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DETAILED AGGREGATE-RESOURCE ASSESSMENT PROJECT, INSULAR NEWFOUNDLAND

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ABSTRACT

This report details the results of the 1990 field program to assess the aggregate-resource potential of (1) Isthmus of Avalon, (2) Northern Arm, (3) Grand Falls, (4) Kings Point, (5) Pasadena–South Brook, (6) Raleigh, (7) Holyrood quarry area, and (8) Shoal Harbour Pond.

On the Isthmus of Avalon, the study was successful in identifying an area of sand and gravel, which could supply aggregate for the construction of the offshore gravity-based structures (GBS) at Great Mosquito Cove. At Raleigh, Kings Point and Northern Arm, aggregate studies were undertaken to better define the high-quality aggregate sites, so they can be protected from conflicting land uses. Studies conducted at Grand Falls, Shoal Harbour Pond and Holyrood identified additional sources of high-quality aggregate material, whereas at Pasadena, the study failed to locate any high-quality aggregate material suitable for use in asphaltic pavement and/or concrete.

During the study, 133 sand, gravel and till samples were collected and analyzed.

INTRODUCTION

In 1982, a long-term program of detailed aggregate-resource assessments was initiated to provide data on the aggregate-resource potential of areas where municipal and other plans are being developed, or where detailed aggregate information is required to meet a specific need (e.g., highway construction). The existing aggregate-resource database (Kirby *et al.*, 1983) has been useful in defining potential land-use conflict areas, but it does not provide detailed information on the aggregate resources themselves, which are necessary to resolve these conflicts. Detailed studies, such as those outlined in this report, should provide the necessary (sieve and petrographic analyses) information required to identify high-quality aggregate reserves or to resolve various land-use conflicts, (e.g., housing development over a high-quality aggregate deposit).

The 1990 field program was conducted in eight areas of the province; (1) Isthmus of Avalon, (2) Northern Arm, (3) Grand Falls, (4) Kings Point, (5) Pasadena–South Brook, (6) Raleigh, (7) Holyrood quarry area, and (8) Shoal Harbour Pond (Figure 1).

FIELD PROGRAM

Potential areas for detailed assessment were selected based on a review of existing aggregate-resource and surficial data, and on the analysis of 1:50,000- and 1:12,500-scale aerial photographs.

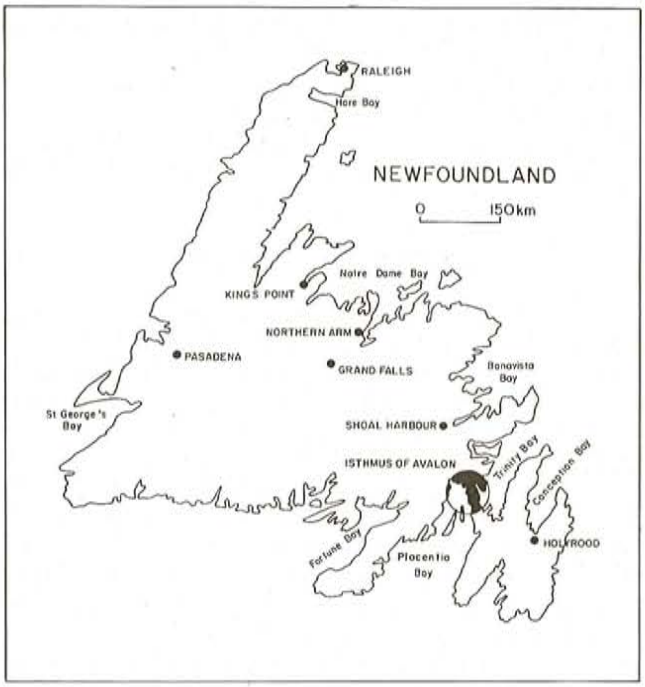

Figure 1. *Location of study area.*

The first phase of field work involved driving along all roads and trails, to verify or update data on previously sampled and/or unsampled surficial deposits (Kirby *et al.*,

1983). Foot traversing was conducted in areas of potential quarry development and sites were selected for sampling.

Backhoe test-pits were used, where possible, to obtain samples used to determine the extent, quantity and quality of the aggregate deposit. Natural exposure or shallow hand-dug pits were used to sample the underlying aggregate material, where a backhoe was not or could not be used.

