	5 117	
1979	14 722	5 342	Estimated
1980	15 297	5 577	
1981	15 871	5 822	
1982	16 445	6 077	
1983	17 019	6 344	
1984	17 594	6 623	
1985	18 168	6 914	
1986	18 742	7 218	



Source: Mineral Economics Division, 1980.

Figure 5-3. Lower mainland sand and gravel consumption — actual, projected, and estimated (10^3 tonnes).

5.4 ELASTICITY OF DEMAND

Commercial consumption and price data from 1962 to 1978 were examined to determine whether variations in the price of sand and gravel had influenced the quantity used during the period. A commodity is price elastic if a certain variation in price results in a larger variation in quantity of the commodity demanded; it is price inelastic if price variations result in smaller variations in demand.

Examination of the data indicates that demand for sand and gravel is perfectly price inelastic. Annual changes in quantities demanded by the commercial sector are insensitive to annual price changes. This can be explained by the fact that this sectoral demand is construction derived and the cost of sand and gravel is a relatively insignificant percentage of total construction costs.

5.5 AGGREGATE PRICING AND COSTS

Data on sand and gravel pricing and costs were derived from operator surveys in 1978. The data show such substantial variance between operators that mean prices are not particularly representative.

PRICES

The price averages shown below are taken from operator surveys and are quoted FOB point of sale at the pit or plant.

TABLE 5.2 PRICE OF SAND AND GRAVEL

Material	Type	Mean Price $/m^3	Standard Deviation $/m^3
Unprocessed	Pit Run	2.17	1.03
Unprocessed	Fill	2.23	0.77
Processed	Screened and washed	5.59	1.73
Processed	Screened and crushed	4.97	1.62

In comparison, data from the Ministry's annual operator statistical surveys indicates that average value for all sand and gravel aggregate materials has risen from about $1.00 per tonne in 1970 to about $1.80 per tonne in 1978 (*see* following Tables 5.3 and 5.4). This data includes data from all producing sectors – highways, railways, municipal, commercial, and imports.

OPERATING COSTS AND TREATMENT COSTS

As is the case with data on prices, cost information elicited in our operator surveys showed substantial variation between operators. Also, we expected the data to illustrate certain economics of scale in operating and treatment costs. From the information provided in Table 5.5, there does not appear to be sufficient evidence to support this

TABLE 5.3 VALUES OF LOWER MAINLAND* SAND AND GRAVEL PRODUCTION

($/tonne)

Years	Highways	Railways	Municipal	Commercial	Imports	Average
1970	1.02	0.00	0.00	1.04	0.96	1.04
1971	1.02	0.00	0.00	0.97	1.00	0.95
1972	1.02	1.91	0.00	1.06	0.84	1.05
1973	1.02	0.27	1.00	1.27	1.06	1.25
1974	0.99	0.36	0.81	1.33	1.07	1.25
1975	1.55	0.00	0.86	1.60	1.20	1.49
1976	1.10	0.00	0.78	1.62	1.50	1.49
1977	0.55	0.00	1.02	1.77	1.90	1.64
1978	1.29	0.00	1.04	1.91	1.99	1.83

Source: Mineral Economics Division

*Includes producers in New Westminster and Vancouver mining divisions.

TABLE 5.4 LOWER MAINLAND AVERAGE PRICES/VALUES FOR SAND AND GRAVEL, 1978

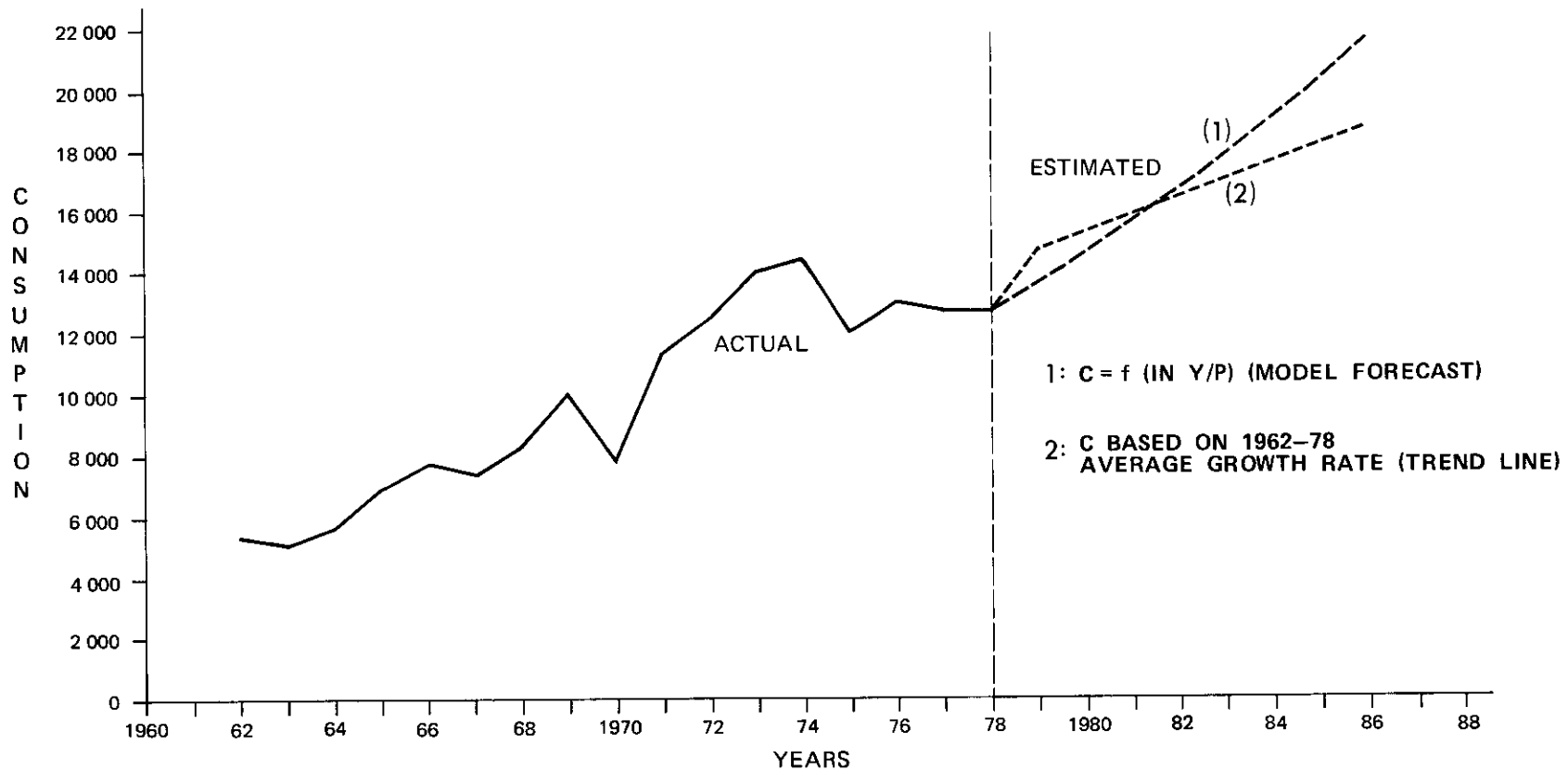
($/m^3)

Data Source	Category	Price
Ministry of Energy, Mines and Petroleum Resources/Statistics Canada	Average sand price	3.22
	Average natural gravel price	2.64
	Average crushed gravel price	5.74
	Average total price	3.06
Ministry of Energy, Mines and Petroleum Resources Fall 1978 survey	Average pit-run gravel price	2.32
	Average screened and crushed gravel price	5.22

TABLE 5.5 OPERATING AND TREATMENT COSTS

Cost Category	Production Category: Up to 50 000 m^3 per year	50 000 to 100 000 m^3 per year	Over 100 000 m^3 per year
Operating costs $/m^3			
Average	4.04	6.33	2.21
Standard deviation	1.32	4.86	1.23
Treatment costs* $/m^3			
Average	1.37	4.46	1.47
Standard deviation	1.17	1.10	1.01

*Included in operating costs.



Source: Mineral Economics Division, 1980.

Figure 5-4. Lower mainland sand and gravel consumption — actual and projected alternatives (10^3 tonnes).

hypothesis in the 50 000 to 100 000-m^3 production range, although for the larger operations (over 100 000 m^3) some cost reductions are observed.

TRANSPORTATION COSTS

Road

Based on the results of the questionnaire, the average cost per truck load is $0.84 per kilometre. Assuming an average truck load of 13 tonnes, the truck transportation cost would therefore be $0.06 per tonne per kilometre.

For comparison it is interesting to mention the following results published by the Canadian Transport Commission, Traffic and Tariffs Branch in *'The Canadian Mineral Aggregate Industry'* (December 1978). The Commission found that, in the Vancouver area, truck-haul distances for barged material range from 8 to a maximum of 40 kilometres. It was also found that in the fiscal year 1976/77 truck transportation costs ranged from $1.40 to $3.20 per tonne in Vancouver.

Water

With the exception of the MacKenzie River system, common carriers in Canada are not required to file freight tariffs on bulk commodities (including sand, gravel, and stone) with any government body. However, current information indicates that barging rates from coastal pits into the Vancouver market are in the order of $1.75 to $2.50 per tonne of processed aggregate depending on the size and handling requirements of the shipment.

VI. FACTORS INFLUENCING SUPPLY

This chapter discusses a range of factors which directly or indirectly relate to the supply and availability of the resource. These factors include the general structure of the producing industries, tenure and tax systems facing the industry, and the respective roles of different Government agencies and the regulations of these agencies.

6.1 PROBLEMS RELATED TO MULTIPLICITY OF AGENCIES AND REGULATIONS

In British Columbia the following Government agencies share responsibility for sand and gravel and have an impact on its production:

Ministry of Lands, Parks and Housing: The Land Management Branch has statutory authority to issue tenure to Crown land and foreshore areas, which authorizes mining for aggregates and collects royalties for the aggregates removed.

Ministry of Environment:

(a) Fish and Wildlife Branch reviews applications for dredging operations from river beds and other water bodies.

(b) Water Management Branch, if requested, reviews applications for gravel extraction where aquifers may be affected or disturbed by extraction. The Branch may review applications for dredging sand and gravel from below the groundwater table.

(c) Resource Analysis Branch has a staff of surficial geologists and air photograph interpreters who are continuously preparing surficial geological resource maps including data on sand and gravel. The Branch also provides analysis of urban suitability in designated areas.

Ministry of Forests: The Ministry has overview responsibility for gravel supplies for primary roads and secondary logging roads, and is itself a user of gravel in the construction of forest access roads. Authority to issue Special Use Permits (SUP) for noncommercial production of sand and gravel in gazetted forests is currently being transferred to Lands, Parks and Housing.

Ministry of Energy, Mines and Petroleum Resources:

(a) The Ministry is responsible for safety standards and reclamation of most privately operated gravel pits that are not integrated with cement or other manufacturing.

(b) General responsibility for mineral resource management.

(c) Responsible for taxation of gravel operations on private land under the *Mineral Land Tax Act*.

Ministry of Finance: The Ministry is responsible for taxation of profits from gravel operations under the *Mining Tax Act*.

Ministry of Transportation and Highways: The Ministry is a major user of the resource. It appraises sources and estimates reserves for its own use. It owns, operates, and inspects gravel pits for road construction and maintenance.

Ministry of Municipal Affairs:	The Ministry is responsible for legislation enabling Municipalities and Regional Districts to pass 'soil removal' (including sand and gravel) regulatory by-laws. Recommends approval of Regional District soil removal by-laws to Cabinet.
Ministry of Agriculture:	The *Soil Conservation Act* requires that the Land Commission approve, under a permit system, any soil removal (including gravel) from agricultural reserve (ALR) lands.
Workers' Compensation Board:	Pits integrated with other industrial installations such as ready-mix plants are inspected by the Workers' Compensation Board. The Workers' Compensation Board also is responsible for safety in noncommercial gravel pits.
Regional Districts:	Regional Districts can influence gravel extraction through recommendations involving zoning by-laws, development plans, building permits, etc.
Municipalities:	Some Municipalities have by-laws which enable them to charge a permit fee on each produced cubic metre of sand and gravel and to implement local safety and reclamation requirements. Many own and operate gravel pits.
Department of Indian and Northern Affairs:	Supervises and regulates sand and gravel production from Indian Reserves.
Environment Canada Fisheries Service:	This federal department regulates dredging operations from rivers and other water bodies under the Canada Federal *Fisheries Act* (Gravel Removal Order).

This proliferation of agency involvement, each with differing rules, jurisdictions, and levels of enforcement, has had a detrimental effect on the industry generally, and has brought the situation to its present state of poor resource management planning and inadequate coordination. One result is that gradually more and more deposits are eliminated from the resource base and potential reserves of mineral aggregate are becoming unavailable for exploitation.

6.2 STRUCTURE OF BRITISH COLUMBIA SAND AND GRAVEL INDUSTRY

The Ministry of Energy, Mines and Petroleum Resources survey of sand and gravel operators in the fall of 1978 enumerated 61 independent operators or companies extracting aggregate from pits in the lower mainland. Of this number, 29 operators produced in the less than 50 000-m^3-per-year range and represented 15 per cent of total annual production. At the other end of the scale, only five companies had annual capacity exceeding 200 000 m^3 but they produced 36 per cent of the total volume for the region. This is shown in Table 6.1.

TABLE 6.1 LOWER MAINLAND SAND AND GRAVEL INDUSTRY CHARACTERISTICS, 1978

Annual Capacity Range m^3/year	Number of Independent Operators/Companies*	Total Annual Production** m^3	per cent
0 <PC ≤ 50 000	29	923 964	(15)
50 000 < PC ≤ 100 000	14	1 114 907	(18)
100 000 <PC ≤ 150 000	6	702 921	(11)
150 000 <PC ≤ 200 000	7	1 098 935	(20)
PC > 200 000	5	2 203 157	(36)
TOTAL	61	6 143 884	(100)

Source: Fall 1978, Sand and Gravel Survey, Ministry of Energy, Mines and Petroleum Resources.
Note: PC = production capacity.
*Includes commercial operators and municipalities responding to survey.
**Production level estimated by operators responding to survey.

The 1974 study showed that four operators in the region controlled about 60 per cent of the commercial market. The 1978 results seem to indicate that this controlling share has declined significantly and many smaller firms have been established in recent years.

The information on product prices and the pricing behaviour of firms is subject to substantial error but illustrates wide price variance for similar product types and locational factors. Also, there appears to be little, if any, overt price leadership based on the survey results. However, a few of the smaller operators did indicate that the majors had occasionally engaged in undercutting prices, thus putting the smaller less profitable operators at a competitive disadvantage. We estimate that less than a dozen of 61 lower mainland firms operating sand and gravel pits were forward-integrated into concrete aggregate, ready-mix or asphalt manufacture.

6.3 TAXATION OF SAND AND GRAVEL INDUSTRY

The industry is currently subject to the following major types of taxes:

Federal

- Federal Corporation Income Tax (36%) (before April 1980 mini-budget)
- Federal Sales Tax at the wholesale level (9%)
- Excise Tax (for instance, on fuel)

Provincial

- British Columbia Corporation Income Tax (15% on major business)
  (12% on small business)
- British Columbia Mining Tax (15%)
- British Columbia Mineral Land Tax (on assessed value if freehold land, most pay minimum of $0.25 per acre).
- Crown Royalties on Crown Gravel Lease (rates vary slightly, minimum is $0.20 per m^3).
- British Columbia Social Services (Sales) Tax (4%)
- British Columbia Corporation Capital Tax (.2% of assessment)

TABLE 6.2 CALCULATION OF FEDERAL INCOME TAX

+	Gross income	
—	Operating costs (mining, processing, marketing, administration, transportation)	
=	Operating profit	
—	Inventory allowance (3% of working capital, tangible stock-in-trade)	
—	CCA major mining and processing assets	(30% write-off)
—	CCA other mining and processing assets	(0 — 30% declining balance)
—	Debt interest	
—	Canadian exploration expense	(0 — 100% write-off)
—	Canadian development expense	(0 — 100% write-off)
—	British Columbia mining tax (at the pro rata of Federal Income to mining income under mining tax)	
=	Income subject to earned depletion	
—	Earned depletion	(25% of above)
—	Loss carry forward	
=	Taxable income	
X	Tax rate [46% — 10% Provincial abatement + 5% surcharge (1980) = 41%]	
=	Tax payable	
—	Tax credits (research and investment tax credits)	
=	Adjusted tax payable	

NOTE: CCA = capital cost allowance.

TABLE 6.3 CALCULATION OF BRITISH COLUMBIA CORPORATION INCOME TAX

+	Operating profit from British Columbia operations
Deductions	
—	Mining tax (at the pro rata of federal income to mining income under mining tax).
—	British Columbia Crown royalties
—	Inventory allowance (3% of working capital, tangible stock-in-trade)
—	British Columbia capital cost allowance*
—	Interest expense
—	British Columbia exploration/development expense*
—	British Columbia earned depletion*
—	Losses carried forward
=	British Columbia taxable income
X	British Columbia corporation income tax rate (15%)
=	British Columbia income tax

*Can be optimized independent of federal deductions

Local

Regional District Tax (property tax on assessed value)
Municipal Property Tax (property tax on assessed value)
Municipal Levies on Production from Municipal Lands

This section describes the major aspects of these types of taxes and royalties.

FEDERAL INCOME TAX

The major features of the federal corporation income tax are described in the attached example (Table 6.2). The major feature distinguishing this from other mineral industries is that the federal resource allowance does not apply since provincial mining tax deductability is permitted.

PROVINCIAL TAXES

Calculation of the British Columbia income tax and mining tax are described in Tables 6.3 and 6.4. The main feature to note is that both are levied against total corporate income rather than on an operation-by-operation basis.

With respect to the mining tax, sand and gravel operations which are forward-integrated with cement product manufacturing or asphalt, have recently faced a serious tax burden with the inclusion of the latter under the scope of the *Mining Tax Act* (MTA). The problem stems from the fact that the processing allowance under the *Mining Tax Act* has been ineffective in removing the income derived from further processing of the sand and gravel from the tax base for mining tax purposes. British Columbia's 1980 budget includes provisions to remove this disparity first by allowing a processing allowance rate of 8 per cent based on the original capital cost of processing assets, and second, by increasing the upper limit on the allowance claimed up to 70 per cent of income for operations which further process the resources into a manufactured form (for example, cement blocks, etc.).

MINERAL LAND TAX

This is a three-tiered tax structure applied only to freehold mineral rights. The basic tax ranges from $0.25 to $1.00 per acre. If the property is 'designated' and is producing a mineral, a basic tax of $2.00 per acre overrides the above minimum and additional tax is also paid based on assessed value times a mill rate. At present, only freehold coal, natural gas, and crude oil pay the second and third components of the tax.

OTHER TAXES

The following other types of taxes are applicable to mining in British Columbia:

1. British Columbia Corporation Capital Tax – This tax is applied on a corporation's paid-up taxable capital employed in British Columbia. The rate of tax is 0.2 per cent. Taxable capital consists of paid-up shares, debt, and reserves capital less allowances for goodwill and investment holdings.

TABLE 6.4 CALCULATION OF BRITISH COLUMBIA MINING TAX

+	Federal taxable income
Add backs:	
+	Federal CCA
+	Federal exploration and development expense
+	Federal earned depletion
=	Income before British Columbia permissive deductions
Deductions/other adjustments:	
–	Crown royalties and mineral land taxes
–	British Columbia capital cost allowance
–	Canadian exploration and development expense
+	Loss adjustments (carry forwards) from other years
+	Federal deductions claimed for non-British Columbia activity
–	British Columbia processing allowance (8% of original cost of processing assets, minimum 15%, maximum 50% or up to 70% depending on degree of further processing)
=	British Columbia taxable income
X	Mining tax rate (15%)
=	Mining tax

NOTE: (1) CCA = capital cost allowance.
(2) Depletion is not allowed.
(3) Losses and profits of two mines can be consolidated by the same tax payer.

2. Municipal and Regional District Taxes — These vary from region to region and are based on assessed value of land and improvements times the applicable mill rate.

3. *British Columbia Social Services Tax* — This is a sales tax and is levied at the origin of purchase on goods and services purchased by a mine for use within British Columbia. The rate of tax is 4 per cent of price.

PROVINCIAL ROYALTIES

The 1970 *Land Act*, chapter 17, section 24, allows the Crown to charge royalties on sand and gravel which is removed from the ground.

> 'Leases or other dispositions granted for the purpose of mining, quarrying, digging, or removal of building or construction materials, including, . . . sand, gravel . . . . may contain provision for the payment of royalty with respect to such material removed from the lands at rates to be determined by the minister.'

The following is a step-by-step discussion of the applications of this provision on a sand and gravel operation after the deposit is initially discovered.

1. If the deposit is located on land which is owned by the Crown it is necessary for the operator to obtain a lease.

2. If the lease is approved, the levy charged depends upon the type of operation to be established.

   (a) *Sand and Gravel Exploitation Only*

      (i) Basic land rent is charged annually and is calculated only on the surface area of the leased land.

      (ii) A royalty is charged on the sand and gravel which is removed from the ground. At present, the minimum royalty charged is $0.20 per cubic metre. This can be increased by the local regional manager of the Ministry of Lands, Parks and Housing if market conditions warrant it. As a result, there are regional differences in the royalty rates charged throughout the province.

   (b) *Additional Facilities*

      When additional facilities, such as an asphalt plant, cement plant, etc., are established on the leased land then the basis of taxing changes:

      (i) The basic annual land rent is charged as before.
      (ii) On top of the sand and gravel royalty charged, a ground rent is also levied. This tax is 8 per cent of the appraised market value for the land and is paid annually.

At present, the royalty payments are collected via the mail. The operator fills in a return stating how much sand and gravel was removed and the Crown then bills the appropriate amount (according to the royalty).

MUNICIPAL ROYALTIES AND LEVIES

Several municipalities in our study region levy royalties or fees on sand and gravel production from municipal lands. These are enabled by various soil removal by-laws. The fees ostensibly provide funds for reclamation of pits and provide a source of revenue for municipalities. The range of royalty rates by municipality is shown in the following Table 6.5.

TABLE 6.5 ROYALTY RATES IN LOWER MAINLAND MUNICIPALITIES

Municipality	Royalty Rate (1978)
Kent	$.13/m^3
Abbotsford	$.20/m^3
Matsqui	$.28/m^3
Mission	$.10/m^3
Maple Ridge	$.20/m^3
Langley	$.26/m^3
Surrey	$.26/m^3
Coquitlam	$.26/m^3

TABLE 6.6 SUMMARY OF MUNICIPAL PERFORMANCE BONDS

Municipality	Performance Bonds
Abbotsford	$ 2 470 per hectare
Burnaby	N/A
Chilliwack	---------
Coquitlam	$10 000
Kent	$ 2 470 per hectare
	$10 000 maximum
Langley	$ 3 705 per hectare
Maple Ridge	$ 50 per 500 cubic yards
Matsqui	$ 5 000 per hectare plus $ 3 000–$20 000
Mission	$ 3 087 per hectare
Nanaimo	$ 4 940 per hectare
Powell River	N/A
Surrey	Assessed for each operation in the land use contract

6.4 TENURE

Sand and gravel pits can be operated under a Special Use Permit if they are for noncommercial use under the *Forest Act*, or under the lease and permits issued by the Ministry of Lands, Parks and Housing for commercial use from Crown lands. District municipalities under the *Municipal Act* have the authority to issue permits to operate gravel pits within their boundaries. The tenure procedure and implications are described for each case in the following subsections.

SPECIAL USE PERMIT (SUP)

A sand and gravel pit can be operated under Special Use Permit if it is for noncommercial use, like road building, for example. The Special Use Permit for nonforest use which includes production of sand and gravel was administered up until October 1979 by the Ministry of Forests under the *Forest Act*. At that time responsibility was transferred by mutual agreement to the Ministry of Lands, Parks and Housing to be administered under the *Land Act*. This agreement is valid until December 31, 1982.

The Special Use Permit is obtained through a regional manager or ranger of the particular forest region, and renewed every year. During active operations, on-site inspection is done by the ranger. Prior to issuance, other government agencies, namely the Ministry of Environment and Ministry of Energy, Mines and Petroleum Resources, are contacted for a vetting of the permit application.

Part of the permit contains a list of special requirements in order to prevent any pollution, erosion, ponding, etc., and a provision for monthly collection of royalty, the rate of which is subject to annual revision.

LEASE ON CROWN LANDS

The Ministry of Lands, Parks and Housing is responsible for the issuance of permits and leases to private operators on Crown land. The permit fee is $25.00 for 90 days. Generally, permits are authorized for use on sand and gravel river bars, but can also be issued on dry land if necessary. Dredging leases must respect the regulations of the *Canada Fisheries Act* and in particular British Columbia Gravel Removal Order made under the same Act. The procedure for obtaining a permit or lease is as follows:

- operator applies to British Columbia Land Commission;
- Land Commission sends application to Ministry of Lands, Parks and Housing after approval by the Commission;
- Ministry of Lands, Parks and Housing then issues a permit if they feel it is valid. Before they do issue a permit they consult other government agencies to ensure that there are no conflicts;
- A permit or lease is then issued if there are no problems.

Leases are usually issued for five to ten or 15-year periods. Under a program developed in 1974, a Land Officer surveys each pit (cross sections) annually to determine how much royalty should be paid. In the lower mainland the royalty rate is $0.52 per cubic metre. The pits are visited two or three times a year compared with once every five years before 1974.

MUNICIPAL AND OTHER PERMITS

Permits to operate gravel pits on any lands within a municipality are regulated under the *Municipal Act*. Under this Act different regulations and prohibitions may be made for different areas of the same municipality. Typically, soil removal by-laws differ slightly between municipalities, but in the lower mainland they generally follow a similar pattern. Under regulations of the *Agricultural Land Commission Act* and *Soil Conservation Act* no person shall use land designated as an agricultural land reserve (ALR) for any purpose other than farm use, and no person shall remove soil or place fill on land in an agricultural land reserve. In the lower mainland and south of the Fraser River in particular, practically all of the areas underlain by gravel are classified as agricultural land reserve. Exemptions have to approved by a municipal council, regional board, or provincial Land Commission, and the following rules apply:

1. *Agricultural Land Commission Act*

   This Act states in section 11.(1) that an exemption from this Act may be obtained automatically if 'in respect of agricultural land in an agricultural land reserve that, on the twenty-first day of December, 1972, was, by separate certificate of title issued under the *Land Registry Act*, less than two acres in area'.

2. In an amendment made to the *Agricultural Land Commission Act*, January 16, 1975, section B, Land Use, (1) Outright Uses, it states the following:

   > 'In addition to the land uses permitted pursuant to the Land Commission Act, the following land uses are permitted in an agricultural land reserve . . . . . .
   > (j) extending the workings of an already existing gravel pit provided the total of acres already excavated and currently being worked does not exceed a maximum of two (2) acres in area'.

   Section B, (2) Conditional Uses, states:

   > 'Notwithstanding the requirements of British Columbia Regulation No. 60/74, the Provincial Land Commission may authorize for the purposes of the Land Commission Act and in the manner set forth in this section, the following land uses, where, in the opinion of the Commission, the proposed use and manner of development thereof does not materially reduce the future agricultural potential of the land or where in the opinion of the Commission the proposed use is in the public interest: . . . . . .
   > (m) gravel pits over two (2) acres in area, peat extractive areas, and turf farms where reclamation and rehabilitation is possible'.

The exemption for sand and gravel operations over two acres (0.809 hectare) within agricultural land reserve boundaries comes under the *Soil Conservation Act*, sections 2 and 3. The operator is required to make application with the local municipality or regional district on which the land is situated. The application for a permit is then sent to the provincial Land Commission. If the Commission approves the application in writing

and if the applicant has complied with the regulations the local authority 'may grant a permit to remove soil from or place fill on land in an agricultural land reserve'.

The local municipality or regional district can refuse a permit even after the Commission has approved it. As a result, there are three possible instances of rejection: (1) the original application to local authorities; (2) the Commission; and (3) the local authorities after Commission approval. Rejection is usually made on the basis of improper reclamation procedures and/or the location of the pit.

The Ministry of Transportation and Highways is not required to apply for a permit from the local government. Under direct British Columbia Regulation No. 9375 the Ministry of Transportation and Highways can make application directly to the Commission.

Under individual soil removal by-laws, district municipalities issue regulations for the industry within their boundaries regarding safety, pollution, drainage and reclamation, permit fees, and performance bonds.

6.5 SAFETY AND RECLAMATION

Safety and reclamation standards are regulated by several agencies with the result that there are differing rules and differing degrees of enforcement. A sand and gravel operation is considered to be a mine under the *Mining Regulation Act* when this material is offered for sale. This applies regardless of location on Crown or private land. Such commercial operations fall under the *Mining Regulation Act* which covers pre-work approval of mining plans with respect to environmental protection, safety of personnel and the general public, and consequent reclamation of mined-out areas. Other sand and gravel operations and those integrated with processing are the responsibility of the Workers' Compensation Board (WCB) under the Industrial Health and Safety Regulations which have no provisions for reclamation or rehabilitation. Municipal soil removal by-laws, however, have provisions for reclamation and are applied to many gravel operations. There are also some provisions for public safety not covered sufficiently by the Industrial Health and Safety Regulations.

SAFETY REQUIREMENTS

1. *Mining Regulation Act*

   Safety regulations under this Act are applied to all commercial producers of sand and gravel who are marketing the product. Inspectors of mines appointed under the *Mining Regulation Act* are responsible for enforcing these regulations.

