ONTARIO
DEPARTMENT
OF
MINES

SAND AND GRAVEL IN SOUTHERN ONTARIO

INDUSTRIAL MINERAL REPORT No. 11

1963

ONTARIO
DEPARTMENT OF MINES

Hon. G. C. Wardrope, *Minister* D. P. Douglass, *Deputy Minister*
M. E. Hurst, *Director of Geological Branch*

Sand and Gravel in Southern Ontario

By
D. F. HEWITT *and* P. F. KARROW

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TABLE OF CONTENTS

Industrial Mineral Report No. 11

PHOTOGRAPHS

FIGURES

GEOLOGICAL MAPS
(in back pocket)

FOREWORD

This report, Sand and Gravel in Southern Ontario, describes 258 sand and gravel deposits of which 202 are in south-central and southeastern Ontario and 56 in southwestern Ontario. An appendix lists 50 gravel deposits not described in the main parts of this report; 21 of these are in south-central and eastern Ontario, and 29 in southwestern Ontario. The deposits in south-central and southeastern Ontario east of longitude 80°W. were described by D. F. Hewitt. The deposits in southwestern Ontario west of longitude 80°W. were described by P. F. Karrow.

Lists of sand and gravel producers were obtained from the Statistician, Ontario Department of Mines, Toronto, to whom statistical returns regarding sand and gravel production are made annually by all operators.

The authors wish to thank the sand and gravel operators for their co-operation in this survey. Considerable assistance was given by L. J. Chapman and Mrs. C. I. Dell of the Ontario Research Foundation, and by engineers of the Materials and Research Section, Ontario Department of Highways, particularly A. Rutka, B. Glassford, K. Ingham, and D. MacDonald.

Field work for this report was carried out in the summers of 1961 and 1962.

SAND AND GRAVEL IN SOUTHERN ONTARIO

BY

D. F. Hewitt[1] *AND* P. F. Karrow[2]

INTRODUCTION

In recent years, there has been a marked expansion of the sand and gravel industry in Ontario. Production has increased from 10,466,891 tons valued at $4,466,862 in 1945, to 75,084,320 tons valued at $43,201,211 in 1961. In 1960, 176 operations were each producing in excess of $10,000 worth of sand and gravel in Ontario.

The main uses for sand and gravel are: for fill, granular base course, and surface course in roads; aggregates in asphalt construction; coarse and fine aggregates in concrete; and building sand in mortar and blocks. Specifications for sand and gravel to be used in concrete and asphalt construction are becoming stricter, and the presence of deleterious materials in the sand and gravel from some areas restricts the markets for this material, especially if chert and shale are common. Beneficiation of sand and gravel to remove deleterious materials is rarely practised in Ontario at the present time.

Round and crushed gravel competes with crushed stone as a coarse aggregate for concrete, preference mainly depending upon cost and availability. Concrete made with round stone aggregate is easier to work especially where concrete is placed in confined spaces. However, the irregular surfaces of the crushed stone give slightly better binding qualities and increased strength to the concrete.

Deposits of sand and gravel are widespread in Ontario. Because sand and gravel are low-priced commodities, sand and gravel producers are commonly localized near urban areas. In the Toronto area it is becoming increasingly difficult to find sources of good-quality sand and gravel. Gravel suitable for concrete aggregate is shipped into Toronto by rail from as far west as Paris, and from as far east as Brighton. Resources of high-quality gravel are lacking in the Toronto area, the nearest source being the Stouffville area.

Sand and gravel are used as backfill in many mines, and a substantial amount of this material is produced in the Sudbury and Timmins areas.

All the larger producers have permanent plants, but a large proportion of the total sand and gravel production from medium-sized and small producers comes from portable crushing and screening plants. These plants are widely used by contractors, especially on road contracts, where large tonnages of granular base course and surface course gravel are required.

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PRODUCTION OF SAND AND GRAVEL IN ONTARIO

The production and value of sand and gravel produced in Ontario from 1945 to 1961 are given in (I).

(I) SAND AND GRAVEL, ONTARIO PRODUCTION, 1945–61

Year	Tonnage	Value
1961	75,084,320	$43,201,211
1960	77,660,833	43,929,708
1959	73,981,703	39,695,602
1958	67,469,064	40,055,031
1957	66,129,158	36,699,895
1956	61,436,363	34,379,015
1955	51,488,067	29,949,730
1954	46,433,191	25,577,612
1953	43,658,099	24,359,496
1952	43,423,737	23,240,203
1951	39,218,058	19,905,293
1950	30,278,234	15,553,186
1949	22,320,753	11,214,136
1948	20,587,398	10,468,216
1947	20,230,499	9,034,131
1946	14,880,006	6,738,695
1945	10,466,891	4,466,862

The tonnage of sand and gravel produced in Ontario has increased sevenfold since 1945, and has increased by 150 percent since 1950.

The output of sand and gravel from 1956 to 1960 came from the sources given in (II).

COMMERCIAL OPERATIONS

Pit Operators

For 1959, reports were received from 356 pit operators and 12 dredge operators.

For 1960, 176 commercial pit operators each reported production in excess of $10,000; of these, 73 each reported production of greater than $100,000 worth of sand and gravel, and 25 reported production greater than $300,000.

Commercial Sand and Gravel Producers in Ontario, 1960

The 176 commercial pit operators that produced in excess of $10,000 worth of sand and gravel in 1960 are listed in the two tables, (III) and (IV). Information was provided from the files of the Statistician, Ontario Department of Mines.

In a preliminary survey of sand and gravel operations in southern Ontario in 1961, 181 gravel pits with plants were visited. Eighty had permanent plants and 101 had portable plants. The largest permanent plants in operation in Ontario have capacities of 400–600 tons per hour.

In 1960 the Ontario Department of Highways approved list of sand and gravel aggregate producers in southern Ontario included 75 producers.

Commercial Materials

The main commercial materials produced by sand and gravel operators are the following:

1-inch crushed or round gravel.
¾-inch crushed or round gravel.
⅝-inch crushed or round gravel.
⅜-inch crushed or round gravel.
¾-inch crusher-run gravel.
concrete sand.
brick sand.
asphalt sand.
railroad ballast.
pit-run gravel and fill.

(II) OUTPUT OF SAND AND GRAVEL

Source		1956	1957	1958	1959	1960
Commercial pit operators	tons	29,583,879	32,134,104	31,853,372	34,559,281	34,670,825
	$	19,595,413	21,100,962	23,514,262	24,520,143	24,254,713
Dredged from the Great Lakes and rivers	tons	1,570,836	1,862,920	1,263,381	1,306,943	1,163,678
	$	1,649,841	1,742,507	1,421,628	1,616,294	1,490,251
Ontario Department of Highways	tons	18,250,000	19,537,000	21,077,081	24,776,179	26,303,751
	$	7,610,000	7,808,000	8,460,000	7,226,546	10,521,500
Counties and townships	tons	10,309,882	10,455,849	11,816,303	11,919,781	14,281,959
	$	5,154,941	5,227,925	5,908,152	5,959,891	7,140,980
Railway ballast	tons	1,721,766	2,139,285	1,458,927	1,419,519	1,240,620
	$	368,820	820,501	750,989	372,728	522,264
Total	tons	61,436,363	66,129,158	67,469,064	73,981,703	77,660,833
	$	34,379,015	36,699,895	40,055,031	39,695,602	43,929,708

(III) PRODUCTION IN EXCESS OF $100,000 IN 1960

COMPANY OR OPERATOR	LOCATION
Armstrong Brothers Co. Ltd.	Brampton
W. J. Bell and Son Construction Co. Ltd.	Stittsville
Billie Construction Co. Ltd.	Smiths Falls
Caledon Sand and Gravel Ltd.	Caledon
Cardinal Construction Ltd.	Cardinal
J. Chefero Sand & Gravel Ltd.	Maple
City Sand & Gravel Ltd.	North Bay
Clarkson Sand and Gravel Ltd.	Clarkson
Coleman Munro Ltd.	Cornwall
Collingwood Sand and Gravel	Collingwood
Consolidated Sand and Gravel Ltd.	Paris, Malton, Pickering
J. Cooke (Concrete Blocks) Ltd.	Aldershot
A. G. Cook Ltd.	Barrie
Alf Cooper and Co.	Fort William
Cox Construction Co. Ltd.	Guelph
DCB Gravel Co. Ltd.	Milton
J. C. Duff Ltd.	Brampton
Durham Crushed Stone Ltd.	Durham
Eastern Gravel and Crushed Stone Ltd.	Caledon
Falconbridge Nickel Mines Ltd.	Sudbury
Fisher Construction Limited	Sudbury
Forwell Sand and Gravel Ltd.	Kitchener
Franceschini Brothers Construction Co. Ltd.	Brampton, Caledon, Cooksville
General Aggregates Ltd.	Oshawa
Gormley Sand and Gravel	Stouffville
Guelph Sand and Gravel Ltd.	Guelph
Highland Creek Sand and Gravel Ltd.	Highland Creek
Hollinger Consolidated Gold Mines Ltd.	Timmins
Holman Construction Co. Ltd.	Rockwood
Kenmore Building Materials Ltd.	Brampton
Keystone Contractors Ltd.	Windsor
H. R. Lockyer and Sons Ltd.	Caledon
Markham Sand and Gravel Ltd.	Markham
J. F. Marshall and Sons	London
K. F. Marshall	Woodstock
McColgan Sand and Gravel Ltd.	Barrie
A. H. McCoy Construction Co. Ltd.	Stittsville
McNamara Construction Co. Ltd.	Port Arthur
C. McRae Ltd.	Byron
Monarch Sand and Gravel Co.	Woodbridge
Moyer Sand and Gravel Ltd.	Fonthill
J. E. Murray	Moorefield
Ontario Custom Crushing Ltd.	Brantford
Ontario Sand and Gravel Co. Ltd.	Maple
Pioneer Construction Co. Ltd.	Sudbury
Preston Sand and Gravel Co. Ltd.	Preston
J. B. Regan Co. Ltd.	Highland Creek, Pickering
F. H. Roberts and Sons	Stouffville
Elwood Robinson Ltd.	Sault Ste. Marie
J. Sabiston Ltd.	Thornhill
Sandy Contracting Co. Ltd.	Goderich
E. E. Seegmiller Ltd.	Kitchener
Smiths Construction Co. Ltd.	Arnprior
C. Smythe for Sand Ltd.	Caledon
South Mountain Construction Co.	South Mountain
Spinks Gravel Ltd.	Leamington
Spratt Sand and Gravel Ltd.	Ottawa
Springbank Sand and Gravel Ltd.	Port Credit
Standard Paving Ltd.	North Bay
Stewart and Broad Construction Co. Ltd.	Prescott
F. A. Stonehouse and Son Ltd.	Komoka
Stouffville Sand and Gravel Ltd.	Stouffville
J. B. Sullivan	Sarnia
Sunderland Sand and Gravel Ltd.	Sunderland
Superior Sand, Gravel, and Supplies Ltd.	Maple
Telephone City Gravel Co.	Brantford
Towland Construction Co. Ltd.	London
Trent Valley Sand and Stone Ltd.	Brighton
Uren Construction Ltd.	Orillia
Varcoe Brothers	Barrie
Western Sand and Gravel Ltd.	Stouffville
Woollatt Industries Ltd.	Leamington
Yundt and McCann Construction Ltd.	Stratford

(IV) PRODUCTION IN EXCESS OF $10,000 IN 1960

COMPANY OR OPERATOR	LOCATION
Aberfoyle Sand and Gravel Co.	Aberfoyle
Adams Sand and Gravel Ltd.	Chatham
Aldershot Contractors Equipment Rentals Ltd.	Aldershot
Alrex Contracting Ltd.	Georgetown
Angelstone Ltd.	Preston
Avondale Sand and Gravel	Maple
K. R. Axford	St. Thomas
H. H. Bannerman	Kincardine
Barclay Transport Ltd.	Kinsale
Blacktop Paving Co. Ltd.	Bridgeport
Blair Sand and Gravel Products Co.	Blair
J. Blake Sand and Gravel Ltd.	West Hill
Braas Brothers	Niagara Falls
R. J. Brewer	Goderich
Burford Sand and Gravel	Burford
Geo. W. Burnett	Courtland
Chas. Burnside	Ottawa
Calaguiro Brothers	Niagara Falls
Campeau Construction Co. Ltd.	Ottawa
Carpenter Sand and Gravel	London
Cecchetto and Sons Ltd.	Sudbury
R. S. Clark	Ingersoll
H. V. Clark	Napanee
Connor Transport	Maple
Cookson Construction	Simcoe
Cooper Concrete Supply Co. Ltd.	Pickering
J. N. Corbett	Mt. Elgin
Daiken Sand and Gravel Ltd.	Brantford
De Sante Brothers Sand and Gravel Ltd.	Maple
Dibblee Construction Co. Ltd.	Ottawa
Dinsmore Construction Ltd.	Windsor
R. Dobbs	Arthur
Doey Gravel and Construction Ltd.	Cedar Springs
H. F. Donegan	Listowel
C. C. Doughty	Bridgenorth
Dunn's Haulage	Woodstock
Edgewater Construction Co. Ltd.	Sarnia
Howard Edwards Supply and Construction Ltd.	Brockville
J. & B. Ennis Sand and Gravel	Orillia
R. Farrish Construction	Listowel
D. R. Ferguson	Brockville
W. Finch	Bracebridge
Fort York Construction Ltd.	Lions Head
R. R. Foster	Ottawa
Frazer Duntile	Ottawa
Bob Garner Construction	Barrie
Gateway Gravel Ltd.	North Bay
Gauley Construction Co.	Ottawa
Glendale Sand and Stone Ltd.	London
Great Lakes Sand and Gravel Co.	Port Arthur
Griffin Bros.	Gananoque
Guelph Sand and Gravel Ltd.	Freelton
Hancock Sand and Gravel	Sunderland
Harnden and King Construction Ltd.	Cobourg
Hartholm Farm Ltd.	Woodstock
Hayward and Picket Ltd.	Milton
Holley Construction Ltd.	Holland Centre
Hughs Haulage	Clarkson
Huron Construction Co.	Chatham
Junipers Haulage and Excavating Ltd.	Meaford
Kemsley and Boyer	Sarnia
J. E. Kerr	Wingham
E. C. King Contracting Ltd.	Owen Sound
Kingston Sand and Gravel Ltd.	Kingston
Jack Lake Construction Ltd.	London

Lake Shore Mines Ltd. ..... Kirkland Lake
Langdon Manufacturing Co. ..... Stratford
Lavis Contracting Co. ..... Goderich
Lee Sand and Gravel Ltd. ..... Stouffville
Harold Martin Construction Ltd. ..... New Lowell
Martini Sand and Gravel Ltd. ..... Preston
Mascioli Construction Co. ..... Timmins
A. McDougall ..... Palmerston
McKenzie Brothers ..... Guelph
R. W. Myers ..... Prescott
J. R. Nash and Son ..... Northwood
Y. W. Nelson and Sons ..... Port Arthur
A. Newbigging ..... Komoka
Nichols Gravel Supply ..... Delhi
Northern Sand and Gravel Co. Ltd. ..... Sudbury
Orrell Ltd. ..... Pickering
Otto Construction Co. Ltd. ..... Tavistock
Peel Sand and Gravel ..... Brampton
Porcupine Equipment Co. ..... Porcupine
Wm. Pratt ..... Gravenhurst
S. A. Price ..... Kemptville
Geo. Radford Construction Ltd. ..... Blyth
Red D Mix Concrete Ltd. ..... London
Regal Washed Sand and Stone Ltd. ..... Peterborough
Ridley Construction Co. ..... Byron
Robertson Sand and Gravel ..... Waterford
O. Santala ..... Copper Cliff
Saugeen Spraying Co. Ltd. ..... Durham
Schneider Sand and Gravel ..... Kitchener
Seeley and Arnill Construction Co. ..... Dundalk
R. A. Shelton and Sons ..... Ingersoll
Sterling Construction Co. ..... Windsor
R. N. Stewart Construction Co. ..... Orillia
Sweets Sand and Gravel Ltd. ..... Seeleys Bay
Lorne Totten ..... Renfrew
Wm. Tonks ..... Komoka
Warren Bituminous Paving Co. ..... Waterloo
Carl West ..... Sarnia

(V) DREDGING OPERATIONS IN ONTARIO, 1960

Company	Location	Vessel	Capacity	Type of Equipment
Cadwell Marine Ltd., Niagara Falls	Lake Ontario and Niagara River	SS. C. W. Cadwell	cubic yards 750	clam shell and suction dredge.
Chatham Sand and Gravel, Chatham	Thames River	Barge Sandra	80	suction dredge.
Erie Sand and Gravel Ltd., Erie, Pennsylvania, U.S.A.	Point Pelee and Lake Erie	m/v John R. Emery m/v Niagara m/v Jos. S. Scobell	400 1,600 2,000	suction dredge. suction dredge. suction dredge.
Holden Sand and Gravel Ltd., Toronto	Hamilton and Niagara	SS. Niagara	650	suction dredge.
Interprovincial Dredging Co. Ltd., Quebec, Que.	Ottawa River at Ottawa	Claude One	100	suction dredge.
A. B. McLean and Sons Ltd., Sault Ste. Marie	Chene Island area, Lake Superior	Barge Malden Barge Chas. W. Johnson Tug Miseford	350 350	2-cubic yard clam.
National Sand and Material Co. Ltd., Toronto	Point Pelee Niagara bar Hamilton harbour	Chas. Dick	1,700	suction dredge.

