Current Research (2014) Newfoundland and Labrador Department of Natural Resources
Geological Survey, Report 14-1, pages 249-265

GRANULAR-AGGREGATE MAPPING IN THE SWEET BAY AND PORT BLANDFORD MAP AREAS (NTS 2C/5 AND 2D/8), EASTERN NEWFOUNDLAND

M.J. Ricketts
Geochemistry, Geophysics and Terrain Science Section

ABSTRACT

Granular-aggregate mapping in 2013 took place in the Sweet Bay (NTS 2C/5) and the Port Blandford (NTS 2D/8) map areas. Granular-aggregate mapping is part of a continuing regional survey to locate aggregate deposits, to alleviate construction problems resulting from aggregate shortages and poor-quality aggregate. Several granular deposits were identified as suitable for construction aggregates. These are located along the Terra Nova North River; south of Georges Pond; between Terra Nova Lake and Georges Pond; along the Terra Nova River; near the southeast side of Terra Nova Lake and the Terra Nova River; between Terra Nova Lake and Pitts Pond; near Northwest Pond; and along the Southwest River. All deposits contain clean sources of gravel and sand, ranging in volume from about 150 000 to 7 000 000 m³ of aggregate. Some deposits are within 1 km of road access points; other deposits are less accessible, or are too small to recommend as potential resource areas.

INTRODUCTION

Mapping of granular aggregates in the Sweet Bay and Port Blandford map areas (Figures 1 and 2) is part of an ongoing program to locate, map, and sample sand, gravel, and till in support of road upgrading and construction activities in the region, and to locate reserves to assist future development in communities. The mapping of aggregate deposits and the provision of data on the quantity and quality of granular aggregate will assist road builders, contractors and consultants in determining the sources and quality of material in a given area, and in evaluating the distance required to transport these materials to a specific job site, a factor that can greatly affect construction cost.

The definition of aggregate depends on the producer, location, and use of the material (Smith and Collis, 1993). However, aggregate, as used in the context of this report, is defined as any hard, inert material such as gravel, sand, crushed stone, or other mineral material that is used in the construction industry (Rutka, 1976; Carter, 1981). The demand for aggregate is closely associated with building construction and road-construction activity, particularly road maintenance, which is by far the most important use of mineral aggregates. Winter ice control, water and sewer systems, driveways, building foundations, backfill and landscaping are also important uses of aggregate. Aggregates are characterized by their high bulk and low unit value, so that the economic value of a deposit is a function of its proximity to a market area, as well as its quality and size (Vanderveer, 1983). Comprehensive planning and resource-management strategies are required to make the best use of available resources, especially in areas experiencing rapid development. Such strategies must be based on a sound

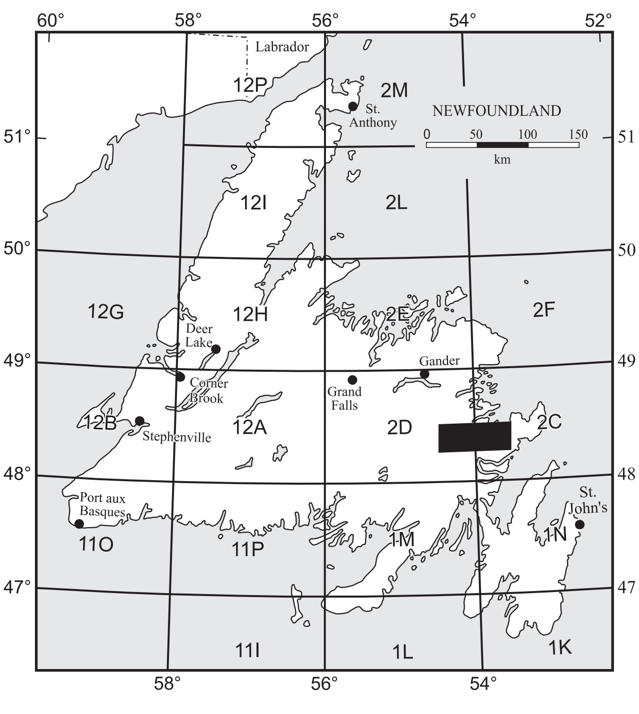


Figure 1. *Location of study area.*

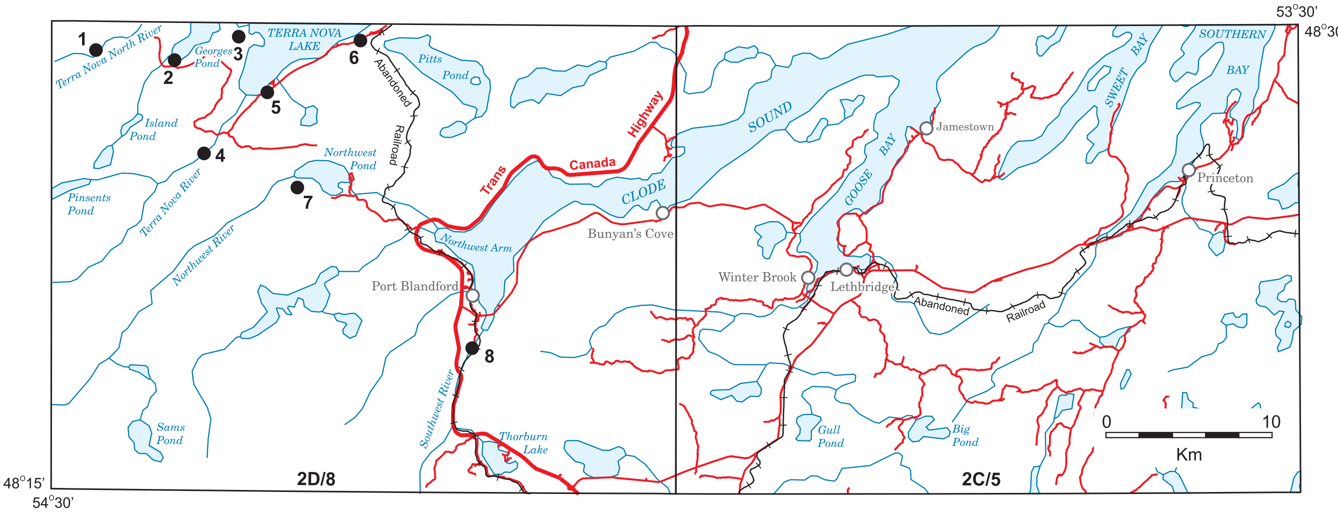


Figure 2. *Location map of granular-aggregate deposits sampled near: 1. Terra Nova North River, 2. Georges Pond, 3. Terra Nova Lake–Georges Pond, 4. Terra Nova River, 5. Southeast Terra Nova Lake-Terra Nova River, 6. Terra Nova Lake–Pitts Pond, 7. Northwest Pond, and 8. Southwest River.*

knowledge of the total mineral aggregate-resource base at both local and regional levels. Aggregate materials can be:

i) processed and used as Class A gravel (aggregate with a maximum diameter of 19 mm, and having a specified proportion of finer grain sizes, and 3 to 6 % silt–clay; Department of Transportation, 2008) or Class B gravel (aggregate with a maximum diameter of 102 mm, and having a specified proportion of finer grain sizes, and 3 to 6 % silt–clay; Department of Transportation, 2008);
ii) processed to mix with a cementing agent to form concrete, asphalt and mortar; or
iii) used as unprocessed pit material.

Knowledge of the nature and distribution of the surficial aggregate deposits (sand, gravel and low silt–clay materials) can assist in estimating the construction cost of projects requiring aggregate. When it is necessary to identify new aggregate sources for production of large quantities of construction materials, the surficial geology of the area and the bedrock geology are important considerations. In a large-scale operation, it may be more economical to truck granular products longer distances rather than use inferior material close at hand; processing cost could be lower and the quality of the product higher, therefore, offsetting the high cost of transportation.

The suitability of material for aggregate use depends on its composition. The silt–clay quantity is important. High silt–clay volumes can cause instability, such as flowage. Too much silt-clay in concrete (>2%) can interfere with the bonding process between the aggregate and the cementing agent. High silt–clay aggregate (>15%) can be used for earth-filled dams, fill and sub-grade road material. Low silt–clay volumes can result in loss of compaction. The presence of deleterious substances (such as silt–clay coatings or iron-oxide staining on the surface of the aggregate), or of blade-shaped fragments, can cause bonding problems with the cementing agent, or the breakdown of aggregate with time.

The suitability of aggregate depends on physical properties and the capability of the rock to withstand stresses placed upon it when it is used as a construction material. The lithology of the pebble fraction (16 to 32 mm) can be evaluated to define the aggregate's petrographic characteristics (Canadian Standards Association, 1973; Ontario Ministry of Transportation, 1994; Bragg, 1995). The petrographic number (PN) can range from 100 to 1000, and is derived by taking the sum of the percentage of each rock type present in the pebble fraction (in a sample of approximately 100 pebbles) multiplied by a petrographic factor (based on soundness and durability) assigned to that rock type (Ricketts and Vatcher, 1996). The petrographic factor is determined by the type and grain size of the rock in a given sample, and by degree of weathering (fresh, slightly, moderately, highly, or intensely weathered) and fracturing. Hence, the lower the PN, the better the quality of aggregate material. For example, a clean, hard, fresh granite would normally have a PN of 100, whereas a friable shale would have a PN of 1000. Most aggregate deposits contain a combination of different rock types having different petrographic factors. The proportion of each of these components determines the PN. For most purposes, aggregate material used in concrete requires a petrographic number of 135 or less, whereas in road asphalt and Class A and B gravels a PN up to 150 is acceptable (Department of Transportation, 2008).