2. Ministry of Transportation and Highways

   The Ministry of Transportation and Highways' sand and gravel operations come under the Workers' Compensation Board's Industrial Health and Safety Regulations. The individual pit managers are responsible for this facet of the operation and must ensure that all Workers' Compensation Board rules are obeyed. Individual municipal and regional district safety regulations are also respected.

3. Workers' Compensation Board (WCB)

The safety rules for the Workers' Compensation Board are covered in the Industrial Health and Safety Regulations. For sand and gravel pits the Regulations have sections on: access to excavations, removal of excavated material, faces and slopes, miscellaneous requirements, safety equipment, control of rock dust, and the use of explosives in different situations. In private pits, where there is no processing on the site (ready-mix, paving mix), the Workers' Compensation Board has only very limited jurisdiction.

4. Municipal Sand and Gravel Operations.

In the municipal by-laws there are certain requirements for public safety concerning operators of gravel pits.

(a) District Municipality of Coquitlam: By-law No. 190

'All excavations and other hazards made pursuant to a Permit shall be fenced and suitable weather-proof signs shall be mounted and maintained on the fence. The fence shall be not less than four (4) feet high and shall be located not more than one thousand (1,000) feet from the hazard or excavation. The signs shall have wording to indicate the danger, the nature of the operation, the presence of the excavation and to prohibit the presence of the public, and shall be placed not more than one hundred (100) feet apart'.

(b) District Municipality of Kent: By-law No. 589, section 8(F)

As per Coquitlam.

(c) District Municipality of Langley: By-law No. 1569, section 7(d)

As per Coquitlam.

Also section 4(vi) states:

'The proposed methods of fencing, enclosing and clearing to assure that no hazard to human or animal life exists'.

Maple Ridge, Matsqui, and Mission District Municipalities have requirements similar to those of Coquitlam.

RECLAMATION AND REHABILITATION

The image of the aggregate industry is diminished in the eyes of the public when abandoned gravel pits are left unreclaimed or used as dumping grounds for old equipment and miscellaneous junk. During the field survey many sand and gravel pits were observed, particularly in rural areas, where very little reclamation had been done. One problem is that there were no rules in the past and the present rules are not the same for all operators and neither is the enforcement. Provisions of the *Mining Regulation Act*, for example, are not applied to all commercial gravel operations due to staff shortage. The noncommercial production of gravel is not subject to inspection by the Ministry of Energy, Mines and Petroleum Resources. Pits lying within municipalities may be excluded from the *Mining Regulation Act* (section 10, subsection 17) if reclamation is adequately secured by their by-law. The multiplicity of jurisdictions with the resulting confusion in direction is also a major problem.

Reclamation requirements are summarized as follows.

1. Commercial Operators

   Under sections 11 and 12 of the *Mining Regulation Act*, it is the duty of every operator to carry out a program for the protection and reclamation of the surface of the land and watercourses affected by the mining. Before commencing such an operation, the owner, according to this Act, must file with the Minister a report containing a program for environmental protection and reclamation of the land during and after the operation of the pit. The Chief Inspector may approve programs on behalf of the Minister pursuant to section 11, subsection 17 of the *Mining Regulation Act*. An environmental performance bond must be deposited to ensure compliance with the program. However, if the protection and reclamation of the land is adequately secured and controlled under any other Act, regulation, or municipal by-law, the pit operator may be exempted from section 11 of the *Mining Regulation Act*.

2. Ministry of Transportation and Highways

   The general rules are:
   - recontour pit after excavation is complete,
   - seed to grass,
   - where in view of road, reforest.

   The requirements of each district vary and it is up to the local officer to state the reclamation practices. These rules apply to pits owned by the Ministry or controlled by them on Crown land.

3. Municipal Requirements

   Soil removal by-laws of individual municipalities contain provisions regarding reclamation of mined-out areas. Some requirements are very specific, citing number of individual tree species per acre and how many pounds of different grass seeds must be used per acre. The effectiveness of the reclamation effort has not been evaluated.

VII. POLICY AND PLANNING CONSIDERATIONS FOR FURTHER WORK

This study was initiated to develop background data which could be used as a basis for improved management of the sand and gravel resource in the lower mainland. Estimates are made of the reserves of the area, locations of these reserves are defined, and the existing regulatory and administrative systems which influence sand and gravel supply and costs of production are given. Objectives for managing these resources should include assurance of adequate supply at minimum cost, appropriate environmental and safety conditions during extraction, sequential and planned use of land containing the resource, rational tax systems, and a simplified and streamlined system of regulation and administration.

The study has revealed a number of factors which under present conditions adversely influence the attainment of these objectives. They are listed in the following as matters which deserve study in any analysis leading toward recommendations for amending government policies.

GEOLOGY

(a) Gaps exist in our knowledge of the sand and gravel deposits of the region. Areas north of the Fraser River which have some potential for containing gravel deposits should be mapped. The extent of some important deposits, notably those in the Coquitlam valley, is not sufficiently known, and should be defined and the nature of the resources evaluated.

(b) Government surveys in appropriate areas should have as one important objective the identification and management of extractable sand and gravel resources. This is partially hampered under present conditions because surficial geology mapping, a key component in the objective, is currently carried out by the Ministry of Environment for other purposes.

(c) Municipalities, which to a large extent control extraction in the lower mainland, should be aware of the distribution and reserves of sand and gravel deposits within their boundaries, and should consider their development in municipal planning and regulation.

TAXATION AND ROYALTIES

(a) The purpose, legal basis, and impact of taxation and royalty assessments on sand and gravel must be defined and rationalized in relationship to the management of this resource. Present tax and royalty systems have grown up *ad hoc* with revenue as the primary objective. Tax and royalty systems should be developed with an appreciation of the needs for managing the resource.

(b) At the provincial level the application of the Mineral Land Tax, Mining Tax, and Crown Royalties should be clarified. Consolidation of the administration of these taxes and royalties in one agency with responsibility for management of the resources would facilitate that management.

(c) Policies for assessing royalties on sand and gravel extracted from Crown land must be defined with due regard for pricing of these commodities.

ADMINISTRATION

Administrative, legal, and regulatory problems identified in this study include the following:

(a) The rights to sand and gravel are issued along with surface rights. Consequently, management of the resource becomes a secondary consideration in many disposals of Crown land. Furthermore, such dispositions are controlled by the provincial agency which has no authority over extraction practices. This leads to poor communications, inefficient administration, and uncoordinated resource development.

(b) In some areas the responsibility for reclamation of gravel pits is still not clear. The *Mining Regulation Act* provides standards for reclamation which are province-wide and the provincial government provides a trained inspection and administrative staff. These procedures, however, are directed solely toward reclamation and do not normally consider land-use planning.

(c) Extraction practices, including pit planning and initial engineering, worker and public safety during operation, and reclamation and public safety after extraction is complete, should be the responsibility of one agency, preferably the Inspection and Engineering Division of the Ministry of Energy, Mines and Petroleum Resources.

(d) All local governments must become more aware of sand and gravel resources and develop sequential land-use planning for optimum extraction.

All the foregoing factors require further study before recommendation for new policies and new legislation can be brought forward. Implementation of new policies for management of the aggregate resources must also recognize the highly competitive nature of the business, and the interests held by various provincial government agencies and by various levels of government. Municipal governments in areas containing gravel resources must be actively involved in the evolution of procedures for management of the resources as they are directly affected by the availability of low-cost supplies of construction aggregate, as well as by the inconveniences of operational and post-operational phases of the industry. Consultation with all affected groups during policy development is essential. Sound sand and gravel management policies must be implemented very soon, as the available reserves in the lower mainland are rapidly nearing depletion.

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APPENDICES

CONDITIONS AND REQUIREMENTS FOR HOLDING A SPECIAL USE PERMIT

EXCERPTS FROM MUNICIPAL SOIL REMOVAL BY–LAWS REGARDING TENURE

EXCERPTS FROM MUNICIPAL SOIL REMOVAL BY–LAWS REGARDING PUBLIC SAFETY

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APPENDIX 1-A – CONDITIONS AND REQUIREMENTS FOR HOLDING A SPECIAL USE PERMIT

The following are excerpts from a typical Special Use Permit.

'IMPROVEMENTS

Before cutting any timber, erecting any building or other structure or making any other improvement to the licence area the Permittee will submit to the Regional Manager a plan showing the locations of the cutting and the locations and specifications of structures, buildings, and other improvements proposed for the permit area.

MISCELLANEOUS

The Permittee will indemnify the Crown against and save it harmless from all claims, demands, suits, actions, causes of action, costs, and expenses faced by the Crown as a result, directly or indirectly, of the Permittee's occupation or use of the permit area.

The parties acknowledge that, for fire protection purposes, sections 121 to 123 of the Forest Act shall apply to the permit area and to the parties as though the permit area were a parcel of Crown land subject to an interest under the Land Act.

The Permittee will at his own expense

(a) repair all damage, except ordinary wear and tear, to roads, trails, irrigation ditches and other improvements on Crown land that results from his use of the permit area, and

(b) dispose of all slash and other refuse resulting from the use of the permit area under this Special Use Permit, in the manner directed by a Forest Officer.

The Special Use Permit is subject to the Forest Act and all regulations made under it.

The Permittee will perform the covenants and will observe the conditions, if any, set out in the attached Schedule.

SPECIAL CONDITIONS:

1. *The permittee shall:*
   - *(a) not allow any substance likely to cause pollution to be deposited at any time within any lake or stream;*
   - *(b) not allow any damage to be done within the highwater level of any stream channel or lake;*
   - *(c) not place or cause to be placed any obstruction or fill within the highwater level of any stream channel or lake.*

2. *There shall be no interference with free public access through or on the permit area, excepting those portions which are occupied by buildings or structures.*

3. *Within ten days after the last day of each month the permittee shall submit to the Regional Manager a signed return showing the number of cubic metres of material re-*

moved from the area described in this permit during the preceding month. Upon receipt of account from the Regional Manager, payment shall be made immediately at the rate of $.39 per cubic metre in respect to all material removed from the permit area for the forthcoming year. This rate shall be subject to revision on any anniversary date or renewal of the permit.

4. *On completion of the use of any gravel pit, or at any time prior thereto whenever required by the Forest Officer, the sides of the gravel pit shall be cut down so that the slopes of the edge of the pit will not exceed the angle of 45 degrees and at any time whenever required by a Forest Officer drainage ditches shall be constructed or other suitable drainage measures taken to prevent the accumulation of water.*

5. *The permittee shall take such measures as directed by the Regional Manager, following preparation of the slopes of the edge of the pit, or rock quarry to prevent erosion and to rehabilitate the site.*

   In the event the permittee fails to carry out the above measures the Regional Manager may assess the permittee the estimated costs to carry out such measures, and the permittee shall forthwith pay the account.

6. *This permit is subject to the provisions of the Health Act and any regulations issued thereunder.*

7. *This permit is subject to the provisions of the Pollution Control Act, and the Litter Act, and any regulations issued thereunder.*

8. *Upon final cessation of operations or at any other time as instructed by the Regional Manager, the permittee shall take such measures as directed by the Regional Manager to prevent erosion and to rehabilitate the site. In the event the permittee fails to carry out the above measures the Regional Manager may assess the permittee the estimated costs to carry out such measures, and the permittee shall forthwith pay the account.*

9. *The permittee shall construct a berm and/or trench of sufficient dimensions around all fuel storage tanks to prevent run-off in the event of fuel spillage. In the event the permittee fails to carry out the above measures the Regional Manager may assess the permittee the estimated costs to carry out such measures, and the permittee shall forthwith pay the account.*

10. *The permittee shall use and maintain the permit area in a manner to cause the least damage to the environment all to the satisfaction of the Regional Manager.*

11. *The Regional Manager reserves the right to recommend, during the term of this Special Use Permit, transferral of the administration of the said Special Use Permit to the Ministry of Lands, Parks and Housing.'*

APPENDIX 1-B – EXCERPTS FROM MUNICIPAL SOIL REMOVAL BY–LAWS REGARDING TENURE

A. DISTRICT MUNICIPALITY OF KENT

Soil Removal By-Law No. 589–1970.

Prospective operators are required to apply to the municipality for a permit to remove sand and gravel. The application must be 'accompanied by detailed plan data prepared by a registered Professional Engineer for the Province of British Columbia or a British Columbia Land Surveyor.' For a list of 'plan requirements' *see* the following excerpt.

The applicant must deposit a bond or irrevocable letter of credit in the amount of $1 000.00 per acre of property to be mined. This bond can be no less than $1 000.00 and no greater than $10 000.00. The bond is held as security by the municipality to ensure that the specified work in the application is carried out. The permit can then be awarded. A permit fee of $.13 per cubic metre is charged.

The municipality can refuse a permit if the plans are not satisfactory or if the mine plans affect adjacent property, etc.

There are a series of requirements made of prospective operators concerning their operations which must be agreed to and obeyed once production begins. Included in these requirements are the reclamation procedures, section 8 (h).

'(2) An application shall be accompanied by detailed plan data and specifications prepared by a registered Professional Engineer for the Province of British Columbia or a British Columbia Land Surveyor, to a scale of one hundred feet (100 feet) to the inch or larger, and show the contour of the ground in its current state with vertical contour intervals of not more than five feet (5 feet) using Geodetic Datum or with vertical contours at such intervals as the municipality may determine according to reasonable engineering standards, and shall contain information with respect to the following matters:

- *(a) all pertinent features including buildings, structures and tree cover; roads, lanes, bridges and natural watercourses;*
- *(b) the proposed slopes which will be maintained upon completion of the operation.*
- *(c) the methods proposed to control the erosion of the banks of the excavation or fill;*
- *(d) the proposed methods of drainage control for the excavation during the excavation;*
- *(e) the proposed methods of access to the site during the excavation;*
- *(f) the proposed methods of fencing, enclosing and clearing to assure that no hazard to human or animal life exists;*
- *(g) the proposed progressive stages of excavation in terms of annual development showing vertical contours specified above, grades and slopes on separate plans for each stage;*
- *(h) the proposed contour of the ground in its final state upon completion of the operation with vertical contours as specified above, and showing the method of access and positive methods of permanent drainage on a separate plan;*
- *(i) the proposed location of machinery, building scales and all other proposed structures and improvements;*

(j) the proposed location of Buffer Zones and tree cover, and location and grade and width of berms.'

'8. Each and every permit issued pursuant to this By-law shall be subject to the following conditions:

(a) the excavation of lands, shall be such that positive gravity drainage is assured. The elevation of the bottom of any excavation shall be such that the lowest point is being drained by gravity to a natural watercourse or a public drainage facility adequate for the purpose. This clause shall not be contrued to prevent the operator from establishing a settling pool;

(b) all damage to adjacent municipal or privately owned drainage facilities, roads, or lanes, or other municipally or privately owned property, or natural watercourses, resulting from the excavation or the removal of soil, shall be repaired. All adjacent drainage facilities and natural watercourses shall be kept free of silt, clay, sand, rubble, debris, gravel and any other matter or thing originating from any excavation of any lands and causing obstruction to such drainage or natural watercourses. Drainage facilities or natural watercourses shall not be polluted;

(c) stockpiles of soil shall be confined to the permit holder's lands and same shall be maintained so that they do not adversely affect or damage adjacent properties or Buffer Zones;

(d) the operation by which the said soil is removed shall not encroach upon, undermine or physically damage any adjacent property;

(e) no natural watercourse shall be altered or diverted, except with the written permission of the Water Rights Branch of the Department of Lands, Forests and Water Resources of the Province of British Columbia and the written permission of the municipality;

(f) all excavations of lands and other hazards shall be provided with suitable Buffer Zones, and suitable weatherproff signs shall be mounted and maintained on the property line at linear distances not to exceed Five Hundred feet (500 ft.) with wording to indicate the nature of the operation, the presence of excavation, and prohibiting the presence of the public;

(g) temporary excavations below the levels permitted in the said plans may be permitted where the municipality is satisfied that such excavations will not detract from the general scheme and intent of this By-law and where the excavation is to be filled with waste or other suitable earth material within the said period;

(h) all surfaces of the excavation shall be covered with the original cover material or with an established growth of grass or some other suitable rooted groundcover, either by seeding or sodding;

(i) all machinery and vehicles used shall be in good and proper working order and contain sound reducing and dust elimination equipment wherever reasonably possible;

(j) no excavations or operations of any kind whatsoever shall occur on any Sunday. No trucks shall be transported to or from lands on any Sunday, except by permit issued by the Municipality. Nothing in this clause shall restrict any manufacturing operations now or in the future to be carried on in any part of the municipality which is presently zoned for industrial use, or which may in the future be zoned for industrial use;

(k) no soil shall be deposited or be permitted to remain within twenty-five feet (25 ft.) of any road allowance or adjacent property, and all vehicles and machinery shall be kept within the confine of the buffer area or berm.

9. The permit holder shall

(a) commence the work within One (1) year from the date of the permit;

(b) complete fifty per centum (50%) of the work within Three (3) years from the date of the permit;

(c) complete the whole of the work within Five (5) years from the date of the permit;

(d) complete all restoration requirements within Six (6) years from the date of the permit.

Failure to comply with these requirements will void the permit, with no refund of fees.'

B. DISTRICT MUNICIPALITY OF CHILLIWACK

A prospective operator must make application under the terms set out in the *Soil Conservation Act*, 1977, that is, he must first apply to the municipality for a permit and then to the Provincial Land Commission. The land in Chilliwack is in the agricultural land reserve. Under the *Soil Conservation Act* the applicant is required to submit a performance bond.

A local By-law, part 14, section 1402 states:

'1. A USE in the GRAVEL PIT ZONE shall not be permitted on a lot of less than 20 acres except where such lot was existing at the effective date of this By-law.

2. A RESOURCE USE in the GP ZONE shall be limited to

a. the extraction of gravel;

b. rock quarries;

c. rock-crushing, subject to the restriction in subsection (3);

d. asphalt-mixing, subject to the restriction in subsection (3).

3. Except where gravel is removed from the bed of a natural stream of running water, the operation of gravel pits shall be subject to the following regulations:

a. Gravel shall not be removed from lands within one hundred feet of a district zoned other than as a GRAVEL PIT ZONE, or within two hundred feet of a public highway;

b. If the extraction of gravel proceeds below the average annual water level within the area of the gravel pit, the excavation shall forthwith be filled back to the said water level;

c. If the extraction of gravel from a parcel of land is discontinued for a period of over six months the owner of the land shall clean up the excavated area and leave it free from all debris, and shall slope the banks of the excavated area so as to remove all danger of cave-in. The clean-up of the pit shall be completed within eight months after the extraction of gravel has been discontinued.

4. Rock crushing and asphalt-mixing equipment may be operated in a GRAVEL PIT ZONE except on lands within five hundred feet of a district zoned other than as a GRAVEL PIT ZONE.'

C. DISTRICT MUNICIPALITY OF ABBOTSFORD

By-Law No. 71—1974, amendment of Sand and Gravel Removal By-law No. 584—1970.
Sand and Gravel By-Law No. 584–1970.

The overall procedure is the same as in the District Municipality of Kent. A performance bond of $1 000.00 per acre up to $10 000.00 maximum is required. A permit fee of $.20 per cubic metre is required. To get a permit approved two-thirds of the municipal council must agree to it. For Tenure Conditions see the following excerpt. The Annual Permit is to be renewed each year.

'8. Notwithstanding anything contained in the application form or accompanying documents, every permit issued pursuant to this By-Law shall be subject to the following conditions:

(a) The excavation shall be such that positive gravity drainage is at all times assured.

(b) All damage to Municipal drainage facilities, roads, lanes or other municipally owned property which in the judgement of the Engineer has been caused by the operation for which the permit was issued, shall be repaired at the expense of or by the permit holder. All such repairs shall be completed to the satisfaction of the Engineer, and until so completed shall be a just and proper charge against the bond deposited pursuant to Section 7(c) of the By-Law.

Without limiting the generality of the foregoing, the obstruction of Municipal drainage facilities by deposit of silt, clay, sand, rubble, debris, gravel and any other matter or thing originating from the soil removal operation shall be considered as damage under this section.

(c) No soil shall be removed from any place within one hundred yards of an arterial highway or from within fifty yards of a secondary highway or from within eleven yards of any other municipal highway; PROVIDED that where the present elevations of lands adjacent to any highway are such that compliance with the provisions of this Clause could result in hazardous or unsightly conditions, the Engineer may, with the approval of the Council, authorize the removal of soil closer to a highway, subject to Clause (c) of this section.

(d) Stockpiles shall be confined to the location prescribed and shall be maintained so that they do not adversely affect or damage adjacent property, and in no case shall the height of any stockpile exceed one fifth of the distance from its nearest side to the closest property line.

(e) No excavation shall be brought to a point below the existing grade of the adjacent road allowances, PROVIDED THAT:

(i) Where, in the opinion of the Engineer, the ultimate level of an existing road may be lower than the present level, he may authorize the excavation to be taken to the anticipated future road level, subject to all other provisions of this By-law.

(ii) Where a parcel of land adjoins two highways of different elevations, the Engineer may, subject to the provisions of this By-Law permit excavation to a depth not greater than that permissible for the highway with the lower elevation as hereinbefore provided for.

9. As soon after completion of the excavation as practicable and in no event longer than twelve (12) months, all surfaces of excavations created by the removal of soil shall:

(a) Be graded or sloped so that no gradient shall be steeper than 1½ to 1.

(b) Be covered with not less than six inches of top soil;

(c) Be sown with grass in quantities not less than twenty (20) pounds per acre.

The requirements of Sections (b) and (c) of this Section shall be at the discretion of the Engineer.'

D. DISTRICT MUNICIPALITY OF MATSQUI

Soil Removal and Deposit By-law No. 1617– August 1978.

The applicant is required to apply to the municipality for a permit. The application must be accompanied by an 'Environmental Impact Study' which should include:

'a. A statement as accurately as possible as to the pattern, quality, and amount of mineral resources within the proposed soil removal site.

b. A report concerning the end use of the land, ie, agricultural, forest industrial or residential and how this is to be implemented.

c. A report describing the soil type, organic matter, depth of topsoil and depth of overburden.

d. A program for stripping, storage and redistribution of material in detail.

e. A report of slope compatibility with the surrounding areas upon rehabilitation of the site . . . . .

f. A detailed ground water survey.

g. Such additional ecological factors governing geology, vegetation, wild life, etc., as required by the municipality for a complete environmental impact assessment.'

It is possible to obtain temporary permits and long term permits. For the latter type the requirements of the detailed plan data are similar to those in Kent.

Aside from the above requirements the applicant is required to deposit an irrevocable letter of credit totalling $5 000.00, plus a further amount of $3 000.00, to a maximum of $20 000.00 for each hectare of property from which soil is to be removed or deposited.

Upon receipt of the permit, the operator is required to pay $0.28 per cubic metre as a permit fee.

The requirements of the permit holder are set out in the following excerpt.

'4. (3) An 'A' type permit application shall be accompanied with detailed plan data and specifications prepared by a registered Professional Engineer for the Province of British Columbia to a scale of 1:1000 or larger and show the contour of the ground in its current state with vertical contours at such intervals as the municipality may determine according to reasonable engineering standards, and shall contain information as required by the municipal engineer with respect to the following matters;

(a) all pertinent features including buildings, structures and tree cover; roads, lanes, bridges and natural watercourses;

(b) the proposed slopes which will be maintained upon completion of the operation;

(c) *the methods proposed to control the erosion of the banks of the excavation or fill;*

(d) *the proposed methods of drainage control for the excavation during the excavation;*

(e) *the proposed methods of access to the site during the excavation;*

(f) *the proposed methods of fencing, enclosing and clearing to assure that no hazard to human or animal life exists;*

(g) *the proposed progressive stages of excavation in terms of annual development showing vertical contours specified above, grades and slopes on separate plan for each stage;*

(h) *the proposed contour of the ground in its final stage upon completion of the operation with vertical contours as specified above, and showing the method of access and positive methods of permanent drainage on a separate plan;*

(i) *the proposed location of machinery, building scales and all other proposed structures and improvements;*

(j) *the proposed location of Buffer Zone and tree cover, and location and grade width of berms;*

(k) *water table elevations;*

(l) *analysis of material by a Soils Engineer to determine its suitability for placement, removal or other use.*

(4) (a) *Every applicant shall produce and file with the application the consent in writing of any mortgage or unpaid vendor or owner of the lands from which it is intended to remove or place soil;*

(b) *Every applicant shall produce authorization from the Land Commission pursuant to the Soil Conservation Act where the land lies within A.L.R.;*

(c) *Every applicant shall produce authorization from the Federal and Provincial Authorities where required.'*

'Conditions required of permit holder

8. *Each and every permit issued pursuant to this By-law shall be subject to the following conditions:*

(a) *the excavation and filling of lands shall be such that positive gravity drainage is assured. The elevation of the bottom of any excavation or fill area be such that the lowest point is being drained by gravity to a natural watercourse or a public drainage facility adequate for the purpose. This clause shall not be construed to prevent the operator from establishing a settling pool;*

(b) *all damage to adjacent municipal or privately owned drainage facilities, roads, or lanes, or other municipally or privately owned property, or natural watercourses, resulting from the excavation, removal, or the deposit of soil, shall be repaired. All adjacent drainage facilities and natural watercourses shall be kept free of silt, clay, sand, rubble, debris, gravel and any other matter or thing originating from any deposit or excavation of any lands and causing obstruction to such drainage or natural watercourses. Drainage facilities or natural watercourses shall not be polluted;*

(c) *stockpiles or soil shall be confined to the permit holder's lands or other authorized land shall be maintained so that they do not adversely affect or damage adjacent properties or Buffer Zone;*

(d) the operation by which the said soil is deposited or removed shall not encroach upon, undermine or physically damage any adjacent property;

(e) no natural watercourse shall be altered or diverted, except with the written permission of the Water Rights Branch of the Department of Lands, Forests and Water Resources of the Province of British Columbia and the written permission of the municipality;

(f) all excavations and fills of lands and other hazards shall be fenced and provided with suitable Buffer Zones, and suitable weatherproof signs shall be mounted and maintained around the property line, with wording to indicate the nature of the operation, the presence of excavation, and prohibiting the presence of the public;

(g) temporary excavations below the levels permitted in the said plans may be permitted where the municipal engineer is satisfied that such excavation will not detract from the general scheme and intent of this By-law and where the excavation is to be filled with approved waste or other suitable earth material within the said period as determined by the municipal engineer;

(h) all surfaces of the excavation or fill shall be covered with topsoil or with an established growth of grass or some other suitable rooted groundcover, either by seeding or sodding;

(i) no soil shall be deposited or removed or be permitted to remain within 7.5 metres of any road allowance or adjacent property, and no vehicles or machinery shall be kept within the confine of the buffer area or berm;

(j) hours of operation shall conform to Anti-Noise By-law No. 735 Section 5(b), i.e. seven o'clock in the morning to eight o'clock in the evening, Monday to Saturday, only;

(k) all working faces of excavations shall be limited to height control within the limitations of the maximum safe reach of excavating equipment being used. The working face height limitations shall be subject to the 'ACCIDENT PREVENTION REGULATIONS', of the WORKMENS' COMPENSATION BOARD OF BRITISH COLUMBIA.

(l) No excavation into the acquifer will be permitted; except to construct settling ponds and water supply pits, both of which shall be shown on the Engineering drawings and will require prior approval by the Municipal Engineer.'

E. DISTRICT MUNICIPALITY OF MISSION

By—Law No. 475—1976.

The tenure requirements are basically the same as in Kent except that the permit cannot be issued for a period over five years.

The performance bond is $1 250.00 per acre.

The permit fee is $0.10 per cubic metre.

If the operator is leasing Crown land the permit fee is $1.00.

The conditions of tenure are the same as those outlined for Matsqui. Special requirements are in the following excerpt.

'8. Each and every permit issued pursuant to this By-Law shall be subject to the following conditions:

(a) the excavation of the Lands shall be such that positive gravity drainage is assured. The elevation of the bottom of any excavation shall be such that the lowest point is being drained by gravity to a natural watercourse or a public drainage facility adequate for the purpose. This subsection shall not be construed to prevent the operator from establishing a settling pool;

(b) all damage to adjacent Municipal or privately owned drained facilities, roads, or lanes, or other municipally or privately owned property, or natural watercourses, resulting from the excavation or removal of soil, shall be repaid. All adjacent drainage facilities and natural watercourses shall be kept free of obstruction and of silt, clay, sand, rubble, debris, gravel and any other matter or thing originating from any excavation or removal of soil. Drainage facilities or natural watercourses shall not be polluted;

(c) stockpiles of soil shall be confined to the Lands and shall be maintained so that they do not adversely affect or damage adjacent properties or encroach on buffer zones;

(d) the operation by which the said soil is removed shall not encroach upon the buffer zone except when specifically provided on the engineering drawings as approved by the Municipality;

(e) no natural watercourse shall be altered or diverted, except with the written permission of the Water Rights Branch of the Department of Lands, Forests and Water Resources of the Province of British Columbia and the written permission of the Municipality;

(f) all excavations of Lands shall be provided with suitable buffer zones and the Owner of such Lands shall effectively warn the public of the nature of the operation and the presence of the excavation.

(g) the Owner of such Lands shall effectively warn the public of any other hazards.

(h) temporary excavations below the levels permitted in the said drawings may be permitted where the Municipality is satisfied that such excavations shall not detract from the general scheme and intent of this By-law and where the excavation is to be filled with waste or other suitable earth material within the said period;

(i) all surfaces of the excavation shall be covered with the original cover material or with an established growth of grass or some other suitable rooted groundcover, either seeding or sodding;

(j) all machinery and vehicles used shall be in good and proper working order and contain sound reducing and dust elimination equipment wherever reasonably possible.