Dredging Operations

In 1960, sand and gravel dredging operations were carried out in Ontario by seven companies listed in (V). Information was provided from the files of the Statistician, Ontario Department of Mines.

Sand and Gravel Prices

Prices for sand and gravel vary greatly depending on the type of material and the location of the operation. The Ontario average price in 1960 and price range for sand and gravel at the pit are given in (VI).

Prices tend to be higher in smaller cities and towns such as Brockville, Gananoque, North Bay, and Bracebridge, where there are fewer producers.

(VI) ONTARIO PRICES, SAND AND GRAVEL

Product	Average Price	Price Range
	per ton	per ton
Crushed gravel	$1.17	$0.60–$2.50
Washed or screened gravel for concrete	1.14	0.50– 1.84
Pit-run gravel	0.70	0.40– 1.23
Railway ballast	1.18	0.50– 2.20
Washed sand for concrete	1.10	0.65– 2.50
Pit-run sand	0.55	0.30– 1.00
Fill	0.48	0.25– 1.00
Mine fill	0.31	0.26– 0.36

SPECIFICATIONS AND USES

DEFINITION OF SAND AND GRAVEL

The classification of sand and gravel is based on size.

ASTM (The American Society for Testing Materials) has defined sand as granular material passing the ⅜-inch sieve and almost all passing the No. 4 (0.187-inch) sieve, and predominantly retained on the No. 200 (0.003-inch) sieve, resulting from the natural disintegration and abrasion of rock or the processing of completely friable sandstone (ASTM Designation C58-55T).

Gravel is defined as granular material predominantly retained on the No. 4 sieve and resulting from the natural disintegration or abrasion of rock or processing of weakly bound conglomerate (ASTM 125-55T). The line between commercial sand and gravel is drawn at 0.187 inch or the No. 4 sieve.

Material finer than 200-mesh is termed silt or clay, depending on the fineness.

Geologists using the Wentworth size-classification divide sand and gravel at the 2 millimetre size, or No. 10 sieve. Detrital material from 0.062 to 2 millimetres is termed sand. A comparison of these size-classifications is given in the accompanying chart, Figure 1. The Wentworth classification divides the sand into very fine, fine, medium, coarse, and very coarse designations.

Lithologically, gravel may be composed of pebbles of any rock type occurring within the area from which the detrital materials were derived. In southern Ontario, limestone and dolomite are most common, but large percentages of granitic, dioritic, and metamorphic rocks from the Precambrian Shield occur in the gravels. Sandstone originating from formations such as the Potsdam Sandstone of eastern Ontario may be locally prevalent. Shale pebbles are generally uncommon in gravel deposits because they rapidly break down on transportation. However, gravels of local derivation in areas underlain by shale may carry many shale pebbles, as in parts of the Toronto area. Chert pebbles, being hard and insoluble, are common in gravels derived from chert-bearing formations such as the Bois Blanc Limestone of southwestern Ontario.

Lithologically, sands are predominantly composed of quartz and feldspar, but carbonate grains, both limestone and dolomite, may be common. Minor accessory minerals such as hornblende, pyroxene, garnet, and mica are common in sands of glacial or glaciofluvial origin. Chert and other rock fragments are present in some sands.

Because there is a continuous size-gradation of clastic materials from sand to gravel, these materials almost always are found together. The proportions of sand and gravel vary, depending on the environment of deposition. Sand may be found without gravel (as in sand dunes) but, in most types of occurrence, sand and gravel are intimately mixed or interstratified with one another.

Specifications for sand and gravel vary greatly depending on their intended uses. Specifications may include size, shape, durability, porosity, specific gravity, abrasion, presence or absence of deleterious materials, proportion of fines, freedom from coatings and weathered surfaces, etc.

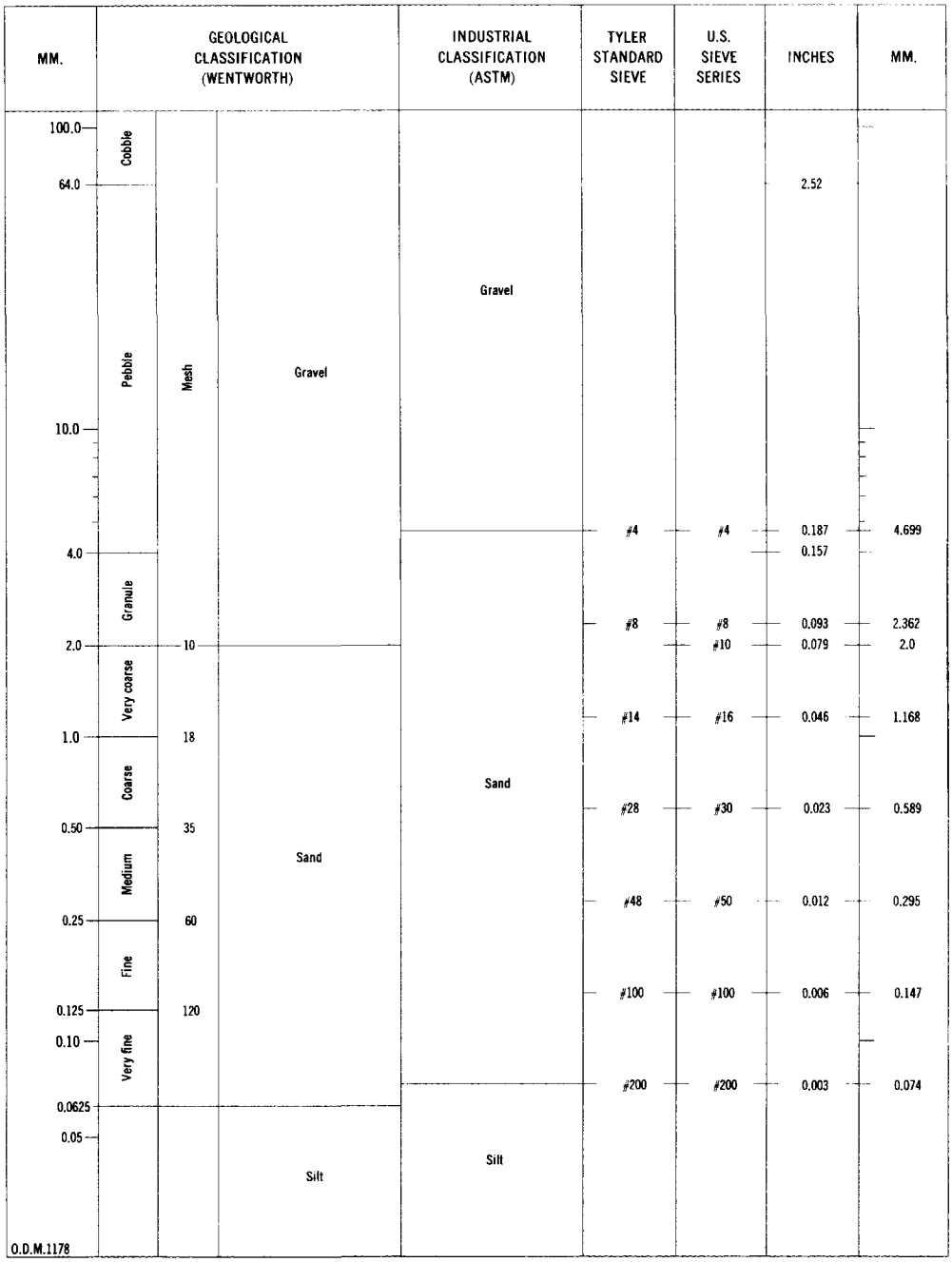


Figure 1—Geological and industrial classifications of sand and gravel, showing common sieve-sizes in inches and millimetres.

TESTS FOR SAND AND GRAVEL

The main tests made on commercial sand and gravel are the following:

Grading tests to determine size-distribution.
Petrographic examination: for presence of deleterious materials, unfavourable structures or textures, objectionable coatings or weathering, etc.
Presence of organic impurities.
Soundness tests:
Magnesium sulphate soundness.
Freezing and thawing tests.
Los Angeles abrasion tests.
Absorption and porosity tests.
Reactivity tests.
Incompatibility tests dealing with thermal coefficient of expansion.
Loss on washing — percentage of fines.
Specific gravity.
Stripping tests — surface tension of aggregate.
Mortar strength tests.

Grading

Grading tests to determine whether sand and gravel intended for commercial uses meet sizing requirements laid down in specifications are carried out by sieve analysis (see also ASTM Method C136-46). Sieve analyses are generally expressed in one of two ways: either in terms of the weight percentage of the entire sample retained on a given sieve and passing the next larger sieve; or in terms of the total weight percentage of the sample retained on, or passing, a given sieve in the sieve series used.

Grading of concrete aggregate affects the uniformity and workability of the concrete mix and has a pronounced effect on the amount of mixing water required to attain workability, and the amount of portland cement required to achieve the necessary strength. In bituminous construction, workability and density depend mostly on size grading. Strength, durability, permeability, and stability of the aggregate in the compacted mass also depend to some extent on grading.

The stability and drainage of railway ballast are affected by grading. Grading is an important factor in determining rate of percolation in sand and gravel used for backfill in mines.

Petrographic Examination

Petrographic examinations of commercial sand and gravel samples by a competent geologist or petrographer is often of primary importance in assessing the presence and effect of deleterious materials that may cause serious difficulties in the commercial application intended. In concrete aggregate, deleterious materials include clay, shale, shaly limestone or dolomite, ochre-producing minerals or iron oxides, chert and opaline silica, schists, secondary micaceous minerals, coated particles, sulphides, sulphates and water-soluble minerals, zeolites, and organic matter.

In assessing sand and gravel for use as concrete or asphalt aggregate, the Ontario Department of Highways makes a preliminary petrographic examination that assigns a Petrographic No. to the aggregate. The Petrographic No. is an empirical value representing the quality of the aggregate based on the number and type of pebbles or grains present. This allows certain numerical limits to be defined on a petrographic basis for aggregate specifications. For example, DHO[1] specifications for coarse aggregate for pavement specify a Petrographic No. of less than 125, and for aggregate used in hotlaid hotmix asphalt surface course (HL3) the Petrographic No. should not exceed 135.

This Petrographic No. is arrived at as follows: a weighed sample of the gravel is examined and the pebbles are classified petrographically into one of 40 petrographic subdivisions, each of which has a characteristic evaluation factor; these factors range between 1.0 for sound, hard limestone, granite, or trap, and 6.0 for clay, shale, or ochre; the weight of the sample in each category is expressed as a percentage of the whole and multiplied by its evaluation factor; the total gives the Petrographic No., which ranges from 100 upwards. For example, if the gravel sample consisted of 40 percent hard limestone (factor 1.0), 40 percent granite (factor 1.0), 10 percent granite gneiss (factor 1.2), 5 percent soft schist (factor 4.0) and 5 percent shale (factor 6.0), the Petrographic No. would be $(40 \times 1.0) + (40 \times 1.0) + (10 \times 1.2) + (5 \times 4.0) + (5 \times 6.0) = 142$.

Chert has a factor of 5, so that for a concrete aggregate (Petrographic No. 125 or less) the maximum allowable percentage of chert pebbles in a gravel consisting of hard limestone and chert would be about 6 percent. The Petrographic No. for 94 percent limestone and 6 percent chert is $(94 \times 1.0) + (6.0 \times 5.0) = 124$. This Petrographic No. is intended to be a guide in evaluating aggregates. Revisions are made at intervals depending on research and performance data.

Regarding chert, ASTM specifications indicate that chert, which will readily disintegrate under the $MgSO_4$ soundness test, should not exceed 1 percent of the total weight of the aggregate. Some chert, however, may prove to be quite sound.

[1]The usual abbreviation for Ontario Department of Highways.

Petrographic analysis of sand is carried out in a somewhat similar manner. A weighed sample of sand is sieved into 8-, 14-, 28-, 48-, 100-, and smaller than 100-mesh fractions. About 100 grains of each size fraction, except the smallest, are examined and divided into 33 petrographic categories, each of which has an evaluation factor. The percentage in each category is multiplied by the evaluation factor, and these are summed to give the petrographic number. The percentages in the smallest size fractions are estimated.

Presence of Organic Impurities

Sand should be low in organic impurities. The percentage of organic impurities is determined by a colorimetric test. A 12-ounce graduate is filled to the 4½-ounce mark with sand. A 3-percent sodium hydroxide solution is added until the volume of sand and liquid is 7 ounces. The bottle or graduate is shaken thoroughly and allowed to stand for 24 hours. The colour of the liquid is then compared with the colorimetric chart. The colour should not be darker than the standard colour in the current ASTM Standard Method C40-33. Any colour darker than straw-yellow indicates excessive organic impurities.

Soundness

The soundness of a stone is its ability to resist the action of weathering agents, particularly freezing and thawing, without disintegration. There are in use two common tests of soundness: the magnesium or sodium sulphate soundness tests; and, the accelerated freezing and thawing tests.

In the sodium or magnesium sulphate soundness tests (ASTM Test C88-56T), a weighed, washed, and dried sample of aggregate is totally immersed in a saturated solution of magnesium or sodium sulphate at 70°F. for 16 – 18 hours, and is then placed in a drying oven for 4 hours at 105°C. (dried to constant weight). The sample is cooled, and the cycle is repeated. After 5 cycles, the sample is sieved and weighed, and the percentage weight loss is measured. For coarse concrete aggregate, the maximum allowable weight loss is 12 percent (DHO specifications). The weight loss depends upon the expansion of the salt absorbed in the pores of the rock and the amount of disintegration of the rock under hydration.

The procedure for conducting accelerated freezing and thawing tests is given in AASHO[1] Method T103-42, but these tests are difficult to standardize. Accelerated freezing and thawing tests are frequently carried out on concrete test cylinders or concrete test beams by subjecting them to alternate freezing and thawing cycles of two-hour duration over 100 – 300 or more cycles. Deterioration is measured during the tests by sonic apparatus, which measures the velocity of ultrasonic wave impulses through the test cylinders.

[1]American Association of State Highway Officials.

Abrasion

The two standard abrasion tests for hardness, toughness, and durability of stone, are the Deval and Los Angeles abrasion tests; the Los Angeles is now more widely used.

In the Deval abrasion test, a sample of stone weighing a total of 5 kilograms, and consisting of 50 pieces broken to cubical shape, is placed in a cast-iron cylinder 20 centimetres in diameter and 34 centimetres long inclined at 30 degrees to the horizontal and rotating at 30 – 33 rpm. At the end of 10,000 revolutions, the loss in weight is determined by sieving through a U.S. Standard No. 12 sieve. The maximum allowable loss generally ranges from 8 to 24 percent, depending on specifications. (ASTM methods D289-55 and D2-33).

In the Los Angeles abrasion test (ASTM Method C131-55), the 5-kilogram sample of the graded aggregate to be tested is placed in a steel cylindrical drum, measuring 28 inches in diameter and 20 inches long, rotating at 30–33 rpm about the cylindrical axis. A radial shelf 4 inches wide extends from end to end inside the drum. A 5-kilogram charge of steel balls is placed in the drum, and it is revolved for 500 revolutions. The loss in weight is determined by sieving, as before, and is expressed as a percentage. Maximum allowable loss ranges from 15 to 35 percent, depending on specifications.

Absorption and Porosity

The water absorption properties of stone depend on porosity. Absorption tests are important in building stone, but may also be important in the case of concrete aggregate for designing concrete mixes and controlling their water content. Porosity may be determined by comparison of the bulk density with the specific gravity of the stone. Percent absorption is calculated by weighing the test sample of aggregate before and after boiling for three hours in water. Maximum allowable absorption is about 2 percent. (See also ASTM Method C127-42: Specific Gravity and Absorption of Coarse Aggregate.)

Reactivity

Failure of concrete due to abnormal expansion, cracking, and pop-outs may be due to reaction between certain reactive minerals in the aggregate and the alkalis (potash and soda) in the portland cement. The amorphous varieties of silica, chalcedonic chert, and opal or opaline chert, are

particularly reactive. A silicate gel forms by reaction of alkalis with the amorphous silica; on hydration this swells, and if it is sufficiently abundant in the concrete, failure may occur. Prevention or minimization of this type of alkali reactivity in concrete may be achieved by using a low-alkali cement. Cement containing less than 0.6 percent alkalis (percentage Na_2O, + 0.658 × percentage K_2O) is recommended.

Failure may also occur owing to the swelling of bentonite or montmorillonite type of clay minerals present in shaly limestone or dolomite.

Reactivity of aggregates may be tested either by chemical methods or mortar bar expansion tests. In the chemical tests (ASTM Method C289-57T) a crushed aggregate sample is placed in a 10 percent solution of NaOH for a certain period, and the amount of silica in the sample soluble in NaOH is determined.

In the mortar bar tests (ASTM Method C227-52T, and ASTM Method C342-55T) test bars are made up with the coarse aggregate, a standard sand, and cements of known alkali content, including both low and high alkali cements. Pozzolans may be added to attempt to reduce alkali reactivity. Periodic length measurements are made over periods up to 12 months; these tests normally require 6 months to one year to complete. Bars showing expansion of over 0.1 percent are definitely reactive.

Incompatibility

Measurement and comparison of the thermal coefficient of expansion of the coarse and fine aggregate and the hydrated cement paste in concrete may be important. If there are wide differences between the respective thermal coefficients of expansion of the aggregate and the cement paste, serious stresses may be set up in climates where the existing severe temperature differences lead to expansion and contraction of various ingredients of the concrete at different rates. Either the optical interferometer or the SR-4 strain gauge is used to measure incompatibility (Rexford 1950, pp. 395–402).

Minerals expand different amounts along different crystallographic axes. Among the minerals with large differential expansion are calcite and feldspar.

