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GRANULAR AGGREGATE-RESOURCE MAPPING IN CENTRAL AND NORTHEASTERN NEWFOUNDLAND

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ABSTRACT

This report gives preliminary results of 1:50,000-scale granular aggregate-resource mapping in the Botwood, Hodges Hill and Point Leamington map areas of central and northeastern Newfoundland. The objective of the project is to conduct a regional aggregate study to locate suitable deposits to assist the construction industry when development occurs in these areas. The largest known potential deposits are located at Peters River, Browns Arm, Northern Arm Brook, Exploits River, Jumpers Brook, Kite Cove and Southwest Brook.

INTRODUCTION

The second year of a regional aggregate-resource mapping program for the Island of Newfoundland was completed during the 1990 field season. The objectives of the program are to locate, map and sample sand, gravel and glacial till materials. Field sampling concentrated on glaciofluvial outwash deposits, which are the major sources of sand and gravel in the province. These deposits are excellent sources of low silt-clay aggregate, which are necessary for use in concrete, asphalt, and Class A and B road gravels. Glacial till is generally regarded as poor quality aggregate due to its large silt-clay fraction and therefore, was given less attention during field investigations.

MINERAL AGGREGATE–A BRIEF DESCRIPTION

Mineral aggregates are defined as any hard, inert material such as gravel, sand, crushed stone or other mineral material that is used in the construction industry (Carter, 1981). They are used extensively in all types of construction activities related to domestic, industrial or other developments. These materials can be, (a) used in an unprocessed form as pit and run, (b) processed and used as Class A road gravels (Department of Transportation, 1987), (generally, aggregate consisting of 100 percent grain-sizes less than 19 mm in diameter and less than 6 percent silt-clay content plus a specified range of percentages for size fractions between these upper and lower limits) and Class B road gravels (generally, aggregate consisting of 100 percent grain-sizes less than 102 mm in diameter and containing less than 6 percent silt-clay plus a specified range of percentages for size fraction between these upper and lower limits) and (c) mixed with a cementing agent to form concrete, asphalt and mortar. Road construction is one of the major uses of aggregate materials. From a municipal viewpoint, street, water and sewer service, driveway construction and building foundations all require aggregate. Backfill is another major use, as are topsoil-type materials for landscaping.

Not all of the materials are suitable as aggregate. Vanderveer (1983) defined the quality of mineral aggregate by their composition. Aggregates containing too much or too little silt and clay when used in road construction can cause instability, e.g., flowage in the base of too much fine material, or the loss of compaction properties in the case of too little fine material. Also, too much fine material in concrete (> 2 percent) can interfere with the bonding process between the aggregate and the cementing agent. The presence of deleterious substances such as silt-clay coating or iron-oxide staining on the surface of the aggregate, and the presence of certain friable or blade-shape fragments, often cause bonding problems with the cementing agent, or the breakdown of aggregate with time.

Aggregates are a high-volume, low-cost material. The cost of transport represents, on average, 30 percent of the delivered price (Vanderveer, 1982). Thus, the location of resources relatively close to the users is important. In the case of Newfoundland, the many users throughout the Island makes a regional-mapping project of the resources vital.

LOCATION AND ACCESS

The field area consisted of the Botwood (2E/3), Hodges Hill (2E/4) and Point Leamington (2E/6) map areas of central and northeastern Newfoundland (Figures 1 and 2).

Most of the field area is easily accessible, by the many major road-routes throughout the study area, numerous logging roads (in use and abandoned), which are usable by all-terrain-vehicles, and waterways accessible by boat and canoe. The only areas with poor ground access are located in the northern–central part of map area 2E/3, between Burnt

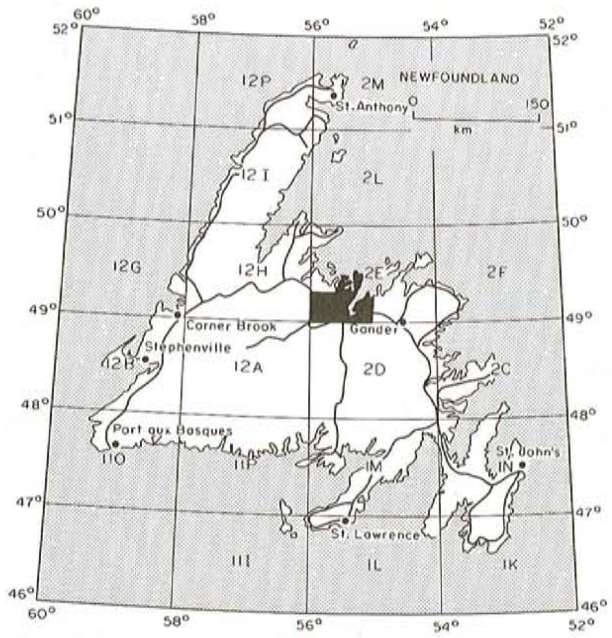

Figure 1. *Location map.*

Arm and Lewisporte, and in the central part of map area 2E/4, between New Bay Pond Road and Mary Ann Lake.

PREVIOUS WORK

Surficial geological mapping at 1:50,000 scale (based mainly on 1978 reconnaissance aerial photographic interpretation) has been completed in most of the study area (Kirby *et al.*, 1989).

An aggregate-resource program was conducted by the Department of Mines and Energy from 1978 to 1982 (Environmental Geology Section, 1983; Kirby *et al.* 1983) covering a 6-km-wide corridor along all major roads and a wider radius around towns and cities in Newfoundland and Labrador. Kirby (personal communication, 1989) conducted detailed sampling in selected granular aggregate deposits in the 2E/3 map area. These deposits are situated along Southwest Brook, Northern Arm, Peters River and the Exploits River. In addition to this data, geotechnical bedrock maps were compiled at a scale of 1:250,000 (Bragg, 1986). Bedrock-aggregate mapping at a scale of 1:50,000 was conducted in central Newfoundland (Bragg, 1990) to locate suitable bedrock deposits where granular aggregates are scarce and/or poor in quality.

GEOLOGICAL SETTING

The bedrock geology of the area consists of intrusive, volcanic and sedimentary rocks (Figure 3). Intrusive rocks dominate the western part of map area 2E/4, the southeast corner of map area 2E/3 and in smaller zones intermixed with volcanic and sedimentary rocks in other parts of the map area.

Intrusive rocks consist essentially of diorite, gabbro, granite, quartz diorite, quartz monzonite and minor trondhjemite. Volcanic and sedimentary rocks include basic to acidic volcanics, sandstone, shale, greywacke, conglomerate and chert.

MAPPING AND ANALYTICAL METHODS

Field work was undertaken in a similar manner to that outlined by Kirby *et al.* (1983). Interpretation of 1:50,000-scale black-and-white aerial photographs was used as a guide to locate potential deposits of sand and gravel. Following this, interpretation of coloured aerial photographs at 1:12,500 scale was conducted in selected areas based on deposit type (e.g., glaciofluvial, marine, till) to delineate deposit boundaries accurately. Where exposures were present, field sampling was carried out at 0.5 to 1.0 km intervals in outwash deposits, and at 1.5 to 2 km intervals in till. Additional samples were taken at each deposit wherever changes in sediment type were observed, where quality differences were apparent, or wherever sediments of variable quality or texture could be quarried separately.

Where possible, samples were taken from natural exposures such as stream cuts, shorelines, and gullied areas or from man-made exposures such as roadcuts and pit and quarry excavations. Where these types of exposures were not available, samples were collected from hand-dug pits, slightly greater than 1 m in depth.

Sampling provided material for petrographic and grain-size analyses, and Los Angeles abrasion and soundness tests. Approximately 15 kg of material were collected for field sieving. Field sieving and petrographic analysis were done on all samples containing >8mm-size material. A split (70 to 140 g) of the sand-silt-clay fraction (<8mm) was retained for laboratory sieving. The laboratory sieving involved drying and splitting the sample to manageable quantities (70 to 140 g) and wet and/or dry sieving of each sample following the procedures outlined in Ricketts (1987). Los Angeles abrasion and soundness tests will be done on selected samples during this coming year. These tests will follow ASTM standards C 88-83, (1990), for soundness, and C 131-89, (1990), for abrasion.