(k) all trees, roots, stumps, slash, and other debris shall be burned or otherwise disposed of as the excavation progresses and shall not be allowed to accumulate and constitute either a fire hazard or unsightly condition;

(l) no stockpiles of soil shall be deposited or vehicles or machinery kept within eight (8) metres of any road allowance or adjacent property.

F. DISTRICT MUNICIPALITY OF MAPLE RIDGE

By-Law No. 988–1970.

Tenure is obtained by the same basic procedures as in the District Municipality of Kent, that is, the permit application must be accompanied by a detailed data plan, a performance bond of $50.00-$500.00 per cubic yard, and a permit fee of $300.00. The conditions of tenure are very similar to those in the other municipalities.

G. DISTRICT MUNICIPALITY OF LANGLEY

Soil Removal By-Law No. 1029–1971.
Amended No. 1569–1976.
Amended No. 1338–1971.

As in Kent, except that the performance bond is $1 500.000 per acre, and the permit is $200.00-$1 000.00 per cubic yard removed. The permit is only valid for 2 years and must be renewed. The following excerpt shows the tenure conditions.

'(21) Every applicant for a permit shall enter into a written agreement with The Corporation of the Township of Langley, which agreement shall provide for the following:

(i) General conditions for the operation of the gravel pit.

(ii) The maximum depth of excavation.

(iii) Non-use perimeter widths and buffer zones. Such widths may be varied at the discretion of the Planning Officer, but shall not be less than One Hundred and Fifty (150) feet when adjacent to a public road nor less than Fifty (50) feet from other property boundaries.

(iv) The removal or non-removal of water and any other conditions pertaining to drainage.

(v) The days of the week and the hours of the day during which the gravel pit may be operated in accordance with the provisions of this Bylaw.

(vi) The control or prohibition of blasting operations.

(vii) The slopes of all surfaces within the excavated area. Slopes shall be a minimum of one (1) foot vertical to every two (2) feet on the horizontal plane.

(viii) The placing of topsoil on all excavated areas. The same shall be spread evenly over the excavated area.

(ix) The seeding to grass of all surfaces of the excavated areas.

(x) Adequate provisions to prevent any erosion to the boundaries of adjacent properties.

(xi) The payment of the cash bond as provided for in Clause (18) hereof; this cash bond to be paid to the Municipal Treasurer to be held in trust by him until all the work is completed in accordance with the plans deposited with and approved by the Planning Officer. In the event that the work is not completed to the satisfaction of the Municipal Council, the work may be performed by the Municipality and the cost thereof deducted from the cash bond held by the Treasurer. Such agreement shall stipulate a termination date of the agreement, and shall provide for entering into such further agreements which may become necessary from time to time. It being, hereby, ordered that all agreements shall conform to the requirements of the Soil Removal Bylaw at the time of signing the individual agreements.'

H. DISTRICT MUNICIPALITY OF SURREY

By-Law No. 4982.

As in other municipalities the applicant must apply to the municipality for a permit to quarry sand and gravel and comply with standard tenure conditions. Permit fees and performance bond are determined for each operation in the land use contract. The permit is only valid for 12 months and must be renewed at the same cost as a new permit.

I. DISTRICT MUNICIPALITY OF COQUITLAM

Soil Removal By-Law No. 190—1973
Amended Soil Removel By-Law No. 737—1977

The applicant must apply to the municipality for a permit and comply with tenure conditions standard to the other municipalities. The permit is valid for only up to 12 months and must be renewed every year. Permit fee is $0.26 per cubic metre, performance bond is $10 000.00.

APPENDIX 1-C – EXCERPTS FROM MUNICIPAL SOIL REMOVAL BY–LAWS REGARDING PUBLIC SAFETY

A. DISTRICT MUNICIPALITY OF COQUITLAM

By-law No. 190

'All excavations and other hazards made pursuant to a Permit shall be fenced and suitable weatherproof signs shall be mounted and maintained on the fence. The fence shall be not less than four (4) feet high and shall be located not more than one thousand (1 000) feet from the hazard or excavation. The signs shall have wording to indicate the danger, the nature of the operation, the presence of the excavation and to prohibit the presence of the public, and shall be placed not more than one hundred (100) feet apart.'

B. DISTRICT MUNICIPALITY OF KENT

By-law No. 589, Section 8 (F)

As per Coquitlam.

C. DISTRICT MUNICIPALITY OF LANGLEY

By-law No. 1569, Section 7 (d)

As per Coquitlam.

Also Section 4 (vi) requires for the application:

'The proposed methods of fencing, enclosing and clearing to assure that no hazard to human or animal life exists.'

The District Municipalities of Maple Ridge, Matsqui, and Mission have similar requirements to the District Municipality of Coquitlam.

APPENDIX 1-D – EXCERPTS FROM MUNICIPAL SOIL REMOVAL BY–LAWS REGARDING RECLAMATION AND REHABILITATION

A. DISTRICT MUNICIPALITY OF ABBOTSFORD

By-law No. 71–1974, Sections 91, b, and c

After excavation has been completed, all surfaces must be graded or sloped so that no gradient shall be steeper than 1½ to 1. Also, all surfaces will be covered with no less than 6 inches of topsoil and sewn with grass in quantities of no less than 20 pounds per acre.

B. DISTRICT MUNICIPALITY OF CHILLIWACK

Gravel must not be removed below average annual water level. If operation is discontinued for 6 months, the area must be cleared of debris and all danger of cave-in must be alleviated.

C. DISTRICT MUNICIPALITY OF COQUITLAM

By-law No. 190, Section 6(e)

Require stable slopes of gradient no more than 1½ to 1 and 15-foot-wide benches at 50-foot vertical intervals. Top soil should cover surfaces no less than 4 inches deep and be seeded with grass. There are specifications as to tree species and densities to be planted in mined-out areas as well as amount of grass seed per acre.

D. DISTRICT MUNICIPALITY OF KENT

By-law No. 589, Section 8(h)

'All surfaces of excavation shall be covered with the original cover material or with an established growth of grass or some other suitable rooted ground cover either by seeding or sodding.'

E. DISTRICT MUNICIPALITY OF LANGLEY

By-law No. 1329 (Section 21: vii, viii, ix, x)

'vii. The slopes of all surfaces within the excavated area shall be a minimum of one foot vertical to every two feet horizontally.
viii. The placing of top soil shall be spread evenly over the excavated area.
ix. The seeding to grass of all surfaces of the excavated areas.
x. Adequate provisions to prevent any erosion to the boundaries of adjacent properties.'

F. DISTRICT MUNICIPALITY OF MAPLE RIDGE

By-law No. 988 (Section 76)

'Damage to drainage facilities, roads or lanes or natural watercourses resulting from the excavation of soil shall be repaired. Drainage facilities and natural watercourses shall be kept free of

silt, clay, sand, rubble, debris, gravel, and any other matter or thing originating from an excavation and causing destruction. Drainage facilities or natural watercourses shall not be polluted.'

G. DISTRICT MUNICIPALITY OF MATSQUI

By-law No. 1617 (Section 8L)

'All surfaces of the excavation or fill shall be covered with top soil or with an established growth of grass or some other suitable rooted groundcover, either by seeding or sodding.'

H. DISTRICT MUNICIPALITY OF MISSION

By-law No. 475 (Section 8)

Conditions are exactly the same as stated in Maple Ridge By-law No. 988 (76).

I. DISTRICT MUNICIPALITY OF SURREY

Reclamation requirements are individually assessed in the land use contracts.

SUMMARY

This report presents the results of a study of the sand and gravel industry of British Columbia. The study was initiated by the Ministry of Energy, Mines and Petroleum Resources (MoEMPR) but funding has also been provided by the Ministry of Crown Lands, the Ministry of Transportation and Highways, the Ministry of Municipal Affairs, Recreation and Culture and the Aggregate Producers Association of British Columbia. The study has been carried out under Contract 90-101 issued by MoEMPR.

The objectives of the study were defined initially as follows:

- Examine the present size of the industry, its contribution to the economy of British Columbia, and its ability to meet the needs of all areas of the Province.
- Assess existing and potential sand and gravel deposits and resources throughout the Province.
- Identify the impact of Regional and Municipal plans on the availability of sand and gravel.
- Investigate current methods of issuing tenure, collection of royalties and fees and setting of performance/reclamation bonds for both private and public pits and recommend means of simplifying these systems.
- Examine the current practice of regulation for safety and health and recommend means for unifying this regulatory control.

These objectives have been modified during the course of the study, in consultation with MoEMPR, to reduce the emphasis on identification of the availability of the resources of sand and gravel in the Province and to concentrate on administrative policies for the industry.

Tasks carried out during the study comprise:

- Review of previous reports and available documentation.

- Mail-out of questionnaires to Regional Districts, Municipalities and pit operators.

- Interviews with representatives of the various Ministries participating in the study, the Aggregate Producers Association and selected pit operators.

The revised objectives of the study have generally been met, although responses to the questionnaires by local governments, in general, failed to elicit conflicts between planning issues and potential gravel pit development. A disappointing number of gravel pit operators responded to the questionnaire, although confidentiality of the response was indicated.

The report makes extensive reference to the Mineral Aggregate Resources Policy of the Province of Ontario. Quotations from the 1976 Working Party report and the 1986 Policy Statement are given below to establish a framework for the study:

> "Mineral aggregates are vital to Ontario's economy and the resource is a matter of provincial interest and concern. The available resource is perceived to be decreasing due to depletion of near-market supplies, alienation of resources by development such as housing, and restrictive controls which make establishment and operation of pits and quarries difficult. The increased costs which result from the scarcity of mineral aggregates is ultimately transferred to the customer. Therefore, it is important that sufficient mineral aggregate resources are available to meet the future needs of Ontario residents.
>
> The problems (of the industry) have no simple solutions. It is difficult to formulate effective legislation and policy for mineral aggregates because of the complexity and interrelating of the several problems. However, the Working Party has concluded that the following be acknowledged:

1. Local involvement is essential in the planning and approval process if concerns are to be effectively stated and considered.

2. Without proper planning, there is no way to protect resources for the future.

3. Acceptable standards of operation are so varied that they defy generalization. Therefore, regulations must allow for local choices and participation.

4. The most effective way to properly control pits and quarries is through shared provincial-municipal control."

These are powerful statements which apply equally well to the B.C. industry. The conclusions and recommendations of the study, which are summarized in Section 13, are intended to provide a framework for development of a regulatory system that will ensure proper management of the granular resources of the province.

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THURBER

Section 1

INTRODUCTION

This report presents the results of a study of the sand and gravel industry of British Columbia funded by the following agencies:

B.C. Ministry of Crown Lands
B.C. Ministry of Energy, Mines and Petroleum Resources (MoEMPR)
B.C. Ministry of Municipal Affairs, Recreation and Culture
B.C. Ministry of Transportation and Highways (MoTH)
Aggregate Producers Association of British Columbia.

The study has been carried out in general accordance with our proposal of February 27, 1989 under Contract 90-101 issued by MoEMPR to Thurber Consultants Ltd. Mr. T. Vaughan-Thomas, P.Eng. of MoEMPR has provided liaison throughout the study between TCL and agencies involved in the study.

The objectives of the study, as defined in our proposal and the Contract, are to:

- Examine the present size of the industry, its contribution to the economy of British Columbia, and its ability to meet the needs of all areas of the Province.
- Assess existing and potential sand and gravel deposits and resources throughout the Province.
- Identify the impact of Regional and Municipal plans on the availability of sand and gravel.
- Investigate current methods of issuing tenure, collection of royalties and fees and setting of performance/ reclamation bonds for both private and public pits and recommend means of simplifying these systems.
- Examine the current practice of regulation for safety and health and recommend means for unifying this regulatory control.

As explained in Section 4.3 of the report, these objectives have been modified during the course of the study, in consultation with Mr. T. Vaughan-Thomas, to modify the emphasis of the study.

Sections 1 through 7 of the report present factual information regarding the present status of the industry and its regulation. Section 8 describes the Province of Ontario's Mineral Aggregate Resources Policy. Section 9 evaluates the information presented in Sections 1 through 8 and presents conclusions. Recommendations are presented in Section 10. Section 11 presents a summary of the conclusions and recommendations of the study.

Draft versions of this report have been reviewed by representatives of all of the agencies sponsoring the study. Review comments have been incorporated into this final version of the report, wherever appropriate. However, the views expressed in the report are those of the author.

Section 2

DEFINITIONS

For the purposes of this report, the term "sand and gravel" includes both natural (pit-run) material recovered from a (gravel) pit and processed materials produced from a pit or quarry by crushing, screening and washing. Pit-run material includes "common compactible fill" as defined by the Ministry of Crown Lands (refer to Section 6.4). The processed materials are commonly referred to as "aggregates"; this terminology is utilized herein where processed material is specifically under discussion. The term "granular material" is also used in the report, where appropriate, to identify material obtained from a gravel pit, excluding material originating from a quarry.

Sand and gravel is used as fill for land development and road and railway grade construction and for roller-compacted concrete. Aggregates are utilized for road base course, asphaltic concrete, concrete and other specialized building materials, such as drain rock.

Within the scope of this report, sand and gravel does not include:

- Dredged sand
- Quarried rock used for riprap
- Specialty stone used for building exteriors and terrazo chips

Units utilized in this report are metric, either cubic metres (m^3) or tonnes. Conversion factors for metric and Imperial units used during the study conform to those previously used by Hora and Basham (1981), and are as follows:

$$1\ m^3 = 1.8 \text{ tonnes} = 1.3 \text{ cubic yards} = 2.0 \text{ short tons}$$

Section 3

STUDY PROCEDURE

3.1 GENERAL

The tasks carried out to initiate the study are summarized as follows:

- Review of available information.
- Mail-out of questionnaires to Regional Districts, Municipalities and pit operators.
- Identification of existing and potential sand and gravel deposits.

Each task is described in detail below.

3.2 REVIEW OF AVAILABLE INFORMATION

The principal references utilized during the study comprise the following, listed in chronological order and identified by a number used in subsequent sections of the report:

1. Hora, Z.D. and Basham, F., "Sand and Gravel Study 1980", Ministry of Energy, Mines and Petroleum Resources, Victoria, 1981.
2. Freeman, P.R., 1986. "Review of Royalties for Quarry Materials off Crown Lands". Unpublished report prepared for B.C. Ministry of Crown Lands.
3. Hora, Z.D., "Sand and Gravel Study 1985", Ministry of Energy, Mines and Petroleum Resources, Victoria, 1988.
4. B.C. Ministry of Crown Lands, Land Administration Manual, Chapter 3.03.0200 (amended January 20, 1989).
5. Buchanan, R.G., Bowes, R. and Crowe, E., "Vancouver Island Highway Project - Preliminary Aggregate

Resource Study", Ministry of Transportation and Highways, Victoria, May 1989.

6. B.C. Auditor General's Annual Report, March 1990.

Additional publications used as reference documents are listed in the References following the last page of text.

3.3 IDENTIFICATION OF GRANULAR RESOURCES

In our February 1989 proposal, it was stated that the location maps of gravel deposits and commercial operations presented in References 1 and 3 would be expanded by:

- Including Vancouver Island and British Columbia north of a line joining Prince Rupert (at 54°N) to Fort St. John (at 56°N).

- Increasing the width of the corridor along highway routes from the 10 km value utilized in the Reference 3 study to 50 km, to reflect the study's conclusion that aggregate is regularly transported 24 km and can be transported 80 km.

This expansion was to be achieved by reference to information in TCL files and 1:50,000 scale terrain maps produced by the Mineral Resources Division of MoEMPR supplemented by terrain analysis of aerial photographs by TCL personnel. The information was to be presented on 1:250,000 scale NTS maps in a separate folio that would accompany the report.

Upon examination of the Mineral Resources Division's terrain maps, it became evident that the transfer of polygons of potential or known aggregate resources from the 1:50,000 scale maps to 1:250,000 scale maps was a time-consuming and non-cost effective task. Furthermore, many of the polygons were in areas that were evidently not available for pit operations, such as developed land or river flood plains. Therefore, in discussion with Mr. T. Vaughan-Thomas, it was agreed that this portion of the work would be discontinued. Instead, information available in

existing references, supplemented by responses to the questionnaires that indicated a surplus or shortage of aggregates in a particular Municipality or Regional District, was to be used for this purpose.

3.4 MAIL-OUT OF QUESTIONNAIRE

A letter was sent out on March 15, 1989 by Mr. G. Bruce McRae, Assistant Deputy Minister of the MoEMPR, to all 28 Regional Districts in the Province and about 120 Municipalities that were judged to have active or potentially active sand and gravel deposits within their boundaries. This letter indicated the purpose and scope of the study and requested cooperation with TCL.

A response to this letter was received from 20 Regional Districts and 40 Municipalities. On June 7, a questionnaire was sent to these agencies, requesting information related to production and use of sand and gravel.

In view of the relatively poor response by the government agencies to Mr. McRae's March 15 letter, a second mail-out of the questionnaire was made by TCL on July 25, 1989 to 8 Regional Districts and 37 Municipalities that did not receive or respond to the March 15 letter.

A separate questionnaire was prepared for gravel pit operators and mailed out to 22 members of the Aggregate Producers Association of B.C. on July 28, 1989. After review of the mailing list with Mr. J. Allard, President of the Association, questionnaires were sent to a further 16 members on August 15. Because of a disappointing response by Association members, a letter was sent October 6 requesting cooperation in the study and confirming that confidentiality of any response would be respected. To supplement the small number of responses that were received, interviews were held with a number of major operators on Vancouver Island and mainland B.C.

A copy of all the correspondence referred to above is included in the Appendix.

A listing of the Regional Districts and Municipalities that participated in the study by completing the questionnaire is presented in Tables 1 and 2. In keeping with our promise of confidentiality, none of the gravel pit operators that responded or were interviewed are identified. However, responses by operators to the Ministry of Transportation and Highways (MoTH)'s telephone survey during the 1989 Vancouver Island Highway study, which is in the public record, are reported herein.

Section 4

OVERVIEW OF THE INDUSTRY

4.1 GENERAL

The distribution of major sand and gravel production centres in British Columbia depends on the availability of the resource and the local demand for residential and industrial purposes. The major commercial (private) pits are generally located within 25 km of the market if the product is trucked, though one operator from northern British Columbia indicated in his response to the questionnaire that he had trucked processed aggregate more than 1000 km. Barging of gravel takes place from Kitimat to Prince Rupert, occasionally between Prince Rupert and the Queen Charlotte Islands and extensively into the Lower Mainland from large pits on tidewater at Victoria, Sechelt, Egmont and Jervis Inlet.

All commercial pits, whether they operate on private or Crown Land, are subject to regulation by MoEMPR as regards health and safety, under the Mines Act. Most operate continuously, subject to the exigencies of market demand.

Non-commercial operators include local municipalities (where they operate their own pits), railway companies, forest companies (for logging road construction) and MoTH. The Mines Act does not exclude such pits from the jurisdiction of MoEMPR but, in practice, MoEMPR exerted little control over non-commercial pits, except for those operated by municipalities. The Workers' Compensation Board, in agreement with MoEMPR, has carried out safety inspections on non-commercial operations. Particularly in the case of pits operated by or for MoTH on gravel reserve areas, and used for road construction or maintenance, the pits are used intermittently, for only a short period of time and only for specific projects. Members of the B.C. Road Builders and Heavy Construction Association are primary users of the MoTH pits.

In late 1988, commercial pit operators formed the Aggregate Producers Association of B.C. The aim of the Association is to promote the interests of the industry and enhance business opportunities in order that the industry can develop and improve. Similar associations exist in Ontario and Alberta.

4.2 SAND AND GRAVEL PRODUCTION

Sand and gravel production figures for commercial (private) pits and non-commercial (MoTH, municipal and railway company) pits for the period 1977 to 1988 are shown in Table 4 for the entire province and by mining division in Table 5. The data is provisional and subject to revision following further analysis by the Mineral Policy Branch of MoEMPR.

The data reported by MoEMPR is derived from information voluntarily reported to MoEMPR by producers in confidence. Since small operators are not surveyed, not all operators submit reports and there is an inclination by operators to understate production because of royalty payments or permit limits, it is believed that the MoEMPR volumes understate actual production, perhaps by as much as 20%.

A graph of total B.C. sand and gravel production between 1962 and 1988, based on MoEMPR data (without adjustment), is presented in Figure 1. Total production peaked in 1987 at 27 million m^3 (49 million tonnes). Production from commercial (private) pits has quite consistently formed about 40% of total production for the past 5 years, with the remaining non-commercial production being mainly associated with road construction using MoTH Reserve pits. Production from the Lower Mainland and coastal pits has ranged between 30 and 60% of the total B.C. production.

Export of sand and gravel was negligible before 1985, and has reached 200,000 to 300,000 tonnes since then, equivalent to less than 1% of production. Imports (from the United States) have averaged about 2.5% of production over the last 15 years.

The industry is estimated to directly employ 4,000 to 5,000 people in production, processing and loading of granular material. Many more are employed in hauling the product from its source to its destination.

4.3 VALUE OF SAND AND GRAVEL PRODUCTION

The value of British Columbia's sand and gravel industry in 1988, according to MoEMPR, was $120 million, based on 49 million tonnes production and an average value of $2.48/tonne. A higher average 1986 selling price of $5.50/$m^3$ (or $3.06/tonne) was reported by Taylor (1989). If this is inflated to a current value of $6.25/$m^3$ (or $3.47/tonne), the total production value is $170 million. These estimates represent at-source values, with no consideration of the cost or value of transport between pit and destination or the considerable social benefit that is derived in terms of providing materials for housing, buildings, roads and other construction projects. Assuming an average haulage cost of $4/tonne, the total direct value of the industry to British Columbia rises to nearly $370 million.

In comparison, the total value of work carried out by the B.C. Road Builders and Heavy Construction Association is currently estimated by the Association to be about $500 million annually, while the value of all metals produced in the Province in 1988 was reported to be $1,876 million and that of coal, $1,041 million.

Section 5

AVAILABILITY OF SAND AND GRAVEL RESOURCE

5.1 GEOLOGICAL DISTRIBUTION

Reference 1 relates the distribution of sand and gravel deposits in the Lower Mainland and along the coast to various episodes of Wisconsin glaciation. Each major glaciation was accompanied by changes in sea level of 200 m or more, causing much of the lowland area to be covered by sea during most of the Quaternary period. Since the lowland is bounded by high mountain ranges on 2 sides, the glaciers terminated in the sea. Therefore, meltwaters released during deglaciation, together with retreating glacier ice, produced widespread and extensive deposits of sand and gravel along the coast and throughout the Fraser lowlands and adjacent areas.

The Quaternary sediments of the Lower Mainland were divided into the lithographic units by Armstrong (1977). Reference 1 indicates that the main units containing sand and gravel are as follows:

- Salish deposits of alluvial origin, comprising beach gravels and deltaic deposits up to 40 m above sea level along the coast and sediments from watersheds in the Lower Mainland.
- Capilano raised alluvial fan deposits, between 40 and 200 m above sea level.
- Sumas outwash and ice-contact deposits
- Fort Langley glacio-marine deltaic sediments, often containing flow tills and overlain by marine silts.
- Vashon outwash and ice-contact deposits. The Vashon gravels have been overridden by glacial ice (and are, therefore, very dense) and are overlain by till.

The Salish deposits are reported to be the least important economically.

Reference 3 describes the relationship between the sand and gravel resources of British Columbia, excluding the Lower Mainland and Vancouver Island, and the glacial history of the province. Unlike the lower Mainland situation, most of the resource is linked to various episodes of Fraser glaciation with only a small percentage representing preglacial or postglacial (alluvial terrace and fan) deposits.

Reference 3 divides the province into 5 regions with similar deglaciation patterns and Pleistocene history, namely:

Area 1 : South-central (Thompson-Okanagan Basin)
Area 2 : Columbia - Kootenay
Area 3 : Central Interior Plateau
Area 4 : Peace River
Area 5 : Skeena and Kitimat Valleys

The reference also identifies areas of the province that are covered by existing soil, landform and terrain maps which show the distribution of granular soils. Vancouver Island is covered by 1:50,000 scale landform maps. These maps, together with surficial geology mapping, were utilized for the Reference 3 study to identify known and potential sources of sand and gravel along the route of the Island Highway between Victoria and Menzies Bay (Campbell River).

5.2 GEOLOGICAL LIMITATIONS

As indicated by the discussion in Section 5.1, deposits of sand and gravel are not evenly distributed throughout the province. The Lower Mainland, Vancouver Island, south-central (Thompson - Okanagan Basin) area and the northern part of the Interior Plateau have substantial resources. The Columbia - Kootenay Basin and the Peace River region have scarce resources, while deposits in the Williams Lake and Clinton area are very small and scarce.

5.3 EXPECTED LIFE AND VOLUME OF KNOWN RESOURCES

MoEMPR surveyed 93 pit operators in 1982 to establish the expected life of their pits (Reference 3). About 30% of the operators, mostly the smaller ones, could not provide an answer. The remainder provided a response which correlated well with MoEMPR's independent assessment. No account of resources contained in MoTH gravel reserves was taken during the survey.

The expected lifetimes beyond the 1982 survey for existing commercial pits at 1980 production rates were reported for major centres as follows:

Kamloops	7 years
Vernon-Armstrong	10 years
Kelowna	5 years
Trail-Nelson	<5 years
Prince George	>50 years
Peace River	5 years
Kitimat-Terrace	6 years

The study identified that the Peace River Region had the biggest potential problem, with no major undeveloped deposits available near population centres and low potential for finding economically viable buried deposits.

It is evident that resources have not run out as quickly as forecast by the 1988 study (Reference 3). This is believed to result from a combination of a pessimistic assessment of pit reserves by operators and MoEMPR, a reduction in demand during the recession in the early 1980s and an increase in the volume of gravel available, due to expansion of existing operations and start-up of new pits.

For the Lower Mainland, Reference 1 indicated in 1981 that gravel resources were available from known sources for well over 10 years. No recent estimate of the resource has been made, but considering that 75% of Capilano deltaic deposits located along the shores of Jervis and Sechelt Inlets have not been explored or developed, and potential resources of granular material exist along the shoreline of Indian Arm and around Pitt Lake, it is evident that many years supply still exists.

The 1989 MoTH survey of Vancouver Island Highway gravel resources indicated generalized volumes available from private pits and MoTH gravel reserves as shown in Table 3. Of the considerable quantity available in the most southerly section of the Island Highway, 7 million m^3 was reported for Butler Bros.' pit in Central Saanich and 20 million m^3 for Construction Aggregates' pit in Colwood. At current production rates, at least 10 years supply is available.

None of the Regional Districts or Municipalities that responded to the questionnaire indicated an immediate shortage of granular resources. However, from discussions with MoEMPR and MoTH, it is expected that the Peace River region, Prince George, Kamloops and the Okanagan valley may experience a shortage in the next 5 to 10 years.

Wherever there is a local shortage of sand and gravel and granular material cannot be brought to the market place for sale at a competitive price, the logical step is to open a quarry in a massive bedrock formation, providing the environmental impact is acceptable. Crushed rock is routinely produced in the U.S.A. (amounting to about 50% of total mineral aggregate production) and near urban centres in Ontario and Quebec at a cost which is only 10 to 20% higher than that required for mining sand and gravel (Reference 3). This allows it to be sold competitively if transportation costs can be offset or a higher quality product can be justified. In British Columbia, very little crushed rock has been utilized, except for railway ballast.

Rock types preferred for a quarry operation are limestone, dolomite, granite and basalt. These are scattered throughout the Province. However, the Peace River Region has little competent rock suitable for a quarry operation, thus compounding the problem of a sand and gravel shortage in the region.

Further discussion of the provincial resources of granular materials is presented in Section 9.2.

5.4 LAND STATUS LIMITATIONS

Land ownership and zoning have significant impacts on the potential for development of sand and gravel deposits, as stated in Reference 3. Commercial pits occupy both private and Crown land, though less than 10% of current production occurs on Crown land (Reference 3). This is because most of the larger pits in the province are on private land close to the market place. It is expected that Crown land production will increase as pits on private land are exhausted. Furthermore, one major pit operator interviewed during the study indicated that the cost of purchasing and holding private land for pit development was prohibitive in comparison to leasing Crown land from the Government. Thus, he did not foresee his company purchasing land in the future for the express purpose of developing a gravel pit. However, it must be noted that the economics of the private land option change very significantly if the operator can market the gravel pit area, after extraction and reclamation are complete, for residential and/or industrial use. Market value of Crown Land used for gravel pits may be affected by the opportunities available for private land operations.

There are few restrictions on pit operation on freehold land outside Municipal boundaries and agricultural land reserves (ALRs). The Agricultural Land Commission's role is further discussed in Section 6.5.

Use of Crown land for sand and gravel extraction is discussed in detail in Section 6.4.

5.5 IMPACT OF LOCAL GOVERNMENT

Pit development within municipal boundaries runs the risk of sterilization of reserves by adjacent or encroaching urban development and rezoning to restrict or curtail operations as a result of pressure from residents. All of the municipalities that responded to the questionnaire indicated concerns with the noise, dust and truck traffic produced by gravel pit operations. These concerns have led to implementation of soil removal bylaws by municipalities.

None of the Regional Districts or Municipalities that responded to the questionnaire (listed in Tables 1 and 2) identified a current conflict between pit development and planning issues. However, this should not be construed to mean that there are not conflicts now or will not be in the future. Certainly, gravel resources in urban areas have been alienated in the past by local government approval for development without consideration of the overall availability of granular materials in the area. It is expected that resolution of future major conflicts in some areas may require a study of the type carried out for the Westwood Plateau area in Coquitlam (Thurber Consultants Ltd., 1985). Identification of gravel resources in a Municipality, and recognition in the community planning process, should also be implemented, as discussed in Section 9.2.