Loss on Washing

The maximum percentage of fines allowable (percentage passing a 200-mesh sieve) may be specified in a graded aggregate used for concrete, asphalt construction, or other uses. Washing may be necessary to reduce the percentage fines in the graded aggregate below the tolerance figures.

The percentage of clay or silt in a sand can be determined by sedimentation tests.

Specific Gravity

Measurements of specific gravity are made frequently, and especially when calculating loads on stressed members in concrete structures.

Stripping

The surface texture and porosity of an aggregate are important in bituminous construction because they affect the adhesion of the bituminous coating and the amount of asphalt required. The term "stripping" refers to the removing or peeling of the bituminous coating from the aggregate particles, generally in the presence of water. Cryptocrystalline Black River Limestone, for example, frequently performs poorly in stripping tests. It may frequently be difficult to get bituminous patches to adhere to wet pavement.

Several stripping tests are used. In one, the aggregate and bituminous material are mixed, cured for 24 hours, covered with distilled water to soak, then given a vigorous shaking. The amount of stripping is judged visually. Immersion-compression tests involve unconfined compression tests on asphalt aggregate mixtures tested in the unsoaked and soaked states. A numerical assessment of stripping is difficult, but the tests give indication of relative resistance to film stripping by various aggregates.

Mortar Strength

Mortar tensile strength tests are carried out on briquets composed of one part portland cement and three parts fine aggregate according to the AASHO Method T-35. These briquets should have a tensile strength comparable to that developed in the same time by mortar of the same proportions and consistency made of portland cement and Ottawa sand.

SPECIFICATIONS FOR SAND AND GRAVEL

The main uses of sand and gravel for which there are definite specifications are the following:

Road construction.
Concrete aggregate.
Aggregate for concrete blocks.
Railway ballast.
Brick sand.
Backfill for mines.

Road Construction

Sand and gravel are used mainly in three types of road construction: traffic-bound roads, in which

the road surface is compacted by traffic; bituminous macadam roads, in which sand and gravel form the aggregate in hotmix hotlaid asphalt construction; concrete roads, where sand and gravel are used as concrete aggregate.[1]

TRAFFIC-BOUND ROADS
Granular Base Course

Information about specifications for granular base course is taken from Ontario Department of Highways Form 314, dated 1957.

Selected granular base course material is used to provide a suitable foundation for concrete pavement, bituminous macadam, or gravel road surfaces. The Ontario Department of Highways petrographic number for granular base course material shall not exceed 200, except where chert is present in which case a petrographic number up to 250 may be approved at the engineer's discretion.

Class A granular base course consists of ¾-inch crusher-run material having a minimum of 30 percent crushed material in the gravel fraction (i.e. retained on the No. 4 sieve).

Class B granular base course is pit-run gravel not exceeding 4 inches in size.

(VII) GRADING REQUIREMENTS FOR GRANULAR BASE COURSE

Sieve Size	Percent by Weight Passing Tyler Sieves	
	Class A (crushed)	Class B (pit run)
4-inch	———	100
⅞-inch	100	57–100
⅝-inch	75–100	———
No. 4	35–60	25–100
No. 14	15–35	10–85
No. 48	5–20	5–40
No. 200	3–8	3–8

It will be seen from the grading requirements that Class B granular base course may consist predominantly of sand if coarser material is not available.

⅝-inch Crushed Gravel Surface Course

Information on specifications for this type of aggregate is taken from Ontario Department of Highways Form 301, dated 1956.

Type A ⅝-inch crushed gravel is used for mixed-in-place mulch aggregate, or for fine grading prior to paving. Type B ⅝-inch crushed gravel is used for shouldering or maintenance gravel.

[1]Specifications are subject to change. Readers should consult Ontario Department of Highways for latest revised specifications on aggregates for road construction.

The coarse aggregates are required to meet the physical and grading specifications as set out in tables (VIII) and (IX).

(VIII) PHYSICAL REQUIREMENTS FOR COARSE AGGREGATE

⅝-INCH CRUSHED GRAVEL

	Type A	Type B
Absorption.....percent max.	2.0	2.5
Petrographic No..... max.	175	185
Loss on washing...percent max.	1.5	2
Crushed material..percent min.	40	30

(IX) GRADING REQUIREMENTS FOR COARSE AGGREGATE

⅝-INCH CRUSHED GRAVEL

Sieve	Percent Passing Tyler Sieves (by weight)
⅝-inch	100
½-inch	65–90
⅜-inch	30–60
¼-inch	10–30
No. 4	0

The fine aggregate shall consist of durable particles free from cementation and shall not contain shale or chert in excess of 10 percent for Type A or 20 percent for Type B. The fine aggregate shall be uniformly graded from coarse to fine and shall meet the grading requirements set out in (X).

(X) GRADING REQUIREMENTS FOR FINE AGGREGATE

⅝-INCH CRUSHED GRAVEL

Sieve No.	Percent Passing Tyler Sieves (by weight)	
	Type A	Type B
4	100	100
8	70–95	60–95
14	40–80	30–80
28	20–60	12–60
48	10–35	4–40
100	3–15	2–20
200	0–10	0–15

The coarse and fine aggregate shall be combined in such proportions that will give the final dry mix the grading as set out in table (XI), which is taken from Ontario Department of Highways Form 301, dated 1956.

(XI) GRADING REQUIREMENTS FOR FINAL DRY MIX

⅝-INCH CRUSHED GRAVEL SURFACE COURSE

Sieve No.	Percent Passing Tyler Sieves, (by weight)	
	Type A	Type B
⅝-inch	100	100
½-inch	75–95	74–95
⅜-inch	51–80	48–78
No. 4	30–50	25–45
No. 8	21–48	15–43
No. 14	12–40	8–36
No. 28	6–30	3–27
No. 48	3–18	1–18
No. 100	1–8	0.5–9
No. 200	0–5	0–7

BITUMINOUS MACADAM ROADS

Mix-in-Place Mulch Surface

The mix-in-place mulch surface used as a bituminous surface course on many country roads uses ⅝-inch crushed stone or gravel surface course material as described in (XI).

Hotmix Hotlaid Asphalt Construction

The Ontario Department of Highways Form 310 divides hotlaid asphalt surface and base courses into six types as follows:

HL 1—Trap Rock Asphaltic Concrete Surface Course.
HL 2—Sheet Asphalt Surface Course.
HL 3—Asphaltic Concrete Surface Course.
HL 4—Asphaltic Concrete Surface or Binder Course.
HL 6—Asphaltic Concrete Binder Course.
HL 8—Asphaltic Concrete Binder Course.

Coarse aggregates used in asphalt construction shall consist of crushed stone or gravel having hard strong uncoated particles conforming to the grading requirements in (XII) and the physical requirements in (XIII), both of which are taken from Ontario Department of Highways Form 310, dated 1961.

(XII) GRADING REQUIREMENTS FOR COARSE AGGREGATE

Size or Sieve No.	Percent by Weight Passing Sieve According to Type			
	HL1	HL3	HL4	HL 6 and 8
1-inch	——	——	——	——
⅞-inch	——	——	——	100
¾-inch	——	——	——	65–88
⅝-inch	——	——	100	50–75
½-inch	100	100	70–85	35–60
⅜-inch	50–70	50–70	30–47	15–35
No. 4	0	0	0	0

(XIII) PHYSICAL SPECIFICATIONS FOR COARSE AGGREGATE

	HL1	HL3	HL4	HL6	HL8
$MgSO_4$ soundness (5 cycles) percent loss max.	5	12	12	12	12
Absorption (by weight). percent max.	1.0	1.75	2.0	1.75	1.75
Petrographic No.....max.	100	135	160	140	160
Loss on washing.....percent max.	1	1.3	1.3	1.3	1.3
Thin and elongate particles percent max.	15	15	15	15	15
Los Angeles abrasion percent loss max.	15	35	35	35	35
Crushed material.....percent min.	100	60	60	60	60

It will be noted that specifications require 60 percent crushed material in the coarse aggregates for HL3, HL4, HL6, and HL8 asphalt pavement. This is because the bond with the asphalt is better on rough irregularly broken surfaces than on the rounded smooth surfaces of particles.

Fine aggregates used in asphalt construction consist of sand or screenings composed of clean, hard, durable particles conforming to the grading requirements in (XIV), which are taken from Ontario Department of Highways Form 310, dated 1961.

(XIV) GRADING REQUIREMENTS FOR FINE AGGREGATE

Sieve No.	Percent by Weight Passing Tyler Sieves		
	HL1 and HL3	HL2	HL4, HL6 and HL8
4	100	100	100
8	80–100	90–100	70–100
14	55–90	75–93	40–90
28	35–70	55–80	20–70
48	15–40	25–60	10–40
100	5–15	5–25	3–15
200	0–5	0–5	0–7
When screenings are used the following percentages apply			
100	5–20	5–25	3–20
200	0–11	0–11	0–14

Some tolerance of material retained on the No. 4 sieve is allowed.

For HL1, HL2, and HL3, the magnesium sulphate soundness loss should not exceed 16 percent; for HL4, HL6, and HL8 the loss should not exceed 20 percent. Not more than 20 percent of the material passing No. 200 sieve should be finer than 0.002 mm. in size.

The coarse and fine aggregates for asphalt construction shall be combined in such proportions to produce a mixture having the grading in (XV), which is taken from Ontario Department of Highways Form 310, dated 1961.

Concrete Aggregate

The maximum size of aggregate used in concrete ranges between 6 inches in massive dam construction, and ⅜ inch in concrete blocks. In concrete highway construction, two sizes of coarse aggregate are used: 1½ inch by ½ inch, and ½ inch by No. 4 mesh. In concrete structures, the maximum size generally ranges between 2½ and ¾ inch. The nominal maximum size generally used for reinforced concrete is ¾ inch.

In the Toronto area, as in many other areas, both gravel and crushed stone are available as coarse aggregate for concrete. The choice may depend on such factors as the following (Lenhardt 1960, p. 737):

> On account of the subspherical shape of its particles, gravel may make a denser concrete than does broken stone. The pieces are slippery, and the freshly poured concrete is more fluid, and does not need as much tamping or puddling as that made from broken stone in order to compact the mix. This is true especially in walls and other forms in which one horizontal dimension is small. Broken stone tends to "hangup" in such forms and leave voids. This advantage of gravel is lost in pavements, and in large forms, and is overcome in other structures by adequate mechanical tamping. One of the main advantages in using broken stone is the uniformity of its composition.

CONCRETE PAVEMENT

Specifications for coarse aggregate used in concrete pavement are given in Ontario Department of Highways Form 1000, dated 1963. Coarse aggregates are separated into two sizes: No. 20 (1½ by ½ inch) and No. 21 (½ inch by No. 4 mesh). These sizes are blended to meet the final mix requirements given in (XVI).

Physical specifications for coarse aggregate in concrete pavement are given in (XVII).

(XVII) PHYSICAL REQUIREMENTS, COARSE AGGREGATE FOR CONCRETE PAVEMENT

$MgSO_4$ soundness (5 cycles)..... percent loss max.	12
Absorption (by weight)..... percent max.	2.0
Petrographic No..... max.	125
Material passing No. 200 sieve. percent max.	1.0
Clay lumps..... percent max.	0.25
Thin or elongate particles..... percent max.	20
Los Angeles abrasion..... percent loss max.	35

Specifications for fine aggregate to be used in concrete pavement are taken from Ontario Department of Highways Form 503, dated 1955, as follows:

> The sand should be sufficiently free of organic impurities to pass the ASTM colorimetric test (Method C40-33). In the magnesium sulphate soundness test, the weight percent loss should not exceed 16 percent. The mortar tensile strength of a briquet made of one part Portland cement and three parts fine aggregate according to AASHO Method T-35 shall be equal to that developed in the same time by mortar of the

(XV) MIXTURE OF COARSE AND FINE AGGREGATES

Sieve No. or Size	Percent Passing Tyler Sieves, by Weight				
	HL1	HL2	HL3	HL4	HL6 and 8
1-inch	——	——	——	——	——
⅞-inch	——	——	——	——	100
¾-inch	——	——	——	——	75–94
⅝-inch	——	——	——	100	65–88
½-inch	100	——	100	82–95	54–80
⅜-inch	72–88	——	72–88	58–82	40–68
No. 4	45–60	100	45–60	40–67	30–50
No. 8	36–60	90–100	36–60	28–67	21–50
No. 14	25–55	75–93	25–55	16–60	12–45
No. 28	16–43	55–80	16–43	8–47	6–35
No. 48	7–24	25–60	7–24	4–27	3–20
No. 100	2–9	5–25	2–9	1–10	1–8
No. 200	0–4	0–7	0–4	0–7	0–6

(XVI) GRADING REQUIREMENTS, COARSE AGGREGATES FOR CONCRETE PAVEMENT

Ont. Dept. Highways Aggregate Size No.	Total Percentage, by Weight, Passing Tyler Sieves						
	Sieve Sizes or No.						
	1½-inch	1-inch	¾-inch	½-inch	⅜-inch	¼-inch	No. 4
20	100	48–68	20–35	0–10	——	——	——
21	——	——	——	90–100	30–60	0–30	0–10
Final mix	100	58–82	36–64	18–50	6–27	0–14	0–4.5

same proportions and consistency made of the same cement and Ottawa sand. When subjected to the structural strength test, mortar specimens containing the fine aggregate shall develop a compressive strength at the age of 7 days using Portland cement, of not less than 90 percent of the strength developed by a mortar prepared in the same manner with the same cement and graded Ottawa sand having a fineness modulus of 2.40, plus or minus 0.10.

The grading specifications for fine aggregate for concrete pavement are given in (XVIII).

(XVIII) GRADING REQUIREMENTS, FINE AGGREGATE FOR CONCRETE PAVEMENT

Sieve No. or Size	Percent by Weight Passing Tyler Sieves
⅜-inch	100
No. 4	90–100
No. 8	70–95
No. 14	50–75
No. 28	25–55
No. 48	10–30
No. 100	0–10
Loss in washing not to exceed 3 percent.	

CONCRETE STRUCTURES

For concrete structures, typical specifications for coarse aggregates are those taken from the Ontario Department of Highways Form 9, dated 1957, which are briefly summarized in (XIX) and (XX).

(XIX) PHYSICAL REQUIREMENTS, COARSE AGGREGATES FOR CONCRETE STRUCTURES

$MgSO_4$ soundness (5 cycles)..percent loss max.	12
Los Angeles abrasion.....percent loss max.	30
Loss in washing.....percent max.	1.0
Absorption.....percent max.	2.0
Thin and elongate pieces.....percent max.	20
Clay lumps.....percent max.	0.25
Petrographic No.	
bridges.....max.	140
culverts.....max.	155

Typical specifications for fine aggregate for concrete structures are similar to those taken from the Ontario Department of Highways Form 9, dated 1957, which are briefly summarized in (XXI).

(XXI) GRADING REQUIREMENTS, FINE AGGREGATE FOR CONCRETE STRUCTURES

Sieve No.	Percent, by Weight, Passing Tyler Sieves
4	100
8	80–100
14	50–85
28	25–60
48	5–30
100	0–10
Loss in washing not to exceed 3 percent.	

Not more than 45 percent shall be retained by any two consecutive sieves. The fineness modulus shall be not less than 2.3 and not more than 3.1. The physical requirements for fine aggregate for concrete structures are similar to those for concrete pavement outlined above.

Aggregate for Concrete Blocks

The aggregate for concrete blocks is minus-⅜-inch material. A typical sieve analysis is given in (XXII).

(XXII) TYPICAL GRADING, AGGREGATE FOR CONCRETE BLOCKS

Sieve No. or Size	Percent Retained on Each Sieve, by Weight
⅜-inch	0
No. 4	25
No. 8	15
No. 16	15
No. 30	15
No. 50	15
No. 100	10
Pan	5

(XX) GRADING REQUIREMENTS, COARSE AGGREGATES, CONCRETE STRUCTURES

Nominal Maximum Size of Aggregate	Total Percent by Weight Passing Tyler Sieves								
	Sieve Sizes (square openings, in inches)								
	2½	2	1½	1	¾	½	⅜	No. 4	No. 8
2-inch stone	100	95–100	———	35–70	———	10–30	———	0–5	———
1½-inch stone	———	100	95–100	———	35–70	———	10–30	0–5	———
1-inch stone	———	———	100	95–100	———	25–60	———	0–10	0–5
¾-inch stone	———	———	———	100	90–100	———	20–55	0–10	0–5
½-inch	———	———	———	———	100	90–100	40–70	0–15	0–5

Railway Ballast

The following information is taken from a report (Goldbeck 1948) on the ASTM Symposium on Mineral Aggregates.

The function of gravel railway ballast is to support the ties, distribute the wheel loads, and provide good roadbed drainage. It is non-rigid and allows some vertical movement under loading. Because railway ballast is continuously exposed to weathering, soundness is important. Ballast is subjected to strong and severe impact-loading, and a tough, durable, hard ballast is desirable.

The American Railway Engineering Association recommends the physical specifications given in (XXIII).

(XXIII) PHYSICAL SPECIFICATIONS FOR RAILWAY BALLAST

	percent
Los Angeles abrasion.....maximum loss	40
Na_2SO_4 soundness (5 cycles).....maximum loss	10
Soft and friable pieces.....maximum	5
Material finer than No. 200 sieve.....maximum	1.0
Clay lumps.....maximum	0.5

The grading specifications for railway ballast vary; the nominal sizes in use are given in (XXIV).