DATA ANALYSIS AND STORAGE

During the 1990 field program, 133 granular, aggregate samples were collected. Samples containing greater than 8-mm-size material were sieved through a bank of 4 sieves (63, 31.5, 16 and 8 mm) in the field. About 100 pebbles from the 16 and 31.5 mm fractions were retained for field rock-type and petrographic analysis using procedures outlined by Bragg (1986). This analysis determines the petrographic rank for the various aggregate samples, which is a measure of their suitability for use as a source of aggregate. The lower the number, the higher the quality of the aggregate material (e.g., 100 best, 1000 worst). A split of the finer than 8 mm fraction was retained for laboratory sieving through a nest of sieves (8, 4, 2, 1, 0.5, 0.25, 0.125 and 0.062 mm) following procedures outlined by Kirby *et al.* (1983).

All of the sieve and petrographic data have been stored in a computer for ease of retrieval and are available upon request from the author at the Department of Mines and Energy. Deposit quality observations are based on standards followed by the Newfoundland Department of Works, Services and Transportation (Specification Book, 1987), which are based on ASTM standards for granular materials. The highest petrographic number permitted for use in concrete is 130, whereas for asphaltic pavement, the number is 135.

ISTHMUS OF AVALON

The objective of this part of the study was to identify sources of aggregate material close to the Bull Arm–Great Mosquito Cove area, which could be used in the construction of the site infrastructure, and the offshore gravity-based structure (GBS). The study was divided into two parts. The first part involved the sampling of the bedrock throughout the Bull Arm area to assess its potential to supply crushed bedrock aggregate (Bragg, *this volume*). The second part involved a surficial aggregate survey within a 30 km radius of Great Mosquito Cove (Figure 2). Ricketts (1986), conducted an aggregate-resource mapping and sampling program throughout the Placentia Bay area. Large reserves of high-quality sand and gravel have been identified in the Swift Current area and at Black River Point, North Harbour Point and Woody Island (Ricketts, 1989). These sites have the potential to supply the required volumes of sand needed to complete the offshore-production platform project but the cost of transporting this material to the Trinity Bay, Bull Arm construction site would be high. This study concentrated on locating sources of sand and gravel closer to the GBS construction site. A number of areas were field checked but the only source of aggregate material identified within the

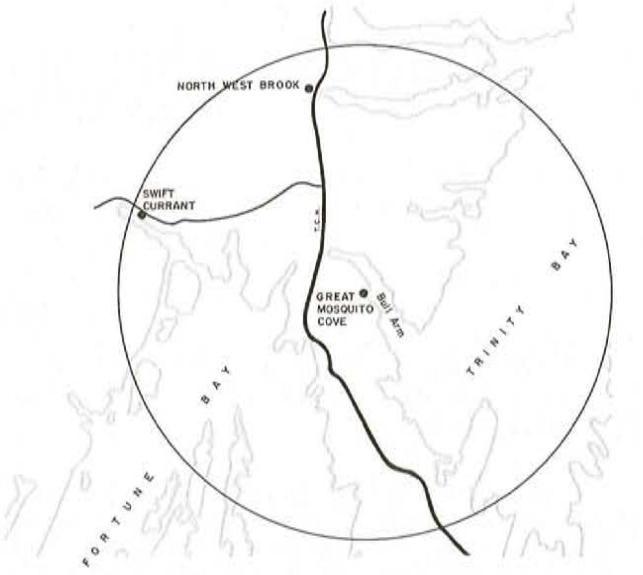

Figure 2. *Isthmus of Avalon study area.*

Bull Arm area is at North West Brook (Figure 2). The deposit is a deltaic deposit composed of stratified sand and gravel, averaging a thickness of about 10 m. The surface is overlain by 1 to 4 m of bog. Nine samples were collected from existing quarry faces and from shallow hand-dug test pits. The results of the sieving show the deposit to be a pebble–cobble gravel having an average grain-size distribution of 67 percent gravel, 32 percent sand and 1 percent silt-clay. The average petrographic number obtained from seven of the samples was 191 having a range of 121 to 306. The presence of conglomerate and ultramafic rocks, which is as high as 15 percent in some samples, results in petrographic numbers in excess of minimum standards. Further testing is needed to determine the suitability of this deposit as a source for aggregate. The total reserves are estimated at greater than 1,000,000 m^3.

NORTHERN ARM

In 1990, an excavator testpitting and sampling program was conducted in a glaciofluvial terrace deposit situated within the town of Northern Arm, to determine the extent of the high-quality gravel deposit (Kirby *et al.*, 1983). The quarry, which is situated within the community, is controversial because it has high vertical faces and has not been rehabilitated in those areas that have been mined. The testpitting program was designed to outline the complete extent of the deposit, and to allow for the development and implementation of a detailed extraction and rehabilitation plan for the area.

Ten backhoe test-pits were dug to an average depth of 3.8 m. The results of the sieve analysis of samples collected from six test pits, gave an average grain-size distribution of 57 percent gravel, 42 percent sand and 2 percent silt-clay, and an average petrographic number of 137. One test-pit exposed sand having a particle-size distribution of 98 percent sand and 2 percent silt-clay. Two unsampled pits revealed

silt-clay, and one other pit intersected till under 0.4 m of sandy gravel. A map showing the extent of the deposit was produced from the information obtained from the test-pits.