A detailed discussion of local Government authority over gravel pit development and operation is given in Section 6.3.

Section 6

REGULATION OF THE SAND AND GRAVEL INDUSTRY

6.1 GENERAL

Gravel extraction operations in a typical B.C. location are subject to the administration, regulation and authority of a large number of agencies within Federal, Provincial, Regional and Municipal governments, as listed in Table 6. The multiplicity of these agencies complicates regulation and monitoring of the industry. Current agency policies and authority are discussed in Sections 6.2 through 6.10. A discussion of how these policies and authority overlap is presented in Section 9. Recommendations for improvement are presented in Section 10.

Flow charts showing the current regulatory process for review and approval of an application for proposed pits on Crown land and private land are shown on Figures 2 and 3, respectively.

6.2 MINES ACT REGULATION

A new Mines Act (Bill 56 - 1989) was proclaimed on July 15, 1990, together with its supporting Health, Safety and Reclamation Code. The new Act covers extraction of all materials including sand and gravel, rock, limestone, earth, clay, coal and other mineral-bearing substances. Thus, gravel pits will be considered on a similar basis as hardrock mineral and coal mines with regard to approval, operation (including occupational health and safety) and reclamation.

The 1989 Mines Act is more general than the Act it replaces and uses the Health, Safety and Reclamation Code to permit amendment of the regulations which govern the mining industry by means of an order of the Lieutenant Governor in Council. The regulations established by the Code will protect workers and the public from risks to

their health and safety arising from mining activities, minimize environmental disturbance in and around the mine (taking into account sound engineering practice and prevailing economic conditions) and protect and reclaim the land and water courses affected by the mine. No minimum size of pit is specified in the Act for application of its provisions, though under Section 10(2) of the Mines Act, the Chief Inspector of Mines may "because of the nature of the proposed work" delete the permit requirements described below. MoEMPR has given no indication yet as to the circumstances under which this exemption will be appropriate.

The administrative procedures required under the 1989 Act are as follows:

1. Under Section 10(1) of the Mines Act, the operator shall apply for and obtain a permit from the Chief Inspector before commencing work in a pit. As part of the application, the operator shall give notice of the intention to commence work by filing with the District Inspector a "Notice of Work" (in accordance with Code Section 6.1.1), comprising a plan outlining the proposed work and a "Proposed Work and Reclamation Program" (in accordance with Code Section 10.1.1(1)).

2. Under Section 10.2.1 of the Code, notice of filing an application under Section 10(1) of the Mines Act shall be published by the applicant in the Gazette and in local newspapers specified by the Chief Inspector, when required by the Chief Inspector. Section 10.2.2 of the Code allows 30 days after publication of the notice for written representations to be submitted to the Chief Inspector by persons affected by the application. The Chief Inspector has indicated that gazetting and newspaper publishing will be standard for pits and quarries in urban areas. In rural areas, the Chief Inspector will refer to the District Inspector to determine the need for gazetting and publication. However, these will be required if there is any reason to doubt that the proposed development is acceptable.

3. Under Sections 10(2) and 10(3) of the Act, a permit issued by the Chief Inspector may contain any conditions he considers necessary, including a requirement

that the operator provide security in an amount and form specified for mine reclamation.

4. Under Sections 6.1.6 and 10.5.1 of the Code, the operator shall provide written notice of not less than 7 days to the District Inspector of intention to stop work.

5. On permanent closure, the pit operator shall file within 90 days a plan showing the pit workings and lease boundaries in accordance with Code Section 10.5.5. Code Section 10.6.3 requires that the land surface be reclaimed to an acceptable use that considers previous and potential uses.

The above procedures ensure that any permit issued by the Chief Inspector takes concerns of the public into account, in addition to those registered by other government agencies during the referral process described in Section 9.5.

Other requirements of the Code that affect operation of gravel pits are as follows:

1. Section 6.6.1 does not permit excavation of "unconsolidated material" from within a 1.5H:1V slope below a property boundary unless (Section 6.6.3) the adjoining property owner agrees in writing.

2. Section 6.6.2 does not permit excavation of rock within 5 m of a property boundary, unless (Section 6.6.3) permission is given by the adjoining property owner.

3. Section 6.7.7 does not permit the height of the working face to be more than 2 m above the reach of the loading equipment, unless the working face is sloped at an angle acceptable to the District Inspector.

6.3 MUNICIPAL REGULATION

The Municipal Act gives local governments the authority to regulate and prohibit removal and deposition of soil within municipal boundaries, under soil removal bylaws.

This authority is directed towards the aspects of gravel pit operation which are of the greatest concern to the municipality, namely noise, nuisance, working hours, safety, truck traffic, road maintenance, aesthetics, pit reclamation and planning.

Soil removal bylaws have also been used to raise revenue, particularly in the Lower Mainland, where municipalities have attempted to charge a fee for removal of soil (including sand and gravel) from pits within their jurisdiction, starting with the District of Maple Ridge in 1969. The legality of this fee was challenged by several producers in the mid-1970s on the basis that it was discriminatory and indirectly taxed the industry whilst not taxing trucks which haul such products as lumber, fuel, freight and dairy products over the same roads. Maple Ridge passed a new bylaw in 1980 that imposed a permit fee of $\$0.20/m^3$. The legal challenge to this bylaw culminated in the Supreme Court of Canada with a September 1986 decision (Kirkpatrick vs. the Corporation of the District of Maple Ridge) that volume-based royalties for soil removal were an indirect form of taxation that was beyond the power of the municipality to impose.

Following this decision, the B.C. Government passed Bill 44 which amended Sections 930(d) and (e) of the Municipal Act to allow local governments to charge a fee for removal or deposition of soil. Immediately thereafter, several Lower Mainland municipalities passed soil removal bylaws with fees ranging from $\$0.26/m^3$ to $\$0.35/m^3$.

Allard Contractors Ltd. petitioned the Supreme Court of B.C. (in Allard vs. the District of Coquitlam) to quash the bylaws because they were essentially unchanged from the one rejected by the Supreme Court of Canada. In July 1988, Justice Trainor ruled in favour of the sand and gravel industry, saying that Bill 44 did not allow for a volumetric permit fee.

Following this decision, the Municipalities of Coquitlam, Maple Ridge and Mission passed soil removal bylaws with "permit fees" changed to volumetric "removal fees". Coquitlam's bylaw, for instance, established a

fee of $100 for a permit to remove soil and a removal fee in the amount of $0.26/$m^3$. Allard Contractors Ltd. returned to the Supreme Court of B.C. in 1989 (in Allard vs. the District of Coquitlam) to have Coquitlam's new bylaw quashed on the grounds that the bylaw:

- Is discriminatory and therefore illegal because the gravel industry is required to pay a fee which is used for construction and repair of municipal roads used by other industries.

- Is invalid because it raises money for reconstruction and repair of roads, contrary to the Northwest Coquitlam Official Community Plan.

- Is not authorized by Section 930(2) of the Municipal Act.

- Imposes fees which constitute an indirect tax that is beyond the authority of the municipality.

Justice Paris dismissed Allard's petition in a March 16, 1989 ruling.

These legal challenges, reinforced by a growing concern by MoEMPR that municipalities were alienating granular resources by zoning or bylaw restrictions and lobbying by the Aggregate Producers Association of B.C. led to amendment of the Municipal Act in June 1989 by Bill 20, which incorporated the following important changes to the Act:

(a) A Council may, by bylaw, regulate or prohibit removal of soil (including sand, gravel and rock) from, or deposition of soil on, any land in the municipality. Prohibition requires the approval of the Minister of Municipal Affairs, Recreation and Culture with the concurrence of the Minister of Energy, Mines and Petroleum Resources.

(b) A Council may, by bylaw, require a permit to be held for removal of soil from or deposition of soil on land within the Municipality and impose rates or levels of fees for the permit and the activity of

soil removal or deposition that vary according to the quantity of soil removed.

(c) The bylaw that imposes permit fees under (b) above has no effect until it is approved by the Minister of Municipal Affairs, Recreation and Culture.

Despite these amendments, the legal challenges to soil removal bylaws by the sand and gravel industry have continued. Rempel Bros. Concrete Ltd. petitioned against the District of Mission's soil removal bylaw in the Supreme Court of B.C. In October 1989, Justice McKenzie set aside the bylaw on the grounds that it was discriminatory, charging $\$0.35/m^3$ for removal of soil from private land but only $1.00 annually for operations on a Crown land lease within the District.

A further challenge was initiated by Thornhill Aggregates Ltd. against the District of Maple Ridge in the Supreme Court of B.C. Heard on June 6, 1990, this action attempted to quash the District's by-law on the grounds that the bylaw is discriminatory and illegal because no permit or removal fee is levied if less than 75 m^3 of soil is removed or the soil removal is related to the development or improvement of land or building construction. Evidence was presented to the Court regarding removal of 26,000 m^3 of soil from land within the District of Maple Ridge without a permit or soil removal fee being required because the excavation was for a building foundation. Justice Callaghan's decision is awaited in this case. In the meantime, it is believed, from review of the questionnaire responses, that no municipality is currently receiving a royalty payment from a gravel pit operator. However, payments are going into a trust fund in several municipalities, pending a final resolution of the legal challenges. In this regard, the Aggregate Producers' Association has indicated (Swanson, 1990) that producers will take all cases to the Appeal Court of B.C. once they have been heard at the Supreme Court level.

The amended Municipal Act enables a local government to enact bylaws to regulate soil removal and disposition, but the extent to which the bylaw can impose conditions

on pit operation is unclear. These conditions could provide for restricted working hours, onerous quantity reporting requirements, a permit period of only 1 year, or a maximum annual volume of soil removal. The District of Chilliwack's soil removal bylaw, which incorporates the first 3 of these conditions, is the only such bylaw to have been enacted and approved in accordance with the amended Municipal Act. However, the validity of bylaws passed by municipalities in accordance with the amended Act is yet to be tested in the Courts. In this regard, Rempel Bros. Concrete Ltd. has indicated it will launch a lawsuit in the B.C. Supreme Court within the 30 day appeal deadline to quash Chilliwack's bylaw on the grounds that, whilst the bylaw does not apply to Rempel's gravel pit operation on an Indian Reserve, the District will claim a royalty for deposition of the gravel in the District at Rempel's processing plant.

It is important to remember that soil removal bylaws adopted by municipalities cannot usurp provincial regulatory authority, but can duplicate it, often unnecessarily in the case of the Mines Act. For instance, some bylaws are understood to establish security bonds for gravel pit operations. However, most bylaws also recognize that provincial inspection of the pit is required since municipal staff do not have the expertise to regulate the mining and reclamation operations.

6.4 MINISTRY OF CROWN LANDS

6.4.1 General

The Ministry of Crown Lands has guidelines for regulation of removal of sand and gravel from Crown land under the Land Act, Sections 15 and 24, in the form of a Quarry Materials Policy statement in Section 3.3.0200 (amended March 20, 1986 and January 20, 1989) of the Land Administration Manual. Other natural substances, such as limestone, marble, shale, clay, mine tailings and mine waste dumps are now defined as "minerals" under the Mineral Tenure Act and the Land Act does not apply to tenure.

The Quarry Materials Policy statement is a public document and is available to anyone on request. However, the sand and gravel industry (including MoTH) was not generally aware of it prior to this study.

The Policy statement is summarized in terms of the strategic goal, objectives and policy in Sections 6.4.2, 6.4.3 and 6.4.4. The operational policy, including rental and royalty payments, is summarized in Section 6.4.5. Direct quotations from the Policy Statement are identified by quotation marks.

A more complete discussion of royalties and fees applied to pit operations on Crown land is presented in Section 7.

6.4.2 Strategic Goal

The Policy statement identifies the Ministry's strategic goals to be as follows:

"The Ministry acknowledges that an assured and continuous supply of quarry materials is vital to the long term viability of the Province's construction industry. It also recognizes that for many areas of the province Crown land is the only existing or potential source of supply for quarry materials used by industry, and that several government agencies have the right to obtain quarry materials from public lands for public works projects."

"Accordingly, the Ministry will seek to ensure that appropriate Crown lands are made available to the quarry materials industry and government agencies provided that resultant quarry operations are undertaken in compliance with safety standards, are cognizant of land use compatibility, and have due regard or environmental sensitivities of the land."

6.4.3 Strategic Objectives

The Policy statement contains the following strategic objectives:

"(a) To provide policy for the use of Crown land containing or potentially containing quarry materials required for commercial and industrial purposes.

(b) To enhance the viability of quarry operations by protecting and assuring a continuous supply of Crown land for quarry materials extraction by private and public sectors.

(c) To ensure an equitable allocation of quarry lands among private operators and public agencies.

(d) To ensure efficient use of Crown land containing quarry resources.

(e) To provide a fair economic return to the Crown for the extraction of quarried materials in a manner which is equitable to the quarry industry.

(f) To foster the safe and orderly development of quarry operations authorized on Crown land pursuant to programs and legislation administered by government.

(g) To promote administrative efficiency through the utilization of the technical expertise of other agencies involved in safety and reclamation of mining and quarry lands.

(h) To facilitate the operation of quarry activities in a manner which minimizes adverse environmental impacts on Crown land."

6.4.4 Strategic Policy

The strategic policy, to achieve the above objectives, is defined in the Policy statement as follows:

"(a) Provide a variety of Land Act tenures appropriate to the requirements of specific quarry operations.

(b) Dispose of Crown quarry resources by open competition, except where new quarry deposits have been identified through independent initiative or where a replacement tenure is required.

(c) Establish pricing based on a royalty fee which reflects the amount of material extracted from Crown land and the market value of the raw material.

(d) Require annual prepayment of a land rental based on land value as a means of encouraging bona fide use of quarry resources.

(e) Issue tenure only after a quarry operator has satisfied the requirements of all relevant regulatory agencies and has submitted and received approval of satisfactory plans for quarry land management and reclamation.

(f) Utilize the Ministry's referral process, inter-agency agreements and other mechanisms to facilitate the operation of quarries in a manner which is safe and orderly, is compatible with adjacent land uses, and is cognizant of the environmental characteristics of the site and its surroundings.

(g) Establish Land Act map reserves withdrawing Crown land for the use of a government agency upon satisfactory demonstration by the agency of a legitimate need for such quarrying lands, and ensure regular review to confirm the need for continuance of such reserves.

(h) Encourage the common use of quarry sites by private operators where small quantities of materials are required on an occasional basis.

(i) Utilize the Ministry's Crown land planning projects as a means of identifying Crown land potentially suitable for quarrying purposes and of reserving such land for future quarrying use."

6.4.5 Operational Policy

The operational policy of the Ministry of Crown Lands is described in the Policy statement as follows:

(i) Method of Disposition

Disposition of Crown quarry land by public tender to determine the royalty rate is the preferred method if "there exists a known deposit of quarry material which is not in active use or a quarry tenure or reserve administered by the Ministry is terminated or not renewed and an inquiry for tenure is received".

A direct offer from a single applicant will be considered by the Ministry where "new quarry deposits have been identified by the applicant or a replacement tenure is being issued".

(ii) Form of Tenure

A Land Act tenure is required before quarry materials can be extracted, except for Provincial ministries. Forms of tenure available to non-Government applicants are summarized in Table 7 and described below.

A licence of occupation is the normal form of tenure for quarry areas during promotion (raising of capital), site development and production stages. A licence is normally issued for 5 years, but can be up to 10 years.

A lease may be issued where tenure is required for a term longer than that of a licence of occupation. The normal term of a lease is 10 years, but can be up to a maximum of 20 years.

A General (Section 10) Quarry licence is issued for up to 6 months where the applicant requires a small quantity of material over a short period or requires permission to access the land for exploration purposes.

A (Section 12) map reserve may be issued "at the request of another Government agency where a legitimate need for the reserve is demonstrated. The maximum term of a reserve is 5 years, with provision for an additional 5 year term following a review of the need for the reserve". Removal of gravel from a gravel reserve by a Government ministry is permitted when the gravel is used for public purposes. Normally, a Transfer of Administration is utilized (rather than a reserve) when the ministry licences use of the resource to a third party.

(iii) Pricing and Payment

Pricing of land for quarrying is based on an annual land rental plus a royalty payment for quarry material removal.

Lessees and licensees are required to annually prepay a land rental of the higher of $200 or 1% of the appraised market value, as established by the Ministry at 10 year intervals. General (Section 10) Quarry licensees pay $100 annually.

Minimum royalty rates established by the Ministry are shown in Table 8. The Policy statement indicates that "higher rates can be charged if recommended by the Regional Director, supported by an independent market appraisal and approved by the Ministry Executive". In practice, most Regional offices of the Ministry now have accredited appraisers on staff and internal appraisals are often deemed sufficient. The "Special Procedures" section of the Manual indicates that if the annual production of a proposed pit is to exceed 100,000 m^3, the application should be referred to the Ministry's Executive Committee for final approval of royalty rates.

As support for a royalty payment, a quarry operator is required to provide the Regional Director with a statutory declaration of the volume or weight of quarry material removed. If annual production exceeds 50,000 m^3, certification of the quantity

removed by a B.C. professional engineer or land surveyor may be required.

(iv) Quarry Material Exempt from Payment

Royalties are not charged for quarry material used in the following manner:

- Construction of public roads on Crown land
- Construction and maintenance of non-private logging roads under Part 8 of the Forest Act
- Public works projects undertaken by local Government
- Construction and maintenance of railway grade by B.C. Rail and construction of CN Rail's Prince Rupert-Prince George-Jasper line.

(v) Approval of the Work System

Use of Crown Land for sand and gravel extraction under the Land Act requires the applicant to obtain approval of the work system and a reclamation permit from MoEMPR and, if the land lies within the Agricultural Land Reserve, a soil removal permit from the Land Commission. Except for a General (Section 10) Quarry Licence application, applicants are also requested to submit a draft management plan to the Regional Director with the tenure application. The Ministry specifies the post-extraction land use to be identified in the draft plan. The draft plan is used to prepare a formal management plan issued as part of the legal tenure document. In all respects, except for specifying post-extraction land use, the management plan required by the Ministry of Crown Lands is similar to the Mining Plan required to be submitted to MoEMPR before quarrying can commence. Management plans are not required for removal of gravel by the Crown from Government gravel reserves.

(vi) Referrals

The principal agencies in the referral process for quarry land use applications are the MoEMPR, MoTH, MoEP and/or DFO, the Agricultural Land Commission

and local government. No referral is made for a General (Section 10) Quarry licence.

6.5 AGRICULTURAL LAND COMMISSION

Development of a pit or quarry on land designated as an agricultural land reserve (ALR) requires approval (in the form of a soil removal permit) from the Agricultural Land Commission. Release of land from the ALR for pit development can be a hindrance on Crown and privately owned land although Taylor (1989) reported that 80 to 90% of pit development applications are approved by the Agricultural Land Commission, generally within 4 months for an area of the order of 5 ha, but longer for larger sites.

The ALR designation may be useful in protecting gravel resources from alienation by industrial or residential development, since the designation requires that any development maintain or enhance the existing agricultural capability of the land. Release of the land for pit development implies that the property can be utilized for agricultural purposes on completion of mining. This is achieved by replacement of topsoil which is stripped off and stockpiled during pit operation (as required by the Mines Act) and may be accompanied by improved site topography and drainage.

6.6 MINISTRY OF TRANSPORTATION AND HIGHWAYS' RESERVES

6.6.1 General

The Ministry of Transportation and Highways (MoTH) is the biggest single user of gravel in the Province, consuming for road construction and maintenance about 40% of all the gravel used in the province and most of the non-commercial tonnage shown in Tables 4 and 5. It has about 4,000 pits, of which between 500 and 600 are working pits in regular use. Most of the pits are registered Reserves on Crown land. The Ministry supplies about 85% of its gravel needs from its own pits, with the remainder being bought from private sector (commercial) pits. With

privatization of road and bridge maintenance operations, most of the Ministry's pits are now used by maintenance contractors as sources of road gravel.

The Reserves on known or suspected areas of granular material constitute a very large resource. The Ministry has recently completed an Aggregate Deposit Information System for the entire Province, as a first step in development of an aggregate resource management program. The Listing is intended to provide a base of information which can be used by management personnel in the Ministry to make decisions regarding use of a particular pit considering location, suitability and available quantity.

6.6.2 Pit Operation

Until now, MoEMPR has had no involvement in operation or abandonment of pits on MoTH gravel Reserves, whether they were used by MoTH crews for road maintenance or by contractors for road construction. In the absence of a development plan prepared by MoTH, operation of the pits has been carried out in accordance with Section 202, Part C (Use of Designated Pits or Quarries) of MoTH's General Specifications for Highway Construction. These specifications provide little guidance to the excavation contractor except that "the Contractor shall not leave the pit or quarry in a condition which will limit its future use." As regards pit reclamation, Section 202 requires the Contractor to "trim the sides of pit excavations to a 1.5 to 1 slope, or such other slope as the Engineer may direct". Further reclamation requirements may be specified in the Special Provisions section of the contract with MoTH.

The absence of MoEMPR involvement in MoTH pits was in contravention of Section 6 of the 1980 Mines Act which identified MoEMPR as responsible for operations and reclamation of all gravel pits in the Province. However, under an agreement established between MoEMPR, MoTH and the Workers' Compensation Board (WCB), the WCB inspected MoTH gravel pit operations, but paid most attention to operational safety of crushing and asphalt plants with, at times, little attention to pit wall stability.

The 1989 Mines Act confirms the responsibility of MoEMPR for inspection of all gravel pit operations. Therefore, particularly with privatization of highway maintenance operations, it is expected that MoEMPR will assume responsibility for health, safety, environment and reclamation aspects of pit operations. WCB's involvement in health and safety aspects of pit operation will be unnecessary. This intervention will require a protocol to be established between MoTH and MoEMPR for pit development, operation and reclamation.

As part of its privatization of road and bridge maintenance in the 1988-89 fiscal year, the MoTH licenced 2,000 of its pits, including most of those in regular use, to maintenance contractors as their main source of gravel. The Ministry retains ownership of the pit and still has access to it for its road construction needs, but the maintenance contractor is responsible for day-to-day pit management. The maintenance contractor is licenced to use gravel from a specified MoTH pit for highway maintenance only.

Unit prices are assigned by MoTH to the various gravel pit products available from each pit for road maintenance. In preparing their tenders, road maintenance contractors can elect to use these prices but have the option of using gravel from other sources (i.e. non-licenced pits) and pricing it accordingly. Whatever the assumed source of gravel, tenders submitted for the maintenance contract include the cost of procuring and transporting gravel to the work site, using assumed annual consumption volumes. Consequently, the value of the gravel is included in MoTH's monthly payment to the contractor. The contractor, in turn, measures the actual volume of material used from the MoTH pit each month and reimburses MoTH appropriately using the unit prices in the agreement. If the contractor elects to use gravel from a non-licenced pit, no payment is made to MoTH.

The Auditor General's March 1990 report indicates that unit prices in the licence agreements for gravel from MoTH pits are uniform across most of the province and do not necessarily reflect the actual cost of procuring gravel in a particular area. The report also states

that "in areas where the licence agreement price is high in relation to actual extraction costs, it encourages the contractor to buy from other sources". As explained above, this option is open to all maintenance contractors. On the other hand, in any area where the licence agreement price is lower than the local market cost, there could be a temptation for the maintenance contractor to sell MoTH material for non-highways work in competition with private pits in the area. Policing of licenced pits by the Ministry's Area Manager and his staff will prevent such abuse.

The Auditor General's report recommends that future licence agreements contain prices that more accurately reflect costs in local areas in order to encourage rational resource allocation choices and provide more accurate project costing by MoTH. This is understood to be one of several changes that MoTH is considering to the licence agreements.

6.6.3 B.C. Road Builders and Heavy Construction Association

This Association, through road construction projects and, to some extent, road maintenance, utilizes most of the granular material which is removed from MoTH Reserves. Thus, it has a vested interest in how the industry is run. The Association recently (May 1990) petitioned the Government to exclude extraction and processing of sand and gravel used for road construction from MoEMPR jurisdiction. This is believed to be a request to maintain the status-quo, with WCB inspecting crushing and asphalt plants for operational safety and virtually no inspection of the pit workings. As stated in Section 9.6.2, it is expected that MoEMPR will assume responsibility for all health and safety aspects of pit operation and reclamation.

6.7 MINISTRY OF FORESTS

The Ministry of Forests (MoF) has authority over the occupancy and use of Crown land within Provincial Forests under the Forest Act when the end use falls into a Forest

Use category. This includes sand, gravel and rock quarrying associated with construction of forest access roads. Application for land tenure under the Forest Act is made under the Special Use Permit (SUP) process. Non-Forest Use of Provincial Forest land, which would include a commercial pit operation, is administered by the Ministry of Crown Lands under the Land Act, as described in Section 6.4.

MoF is a user of gravel in the same manner as MoTH, with responsibility for ensuring that adequate supplies of gravel are available adjacent to primary and secondary logging roads for road construction and maintenance.

Under the SUP process, once an application for pit development is received by the Ministry, it is forwarded to the Timber Harvesting Branch in Victoria for land status clearance. This involves referral to the Ministry of Crown Lands, Ministry of Parks, MoE, MoEMPR (for mineral claim conflict only) and the Agricultural Land Commission for comment and approval. Thus, any land use conflict associated with pit development, in a placer claim area, for instance, would be identified during the referral stage.

A land rent is assessed by MoF for tenure under an SUP, but no royalty is charged for material removed from the pit. The land rent rates are currently (February 1990) under review by MoF, but, in the meantime, are intended to conform to the rates for similar tenure issued under the Land Act.

Except for the SUP referral process referred to above, MoF operates independently of MoEMPR and imposes its own standards on pit operation and reclamation.

6.8 ENVIRONMENTAL REGULATION

As indicated by Table 6, environmental regulation of gravel pit operations is shared between the Federal Department of Fisheries and Oceans Canada (DFO) and the Provincial Ministry of Environment (MoE), depending on the location of the pit.

DFO has a specific responsibility for anadromous fish* and has regulatory power under the Fisheries Act for these species. However, Fisheries Act regulations have been difficult to enforce in the courts, as shown by disputes over gravel pit operations in the Coquitlam River valley.

The Waste Management Branch of MoE is responsible for regulating industrial wastes, including sediment produced from gravel pit operations, and water quality under the Waste Management Act and, in part, under the Water Act. However, it is known that this authority has not been exercised in the Lower Mainland nor, presumably, elsewhere in the Province.

Though permits have not been issued by MoE to regulate the quantity of water discharged from settling ponds associated with gravel pits, DFO has attempted, at least in the Lower Mainland, to enforce a maximum sediment level of 75 mg/L of suspended solids above the adjacent river background in any discharge of run-off from pit property (Thurber Consultants, 1988). This has proved to be difficult to achieve in, for example, gravel pits in the Westwood Plateau area of Coquitlam because of the colloidal nature of the suspended solids. Settling times of months are required for these materials without flocculation. DFO has indicated that it will permit dilution of sediment pond effluent to bring the suspended sediment level below the 75 mg/L criterion if the dilution water originates from groundwater wells on the property. It will not permit dilution by using water from streams that traverse the property and remain virtually free of sediment. This policy indicates a greater concern for the sediment load entering the river than for the ability of the river to handle the load without adverse environmental effects on the fisheries resource.

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* Anadromous fish are born in fresh water, spend part of their adult lives in salt water and return to fresh water to spawn. Thus, they are found in rivers and tributary streams which flow into the ocean.

The philosophy of the MoE is quite different (MoEP, 1985). The provincial standards take into account the use of the water that is to be protected and the existing water quality. The MoE permits changes which it feels can be tolerated, utilizing the assimilative capacity of the stream. Thus, MoE standards do not apply to the zone surrounding the discharge point nor for up to 100 m downstream in order for dilution of the effluent to occur and background levels to be re-established.

It is believed that the MoE approach to preservation of water quality is more appropriate for gravel pit operations adjacent to fish-bearing streams since mineral soil sediment is not toxic to aquatic life.

6.9 HEALTH AND SAFETY REGULATION

The purpose of the Health, Safety and Reclamation Code which supports the Mines Act 1989 is stated in the Code to be to protect employees and all other persons, including the public, from undue risks to their health and safety arising out of or in connection with activities at mines. The Code is to be implemented by MoEMPR inspectors. Thus, sufficient experienced inspection staff must be available to carry out this work satisfactorily.

At gravel pits operated by or for MoTH and the Ministry of Forests and at other pits where the raw material is directly processed on site and incorporated into concrete or asphalt, the Workers' Compensation Board (WCB) has carried out inspections for health and safety, under an informal agreement with MoEMPR. It is understood that these inspections have been infrequent. Although the Code does not specifically cover safety requirements for crushers and concrete or asphalt plants in Part 4 (Buildings, Machinery and Equipment), these often form an essential part of the gravel pit operation. Thus, if, as expected with implementation of the Code, MoEMPR takes over inspection of these facilities from WCB, the Code may need amending to incorporate existing WCB regulations.

The sand and gravel industry has had a good safety record based on data collected by MoEMPR for the annual Safety Awards for Open Pit Mines and Quarries. Three of the 8 operations which submitted reports for 1989 had zero lost-time injuries for a total of 60,000 hours of work, while the remaining five operations had only 24 injuries (often minor) during 300,000 hours of work.