(XXIV) NOMINAL SIZES USED IN RAILWAY BALLAST

Grading Specification	Size of Stone
ASTM No. 24	2½ to ¾ inch
ASTM No. 3	2 to 1 inch
ASTM No. 4	1½ to ¾ inch
ASTM No. 5	1 to ⅜ inch
ASTM No. 57	1 inch to No. 4 sieve

Brick Sand

The "brick sand" commonly produced by commercial sand and gravel operators in Ontario is primarily used as aggregate in masonry mortar. ASTM specifications (ASTM C144-52T) for aggregate in masonry mortar are given in (XXV); not more than 50 percent should be retained on any two consecutive sieves, and not more than 25 percent between the No. 50 and No. 100 sieves.

(XXV) MASONRY MORTAR AGGREGATE (ASTM)

Sieve No.	Percent (by weight) Passing Sieves
4	100
8	95–100
16	60–100
30	35–70
50	15–35
100	2–15

Sieve analysis of brick sand produced in southern Ontario indicates that, in practice, the sand in use is actually much finer than called for in the specifications in (XXV).

Sieve analyses of samples of brick sand from 12 commercial producers in southern Ontario are given in (XXVI).

Backfill for Mines

Large tonnages of sand are used for backfill in mines, particularly in the Sudbury and Timmins areas. The most important property in sand used as backfill is the water percolation rate. The sand fill should be porous and permeable enough to allow ready percolation of water through the fill. At Hollinger Gold Mines a percolation rate of 6 inches per hour or better is specified (Quinn 1944).

(XXVI) SIEVE ANALYSES OF BRICK SAND FROM ONTARIO PRODUCERS

Sample No.	Weight-percent Retained on Tyler Standard Sieves						
	No. 8	No. 14	No. 28	No. 48	No. 100	No. 200	Fineness Modulus
1	0.4	2.8	18.8	68.5	93.9	97.9	1.84
2	0.1	1.1	6.2	34.4	81.5	95.2	1.21
3	0.1	4.8	21.5	51.5	88.2	96.7	1.66
4	3.9	8.8	13.7	46.2	92.6	97.5	1.65
5	0.8	4.7	13.2	34.4	81.6	95.4	1.35
6	———	0.4	12.5	68.4	95.4	99.4	1.77
7	0.2	1.0	8.2	53.7	89.1	96.6	1.52
8	0.1	1.3	7.1	34.0	82.2	97.4	1.25
9	2.9	7.7	16.3	36.1	81.9	95.7	1.45
10	1.4	5.3	14.4	57.8	93.9	98.8	1.73
11	0.8	2.2	6.2	27.8	80.0	94.6	1.17
12	1.4	4.6	13.8	46.4	89.3	97.6	1.56
Average	1.1	3.7	12.6	46.6	87.4	96.9	———
ASTM Specifications	0–5	0–40	30–65	65–85	85–98	———	———

At the mines of the International Nickel Company of Canada Limited, at Sudbury, a percolation rate of at least 5 inches per hour is specified for hydraulic fill (McCreedy and Taylor 1960). Tests made by Inco engineers indicate that a good sand for use as hydraulic minefill should contain not more than 10 percent plus-65-mesh, 20 to 25 percent minus-200-mesh material, and not more than 3.5 percent minus-800-mesh.

Special Industrial Sands

For many specialized industrial uses, silica sand composed mainly of quartz grains is required. Most of the sand deposits in Ontario are of glacial origin and have resulted from the rapid mechanical breakdown of rocks of the provenance area. The sands are, therefore, composed of substantial proportions of feldspar and carbonate as well as quartz. The dune sands of Prince Edward county are typical of the southern Ontario sand deposits and have the following mineralogic composition (Woodward 1949):

	Percent
Orthoclase and microcline	25
Plagioclase	4
Quartz	50
Calcite	18
Minor accessory minerals: magnetite, garnet, hornblende, tourmaline, epidote, biotite, etc.	3

Owing to their mineralogic composition, most of the sand deposits of southern Ontario are not well suited to specialized industrial uses where a silica sand is usually required.

Requirements for various types of industrial sands are outlined by T. D. Murphy (1960) in a chapter of the AIME volume on Industrial Minerals and Rocks. Information contained in most of the following subsections is largely derived from this source.

ABRASIVE SANDS

Sand-Blast Sand

"Blasting sand is a sound closely-sized quartz sand which, when propelled at high velocity by air, water or controlled centrifugal force, is effective for such uses as cleaning metal castings, removing paint and rust, or renovating stone veneer" (Murphy 1960, p. 763). Specifications are based mainly on composition and size distribution.

Glass-Grinding Sand

"Glass-grinding sand is a clean, sound, fine to medium-grained silica sand, free from foreign material and properly sized for either rough grinding or semifinal grinding of plate glass" (Murphy 1960, p. 764).

Stone-Sawing and Rubbing Sand

"Stone-sawing and rubbing sand is a relatively pure, sound, well-sorted, coarse grained siliceous material free from flats and fines, used for sawing and rough-grinding dimension stone" (Murphy 1960, p. 764). Specifications of size and quality show some flexibility depending on availability of various types of sand.

GLASS SAND

"For the manufacture of glass, silica sand of high purity is specified. For most requirements the iron oxide content is less than 0.06 percent and the alumina content less than 0.5 percent" (Murphy 1960, p. 763). A glass sand should all pass 20-mesh and not more than 3 percent should pass 80-mesh.

SAND FOR SILICON CARBIDE

Specifications for silica sand used in the manufacture of silicon carbide are given by Keith (1946). "The silica content is generally specified as 99.25 percent minimum. Lime, magnesia, and phosphorus are objectionable. Small amounts of iron and alumina are tolerated but should be constant from one shipment to another. Canadian manufacturers are using a sand with AFA fineness No. 35."

FOUNDRY SANDS

For foundry sand, a highly refractory tough silica sand having rounded grains with rough surfaces is preferred. Depending on the size and type of casting, various size-grades of sand are used, graded according to the American Foundrymen's Association specifications. The silica sands are bonded with clay; rough grain surfaces improve the bonding power. Rounded grains are preferred to angular grains because the roundness increases the permeability of the sand, which allows the escape of gases during casting.

Core Sand

"Core sand is washed and graded silica sand low in clay substance and of high permeability, suitable for core-making in ferrous and non-ferrous foundry practice" (Murphy 1960, pp. 767, 768).

Naturally Bonded Molding Sand

"Naturally bonded molding sand is crude silica sand containing sufficient indigenous clay to make it suitable for molding ferrous or non-ferrous castings" (Murphy 1960, pp. 767, 768).

Processed Molding Sand

"Processed molding sand is washed and graded quartz sand which, when combined with appropriate bonding agents in the foundry, is suitable for use for cores and molds in ferrous and non-ferrous foundry practice" (Murphy 1960, pp. 767, 768).

Furnace Bottom Sand

"Furnace bottom sand is unwashed and partially aggregated silica sand suitable for lining and patching open hearth and electric steel furnaces which utilize an acid process" (Murphy 1960, pp. 767, 770, 771).

FILTER MEDIA

"Washed and graded sand and gravel are used for filtration of municipal and industrial water supply systems. Specifications regarding sizing, soundness, shape and composition are strict" (Murphy 1960).

SANDFRAC SAND

"Clean rounded silica sand between 16- and 60-mesh is used for hydraulic fracturing in oil and gas fields. The sand is forced into bedding planes and joints during hydraulic jacking. When the pressure is released the sand keeps the cracks open and allows increased flow capacity in the formation" (Murphy 1960).

TYPES OF SAND AND GRAVEL DEPOSITS

The three main types of sand and gravel deposits found in Ontario are: stream and river deposits; beach deposits; glacial deposits.

STREAM AND RIVER DEPOSITS

Sand and gravel is laid down by streams and rivers as channel deposits, bars, terraces, alluvial fans, and deltas. Stream and river deposits are, generally, relatively free from silt and clay. These deposits are frequently well-sorted. Very little sand and gravel is produced from present-day stream and river valleys in Ontario, but some of the largest gravel operations are in gravel deposits laid down in glacial spillways.

Sand and gravel is dredged from the Thames River near Chatham, the Ottawa River near Ottawa, and the Niagara River near Niagara-on-the-Lake.

BEACH DEPOSITS

Deposits of sand and gravel exist as beaches, bars, and spits, along the shores of lakes and seas. The principal beach deposits being worked in Ontario are associated with glacial lakes Iroquois and Algonquin and the Champlain Sea of glacial times; these are dealt with under Glacial Deposits.

Few modern beach deposits are being worked at present for sand and gravel. The Niagara bar, off the mouth of the Niagara River, is dredged for sand. Lake Erie beach gravels are dredged near Merlin.

GLACIAL DEPOSITS

Most of the sand and gravel deposits in southern Ontario are associated in origin with the Pleistocene ice-sheet that covered southern Ontario in glacial times. A knowledge of the glacial history of southern Ontario during the retreat of the ice-sheet is, therefore, essential to the study of sand and gravel deposits.

Glacial History of Southern Ontario

Field work in United States and Canada has revealed evidence of four major cold intervals (glacial stages) during which great ice-sheets spread over the region of the Great Lakes from the north and northeast. Following each cold interval there has been a warm interval (interglacial stage) as warm as or warmer than our present climate. Most authorities believe we are now in an interglacial stage and that, thousands of years from now, ice-sheets will once again cover southern Ontario. During the interglacial stages, the ice-sheets were very much diminished in area, although it has not been established whether or not they completely disappeared.

In Canada, where field studies are, generally, less advanced than in United States, only some of the glacial and interglacial stages have been recognized. The subdivisions of the Pleistocene Epoch or "ice age" are shown in (XXVII);

(XXVII) SUBDIVISIONS OF THE PLEISTOCENE EPOCH

Interglacial Stages	Glacial Stages
Recent (1)	Wisconsinan (1)
Sangamonian (1)	Illinoian (1)
Yarmouthian	Kansan
Aftonian	Nebraskan

(1) Deposits present in southern Ontario.

Only the deposits of the last ice-sheet are known in any detail, because older deposits have been largely removed by later erosion; the remaining portions of the older deposits are buried under, and concealed by, later deposits. Study of deep expo-

sures along rivers and lake bluffs has revealed the presence of these older deposits, and it is assumed that each glaciation laid down a variety of materials similar to those of the last glaciation.

Presented here is a summary of the events that took place when the various deposits were laid down. Most of the discussion deals with the retreat of the last ice-sheet because more information is available and because most of the known gravel deposits were formed at that time.

ILLINOIAN STAGE

The only deposits in Ontario believed to be of Illinoian age are to be found in Toronto. Glacial till, heavily-charged with shale from the underlying bedrock, has been found under warm-climate interglacial beds in the Don Valley brickyard (Coleman 1933) and in excavations for subways in downtown Toronto (Watt 1954). In the latter exposures, the till is associated with glaciolacustrine varved clays. An exposure of similar till has been found recently along the Rouge River in Scarborough township (Karrow1962). The till is usually rather thin (2–6 feet thick). The ice that deposited the till apparently moved westward out of the Lake Ontario Basin (Terasmae 1960).

SANGAMONIAN STAGE

Stratified clay, sand, and gravel (named the Don Beds) containing fossil plants and animals associated with a climate warmer than the present have been encountered at the Don Valley brickyard (Coleman 1933), in subway excavations (Watt 1954) and deep foundation excavations in downtown Toronto. They are not known to occur anywhere else in Ontario. They have a maximum thickness of about 30 feet. The sediments are considered to be stream or delta deposits formed when lake-level was about 60 feet higher than now.

Following the deposition of the Don Beds, the climate became cooler, and the lake-level rose considerably. About 150 feet of fossiliferous clay and sand (named the Scarborough Beds) were deposited at this time. Some controversy exists about the age of these beds. A radiocarbon date on the upper part of the beds gave an age greater than 52,000 years (H. de Vries, personal communication); they may be late Sangamonian or early Wisconsinan in age. Terasmae (1960) has discussed this problem. Deposits that are, perhaps, comparable in age have also been found in northern Ontario (Terasmae 1958; Terasmae and Hughes 1960b).

WISCONSINAN STAGE

Recent work has indicated that the Wisconsinan glaciation consists of two major ice-advances separated by a cool (but not cold) interval (Dreimanis 1958). Glacial deposits, including till, clay, and sand, assigned to the early Wisconsinan have been found in the Toronto area and along the north shore of Lake Erie (Dreimanis 1960). Ice-movement was from east to west along the Lake Ontario and Lake Erie basins.

During the cool interval that followed the retreat of the early Wisconsinan glacier, fossiliferous sands were deposited. Radiocarbon dating on plant-remains indicates an age for these deposits of 27,000 to 47,000 years before the present; during that time, the ice-front fluctuated, although it had withdrawn an unknown but considerable distance from its earlier maximum extent.

By 27,000 years ago, a major ice-advance was underway and by 20,000 years ago the ice had spread to its maximum extent, reaching as far south as southern Ohio (Goldthwait 1959). Pulsating retreat of the ice is recorded in the complex succession of end moraines and glacial lakes in the various basins of the Great Lakes.

The history of the retreat of the last ice-sheet has been covered in varying degrees of detail by several writers (Leverett and Taylor 1915; Chapman and Putnam 1951; Prest 1957; Flint 1957; Hough 1958). This history is intimately related to the complex succession of glacial lakes that were damned up, then drained, by the fluctuating ice-front. Only the main features will be touched upon here, particularly as they affected the deposition of sand and gravel.

As far as is known, all of southern Ontario was covered by glacial ice until about 14,000 years ago. The first land to appear through the retreating ice was the highland, northwest of Orangeville, that now stands higher than 1,700 feet above sea-level. We know, however, that it was not as high then, because the great weight of the ice-sheet depressed the earth's surface, the amount of depression varying with the thickness of the ice. During and following the melting of the ice, the land gradually rose again and is still rising in some areas. Because the ice was thicker to the north, the land surface is being gradually tilted southward. The shorelines of glacial lakes are now tilted as well.

Around the first land to appear through the ice, large meltwater streams deposited their heavy load of sand and gravel to form kame-like accumulations such as are to be found in the Orangeville and Waterloo moraines. The area of exposed land increased as the ice melted back, and meltwater, dammed up by the ice, formed lakes to the southwest. Eventually the ice had melted back to the position shown in Figure 2 along the Paris and Wyoming moraines. This is correlated with the Port Huron position in Michigan having an age of 12,800 years and the large lake that existed at that

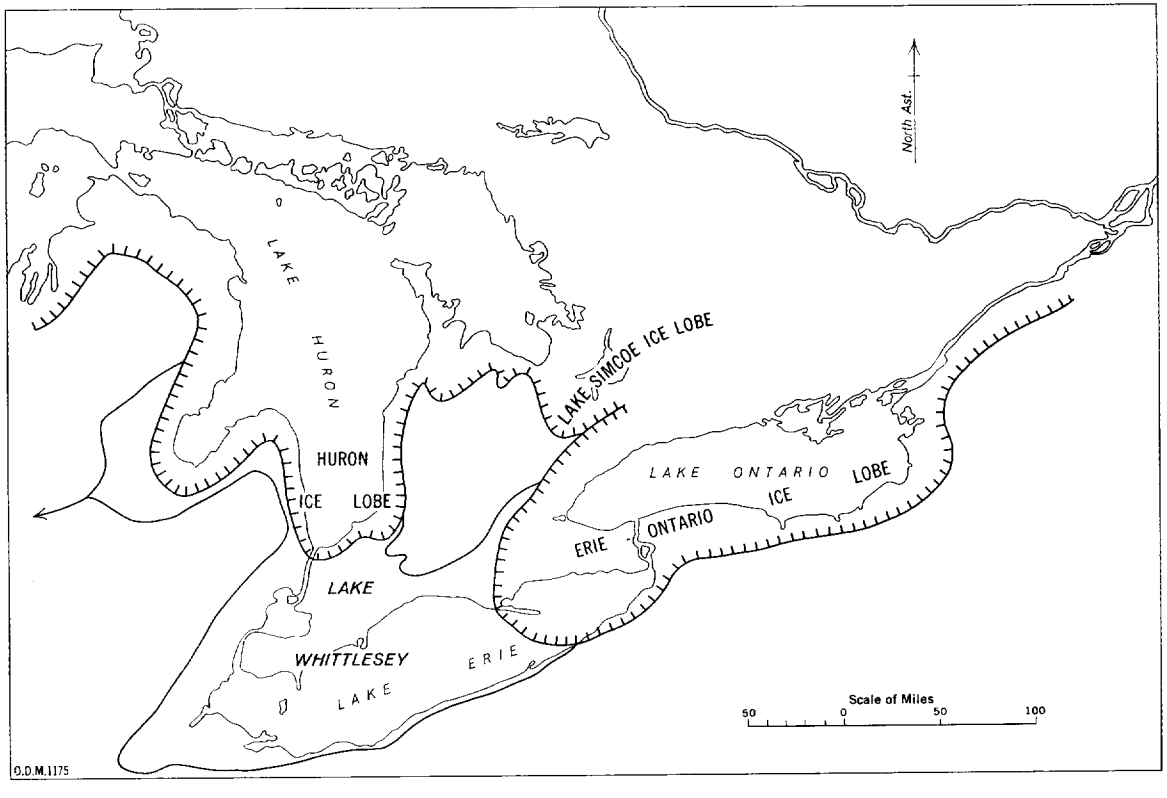


Figure 2—Ice-front position at Paris and Wyoming moraines, with Lake Whittlesey.