GRAND FALLS

This site is located approximately 23 km west of Grand Falls and 1 km south of the Trans-Canada Highway along the banks of the Exploits River (Figure 3). The deposit was located in 1989 (Kirby, 1990) and samples collected from shallow hand-dug pits indicated high-quality sand and gravel. The deposit is subdivided into two areas based on terrain type. Area 1 is a flat, glaciofluvial terrace deposit having a widely spaced black spruce vegetation cover (Plate 1). A total of 14 backhoe test-pits were dug to an average depth of 3.5 m. The deposit is composed of a pebble–cobble gravel having an average grain-size distribution of 67 percent gravel, 32 percent sand and less than 1 percent silt-clay, and an average petrographic number of 216. The relatively high petrographic number is due to the presence of moderately weathered conglomerate and to a lesser extent, weathered acidic volcanic rocks. Conglomerate comprises, on average, 15 percent of the pebble content. Detailed testing, which included Los Angeles abrasion and alkali reactivity tests, will have to be performed to determine the suitability of this deposit as a source of aggregate for concrete and/or asphaltic pavement.

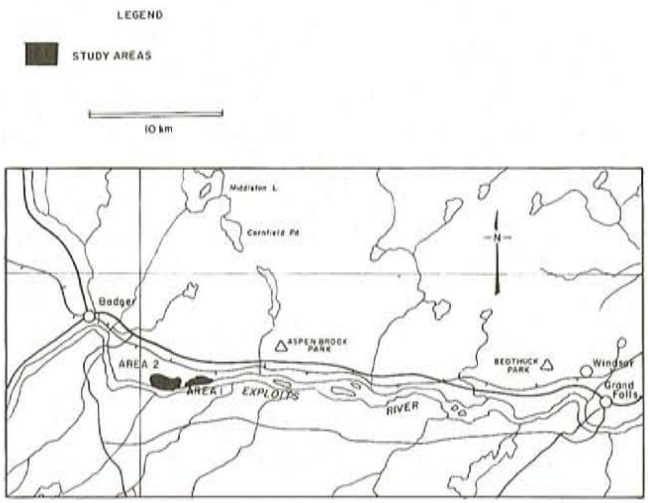

Figure 3. *Grand Falls study areas.*

Area 2 is located to the west of Area 1 (Figure 3) and is composed of a series of forested ridges, which represent interfluves between drainage channels cut through a glaciofluvial terrace, during the Holocene. Eighteen backhoe test-pits were dug into the ridges and into the intervening channels to an average depth of 3.4 m. This deposit is a pebble–cobble gravel having an average grain-size distribution of 71 percent gravel, 28 percent sand and less than 1 percent silt-clay, and an average petrographic number of 198. The relatively high petrographic number is due to the presence of moderately weathered sedimentary rocks, which include siltstone and fine to medium sandstone that comprises 30 to 35 percent of the pebble fraction. In some samples, moderately weathered acidic volcanic rocks cause an increase in the petrographic number. Further testing is required on this deposit to determine its suitability for concrete or asphaltic pavement.

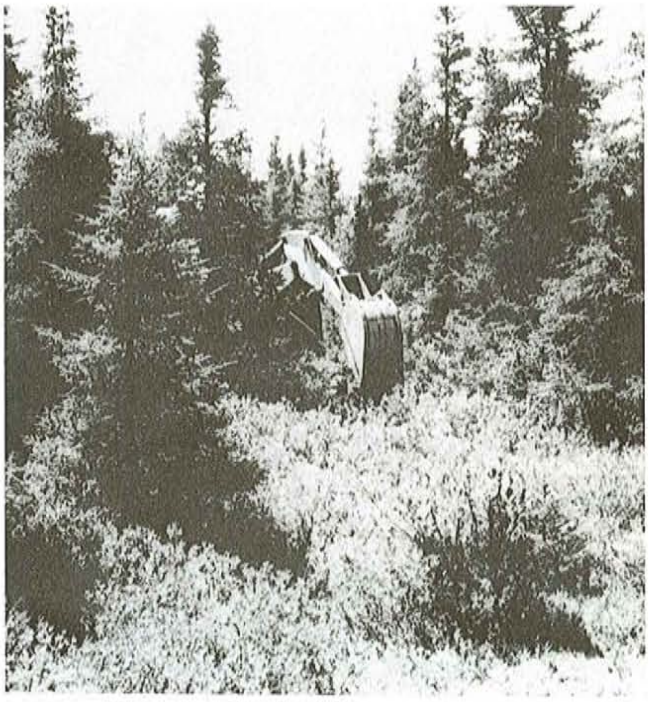

Plate 1. *Widely spaced black spruce is the typical vegetation cover encountered on the glaciofluvial terrane in Area 1, west of Grand Falls.*