CLAST-TYPE ANALYSIS

The aggregate samples were examined to help determine the petrographic characteristics of the pebble fraction (16 to 32 mm). A petrographic number was calculated using similar procedures outlined in CSA standard A23.2.30 (Canadian Standards Association, 1973). The petrographic number, which can range from 100 to 1000, is derived by taking the sum of the percentage of each rock type present in the pebble fraction (approximately 50 pebbles) multiplied by a petrographic factor (based on soundness and durability) assigned to that rock type (Bragg, *this volume*). The petrographic factor is determined mostly by the rock type and textures present in a given pebble sample and also by the presence of silt-clay coatings, weathering, staining, degree of sphericity, rounding and fractures. The lower the petrographic number, the better the quality of aggregate material. For example, a clean, hard, fresh granite would

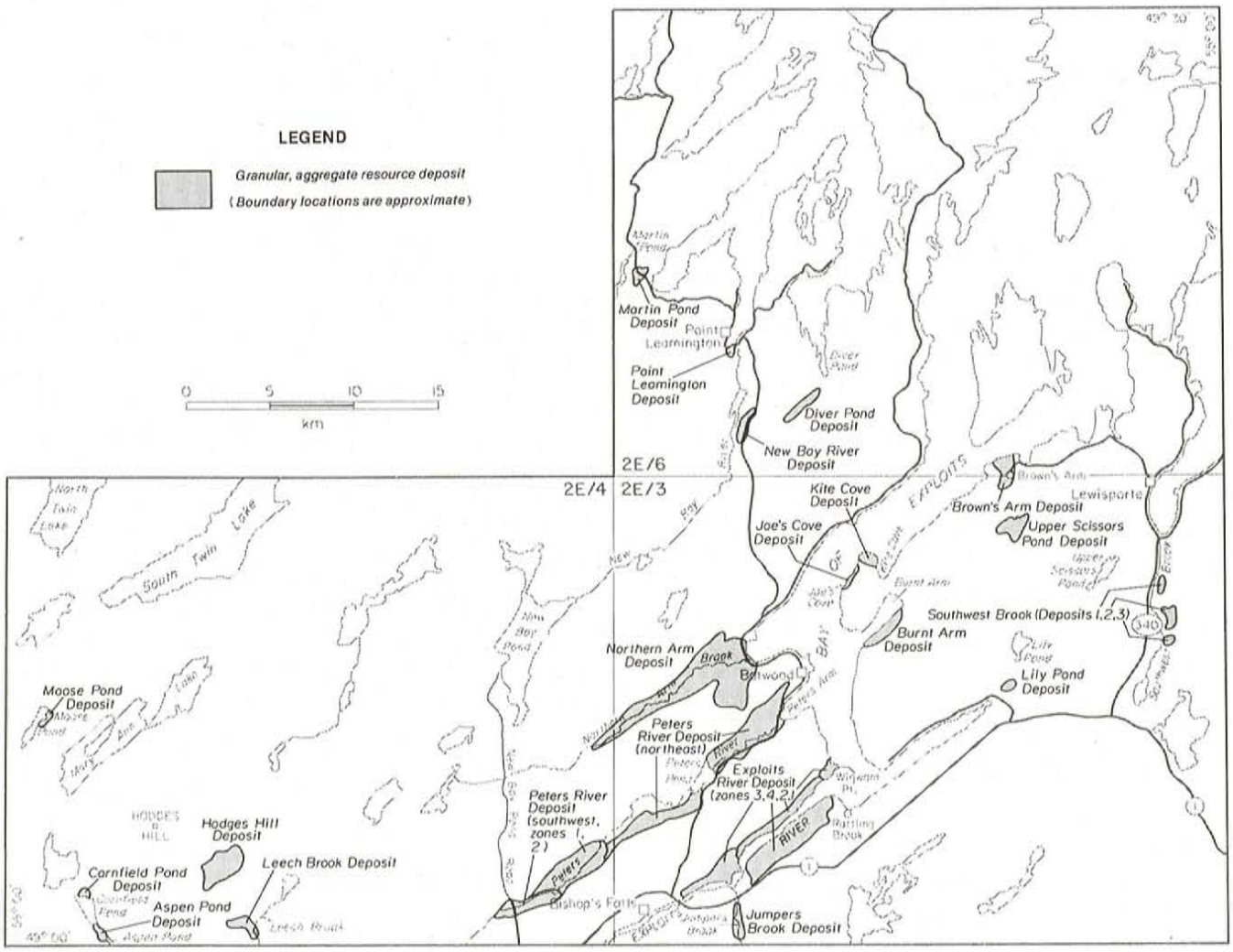

Figure 2. *Potential aggregate-resource deposits in the Botwood (2E/3), Hodges Hill (2E/4) and Point Leamington (2E/6) map area.*

normally have a petrographic number of 100, whereas for a friable, soft shale it would be 1000. A combination of different rock types with different petrographic factors in one granular sample would give a petrographic number between 100 and 1000 (Table 1). For most purposes, aggregate material used in concrete, in Newfoundland, requires a petrographic number of 135 or less, and a petrographic number of 150 or less for use in road asphalt and Class A and B gravels (Department of Transportation, 1987).

RESULTS

Grain-size analyses were done on 225 samples. The results plot as cumulative curves for each sample similar to those of Kirby *et al.* (1983). A computer program is used to calculate percentages of gravel, sand, and silt-clay data. Individual sieve percentages can also be calculated from these graphs.

A review of landform classification and grain-size analyses will be made and results drafted on 1:50,000-scale maps. These maps will show aggregate zones determined by quantity and type of material, sample numbers and type of sample collected (sand, gravel, silt and till). Boundaries around designated aggregate zones will be determined principally from airphoto investigations, and may not represent the true extent of any deposit that can be used as a source of aggregate.

POTENTIAL DEPOSITS

The following are brief descriptions (described in order by mapsheet) of some of the potential granular aggregate-resource deposits in the study area (Figure 2; Table 2). The descriptions include deposit location, length, width and thickness of deposits, exposure types where samples were collected, average percentage of gravel, sand, and silt-clay and range of petrographic numbers for each deposit (results of grain-size and petrographic analyses are based on a compilation of sample data collected during the 1990 field season and previous sample programs by the Department of Mines and Energy since 1978).