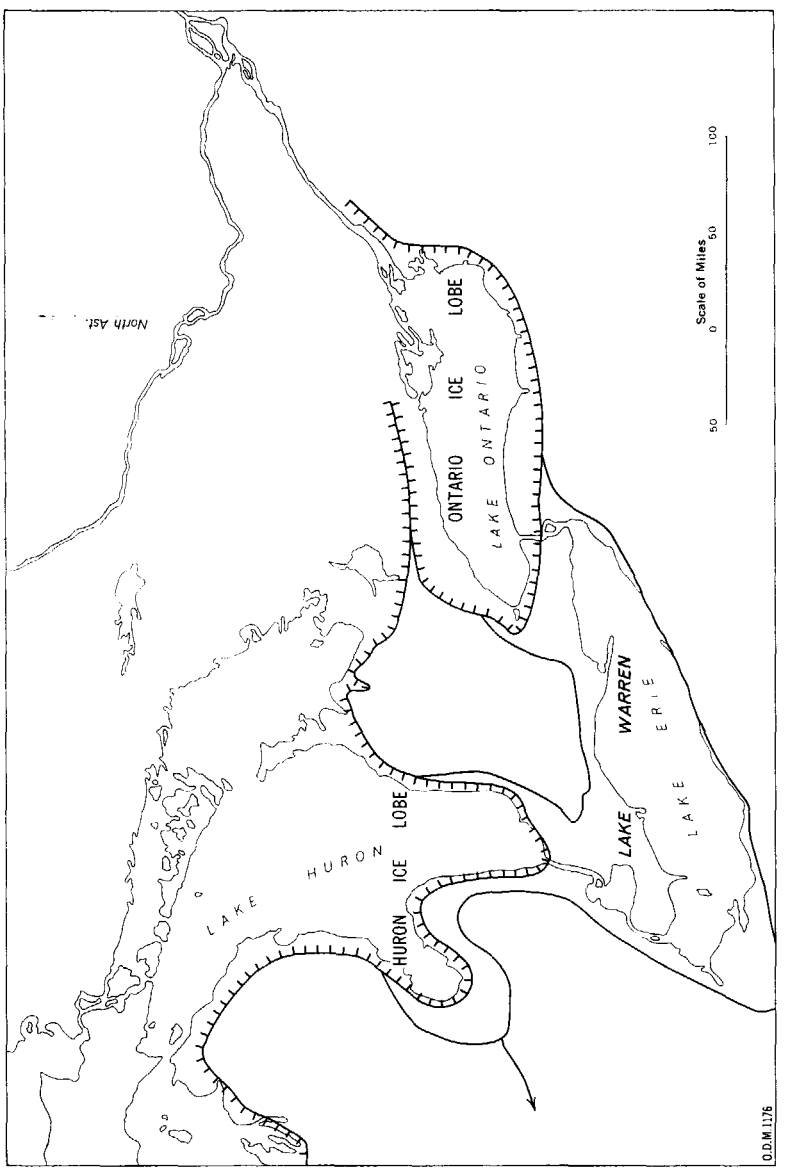


Figure 3—Ice-front position at Niagara Escarpment, with Lake Warren.

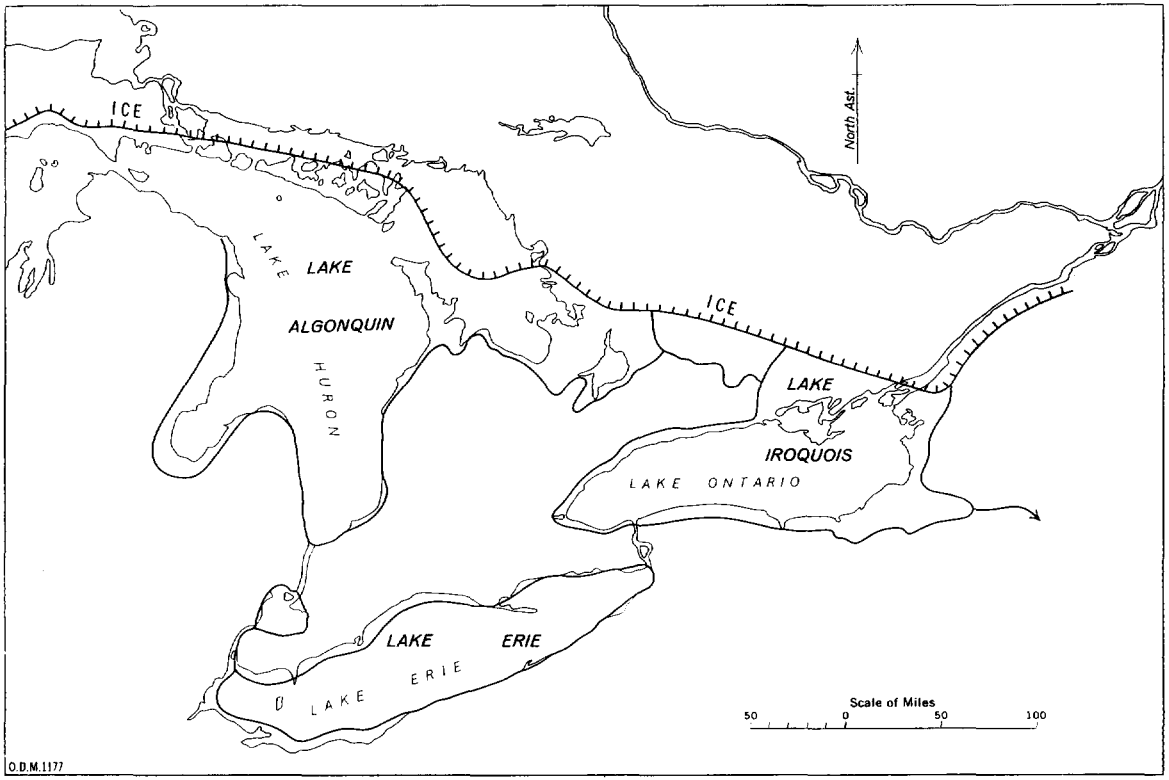


Figure 4—Ice-front position in eastern Ontario, with Lake Algonquin and Lake Iroquois.

Crest of a small esker near Freelton, Wentworth county.

Sunderland esker on highway No. 7.

time (Lake Whittlesey) drained southwest to the Mississippi River. Lake Whittlesey left a prominent shoreline in southwestern Ontario and some of the old beach deposits have been sources of gravel. A large delta, consisting of sand and gravel, formed at what was then the mouth of the Thames River just west of London. The lake continued to exist while the ice retreated east of the Galt moraine, leaving its mark on the drumlins in Beverley township. During this phase of retreat, the eskers of Wellington, Grey, and Huron counties were constructed as were the spillway terrace gravels along the Speed and Grand rivers that fed into Lake Whittlesey.

The next prominent lake was Lake Warren, which also drained to the southwest. A larger delta was built by the Thames River around Bothwell. As it did in Lake Whittlesey, postglacial uplift of the land has tilted the old shoreline to elevations that are near 875 feet north of Dundas and near 700 feet around Blenheim. Another large delta was built in Norfolk county at the mouth of the Grand River. The ice-front had retreated farther to stand along the Niagara Escarpment in the east and farther north in the Huron basin. This phase is shown in Figure 3. The Oak Ridges moraine and the large eskers of eastern Ontario probably formed soon after this.

A major ice-retreat associated with a temporary warming of the climate caused the ice to clear part of the Ontario Basin, allowing the formation of Lake Iroquois about 12,000 years ago (Karrow, Clark, and Terasmae 1961) and its outlet down the Hudson valley. In the Huron Basin, another major glacial lake (Lake Algonquin) formed and drained into Lake Iroquois along the Trent Valley. The position of the ice-front is unknown, but it probably lay in the rough country east of Georgian Bay. Both Lake Iroquois and Lake Algonquin beach deposits have been sources of gravel. This phase is shown in Figure 4.

As the ice retreated northward, it uncovered the St. Lawrence Valley. Having been depressed below sea-level by the weight of ice, the land east of Pembroke and Brockville was flooded by marine water to form the Champlain Sea. Marine shells and whale bones have been found in the clays and beach deposits at many places covered by the sea.

Eventually, the ice melted back to free the Nipissing–Ottawa Valley, and Lake Algonquin ceased to exist because of free drainage to the east. The drainage of Lake Algonquin and the earlier part of the Champlain Sea have been dated at about 10,000 or 11,000 years ago (Terasmae and Hughes 1960a).

Gradual uplift of the land and disappearance of the ice-sheet have brought conditions to those we know today.

Eskers

An esker is a long narrow winding ridge of sand and gravel laid down as a stream deposit by glacial meltwater flowing through crevasses and channels in or beneath a stagnant ice-sheet. The height of these ridges ranges between a few tens of feet and 100 feet or more. The ridges are ordinarily less than 300 feet wide, although esker deposits up to ½ mile wide are to be found. Not every linear ridge has a regular longitudinal profile; some are hummocky or noded in character where the stream deposited knobs of sand and gravel along its course.

The typical esker is composed of a heterogeneous assemblage of poor- to well-sorted sand and gravel. The poorest-sorted parts may show a wide variation in size of gravel from large erratics to fine gravel, and it is difficult to predict the type of material to be found in an esker deposit. Many of the deposits of well-bedded medium to fine sand are to be found on the flanks of the esker ridge.

Owing to the fact that in many places the eskers were the last glacial material deposited, these prominent sand and gravel ridges running across the country form a good source of sand and gravel. Pits are most conveniently established where township roads cross eskers.

The tonnages of sand and gravel present in many esker deposits is limited by the size of the esker ridge, which may be only 200 feet wide and 30 to 50 feet high. However, large eskers, such as the Norwood esker at Norwood or the Brampton esker, contain very substantial tonnages. The Brampton esker is worked by nine sand and gravel producers over a length of three miles.

(XXVIII) ESKERS WORKED FOR GRAVEL

Esker	Location of Pits	County
Frankford-Marlbank	Frankford	Hastings
	Marlbank	Hastings
	Beaver Lake	Lennox and Addington
Tweed	Tweed	Hastings
Tamworth	Tamworth	Lennox and Addington
Picton	Picton	Prince Edward
Trenton	Trenton	Northumberland
Campbellford	Campbellford	Northumberland
Norwood	Norwood	Peterborough
Douro	Peterborough	Peterborough
Bridgeworth	Lakefield	Peterborough
Omemee	Omemee	Victoria
Fenelon Falls	Fenelon Falls	Victoria
Sunderland	Sunderland	Ontario
Brampton	Brampton	Peel
St. Marys	St. Marys	Perth
Moncrieff	Moncrieff	Huron
Winthrop	Winthrop	Huron
Seaforth	Seaforth	Huron

Heterogeneous sand and gravel assemblage in the Norwood esker.

The main eskers in southern Ontario have been mapped by Chapman and Putnam (1951). Those that have been worked for gravel are listed in (XXVIII).

FRANKFORD–MARLBANK ESKER

The Frankford–Marlbank esker, described by Chapman and Putnam (1951, p. 61), is the longest in southern Ontario. It has been traced for more than 50 miles, from near Codrington on highway No. 30 north of Brighton, in a northeasterly direction through Frankford and Marlbank, to a point about four miles north of Beaver Lake in Sheffield township, Lennox and Addington county. The road from Erinsville through Marlbank to Lime Lake runs along the crest of the esker for several miles.

The stream that formed this esker deposit flowed southwest across the Paleozoic–Precambrian contact at the south end of Beaver Lake. The character of the gravel changes rapidly south of the Paleozoic contact. North of the contact, the gravel is composed entirely of Precambrian acid igneous, basic, and metamorphic rocks; however, one-eighth of a mile southwest of the Paleozoic contact at Erinsville Station the gravel contains 18 percent Paleozoic rocks, and three-eighths of a mile from the contact the gravel contains 50.5 percent Paleozoic rocks. Four miles from the Paleozoic contact, at Marlbank, the gravel is composed of 73.8 percent Paleozoic rocks. These figures indicate that a large proportion of the load carried by the glacial stream was locally derived.

Pebble analyses of six gravel samples from pits along the Frankford–Marlbank esker in the vicinity of the Paleozoic contact are given in (XXIX).

Gravel pits in the Frankford–Marlbank esker are being worked near Frankford in Sidney town-

(XXIX) PEBBLE ANALYSES OF GRAVEL SAMPLES FROM THE FRANKFORD–MARLBANK ESKER IN THE VICINITY OF THE PALEOZOIC CONTACT

Sample No.	Locality	Distance and Direction from Paleozoic Contact	Types of Pebbles				
			Precambrian			Paleozoic	
			Acid Igneous	Basic	Meta-morphic	Basal Arkose	Limestone
			percent	percent	percent	percent	percent
1.....	2 miles north of Beaver Lake	4 miles north	33	5	62	nil	nil
2.....	⅛ mile southwest of Erinsville Station	⅛ mile southwest	29.7	3.6	48.7	4.5	13.5
3.....	⅜ mile southwest of Erinsville Station	⅜ mile southwest	13.8	nil	35.7	8.3	42.2
4.....	1 mile east of Marlbank	3 miles southwest	22.8	nil	15.2	17.2	44.8
5.....	½ mile south of Marlbank	4 miles southwest	8.2	nil	16.4	10.7	64.7
6.....	4 miles southwest of Marlbank	8 miles southwest	6.0	nil	12.0	14.0	68.0

Kames and outwash near Ayr, Waterloo county.

ship, near Naphan in Tyendinaga township, near Marlbank in Hungerford township and in Sheffield township.

OTHER ESKERS

The other eskers are described in pages 48–142 of this report, in which Ontario sand and gravel producers are described under locality headings. The Tweed esker is somewhat unusual in the Precambrian area north of Tweed. South of Tweed the esker may be traced for a distance of approximately 16 miles to its junction with the Frankford–Marlbank esker north of Foxboro. Throughout this section, the esker travels across Paleozoic limestone and forms the normal narrow esker ridge from 50 to 75 feet in height. North of Tweed, the area is a rather flat and bare peneplain of Precambrian crystalline rocks, mainly of the granitic gneiss type. Across this peneplain, the Tweed esker can be traced for a distance of 20 miles, extending in a northerly direction more or less parallel to the Skootamatta River, past the village of Flinton, into Anglesea township. Throughout this length, the path of the esker is marked by a linear band of stratified sand and gravel up to ½ mile wide and 10–30 feet thick. There is no well-defined esker ridge, but the path of the stream can be traced by the wide swath of sand and gravel crossing the rocky peneplain.

The Brampton esker differs from the others in that it is a buried esker that was overridden by the last Wisconsin ice-sheet and covered by glacial till. This till-sheet must be stripped off before the sand and gravel deposits are exposed.

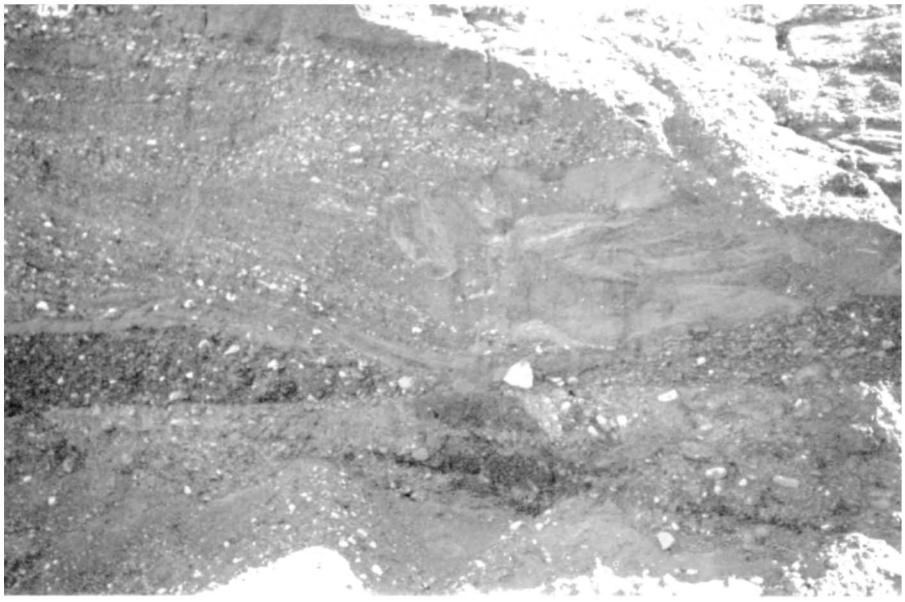
Kames

As glacial meltwaters poured off the ice-sheet, deposits of sand and gravel were built up along the ice-margins. These ice-contact deposits, which generally take the form of hills or knobs, are called "kames". Many kames were formed as deltas or alluvial cones where the meltwater streams pour from the ice-sheet. As the ice melted, these deposits, which had been built up against the ice-face, slumped; subsidence features are characteristic of these deposits.

Kames are very common in some of the end or interlobate moraines. The Oak Ridges moraine, an interlobate moraine between the Lake Ontario and Lake Simcoe lobes, is termed a "kame moraine" owing to the large proportion of kame material in the moraine. Other examples of interlobate kame moraines are the Waterloo sandhills, the Elmira moraine, and the Orangeville moraine. Kame deposits are also very common in parts of the Galt and Paris moraines between Galt and Erin. Kame deposits are more often associated with the coarse-grained tills (e.g. Wentworth Till in the Paris and Galt moraines).

Sand and gravel that were laid down by water between the ice-sheet and higher ground are termed "kame terraces". Because the meltwater proceeded from the ice-front, kames may be found to grade

Kame sand and gravel in Emily township, Victoria county.



Frozen sand boulders in kame sand and gravel near Campbellville, Halton county.

into glacial outwash deposits farther from the ice-front.

Kames are composed of irregularly bedded and crossbedded sand and gravel that is frequently poorly-sorted.