The presence of silt–clay coatings (clean, thin, medium, or thick), staining, rounding of pebbles, and the number of fracture faces and the pebble sphericity are important considerations in assessing the suitability of an aggregate for concrete. These factors affect the bonding capabilities of concrete, and the amount of water necessary to make a concrete, both of which have a direct impact on the strength of a concrete.

STUDY AREA AND PHYSIOGRAPHY

The study area (Figures 1 and 2) is located in eastern Newfoundland, between longitude 53°30’W and 54°30’W, and latitude 48°15‘N and 48°30’N. It covers two 1:50 000-scale map sheets: Sweet Bay (NTS map area 2C/5) and Port Blandford (NTS map area 2D/8).

The topography includes rolling hills and areas of bog, rock ridges and barren surfaces, short ranges of hills, gently sloping shorelines and steep rock cliffs. Like most of Newfoundland, the area has numerous small streams and ponds. Elevations are generally less than 240 m above sea level (asl), with one peak north of Pinsents Pond rising to 285 m, and another 5 km northeast of Thorburn Lake rising to 330 m (NTS map area 2D/8).

There is a network of paved roads including the Trans-Canada Highway (TCH) as well as gravel roads, abandoned railway tracks, and walking/ATV trails. All major rivers in the map area run north and northeast. The rivers are shallow, with numerous rapids, making them nearly impossible for boat access. The shoreline areas around Cloude Sound, Sweet Bay, and Southern Bay are easily accessible by boat. Only the southwest part of NTS map area 2D/8 has poor access. This area can only be efficiently accessed by helicopter.

MAPPING AND ANALYTICAL METHODS

Assessing the potential use and value of granular aggregates can be complex, especially when a variety of different materials types occur within any given aggregate deposit. Interpretation of aerial photographs (1:50 000-scale black-and-white, and 1:12 500-scale colour photographs) is the first stage in locating potential deposits. Airphoto interpretation is used to produce preliminary surficial geology maps that show the distribution and nature of the various deposits within an area. These maps commonly show a variety of tills, sand, and gravel deposits. Till is a sediment deposited by glaciers, commonly with a wide variety of grain sizes. Sand and gravel are commonly formed by fluvial action, by either glacial meltwater or postglacial streams.

Granular-aggregate maps are a derivative of surficial-geology maps supplemented by ground proofing and sampling. They subdivide potential aggregate deposits into high, moderate, low, undefined, and areas of potential sand. The size of the deposit can be determined if its aerial extent and average thickness are known or can be estimated. Thickness values are approximations, based on the face heights of pits developed in the deposit, roadside exposure, or features of the general landscape such as the height of ridges or terraces above the surrounding terrain. From all data, individual deposits may be assigned one of five zones, with zone 1 being the area of highest potential (Kirby *et al.*, 1983).

Table 1. Composite soil-sediment description (Carter, 1983)

Description	Composition
Slightly sandy gravel	>95% gravel
Sandy gravel	5 to 20% sand
Very sandy gravel	>20% sand
Sand/gravel	About equal
Very gravelly sand	>20% gravel
Gravelly sand	5 to 20% gravel
Slightly gravelly sand	>95% sand

In addition to the data collected from aerial photographs, the composition of various sediment types (Table 1) was described using parameters defined by Carter (1983). Data were obtained in the field by examining natural exposures (*e.g.*, stream cuts, shorelines, and gullies) or man-made exposures (*e.g.*, roadcuts, and pit and quarry excavations). Where exposures were not available, samples were collected from hand-dug pits. In some places, hand-dug pits were not practical because of boulders or a thick, cemented soil B-horizon, making it difficult to see the undisturbed parent material. In some deposits, the lack of exposures meant that deposit thickness was difficult to assess. The scarcity of vertical sections, combined with the presence of a concealing surface mat of organic material in many places, made positive interpretation of the nature and extent of the glacial sediments heavily dependent upon evaluation of the geomorphology. Thus, in most instances, surface form was an important aspect in recognition of the unit mapped. Obvious landform boundaries were the basis of many delineations. Other features recorded in the field were sediment thickness, bolder content, presence of compact layers, and the presence of vegetation.

Approximately 15 kg of material were collected for field sieving at each site. Field sieving and petrographic analysis were performed on most samples containing >8 mm size material. A split of the sand-silt-clay fraction (<8 mm) was retained for laboratory sieve analysis, which involved drying and further splitting the sample to a manageable size (70 to 140 g) and wet and/or dry sieving of each sample following the procedures outlined by Ricketts (1987). These data were used to outline zones of aggregate potential on aggregate-resource maps.

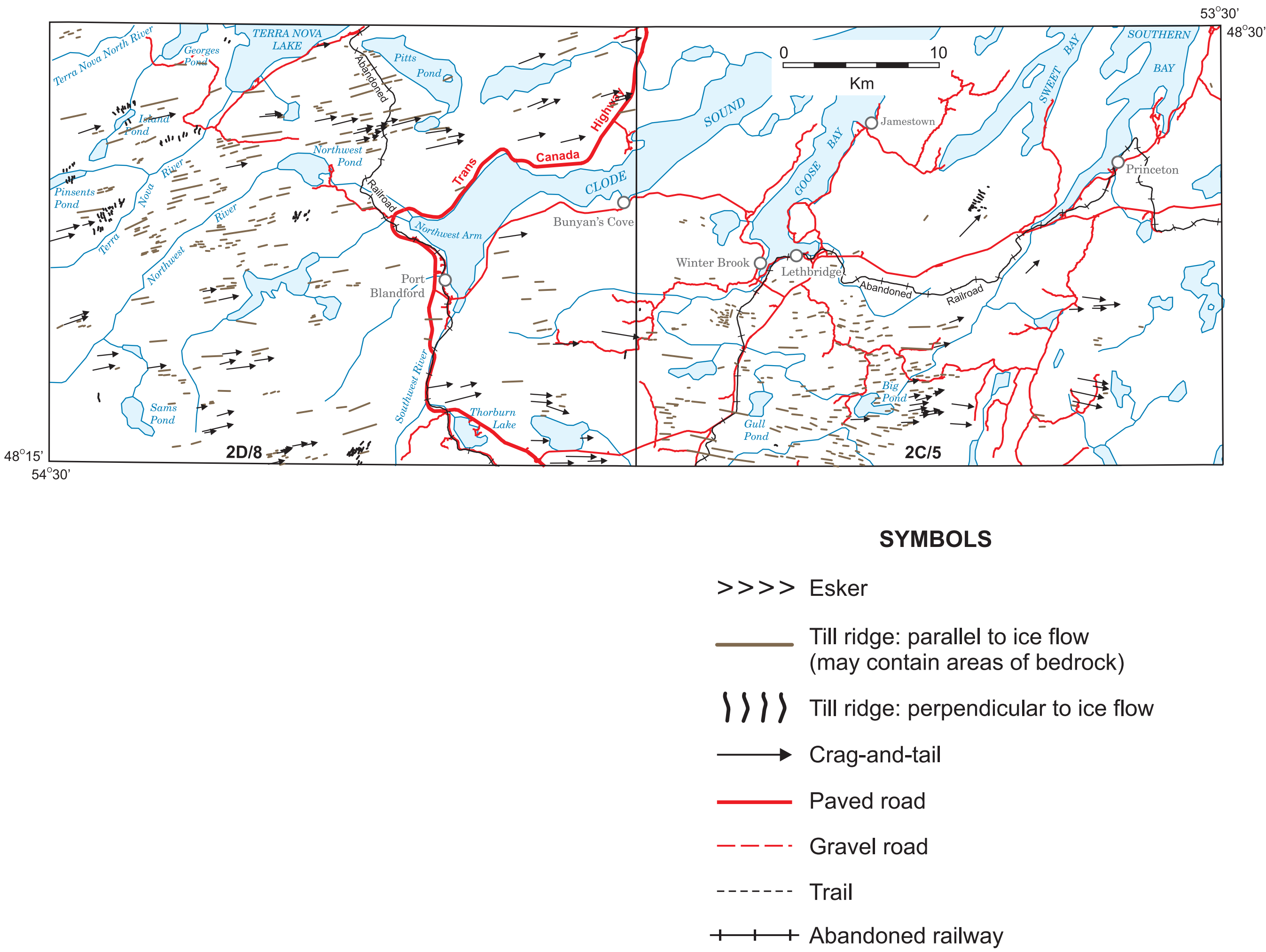


Figure 3. *Till ridges, and craig-and-tail hills.*

SURFICIAL GEOLOGY

Reconnaissance surficial geological mapping at 1:50 000 scale was completed by Kirby *et al.* (1983) as a precursor to aggregate mapping in the Province, within a 6-km-wide road corridor. Later more extensive map coverage of the Bonavista (NTS 2C) and Gander Lake (NTS 2D) map areas, at 1:250 000 scale, was compiled by Liverman and Taylor (1993, 1994). Detailed surficial mapping of NTS map areas 2C/5 and 2D/8 was completed by Batterson and Taylor (2003a, b), at 1:50 000 scale. During the 2013 aggregate program, airphotographs at 1:12 500 scale were used for surficial interpretation.