6.10 INDIAN RESERVES

No Provincial or local Government agency has jurisdiction with respect to the use and occupation of land on Indian Reserves, although the Province does have jurisdiction over ancillary matters and most Provincial laws apply (C. McNichol, Ministry of Native Affairs, Victoria, pers. communication). Thus, the legal status of MoEMPR and other Provincial government agencies in regulating operation of gravel pits on Indian Reserves is unclear, despite the possibility of development of very large operations, such as that on a 200 ha site in Chilliwack. Furthermore, it is not apparent that the Federal Government exercises regulation of the pits.

MoEMPR has developed a policy of inspecting the pits for compliance with health and safety regulations, if the pit is operated by a non-Indian contractor. However, the legal authority of MoEMPR's inspection is unclear. Pit reclamation is perceived by MoEMPR to lie outside its jurisdiction.

Section 7

ROYALTIES AND FEES FOR CROWN LAND OPERATIONS

7.1 GENERAL

Payment and collection of royalties or permit fees for gravel pit operations within Municipal boundaries has been described in Section 6.3. In this section, a discussion of royalties which apply to operations on Crown land is presented, based primarily on the analysis in Reference 2 (Freeman, 1986). It is important to note that gravel extraction by private operators on Crown Land within Municipal boundaries is subject to both Municipal and Provincial royalty payments.

The total royalty paid to the Crown by gravel operators in the Province is estimated to be about $1 million currently, with about $550,000 derived from Lower Mainland operations (F. Csizmadia, Ministry of Crown Lands, Burnaby, pers. communication).

Reference 2 describes the present (unit royalty rate) system for collection of royalties from gravel pits and quarries on Crown lands and presents 4 other options, comprising:

- Percentage of gross sales
- Profits- or income-based taxation
- Rate of return taxation
- Auctions.

Each of these options and the recommendations given in Reference 2 are summarized below. Direct quotations from the reference are indicated by quotation marks.

7.2 DESCRIPTION OF SYSTEMS

7.2.1 Current System (Unit Royalty Rate)

Royalty payments are traditional in the sand and gravel industry as an up-front form of taxation because

there is relatively little risk involved in extracting a resource that is accessible and demand-driven.

The present system utilizes a unit royalty rate which depends on the type of material excavated and location within the Province. The amount paid by the operator to the Province, usually on the anniversary date of the lease, is calculated as the royalty multiplied by the amount extracted. The minimum royalty rates currently established by Crown Lands, Victoria, are shown in Table 8. Regional offices can charge a royalty in excess of the Provincial minimum if an independent market appraisal is submitted to the Ministry Executive and approved. This has resulted, for instance, in royalty rates of $0.60/tonne being used for pits in the Whistler-Squamish area and $0.45/tonne for the Chilliwack area. Freeman suggested that rates higher than the minimum have been set without the independent appraisal required by the Ministry of Crown Lands' Quarry Materials Policy statement. However, as indicated in Section 9.4.5, most of the Ministry's Regional offices have accredited appraisers on staff and considerable discretion is given to the offices with regard to implementation of policy, with market value being the fundamental objective. Furthermore, if the procedure specified in the Policy statement, requiring royalty rates for pits with a proposed annual production in excess of 100,000 m^3 to be referred to the Ministry's Executive Committee for approval, is followed, independent appraisal is inappropriate for larger pits.

Reference 2 indicates that "there is no policy statement on how the unit royalties are to be determined" by the Ministry and its regional offices. Thus, "inconsistent treatment of potential operators and use of evaluation procedures that have little if any economic rationale" may result. In commenting on a draft of this report, the Ministry indicated that it "has a standard procedure for determining royalty rates based on a formula which reflects (the) local private market".

7.2.2 Percentage of Gross Sales

Application of this royalty is complicated by costs incurred (and value added) by processing of the excavated

material and transportation of the product to the point of sale. Discrimination against firms which process and transport to the point of sale should be avoided.

This system is used by MoEMPR for collection of coal royalties by application of a 3.5% tax on the "mine head value" that makes allowance for moving raw or clean coal from mine site to the port.

7.2.3 Profit- or Income-Based Taxation

In this system, a tax rate is applied to the annual profit, defined as revenue less operating costs and depreciation. The tax is difficult to administer since some of its components are not observable.

7.2.4 Rate of Return Taxation

This type of taxation ensures that a suitable rate of return is forthcoming on investment, unlike a profits-based system. Thus, it would increase the likelihood that an operation requiring a large investment would be developed.

7.2.5 Auction

An auction system could be used to dispose of a resource on a once-and-for-all basis with no requirement for further taxes. The price would reflect the operator's expectation of profits adjusted for risks involved in resource and market uncertainties and reclamation costs. Upon exhaustion of the resource, the land would revert to the Province.

Such a system presumes that there will be more than one firm competing for the deposit.

7.3 EVALUATION OF OPTIONS

Freeman's assessment of the options presented in Section 7.2 is summarized below.

The current system of unit royalty rates has the following problems:

- The rate does not adjust automatically to changing economic conditions.

- There is no relationship between royalty rate and profits.

- The tax discriminates against firms operating marginal deposits.

- There is no assurance that the Province is getting a fair return from all producers since royalty rates throughout the Province are similar, despite variations in location and quality of the resource.

The percentage of gross sales system adds a constant increment onto the sale price, adjusted for processing or transportation costs, and therefore discriminates against firms which have lower profitability due to poor deposit or location. The tax is easier to administer than the unit royalty as it adjusts automatically for inflation.

An income- or profit-based royalty is equitable and shares the risk between industry and Government, since if there is no net income, no tax is paid. Financial statements would need to be submitted by operators for audit.

The rate of return taxation system has all the benefits of an income-based system but is more suited to industries requiring a large capital investment than to the sand and gravel industry.

An auction requiring a lump sum bid for the deposit reduces Government's future administrative costs substantially but uncertainties regarding the nature of the deposit and future market demands make it a difficult process for operators to establish a realistic bid.

Freeman concluded that a profit-based royalty is the best alternative, primarily because the system is desirable on economic theory grounds and it can be implemented under the Mining Tax Act. It would eliminate the difficulty of setting royalties and, if the Mining Tax Act is used, would reduce administrative duplication and simplify the tax structure.

Freeman recognized that the Government may choose to retain the current, unit royalty rate system.

7.4 DETERMINATION OF THE UNIT ROYALTY RATE

Reference 2 identifies the following factors to be important in setting a unit royalty rate for sand and gravel operations on Crown land:

- Operator's ability to pay
- Value of the in-place resource before extraction and processing
- Revenue requirements of Government
- Structure of the industry.

Freeman identified the operator's ability to pay as the most important factor to consider. Operators are subjected to taxation at municipal, provincial and federal levels, as illustrated in Table 9, and the determination of a royalty rate is essentially a tax sharing problem between various levels of government. The tax systems have largely developed independently, driven by revenue requirements primarily.

Freeman postulated that, since the unit royalty imposed on pit operators by the Ministry of Crown Lands does not explicitly allow for the other taxes that are payable, there is a possibility that the current royalty may be prohibiting new pit development initiatives in the Province. However, he gave no evidence in this regard.

The Ministry's position regarding the royalty to be paid to the Crown is that it "should reflect the private market or be established by a process which determines the willingness to pay, that is a competitive bid by public tender".*

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* Source: Mr. D. Brown, Ministry of Crown Lands, Victoria.

Section 8

ONTARIO'S MINERAL AGGREGATE RESOURCES POLICY

The Province of Ontario has been in the forefront in Canada in establishing effective legislation related to the sand and gravel industry, culminating in Bill 170, the Aggregate Resources Act, which came into force on January 1, 1990. Circumstances are similar in B.C. and thus the Bill and associated regulations and policy statements can apply to a large extent to the B.C. industry. They are, therefore, extensively quoted below.

Prior to passing of Bill 170, Government involvement in the province's aggregate resources industry was directed towards regulation, operation and rehabilitation of pits and quarries by means of the Pits and Quarries Control Act passed in 1971. However, despite considerable improvement brought about by the Act, difficulties with enforcement and resource planning still existed. Consequently, in 1975, the Ontario Mineral Aggregate Working Party was established to examine the situation and suggest alternatives. Over a 2-year period, the 14 person Working Party, made up of representatives of provincial and municipal governments, industry and special interest groups, met with 18 of 24 groups that submitted written briefs, conducted 6 open houses, and received over 600 written comments from the public, including return of 300 coupons from a 4-page tabloid published in local newspapers with a total circulation of over 170,000 households. The Working Party submitted its report "A Mineral Aggregate Resource Management Policy for Ontario" in December 1976. The report contained 64 recommendations for new policy and legislation and, after extensive review by a wide variety of interested groups and individuals, the Ontario Ministry of Natural Resources adopted 12 major guidelines, in general support of the Working Party's recommendations. From these guidelines, the Ministry of Natural Resources developed new legislation (the Aggregate Resources Act) that provides for the control and rehabilitation of pit and quarry operations through a licensing process and a policy statement that provides directions to municipalities regarding their planning for mineral aggregate resources and the aggregate industry.

The Aggregate Resources Act, the accompanying policy statement and previous studies carried out for the Ontario Ministry of Natural Resources* are summarized as follows:

- Mineral aggregates** are vital to Ontario's economy and the resource is a matter of provincial interest and concern. The available resource is perceived to be decreasing due to depletion of near-market supplies, alienation of resources by development such as housing, and restrictive controls which make establishment and operation of pits and quarries difficult. The increased costs which result from the scarcity of mineral aggregates is ultimately transferred to the customer. Therefore, it is important that sufficient mineral aggregate resources are available to meet the future needs of Ontario residents.

- The principles adopted for mineral aggregate resource planning in Ontario are as follows:

  (a) Mineral aggregates are essential non-renewable natural resources. They should be recognized as important components in any comprehensive land use or resource management program.

  (b) Mineral aggregates should be available to the consumers of Ontario at a reasonable cost.

  (c) All parts of Ontario possessing mineral aggregate resources share a responsibility for meeting future Provincial demand. Mineral aggregate resources vary in quality and significance. Demand for them varies depending on location and circumstances.

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* See References.

** For the purposes of the Ontario legislation, "mineral aggregates" means sand, gravel, shale, limestone, dolostone, sandstone and other mineral materials used in construction. The term is equivalent to "sand and gravel" as used elsewhere in this report.

(d) Notwithstanding the need for mineral aggregates, it is essential to ensure that extraction is carried out with minimal social and environmental cost. The protection of the natural environment is of particular importance, as is the wise management of the Province's physical resources. In this regard there is a recognized need to develop policy and regulatory provisions that establish good operating standards, ensure rehabilitation and establish evaluation and approval procedures for creating new operations and expanding existing operations.

(e) The supply of mineral aggregates as an essential construction material is important to the overall development of any area. It is necessary to maintain sources of supply as close to markets as possible until such time as long distance transportation becomes feasible.

(f) Other land uses may, in specific instances, take precedence over aggregate extraction.

(g) Temporary pits and quarries are needed, often at short notice, to supply mineral aggregates for projects of public authorities such as roads, at minimum cost to the taxpayer. Consultation with municipalities will be followed to ensure minimal adverse impacts on the social and natural environment and to ensure effective rehabilitation.

(h) Municipalities have an important role in planning for mineral aggregate resources and aggregate operations and should encourage the concept of extraction as an interim land use activity.

- The policy of the Ontario Government with regard to mineral aggregates is as follows:

(a) All land use planning and resource management agencies within the Province shall have regard for the implications of their actions on the availability of mineral aggregate resources to meet future local, regional and provincial needs.

(b) Any planning jurisdiction, including municipalities, shall identify and protect as much of its mineral aggregate resources as is practicable, in the context of other land use planning objectives, to supply local, regional and provincial needs.

(c) Official (development) plans shall identify and protect legally existing pits and quarries from incompatible land uses to the maximum extent realistically possible in the context of the municipality's other land use planning objectives, and in recognition of the continuing local, regional and provincial need for mineral aggregates.

(d) Municipalities may allow land development in areas of mineral aggregate resources which are protected in the official plan if it can be shown that extraction is not feasible or the proposed land use or development would not significantly preclude or hinder future extraction or serves a greater long term interest of the general public than does aggregate extraction.

(e) Zoning by-laws shall regulate all legally existing pits and quarries in such a way that these operations are a permitted activity with no uses or other activities permitted within the zoning category that are incompatible with mineral aggregate operations.

(f) In municipalities which do not require an official plan, mineral aggregate deposits identified by the Ministry of Natural Resources in conjunction with the municipality shall be placed in a zoning category which prohibits uses that are incompatible with possible future extraction.

(g) Temporary pits and quarries (referred to as "wayside pits and quarries") required for public authority projects, such as roads, shall be permitted in all zoning categories except in those established to recognize existing development or areas of particular environmental sensitivity.

- The Ministry of Natural Resources, within the context of its mandate to manage mineral aggregate resources at the provincial level, will:

  (a) Provide all pertinent geological information, including mineral aggregate resource mapping and technical assistance, to any government body or planning authority, in particular municipalities, and assist municipalities to define and protect mineral aggregate resource areas.

  (b) Provide comments to planning review and approval agencies on proposed planning actions that may have implications for mineral aggregate resource development.

  (c) Prepare guidelines for the Ministry, municipalities and other agencies responsible for mineral aggregate resource planning and management, to assist in implementing this policy statement.

  (d) Undertake research programs to investigate a wide array of mineral aggregate resource management topics, including investigation of alternative sources of supply.

  (e) Promote the concept of extraction as an interim land use activity by encouraging pit operators to make the most effective use of the land resource and operate the site in a manner as compatible as possible with surrounding land uses and activities and, on completion of extraction, to rehabilitate the pit to an acceptable condition which is compatible with adjacent land uses.

The Aggregate Resources Act, in comparison to the Pits and Quarries Act which it replaced, provides for an increase in the quality and quantity of pit rehabilitation, more municipal liaison, municipal remuneration and power to suspend a licence.

Approval procedures under the Act are classified into 4 categories, namely:

- Class A licence for commercial operations extracting more than 20,000 tonnes annually in designated areas (essentially southern Ontario).

- Class B licence for commercial operations extracting 20,000 tonnes or less in designated areas.

- Wayside pit and quarry pits in designated areas.

- Aggregate permits on Crown land, all beaches and dredging in lakes and rivers.

The licencing process for Class A and B operations requires submission of a comprehensive mining plan for review and approval by the Ministry of Natural Resources. A notice of application is required to be published in local newspapers and the application is circulated to appropriate local and provincial government agencies. The Ministry receives objections and comments and can issue a licence or refer the matter to the Ontario Municipal Board for a public hearing. On receipt of the Board's recommendations, following the hearings, the Ministry must make a final decision and issue or refuse to issue a licence.

It is of significance that the Minister cannot issue a licence that is in contravention of a municipal zoning by-law. This led, in the case of the Township of Puslinch, to an Ontario Municipal Board public hearing that spanned 3 calendar years to consider changes in municipal zoning that would preclude extraction of a very significant aggregate resource (Ariens, 1990). The hearing is estimated to have cost $5 million in professional fees (Canadian Aggregates, 1990).

The Act also provides for remuneration to municipalities to cover costs resulting from aggregate operations. Of the $0.06/tonne annual licence fee, $0.04 goes to the local municipality, $0.005 to the region or county, $0.01 to the province and $0.005 to a fund for studies of the rehabilitation requirements of abandoned pits and quarries and the actual rehabilitation work.

Section 9

DISCUSSION AND CONCLUSIONS

9.1 GENERAL

The information presented in Sections 5 through 8 of the report is discussed in this section, with reference to the study terms of reference presented in Section 1, and conclusions are drawn.

9.2 PROVINCIAL RESOURCES OF GRANULAR MATERIALS

No realistic estimate of the Province's granular resources is available. This is necessary to permit rational planning by MoEMPR, MoTH, pit operators and other agencies involved in the industry. This task was originally to be part of this study, by extending MoEMPR's 1988 study (Reference 3) to cover the entire province. However, this work was not carried out, as explained in Section 3.3. The Surficial Geology Unit of MoEMPR is the appropriate government agency to undertake this work. The Aggregate Deposit Information System completed by MoTH for its Reserves should be utilized by MoEMPR, together with existing 1:50,000 scale terrain maps prepared by the Mineral Resources Division of MoEMPR, showing gravel areas in the province south of a line joining Prince Rupert to Fort St. John. The MoEMPR maps need to be field checked or viewed in conjunction with current vertical aerial photographs to eliminate areas which are already alienated due to land development or are not available for gravel extraction due, for instance, to river flood plain designation.

Once the mapping described above is completed, it should be circulated to all Federal, Provincial and local government agencies for review and finalization.

Provincial reserves should be established on identified and available resources to ensure that the resource is not alienated without consideration of the consequences.

On Crown land, this will be straightforward. However, the Province will need to seek powers to preserve resources on private land, similar in concept to Agricultural Land Reserves.

Official Community Plans developed by municipalities and Regional Districts should identify areas of sand and gravel that are to be protected.

An attempt should also be made during this mapping task to assess the quality of the granular resource and its suitability as aggregate for concrete, asphaltic concrete and road pavement construction. This information will often be available from MoTH's Aggregate Deposit Information System for reserve areas.

9.3 LIMITATIONS TO PROVINCIAL SUPPLY OF GRANULAR MATERIALS

The questionnaire responses submitted by the municipalities and Regional Districts listed in Tables 1 and 2 did not indicate an immediate shortage of granular material anywhere in the Province. However, it is known that at least the Peace River Region will have a supply problem within the next several years, with a consequent increase in cost to the community as haul distances increase or rock quarries are established as alternative sources of supply.

The study described in Section 9.2 will provide the basic data to more clearly identify the upcoming shortfalls. It will also establish in which areas of the Province MoTH Reserves will control the overall supply of gravel in the future.

9.4 CURRENT ADMINISTRATION OF PIT OPERATIONS

The current regulatory framework for the sand and gravel industry is complex involving Federal, Provincial and local government agencies with, in some cases, overlapping jurisdictions, as illustrated in Table 6: However, the system seems to have worked so far and very little gravel has been lost to date as a result of land development compared to the total Provincial resource.

The major problems identified with the current system are summarized as follows:

- Duplication of information required for different Ministries during the application process.
- Uncertainty as to which agency has the mandate to manage the Provincial resource.
- Inequity in application of municipal soil removal (and deposition) fees, assuming the Courts rule such fees to be legal.
- Differences in the philosophy of environmental control of gravel pit operations by Federal and Provincial agencies.
- Apparent absence of control over safety, health and reclamation aspects of non-commercial operations (MoTH, MoF, railway company and municipal pits).
- Operation of pits on Indian Reserves.

These problems are described in Sections 9.5 through 9.10.

9.5 PIT DEVELOPMENT APPLICATIONS

9.5.1 Current Systems

The current approval process for pit applications on Crown land and private land is shown on Figures 2 and 3 respectively.

The problems evident from these figures and identified during discussions with government and industry personnel include:

- A Crown land application can be referred to the same government agency twice, the first time by the Ministry of Crown Lands and the second by MoEMPR.
- The pit concept plan required to be submitted with a tenure application to the Ministry of Crown Lands

duplicates, to some extent, the mining plan that MoEMPR require.

- Applications for pits on private land within a municipality, but outside the ALR, have been approved by the local government without reference to MoEMPR. Thus, a pit operation has commenced without an approved mining plan being in place. Applications received by the Agricultural Land Commission are generally referred to MoEMPR, thus preventing premature gravel extraction.

- A land status check is not clearly identified as a requirement in the private land approval process. Thus, it is theoretically possible for Crown land to be identified as private land on the "Notice of Work" submitted to MoEMPR.

- The elapsed time between initiating an application and receiving a permit to commence mining is generally not less than 3 months and can be as much as 1 year for Crown land applications.

Recommendations for improving the current system of pit approval are presented in Section 10.2. Alternative systems are described below.

9.5.2 The "One Window Approach"

The sand and gravel industry (through the Aggregate Producers' Association) has requested a "one-window approach" similar to that of Ontario's Ministry of Natural Resources for application, approval, operation and reclamation phases of a gravel pit to simplify a process that can involve 3 levels of government. The MoEMPR is the preferred lead agency, since the Mines Act, which it enforces, covers all aspects of the pit from application to reclamation. The flow chart for approval of an application for pit development under this system is shown on Figure 4. As the lead agency, MoEMPR would receive the application and ensure that it is circulated to other government agencies for comment or approval, as appropriate. Responsibility for tenure for operations on Crown land would remain with the Ministry of Crown Lands, but MoEMPR would have much better insight into the resources of the area covered by

the application and the current need for development of that resource. However, it is not proposed that MoEMPR have veto power over Crown Lands' objections to an application. For proposed operations within Municipal boundaries, conformance of the application with the Official Community Plan (prepared as described in Section 12.2) should be a priority.

Concern has been expressed regarding the ability of MoEMPR with its present manpower resources to continue its current level of pit inspection activities and undertake the lead agency role, as described in this section. Thus, additional staff may be required in MoEMPR if this system is adopted.

An alternative concept which would avoid MoEMPR staff increase is described in Section 9.5.3.

9.5.3 Sand and Gravel Commission

A central authority could be established to manage the sand and gravel industry in the form of a Sand and Gravel Commission modelled on the present Agricultural Land Commission.

The Commission would fulfill the one-window approach requested by the industry, particularly if it combined the present roles of MoEMPR and Crown Lands and took over responsibility for permitting, tenure and collection of royalties and inspection of pit operations. Distribution of royalties would be done on an equitable basis. The Commission could provide improved overall control over a depleting asset, by identifying current resources and the need for exploration to identify new deposits to meet production demands, and provide liaison between operators and municipal governments to reduce conflict at the local level.

On the negative side, the Commission could be perceived to be a new bureaucracy which would be in conflict with the government agencies that are currently involved in the process. In particular, it is expected that Fisheries and Oceans Canada would be very reluctant to pass control of fisheries protection over to a Provincial agency. Thus, it is expected that considerable further discussion will be required before such a Commission could be established.

The Commission could, alternatively, be established as a facilitator, or central agency, to provide liaison between Federal, Provincial and local government agencies, on the one hand, and pit operators, on the other. In this role, the Commission would have no regulatory authority, but would satisfy the one-window approach requested by the industry and provide a coordinated review process by government.

9.6 USE OF CROWN LAND

It is expected that there will be a trend for use of private land for pit development to decrease in the future, and use of Crown land to increase. This is because of the high cost of purchasing and holding private land unless its post-extraction use is for residential development, particularly in the Lower Mainland. Thus, pressure on Crown land and its resources will increase.

The Crown can choose to either sell land which contains gravel resources to a potential operator or lease the land and collect royalty payments. With knowledge of the cost of buying or leasing Crown land, as compared to using private land, the operator can select his preferred option, based on long term economics. It is important that the Ministry of Crown Lands establish market value for the resource at the proposed land sale price or royalty and be satisfied that there is a market to be served by the particular pit and operator.

The Ministry's Quarry Materials Policy statement is an important document which identifies the basic regulatory procedures that are to be followed. It is, therefore, a concern that the sand and gravel industry (including MoTH) appears to not have been aware of the document prior to this study. The Policy statement contains many important and, to some in the industry, controversial statements.

The Ministry's policy for the Lower Mainland Region is that Crown land identified for gravel extraction in areas where there is evident competitive interest will be offered for use and development by public tender to provide a fair economic return to the Crown. Thus, the Ministry will not

process applications for Crown Land for gravel extraction in such areas. If the area is judged to be suitable for development, the Ministry will advertise the area for public disposition, as occurred recently with a portion of the Westwood Plateau gravel area in Coquitlam. Thus, a contractor who identifies a potential gravel prospect and makes application to the Ministry may have his application rejected, but subsequently find his competitors bidding on development of the prospect which he identified. Alternatively, the land may be transferred to MoTH in the form of a Gravel Lease, according to pit operators interviewed for the study. This policy is in conflict with Strategic Policy (b), as stated in Section 9.4.4, and Operational Policy (i), as stated in Section 9.4.5. In more remote areas of the Province, where competition between pit operators is less severe, it is understood that Strategic Policy (b) is implemented and the Ministry deals directly with applicants. Thus, it appears that the Ministry permits the Regional offices to exercise some discretion with regard to implementation of policy whilst conforming to the principle of applying a fair and open process which promotes competition and obtaining fair market value to the resource.

Disposition of gravel areas by public tender is consistent with the Ministry of Crown Lands' mandate to offer land for the "highest and best use" and to obtain market value for the Crown's resources. However, this process may reduce the incentive of individual pit operators to seek out new gravel areas in populated areas. In contrast, if sand and gravel were classified as a mineral under the Mineral Tenure Act, the first staking of a potential gravel area would be recognized as the applicant and interest by other operators would be extinguished. Royalty payments under this scheme would not be subject to the pressure of competition, but would be negotiated, as they are now in remote areas of the Province. However, other consequences of classification of sand and gravel as a mineral, such as taxation, may be unacceptable to the industry.

Other, apparent, inconsistencies in application of the Quarry Materials Operational Policy to use of Crown land are listed below, followed by comments provided by the Ministry of Crown Lands during its review of a draft version of this report.

- The maximum term of a lease for gravel extraction is stated to be 20 years, whereas 30 year leases have been issued and the recent Westwood Plateau offering indicated a 30 year lease would be issued. The Ministry's current position is that its regional offices are permitted to exercise considerable discretion in implementing policy.

- The maximum term of a reserve issued to a Government agency is stated to be 10 years whereas no limitation has been placed on MoTH gravel reserves. The Ministry's current policy is that reserves are reviewed every 5 years and renewed, if appropriate, for a further 5 year period without limit.

- The draft management plan that must be submitted with the tenure application (for all but MoTH gravel reserves) is, to a large extent, a duplication of information submitted to MoEMPR. The Ministry justifies the requirement for submission of a management plan in order to fulfill its responsibility for stewardship and proper use of the land. However, the Ministry admits that options to coordinate the plan submission with MoEMPR should be explored.

9.7 ROYALTY PAYMENTS FOR CROWN LAND PITS

Minimum royalty rates for commercial (private) operations on Crown land, shown in Table 8, are set by the Ministry of Crown Lands, but, according to the Ministry's Land Administration Policy statement, can be set higher by public tender or the Ministry, if deemed appropriate and supported by independent market appraisal. In practice, many of the Ministry's Regional offices have accredited appraisers on staff to establish market values for a variety of land uses. Thus, an independent appraisal may be unnecessary. Furthermore, the royalty rates established by the Ministry do not explicitly allow for the other taxes that an operator must pay, leading to the conclusion (Freeman, 1986) that new pit development in the Province may be discouraged. No royalty is charged for non-commercial operations on Crown land.

It is concluded that further consideration of this topic is required by the Ministry of Crown Lands with the following principal components:

- Table 8 indicates the Ministry has differing rates for sand and gravel ($0.35/tonne), rock for crushing ($0.60/tonne) and limestone ($0.35/tonne). These materials go to the same market and, therefore, the same royalty may be appropriate.

- The variable quality and value of the granular materials that are extracted should be considered, possibly increasing the material classifications from the two that are currently used (sand and gravel at $0.35/tonne and compactible fill at $0.20/tonne). Since royalty payments are commonly checked on an annual basis by aerial photography and photogrammetric mapping, application of more than one material classification in a pit may be difficult.

- Payment of royalties by all operators on Crown land, whether private or non-commercial, should be considered to ensure fair business practice.

- Collection of royalties on a more frequent basis than annually should be considered to reduce the potential for non-collection at all.

- Royalty rates set by the Regional offices should be monitored to ensure consistent treatment of pit operators throughout the province.

- A portion of the royalty paid by operators on Crown land within or near to a municipality could be transferred to the municipality by the Provincial government.

9.8 MUNICIPAL REGULATION

The Municipal Act enables local governments to regulate and prohibit sand and gravel extraction within municipal boundaries, by means of soil removal bylaws, except that prohibition requires the approval of the Minister of

Municipal Affairs, Recreation and Culture with the concurrence of the Minister of Energy, Mines and Petroleum Resources. This review and approval process would be enhanced and consultation and cooperation established as standard procedures for management of the industry, if draft soil removal bylaws were referred to interested parties before they are adopted. Such parties should include the public, other government agencies and the Aggregate Producers Association.

Concern has been expressed by the Aggregate Producers Association to the Minister of Municipal Affairs, Recreation and Culture regarding Section 316 of the Municipal Act. Application of this Section has caused considerable delays in trial scheduling during challenges to municipal bylaws in the Supreme Court of British Columbia. The difficulty relates to the word "heard" in Section 316 which requires a judge of the Supreme Court to be "seized of the application" when the Court challenge is initiated. The action can only proceed when the "seized" judge is able to hear the case. It is understood that replacement of "heard" by "filed" in Section 316 would be sufficient to allow the action to proceed more expeditiously.

9.9 APPLICATION OF MUNICIPAL SOIL REMOVAL FEES

The sand and gravel industry (through the Aggregate Producers' Association) has requested a "level playing field" with regard to fees for soil removal from land in a municipality and pointed out the inequity that arises from operation of pits in adjoining municipalities that have different soil removal fees. Furthermore, the Association has, by reference to one of the legal challenges to soil removal bylaws, requested that removal and sale of significant quantities of gravel by building and subdivision contractors in a municipality be subject to the same permit requirements and royalties as a gravel pit in the area.

A further argument of the Association is that the sand and gravel industry has been singled out under the Municipal Act, with the municipalities being given different taxation powers in respect of sand and gravel than is normally available. Thus, it is questioned why a municipality

is empowered to levy a tax against the sand and gravel industry within its borders for road repair when logging trucks or other heavy trucks using the same roads pay no such tax. Furthermore, this tax has reportedly been applied to an operation that barged the product out of a municipality without use of trucks, yet does not apply to material barged into a municipality and then trucked. Nor does the tax apply to pit operations on Indian Reserves within Municipal boundaries.