Kame deposits of sand and gravel are worked extensively in southern Ontario. Perhaps the most important of these are the kame deposits of the Oak Ridge interlobate kame moraine mentioned above. This kame moraine forms a ridge extending from the Escarpment in an easterly direction through Goodwood, south of Port Perry and Rice Lake, to the vicinity of Castleton, north of Colborne. Sand and gravel pits are operated in this kame moraine at Maple, Aurora, Stouffville, and Bethany.

When the Lake Ontario ice-lobe stood against the Niagara Escarpment at St. Catharines, an extensive kame delta was built up at Fonthill, measuring two miles by one mile. The flat-topped kame stands 75 feet above the surrounding country. The Moyer and Fonthill sand and gravel pits are in this deposit. Because the ice stood on an area of Queenston Shale to the north, the deposit contains an abundance of Queenston Shale pebbles and clay.

The Markham Sand and Gravel deposit in Markham township is a buried kame that was overridden in the last ice-advance. The kame gravels are covered by one or more till-sheets (Dreimanis and Terasmae 1958). Because the area is underlain by the Dundas and Collingwood shales, the gravels contain a large proportion of shale and siltstone pebbles from the Dundas and Collingwood formations.

Other kame deposits are worked in the Barrie and Joyceville–Seeleys Bay area. The sand and gravel deposit worked by Consolidated Sand and Gravel Limited north of Malton in Chinguacousy township is a buried kame covered in places by a thin till. The gravel deposits southwest of Milton, worked by Hayward and Picket, D.C.B. Gravel Company, and the Township, are in a large kame or kame terrace.

Because kame deposits were formed at the edge of the ice, many of them are covered by a layer of glacial till. This condition can be seen in McNamara's pit at Woodstock, the Warren Paving pit near Williamsburg, Markham Sand and Gravel, and Giordano's pit at Whitevale.

Spillway Gravels

Some of the largest gravel deposits worked in Ontario are river channel and gravel terrace deposits laid down in glacial spillways. These spillways carried the meltwater from the retreating lobes of the continental glacier southward to glacial lakes that preceded the present Great Lakes system. The gravel terraces and spillway channel deposits consist of sheets of well-rounded, bedded, rather uniform gravel containing some sand and, in some places, silt. Such gravel deposits are likely to be thick and extensive, and occupy valleys that were the former sites of glacial rivers.

The oldest of the spillway systems is found in the Thames River valley and was formed in an interlobate position between the Huron and Erie ice-lobes. Numerous operators work gravel deposits in this system: Oxford Sand and Gravel, G.B. Thornton, Alfred Tree Sand and Gravel, Dunn's Haulage, R.S. Clark and Son, Towland Construction, Fryer pit (Walmsley), J. F. Marshall and Son Sand and Gravel, Riverside Construction, and Glendale Sand and Gravel.

The Erie–Ontario lobe, occupying the basins of lakes Erie and Ontario, retreated to the east, and periods of cessation of movement or short readvance are marked by terminal moraines. When the ice-lobe stood east of Paris, Galt, and Guelph, the Paris and Galt moraines were built up. During that time, glacial drainage from the Erie–Ontario lobe and from the northern lobes flowed southward and formed an extensive series of spillways from Orangeville and Caledon, to Paris on the west side of the Paris and Galt moraines. At that time a large sandy delta was built up in glacial Lake Whittlesey south of Brantford. The extensive spillway gravels of the Caledon, Guelph, Paris, and Brantford areas were formed at this time. Gravel deposits operated by C. Smythe for Sand Limited, Armstrong Brothers Company, Caledon Sand and Gravel, Eastern Gravel and Crushed Stone, and Premier Building Materials near Caledon, are in this spillway system.

Farther southwest, along the Speed River spillway, are the pits of Guelph Sand and Gravel, Preston Sand and Gravel, Martini Sand and Gravel, Angelstone Limited, and Lasby Sand and Gravel. Small-tributary outwash bodies in the drumlin field between the Speed and Grand Rivers are worked by Marden Sand and Gravel, and E. and E. Seegmiller (Faye pit). Large terraces along the Grand River east of Kitchener are worked by Forwell Sand and Gravel.

The Grand River spillway yields the greatest quantity of sand and gravel south of Paris and Brantford; pits in this spillway are operated by: Consolidated Sand and Gravel (East Paris and West Paris pits), Telephone City Gravel Company Limited, Flintkote Company, Brown Sand and Gravel, Daiken Sand and Gravel, and Burford Sand and Gravel. Deposits at Waterford, worked by A. Walker and Sons, A.S. Robertson Sand and Gravel, and Waterford Sand and Gravel, are of uncertain origin; they may have been formed as deltaic

Spillway terrace gravel along the Grand River west of Brantford.

Buried deltaic sand and overlying till; Sabiston pit, Thornhill.

spillway deposits during a lower glacial lake-level in the Erie basin.

Pebble counts along the Grand River spillway between Kitchener and Brantford show a generally high dolomite content, but variations are sporadic and apparently non-systematic.

Farther east, another halt in the retreat of the Ontario lobe is marked by a prominent glacial spillway extending from Tottenham, through Inglewood and Georgetown, to Campbellville. The Industrial Sand and Gravel deposit north of Georgetown is in this spillway.

Spillway gravel deposits are not commercially important in eastern Ontario. Drainage from glacial Lake Algonquin into glacial Lake Iroquois formed three spillways, the Otonabee, Warsaw, and Indian River spillways, in the Peterborough area (Gravenor 1957). The only gravel deposit found in a glacial spillway in the Peterborough area is that of Regal Washed Sand and Stone Company in Douro township.

Water in the glacial spillways eroded large quantities of sand and gravel and carried them into glacial Lake Iroquois where they were deposited as deltas and later redeposited by wave action into beaches, bars, spits, and related deposits (Gravenor 1957).

Deltaic Deposits

Deltas are sedimentary deposits laid down by a stream or river where it empties into a lake or sea. Deltaic deposits generally consist of fine to medium sand and silt. The deposits are well-bedded and crossbedded, and are well-sorted. Gravel is generally lacking, or is present only in minor quantities, in channel deposits in the delta.

Deltaic sand deposits formed in glacial lakes are common in southern Ontario. In the Toronto area the well-sorted stratified sand deposits operated by Monarch Sand and Gravel near Kleinberg, by Miller Paving in Scarborough, and by J. Sabiston near Thornhill, are deltaic deposits laid down by glacial streams.

Deltas formed by the Thames spillway at successively lower lake-levels are worked for sand and gravel by Alec Newbigging and W. Tunks at Komoka, and J. R. Nash Sand and Gravel, and Adams Sand and Gravel east of Chatham.

There is no doubt that part of the Grand River spillway deposits grade into deltas formed in lakes Whittlesey and Warren. Small deltas are found in many places but few have been exploited.

Beach Deposits of Glacial Lakes

During the retreat of the Pleistocene ice-sheet from Ontario, glacial lakes were formed, and these covered substantial portions of southern Ontario. Beach deposits, formed along the shorelines of these glacial lakes, are important sources of sand and gravel. In places, the shorelines are marked by a wave-cut bluff, a destructional feature; in other places, depositional features, such as beach bars and spits, are present. The mouths of glacial rivers and streams may be marked by deltas.

Sand and gravel deposits along shorelines are characteristically long and narrow, and rarely more than 20 feet thick. Most beach deposits are only 8 to 10 feet thick, but exceptionally large gravel bars, in excess of 100 feet in thickness, are known to have been formed. Coleman (1936, p.6) recorded a thickness of 116 feet of sand and gravel in the Iroquois bar at Hamilton Bay. Beach gravels are, characteristically, well-sorted and well-stratified. Most beach sands are more poorly sorted than fluvial and deltaic sands.

The nature and size of sand and gravel deposits built up along the shoreline depend on several factors: the size and length of life of the glacial lake, the fetch and sweep of waves and currents, and the nature and supply of materials. The three main sources of material for beaches are cliff erosion, erosion of the lake bottom, and longshore transportation of materials discharged into the lake by rivers and streams.

The amount of sand and gravel available to form beach deposits depends to a large extent on the nature of the material forming the shoreline and adjacent lake bottom. Where the shoreline is an easily eroded till, the type of gravel will depend on the stoniness and character of pebbles in the till; the composition of the beach gravels will reflect the composition of the till. The unconsolidated sands, and the clays and tills of the Scarborough Bluffs, are at present being eroded by Lake Ontario, and the eroded materials that are being carried westward by longshore currents have formed the spit, known as Toronto Island, across Toronto Bay.

Where cliffs and lake bottom are formed of bedrock, the type of bedrock will determine the character of the shingle beaches. Near Port Credit, for example, where the bedrock floor is Dundas Shale that contains numerous harder layers of calcareous siltstone, the beach gravels are composed mostly of flat pebbles of the siltstone.

The shoreline of glacial Lake Iroquois, which occupied the basin of Lake Ontario, was well-developed, as were the shorelines of glacial Lake Algonquin in the Lake Simcoe area; these lakes apparently existed for many hundreds of years, a length of time sufficient to develop a well-marked shoreline comparable to that of the present Lake Ontario.

Modern Lake Ontario shorecliff at Simcoe point,
Pickering township.

Lake Nipissing shorecliff west of Little Current,
Manitoulin Island.

LAKE IROQUOIS SHORELINE

The position of the shoreline of glacial lake Iroquois is shown on Figure 4, and may also be distinguished on map No. 2038 accompanying this report. The shoreline has been described by Coleman (1937) and Chapman and Putnam (1951, pp. 86–88).

From Queenston to Hamilton, the Iroquois shoreline forms a low bluff near the base of the Niagara Escarpment. The bedrock is Queenston Shale, which lacks hard layers and yields few durable pebbles. A gravel bar three miles long extends from Homer through St. Catharines, and highway No. 8 follows this bar; no gravel pits are now operated in the bar. Beach deposits are not found between St. Catharines and Stoney Creek. Another gravel bar extends northwest from Stoney Creek for 2½ miles to Bartonville. At Hamilton a major bar was developed at the western end of Lake Iroquois, similar to the present-day bar forming Burlington beach in Lake Ontario. The Iroquois bar, which now stands as an embankment more than 100 feet high, separates the Dundas marsh from Hamilton Bay. The highway and railway approaching Hamilton from the north cross the bar. The Hamilton rock gardens occupy the site of an abandoned gravel pit in the bar, which consists of stratified sand and partly cemented gravel.

At Aldershot the Iroquois beach gravels are now worked by J. Cooke Limited, and were formerly worked by Howard Concrete and Materials Limited until almost depleted. The partially cemented gravel deposit is about 20 feet thick and is composed mostly of red, green, and brown siltstone derived from hard layers in the Queenston and Dundas shales. The presence of substantial amounts of Dundas Siltstone indicates that the source of much of the gravels lay northeast. The average size of the gravel pebbles is 2–3 inches.

From Aldershot to Clarkson, the shoreline crosses an area underlain by red Queenston Shale. Beaches and gravel bars are scarce and most of the low shorecliff is cut in the red shale. At the Credit River valley, between Erindale and the Queen Elizabeth Way, is an extensive deposit of beach gravel worked by Franceschini Brothers, Sherman Sand and Gravel, Clarkson Sand and Gravel, R. H. Pinchin, and Hughs Haulage. The gravel deposit is medium gravel, imbricated, from 20 to 40 feet thick, resting on Dundas Shale. Almost all the pebbles are composed of the harder calcareous siltstone from layers in the underlying shale. Owing to the high percentage of pebbles of laminated calcareous siltstone and shale in the beach deposits from Aldershot to Toronto, these gravels are unsuitable for concrete aggregate.

The Iroquois beach and associated sand and gravel deposits were developed well in what is now the Toronto area, and have been described in detail by A. P. Coleman (1933). The Iroquois shoreline in Toronto is marked by a prominent shorecliff that may be seen in many places, for example, at Casa Loma and Avenue Road hill. Where the two rivers, the Humber and the Don, entered glacial Lake Iroquois, extensive gravel bars were built westward across the rivermouths by easterly storms. These gravel deposits were operated for many years to supply sand and gravel for the Toronto area; however, urban development gradually encroached on the remaining areas of good gravel, and the deposits are no longer operated.

At Scarborough Bluffs, the present shoreline of Lake Ontario has eroded and removed the old Iroquois shoreline for a short distance. From the Scarborough Bluffs, the Iroquois shoreline runs north to the Rouge River valley where shallow beach gravel deposits lie both southwest and northeast of the Rouge River valley. The sand and gravel pits of J. Blake Sand and Gravel, J. B. Regan, and Highland Creek Sand and Gravel are in these beach deposits. Large quantities of the beach deposits in several areas have been depleted, and only small reserves now remain. Thick deposits of glacial drift covered the shale bedrock in Scarborough and Pickering townships, and little or none of the Collingwood and Gloucester shales appear in the gravel. Lake Iroquois reworked the glacial till of its shoreline in this area, and the gravels are mainly composed of Black River and Trenton limestones, and Precambrian crystalline rocks, which are the principal rock types carried from the east by the Lake Ontario ice-lobe. The same limestone and Precambrian crystalline rocks predominate in the compositions of beach gravels from Pickering township to Trenton. This stretch is underlain by Trenton limestones. A small but persistent proportion of white Potsdam Sandstone pebbles from the Kingston area is found in all the gravels from Kingston to Toronto where it was carried in the moraines of the Lake Ontario ice-lobe.

Small Iroquois beach deposits are worked in Pickering township by Orrell Limited, Consolidated Sand and Gravel, Kinsale Sand and Gravel, and I. A. Hess. Shallow Iroquois beach gravels north of Oshawa have been largely worked-out. Two Iroquois beach deposits are worked north of Bowmanville by Bowmanville Sand and Gravel, and General Aggregates Limited. North of Port Hope, Sleeman Brothers operate a gravel pit in a

beach deposit that lies some distance south of the main Iroquois shoreline.

North of Colborne, the Iroquois shoreline is marked by a prominent shorecliff paralleling the shore of Lake Ontario. Three miles east of Colborne, at Biddy Lake, the shoreline swings southeast in a series of gravel bars that extend for two miles. Just north of highway No. 2, the shoreline swings northeast, and an extensive bar is formed running northeast; this beach deposit in Cramahe township, four miles east of Colborne, is one of the largest in Ontario. The gravel deposit, which is 20 to 30 feet thick, is operated by Trent Valley Sand and Stone Limited.

During the life of Lake Iroquois, the ice-front extended across southeastern Ontario, roughly from Lakefield through Havelock to Sydenham and thence to Kingston, as indicated on Ontario Department of Mines map 45f (Coleman 1937).

East of a line running roughly from Colborne to Havelock, eastern Ontario south of the ice-front was inundated by the waters of Lake Iroquois except for the high ground of the Oak Ridges interlobate moraine that extends as far east as the Murray Hills, three miles west of Trenton. Beyond the Murray Hills, which formed the east end of a peninsula extending eastward into Lake Iroquois, only occasional highlands formed islands in the lake. A broad wave-cut terrace at 575 feet elevation marks one level of Lake Iroquois around the Murray Hills.

Stretches of Iroquois beach may be found along the Iroquois shoreline running north of the interlobate moraine from Cramahe township, Northumberland county, west of Warkworth and Campbellford, to Havelock. These features are described well by Coleman (1937, pp. 17–21).

In Lake Iroquois north and northeast of what is now Trenton, the prevailing direction of wind and wave action was from the southeast. This resulted in two types of beach deposits.

In the first case, where highlands stood up in the lake as islands, beach deposits are found along the exposed east and southeast shores. West of Campbellford, a series of hills formed islands extending northeast to Heeley Falls. Beaches are found on the southeast flanks of these hills, but not on the northwest slopes.

In the second case, drumlin hills stood up on the lake floor to an elevation approximately that of lake-level. These hills were planed down and truncated by wave action until their flat wave-cut tops stood at the effective wave-base, possibly 25 to 40 feet below lake-level. Gravel from these truncated hills was carried across the wave-cut terrace and accumulated on the lee or northwest side of the truncated hill, where it now exists as foreset beds dipping to the northwest. In this case, the best place to prospect for gravel deposits is on the northwest side of truncated hills.

Examples of this type of beach deposit may be seen two miles east of Campbellford, where a group of drumlins has been truncated at an elevation of 600 feet. Gravel deposits are operated by Thomson Brothers, and Trent Valley Sand and Stone along the west side of the hill.

A similar type of deposit is found 4 miles east of Frankford where a series of drumlins is truncated at 575 feet. A gravel deposit on the west or lee side of the hill is operated by H. J. MacFarland Company. A third example of this type of gravel accumulation is found at Pancake Hill south of Fuller, in Huntingdon township, Hastings county. Here, the truncated hill has an elevation of 700 feet, and extensive gravel deposits on the west or lee side of the hill were formerly operated by Consolidated Sand and Gravel Company. Probably, other gravel deposits of this type exist in the area.

LAKE ALGONQUIN SHORELINE

Most of the sand and gravel deposits in the Barrie–Orillia–Midland area of Simcoe county are beach deposits along the old shoreline of glacial Lake Algonquin. These beaches are described by R. E. Deane (1950, pp. 43–80) and Chapman and Putnam (1951, pp. 82, 83). The following sand and gravel operations in Simcoe county are in beaches of Lake Algonquin: Lafontaine Sand and Gravel, in Tiny township, near Penetanguishene; Teedon Sand and Gravel, in Tiny township, near Waverley; Innisfil Gravel Supplies, in Innisfil township, near Barrie; Varcoe Brothers, in Vespra township, near Barrie; R. H. Stewart Construction Limited, Cole and Davey, Acme Sand and Gravel, and J. and B. Ennis Sand and Gravel, near Barrie.