KINGS POINT

During 1989 and 1990, an increasing number of crown land applications have been received for land in the area of the deltaic sand and gravel deposits at Kings Point. A subsequent inspection revealed that large areas of the delta south of Paddy's Brook have already been sterilized due to conflicting land uses (e.g., community expansion) (Figure 4). No work was done north of Paddy's Brook because there are presently no conflicting land uses in this area. The aim of this study is to map the conflicting land uses and identify areas that should be set aside for future aggregate extraction.

The Kings Point delta is a glaciomarine delta formed during deglaciation (Tucker, 1974). Samples collected from natural and man-made exposures, showed the delta is composed of well-sorted sand and gravel (Plate 2) having an average grain-size distribution (from twelve samples collected) of 60 percent gravel, 39.5 percent sand and 0.5 percent silt-clay and an average petrographic number of 110. The grain-size distribution and excellent petrographic characteristics make this deposit a source of sand and gravel for all high-quality aggregate uses. Figure 4, shows the locations of the existing land-use conflicts and the areas that should be set aside as future aggregate sources.

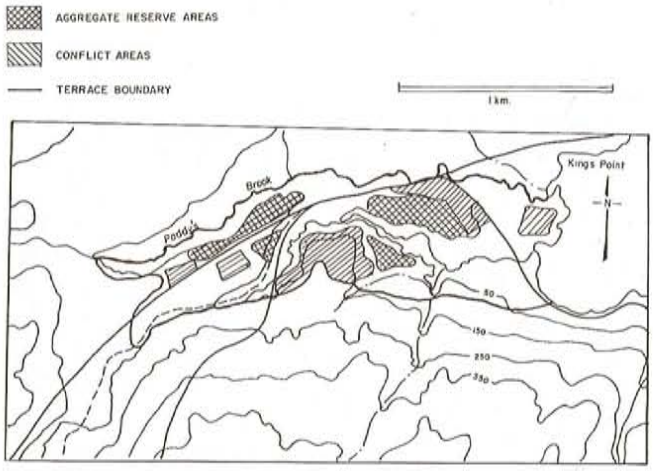

Figure 4. *Land-use within the Kings Point study area.*

Plate 2. *Foresets of well sorted sand and gravel in a quarry at Kings Point.*

PASADENA–SOUTH BROOK

At this site, work concentrated on locating sources of high-quality sand and gravel for use in the reconstruction of the Trans-Canada Highway through the Pasadena area. Previous aggregate-resource mapping within the Pasadena Municipal planning area (Kirby, 1985) has shown that the community of Pasadena is built over an extensive sand and gravel deposit. Several potential aggregate sites were identified, however, due to their poor petrographic characteristics, they are unsuitable for use as concrete or asphaltic pavement, but could be used to produce crushed road gravel.

In 1990, field work concentrated on locating high-quality aggregate in the South Brook River valley, a north-south trending valley between Grand Lake and Deer Lake. (Figure 5). The delta on which Pasadena is sited was formed as South Brook entered a much higher Deer Lake during deglaciation (Batterson and Taylor, 1990). Sampling along the western side of the valley was confined to existing natural and man-made exposures. The majority of the deposits are composed of silty tills or colluvium. Gravel deposits located were a raised delta at 136 m a.s.l., (Batterson and Taylor, 1990), and a similar gravel deposit at the same elevation, but located near Northern Harbour, Grand Lake; the former is composed of stratified sandy gravel. Both of these deposits are small and have poor petrographic characteristics having petrographic numbers of 225 and 455, respectively.