Till is the dominant overburden type, generally thicker in the western and southern parts of the map area. The east and northeast of NTS map area 2C/5 consist of extensive rock outcrop and till veneers, and minor areas of bog. Elsewhere, bog cover is common throughout most of the map area. Numerous lineated till ridges, parallel to ice flow, are located around Gull Pond and Big Pond in the southwest of NTS map area 2C/5, and around Northwest Pond in the northwest of NTS map area 2D/8. Craig-and-tail features are more noticeable in the southeast of NTS map area 2C/5, and in most of NTS map area 2D/8. Till ridges oriented perpendicular to ice flow, are located southeast of Winter Brook, in NTS map area 2C/5, but are more prominent in NTS area 2D/8, in areas around Pinsents Pond, Island Pond, Terra Nova River, south of Northwest Pond, and west of Thorburn Lake (Figure 3).

Glaciofluvial deposits are located along the major river valleys, including the Terra Nova North River, Terra Nova River, Northwest River, and Southwest River. These occur as eskers, eroded gravels, gravel hummocks, gravel veneers, and gravel planes. In addition, fluvial gravel deposits are found in some of these valleys, but these are generally less than 2 m thick, making them less suitable for quarry sites. Gravel deposits represent approximately 5 to 10% of the total surficial deposits in NTS map area 2D/8. There are a few marine deposits located in shoreline areas, consisting of marine veneers and beach ridges. The largest marine deposits consist of a marine fan located in Northwest Arm, and a marine terrace in Port Blandford (Batterson and Taylor, 2003b). These consist of fine sand, silt, clay, and minor gravel.

PREVIOUS AGGREGATE MAPPING

Aggregate-resource reconnaissance mapping (Environmental Geology Section, 1983a, b; Kirby *et al.*, 1983) provided site and sample data along all road networks in Newfoundland and Labrador. In addition, geotechnical bedrock maps were compiled at a scale of 1:250 000 (Bragg, 1985). Later, Bragg (1994) released site location maps at 1:50 000 scale showing rock types and petrographic numbers. This was followed by a report (Bragg, 1995) with information on the petrographic quality of different rock types to determine their potential as construction aggregate.

Granular-aggregate maps were originally available in blueline format. Most of these maps (215) have been digitized. The digital process is ongoing, and is expected to be completed within two years. All digital aggregate data are available online in the Geoscience Atlas (http://gis.geosurv.gov.nl.ca/).

AGGREGATE POTENTIAL

Surficial deposits in the map area consist of till, glaciofluvial sand and gravel, fluvial sand and gravel, marine sand-silt-clay, and organic material. Till is widespread over most of the area with composition commonly related to underlying or proximal bedrock. Generally, tills have a higher silt-clay content than sands and gravels, which renders most of these deposits unsuitable for construction purposes, unless washed to remove the silt. Potential quarry sites for low silt-clay tills are outlined on 1:50 000-scale maps (Ricketts, 2014a, b).

Sand and gravel have the greatest economic potential. However, not all of these deposits are discussed in this report. For example, in Port Blandford, and near Northwest Arm, deposits vary from sandy gravel to silty sand and silt. These are in a residential area, or controlled by the Terra Nova Golf Resort, areas where quarry activity is unlikely to be permitted. In other areas, deposits outlined on previous aggregate maps are nearly exhausted by quarrying, and other deposits are too small or show low potential, making them unsuitable to designate as aggregate zones. These include deposits near Bunyan's Cove, Lethbridge, Jamestown, and Princeton. Sample locations and grain-size data for these areas are shown on 1:50 000-scale aggregate-resource maps (Ricketts, 2014a, b). Deposits along the southwest part of Terra Nova North River, Terra Nova River, and Northwest River were outlined by aerial-photograph interpretation alone. These deposits were not sampled in the field because of their distance from roads, and unsuitability for foot traversing. Therefore, there is insufficient information to determine sand and gravel potential.

Table 2. Petrographic classification (Bragg, 1995)

Classification	
Good (PN 100-135)	-Excellent for major asphalt/concrete construction
Fair (PN 136-300)	-May be used in minor construction (gravel roads, house foundations, minor retaining walls, low-traffic asphalt roads) if it passes other required specifications
Poor (PN 301-600)	-Should only be used as fill material
Deleterious (PN 601-1000)	-Unsuitable for aggregate use

Sand and gravel deposits sampled at eight locations in NTS map areas 2D/8 are discussed below. No significant deposits were found in NTS map area 2C/5 (Figure 2). Potential deposit reserves range from 150 000 m^3 to 7 000 000 m^3. Gravelly sand is the most common deposit type in this area, with one of very gravelly sand, and one deposit with near equal amounts of sand and gravel, although textures vary greatly within deposits.

Petrographic analyses were completed on 110 pebble samples. Petrographic numbers for 25 of these samples were higher than 200, and of these, four were greater than 250. The highest PN was 269. Most of the higher numbers were reported for till samples, collected in areas where weathered siltstone and shale have higher percentages of the pebble fraction. Petrographic classification (good, fair, poor, or deleterious; Table 2) was determined by using a list of petrographic factors for rock types in Newfoundland and Labrador (Bragg, 1995). Estimated deposit quantity, grain-size data and petrographic numbers are summarized in Table 3.

DEPOSIT 1

Deposit 1 is located along the Terra Nova North River in the northwest part of the map area, 1.5 km from a gravel road near Georges Pond (Figures 2 and 4). It is a glaciofluvial deposit consisting of eroded gravel, gravel veneers, and a gravel plain, intertwined with deposits of fluvial origin and

Table 3: Summary results of sand and gravel deposits sampled in NTS map areas 2C/5 and 2D/8

Deposit	Estimated m^3	No. of Samples Analyzed	Mean Grain-size Analyses % gravel +5mm	%Sand .078mm to 5mm	% SL-CL -.078	Petrographic Numbers (PN) No. of Samples Analyzed	PN Average	PN Range	Morphology
1. Terra Nova North River	5 000 000	8	27.0	72.2	0.8	5	112	100-131	Ge/Gv/Gp/Fe
2. Georges Pond	150 000	2	25.5	73.3	1.2	2	116	113-118	Gf/Gh
3. Terra Nova Lake-Georges Pond	2 500 000	5	22.8	74.2	3.0	3	113	107-121	Gp/Gv/Gr
4. Terra Nova River	2 000 000	7	54.9	44.6	0.5	7	151	113-225	Ge/Gr/Fe
5. Southeast Terra Nova Lake-Terra Nova River	1 500 000	7	36.6	62.3	1.1	9	132	119-161	Ge/Gv/Gr
6. Terra Nova Lake-Pitts Pond	7 000 000	18	22.2	74.8	3.0	7	120	112-128	Ge/Gr/Gb/Gk/Gv
7. Northwest Pond	500 000	13	52.4	45.8	1.8	10	136	118-153	Ge/Gh
8. Southwest River	1 000 000	7	22.8	74.1	3.1	2	191	146-235	Gv/Mt

Note: Estimated quantities in table are based on airphoto analysis and field investigations along roadcuts, shallow hand-dug pits, and natural exposures. Grain-size results and petrographic numbers (PN) are based on a compilation of sample data for each deposit.

Gv (Gravel veneer); Ge (Gravel eroded); Gh (Gravel hummock); Gr (Gravel ridge); Gb (Gravel blanket); Gk (Gravel kettled); Fe (Fluvial gravel eroded), Mt (Marine terrace).

bog. These deposits cover a valley area over 3 km long and 0.5 km wide. Extensive deposits of eroded till, till blankets, till veneer, till ridges, bog, and rock outcrop are located in the surrounding area.

Deposit 1 is a combination of gravel and sand zones having an estimated 5 000 000 m^3 of aggregate. Grain-size analyses of eight samples collected from pits 1 to 1.2 m deep, and 2- to 5-m-high riverbank exposures (Plate 1) show an average of 27.0% gravel, 72.2% sand, and 0.8% silt–clay (Table 3). Two other samples showed 13.3 and 27.7% silt–clay content. These are believed to be localized, and should not affect the economics of quarrying in most of the deposit. Pebbles consist of fresh to moderately weathered granite (48%), fresh volcanics (22%), fresh to moderately weathered gneiss (18%), quartz (9%), fresh shale (1%), fresh gabbro (1%) and moderately to intensely weathered undefined rock types (1%). Petrographic numbers of five samples analyzed range from 100 to 131 with an average of 112.

There is also potentially economic gravel–sand aggregate near the west and southwest end of deposit 1, covering a 400 000 m^2 area. This area was not sampled.

.