The depths of most of these gravel deposits is shallow and rarely exceeds 15–20 feet; the deposits are composed mainly of pebbles of limestone and crystalline Precambrian rocks.

The Algonquin beach can be traced westward around the south and west shores of Georgian Bay, down the west side of the Bruce Peninsula to a point south of Kincardine; in the area north of Goderich, shore erosion by Lake Huron has removed the beach for many miles. South of Goderich the beach nearly coincides with that of Lake Nipissing (a much younger lake-stage, about 4,000 years old) and continues to near Sarnia where one of its outlets (Port Huron) existed. The pits of

Lake Algonquin beach gravels, Meaford. Note rounded pebbles and imbrication.

Juniper Excavating at Meaford, and of Edson Construction, and Kemsley and Boyer at Sarnia, exploit gravels of lakes Algonquin and Nipissing.

Pits of Spinks Gravel Limited, and Woolatt Limited, are operated in beach gravels on the Leamington moraine in Essex county. These beaches are believed to have been formed by lakes Whittlesey and Warren, and are slightly older than those formed by Lake Algonquin. Lake Warren beach deposits have been worked at many places north of Lake Erie, including pits of Huffman Sand and Gravel, and Doey Construction, near Cedar Springs, Johnston and Moulton Sand and Gravel in western Elgin county, and K. R. Axford Sand and Gravel, Bannockburn Farms, and McLaw's Crushing, near St. Thomas.

The beaches of lakes Warren and Whittlesey have been traced from north of Hamilton to the vicinity of Ridgetown; there, they swing northward to the vicinity of Arkona and parallel the shore of Lake Huron to the Kincardine district. Edgewater Construction operates a pit in the Warren beach near Wyoming.

BEACHES OF THE CHAMPLAIN SEA

After withdrawal of the ice-sheet from southern Ontario, the whole of eastern Ontario east of Kingston between the St. Lawrence and Ottawa Rivers was inundated by an arm of the sea called the Champlain Sea. As this sea withdrew, beaches were formed along the margins of the sea in several places in eastern Ontario. The main Champlain beach deposits being worked commercially for sand and gravel are in the Ottawa and Cornwall areas.

The beaches of the Ottawa area are described by W. A. Johnston (1917). In Gloucester and Osgoode townships, south of Ottawa, a southeasterly-trending beach deposit is worked by Spratt Sand and Gravel, Frazer Duntile Limited, Moffats Equipment Rentals Limited, and Billie Construction Limited. The presence of appreciable quantities of Ordovician shale and soft brown Beekmantown Dolomite in these beach gravels is detrimental to their use in concrete aggregate. Other northwest-trending beaches are found north of Stittsville in Huntley township, and gravel pits are operated there by W. J. Bell and Son, A. H. McCoy Construction Company, and Spratt Sand and Gravel. These beach gravels are shallow, and rarely exceed 15 feet in thickness.

In the Cornwall area, beach and bar deposits exist in numerous localities, mainly on the north and northwest flanks of drumlins. These are described in some detail on pages 117–19. The main beach deposits being worked in the Cornwall area are the Moss pit and New York Central pit of Coleman Munro Limited, and the Parent pit of Cornwall Gravel Company.

UTILIZATION OF SAND AND GRAVEL DEPOSITS IN ONTARIO

Sand and gravel deposits are widely distributed in southern Ontario. The utilization of sand and gravel, as aggregates in concrete and asphalt, depends upon the quality of material available. In certain areas, objectionable quantities of chert, shale, laminated siltstone, or soft and crumbly pebbles render the gravels unfit for use in concrete and asphalt construction.

Pebbles are formed by the mechanical breakdown of rocks in the source-area; therefore, the character of the gravel produced by processes of weathering is greatly influenced by the nature of the bedrock formations and the percentage of exposure available for weathering.

The accompanying geological maps of southern Ontario indicate the distribution of bedrock formations. Because the sand and gravel deposits of southern Ontario are mainly associated with the last advance of the Pleistocene ice-sheet across Ontario, the directions of advance of the ice-lobes are indicated on the map. These represent the direction of transport of gravel from source-formations.

Analyses of pebble assemblages from 150 gravel deposits in southern Ontario are plotted on the accompanying maps (*see* back pocket).

Map No. 2039

Map No. 2039 gives the percentages of limestone, dolomite, and Precambrian crystalline pebbles in the gravel samples examined. Limestone, dolomite, and Precambrian crystalline rocks form the major part of the pebbles in southern Ontario gravels.

PRECAMBRIAN ROCKS

Precambrian rocks underlie the districts of Parry Sound, Muskoka, Nipissing, the counties of Haliburton and Renfrew, the northern parts of the counties of Simcoe, Ontario, Victoria, Peterborough, Hastings, Lennox and Addington, and Frontenac, and the eastern parts of Leeds and Lanark counties. Gravel deposits in these areas are composed entirely of Precambrian crystalline rocks ranging from granite and granite gneiss to basic intrusive rocks, and including Precambrian metasedimentary rocks (paragneiss, quartzite, marble, and schists). For the most part, these Precambrian pebbles are sound, but locally there may be concentrations of soft, crumbly and easily disintegrated, weathered granite, granite gneiss, paragneiss or schist.

On the Precambrian Shield, gravels are normally 100 percent Precambrian pebbles. Although the Precambrian Shield forms an important source-area for pebbles throughout southern Ontario, the percentage of Precambrian pebbles in the gravels drops markedly where the Precambrian boundary is crossed. In the Orillia area, for example, a few miles south of the Precambrian contact at Washago, the proportion of Precambrian rocks in the gravels ranges between 8 and 31 percent, in spite of the fact that the ice moved here from north to south. Similarly in the Peterborough area, ten to fifteen miles south of the Precambrian contact, the proportion of Precambrian pebbles ranges between 4 and 20 percent; the remainder consists of Black River Limestone, which underlies the area. Here also, the ice moved south from the Precambrian Shield. These figures indicate that the bedrock formations, where durable and well-exposed, likely provided the major proportion of pebbles in local gravels.

Throughout the part of southern Ontario that is underlain by Paleozoic formations, Precambrian rocks appear in the gravels in proportions ranging between 2 and 58 percent. The ice-lobes moving from the north and east brought a steady supply of hard durable Precambrian pebbles; the proportion of such pebbles in the gravel depends largely on the ease of availability, and the durability, of local Paleozoic bedrock formations. In the Orillia and Peterborough areas already mentioned, the local Black River Limestone is well-exposed and supplies a flood of durable limestone pebbles that locally predominate in the gravels and decrease the percentage of Precambrian pebbles.

Similarly a flood of calcareous siltstone pebbles from the Meaford–Dundas formations in the Iroquois beach deposits between Hamilton and Toronto locally decrease the Precambrian pebble percentages.

The Precambrian pebble assemblages in central and eastern Ontario differ from those in southwestern Ontario. The Precambrian rocks that are present in the gravels of central and eastern Ontario are derived mainly from the Grenville Province in southern Ontario and have been transported by the Lake Ontario, Lake Simcoe, and Georgian Bay lobes; the rocks that predominate in these gravels are granite gneisses, granitized and syenitized gneisses, paragneisses, and amphibolites. The Precambrian rocks that are present in the gravels of southwestern Ontario are derived mainly from the Huronian area of the north shore of Lake Huron and have been transported south

by the Lake Huron lobe; the rocks that predominate are basic intrusive rocks (such as diorite and diabase), basic volcanic rocks, quartzite, and granite.

LIMESTONES AND DOLOMITES

The main limestone and dolomite formations exposed in southern Ontario are given in (XXX).

(XXX) LIMESTONE AND DOLOMITE IN SOUTHERN ONTARIO

Formation or Group	Age
Beekmantown Dolomite	Ordovician
Black River-Trenton limestones	Ordovician
Guelph-Lockport-Amabel dolomites	Silurian
Bertie-Akron Dolomite	Silurian
Bois Blanc Limestone	Devonian
Detroit River and Delaware limestone and dolomite	Devonian

The Beekmantown Dolomite is exposed in the Ottawa–Brockville area; it supplies dolomite pebbles to the gravel in the Ottawa, Smiths Falls, Brockville, and Seeleys Bay areas. Although most of these dolomite pebbles are sound, there may be a certain proportion of soft weathered brown dolomite pebbles that are unsound.

Black River and Trenton limestones are exposed in the Ottawa–St. Lawrence lowland between Ottawa and Hawkesbury, and south to the St. Lawrence River between Morrisburg and Cornwall. From these formations came the sound limestones pebbles for the gravels of the Ottawa–Cornwall–Brockville areas. The Trenton–Black River limestones also are exposed in a wide band extending from Midland on Georgian Bay to Kingston on Lake Ontario. Throughout this band, the Black River limestones are well-exposed, often with little soil-cover, and they supply a flood of sound grey fine crystalline limestone pebbles to the gravels of south-central Ontario between the Precambrian contact and Lake Ontario. These limestones are the most common pebbles in the Orillia, Midland, Barrie, Lake Simcoe, Stouffville, Pickering, Peterborough, Oshawa, Campbellford, Brighton, and Belleville areas. The proportion of Black River and Trenton limestone pebbles in these areas ranges between 70 and 95 percent.

The Guelph–Lockport–Amabel dolomites are exposed along the crest of the Niagara Escarpment from Niagara Falls to the Bruce Peninsula and extend south or southwest from the Escarpment for 6–20 miles. These formations supplied abundant dolomite pebbles mainly to the areas underlain by these formations, and to the areas to the south and west, in the direction of ice-movement. These formations supplied pebbles also to the main Orangeville–Paris–Brantford spillways, and these dolomites are abundant in the spillway gravels.

The Bertie–Akron Dolomite and overlying Bois Blanc Limestone, Detroit River Limestone and Dolomite, and Delaware Limestone, underlie a large area in central southwestern Ontario. These rocks are exposed along the shore of Lake Huron from Southampton almost to Kettle Point and extend across to Lake Erie where they are exposed between Port Stanley and Fort Erie. Limestone and dolomite pebbles from these formations are abundant in southwestern Ontario.

SILTSTONE

Map No. 2040 shows the distribution of calcareous siltstone pebbles in southern Ontario gravels. The Meaford and Dundas shales, which form the bedrock surface in a wide band extending from Meaford to Toronto, contain numerous thin bands of calcareous siltstone. The soundness of siltstone pebbles is variable. Some varieties of siltstone form sound pebbles; other varieties, owing to their laminated or weathered character, may easily break down and are, therefore, objectionable in concrete or asphalt aggregate. Where siltstone is present in the gravel, an examination should be made to determine whether or not deleterious varieties of siltstone are present.

As these pebbles are transported from their source-area, which is the Meaford–Dundas outcrop-area, the more friable and laminated varieties of siltstone readily break down and disappear. Within a transport distance of 15–20 miles, only the sounder siltstone pebbles persist in the gravels. Thus, during transportation and weathering, a beneficiation of the gravel is effected by removal of most of the unsound siltstone pebbles.

SHALE

The distribution of shale pebbles in the gravels of southern Ontario is shown on map No. 2041. Because shale is soft, and easily disintegrates, shale pebbles are only found in gravels close to their source-area. Shale pebbles are objectionable in concrete and asphalt aggregate.

In the Ottawa area, the Carlsbad and Billings shales, which form the bedrock in an area southeast of Ottawa, locally supplied shale pebbles to the gravels of the area south of Ottawa in Gloucester and Osgoode townships.

The area underlain by Collingwood, Meaford–Dundas, Blue Mountain, and Queenston shales in the Toronto–Collingwood area is indicated on map No. 2041. These formations supplied small amounts of shale to gravels in some parts of this area but, normally, shale pebbles break down rapidly and do not constitute an important pebble type in the gravels. Red Queenston Shale is present

in the Glen Williams, Niagara Falls, and Fonthill areas.

Shale is more prevalent in the gravels of Kent county, most of which is underlain by black and grey shales of the Kettle Point and Hamilton formations of Devonian age.

CHERT

The distribution of chert pebbles in the gravels of southern Ontario is shown on map No. 2042. Some varieties of chert are reactive in concrete aggregate and cause cracking and pop-outs. ASTM specifications indicate that unsound varieties of chert should not exceed 1 percent of the total weight of aggregate. It has not yet been established what proportion of Ontario cherts are reactive.

The principal chert-bearing formation in southern Ontario is the Bois Blanc Limestone that is exposed in a band 6–8 miles wide extending from Fort Erie through Hagersville, Woodstock, Tavistock, and Listowel, to Port Elgin on Lake Huron. Throughout part of its length, the Bois Blanc Formation forms a low escarpment on the bedrock surface. In places the chert is abundant and makes up as much as 60 percent of the rock (Hewitt 1960, p.131). This formation undoubtedly supplied most of the chert for the gravels of the Woodstock–London–St. Thomas area and a substantial percentage of the chert farther west in the Chatham–Sarnia area.

Chert is present in parts of the Delaware (Dundee) Formation, and this formation contributed chert to the gravels of Kent, Lambton, and Essex counties.

Chert abounds in the Ancaster chert beds of the Goat Island member of the Lockport Dolomite Formation in the area between Dundas and Queenston. These chert beds supplied small amounts of chert to the gravels of the Brantford, Paris, and Kitchener areas.

Minor amounts of chert are locally present in the Manitoulin Dolomite of the Owen Sound area, the Bertie-Akron Dolomite of the Fort Erie–Cayuga area, the upper and lower Black River Limestone of the Midland–Orillia–Coboconk area, and the lower Trenton of the Ottawa–L'Orignal area. Because chert is normally rare and sparsely distributed in these formations, only small amounts of chert appear from place to place in the gravels. Chert, being mechanically hard, is very durable as a pebble and may be carried long distances.

MINERALOGICAL COMPOSITION OF SAND

A mineralogical study of 95 samples of sand from south-central and southeastern Ontario was made by Mrs. C. I. Dell of the Ontario Research Foundation. The results of this mineralogical study are given in the accompanying table. The locality numbers refer to localities shown on the index map of sand and gravel deposits, map No. 2038. The minus-28-plus-48 mesh fraction of the sand was studied in most cases.

Comments on the mineralogical composition of sands of south-central and southeastern Ontario are given by L. J. Chapman, director of the Department of Physiography, Ontario Research Foundation:

> Clean, hard sand is the complement of sound, hard, coarse aggregate for concrete. Natural deposits vary in composition as well as in grain sizes. Soft, unstable material, especially shale is abundant between Toronto and Milton and along the Niagara escarpment. The amount of shale and siltstone together runs from 8 to nearly 40 percent, the highest being along the Escarpment. In general the amount in the deposits diminishes eastward reaching levels of less than 5 percent in the Oshawa area. North and east of Oshawa the shale and siltstone content is around 1 percent over a large area. There are two unusual samples from Fenelon Falls and Havelock containing 14 and 14.5 percent of shale plus siltstone. Probably this comes from basal strata of the Ordovician rocks and represents localized materials. Three samples north of Peterborough contain around 4 or 5 percent while one at Lakefield was free of these materials. This is typical of the analyses obtained on all the deposits around Trenton, Kingston and eastward. The four deposits on the Canadian Shield up to North Bay and Sudbury were all free of shale and this is probably representative of this region.
>
> Unfortunately, no samples have been collected yet from southwestern Ontario, leaving a gap in the information for southern Ontario.
>
> It may be noted that in the area northeast of Brampton one deposit contains much less shale and siltstone than usual. Obviously the source is different. Similarly, in Pickering township one sample is much higher in these deleterious materials than the others pointing up the fact that generalizations cannot always be trusted.

Mineralogical Composition of Sand in South-Central and Southeastern Ontario

(Mineralogical studies carried out by C. I. Dell, Ontario Research Foundation.)

All proportions are taken to the nearest ½ percent.