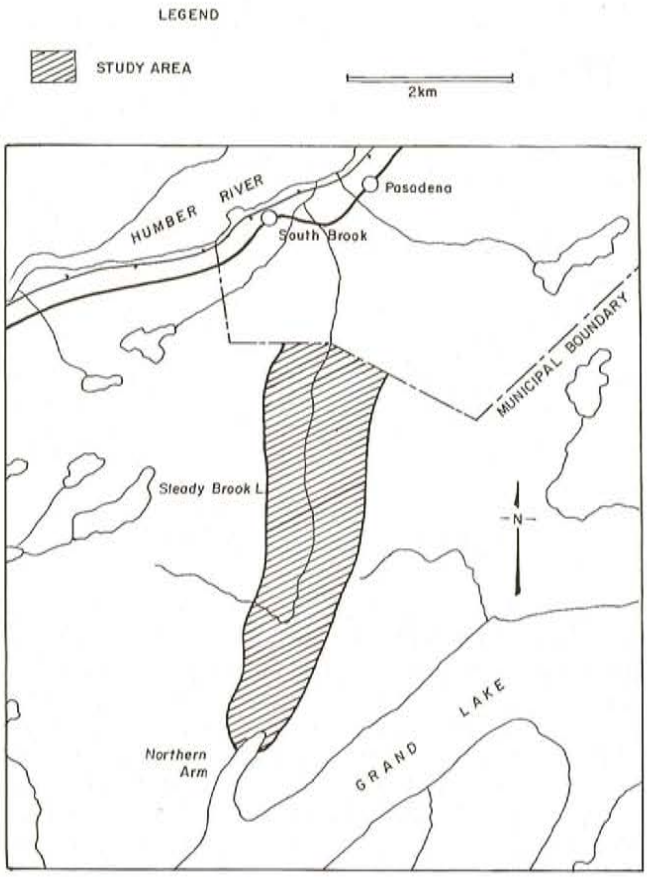

Figure 5. *Pasadena–South Brook study area.*

Most of the sampling was conducted on the east side of South Brook River valley, where a number of distinct terrace

levels were identified and testpitted using a tracked excavator. Nineteen test-pits were dug to an average depth of 3.6 m. Seven sites between 65 and 105 m a.s.l., revealed fine sand over silt-clay (Plate 3), having a silt-clay content ranging from 60 to 93 percent. The remaining twelve test-pits were dug between 105 and 165 m a.s.l. The majority of these pits were dug parallel to the river over a distance of 1 km, and crossed two incised stream channels. Two distinct types of sediment were identified. On the interfluves between the channels, sampling revealed a silty till having a grain-size distribution of 32 percent gravel, 51 percent sand and 17 percent silt-clay, and an average petrographic number of 339. Samples collected in areas affected by the stream channels have revealed a gravelly diamicton interpreted as a washed till, with an average grain-size distribution of 46 percent gravel, 50 percent sand and 4 percent silt-clay, and an average petrographic number of 293. The poor petrographic characteristics in both areas are the result of metasedimentary rocks, which compose up to 40 percent of the pebble fraction of the samples collected. These deposits could be used as a source of fill or crushed gravel, but would not be suitable as a source of aggregate for asphaltic pavement or concrete.

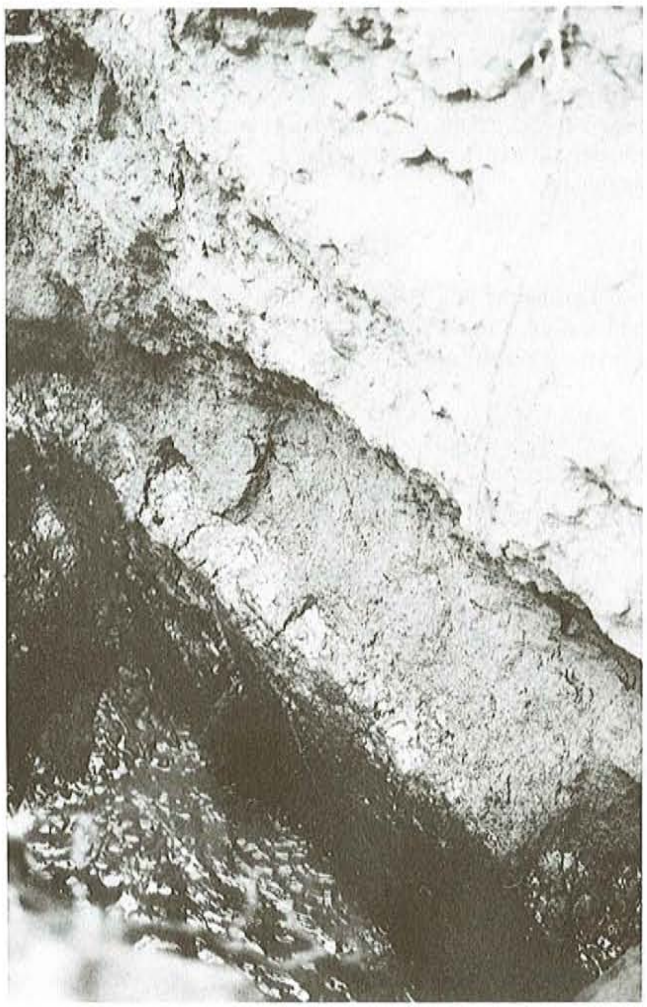

Plate 3. *Stratified sand over silty sand over clay in a test pit at Steady Brook.*

RALEIGH

The original inventory of the aggregate-resources project (Kirby *et al.*, 1983) identified a large area of high-quality aggregate within the planning area (Figure 6). Since the original inventory was completed, large areas within the zone have been sterilized due to community expansion, and the new municipal plan called for the establishment of a housing sub-division within the aggregate zone. Therefore, this study was undertaken to redefine the aggregate zone.