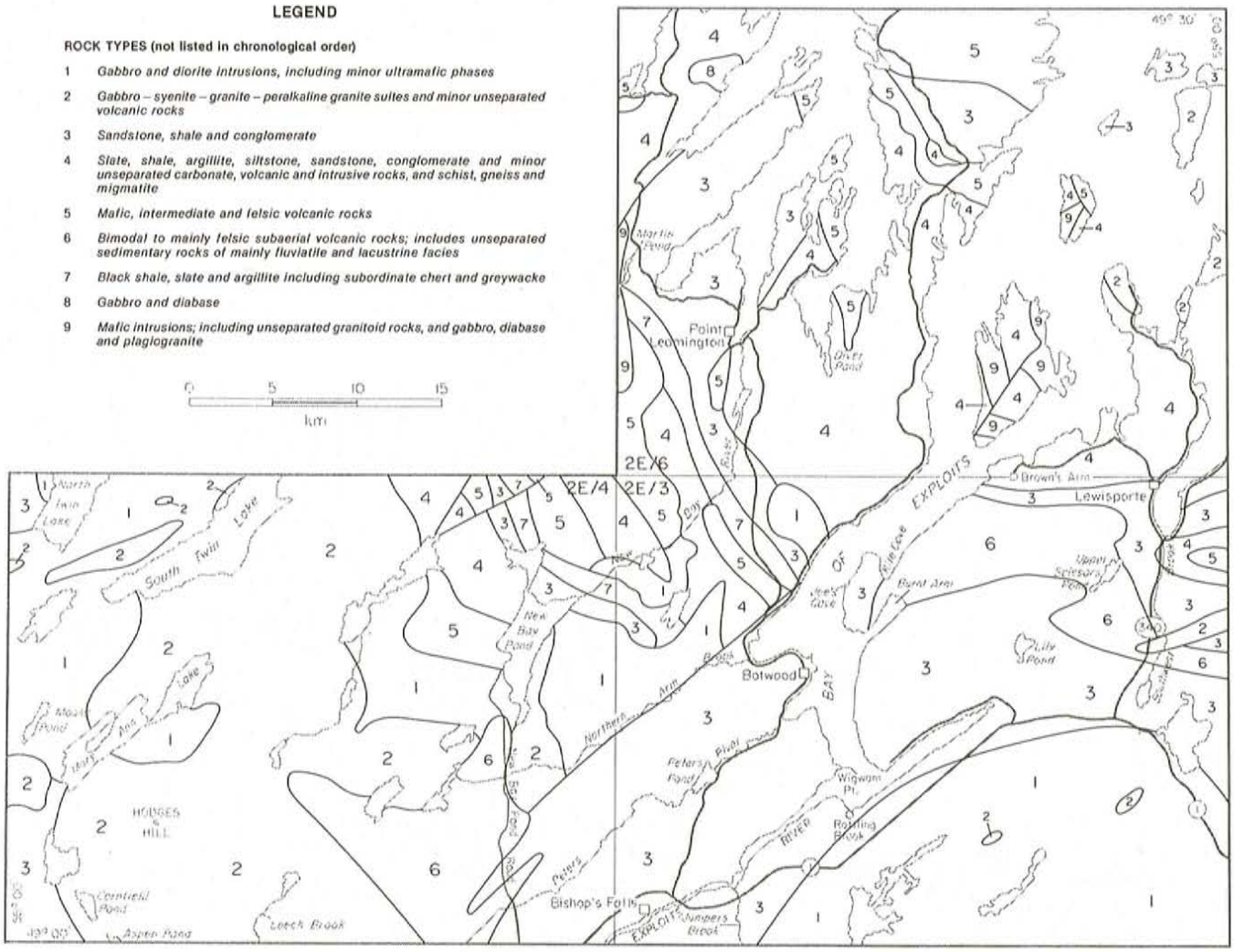

Figure 3. *Generalized geology in the Botwood (2E/3), Hodges Hill (2E/4) and Point Leamington (2E/6) map area (after Colman-Sadd* et al., *1990; Andrews, 1980; and Dean, 1977).*

Table 1. Example for calculating petrographic numbers for a granular aggregate sample with different rock types

Rock type	# of pebbles	%		Petrographic factor	
Shale	12	22	x	10	= 220
Granite	27	50	x	1	= 50
Sandstone	10	19	x	3	= 57
Schist	5	9	x	6	= 54
				Sum	= 381
				Petrographic number	= 381

MAP AREA 2E/3

SOUTHWEST BROOK

Southwest Brook is located in the eastern part of map area 2E/3, along the east side of Route 340 leading from the Trans-Canada Highway (TCH, Route 1) to Lewisporte. It is in a region of dense to moderate forest growth, underlain by topsoil and iron-oxide layers ranging from 0.5 to 1.1 m in thickness. Three deposits of glaciofluvial outwash material were sampled in this area (Figure 2, Table 2). Sample types consisted of gravel, sand, and silt-clay materials.

Deposit 1 is situated 2 km south of Lewisporte. This deposit is 900 m long, 200 m wide and up to 8 m thick. Eighteen samples taken from this area were collected from quarries and backhoe pits averaging a depth of 3.4 m. Grain-size analyses of these samples indicate variable textures throughout the deposit (Figure 4), but generally consists of class-B-type material mixed with medium sandy gravel, fine to medium sand, silty sand and silt. Six of the 14 samples analyzed in this area have silt-clay content greater than 4 percent with a high of 38.7 percent. Quarrying in the northern part of this area has resulted in approximately 25 percent removal of this deposit. Remaining aggregate in the northern area consists of less usable silty-sand and silt-clay type material. Areas south of the quarry require further sampling

Table 2. Summary and comparisons of aggregate zones in central and northeastern Newfoundland

		Grain-size analyses				Petrographic analyses		
Deposit	Estimated m3 x10^6	# of samples analyzed	% Grv. (+5mm)	% Sd. (+.078 to 5mm)	% Slt-Cly (-78 um)	# of samples analyzed	Range	Average
Southwest Br.								
Zone 1	0.1–0.5	18	50.0	43.0	7.0	14	144-389	252
Zone 2	0.5–1.0	6	39.9	57.9	2.2	3	148-293	208
Zone 3	0.5–1.0	2	32.0	66.0	1.4	1	327	327
Lily Pond	< 1	1	1.0	95.7	3.2	0		
Kite Cove	5.0–10	1	56.0	43.7	2.3	1	238	238
Northern Arm	> 10	28	44.6	54.4	1.0	19	119-340	218
Peters River (northeast)	> 10	28	43.0	55.9	1.1	17	151-450	273
Exploits River								
Zone 1	0.5–1.0	3	49.0	50.8	0.2	3	408-482	442
Zone 2	5.0–10	7	7.3	92.6	0.1	0		
Zone 3	5.0–10	14	65.5	34.0	0.5	12	185-704	406
Zone 4	> 10	30	37.3	62.2	0.5	21	140-498	270
Jumpers Brook	0.5–1.0	5	36.2	59.5	4.3	3	176-282	212
Peters River (southeast)								
Zone 1	> 10	3	11.0	80.0	9.0	1	455	455
Zone 2	5.0–10	12	51.8	46.7	1.5	9	146-503	286
Hodges Hill	0.5–1.0	2	61.2	38.6	0.3	2	150-156	153
Aspen Pond	0.1–0.5	1	86.8	13.0	0.2	1	224	224
Cornfield Pond	< 0.1	1	67.9	31.8	0.3	1	106-106	106
Moose Pond	0.1–0.5	3	39.9	54.6	8.5	3	168-202	185
Browns Arm	>10	7	51.4	47.6	0.9	4	213-457	324
Diver Pond	0.1–0.5	2	76.6	23.3	0.1	2	236-248	242
New Bay River	0.1–0.5	3	25.7	73.2	0.1	2	438-517	477
Point Leamington	0.1–0.5	6	46.6	50.5	2.9	4	213-457	324
Martin Pond	0.1–0.5	2	64.4	34.9	0.7	2	152-534	346

Note: Estimated quantities in Table 2 are based on airphoto analysis and field investigation where roadcuts, shallow hand-dug pits and natural exposures permitted. Detailed sampling methods such as drilling were not conducted. Grain-size percentages are based on a compilation of samples for each deposit and do not take into account extent and thickness of units at any one location.

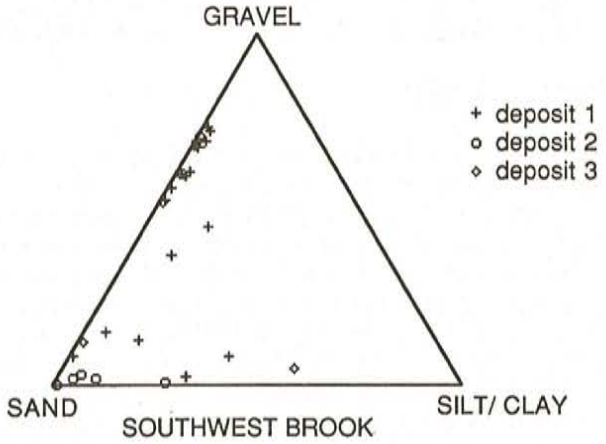

Figure 4. *Ternary diagram showing granular distribution of samples collected in deposits along Southwest Brook.*

to determine grain-size distribution and possible variations in deposit thickness.

Petrographic numbers (14 samples) range from 144 to 389 with an average of 252. The petrographic quality of this deposit is greatly reduced by the high content (55 percent) of slightly weathered to highly weathered sandstone, conglomerate, diorite, granodiorite and volcanic rocks. Fresh, hard granite, granodiorite and volcanics constitute the rest of the deposit. Variations in grain-size distribution and generally high petrographic numbers make this deposit unsuitable as a source of high-quality aggregate.

Deposit 2 is situated 4.5 km south of Lewisporte along Southwest Brook. This deposit is 900 m long, 500 m wide and 4 m thick. Six samples were taken from quarries and backhoe pits. Grain-size analyses of sampled material show

an average of 39.9 percent gravel, 57.9 percent sand and 2.2 percent silt-clay. Samples showed variations of silt-clay from 0.75 percent to 9.82 percent with the exception of one silty-sand sample having a silt-clay content of 27 percent (Figure 4). Approximately 50 percent of this zone has been quarried. Most of the remaining material consists of silty sand and silt. Petrographic numbers for 3 samples analyzed in this deposit are 148, 183 and 293.

This zone is regarded as having low economic potential because of past removal, and the leaving behind of high silt-clay materials that have low economic value.