The Association has requested the Minister of Municipal Affairs, Recreation and Culture to eliminate soil removal fees from bylaws enacted under the Municipal Act in favour of a taxation system which applies to all trucking companies using a municipality's road system. Use of business plates is one suggestion, but this involves a multiplicity of plates, even for operations confined to the Lower Mainland. The Association has, alternatively, indicated it would support collection of soil removal fees by a municipality (or central agency) provided these fees were evidently used for construction or maintenance of roads that largely service operating gravel pits. Several of the municipalities that responded to Question 15 of the questionnaire suggested that the Municipal Act be amended to allow a Reserve Fund to be established for collection of the fees and use only for road construction and maintenance.

9.10 OPERATION OF NON-COMMERCIAL GRAVEL PITS

Several of the municipalities that responded to the questionnaire identified the operation of gravel pits on MoTH Reserves as a problem due to insensitivity to the local government jurisdiction, the unregulated nature of the operation and the lack of financial contribution to road costs.

The Ontario Mineral Aggregate Working Party spent a considerable portion of its time on the Ontario equivalent, the wayside pits and quarries. The Working Party concluded that wayside pits and quarries generally generate local social and economic benefits and contribute to the provincial economy. It also concluded that the same standards of pit operation and reclamation as apply to commercial pits should be maintained.

The most evident solution to this problem is to bring MoTH Reserve pits entirely under the regulatory control of MoEMPR, with the consequent requirements for submission of mining plans, including reclamation. However, it should be recognized that this system is established for continuous, long-term gravel extraction, rather than the intermittent use, often with different operators, that a Reserve pit generally experiences. Therefore, it is suggested that agreement be reached between MoTH and MoEMPR that MoTH Reserve pits will be operated in accordance with MoEMPR standards and guidelines.

Section 10

RECOMMENDATIONS

10.1 PROVINCIAL RESOURCES OF GRANULAR MATERIALS

The provincial resources of granular materials should be determined, in accordance with the discussion in Sections 9.2 and 9.3.

10.2 PIT DEVELOPMENT APPLICATIONS

If the current approval system, as described in Section 9.5, is to be retained in concept, it is recommended that the following changes be made to streamline the process:

- The Ministry of Crown Lands and MoEMPR should coordinate the referral process to avoid, to the fullest extent possible, government agencies reviewing the same application twice.

- The Ministry of Crown Lands should review and minimize its requirements for the preliminary pit concept plan that is submitted with a tenure application.

- Local governments should be required to inform MoEMPR of any application for pit development on private landand should inform the applicant of the requirement to obtain MoEMPR approval of a mining plan. Applicants for pit development on private land should be required to provide a State of Title to ensure that the land owner is correctly identified. Alternative systems, identified as the "One Window Approach" (Section 9.5.2), with MoEMPR as the lead agency, and a Sand and Gravel Commission (Section 9.5.3), modelled on the Agricultural Land Commission, should be considered to improve the approval process.

10.3 CROWN LAND ROYALTIES

Royalty rates set by the Ministry of Crown Lands for operations on Crown land should be reviewed, as described in Section 9.7.

10.4 SOIL REMOVAL BYLAWS

It is recommended that the Ministry of Municipal Affairs, Recreation and Culture refer all draft soil removal bylaws to the public, other government agencies and the Aggregate Producers Association for comment before they are approved by the Ministry.

10.5 SOIL REMOVAL FEES

It is recommended that the "level playing field" requested by the Aggregate Producers Association with regard to fees for soil removal from (and deposition on) municipal land be established. Consideration should be given to:

- Replacement of municipal fees in favour of business plates or other means to tax all truckers using municipal roads.

- Standardization of municipal fees across the Province, or within major regions of the Province with the possibility of utilizing more than one material classification.

- Adoption of the Ontario Aggregate Resources Act concept of utilizing a combined municipal and provincial royalty paid by all operations whether they are on private, municipal or Crown land. The royalty would be returned, in part, to the local municipality in which the pit is located for road maintenance purposes.

10.6 ENVIRONMENTAL REGULATION

The difference in philosophy regarding control of discharges from gravel pits into fish-bearing streams

between MoE and DFO, as described in Section 6.8, should be resolved to avoid the appearance of conflict in regulatory agencies. If agreement can be obtained from DFO, it is recommended that MoE permits be issued under the Waste Management Act for control of effluent discharge from gravel pits.

10.7 HEALTH AND SAFETY REGULATION

It is recommended that MoEMPR undertake inspection of all aspects of gravel pit operation under the authority of the Health, Safety and Reclamation Code which supports the 1989 Mines Act. The facilities to be inspected include crushers and concrete and asphalt plants, if these are on the pit property.

10.8 OPERATION OF NON-COMMERCIAL GRAVEL PITS

It is recommended that all non-commercial pits operated by MoTH, Ministry of Forests, municipalities and railway companies be operated in accordance with MoEMPR standards and be subject to MoEMPR regulation.

10.9 PIT OPERATION ON INDIAN RESERVES

The legal status of MoEMPR involvement in regulating gravel pits on Indian Reserves is unclear. It is recommended that discussions be initiated with Indian Bands with active or potential gravel pits and Indian and Northern Affairs Canada to establish a meaningful protocol for approval of Mining Plans prior to the start of mining, inspections during operation of the pit and approval of pit reclamation.

10.10 PROVINCIAL TASK FORCE

This study has established many of the problems that are facing the sand and gravel industry in British Columbia and suggested remedies, in some cases, and items for further study, in others. There is a need to clearly

establish provincial strategic objectives and public policy for management of the industry. Thus, it is recommended that a Task Force be established, similar in concept to the Ontario Mineral Aggregate Working Party, with representatives of government and industry, to continue the work initiated by this study.

Section 11

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

The main conclusions and recommendations of this study are summarized as follows:

1) Present Size of the Industry

The total annual production of sand and gravel in British Columbia is conservatively estimated to be about 50 million tonnes, as shown in Figure 1. Of this volume, about 60% is produced by commercial (private) pits and the remainder from pits operated by the Ministry of Highways and Transportation (MoTH), municipalities and railway companies. Production from commercial pits in the Lower Mainland and on the coast, supplying the Lower Mainland, currently amounts to 50% of the B.C. production, or about 15 million tonnes.

2) Present Value of Sand and Gravel Production

The current market value of B.C.'s total sand and gravel production is about $170 million annually, of which about $100 million is contributed by production from commercial pits. These figures represent at-source values, without consideration of the cost and value of transport between pit and destination or of the social benefits derived from providing construction materials for projects such as housing, buildings or roads. The total direct value of the industry allowing for trucking is estimated to be nearly $370 million. In comparison values of $1,876 million and $3,220 million were reported for 1988 production of, respectively, all metals and coal in B.C. and the B.C. Road Builders and Heavy Construction Association estimates the current total value of its members' work to be about $500 million annually.

About $1 million is paid by the industry to the Government as royalty for gravel extraction on Crown Land.

3) Provincial Resources of Granular Materials

The Province's available resources of granular materials should be established by the Surficial Geology Unit of the Ministry of Energy, Mines and Petroleum Resources (MoEMPR). The 1:50,000 scale terrain maps of the southern half of the province, prepared during MoEMPR's 1988 study (Reference 3), should be utilized, but need to be reviewed to assess the availability of granular deposits within municipal boundaries and, for instance, in river flood plain areas. Data in MoTH's Aggregate Deposit Information System for gravel reserves should also be utilized.

A Provincial gravel reserve should be established on identified and available resources on Crown land, to ensure that the resource is not alienated without consideration of the consequences.

The Province should seek powers to preserve resources on private land, similar in concept to Agricultural Land Reserves.

4) Limitations to Provincial Supply of Granular Materials

No municipality or Regional District that responded to the questionnaire indicated an immediate shortage of granular material. However, it is believed that the Peace River Region, Kamloops and the Okanagan valley will experience shortages within the next several years. The study recommended in 1) will identify areas where MoTH gravel reserves control the supply and will establish areas of upcoming shortfall to allow alternatives, such as rock quarries, to be investigated.

5) Current Administration of Pit Operations

The current regulatory framework for the sand and gravel industry is complex, as illustrated by Table 6, and not without its problems. However, the system seems to have worked so far and prevented significant loss of gravel compared to the total Provincial resource.

6) Pit Development Applications

To improve the present systems of approval for pit development on Crown and private land, shown on Figures 2 and 3, it is recommended that:

- The Ministry of Crown Lands and MoEMPR should coordinate the referral process for applications to prevent duplication of review by government agencies.

- The Ministry of Crown Lands should review if it is necessary for a pit concept plan to accompany a tenure application.

- Local governments should inform MoEMPR of any application for pit development on private land.

- Applicants should provide a State of Title.

7) The "One Window Approach"

The Aggregate Producers' Association of B.C. has requested a "one window approach" to streamline application, approval, operation and reclamation phases of gravel pit development. It is recommended that MoEMPR act as the lead agency, to receive the application and circulate it to other government agencies for comment or approval, as appropriate, in the same manner as the Ontario Ministry of Natural Resources. By this means, MoEMPR's knowledge of the resources of the area covered by the application and the current need for development of that resource will be utilized. The flow chart for such a system is shown on Figure 4.

Responsibility for land tenure for operations on Crown Land should remain with the Ministry of Crown Lands.

8) Sand and Gravel Commission

As an alternative to the one-window approach described in 7), a new government agency (identified herein as the Sand and Gravel Commission) should be considered. The Commission could combine the present roles of MoEMPR and Crown Lands with responsibility for permitting, tenure,

royalty collection and inspection of pit operations. Alternatively, the Commission could be a facilitator, providing liaison between Federal, Provincial and local government agencies, on the one hand and pit operators, on the other. Considerable further discussion with the government agencies that are currently involved in the process will be required before such a Commission could be established.

9) Use of Crown Land

Use of Crown land for gravel pits is expected to increase in the future due to the high cost of purchasing and holding private land. The Ministry's regional offices are permitted to exercise considerable discretion in implementing policy, sometimes in conflict with the Ministry's Land Administration Manual. However, the Ministry's stated position is that Crown land use will be awarded by a fair and open process which promotes competition and produces a fair market value for the resource.

10) Crown Land Royalties

Minimum royalty rates for quarrying on Crown land are set by the Ministry of Crown Lands, as indicated in Table 8, but higher rates can be established by public tender or by the Ministry, if deemed appropriate and supported by independent market appraisal according to the Ministry's Land Administration Policy statement. In practice, many Regional offices have accredited appraisers on staff to regularly establish market values for a wide range of land uses. It is recommended that the Ministry monitor royalty rates set by the Regional offices to ensure consistent treatment of pit operators throughout the province.

Additional recommendations concerning imposition and payment of Crown land royalties are as follows:

- Consideration should be given to equalizing the royalty rates for sand and gravel, rock for crushing and limestone, since these materials go to the same market.

- The material classification system which is presently in use and allows only a choice between sand and

gravel or common compactible fill should be reviewed with the intent of increasing the number of classifications to reflect the variable quality and value of the granular materials that are extracted. However, volume measurement for royalty payments on an annual basis by aerial photography and photogrammetric mapping may render use of more than one material classification not feasible.

- Collection of royalties on a more frequent basis than annually should be considered to reduce the potential for non-collection at all.

- Payment of royalties by all pit operators on Crown land, whether private or non-commercial, should be implemented to ensure fair business practice.

- To enhance the equitable imposition of royalties, it is recommended that a portion of the royalties paid to the Government by operators of pits on Crown land be transferred into the Reserve Fund of a municipality in which the pit is located or is extensively used by gravel trucks operating from the pits. An alternative to this concept, utilized in Ontario, is to assess a combined Provincial and municipal royalty against all operations, then to divide the income generated into Provincial and municipal portions (with a third portion into a "rehabilitation fund") which are reimbursed to the appropriate authorities. This is truly the "level playing field" desired by the Association and is recommended for further consideration.

11) Municipal Regulation

The Municipal Act enables local governments to regulate and prohibit sand and gravel extraction by means of soil removal bylaws.

It is recommended that while draft soil removal bylaws are being reviewed by the Ministry of Municipal Affairs, Recreation and Culture and MoEMPR before they can be adopted, they should also be referred to the public, the Aggregate Producers Association and other government agencies for comment.

Legal challenges to various soil removal bylaws enacted by Lower Mainland municipalities have been ongoing since the mid-1970s. To minimize delays in trial scheduling in the future, the Aggregate Producers Association has requested a one-word change to Section 316 of the Municipal Act.

12) Municipal Soil Removal Fees

Although the Municipal Act allows municipalities to charge a variable soil removal fee under a soil removal bylaw, the validity of the bylaws is still being challenged in the courts by pit operators on the grounds that the variable fee is not applied to Crown land operations within the municipality and discriminates against gravel trucks since it is not applied to logging trucks or other heavy trucks which use the same roads. Furthermore, inequities result from adjoining municipalities that have different soil removal fees and different policies regarding material barged into or out of a municipality and the inability of municipalities to enforce soil removal fees for pits on Indian Reserves within municipal boundaries.

It is recommended that soil removal fees be standardized across the Province, or within major regions of the Province, with consideration given to using more than one national classification.

It is also recommended that building and subdivision contractors who extract and sell gravel during the course of a project within a municipality be subject to the same permit requirements and royalty payments as a gravel pit in the area.

The Aggregate Producers Association has requested that soil removal fees be eliminated in favour of a taxation system that applies to all trucking activities within a municipality. If this is not feasible, the Association has indicated it would support soil removal fees providing municipalities clearly demonstrate that the fees are to be used for construction and maintenance of roads travelled by gravel trucks by, for example, creation of a Reserve Fund.

13) Environmental Regulation

The major concern concerning environmental regulation is to resolve the difference in philosophy regarding control of discharges from gravel pits between Federal (DFO) and Provincial (MoE) agencies with jurisdiction. If agreement can be reached with DFO, MoE permits should be utilized for control of effluent discharge.

14) Health and Safety Regulation

It is recommended that MoEMPR undertake inspection of all aspects of gravel pit operation under the authority of the Health, Safety and Reclamation Code of the 1989 Mines Act, including crushers and concrete and asphalt plants if they are on the pit property.

15) Operation of Non-Commercial Gravel Pits

Operation of MoTH gravel pits within municipal boundaries has caused concern to some local authorities due to MoTH insensitivity and lack of contribution to road maintenance costs and the apparent unregulated nature of the operation. The Auditor General's March 1990 report on gravel management by MoTH indicated that though the Ministry has, in concept, suitable processes to manage its individual pits efficiently and properly account for the gravel extracted, some of the processes are new and not yet in place and some policies are incomplete.

It is recommended that, in concept, operation of MoTH pits be subject to the same regulatory control under MoEMPR as private pits. This same recommendation applies to non-commercial pits operated by municipalities, Ministry of Forests and railway companies.

16) Pit Operation on Indian Reserves

The legal status of the MoEMPR and other provincial government agencies in regulating operation of gravel pits on Indian Reserves is unclear. It is recommended that discussions be initiated with Indian and Northern Affairs Canada and Indian Bands with active or potential gravel pits to establish a meaningful protocol.

17) Provincial Sand and Gravel Task Force

It is recommended that a Provincial Task Force be formed to continue the work initiated by this study and to establish provincial strategic objectives and public policy for management of the industry.

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* List does not include references identified in Section 4.2 of report.

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Table 1

REGIONAL DISTRICTS THAT PARTICIPATED IN STUDY

Alberni - Clayoquot
Bulkley Nechako
Capital
Cariboo
Central Fraser Valley
Central Kootenay
Columbia Shuswap
Comox - Strathcona
Cowichan Valley
Dewdney - Alouette
Greater Vancouver
Kitimat - Stikine
Kootenay Boundary
Nanaimo
North Okanagan
Peace River
Powell River

Table 2

MUNICIPALITIES THAT PARTICIPATED IN STUDY

Armstrong	North Saanich
Burns Lake	North Vancouver
Central Saanich	100 Mile House
Colwood	Osoyoos
Creston	Penticton
Coquitlam	Port Coquitlam
Esquimalt	Port McNeill
Fort St. John	Port Moody
Kamloops	Prince Rupert
Kent	Princeton
Kimberley	Richmond
Kitimat	Saanich
Hudson's Hope	Salmon Arm
Langley	Sechelt
Maple Ridge	Sidney
Matsqui	Spallumcheen
Metchosin	Sparwood
Mission	Squamish
Nanaimo	Vancouver
Nelson	West Vancouver
North Cowichan	Whistler

Table 3

VANCOUVER ISLAND HIGHWAY GRAVEL RESOURCES

Section of Highway	Approx. Known Granular Resource Volume (m^3) Private Producers	MoTH Reserves
Victoria-Duncan	>30 million	1 million
Duncan-Parksville	1 million	3 million
Parksville-Mud Bay	1 million	3 million
Mud Bay-Menzies Bay	1 million	2.5 million

Table 4

B. C. SAND AND GRAVEL PRODUCTION

Year	Production (tonnes x 1000)		
	Commercial	Non-commercial	Total
1978	21,600	16,800	38,400
1979	25,300	20,900	46,200
1980	28,800	16,500	45,300
1981	26,400	16,000	42,400
1982	15,000	11,700	26,700
1983	16,100	25,000	41,100
1984	18,700	17,000	35,700
1985	18,800	30,200	49,000
1986	19,600	23,300	42,900
1987	20,100	29,100	49,200
1988	20,100	28,500	48,600

Source: MoEMPR, Mineral Policy Branch

Note: Data is preliminary and subject to revision.

Table 5

BC SAND AND GRAVEL PRODUCTION BY MINING DIVISION (TONNES x 1000)

Mining Division	1978 Com-mercial	1978 Non-Com-mercial	1978 Total	1979 Com-mercial	1979 Non-Com-mercial	1979 Total	1980 Com-mercial	1980 Non-Com-mercial	1980 Total	1981 Com-mercial	1981 Non-Com-mercial	1981 Total
Vancouver Island												
1 - Alberni	437	131	568	616	261	877	607	406	1013	71	409	480
11 - Nanaimo	1479	268	1747	2311	681	2992	2572	1004	3576	2230	783	3013
24 - Victoria	3803	142	3945	3539	124	3663	4533	169	4702	4232	319	4551
Subtotal	5719	541	6260	6466	1066	7532	7712	1579	9291	6533	1511	8044
Lower Mainland												
13 - New West	6826	1108	7934	9285	1554	10839	8359	933	9292	10692	1290	11982
22 - Vancouver	3528	222	3750	3488	707	4195	3791	246	4037	3964	304	4268
Subtotal	10354	1330	11684	12772	2261	15033	12150	1179	13329	14656	1594	16250
Remainder												
2 - Atlin		14	14		18	18		31	31			
3 - Cariboo	745	406	1151	1099	3778	4877	541	2968	3509	864	2761	3625
4 - Clinton	48	240	288	36	1778	1814	33	1433	1466	53	711	764
5 - Fort Steele	325	234	559	348	657	1005	1014	678	1692	384	506	890
6 - Golden	1	75	76	156	279	435	89	276	365		417	417
7 - Greenwood	19	136	155	20	383	403	14	380	394	23	279	302
8 - Kamloops	707	585	1292	327	1257	1584	356	1219	1575	290	873	1163
9 - Liard	1207	886	2093	1314	1465	2779	969	1397	2366	452	3094	3546
10 - Lillooet		6	6		35	35		33	33		401	401
12 - Nelson	216	284	500	256	504	760	353	499	852	181	543	724
14 - Nicola	76	65	141	44	197	241	11	189	200	41	329	370
15 - Omineca	170	496	666	133	1552	1685	534	1173	1707	185	1052	1237
16 - Osoyoos	219	166	385	309	116	425	256	109	365	179	151	330
17 - Revelstoke	34	118	152		392	392		388	388	426	134	560
18 - Similkameen	14	230	244		172	172	83	165	248	6		6
19 - Skeena	702	298	1000	1107	878	1985	3469	1565	5034	1167	416	1583
20 - Slocan		72	72		170	170		168	168		402	402
21 - Trail Creek		10091	10091		2906	2906	53	344	397	58	152	210
23 - Vernon	564	417	981	854	723	1577	1174	695	1869	865	556	1421
25 - Unassigned	435	109	544	67	347	414			0		117	117
Subtotal	5482	14928	20410	6070	17607	23677	8949	13710	22659	5174	12894	18068
BC Total	21555	16799	38354	25308	20934	46242	28811	16468	45279	26363	15999	42362

Table 5 (continued)

BC SAND AND GRAVEL PRODUCTION BY MINING DIVISION (TONNES x 1000)

Mining Division	1982 Com-mercial	1982 Non-Com-mercial	1982 Total	1983 Com-mercial	1983 Non-Com-mercial	1983 Total	1984 Com-mercial	1984 Non-Com-mercial	1984 Total	1985 Com-mercial	1985 Non-Com-mercial	1985 Total
Vancouver Island												
1 - Alberni	152	155	307	90	146	236	141	86	227	101	140	241
11 - Nanaimo	1217	549	1766	724	873	1597	865	410	1275	1051	256	1307
24 - Victoria	2082	116	2198	3324	435	3759	3350	239	3589	3434	112	3546
Subtotal	3451	820	4271	4138	1454	5592	4356	735	5091	4586	508	5094
Lower Mainland												
13 - New West	5751	1518	7269	5867	3852	9719	7192	7555	14747	5685	11609	17294
22 - Vancouver	2454	130	2584	2600	269	2869	3452	325	3777	4419	1492	5911
Subtotal	8205	1648	9853	8467	4121	12588	10644	7880	18524	10104	13101	23205
Remainder												
2 - Atlin		6	6			0		4	4		241	241
3 - Cariboo	463	1377	1840	933	4561	5494	440	1205	1645	653	2136	2789
4 - Clinton	13	228	241	24	646	670	28	253	281	73	676	749
5 - Fort Steele	296	237	533	205	1085	1290	235	248	483	183	680	863
6 - Golden	23	103	126	57	661	718	173	113	286	239	167	406
7 - Greenwood	15	152	167	196	522	718	33	117	150	31	149	180
8 - Kamloops	337	649	986	300	1759	2059	324	701	1025	776	1681	2457
9 - Liard	183	1944	2127	453	4178	4631	387	1470	1857	646	2309	2955
10 - Lillooet		221	221		164	164	7	123	130	21	132	153
12 - Nelson	77	192	269	115	489	604	79	264	343	68	312	380
14 - Nicola	121	32	153	25	421	446	18	1616	1634	46	5127	5173
15 - Omineca	43	405	448	54	1408	1462	605	554	1159	157	770	927
16 - Osoyoos	26	100	126	208	327	535	80	132	212	87	148	235
17 - Revelstoke	129	783	912	19	384	403	18	52	70	18	107	125
18 - Similkameen	2	365	367			0			0			0
19 - Skeena	1001	242	1243	507	1442	1949	262	664	926	335	422	757
20 - Slocan		99	99		188	188		187	187		113	113
21 - Trail Creek	43	84	127	29	103	132	14	68	82	9	139	148
23 - Vernon	543	795	1338	420	1065	1485	967	575	1542	736	1123	1859
25 - Unassigned		1247	1247			0			0		198	198
Subtotal	3315	9261	12576	3545	19403	22948	3670	8346	12016	4078	16630	20708
BC Total	14971	11729	26700	16150	24978	41128	18670	16961	35631	18768	30239	49007

Table 5 (continued)

BC SAND AND GRAVEL PRODUCTION BY MINING DIVISION (TONNES x 1000)

Mining Division	1986 Com-mercial	1986 Non-Com-mercial	1986 Total	1987 Com-mercial	1987 Non-Com-mercial	1987 Total	1988 Com-mercial	1988 Non-Com-mercial	1988 Total
Vancouver Island									
1 - Alberni	109	108	217	143	106	249	176	107	283
11 - Nanaimo	706	276	982	1306	307	1613	1036	276	1312
24 - Victoria	4503	186	4689	4640	178	4818	2803	202	3005
Subtotal	5318	570	5888	6089	591	6680	4015	585	4600
Lower Mainland									
13 - New West	7674	3074	10748	7690	2879	10569	8821	3018	11839
22 - Vancouver	2621	850	3471	1131	726	1857	2720	732	3452
Subtotal	10295	3924	14219	8821	3605	12426	11541	3750	15291
Remainder									
2 - Atlin		13	13		6	6		6	6
3 - Cariboo	290	3010	3300	387	1600	1987	389	1664	2053
4 - Clinton	97	981	1078	500	525	1025	99	524	623
5 - Fort Steele	604	442	1046	100	250	350	96	282	378
6 - Golden	263	389	652	492	278	770	255	266	521
7 - Greenwood	16	143	159	41	190	231	20	186	206
8 - Kamloops	476	3248	3724	551	3728	4279	690	3769	4459
9 - Liard	388	2106	2494	757	2203	2960	501	1951	2452
10 - Lillooet	19	153	172	7	212	219	7	213	220
12 - Nelson	91	295	386	229	283	512	118	282	400
14 - Nicola	45	1978	2023		10486	10486	68	10454	10522
15 - Omineca	294	949	1243	111	1009	1120	82	1024	1106
16 - Osoyoos	245	382	627	249	661	910	294	665	959
17 - Revelstoke	5	141	146	13	349	362	111	346	457
18 - Similkameen		15	15		281	281		282	282
19 - Skeena	358	402	760	655	539	1194	553	582	282
20 - Slocan		107	107	83	191	274		186	186
21 - Trail Creek	2	79	81	27	60	87	115	59	174
23 - Vernon	752	1568	2320	963	1463	2426	990	1410	2400
25 - Unassigned		2436	2436		634	634	189		189
Subtotal	3945	18837	22782	5165	24948	30113	4577	24151	28728
BC Total	19558	23331	42889	20075	29144	49219	20133	28486	48619

Source: MoEMPR, Mineral Policy Branch

Note: Data is preliminary and subject to revision

Table 6

GOVERNMENT AGENCIES AND RESPONSIBILITIES FOR MINING AND ENVIRONMENTAL PROTECTION AT GRAVEL PITS

Agency	Regulation/Responsibility
Municipal	
Municipality	Municipal Act Soil Removal Bylaw Municipal zoning
Regional	
Regional District	Regional land use
Provincial	
Agricultural Land Commission	Agricultural land reserves
Ministry of Crown Lands	Land Act Gravel removal leases
Ministry of Energy, Mines and Petroleum Resources	Mines Act (1989) Health, Safety and Reclamation Code
Ministry of Environment and Parks	Environment Management Act Waste Management Act Water Act Wildlife Act (Federal) Fisheries Act
Ministry of Forests	Logging roads
Ministry of Municipal Affairs, Recreation and Culture	Municipal Act
Ministry of Transportation and Highways	Gravel reserve areas
Federal	
Fisheries and Oceans Canada	Fisheries Act

Table 7

CROWN LAND TENURE

Form of Tenure	Normal Term	Pricing	Method of Disposition
Licence of Occupation	5 years (10 years maximum)	Annual land rent (equal to greater of $200 or 1% of appraised market value of land) plus royalty payment based on quantity of material removed.	Public tender or application
Lease	10 years (20 years maximum)		
General (Section 10) Quarry Licence	6 months		Application
Reserve	5 years (10 years maximum)	N/A	On request of a government agency

Table 8

CURRENT MINIMUM ROYALTY RATES
FOR OPERATIONS ON CROWN LAND

Material	Royalty ($) Per tonne	Per m^3
Sand and gravel	0.35	0.63
Sand from Fraser River below Hope	0.40	0.72
Rock for crushing	0.60	0.92
Limestone	0.35	-
Common compactible fill*	0.20	0.36

Source: Ministry of Crown Lands Quarry Materials Policy Statement.

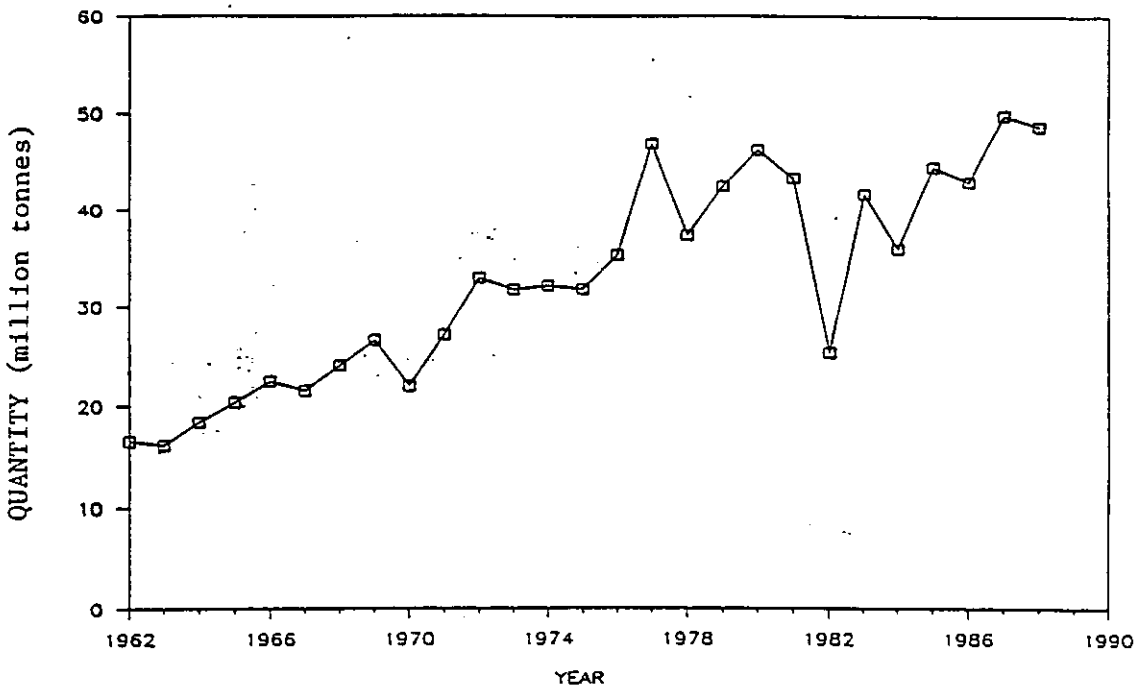
* Defined as "unsorted material used to fill or level land but not sand and gravel, rock or other material used for the same purpose".