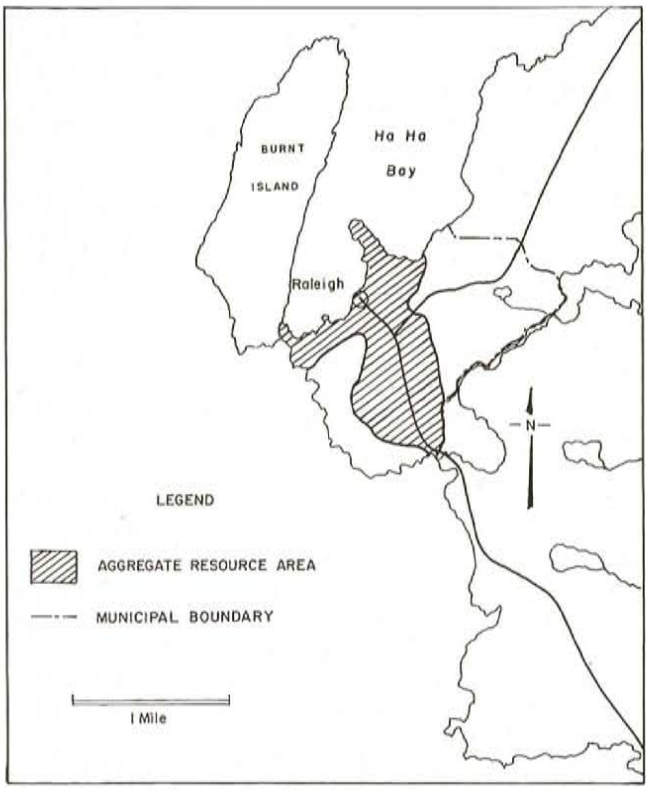

Figure 6. *Raleigh study area.*

The area identified as high-quality aggregate (Figure 6) is covered by a thin veneer (less than 2 m) of dark brown to black marine sandy gravel, having numerous rock outcrops and thicker deposits of gravel in the hollows between the outcrops. Grain-size distribution of three samples collected and analyzed show an average of 49 percent gravel, 50 percent sand, and less than 1 percent silt-clay, and an average petrographic number of 183. This material is only used as a source of fill mainly because it is a thin and discontinuous deposit and because of its colour. As a result of this, only an area of 300 m around the existing quarries will be reserved exclusively for quarry activity.

The main source of concrete aggregate are thin (<2.5 m) raised marine beach sediments and talus deposits eroded from the steep vertical cliffs on Burnt Island (Figure 6). The raised marine beach sediments are found in shallow depressions in the bedrock surface scattered throughout Burnt Island, whereas the talus is found at the base of the steep cliff mainly at the northern end of the Island (Plate 4). Sieve

Plate 4. *Talus used in the production of concrete on Burnt Island.*

analysis of the raised marine deposits give an average grain-size distribution for two samples of 64 percent gravel, 35 percent sand and less than 1 percent silt-clay, and an average petrographic number of 100. The talus deposits have a grain-size distribution from two samples of 92 percent gravel, 6 percent sand and 2 percent silt-clay, and an average petrographic number of 100. These deposits are derived from limestone of the Lower Ordovician St. Georges Group and the Middle Ordovician Table Head Group (Howse, 1990). Both of these sources, when combined, would make an excellent quality aggregate for most uses.

HOLYROOD

This deposit is located in a north-south oriented valley between Butter Pot Pond and Fenelons Pond, south of Holyrood (Figure 7). The area is composed of hummocks, which range between 5 and 10 m in height and have shallow bogs between the ridges. The hummocks are generally composed of sandy till with scattered boulders, and some sand and gravel lenses. This deposit is presently the site of two large quarry operations, which supply concrete aggregate to the St. John's and area market (Figure 7). Kirby (1990) conducted a testpitting program, east and south of the existing quarries and, identified additional high-quality reserves (Figure 7).

The present program sampled the area to the north of the existing quarry. Samples obtained from 14 excavator dug test-pits have an average depth of 3.1 m. The average grain-size distribution for the fourteen samples collected was 57 percent gravel, 37 percent sand and 6 percent silt-clay, and an average petrographic number of 109. These results are consistent with other samples collected in the area and extend the limits of the known resource.