Deposit 3, located farther south along Southwest Brook than deposits 1 and 2, is approximately 6 km south of Lewisporte and is approximately 600 m long, 300 m wide and 5 m thick. Three samples collected from this area were taken from quarry exposures averaging 6 m in thickness (Plate 1). One sample was similar to a Class A road-gravel texture and two others consisted of fine to medium sand, and a fine sand and silt. Fine to medium sand is apparent along most exposures (approximately 65 percent), whereas Class A material was sampled in the east part of the quarry (approximately 20 percent of exposed material). The remaining material consists of silty sand (Figure 4), located in the southwest corner of the quarry. This area is currently being quarried to obtain a blending sand for use in concrete.

Plate 1. *Sand and sandy gravel in active quarry in Zone 3 near Southwest Brook.*

Only one sample taken from this zone contained material greater than 16 mm and can be used to determine petrographic qualities. A petrographic number of 327, which is a low-quality aggregate, was mainly due to the relatively high content (64 percent) of slightly weathered to intensely weathered sandstone, siltstone, granite, volcanic rocks, diorite and gabbro. The deposit also contains 36 percent fresh, hard volcanic rocks, diorite and gabbro.

This deposit may contain enough material to sustain the present operator for another 3 to 5 years at present removal rate (B. White, personal communications, 1990).

LILY POND

The Lily Pond deposit is a small outwash deposit located near the central part of map area 2E/3, 1 km south of Lily Pond (Figure 2). It is approximately 400 m long, 25 m wide and up to 1.5 m thick. It is in a region of dense forest growth underlain by approximately 0.6 m of topsoil and iron oxide. One sample was collected from a 1-m-deep backhoe pit. Grain-size analyses of the sampled material indicate that this deposit contains 1 percent gravel, 97.7 percent sand and 3.2 percent silt-clay. It has a dominantly fine sandy texture with 30 percent of the material between 0.25 and 0.5 mm in diameter. Petrographic examination of coarse aggregate was not possible. The small size of this deposit greatly reduces its economic potential.

KITE COVE

The Kite Cove deposit is a large delta formed at the northwest side of Kite Cove in the northern part of map area 2E/3 (Figure 2). This deposit is 800 m long, 300 m wide and up to 40 m thick. Dense forest growth covers most of this deposit. One sample was collected from a 20-m-high quarry exposure. Grain-size analysis of sampled material indicates it is similar to Class A type road gravel with size fractions from 1 to 64 mm forming 10 to 15 percent of sample weight. No material was collected in the +64 mm sieve but cobbles and boulders were observed along the 20-m-high-site exposure (Plate 2).

A petrographic number of 238 was determined from 23 percent moderately weathered to weathered siltstone, sandstone, conglomerate, tuff, granites and volcanic rocks, and 75 percent fresh to slightly weathered, hard, sandstone, gabbro and volcanic rocks.

Due to the size of this deposit, additional sampling is required to determine its quality and economic potential.

NORTHERN ARM

The Northern Arm deposit is located along Northern Arm Brook and around the community of Northern Arm in the west part of map area 2E/3 (Figure 2). This deposit covers a large area, extending over 8 km from Northern Arm in a southwest direction along both banks of Northern Arm Brook. The width of this deposit varies from 1 to 3 km and thickness from 1 to 12 m. It is situated in a area of dense forest growth, bog and minor cleared areas for farmland. Topsoil and iron-oxide layers may vary from 0.7 to 1.4 m in thickness. Bog cover has a thickness up to 2 m along the valley floor area of Northern Arm Brook. Twenty-eight samples were collected from this deposit from road and

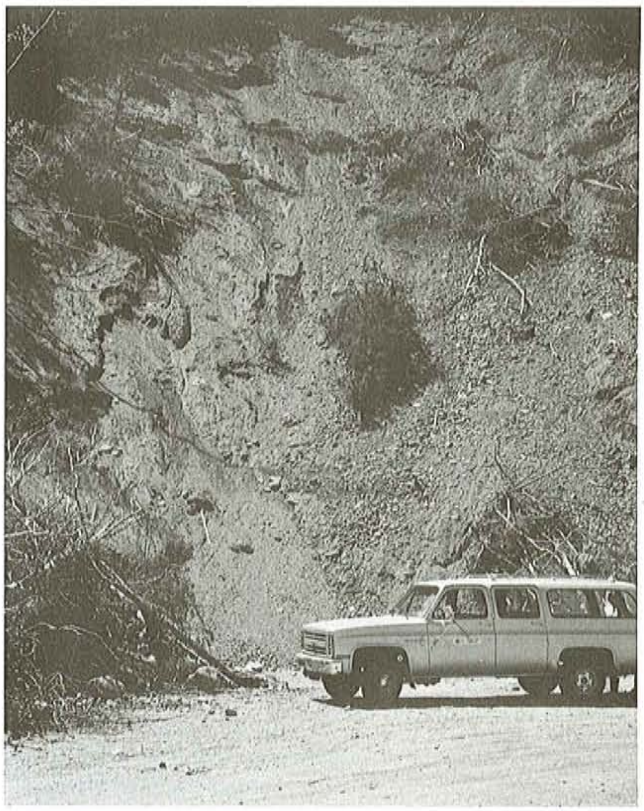

Plate 2. *Gravel exposure in 40-m-high delta at Kite Cove.*

quarry exposures, stream cuts (Plate 3) and backhoe pits, averaging 3.5 m high. Grain-size analyses show variable textures from Class A type materials to silty sands (Figure 5). This deposit is estimated to contain 45 percent gravel, 54 percent sand and 1 percent silt-clay based on analysis of 28 samples (Table 2). Five other samples showed a range of 8.6 to 25 percent, but these analyses are not typical throughout the deposit. Past and present mining activity has removed large amounts of material from this deposit. However, due to its large size, several quarrying operations can operate in this area for many years at present excavation levels, without severely depleting the resource.

Petrographic analysis was conducted on 19 samples collected in the Northern Arm deposit. Petrographic numbers range from 119 to 340 with an average of 218. High petrographic numbers in the Northern Arm deposit result from weathering of normally hard rock types such as granite, norite and gabbro, making the pebbles softer and easily breakable. Sandstone and conglomerate are also present in this area and contribute to higher petrographic numbers.

This deposit can provide suitable low silt-clay aggregate appropriate for use in concrete and paving projects. However, selective mining is necessary due to the variable petrographic qualities throughout the deposit.

Plate 3. *Gravel in 3-m-high stream cut along Northern Arm Brook.*

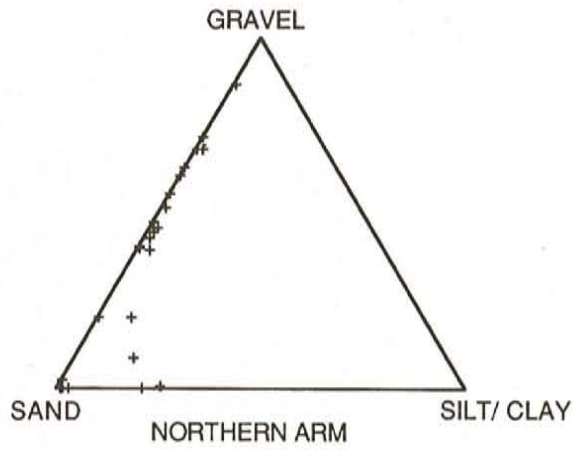

Figure 5. *Ternary diagram showing granular distribution of samples collected in glaciofluvial outwash material at Northern Arm.*

PETERS RIVER (NORTHEAST)

This large deposit stretches over 12 km, in a southwest direction from Peters Arm to beyond Peters Pond in the western part of map area 2E/3 (Figure 2). It varies from 0.2 to 1 km in width and has an estimated thickness from 6 to 25 m that averages about 13 m. Dense forest and minor cleared areas for farmland cover this deposit. Topsoil and iron-oxide lavers may range from 0.5 to 1.2 m in thickness. Thirty-three samples were collected in this area from roadcuts, stream cuts, quarry exposures (Plates 4 and 5) and in backhoe pits averaging a depth of 4.9 m. Grain-size analyses show a wide range of textures with gravel content ranging from 0 to 90 percent. Silt-clay content is generally around 1 percent, although 5 samples have a silt-clay content between 5 and 15 percent (Figure 6). This deposit, based on analysis of 28 samples, is estimated to contain an average