DEPOSIT 2

Deposit 2 is located on the east side of a gravel-base road near the south end of Georges Pond, in the northwest part of the map area (Figures 2 and 5). It consists of a 1- to 2-m-thick glaciofluvial fan, and 3- to 4-m-thick eroded gravel. Surrounding surficial material consists of till veneer, concealed bedrock and bog.

Deposit 2 contains approximately 150 000 m^3 of very gravelly sand. Two samples, collected from pits, 1.1 and 1.4 m deep, contained 25.5% gravel, 73.3% sand, and 1.2% silt–clay (Table 3). Pebbles consist of fresh granite (39%), fresh to slightly weathered gneiss (22%), fresh to slightly weathered gabbro (19%), fresh to moderately weathered volcanics (12%) and quartz (8%). Petrographic numbers of 113 and 118 were determined from analyses of two samples.

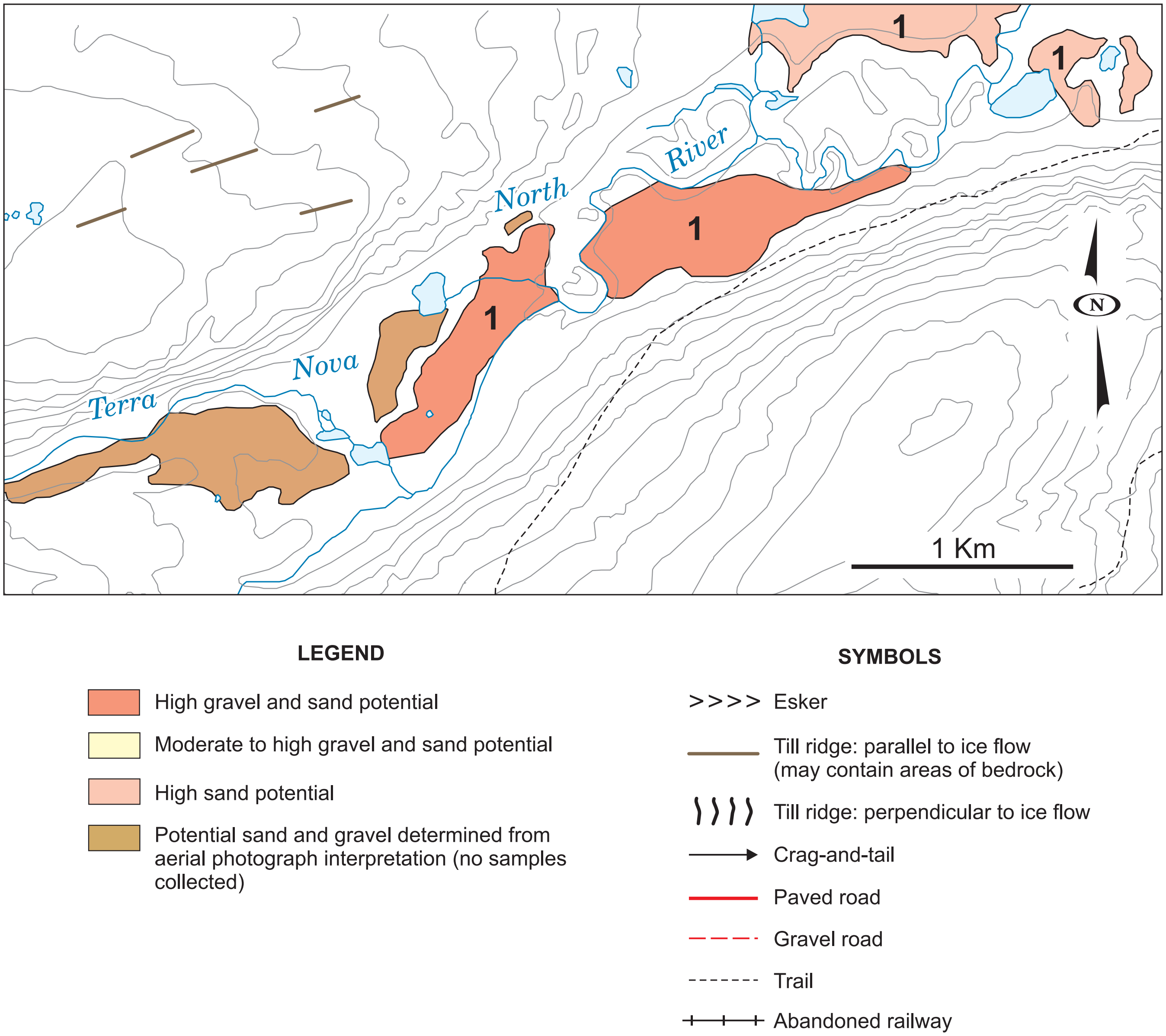


Figure 4. *Terra Nova North River gravel and sand deposits.*

Plate 1. *Stream cut through deposit 1 along the Terra Nova North River.*

Three small, posibly gravel hummocks, are also located in this area. These were not sampled.

DEPOSIT 3

Deposit 3 is located between Terra Nova Lake and Georges Pond, 1.8 km north of a gravel road in the northwest part of the map area (Figures 2 and 6). It consists of gravel ridges, gravel veneers, a gravel plain and fluvial aggregate. Till veneer, rock outcrop and bog are common in the surrounding areas.

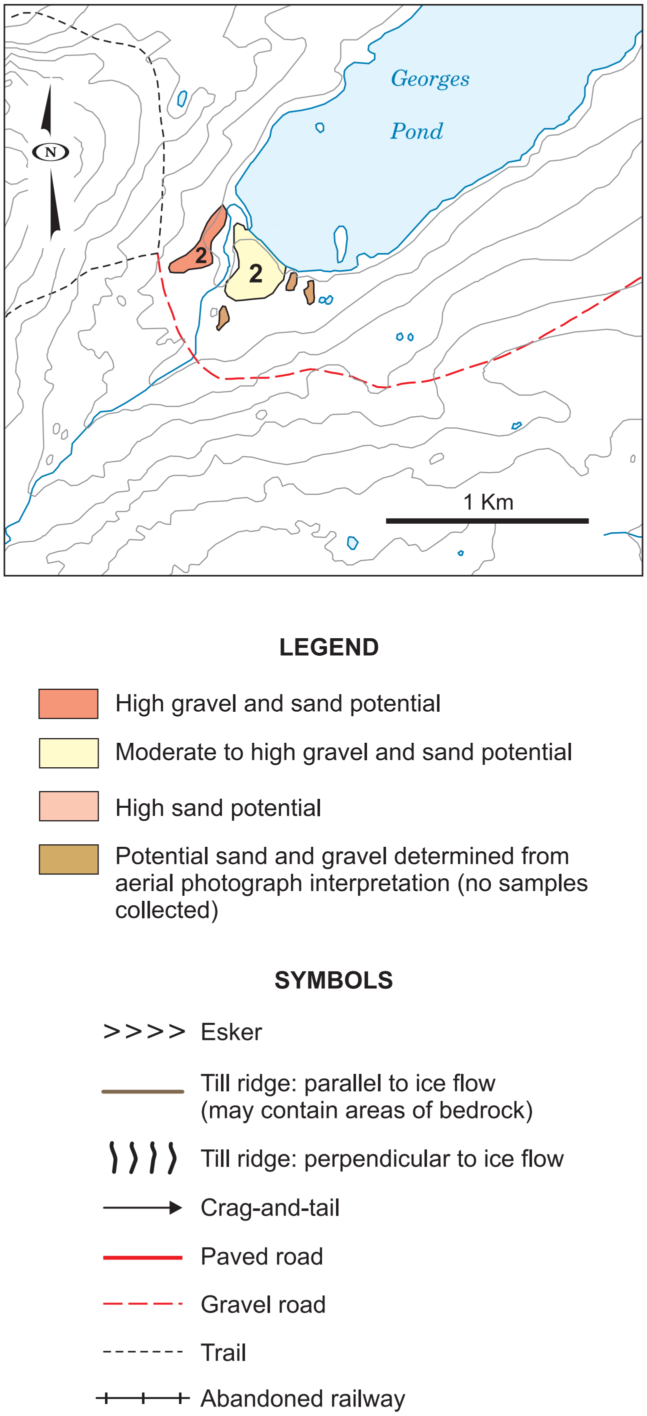


Figure 5. *Georges Pond deposit.*

Aggregate reserves in deposit 3 are estimated to be about 2 500 000 m^3. Grain-size analyses of samples collected from three hand-dug pits, 1.3 to 1.7 m deep, and two lakeshore exposures, 5 m in height (Plate 2) show an average of 22.8% gravel, 74.2% sand, and 3% silt–clay (Table 3). Approximately 25% boulder and cobble content was observed at one of the three hand-dug pits. Sand content varies from 49.7% to 86.9%, predominantly between 0.5 and 1 mm, comprising nearly 36% of the sample weight. Pebbles are dominantly of fresh to moderately weathered granite (65%). Other rock types include fresh to moderately weathered gneiss (16%), fresh volcanics (10%), fresh gabbro (5%) and quartz (4%). Petrographic numbers of 107, 112, and 121 were determined from analyses of three samples.