SHOAL HARBOUR POND

A testpitting program using a crawler excavator was conducted at Shoal Harbour Pond, approximately 10 km north of Clarenville (Figure 8). The area was first identified during the Inventory of Aggregate Resources Program (Kirby *et al.*, 1983) and comprises an esker complex area, which has numerous esker ridge segments and hummocks up to 15 m in height (Plate 5); the area was heavily used, in 1989, for aggregate in the reconstruction of the Trans-Canada Highway, west of Clarenville. The aim of this program was to identify areas of gravel adjacent to the existing quarries suitable for use in concrete production. The testpitting was confined to an area southwest of the existing quarries, an area composed of a series of steep-sided esker ridges covered by a mature stand of widely spaced black spruce or cutover.

Five test-pits were dug and sampled in the ridge area to an average depth of 4 m, revealing a sandy pebble gravel having an average grain-size distribution of 55 percent gravel, 44 percent sand and less than 1 percent silt-clay. Petrographic analysis has not yet been completed on these samples, but samples collected in the same area in 1979 have an average petrographic number of 155 (Kirby *et al.*, 1983). Further physical and chemical testing will have to be conducted on the deposit to determine its suitability as a source of concrete aggregate.

SUMMARY

During the 1990 field season, 133 samples were collected and analyzed from eight field areas across the island. The summary results are as follows.

(1) Isthmus of Avalon—the study was successful in identifying an area of sand and gravel, which could be used to supply aggregate material for use in the construction of a GBS at Great Mosquito Cove.

(2) Northern Arm—a testpitting program was conducted to determine the extent of an aggregate deposit within the town. The information was required so that a detailed extraction and rehabilitation plan can be developed for inclusion in the town's Municipal Plan.

(3) Grand Falls—a testpitting program was conducted 23 km west of Grand Falls and was successful in verifying the existence of a high-quality aggregate deposit, with the potential to supply high-quality aggregate to the Grand Falls and area market.

(4) Kings Point—work in this area concentrated on identifying areas of high-quality aggregate within the Kings Point delta system, which have not been sterilized due to conflicting land uses.