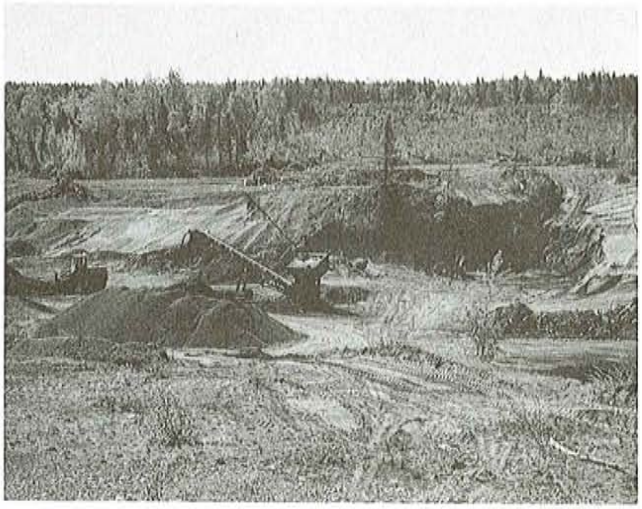

Plate 4. *Sand quarry in glaciofluvial outwash deposit at Peters River.*

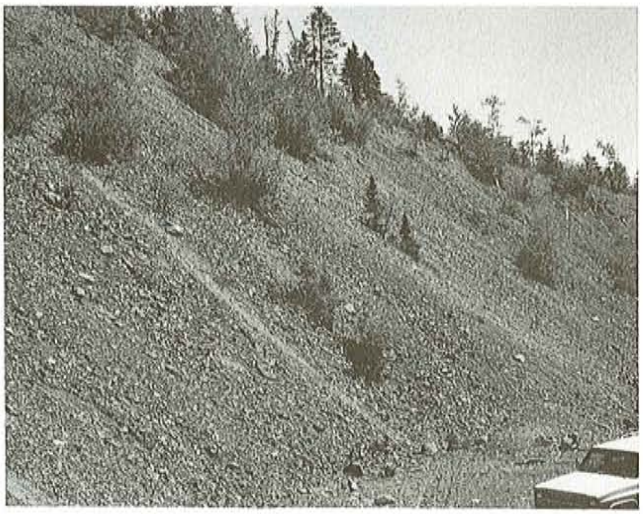

Plate 5. *Coarse gravel deposit (77 percent gravel) along 15-m-high quarry exposure in the northeast part of Peters River.*

of 43 percent gravel, 55.9 percent sand and 1.1 percent silt-clay.

Petrographic numbers range from 151 to 450 with an average of 273 (17 samples). High petrographic numbers result from slightly weathered to weathered sandstone, siltstone, volcanic rocks (80 percent average). The remaining rock types include fresh to slightly weathered, hard granites, gabbro, volcanic rocks and diorite.

The variable textures found throughout this deposit allow for a wide range of uses for this material. However, the petrographic qualities are generally poor and this will restrict its use in most concrete and road-paving projects.

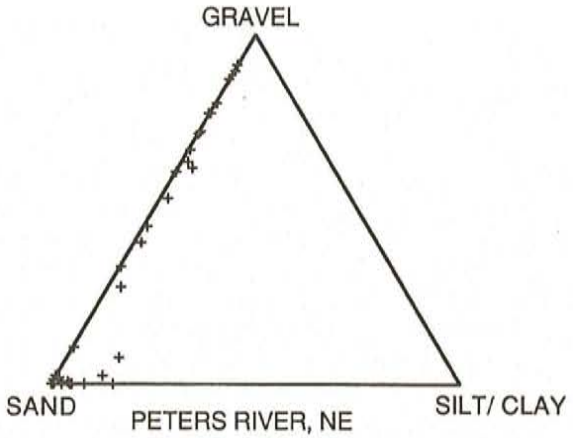

Figure 6. *Ternary diagram showing granular distribution of samples collected in glaciofluvial material at Peters River (northeast).*

EXPLOITS RIVER

The lower part of the Exploits River is situated in the southwest corner of map area 2E/3.The banks of this river consist of an extensive deposit of glaciofluvial outwash material, over 11 km in length and up to 10 m thick. It is overlain by dense forest growth and bog. Extensive cabin development has occurred on the southeast bank of the river. This area can be divided into 4 different zones (Figure 2), each having differing grain-size distributions (Table 2).

Zone 1 is located on the northeast bank near the mouth of the river in the Bay of Exploits at Wigwam Point. It is approximately 1200 m long, 150 m wide and 1 to 5 m thick. Dense forest growth and residential development cover this zone. In this area, topsoil and iron-oxide layers average 0.6 m in thickness. Three samples collected in this area were taken from riverbank exposures averaging 3.6 m thick. Grain-size analyses of sampled material in this area indicate that gravel content varies between 30 and 56 percent, sand content varies between 38 and 70 percent, and silt-clay content is less than 0.5 percent (Figure 7).

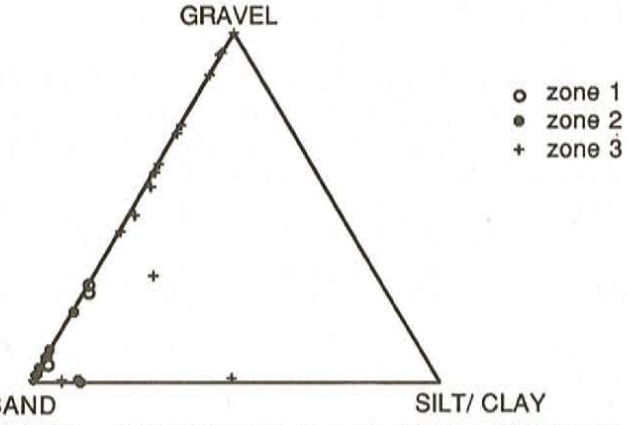

Figure 7. *Ternary diagram showing granular distributions of samples collected in Zones 1, 2 and 3 along the Exploits River.*

Petrographic characteristics are poor, as indicated by high petrographic numbers of 408, 436 and 482. Poor petrographic quality, residential development on part of this deposit, and its thin occurrence in some areas may make it uneconomical for large-scale mining activity.

Zone 2 is also located on the northeast bank of the Exploits River; it extends to the southwest from Zone 1, for a distance of 6 km. It is approximately 300 m wide and has a thickness of 8 m. Bog covers most of this zone. Bedrock exposures protrude through the deposit at two locations. Nine samples collected in this area were taken from stream cuts having an average thickness of 8 m (Plate 6). The deposit, determined from the analysis of 7 samples, is estimated to contain an average of 7.3 percent gravel, 92.6 percent sand and 0.1 percent silt-clay. Two samples collected in the southwest part of this zone contain 88 percent sand and 12 percent silt-clay (Figure 7). Throughout the zone, the sand is generally fine, having fractions from 0.25 mm to 0.5 mm, which make up between 35 to 75 percent sediment. Due to the fine texture of this zone, no petrographic analyses could be conducted.

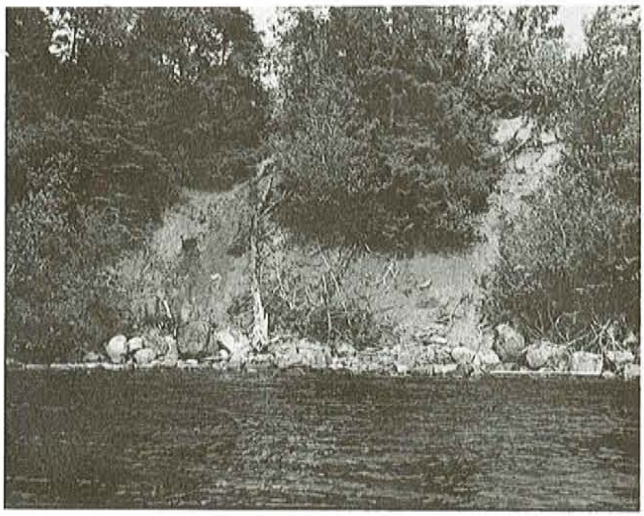

Plate 6. *Ten-metre-high sand exposure in Zone 2 along the Exploits River.*

High silt-clay content (11 percent) in the southwest part of this deposit will restrict its use and low gravel content makes it unsuitable for road gravel. If petrographic qualities are determined to be satisfactory, it could be used in asphalt as a blending sand or winter road sand.