DEPOSIT 4

Deposit 4 is located along the Terra Nova River, 6 to 9 km southwest of Terra Nova Lake. It is accessible by a poorly maintained gravel road. Deposit 4 consists of a fluvial gravel covering an area approximately 1 500 000 m^2, and a 300-m-long esker (Figures 2 and 7). Numerous till ridges are located in the south and southeast of this deposit. Till blanket, till veneer, and eroded till are common in this area.

An estimated 2 000 000 m^3 of aggregate is present in this deposit. Grain-size analyses of seven samples collected from 1.2- to 2-m-high exposures along riverbanks (Plate 3), and in hand-dug pits show an average of 54.9% gravel, 44.6% sand, and 0.5% silt–clay (Table 3). The dominant grain-size ranges between 8 and 16 mm, comprising nearly 30% of sample weight. Pebbles consist of fresh to moderately weathered volcanics (31%), fresh to moderately weathered granite (26%), fresh to moderately weathered gneiss (15%), fresh to moderately weathered gabbro (8%), quartz (8%), fresh to moderately weathered paragneiss (7%), fresh schist (3%) and fresh quartzite (1%). There are also minor amounts of fresh to moderately weathered shale, fresh siltstone, and fresh syenite (1%). Petrographic numbers of 7 samples range from 113 to 225 with an average of 151.

With the exception of the esker ridge, most of deposit 4 is less than 2 m thick. Oxidization was noted in exposures at three sample sites. These factors will reduce the potential for a quarrying. However, if gravel and sand are found in the southwest where a large, unsampled potential deposit was outlined by airphoto interpretation, data will need to be re-evaluated.

DEPOSIT 5

Deposit 5 is located near southeast side of Terra Nova Lake and Terra Nova River (Figures 2 and 8). It consists of nine aggregate zones spaced over an 8 km distance. These zones consist of glaciofluvial deposits of eroded gravel, gravel ridges, and gravel veneers. Eroded till, till ridges, till blanket, fluvial deposits and bog are common in the surrounding area. A gravel road runs along part of the southeast boundary of the deposit.

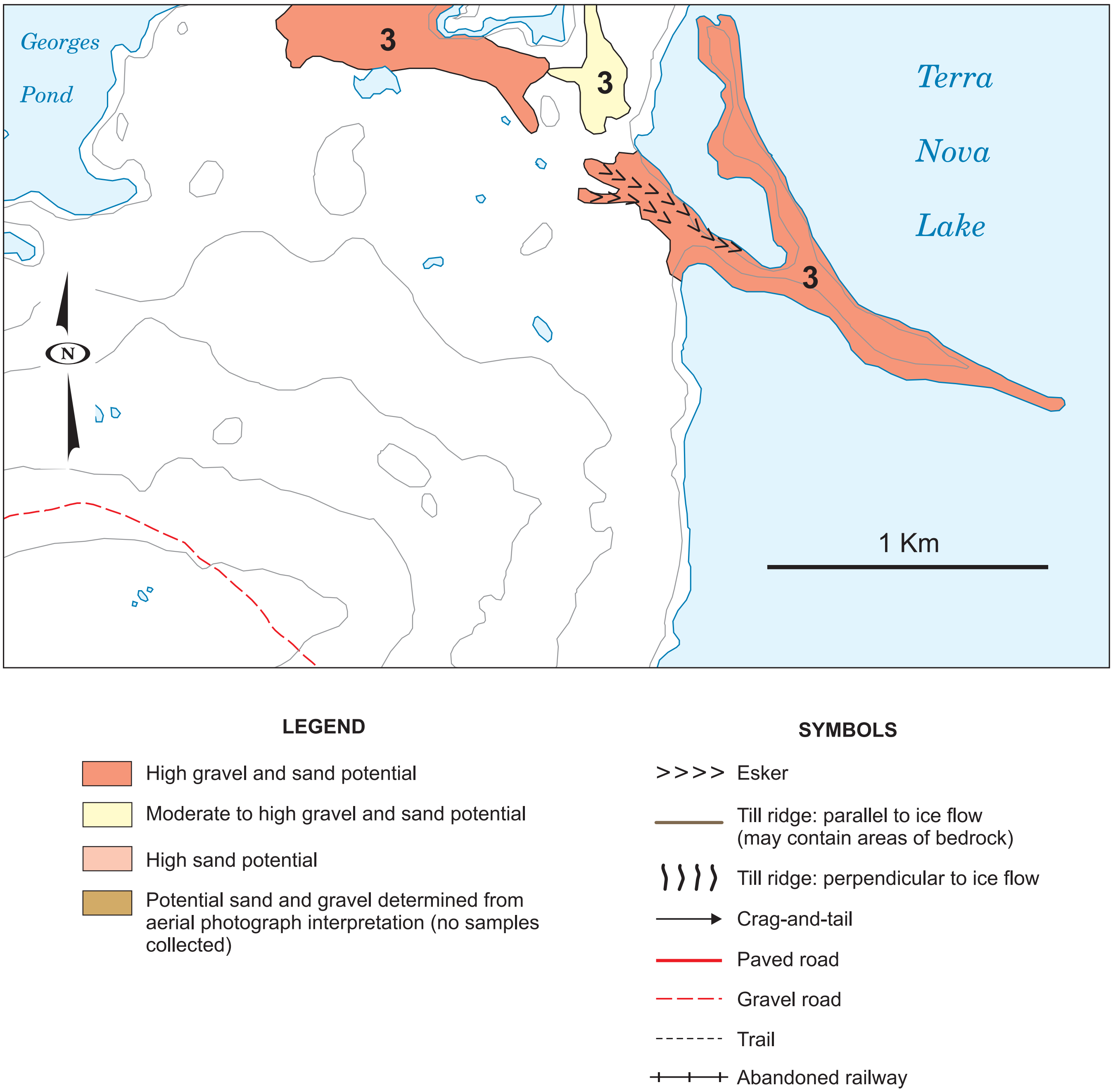


Figure 6. *Terra Nova Lake-Georges Pond deposit.*

An estimated 1 500 000 m^3 of gravelly sand is located in deposit 5. Thickness ranges from 1 to 5 m. Grain-size analyses of 13 samples collected from 1- to 3-m-high exposures along roadsides (Plate 4), quarries and shoreline (Plate 5), and in hand-dug pits, show 36.6% gravel, 62.3% sand, and 1.1% silt–clay (Table 3). Approximately 15 to 20% boulder and cobble content was noted at four sample sites. Dominant grain sizes occur in the 0.25 to 2 mm range, making up nearly 45% of the total sample weight. Pebbles consist of fresh to slightly weathered granite (32%), fresh to moderately weathered volcanics (22%), fresh to moderately weathered paragneiss (19%), fresh to moderately weathered gneiss (18%), quartz (8%) and highly weathered undefined pebbles rock types (1%). Petrographic numbers of 9 samples range from 119 to 161 with an average of 132.

DEPOSIT 6

Deposit 6 is located between Terra Nova Lake and Pitts Pond in the north end of the map area (Figures 2 and 9). It

Plate 2. *Lakeshore exposure in deposit 3 along Terra Nova Lake.*

Plate 3. *Stream cut through deposit 4 along the Terra Nova River.*

consists of eroded gravel, gravel veneer and a gravel plain. Surrounding deposits consist of till blanket, eroded till, concealed bedrock and bog. A gravel road has been constructed though this deposit (Figures 2 and 6). Deposit 6 extends beyond the area of 2013 coverage, into NTS area 2D/9.

Deposit 6 is the largest in the study area, containing approximately 7 000 000 m^3 of gravelly sand. Grain-size analyses of 17 samples collected from exposures 1.1- to 6-m-high in hand-dug pits, roadsides and quarries (Plate 6) show 22.2% gravel, 74.8% sand, and 3% silt–clay (Table 3). Sand content varied from 36.8 to 98.7%. The dominant grain size is between 0.25 and 1 mm, making up nearly 20% of sample weight. Fourteen samples had less than 1% silt–clay, and nine samples had more than 80% sand. Pebbles are dominantly fresh to moderately weathered granite (57%), with the remainder consisting of fresh to moderately weathered gneiss (23%), fresh to moderately weathered volcanics (14%), quartz (4%) and moderately weathered siltstone (1%). There are minor amounts of fresh syenite, fresh quartzite and intensely weathered shale (1%). Petrographic numbers of seven samples range from 112 to 128, with an average of 120.