Table 9

TAXES APPLIED TO SAND AND GRAVEL OPERATIONS

Tax Vehicle	Tax
Municipal	Property tax
	Royalty/permit fee
Provincial	Corporate income tax
	Mining tax
	Sales tax
	Fuel tax
	Unit royalty (to Crown Lands)
	Land rent fee (to Crown Lands)
	Property tax
	Corporation capital tax
	Workers' Compensation
Federal	Corporate income tax
	Fuel tax
	Sales tax
	Payroll taxes (CPP, UIC)
	Import duty

Source: Freeman (1986).



Source: Taylor (1989)

B.C. SAND AND GRAVEL PRODUCTION

Figure 1

FLOW CHART OF CURRENT TYPICAL APPROVAL PROCESS FOR APPLICATION TO DEVELOP PIT ON CROWN LAND

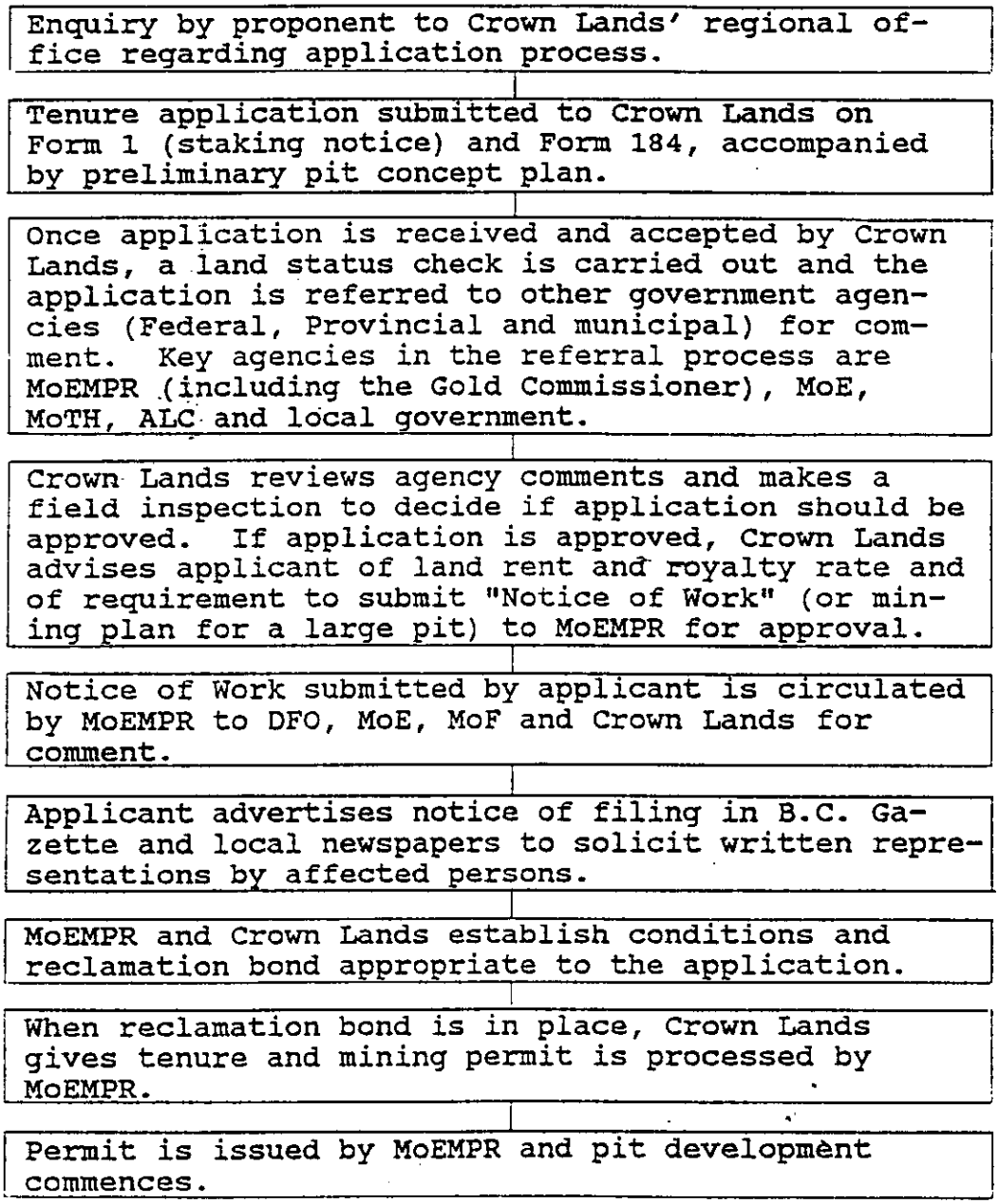
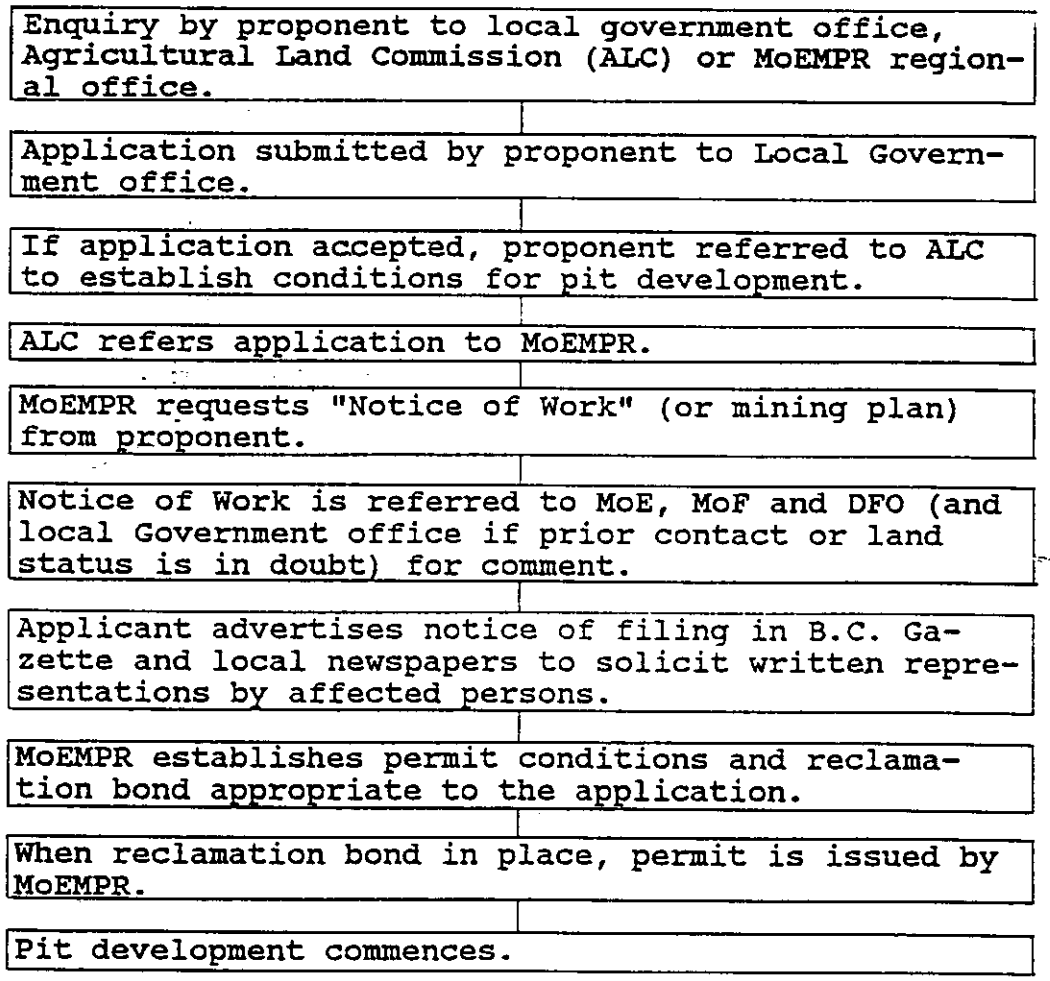


Figure 2

FLOW CHART OF CURRENT APPROVAL PROCESS FOR APPLICATION TO DEVELOP PIT ON PRIVATE LAND



* Not appropriate if land not in ALR.

Figure 3

"ONE WINDOW APPROACH"
FOR APPROVAL OF APPLICATION TO DEVELOP PIT

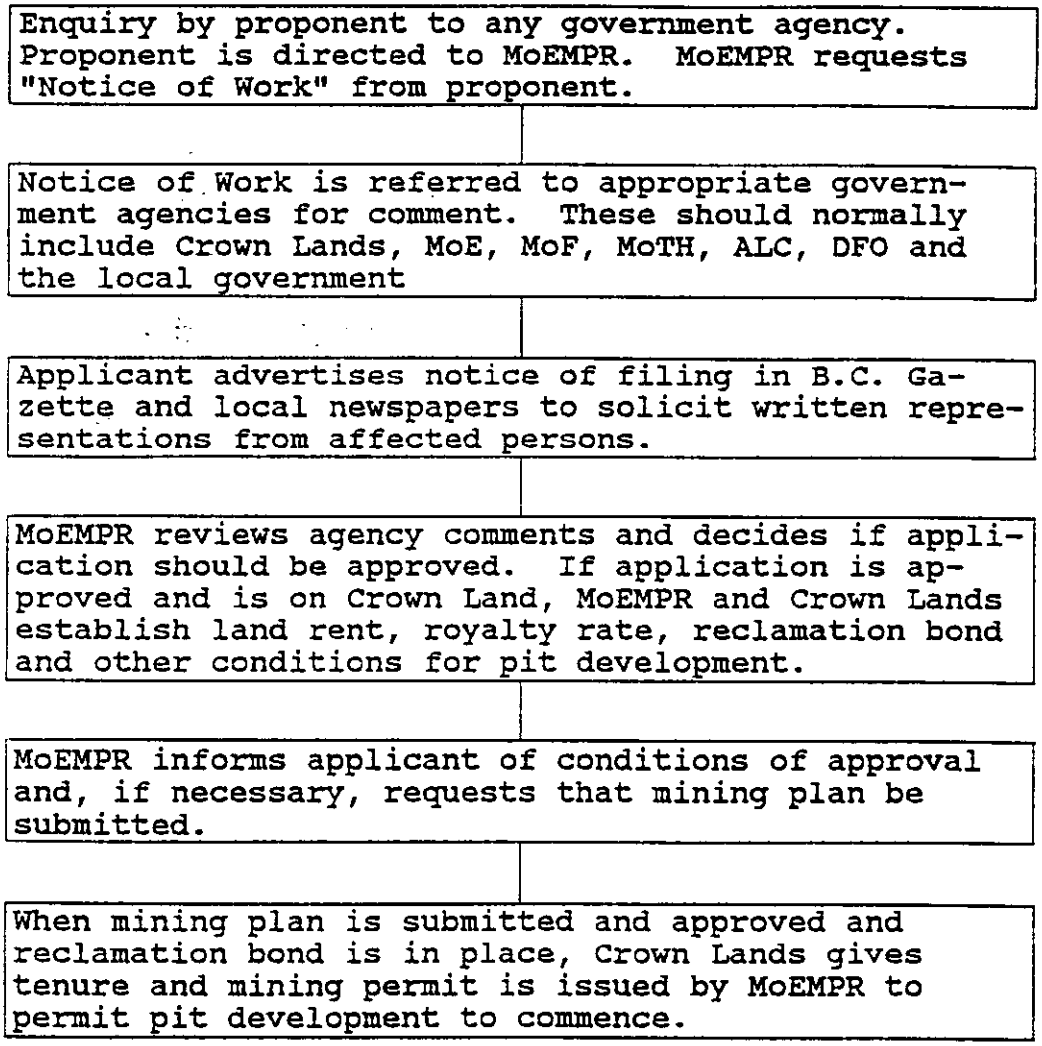


Figure 4

Province of
British Columbia

ASSISTANT DEPUTY MINISTER

Ministry of
Energy, Mines and
Petroleum Resources

Parliament Buildings
Victoria
British Columbia
V8V 1X4

March 15, 1989

Dear Sir:

The Ministry of Energy, Mines and Petroleum Resources has retained Thurber Consultants Ltd. of Vancouver to undertake a study of the sand and gravel industry in British Columbia. This study has the support of, and is jointly funded by the following agencies:

Ministry of Crown Lands
Ministry of Energy, Mines and Petroleum Resources
Ministry of Transportation and Highways
Ministry of Municipal Affairs, Recreation and Culture
British Columbia Sand and Gravel Association.

The purpose of the study is to:

- Examine the present size of the industry, its contribution to the economy of British Columbia, and its ability to meet the needs of all areas of the Province.
- Assess existing and potential sand and gravel deposits and resources throughout the Province.
- Identify the impact of Regional and Municipal plans on the availability of sand and gravel.
- Investigate current methods of issuing tenure, collection of royalties and fees and setting of performance/reclamation bonds for both private and public pits and recommend means of simplifying these systems.

.../2

- Examine the current practice of regulation for safety and health and recommend means for unifying this regulatory control.

A draft report is expected from Thurber Consultants Ltd. on April 30, 1989. Therefore, time is of the essence in initiating and proceeding with the study.

I request your cooperation in providing a quick response to a mailed questionnaire that you will shortly receive from Thurber Consultants Ltd. The information that will be sought includes the following:

- Identification of active or proposed gravel pits on private and Crown Land within the municipal boundaries, preferably on topographic maps of 1:10,000 scale.
- Production figure for the pits within the Municipal boundaries.
- Present practice for regulating operations.
- Present or anticipated conflicts between gravel pit operations or expansion and municipal planning projects.

In confirming your willingness to cooperate with the study, I request you identify a staff person who can be contacted by Thurber Consultants Ltd. to facilitate the information gathering and assessment. Would you please send your reply to:

Mr. T. Vaughan-Thomas
Manager of Health and Safety Standards
Ministry of Energy, Mines and
Petroleum Resources
105 - 525 Superior Street
Victoria, British Columbia
V8V 1X4.

Yours sincerely,

G. Bruce McRae
Assistant Deputy Minister

THURBER CONSULTANTS LTD.

Suite 200 - 1445 West Georgia St., VANCOUVER, B.C. V6G 2T3 Phone (604) 684-4384

June 7, 1989

File: 15-8-10

Company
Address
City
Code

Attention: Name
Title

SAND AND GRAVEL INDUSTRY STUDY

Dear Sirs:

In response to Mr. G.B. McRae's letter of March 15, 1989, you indicated a willingness to participate in the study which this firm is conducting on behalf of the Ministry of Energy, Mines and Petroleum Resources. In this regard, enclosed herewith is a questionnaire which we request you complete at your earliest convenience and return to this office to provide baseline data for the study. In completing the questionnaire, you may find you need to ask for clarification or to discuss the response more fully. If so, please do not hesitate to contact the undersigned.

We welcome constructive comment on any of the topics raised in the questionnaire and encourage you to be frank in your response. This will assist in reaching conclusions and making recommendations on completion of the study that are meaningful and practicable. If you wish your response to be treated in confidence, please indicate this in your transmittal letter.

Continued....

On behalf of the Ministry, we express our thanks for your cooperation in the study and for taking time to complete the questionnaire. On a selected basis, we expect follow-up visits will be made to some municipalities and Regional Districts for further discussion.

Yours very truly,
Thurber Consultants Ltd.

D. Smith, P.Eng.
Principal

DS/aa/c

Enclosure

SAND AND GRAVEL INDUSTRY STUDY
BY THURBER CONSULTANTS LTD.
QUESTIONNAIRE FOR MUNICIPALITIES AND REGIONAL DISTRICTS

1. Please provide a map of suitable scale showing the area under your jurisdiction with, if possible, active gravel* pits and gravel reserves identified. Include Ministry of Transportation and Highways' pits and reserves.

2. Please provide a list of active gravel pit operators in your area of jurisdiction.

3. Can you provide annual production volumes for these pits for the last 5 years?

4. Do you currently regulate the operation of these pits by a Soil Removal Bylaw or other means? Do you collect royalties?

5. Do you have reclamation requirements for these pits? Do you consider these sufficient to ensure the pit will be left in an acceptable condition?

6. Do you regulate backfilling of the pit excavations? Do you allow backfill material to be imported from off-site? Do you charge a fee for deposition of material, as allowed under Bill 44?

7. Are you experiencing current conflicts between operation of the pits and planning issues? Such conflicts could arise from truck traffic, noise and dust, safety, pit expansion into potential housing or industrial development areas, etc? Please be as specific as possible.

8. Is gravel from pits operating within your jurisdiction trucked to destinations outside your area? Can you estimate a percentage? Do you know how far it is trucked, in terms of average and maximum distance?

9. Please provide (estimated) annual gravel consumption volumes for the area within your jurisdiction for the past 5 years and the next 5 years. If you do not have this information, please indicate if you expect consumption to increase or decrease over the next 5 years, and by what percentage.

---

* For the purposes of this questionnaire, "gravel" includes natural sands and gravels and processed aggregates.

10. Are you aware of any undeveloped but potential gravel resources in your area of jurisdiction that lie in the Agricultural Land Reserve or are alienated for any other reason? If so, please identify.

11. Have you had any recent contact with the Ministry of Energy, Mines and Petroleum Resources regarding gravel pit operation in your area of jurisdiction?

12. Do you have any concerns regarding Provincial Government agency involvement in current land tenure/leasing practices, royalty/fee assessment, pit operation, safety and health regulations, environmental control and reclamation requirements? If so, please specify.

13. Are you aware of proposed changes to the Mines Act? Do you have any concerns in this regard?

14. Do you favour changes in local government control versus Provincial regulation of gravel pits?

15. Do you utilize any royalty payments made by pit operators for road maintenance of gravel truck routes, reclamation of abandoned pits, or other measures directly connected to gravel extraction? Do you favour this approach?

THURBER CONSULTANTS LTD.

Suite 200 - 1445 West Georgia St., VANCOUVER, B.C. V6G 2T3 Phone (604) 684-4384

July 25, 1989

File: 15-8-10

Company
Address
City
Code

Attention: Name
Title OB

SAND AND GRAVEL INDUSTRY STUDY

Dear Sirs:

Thurber Consultants Ltd. is conducting a study of the Province's sand and gravel industry for the Ministry of Energy, Mines and Petroleum Resources. In this regard, Mr. G.B. McRae, the Deputy Minister, wrote to you on March 15 requesting your cooperation in the study. There is no record of you responding to Mr. McRae's letter (a copy of which is enclosed). However, we seek your input to the study, and on the assumption that your positive response to Mr. McRae has been mislaid or that the lack of response was an oversight, we enclose the questionnaire that was sent to other Municipalities and Regional Districts.

We request that you complete the questionnaire at your earliest convenience and return to this office to provide baseline data for the study. In completing the questionnaire, you may find you need to ask for clarification or to discuss the response more fully. If so, please do not hesitate to contact the undersigned.

We welcome constructive comment on any of the topics raised in the questionnaire and encourage you to be frank in your response. This will assist in reaching conclusions and making recommendations on completion of the study that are meaningful and practicable. If you wish your response to be treated in confidence, please indicate this in your transmittal letter.

Continued....

On behalf of the Ministry, we express our thanks for your cooperation in the study and for taking time to complete the questionnaire. On a selected basis, we expect follow-up visits will be made to some municipalities and Regional Districts for further discussion.

Yours very truly,
Thurber Consultants Ltd.

D. Smith, P.Eng.
Principal

DS/aa/1

SAND AND GRAVEL INDUSTRY STUDY
BY THURBER CONSULTANTS LTD.
QUESTIONNAIRE FOR MUNICIPALITIES AND REGIONAL DISTRICTS

1. Please provide a map of suitable scale showing the area under your jurisdiction with, if possible, active gravel* pits and gravel reserves identified. Include Ministry of Transportation and Highways' pits and reserves.

2. Please provide a list of active gravel pit operators in your area of jurisdiction.

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---

* For the purposes of this questionnaire, "gravel" includes natural sands and gravels and processed aggregates.

THURBER

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14. Do you favour changes in local government control versus Provincial regulation of gravel pits?

15. Do you utilize any royalty payments made by pit operators for road maintenance of gravel truck routes, reclamation of abandoned pits, or other measures directly connected to gravel extraction? Do you favour this approach?

THURBER CONSULTANTS LTD.

Suite 200 - 1445 West Georgia St., VANCOUVER, B.C. V6G 2T3 Phone (604) 684-4384

July 28, 1989

File: 15-8-10

Company
Address
City
Code

Attention: Name

SAND AND GRAVEL INDUSTRY STUDY

Dear Sirs:

This firm is conducting a study of the Province's sand and gravel industry on behalf of the Ministry of Energy, Mines and Petroleum Resources. The study is supported and partially funded by the Aggregate Producers Association of British Columbia. The objectives of the study are to:

- Examine the present size of the industry, its contribution to the economy of British Columbia, and its ability to meet the needs of all areas of the Province.
- Assess existing and potential sand and gravel deposits and resources throughout the Province.
- Identify the impact of Regional and Municipal plans on the availability of sand and gravel.
- Investigate current methods of issuing tenure, collection of royalties and fees and setting of performance/reclamation bonds for both private and public pits and recommend means of simplifying these systems.

Continued....

- Examine the current practice of regulation for safety and health and recommend means for unifying this regulatory control.

A Questionnaire has been sent to Municipalities and Regional Districts and responses are being received. To supplement and balance the Government Agency viewpoints, enclosed herewith is a questionnaire which we request you complete at your earliest convenience and return to this office to provide baseline data for the study. In completing the questionnaire, you may find you need to ask for clarification or to discuss the response more fully. If so, please do not hesitate to contact the undersigned.

We welcome constructive comment on any of the topics raised in the questionnaire and encourage you to be frank in your response. This will assist in reaching conclusions and making recommendations on completion of the study that are meaningful and practicable. If you wish your response to be treated in confidence, please indicate this in your transmittal letter.

On behalf of the Ministry, we express our thanks for your cooperation in the study and for taking time to complete the questionnaire. On a selected basis, we expect follow-up visits will be made to some municipalities and Regional Districts for further discussion.

Yours very truly,
Thurber Consultants Ltd.

D. Smith, P.Eng.
Principal

DS/aa/j

Enclosure

SAND AND GRAVEL INDUSTRY STUDY
BY THURBER CONSULTANTS LTD.
QUESTIONNAIRE FOR GRAVEL PIT OPERATORS

1. Please provide a map showing the location of the gravel pit areas in which you are currently operating or have control over.

2. Are there operating pits adjacent to your boundaries? Do you have any operating agreement as to how mining will be carried out along the boundary?

3. Can you provide annual production volume and market value for the pits for the last 5 years? Please separate into pit-run and processed aggregates.

4. Do you know the volume of gravel reserves within the present permit boundary? How long do you expect to operate until the pit is exhausted?

5. Are you aware of any current or potential conflicts between pit operation and planning issues. Such conflicts could arise from truck traffic, noise and dust, safety, pit expansion into potential housing or industrial development areas, etc? Please be as specific as possible.

6. What is the maximum distance you transport gravel?

7. Do you pay royalties to any Government agency for pit operation?

8. What Government agencies regulate operation of your pit?

9. Do you have any concerns regarding Provincial Government agency involvement in current land tenure/leasing practices, royalty/fee assessment, pit operation, safety and health regulations, environmental control and reclamation requirements? If so, please specify.

10. Are you aware of proposed changes to the Mines Act? Do you have any concerns in this regard?

11. Do you favour changes in local government control versus Provincial regulation of gravel pits?

THURBER CONSULTANTS LTD.

Suite 200 - 1445 West Georgia St., VANCOUVER, B.C. V6G 2T3 Phone (604) 684-4384

August 15, 1989

File: 15-8-10

Company
Address
City
Code

Attention: Name

SAND AND GRAVEL INDUSTRY STUDY

Dear Sirs:

This firm is conducting a study of the Province's sand and gravel industry on behalf of the Ministry of Energy, Mines and Petroleum Resources. The study is supported and partially funded by the Aggregate Producers Association of British Columbia. The objectives of the study are to:

- Examine the present size of the industry, its contribution to the economy of British Columbia, and its ability to meet the needs of all areas of the Province.
- Assess existing and potential sand and gravel deposits and resources throughout the Province.
- Identify the impact of Regional and Municipal plans on the availability of sand and gravel.
- Investigate current methods of issuing tenure, collection of royalties and fees and setting of performance/reclamation bonds for both private and public pits and recommend means of simplifying these systems.

Continued....

- Examine the current practice of regulation for safety and health and recommend means for unifying this regulatory control.

A Questionnaire has been sent to Municipalities and Regional Districts and responses are being received. To supplement and balance the Government Agency viewpoints, enclosed herewith is a questionnaire which we request you complete at your earliest convenience and return to this office to provide baseline data for the study. In completing the questionnaire, you may find you need to ask for clarification or to discuss the response more fully. If so, please do not hesitate to contact the undersigned.

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On behalf of the Ministry, we express our thanks for your cooperation in the study and for taking time to complete the questionnaire. On a selected basis, we expect follow-up visits will be made to some municipalities and Regional Districts for further discussion.

Yours very truly,
Thurber Consultants Ltd.

D. Smith, P.Eng.
Principal

DS/aa/j

Enclosure

SAND AND GRAVEL INDUSTRY STUDY
BY THURBER CONSULTANTS LTD.
QUESTIONNAIRE FOR GRAVEL PIT OPERATORS

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10. Are you aware of proposed changes to the Mines Act? Do you have any concerns in this regard?

11. Do you favour changes in local government control versus Provincial regulation of gravel pits?

THURBER CONSULTANTS LTD.

Suite 200 - 1445 West Georgia St., VANCOUVER, B.C. V6G 2T3 Phone (604) 684-4384

October 6, 1989

File: 15-8-10

Company
Address
City
Code

Attention: Name

SAND AND GRAVEL INDUSTRY STUDY

Dear Sirs:

We have had a very disappointing response to the questionnaire sent out to gravel pit operators on July 28 and August 15. Of the 38 operators on the mailing list, only four have replied in writing and one by telephone.

We understand that confidentiality of the responses is an important factor to the producers. We attempted to set these fears at rest with our September 8 memorandum sent to Mr. Jim Allard for discussion at the September 11 meeting of the Aggregate Producers Association. Furthermore, we understand that, at the meeting, the Association's support of the study was confirmed and all members were urged to respond.

We remind you that this is an opportunity to express your concerns and the difficulties you have experienced with Government agencies in developing and operating a gravel pit. Your suggestions for improved or simplified administration are welcomed. The recommendations of the study will include reference to tenure, royalties and bonds, all of which can have an important effect on your business.

Continued....

We again urge you to respond to the questionnaire in the very near future. If you have difficulty with responding to any of the questions, for instance, Questions 3 and 4, omit these from your response.

If you have any questions, please do not hesitate to call me.

Yours very truly,
Thurber Consultants Ltd.