Zone 3 is located on the northwest bank of the Exploits River adjacent to the southwest boundary of Zone 2 and 300 m northeast of the Trans-Canada Highway. Zone 3 is 3000 m long, 200 to 1000 m wide and varies from 2 to 12 m in thickness. It is covered by bog, low bush and tree growth. Bog cover is up to 2 m thick in some areas. Eighteen samples collected in this zone were taken from roadcuts, stream cuts, quarry exposures and backhoe pits averaging 3 m in thickness. This zone is estimated to contain an average of 65.5 percent gravel, 34.0 percent sand and 0.5 percent silt-clay based on analyses of 14 samples. Four other samples showed silt-clay content ranging from 7 to 48 percent (Figure 7). However, these four samples are not a typical representation of material and were not included in average analysis. This deposit has been extensively quarried in the past and most of the remaining material is covered by bog.

Petrographic analyses of 12 samples from Zone 3 has shown high proportions of soft, friable pebbles resulting from slight to high weathering. Pebble types affected by weathering include sandstone, tuff, phyllites, pelitic schist, and minor amounts of volcanic rocks and granites, totalling 65 percent of all samples. Hard, fresh pebbles consisting of gabbro and sandstone make up the remaining 35 percent. Petrographic numbers range from 185 to 704 with an average of 406.

Quarrying at present removal rates may be able to continue for some time, however, localized areas of high silt-clay content and thick bog cover will hinder quarrying, and poor petrographic quality will restrict its use.

Zone 4 is located on the southeast bank of the Exploits River between Rattling Brook and Jumpers Brook in map area 2E/3 (Figure 2). Zone 4 is approximately 9000 m long, 300 to 1000 m wide and up to 10 m thick. This zone is covered by cabin development, moderate tree growth and low bush cover, and small areas of bog and farmland; topsoil and iron-oxide layers average 0.8 m in thickness. Thirty-one samples were collected in this area, from stream cut, quarry exposures and backhoe pits averaging 2.5 m thick. This deposit is estimated to contain an average of 37.3 percent gravel, 62.2 percent sand and 0.5 percent silt-clay based on analyses of 30 samples. One other sample had a silt-clay content of 41 percent (Figure 8), which is not typical of exposed material throughout the zone. The northwest and north sections of this zone are covered by extensive cabin development. Quarrying in the past has removed considerable amounts of material from parts of this area and has uncovered bedrock near surface levels in some areas.

Petrographic analyses of 21 samples from this area has shown that the pebble fraction contains an average of 87 percent slightly weathered sandstone and 13 percent highly weathered unidentified pebbles. Petrographic numbers range from 140 to 498 with an average of 270.

Cabin development and farmland will reduce access to most of this area. Although grain-size analyses indicate Zone 4 to be an excellent source of low silt-clay aggregate, petrographic qualities are too poor to allow this material to be used in most concrete or road-paving-type projects. The possibility of locating bedrock in unquarried areas will reduce the estimated quantity given in Table 1.

JUMPERS BROOK

The Jumpers Brook deposit is a delta located near the southwest corner of map area 2E/3 (Figure 2). It is

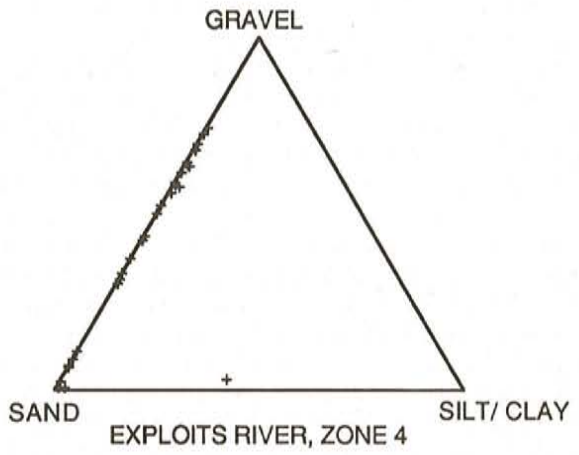

Figure 8. *Ternary diagram of samples collected in Zone 4 along the Exploits River.*

approximately 1800 m long, 200 m wide and 5 m thick. Forest growth, which covers this deposit, is underlain by a 0.8 m layer of topsoil and iron oxide. In this area, five samples were collected from quarry exposures averaging 4 m in thickness (Plate 7). Generally, this deposit consists of compacted sandy gravel and sand, and fine sand and silt in the north end of the deposit. Iron-oxide staining is a common characteristic throughout gravel. This deposit is estimated to contain 36.2 percent gravel, 59.5 percent sand and 4.3 percent silt-clay based on analyses of 5 samples. Gravel content ranges from 1 to 74 percent, sand from 24 to 92 percent and silt-clay from 0.5 to 11.1 percent.

Petrographic analyses of 3 samples has shown 46 percent pebbles consist of slightly weathered to intensely weathered diorite, granites, volcanic rocks and sandstone, and 54 percent consist of fresh, hard diorite, granites, gabbro, volcanic rocks, quartz pebbles and sandstone. Petrographic numbers of these samples are 176, 178 and 282.

Iron-oxide staining occuring throughout parts of this gravel and sand deposit, and poor petrographic qualities, make this deposit unsuitable for high-quality aggregate.

2E/4 MAP AREA

PETERS RIVER (SOUTHWEST)

The southwest part of Peters River is located in the southeast corner of map area 2E/4. The river flows through a large glaciofluvial outwash deposit over 9 km long and varying between 150 to 1600 m wide. It is covered by dense forest growth, farmland and bog. This deposit can be divided into 2 zones (Figure 2) based on grain-size analyses (Table 2, Figure 9).

Zone 1 consists of a large sand deposit, 4000 m long, 1600 m wide and estimated to be 8 m thick. Three samples were collected from shallow roadcuts averaging 0.6 m in thickness. This zone is estimated to contain 11 percent gravel,

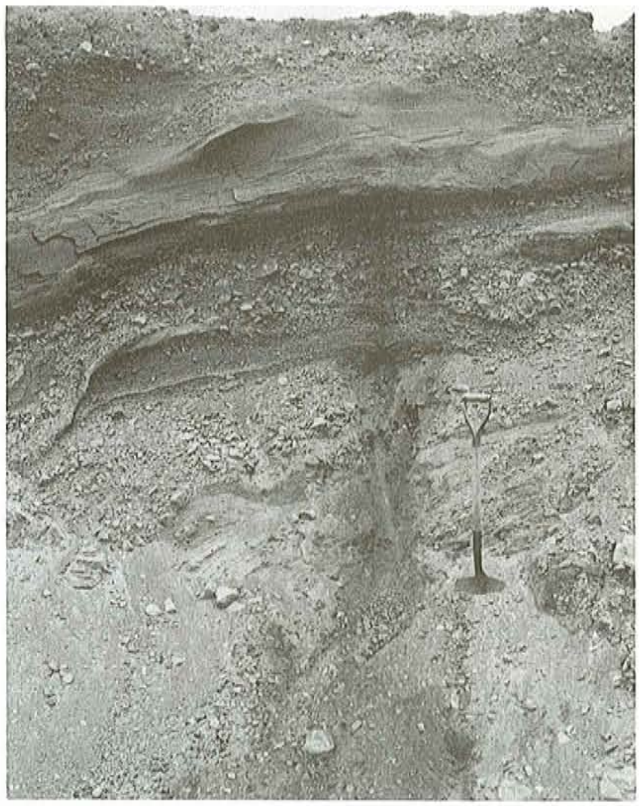

Plate 7. *Compacted gravel and sand in delta deposit at Jumpers Brook. Iron-oxide staining is a common characteristic throughout sediment in this area.*

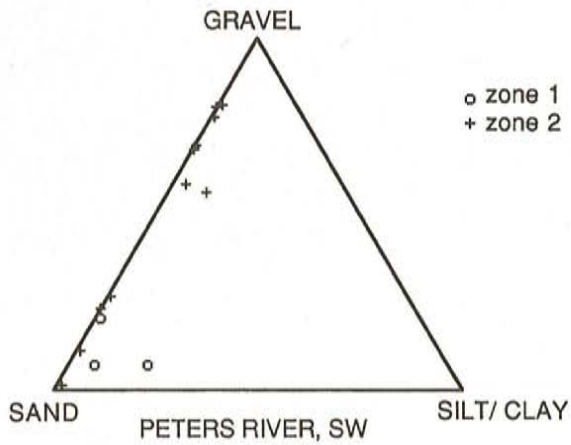

Figure 9. *Ternary diagram showing granular distribution in Zones 1 and 2 in the southwest part of Peters River.*

80 percent sand and 9 percent silt-clay based on the analyses of sampled material; silt-clay ranges from 1.4 to 19.3 percent in these samples (Figure 9).