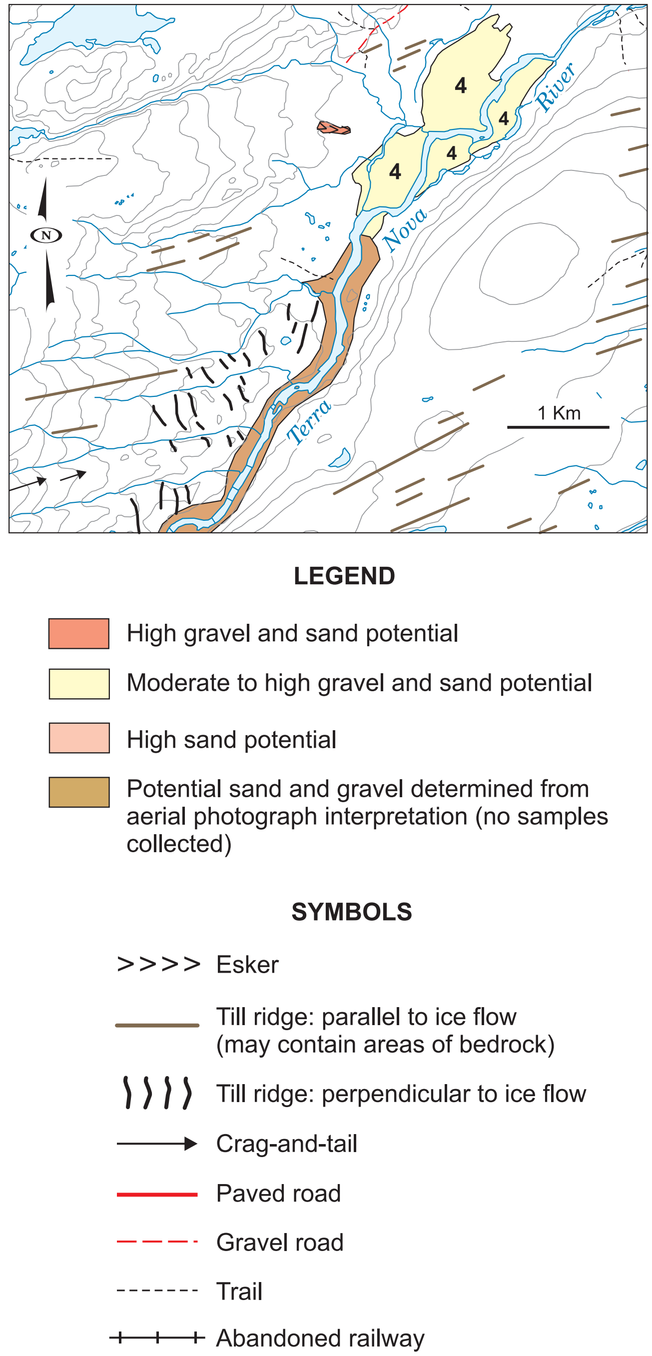


Figure 7. *Terra Nova River deposit.*

DEPOSIT 7

Deposit 7 is located near the southwest end of Northwest Pond (Figures 2 and 10). It has ten aggregate zones consisting of gravel ridges, gravel veneer, hummocky gravel and eroded gravel. Till veneer, concealed bedrock, bog and lineated till ridges are present in the surrounding area. The nearest road access is a gravel road approximately 400 m east.

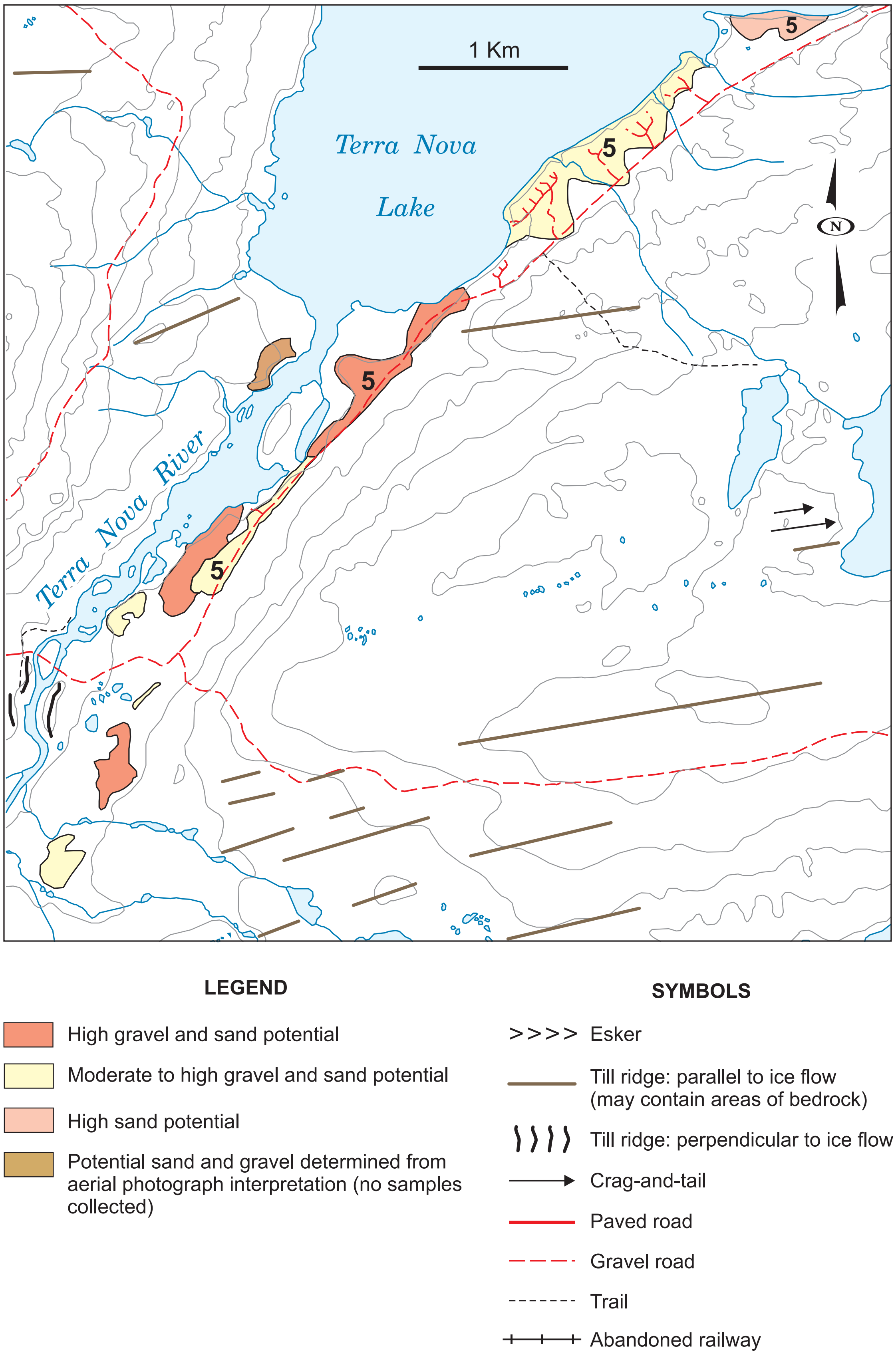


Figure 8. *Southeast Terra Nova Lake-Terra Nova River deposit.*

Plate 4. *Roadside exposure in deposit 5 near the southeast side of Terra Nova Lake.*