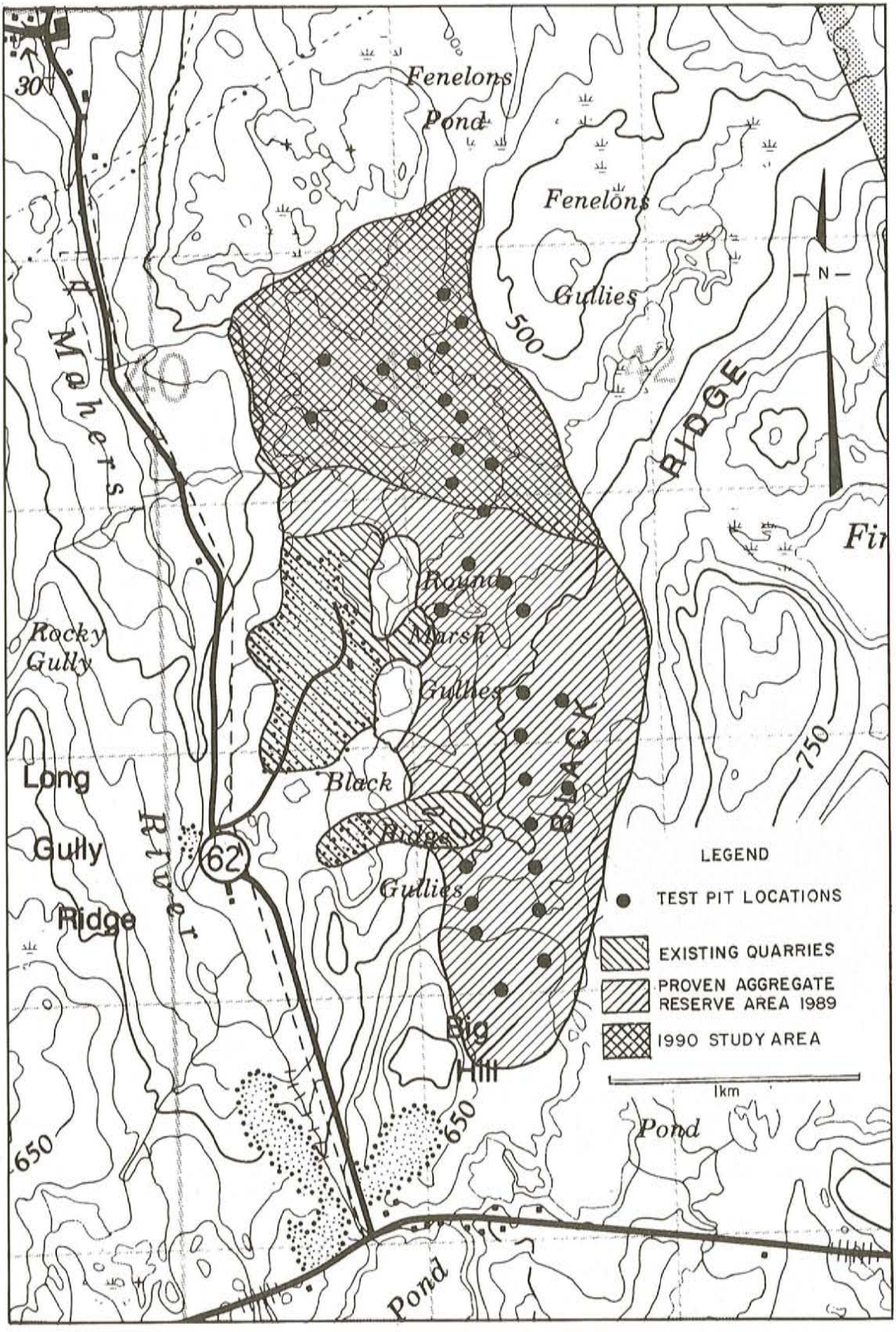

Figure 7. *Holyrood study area.*

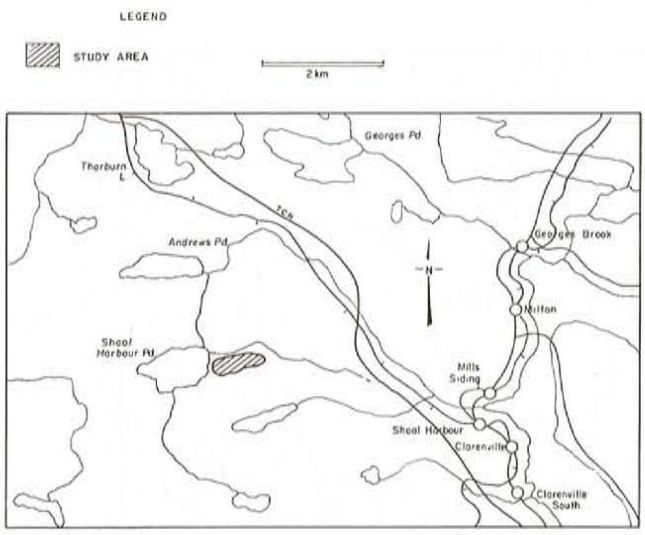

Figure 8. *Shoal Harbour Pond study area.*

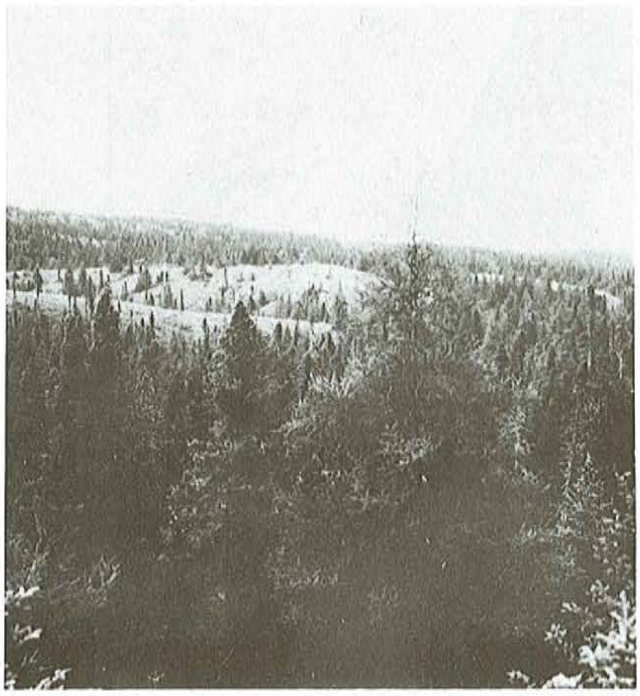

Plate 5. *Esker complex area near Shoal Harbour Pond.*

(5) Pasadena–South Brook–work conducted mainly in the South Brook River valley failed to locate large reserves of high-quality aggregate suitable for use in the re-construction of the Trans-Canada Highway through the Pasadena area.

(6) Raleigh–work in this area concentrated on redefining the aggregate-resource zones within the Raleigh municipal planning area. This work led to the elimination of the aggregate-resource zones within the planning area and the identification of aggregate resources suitable for use in concrete on Burnt Island.

(7) Holyrood–a testpitting program conducted in the area to the north of the existing quarries has verified the continuation of this deposit in that direction.

(8) Shoal Harbour Pond–a testpitting program conducted to the southwest of the existing quarries was successful in identifying additional sources of sand and gravel suitable for use in the production of concrete.

ACKNOWLEDGMENTS

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