D. Smith, P.Eng.
Principal

DS/aa/w

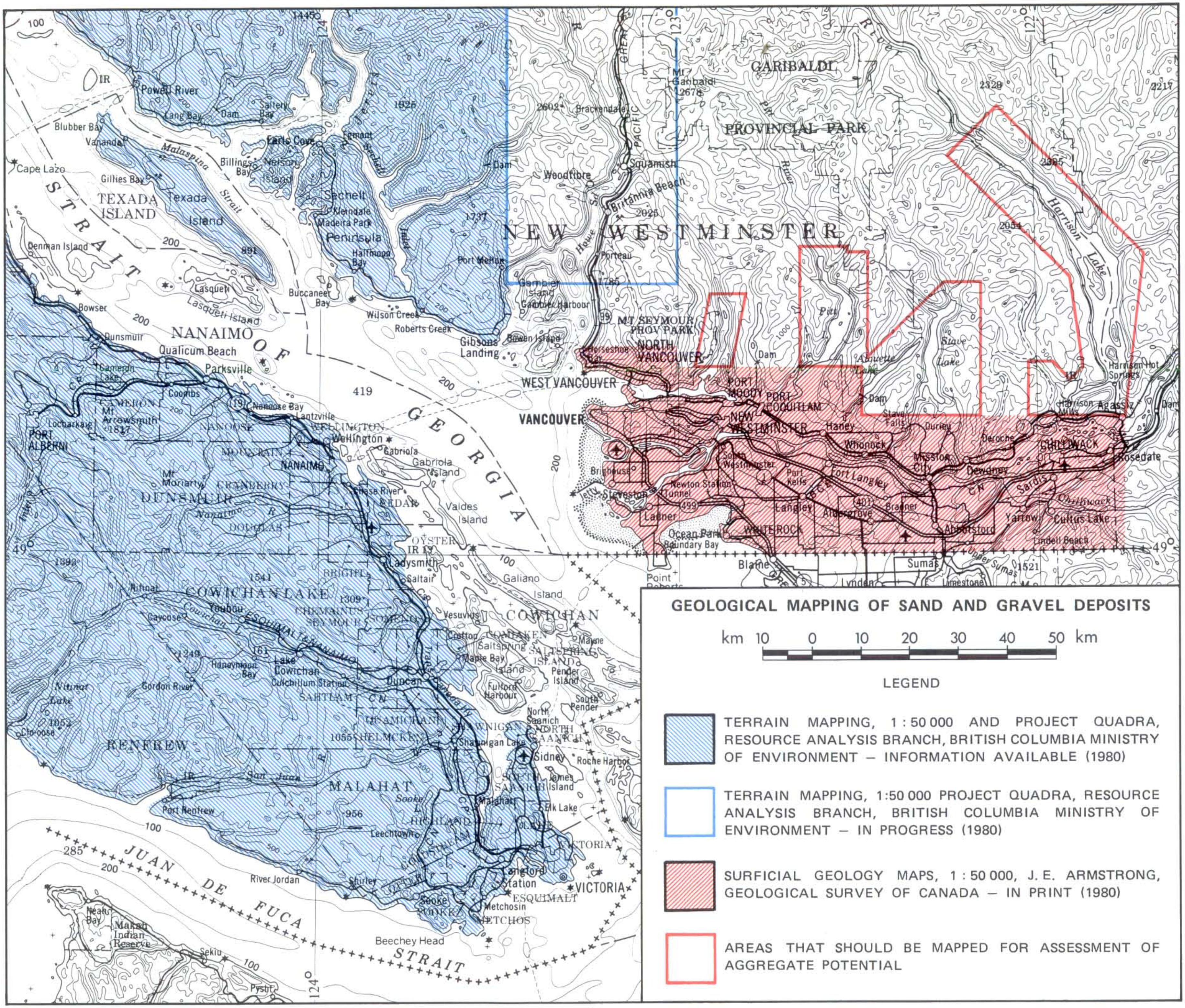

GEOLOGICAL MAPPING OF SAND AND GRAVEL DEPOSITS
km 10 0 10 20 30 40 50 km
LEGEND
TERRAIN MAPPING, 1:50 000 AND PROJECT QUADRA, RESOURCE ANALYSIS BRANCH, BRITISH COLUMBIA MINISTRY OF ENVIRONMENT – INFORMATION AVAILABLE (1980)
TERRAIN MAPPING, 1:50 000 PROJECT QUADRA, RESOURCE ANALYSIS BRANCH, BRITISH COLUMBIA MINISTRY OF ENVIRONMENT – IN PROGRESS (1980)
SURFICIAL GEOLOGY MAPS, 1:50 000, J. E. ARMSTRONG, GEOLOGICAL SURVEY OF CANADA – IN PRINT (1980)
AREAS THAT SHOULD BE MAPPED FOR ASSESSMENT OF AGGREGATE POTENTIAL
GARIBALDI
PROVINCIAL PARK
NEW WESTMINSTER
STRAIT OF GEORGIA
JUAN DE FUCA STRAIT
TEXADA ISLAND
NANAIMO
DUNSMUIR
COWICHAN LAKE
RENFREW
MALAHAT
COWICHAN
Powell River
Squamish
Woodfibre
Britannia Beach
Gibsons Landing
WEST VANCOUVER
NORTH VANCOUVER
VANCOUVER
PORT MOODY
PORT COQUITLAM
NEW WESTMINSTER
Haney
Whonock
Mission
Chilliwack
Rosedale
Agassiz
Harrison Lake
Harrison Hot Springs
Langley
Aldergrove
Abbotsford
Sumas
White Rock
Ladner
Steveston
Blaine
Qualicum Beach
Parksville
Nanaimo
Ladysmith
Duncan
Lake Cowichan
Sidney
VICTORIA
Port Renfrew
PORT ALBERNI
Sechelt
Port Mellon

FIGURE 3-2.

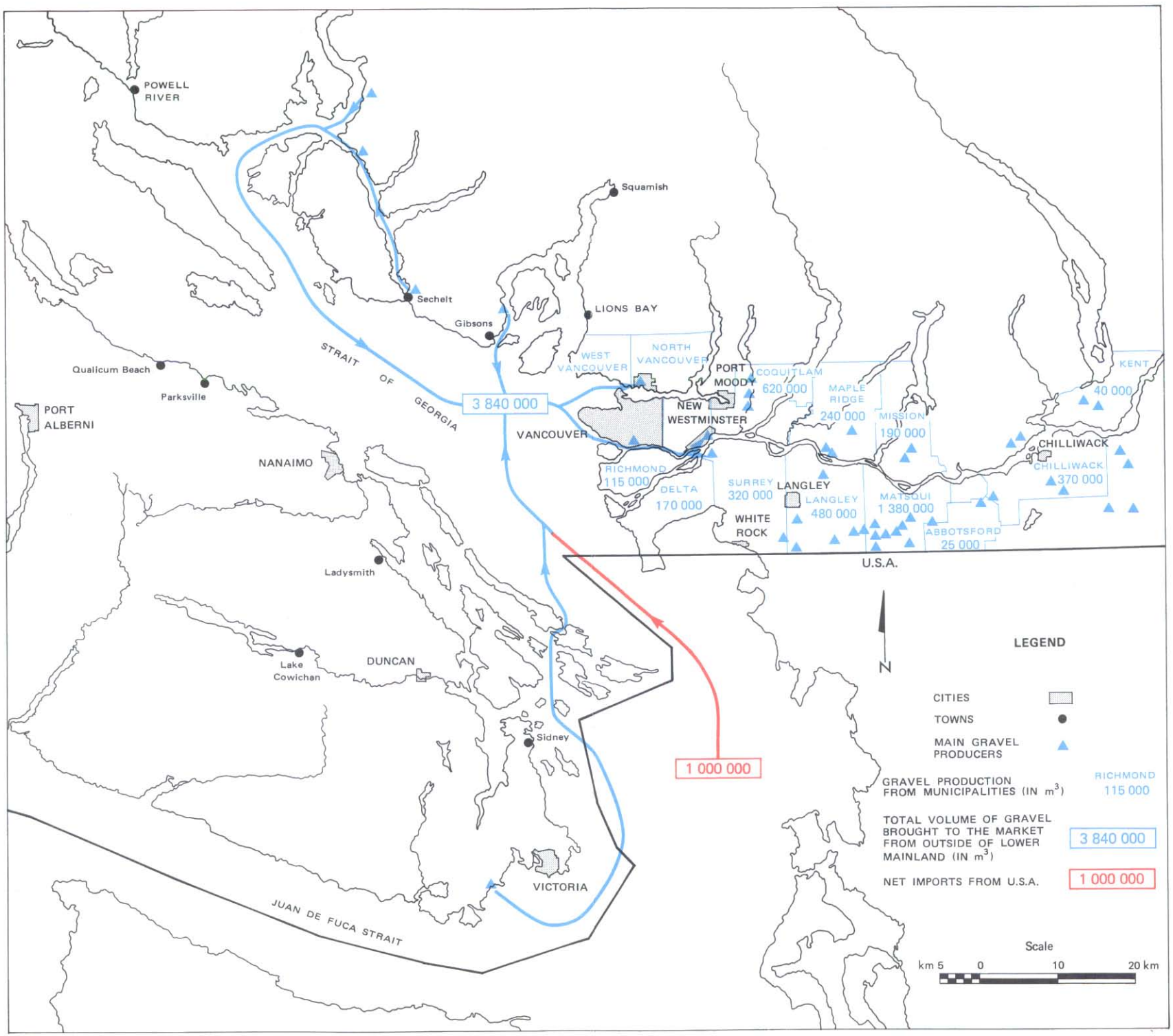
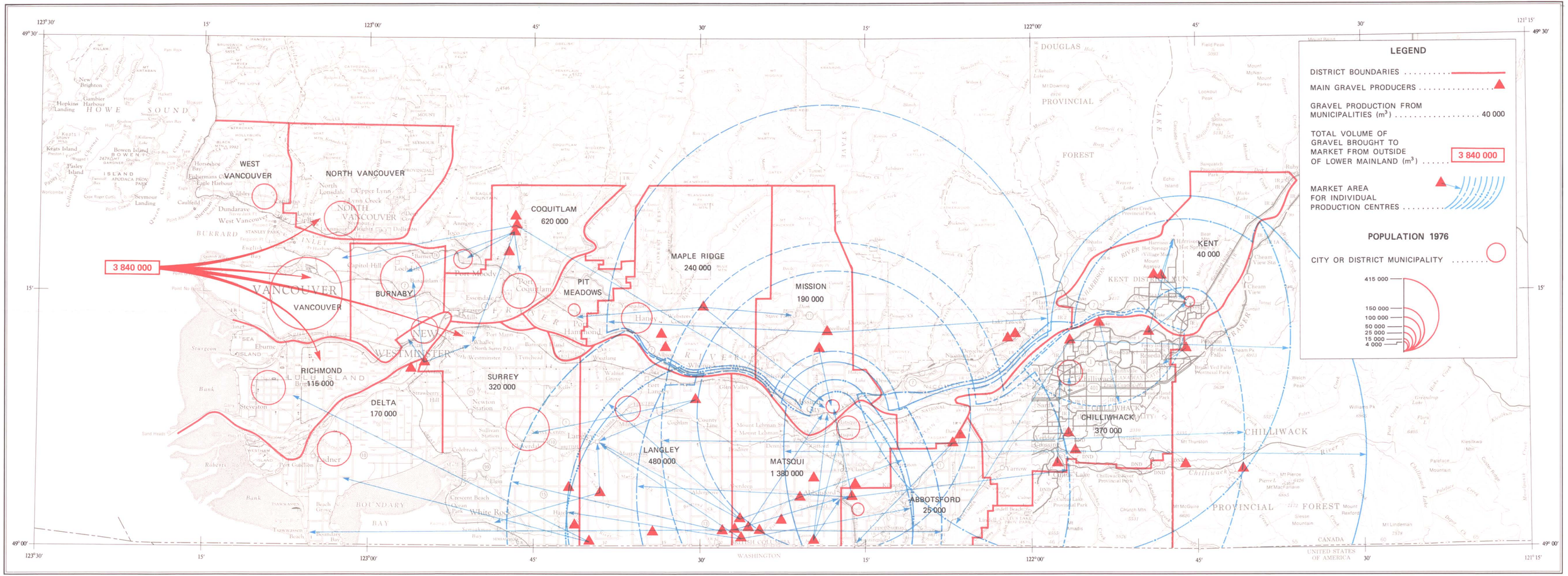


FIGURE 4-1. GRAVEL PRODUCTION AND CONSUMPTION IN THE LOWER MAINLAND AND GREATER VANCOUVER



PAPER 1980–10 **Fig. 4–2**

DISTRIBUTION PATTERN OF SAND AND GRAVEL IN THE LOWER MAINLAND

M1

Province of British Columbia
Ministry of Energy, Mines and Petroleum Resources

Fig. 3–1

GRAVEL DEPOSITS OF N.T.S. MAP SHEETS 92H/4,5, 92G/1,8, 92G/2,7, 92G/3,6.

PAPER 1980–10

COMPILED BY Z. D. HORA

SYMBOLS

- AGRICULTURAL LAND RESERVE
- SAND AND GRAVEL DEPOSITS
- SAND AND GRAVEL DEPOSITS WITHIN THE AGRICULTURAL LAND RESERVE
- GRAVEL PIT (INACTIVE) 4
- ACTIVE PIT 4
- QUARRY Q
- MINISTRY OF TRANSPORTATION AND HIGHWAYS PITS –
  - ACTIVE LEASE 1237B
  - DEPLETED PIT
  - LEASE, STATUS UNKNOWN ?
  - LEASE, UNDEVELOPED
- LEASE OR PERMIT BOUNDARY
- PERMIT PENDING ?
- MUNICIPAL PIT A,C,L...etc.
- AREA EXCAVATED OR DEPLETED
- LEASE, STATUS UNKNOWN ? 1237
- APPROXIMATE LIMITS OF MINED OUT AREA
- DISTRICT BOUNDARY
- URBAN AREAS UNDERLAIN BY GRAVEL DEPOSITS

ABBREVIATIONS

ABAND	ABANDONED
C	CEMETERY
Co	COUNTY
E	ELEVATOR
Fy	FERRY
IR	INDIAN RESERVE
H	HOSPITAL
L	LOT
Micro	MICROWAVE
Mun	MUNICIPALITY
PH	POWER HOUSE
RCMP	ROYAL CANADIAN MOUNTED POLICE
Res	RESERVOIR
Transf	TRANSFORMER
TFL	TREE FARM LICENCE

LOCATION MAP

Scale 1:3 000 000

Fig. 3–1d GRAVEL DEPOSITS OF N.T.S. MAP SHEETS 92G/3,6.

LULU ISLAND/NORTH VANCOUVER

Scale 1:50,000 Échelle

Miles 1 0 1 2 3 Miles
Metres 1000 0 1000 2000 3000 4000 Mètres
Yards 1000 0 1000 2000 3000 4000 Verges

PAPER 1980–10 **Fig. 3–1b GRAVEL DEPOSITS OF N.T.S. MAP SHEETS 92G/1,8.**

MISSION/STAVE LAKE

REFER TO FIG. 3–1d FOR SYMBOLS.

92G/8

92G/1

Scale 1:50,000 Échelle

Miles 1 0 1 2 3 Milles

Metres 1000 0 1000 2000 3000 4000 Mètres

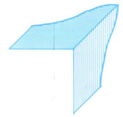
Yards 1000 0 1000 2000 3000 4000 Verges

Fig. 2–2

FENCE DIAGRAM OF SAND AND GRAVEL DEPOSITS BETWEEN LANGLY AND ABBOTSFORD.

PAPER 1980–10

SAND AND GRAVEL



SILT, CLAY; GLACIAL TILL

BEDROCK

AFTER E. C. HALSTEAD, 1979

NEW WESTMINSTER / MISSION

HORIZONTAL

Scale 1:50,000 Échelle

Miles 1 0 1 2 3 Miles

Metres 1000 0 1000 2000 3000 4000 Mètres

Yards 1000 0 1000 2000 3000 4000 Verges

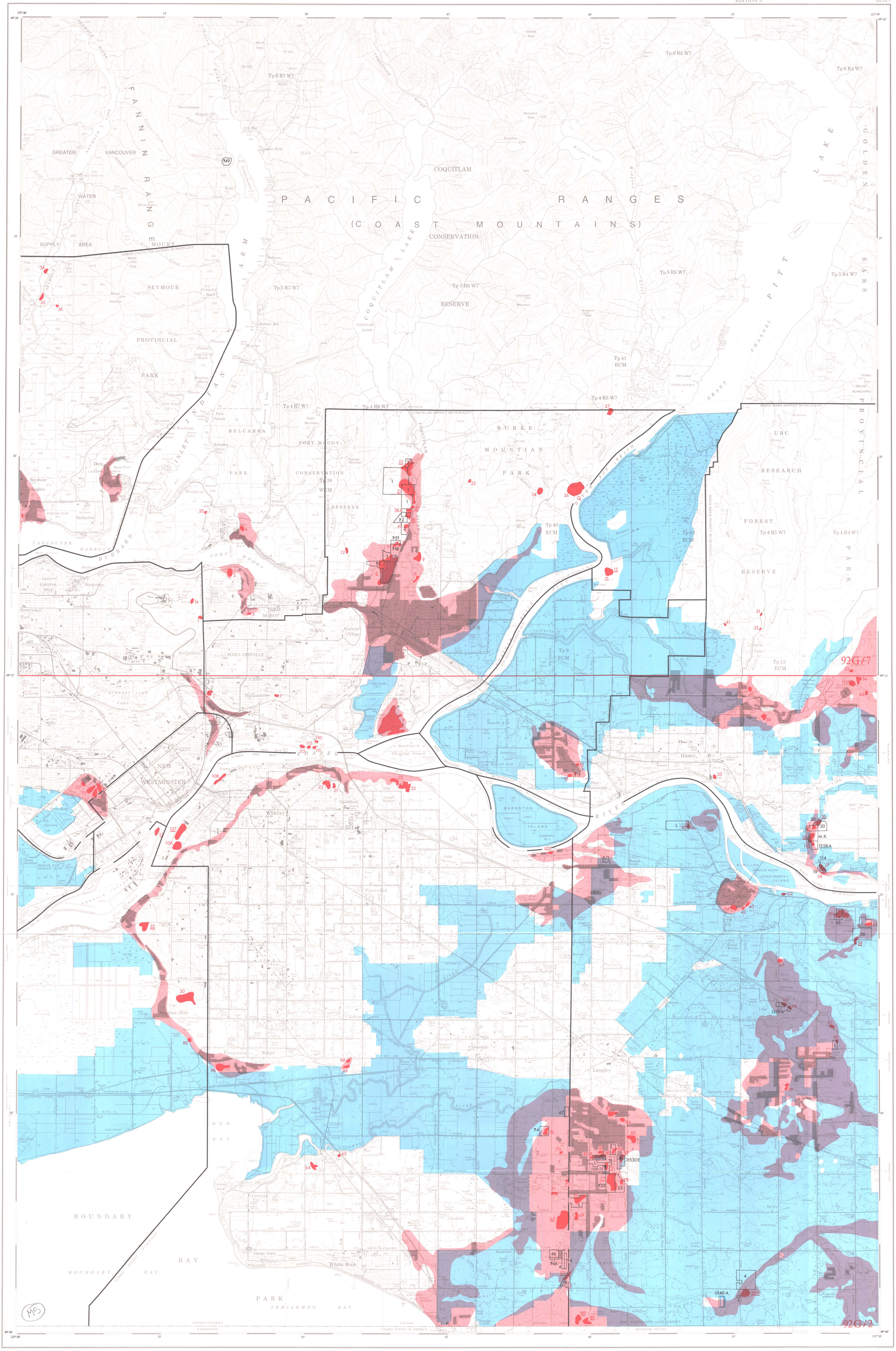
VERTICAL

Scale 1:5,000 Échelle

Miles 0.1 0 0.1 0.2 0.3 Miles

Metres 100 0 100 200 300 400 Mètres

Yards 100 0 100 200 300 400 Verges



PAPER 1980–10 **Fig. 3–1c GRAVEL DEPOSITS OF N.T.S. MAP SHEETS 92G/2,7**

NEW WESTMINSTER/COQUITLAM

REFER TO FIG. 3–1d FOR SYMBOLS

Scale 1:50,000 Échelle

Miles 1 0 1 2 3 Milles

Metres 1000 0 1000 2000 3000 4000 Metres

Yards 1000 0 1000 2000 3000 4000 Verges

PAPER 1980–10 **Fig. 3–1a GRAVEL DEPOSITS OF N.T.S. MAP SHEETS 92H/4,5.**

CHILLIWACK/HARRISON LAKE

REFER TO FIG. 3–1d FOR SYMBOLS

Scale 1:50,000 Échelle

Miles 0 1 2 3 Miles

Metres 1000 0 1000 2000 3000 4000 Mètres

Yards 1000 0 1000 2000 3000 4000 Verges

Fig. 2–4 SAND AND GRAVEL DEPOSITS IN SECHELT AND JERVIS INLET AREA.

PAPER 1980–10

M7

■ SALISH DEPOSITS

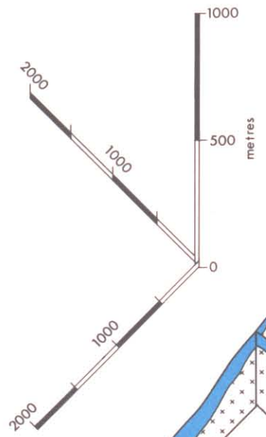
▲ CAPILANO DEPOSITS

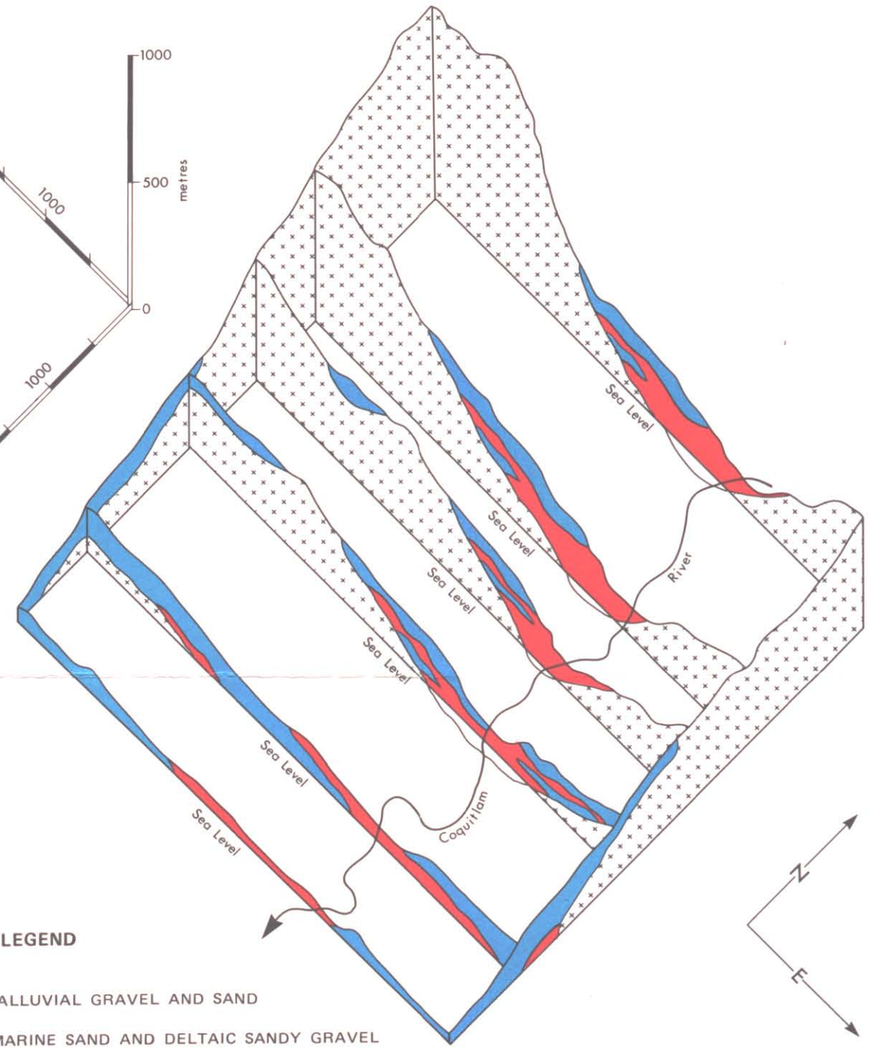
○ ACTIVE PITS

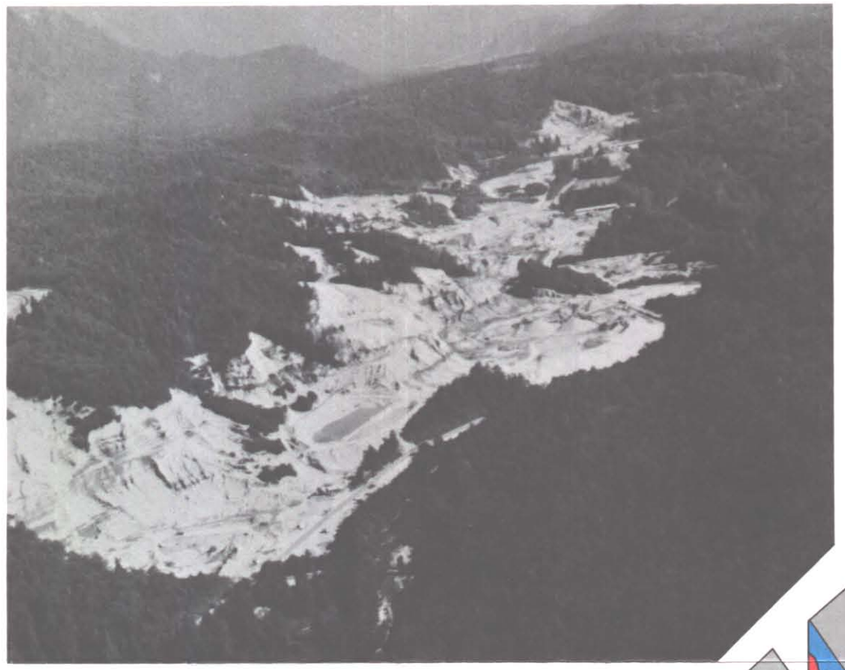
Scale 1:250,000

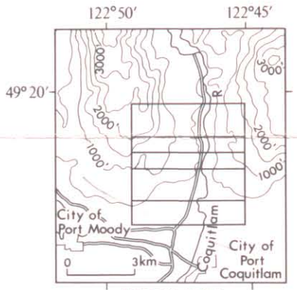
km 5 0 5 10 20 km

PAPER 1980–10 Fig. 2–3 LOWER COQUITLAM VALLEY - HYPOTHETICAL FENCE DIAGRAM, BLOCK DIAGRAM OF THE WEST SLOPE

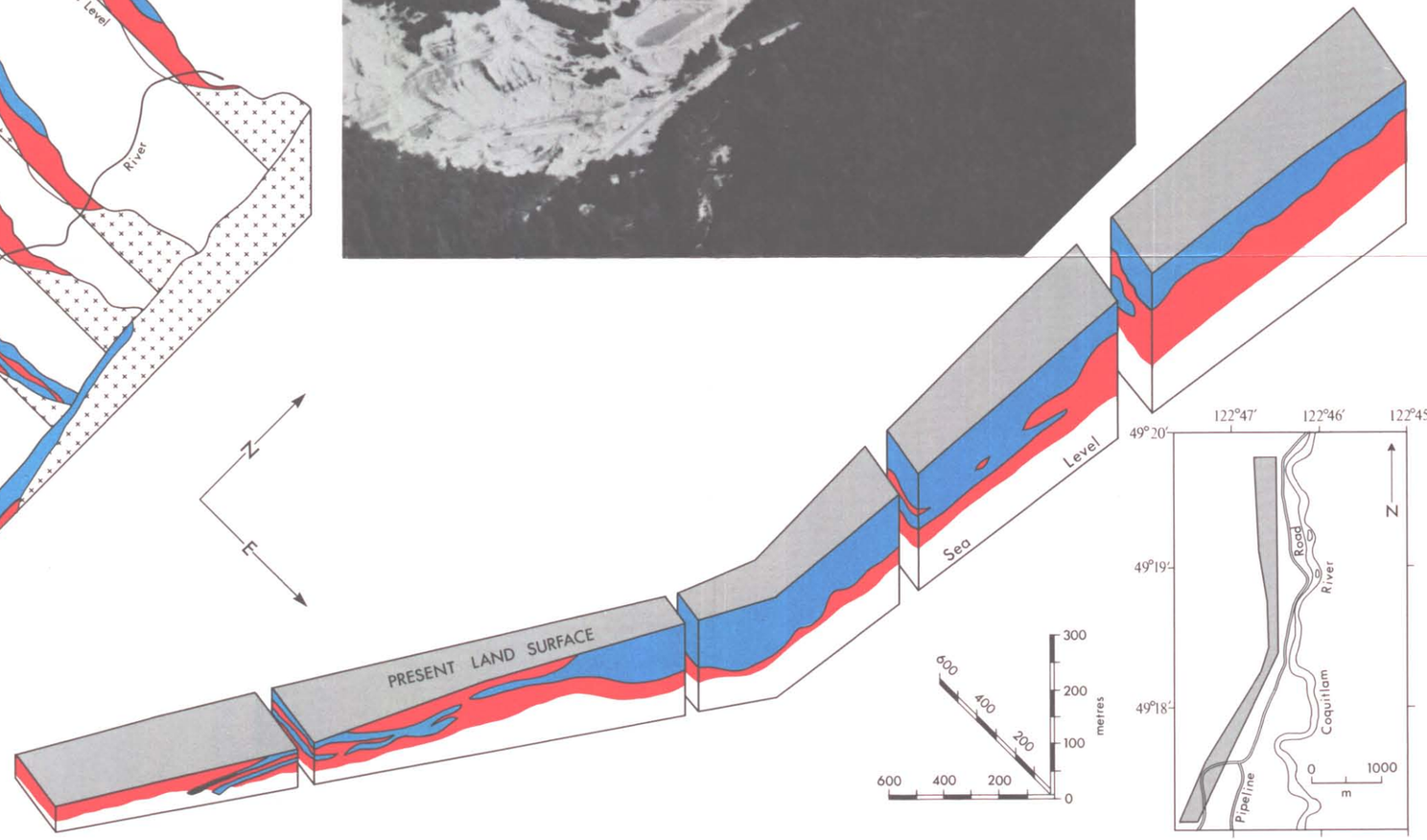








INDEX MAP



LEGEND

COQUITLAM RIVER SEDIMENTS: ALLUVIAL GRAVEL AND SAND

CAPILANO SEDIMENTS: RAISED MARINE SAND AND DELTAIC SANDY GRAVEL

QUADRA SAND: GLACIOFLUVIAL GRAVELLY SAND

HIGHBURY SEDIMENTS: RUSTY GRAVELLY SAND AND SILT

PRE–HIGHBURY SEDIMENTS: COBBLE GRAVEL WITH MINOR SAND AND SILT, SEMI–PERVIOUS

CAPILANO SEDIMENTS: GLACIOMARINE CLAYEY SILTS

VASHON DRIFT, COQUITLAM DRIFT: LODGMENT AND FLOW TILL; LENSES OF SAND, GRAVEL, AND STONY SILTS

SEMIAHMOO DRIFT: LODGMENT TILL, STONY CLAYEY SILTS; OUTWASH BOULDER SANDY GRAVELS

BEDROCK

AFTER J. E. ARMSTRONG (1977) AND S. R. HICKOCK (1976)