Plate 5. *Lakeshore exposure in deposit 5 along Terra Nova Lake.*

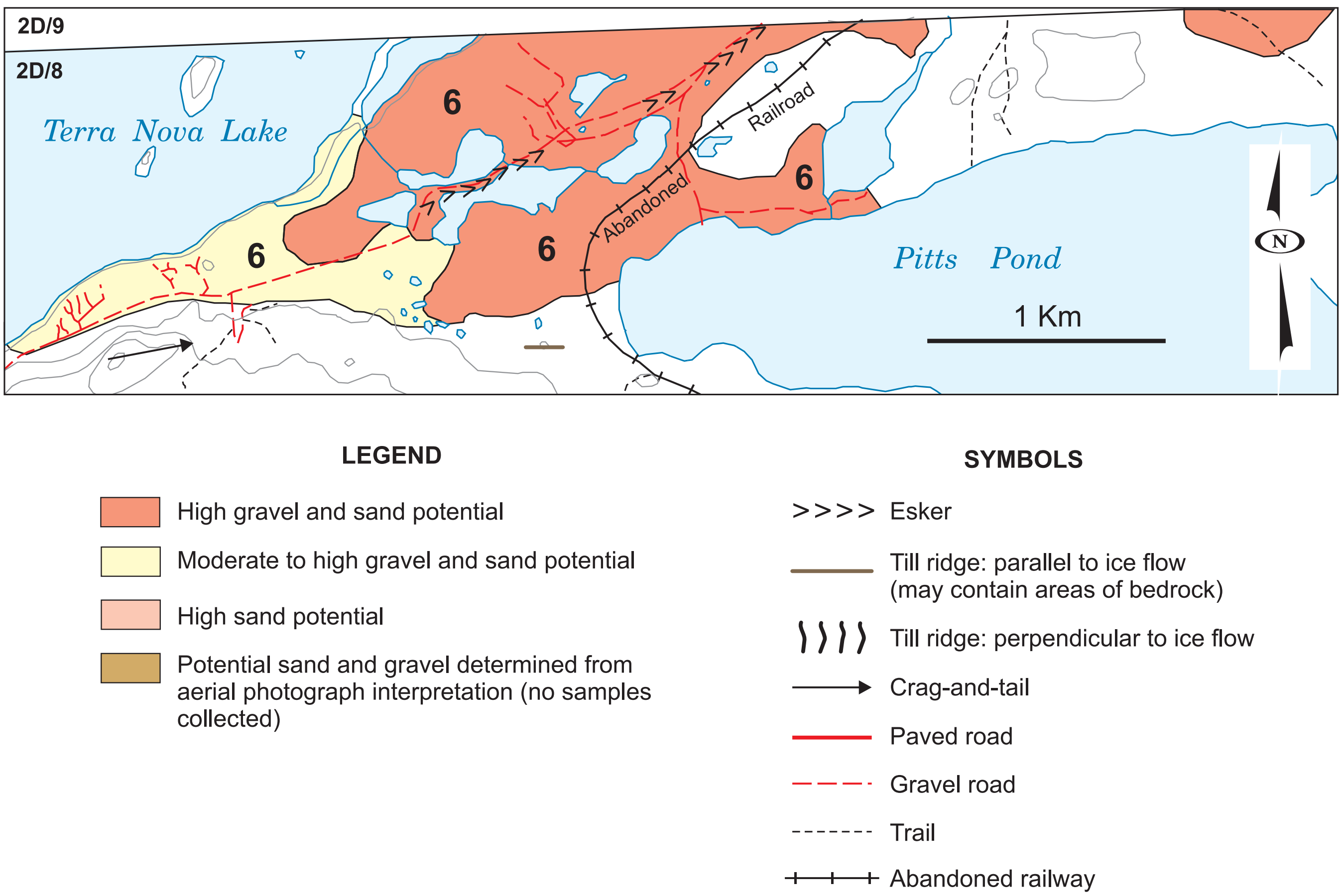
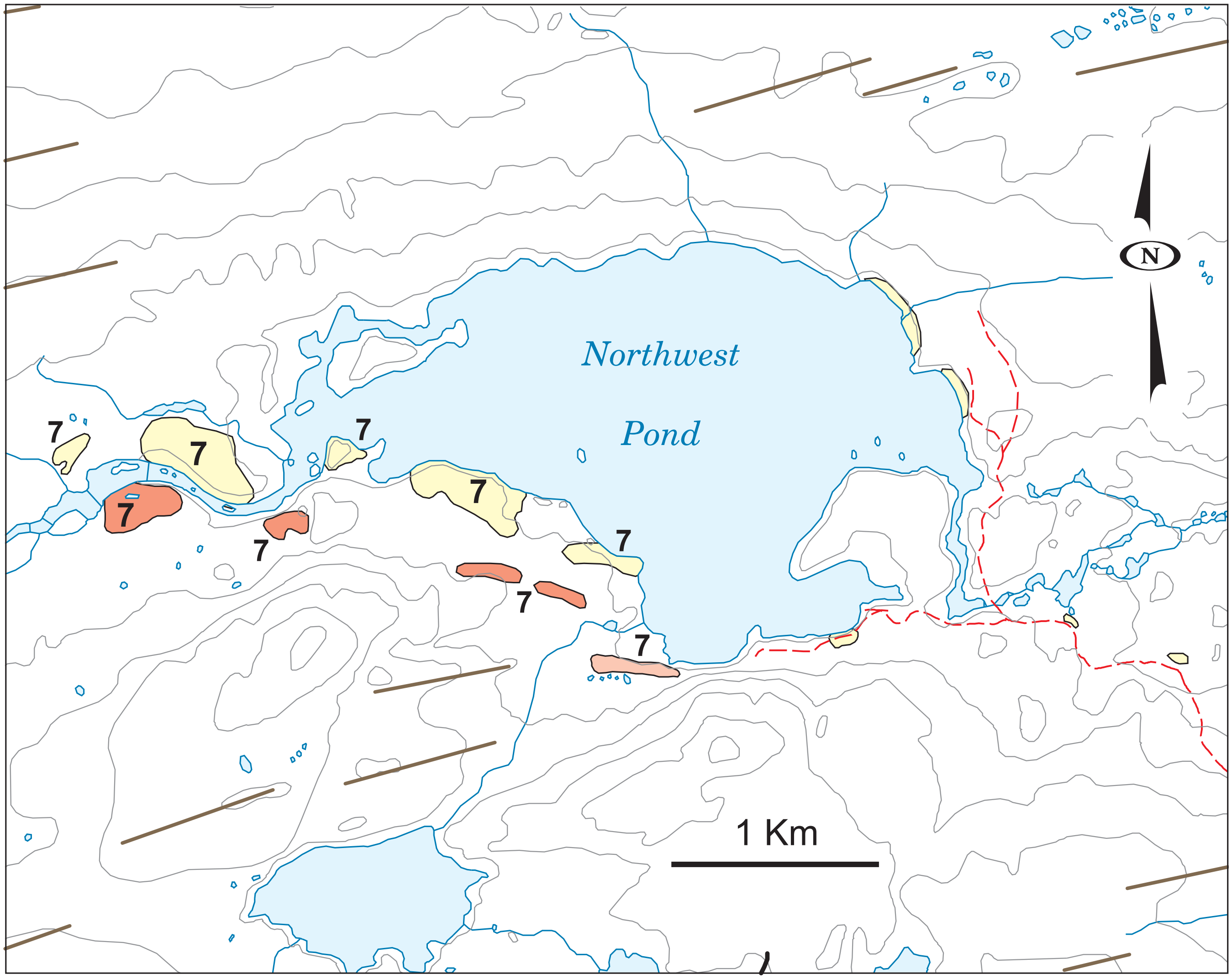


Figure 9. *Terra Nova Lake-Pitts Pond deposit.*

Deposit 7 contains an estimated 500, 000 m^3 of sand and gravel. Unit thickness ranges from 2 to 5 m. Grain-size analyses of thirteen samples collected from 1- to 2-m-high exposures along river cuts and in hand-dug pits show 52.4% gravel, 45.8% sand and 1.8% silt–clay (Table 3). Up to 20% boulder and cobble content was noted at five sample sites. Most samples fall into the category of very sandy gravel, with the exception of two samples with near equal amounts of sand and gravel, two of very gravelly sand, and one of slightly gravelly sand. Pebbles consist of fresh to moderately weathered granite (42%), fresh to highly weathered gneiss (33%), fresh to intensely weathered gabbro (11%), fresh to moderately weathered volcanics (9%), quartz (4%) and fresh conglomerate (1%). Petrographic numbers of 10 samples range from 118 to 153, with an average of 136.



LEGEND

- High gravel and sand potential
- Moderate to high gravel and sand potential
- High sand potential
- Potential sand and gravel determined from aerial photograph interpretation (no samples collected)

SYMBOLS

- >>>> Esker
- Till ridge: parallel to ice flow (may contain areas of bedrock)
- Till ridge: perpendicular to ice flow
- Crag-and-tail
- Paved road
- Gravel road
- Trail
- Abandoned railway