Petrographic analyses of one sample indicate poor petrographic quality having a petrographic number of 455.

Variable silt-clay content, and poor petrographic qualities based on one sample, make it necessary to have

further sampling to determine the deposit's potential. Farmland development and a tree nursery may prevent quarrying activity in most of this area.

Zone 2 is located southwest of Zone 1 and crosses New Bay Pond Road. It is 4 km long, 0.2 to 1.1 km wide and has an estimated thickness of 6 m. Zone 2 contains more gravel than Zone 1 (Table 2) and has been extensively quarried in the past. Twelve samples collected in this area were taken from roadcuts, quarry exposures, and backhoe pits averaging 2.5 m in thickness. Grain-size analyses of sampled material (Figure 9) indicate this zone contains an average of 51.8 percent gravel, 46.7 percent sand and 1.5 percent silt-clay.

Petrographic analyses of 9 samples indicate that 28 percent of the sample is moderately weathered to highly weathered sandstone, siltstone, conglomerate and undefined pebbles. The remaining 62 percent consists of fresh, hard granites, volcanic rocks, gabbro, chert and diorite. Petrographic numbers range from 146 to 503 and have an average of 286.

Grain-size analyses indicate this deposit is a good source of low silt-clay aggregate, however, poor petrographic qualities make it unsuitable for use in concrete or road-paving-type projects.

HODGES HILL

The Hodges Hill deposit is located in the west part of map area 2E/4, 2 km south of Hodges Hill (Figure 2). This deposit is approximately 1200 m long, 600 m wide and 2 to 5 m thick. Bedrock and till hummocks protrude through the gravel at several locations. Moderate forest growth covering this deposit is underlain by a 0.5 m layer of topsoil and iron oxide. Two samples collected in this area were taken from the base of a 2-m-deep bulldozed pit, and from a 1-m-high roadcut. Grain-size analyses of sampled material show a range of 48 to 75 percent gravel, 25 to 52 percent sand and less than 1 percent silt-clay. Visual observations indicate approximately 25 to 35 percent boulder–cobble material, with surface boulders up to 1.8 m thick.

Petrographic analyses of two samples indicate the Hodges Hill deposit is composed of 36 percent slightly weathered to weathered siltstone, sandstone, granites and volcanic rocks. The remaining 64 percent consist of fresh, hard sandstone, granites, diorite, and volcanic rocks. The petrographic numbers of these two samples are 150 and 156.

Crushing or screening will be needed in this deposit to remove the coarse aggregate fraction, if it is to be used in road paving or as a Class A road gravel. Petrographic numbers indicate this material is unsuitable for concrete purposes.

ASPEN POND

The Aspen Pond deposit is located at the north end of Aspen Pond near the southwest corner of map area 2E/4 (Figure 2). This deposit is approximately 700 m long, 150 m wide and 3 m thick. Moderate forest growth in this region is underlain by a 0.6-m-thick layer of topsoil and iron oxide. One sample was collected from a 1.8-m-deep bulldozed pit. Forty percent boulder–cobble content was estimated visually. Grain-size analyses of sampled material show 86.8 percent gravel, 13 percent sand and 0.2 percent silt-clay.

Petrographic analyses of sampled material has shown 64 percent highly and weathered sandstone and 36 percent fresh to slightly weathered granite and volcanic rocks. A petrographic number of 224 was determined for this sample.

Grain-size analyses indicate this deposit is favourable as a source of low silt-clay type material, but poor petrographic qualities and high boulder–cobble content reduces its economic potential.

CORNFIELD POND

The Cornfield Pond deposit is located at the north end of Cornfield Pond in the southwest corner of map area 2E/4 (Figure 2). It consists of a small glaciofluvial terrace deposit, approximately 300 m long, 200 m wide and 2.5 m thick. Forest growth and minor bog cover overlie this deposit. Topsoil and iron-oxide layers have an average thickness of 0.8 m. One sample was collected from a 2.5-m-high quarry exposure. This exposure consisted of approximately 30 percent cobbles and boulders and localized sand lenses. Grain-size analysis of this sample showed 67.9 percent gravel, 31.8 percent sand and 0.3 percent silt-clay.

A petrographic number of 106 was determined for one sample. The pebble fraction consists of 94 percent fresh, hard volcanic rocks, gabbro and granites and 6 percent weak, soft conglomerate.

Although petrographic characteristics of this deposit are favourable for all types of high-grade aggregate uses, its potential is reduced by its high cobble–boulder content and small size.

MOOSE POND

The Moose Pond deposit adjoins the northeast side of Moose Pond, on the west side of map area 2E/4 (Figure 2) and consists of a shallow glaciofluvial outwash deposit. Its approximately 1 km long, 0.2 km wide and 2 m thick. Forestry operations have removed tree cover from this area. Topsoil and iron-oxide thickness vary from 0.3 to 0.7 m in thickness. Sections throughout the deposit show sand and silt lenses, and areas consisting of 30 to 40 percent boulder and cobble material. Three samples were taken from bulldozed

pits and a roadcut, each averaging 2 m in thickness. Grain-size analyses of sampled material indicate variable textures. One sample contained 81 percent coarse sand material (< 2 mm in diameter), and 19 percent silt-clay. Another sample showed a coarse texture having 22 percent of the material in the 64 mm sieve, and the third sample showed a more even distribution (10 to 15 percent) of material throughout most sieve fractions and dropping to 3.2 percent in the pan fraction. All samples contained more than 3.2 percent silt-clay.

Petrographic analyses of sample material show poor characteristics with pebble types consisting of 38 percent poor quality sandstone, diorite, and volcanic rocks. The remaining 62 percent consist of fresh, durable volcanic rocks, granite, gabbro and quartz pebbles. The petrographic numbers of 2 samples collected in this area are 168 and 202.

Small size, shallow thickness, variable texture and poor petrographic qualities greatly reduces the economic potential of this deposit.

MAP AREA 2E/6

BROWNS ARM

The Browns Arm deposit is located at Browns Arm in the area lying at the border between map areas 2E/6 and 2E/3 (Figure 2). This deposit consists of a large delta, 1.5 km long, 0.7 km wide and up to 50 m thick. Rock outcrop protrudes the centre of this deposit, covering about 10 percent of the surface area. Approximately 50 percent of the area is cleared for farmland, and peripheral areas on the east and north sides are residential. Areas of dense forest growth cover smaller sections. This deposit contains variable interbeds of sandy gravel, gravel, cobble gravel and silty sand (Plate 8). Seven samples were taken from quarry exposures, averaging 14 m high. It is estimated to contain an average of 51.4 percent gravel, 47.6 percent sand and 0.9 percent silt-clay based on grain-size analyses of 6 samples (Figure 10). Another sample had a silt-clay content of 18.7 percent but this does not represent typical sections throughout the deposit.

Petrographic analyses of 3 samples indicate poor-quality material with approximately 54 percent of the pebbles consisting of slightly to highly weathered sandstone, gabbro, volcanics, conglomerate and undefined pebbles. Petrographic numbers of 4 samples range from 213 to 457 with an average of 324.

Grain-size analyses indicate this deposit may provide an excellent source of low silt-clay and Class A aggregate used in road construction, but poor petrographic qualities reduce its potential as a source of higher quality material for use in concrete and road-paving projects.

DIVER POND

The Diver Pond deposit is situated southwest of Diver Pond in the west part of map area 2E/6 (Figure 2). This is

Plate 8. *Sandy gravel, gravel and cobble–gravel visible along 20-m-high quarry exposure in the Browns Arm delta deposit.*

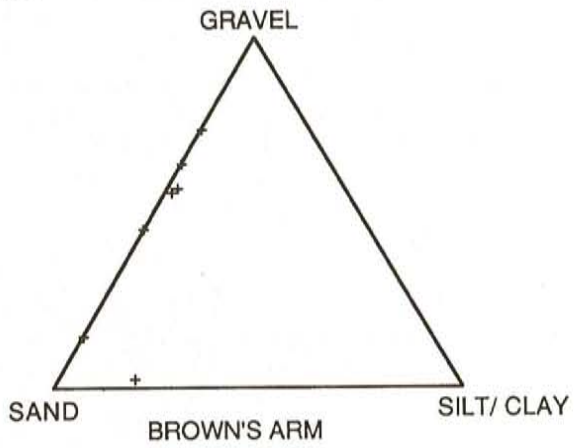

Figure 10. *Ternary diagram showing granular distribution of samples collected in a delta at Browns Arm.*

a shallow glaciofluvial outwash deposit, 1.3 km long, 0.3 km wide and 1.5 m thick. Moderate tree growth and low bush growth cover most of this deposit. Topsoil and iron-oxide layers average 0.6 m in thickness. Two samples were collected in this area, from a 2.5-m quarry exposure and from a 1-m-deep hand-dug pit. This deposit is estimated to contain 74 to 79 percent gravel, 21 to 26 percent sand and less than 1 percent silt-clay based on analyses of sampled material.

Petrographic analyses of 2 samples indicate 62 percent of the pebbles in this deposit are slightly weathered to weathered volcanic rocks, gabbro, granite, sandstone and siltstone. The remaining 38 percent consist of fresh, durable volcanic rocks, gabbro, granite and siltstone. Petrographic numbers of these 2 samples were 236 and 248.

Shallow thickness and poor petrographic qualities gives this deposit low economic potential.

NEW BAY RIVER

The New Bay River deposit is located along New Bay River in the southwest part of map area 2E/4 (Figure 2). This deposit is approximately 1.5 km long and 0.3 km wide and may vary from 0.1 m to 7.0 m thick. Moderate forest growth covers the top of this deposit. Three samples were taken from road exposures averaging 2.5 m thick. Grain-size analyses of sampled material indicate this deposit is composed of sandy gravel to sand, averaging 25.7 percent gravel, 73.2 percent sand and 0.1 percent silt-clay. Gravel contents range from 13 to 31 percent, sand from 66 to 87 percent and silt-clay from 0.5 to 2.4 percent.

Petrographic analyses indicate very poor quality material with petrographic numbers of 438 and 517.

Low volumes and poor petrographic qualities give this deposit poor economic potential.

POINT LEAMINGTON

The Point Leamington deposit is situated in the community of Point Leamington on the west side of map area 2E/6 (Figure 2). This area consists of a delta approximately 450 m long, 250 m wide and up to 12 m thick. Forest growth, residential development and a graveyard occupy the top of this deposit. Topsoil and iron-oxide layers average about 0.7 m in this area. A silt-sand lens, low boulder content (less than 20 percent), and 4 to 6 percent silt-clay in a 4-m-thick upper gravel unit, were noted in the field. The exposed surface of the sand-silt unit is 10 m wide and 4 m high, and the silty gravel unit is approximately 25 m long and covers the top 3 m of half of the quarry face. Although textures may vary throughout the deposit (Figure 11), sample data generally indicate it is similar to Class A gravel. Six samples were taken from quarry exposures averaging 5.5 m (Plate 9). This deposit is estimated to contain an average of 46.6 percent gravel, 50.5 percent sand and 2.9 percent silt-clay based on analyses of sampled material.

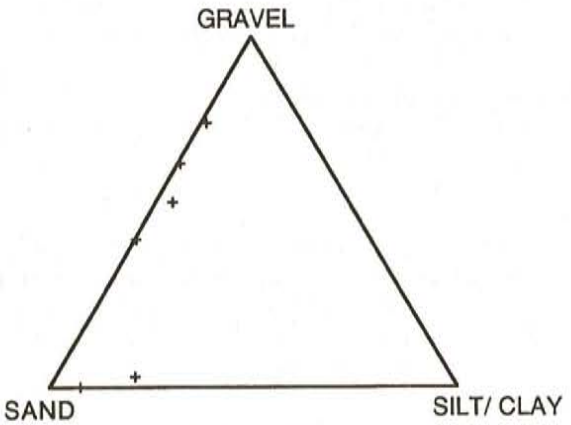

Figure 11. *Ternary diagram showing granular distribution of samples collected in delta deposit at Point Leamington.*

Plate 9. *Seven-metre-high quarry exposure in delta deposit at Point Leamington.*

Petrographic analyses of 4 samples indicate poor quality with pebbles consisting of 62 percent slightly weathered to weathered sandstone, gabbro, volcanic rocks, siltstone and granite. The fresh durable pebbles consist of volcanic rocks, siltstone and quartz. Petrographic numbers in the Point Leamington deposit range from 213 to 457 with an average of 324.

Grain-size analyses indicate this deposit can be used as a source of low silt-clay aggregate. However, poor petrographic qualities reduce its potential as a higher quality aggregate necessary for use in concrete or road-paving-type projects.

MARTIN POND

The Martin Pond deposit is located on the northeast side of Martin Pond in the west part of map area 2E/6 (Figure 2). This deposit is approximately 800 m long, 600 m wide and 2 m thick. Moderate tree growth and a small bog cover this deposit. Topsoil and iron-oxide layers average about 0.8 m in thickness. Two samples were collected from 1.5-m and 3.8-m-high quarry exposures. This deposit is similar to Class A gravel, having grain sizes peaking in the 8 to 16 mm range, constituting 23 percent of the sample. Grain-size analyses of sampled material showed 57 to 71 percent gravel, 28 to 42 percent sand and 0.3 to 1.1 percent silt-clay.

Petrographic analysis of one sample indicates poor quality material due to the presence of 54 percent slightly weathered to weathered gabbro, volcanic rocks and granite pebbles. The remaining 46 percent consist of fresh gabbro, sandstone, volcanic rocks and quartz pebbles. Petrographic numbers of two samples in the Martin Pond deposit were 152 and 534.

Grain-size distribution indicate this deposit can be used as a Class A road gravel but its shallow thickness

and poor petrographic qualities reduce its economic potential.

OTHER DEPOSITS

Besides the areas sampled and outlined above, 4 other potential resource areas were noted from aerial photograph interpretation but were not field checked. These deposits will be sampled during the 1991 field season. Three of these deposits are located in the 2E/3 map area, at Joe's Cove in the Bay of Exploits, Burnt Arm, and 5 km northwest of Upper Scissors Pond. One other potential deposit is located in the 2E/4 map area, along Leech Brook (Figure 2).

SUMMARY

Granular deposits were sampled at many locations within the study area to determine their potential for use in the aggregate industry. The results reveal differences between these deposits that may determine their suitability for various construction purposes. The data is based on grain-size analyses, and petrographic examination of the pebble fraction (16 to 32 mm) from samples collected in each deposit.

Several deposits are thin (around 2 m) and would require extensive overburden clearing to quarry small amounts of material, thereby increasing excavating cost. Deposits of this type are located at Cornfield Pond, Aspen Pond, Moose Pond, Hodges Hill, Lily Pond, Diver Pond and New Bay River.

Many of the deposits sampled have sufficient quantities of material to support large quarrying operations over a considerable length of time (exceeding a 10-year production period). These deposits, located at Peters River, Browns Arm, Northern Arm and Kite Cove, may exceed 10,000,000 m^3 of material. Other large deposits are located at Jumpers Brook and Point Leamington. These deposits have been extensively mined in the past but are estimated to have between 500,000 m^3 and 1,000,000 m3 of material remaining.

Low silt-clay content is necessary for aggregates used in concrete projects and asphalt. Most deposits sampled have a silt-clay content of less than 1 percent. Other deposits may have zones of sand-silt or silt-clay, which can be avoided during quarrying. This reduces the need for washing the material, thereby reducing overall cost. In some areas, screening or crushing may be necessary to remove the coarse aggregate fraction.

Petrographic results indicate generally poor quality material throughout the study area. Only two deposits show petrographic numbers low enough to indicate suitable aggregate material for use in concrete or asphalt type projects. These are thin deposits located at Cornfield Pond and Hodges Hill. Two other deposits, where multiple samples were collected, show variable petrographic qualities, in which some of the samples are within acceptable petrographic limits, to allow high-quality aggregate use. These deposits are located at Northern Arm and Southwest Brook. In these areas, detailed sampling is necessary to locate suitable zones for quarrying.

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