Figure 10. *Northwest Pond deposit.*

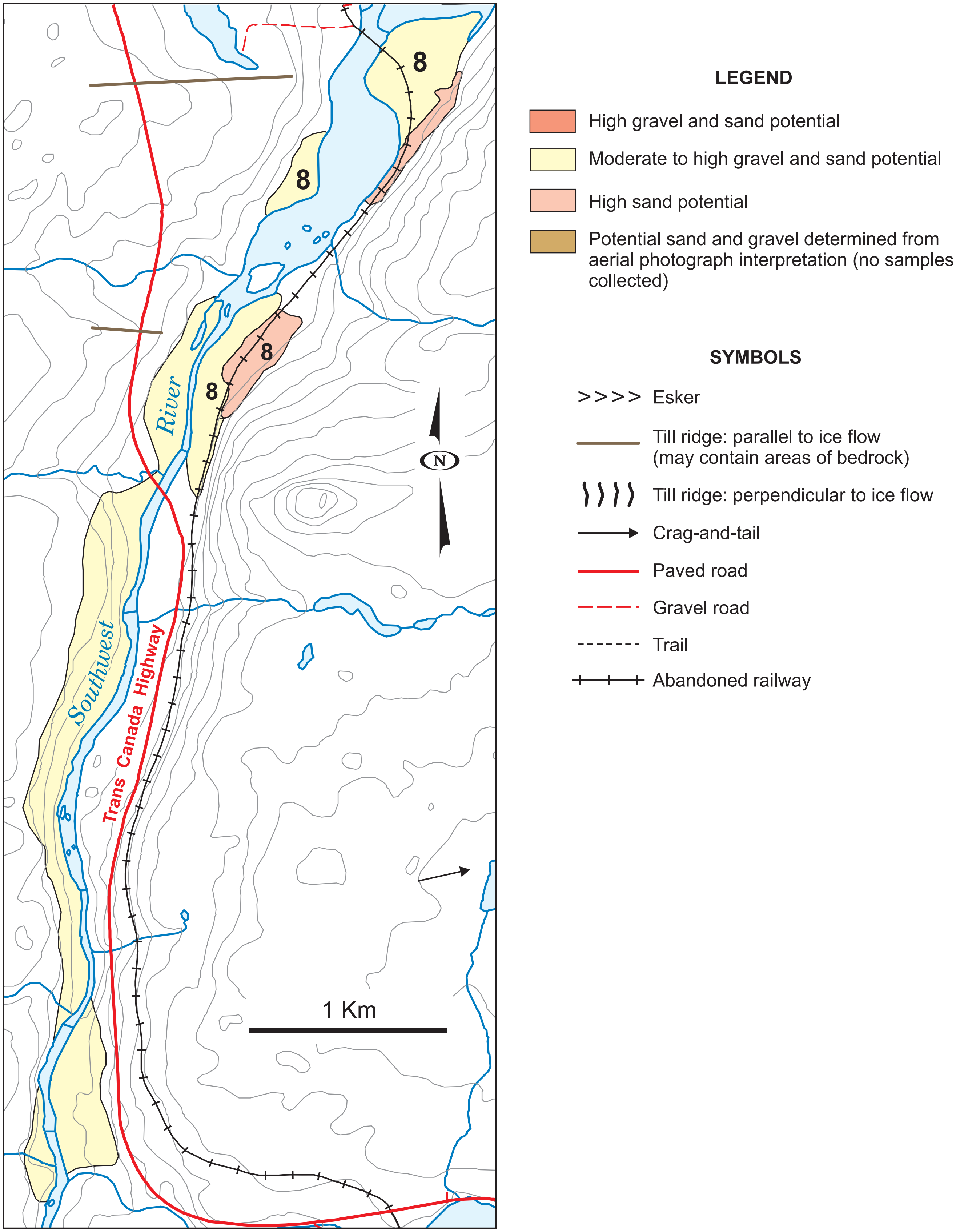


Figure 11. *Southwest River deposit.*

Plate 6. *2.5 m of gravel overlying 2.5 m of sand along 5-m-high quarry exposure in deposit 6.*

Plate 7. *Fine sand, silty sand, and minor gravel, along 7-m-high quarry exposure in deposit 8 near Southwest River.*

DEPOSIT 8

Deposit 8 is located along the banks of Southwest River in the area between Port Blandford and Thorburn Lake (Figures 2 and 11). Thick units of silty sand and gravel, possibly of marine origin, are visible in the north part of this deposit (Plate 7). Deposit 8 consists mostly of eroded gravel and gravel veneers. Parts of the deposit were quarried in the past, and originally where thick gravel units were located, there remain thin exposures of gravel, or silty sands that are less valuable than sand and gravel aggregate. Deposit 8 is approximately 7 km long and 300 m wide. Thickness is generally less than 2 m, except in the northeast where quarry exposures are 5 m high.

The remaining aggregate in deposit 8 is estimated to amount to about 1 000 000 m^3. Grain-size analyses of seven samples collected from 2- to 5-m-high roadside exposures and in quarries show 22.8% gravel, 74.1% sand and 3.1% silt–clay (Table 3). Sand content varies from 35.3 to 91.7%. Silt–clay content is over 3% in five of the eight samples collected, and 59.5% in one sample not included in the calculation of the average. Pebbles consist of fresh volcanics (46%), fresh to slightly weathered granite (30%), fresh to moderately weathered sandstone (14%), fresh siltstone (8%) and guartz (2%). Petrographic numbers of 146 and 235 were determined from analyses of two samples.

Although this deposit has a significant quantity of aggregate, it extends over a large area, is generally less than 2 m thick, and has local high silt-clay content. The limited thickness and high silt–clay content will reduce the potential for large-scale quarry activity in the future.

SUMMARY

Deposits sampled during the 2013 field season range in quantity from 150 000 m^3 to 7 000 000 m^3. Deposits may be suitable for quarry development depending on their location, quantity, and quality of material and the type of material needed, whether for use in road construction, asphalt, cement, or for winter ice control. All deposits are located less than 2 km from access roads, although distance to potential markets maybe much greater. Gravelly sand is the most common deposit type, with one deposit of very gravelly sand, and one with near equal amounts of sand and gravel. High boulder content was not encountered in most deposits, although deposits may require screening or crushing to obtain the aggregate grain-size fractions required in some construction projects. Petrographic quality is good, with the exception of some samples collected at Southwest River and Terra Nova River, where average petrographic numbers were 191 and 151. If resources in these areas are considered for aggregate use, more detailed sampling and testing will be needed to determine quality.

Some deposits are not accessible by road. It may not be economically feasible to quarry in these areas, or in areas where aggregate has to be trucked over a long distance. Smaller deposits may be suitable for pit-run operations, but not for large construction projects where asphalt or concrete plants are required.

ACKNOWLEDGMENTS

Devin Saunders was a reliable, enthusiastic, and hard-working assistant for the duration of the field program. Logistical support from Gerry Hickey was greatly appreciated. Tony Paltanavage is acknowledged for his assistance with drafting of figures. Steve Amor reviewed an earlier version of this report.

REFERENCES

Batterson, M.J. and Taylor, D.M.
2003a: Landforms and surficial geology of the Random Island map area (NTS 2C/4). Newfoundland Department of Mines and Energy, Geological Survey, Map 2003-01, Scale 1:50 000, Open File 002C/04/0117.

2003b: Landforms and surficial geology of the Tug Pond map area (NTS 2D/01). Newfoundland Department of Mines and Energy, Geological Survey, Map 2003-04, scale 1:50 000, Open File 002D/01/0434.

Bragg, D.J.
1995: Petrographic examination of construction aggregate. *In* Current Research. Newfoundland Department of Mines and Energy, Geological Survey, Report 95-1, pages 77-89.

1994: Site location maps at 1:50 000 scale showing rock types and petrographic numbers. Newfoundland Department of Mines and Energy, Geological Survey, Maps 94-148 and 94-154.

1985: Geotechnical bedrock complication map series, scale 1:250 000. Newfoundland Department of Mines and Energy, Mineral Development Division, Open File NFLD/1485.

Canadian Standards Association
1973: CSA standard A23.2.30, Rexdale, Ontario, pages 207- 209.

Carter, M.
1983: Geotechnical Engineering Handbook. University of Wales Institute of Science and Technology. Pentech Press, London and Plymouth, 226 pages.

Carter, P.D.
1981: The Economics of Mineral Aggregate Production and Consumption in Newfoundland and Labrador. Newfoundland Department of Mines and Energy, St. John's, Newfoundland, 112 pages.

Department of Transportation
2008: Specifications Book (third edition). Government of Newfoundland and Labrador, Department of Works, Services, and Transportation, Highway Design Division, St. John's.

Environmental Geology Section
1983a: Site data and 1:50 000 scale maps. Field maps for all surficial and glacial mapping, and aggregate resource mapping projects. Mineral Development Division, Department of Mines and Energy, Government of Newfoundland and Labrador, Open File NFLD/1267.

1983b: 1:50 000 scale aggregate resource maps outlining zones of aggregate potential within a 6-km-wide corridor in Newfoundland and Labrador. Newfoundland Department of Mines and Energy, Mineral Development Division, Maps 82-107 and 82-113, Open File NFLD/1300.

Kirby, F.T., Ricketts, R.J. and Vanderveer, D.G.
1983: Inventory of aggregate resources of Newfoundland and Labrador. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 83-2, 36 pages.

Liverman, D. and Taylor, D.M.
1993: Surficial geology of the Bonavista (NTS 2C) and Wesleyville (NTS 2F) map areas. Newfoundland Department of Mines and Energy, Geological Survey, Map 1993-48, scale 1:250 000. Open File NFLD (2273).

1994: Surficial geology of the Gander Lake map area (NTS 2D). Newfoundland Department of Mines and Energy, Geological Survey, Map 94-232, scale 1:250 000. Open File 2D (297).

Ontario Ministry of Transportation
1994: Procedures for petrographic analysis of coarse aggregate. Ministry of Transportation, Ontario, Laboratory Testing Manual, Volume 2, LS-609, 18 pages.

Ricketts, M.J.
1987: Coastal Labrador aggregate resources. Newfoundland Department of Mines and Energy, Mineral Development Division, Mineral Resource Report 5, 50 pages.

2014a: Granular-aggregate resources, Sweet Bay map area (NTS 2C/5). Government of Newfoundland and Labrador, Department of Natural Resources, Geological Survey, Map 2014-02. Open File 002C/05/0206.

2014b: Granular-aggregate resources, Port Blandford map area (NTS 2D/8). Government of Newfoundland and Labrador, Department of Natural Resources, Geological Survey, Map 2014-03. Open File 002D/08/0806.

Ricketts, M.J. and Vatcher, S.V.
1996: Granular aggregate-resource mapping in the Roddickton-Main Brook area, Great Northern Peninsula, Newfoundland. *In* Current Research. Newfoundland Department of Natural Resources, Geological Survey, Report 96-1, pages 41-53.

Rutka, A.
1976: Economic use of mineral aggregate in road construction (Draft Report). Ontario Ministry of Transportation and Communications. Prepared for Presentation to the Mineral Aggregate Working Party, March 17, 1976.

Smith, M.R and Collis, L
1993: Aggregates: Sand, gravel and crushed rock aggre-

gate for construction purposes (2nd edition). Geological Society of London, Geological Society Engineering Geology Special Publication No. 9, 339 pages.

Vanderveer, D.G.
1983: Aggregates - the often maligned and often forgotten mineral. *In* 19th Forum on the Geology of Industrial Minerals – Proceedings. *Edited by* S.E. Yudt. Ontario Geological Survey, Miscellaneous Paper 114, pages 65-78.