Property No. in this Report and on map No. 2038	(1)	(2)	(3)	(4)	(4)	(6)	(6)	(7)	(7)	(8)	(9)	(9)
Locality or Company operation	Calaguiro Brothers, Niagara Falls	Braas Brothers, Niagara Falls	Fonthill Sand and Gravel, Fonthill	Moyer Sand and Gravel Ltd., Fonthill	Moyer Sand and Gravel Ltd., Fonthill	Halton County Pit, Milton	Hayward and Picket Ltd., Milton	DCB Gravel Co., Milton	DCB Gravel Co., Milton	Oriole Block Co., Georgetown	Sherman Sand and Gravel Ltd., Clarkson	Sherman Sand and Gravel Ltd., Clarkson
Quartz	37.0	41.5	26.5	30.5	28.5	24.5	16.5	15.0	23.0	42.5	36.0	28.5
Feldspar	19.0	19.5	12.0	16.5	6.5	10.5	13.0	15.5	11.0	12.5	17.0	6.5
Paleozoic Limestone	11.0	11.0	18.0	11.0	28.5	23.5	27.5	21.0	29.0	19.5	22.5	29.5
Grey Shale and Siltstone	16.5	15.0	29.5	38.5	22.0	20.5	25.0	24.5	15.5	12.0	17.0	25.0
Red Shale and Siltstone	12.0	11.5	8.0	—	9.5	8.5	2.0	10.0	4.0	0.5	0.5	0.5
Black Shale	—	—	—	—	1.5	1.0	1.0	1.5	—	1.0	1.0	1.0
Quartz Sandstone	—	—	—	—	—	—	—	—	1.0	—	—	0.5
Dolomite	—	—	—	—	—	0.5	3.5	1.5	—	—	0.5	0.5
Precambrian Limestone	—	—	—	—	—	—	—	—	—	—	—	—
Acid Igneous Rocks	2.0	1.0	3.0	1.0	1.0	8.0	9.5	8.0	8.0	8.5	4.5	6.0
Basic Igneous Rocks	1.5	—	1.0	—	0.5	1.5	0.5	2.0	4.0	1.5	0.5	1.0
Hematite-Limonite	—	—	0.5	1.5	—	—	—	—	—	—	—	—
Biotite	—	—	—	—	—	0.5	0.5	—	0.5	—	—	—
Muscovite	—	—	—	—	—	0.5	—	—	—	—	—	—
Hornblende	0.5	0.5	1.0	0.5	0.5	0.5	0.5	1.0	2.5	1.5	0.5	0.5
Pyroxene	0.5	—	—	—	—	—	—	—	0.5	—	—	—
Garnet	—	—	0.5	—	—	—	0.5	—	0.5	0.5	—	—
Magnetite	—	—	—	—	—	—	—	—	0.5	—	—	—
Unidentified	—	—	—	0.5	—	—	—	—	—	—	—	—
Cemented Aggregates	—	—	—	—	1.5	—	—	—	—	—	—	0.5

Mineralogical Composition of Sand in South-Central and Southeastern Ontario

(Continued)

Property No. in this Report and on map No. 2038	(11)	(12)	(13)	(14)	(18)	(19)	(21)	(22)	(29)	(30)	(31)	(33)
Locality or Company operation	Clarkson Sand and Gravel Ltd., Clarkson	R. H. Pinchin, Clarkson	Franceschini Brothers Constr. Ltd., Erindale	Consolidated Sand and Gravel Ltd., Malton	Salisbury Sand and Gravel Co., Brampton	Franceschini Brothers Constr. Ltd., Brampton	Armstrong Brothers Co. Ltd., Brampton	Armstrong Brothers Co. Ltd., Brampton	Monarch Sand and Gravel Co., Kleinburg	Superior Sand, Gravel, and Supplies Ltd., Maple	Ontario Sand and Gravel Co. Ltd., Maple	J. Chefero Sand and Gravel Ltd., Maple
Quartz	22.5	35.0	25.5	33.0	28.5	38.0	23.0	37.5	34.5	42.5	42.5	36.5
Feldspar	16.0	21.0	20.5	24.0	14.0	16.0	3.5	8.0	18.0	22.0	19.0	23.5
Paleozoic Limestone	27.0	23.0	26.5	27.5	38.5	24.0	36.5	21.5	30.0	25.0	25.0	28.5
Grey Shale and Siltstone	21.5	12.5	16.0	4.5	7.5	10.0	22.5	9.5	5.0	2.0	3.0	2.0
Red Shale and Siltstone	2.0	—	1.0	—	—	—	—	—	—	—	—	—
Black Shale	2.5	1.5	1.5	1.5	1.5	2.5	3.5	1.5	4.0	1.0	2.5	2.5
Quartz Sandstone	—	—	—	0.5	—	—	—	—	0.5	—	—	—
Dolomite	—	—	0.5	—	1.0	0.5	1.0	1.5	—	—	—	—
Precambrian Limestone	—	—	—	—	—	0.5	—	—	—	—	—	—
Acid Igneous Rocks	6.5	5.5	5.5	7.0	5.5	5.5	6.0	2.0	4.0	5.0	5.5	3.5
Basic Igneous Rocks	2.0	0.5	1.5	0.5	0.5	0.5	2.5	0.5	0.5	1.0	1.0	2.5
Hematite-Limonite	—	—	—	—	—	—	0.5	—	0.5	0.5	—	—
Biotite	—	—	—	0.5	0.5	—	0.5	—	0.5	—	0.5	—
Muscovite	—	—	—	—	—	—	—	—	0.5	—	—	—
Hornblende	—	0.5	—	0.5	1.0	1.5	0.5	—	2.0	0.5	0.5	0.5
Pyroxene	—	—	—	—	—	0.5	—	—	—	—	—	—
Garnet	—	0.5	0.5	0.5	0.5	0.5	—	—	—	0.5	0.5	0.5
Magnetite	—	—	—	—	—	—	—	—	—	—	—	—
Unidentified	—	—	—	—	—	—	—	—	—	—	—	—
Cemented Aggregates	—	—	—	—	1.0	—	—	18.0	—	—	—	—

Mineralogical Composition of Sand in South-Central and Southeastern Ontario

(Continued)

Property No. in this Report and on map No. 2038	(42)	(43)	(44)	(46)	(47)	(48)	(49)	(51)	(57)	(68)	(69)	(70)
Locality or Company operation	J. Sabiston Ltd., Thornhill	Harrison's Pit, Mt. Albert	Commercial Sand and Gravel, Stouffville	Lee Sand and Gravel Ltd., Stouffville	F. H. Roberts and Sons, Stouffville	Western Sand and Gravel Ltd., Stouffville	Stouffville Sand and Gravel Ltd., Stouffville	J. Blake Sand and Gravel Co. Ltd., West Hill	Bolton Sand and Gravel, Mono Mills	McColgan Sand and Gravel Ltd., Barrie	Varcoe Brothers Ltd., Barrie	Giordano Sand and Gravel, Whitevale
Quartz	35.5	25.0	35.0	33.0	37.5	32.5	33.5	32.0	28.0	37.5	42.5	28.5
Feldspar	25.5	17.5	15.5	15.0	10.5	17.0	18.5	29.0	23.5	23.0	21.0	17.5
Paleozoic Limestone	26.5	52.5	42.0	39.5	45.5	38.0	40.5	29.5	37.5	25.5	27.5	34.5
Grey Shale and Siltstone	3.0	0.5	1.0	1.0	0.5	—	—	2.0	1.5	—	—	0.5
Red Shale and Siltstone	—	—	—	—	—	—	—	—	—	—	—	—
Black Shale	1.0	0.5	2.0	3.5	0.5	3.0	2.5	0.5	0.5	—	—	0.5
Quartz Sandstone	—	—	—	—	—	—	—	0.5	—	—	—	—
Dolomite	0.5	—	0.5	—	0.5	—	—	0.5	2.5	—	—	2.5
Precambrian Limestone	—	—	—	—	—	—	—	—	—	—	—	—
Acid Igneous Rocks	5.5	2.5	0.5	5.0	2.5	6.0	2.0	4.0	3.5	10.0	4.5	13.0
Basic Igneous Rocks	1.0	0.5	1.5	0.5	1.0	1.5	1.5	0.5	1.5	2.5	2.0	1.0
Hematite-Limonite	—	—	—	—	—	—	—	—	0.5	—	—	—
Biotite	—	—	—	—	—	0.5	—	0.5	—	—	—	0.5
Muscovite	—	—	—	—	—	—	—	—	—	—	—	—
Hornblende	1.0	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	1.0	1.5	1.0
Pyroxene	—	—	—	1.0	0.5	0.5	0.5	—	—	—	—	0.5
Garnet	0.5	0.5	1.0	—	0.5	0.5	0.5	0.5	0.5	0.5	0.5	—
Magnetite	—	—	—	—	—	—	—	—	—	—	0.5	—
Unidentified	—	—	—	0.5	—	—	—	—	—	—	—	—
Cemented Aggregates	—	—	—	0.5	—	—	—	—	—	—	—	—

Mineralogical Composition of Sand in South-Central and Southeastern Ontario

(Continued)

Property No. in this Report and on map No. 2038	(72)	(74)	(78)	(80)	(83)	(84)	(86)	(88)	(90)	(92)	(93)	(97)
Locality or Company operation	Consolidated Sand and Gravel Ltd., Pickering Twp.	Lot 15, Con. IV, East Whitby Twp.	Lot 20, Con. IV, Uxbridge Twp.	Coppins Pit, Uxbridge Twp.	Sunderland Sand and Gravel Ltd., Sunderland	Hancock Sand and Gravel Ltd., Sunderland	M. L. Avery Sand and Gravel, Brock Twp.	H. G. Graham, Fenelon Falls	Highland Creek Sand and Gravel Co. Ltd., Bethany	Bowmanville Sand and Gravel, Bowmanville	General Aggregates Ltd., Oshawa	Trenton Gravel Products, Murray Twp.
Quartz	33.0	29.5	25.0	33.5	24.5	30.5	21.0	18.5	25.5	25.5	36.0	19.5
Feldspar	20.5	19.0	15.5	11.5	12.0	7.0	8.0	24.5	18.5	19.5	22.0	16.0
Paleozoic Limestone	34.0	45.0	46.0	44.5	60.5	46.0	66.5	38.0	43.0	49.0	35.0	57.0
Grey Shale and Siltstone	1.0	1.0	—	1.5	—	3.5	—	14.0	0.5	1.0	—	1.5
Red Shale and Siltstone	—	—	—	—	—	—	—	—	—	—	—	—
Black Shale	0.5	0.5	2.5	1.0	0.5	3.0	—	—	0.5	0.5	—	—
Quartz Sandstone	—	—	—	—	—	0.5	—	—	0.5	—	—	—
Dolomite	—	0.5	—	—	—	0.5	0.5	0.5	0.5	0.5	—	—
Precambrian Limestone	—	0.5	—	—	—	—	—	—	—	—	0.5	1.5
Acid Igneous Rocks	7.5	2.0	8.5	3.0	1.0	6.5	3.0	3.0	5.0	1.0	4.5	3.5
Basic Igneous Rocks	1.0	0.5	1.0	3.5	0.5	0.5	0.5	—	5.0	1.5	0.5	0.5
Hematite-Limonite	0.5	—	—	—	—	—	—	—	0.5	—	—	—
Biotite	—	—	—	—	—	—	—	—	—	—	—	—
Muscovite	—	—	—	—	—	—	—	—	—	—	—	—
Hornblende	1.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	1.5	0.5
Pyroxene	0.5	0.5	0.5	0.5	—	0.5	—	0.5	—	—	—	—
Garnet	—	0.5	0.5	0.5	0.5	0.5	—	—	—	0.5	—	—
Magnetite	—	—	—	—	—	—	—	—	—	—	—	—
Unidentified	—	—	—	—	—	0.5	—	0.5	—	—	—	—
Cemented Aggregates	—	—	—	—	—	—	—	—	—	—	—	—

Mineralogical Composition of Sand in South-Central and Southeastern Ontario

(Continued)

Property No. in this Report and on map No. 2038	(103)	(104)	(108)	(111)	(115)	(116)	(117)	(119)	(120)	(121)	(122)	(124)
Locality or Company operation	Dunford Brothers, Peterborough	Regal Washed Sand and Stone Ltd., Peterborough	C. C. Doughty, Lakefield	Hopkins Sand and Gravel, Foxboro	Frost Pit, Frankford	Bancroft Concrete Products, Dungannon Twp.	Prince Edward County Pit, Picton	Lot 1, Con. V, Loughborough Twp.	R. H. Richardson Sand Supply, Sydenham	Kingston Sand and Gravel Ltd., Kingston Twp.	J. W. McKendry, Glenburnie Pit, Kingston Twp.	J. W. McKendry, Washburn Pit, Storrington Twp.
Quartz	28.5	18.0	23.0	27.0	23.0	39.5	56.5	62.5	45.0	54.5	62.0	50.5
Feldspar	29.0	20.5	37.5	29.5	25.5	53.5	20.5	16.5	31.0	24.0	33.0	29.0
Paleozoic Limestone	24.0	36.0	24.0	21.5	43.0	—	15.0	4.5	8.0	—	1.0	10.5
Grey Shale and Siltstone	3.5	5.0	—	5.5	1.5	—	2.0	5.0	0.5	1.5	0.5	3.0
Red Shale and Siltstone	—	—	—	—	—	—	—	—	—	—	—	—
Black Shale	0.5	—	—	—	—	—	0.5	0.5	—	—	—	—
Quartz Sandstone	0.5	—	—	—	—	—	—	0.5	—	0.5	—	0.5
Dolomite	—	2.0	—	—	0.5	—	0.5	2.5	1.0	1.5	—	—
Precambrian Limestone	—	—	2.0	0.5	—	0.5	—	1.0	5.5	8.5	—	2.0
Acid Igneous Rocks	10.0	14.0	6.0	10.0	3.0	4.0	2.0	2.0	3.5	4.0	0.5	2.0
Basic Igneous Rocks	3.5	2.5	2.5	2.5	3.0	—	1.0	2.0	1.0	3.5	1.0	1.0
Hematite-Limonite	—	—	—	—	—	—	0.5	2.0	0.5	0.5	0.5	—
Biotite	—	0.5	1.5	0.5	—	0.5	—	0.5	—	0.5	0.5	—
Muscovite	—	—	—	—	—	0.5	—	—	1.0	—	—	—
Hornblende	0.5	1.0	2.0	2.0	0.5	1.5	0.5	0.5	2.0	—	0.5	1.0
Pyroxene	—	—	0.5	0.5	—	—	0.5	—	0.5	1.0	—	0.5
Garnet	—	0.5	0.5	0.5	—	—	—	—	—	—	0.5	—
Magnetite	—	—	—	—	—	—	—	—	—	—	—	—
Unidentified	—	—	0.5	—	—	—	0.5	—	—	—	—	—
Cemented Aggregates	—	—	—	—	—	—	—	—	—	—	—	—

Mineralogical Composition of Sand in South-Central and Southeastern Ontario

(Continued)

Property No. in this Report and on map No. 2038	(126)	(131)	(133)	(134)	(135)	(136)	(138)	(139)	(141)	(142)	(146)	(157)
Locality or Company operation	Marker Block and Tile Ltd., Joyceville	Lot 12, Con. VII, Rear of Leeds and Lansdowne Twp.	Sweets Sand and Stone Ltd., Seeleys Bay	J. Robertson, Lyndhurst	Sweets Pit, Rear of Leeds and Lansdowne Twp.	Lyn Sand Pit, Elizabethtown Twp.	J. B. Boyle, Gananoque	Dixon Pit, Gananoque	Spratt Sand and Gravel, Gloucester Twp.	Frazer Duntile, Osgoode Twp.	Frazer Duntile, Nepean Twp.	A. L. Gould, Renfrew
Quartz	47.5	48.0	43.5	45.5	52.5	33.0	56.5	54.0	32.5	35.5	44.5	26.0
Feldspar	32.0	30.0	23.5	24.5	38.0	17.5	33.0	24.5	41.5	42.0	45.5	29.0
Paleozoic Limestone	7.0	9.5	7.0	14.5	1.5	34.0	1.5	3.0	6.5	4.5	1.5	7.5
Grey Shale and Siltstone	2.5	1.5	6.5	8.5	0.5	5.5	0.5	4.0	5.0	4.0	0.5	4.5
Red Shale and Siltstone	—	—	—	—	—	—	—	—	—	—	—	—
Black Shale	—	—	—	—	—	—	—	—	0.5	0.5	—	—
Quartz Sandstone	—	—	0.5	—	—	—	—	1.0	—	—	—	—
Dolomite	0.5	2.5	4.5	0.5	—	—	—	2.0	—	—	—	—
Precambrian Limestone	—	1.0	2.5	0.5	0.5	—	1.0	3.5	—	—	—	3.5
Acid Igneous Rocks	7.0	3.0	5.5	3.0	3.0	2.5	5.0	4.0	10.0	5.5	3.5	15.0
Basic Igneous Rocks	2.5	2.5	4.0	1.0	0.5	0.5	1.0	0.5	1.5	3.0	2.0	7.0
Hematite-Limonite	—	—	—	0.5	1.0	0.5	0.5	—	—	—	—	0.5
Biotite	—	1.0	—	—	0.5	—	—	—	0.5	0.5	—	1.5
Muscovite	—	—	0.5	0.5	—	—	—	—	—	—	—	0.5
Hornblende	0.5	0.5	—	0.5	2.0	1.0	0.5	1.0	1.0	3.5	1.5	4.0
Pyroxene	0.5	—	1.0	—	—	—	—	1.5	0.5	0.5	0.5	0.5
Garnet	—	—	—	—	—	0.5	—	0.5	0.5	0.5	0.5	0.5
Magnetite	—	—	0.5	—	—	—	0.5	0.5	—	—	—	—
Unidentified	—	0.5	0.5	0.5	—	—	—	—	—	—	—	—
Cemented Aggregates	—	—	—	—	—	—	—	—	—	—	—	—

Mineralogical Composition of Sand in South-Central and Southeastern Ontario

(Continued)

Property No. in this Report and on map No. 2038	(159)	(224)	(226)	(226)	(233)	(234)	(235)	(236)	(244)	(246)	(247)	(249)
Locality or Company operation	NYC Pit, Coleman Munro Ltd., Cornwall Twp.	Miller Paving Ltd., West Hill	John B. Regan Co. Ltd., Scarborough	John B. Regan Co. Ltd., Scarborough	Crawford Sand and Gravel Ltd., Westhill	Highland Creek Sand and Gravel Ltd., Brougham	Gormley Sand and Gravel Ltd., Whitchurch Twp.	Gormley Sand and Gravel Ltd., Whitchurch Twp.	Alrex Sand and Gravel, Georgetown	J. A. Thompson, Burks Falls	G. A. Wilkinson, Huntsville	Livingston Sand and Gravel, Brampton
Quartz	41.0	35.5	40.5	28.0	42.5	35.5	33.5	32.5	35.5	34.5	46.0	47.5
Feldspar	20.5	22.5	20.5	18.5	15.0	20.0	24.5	12.5	13.5	39.5	30.0	16.5
Paleozoic Limestone	27.0	17.0	19.5	37.5	32.0	39.0	35.0	43.5	27.0	—	—	23.0
Grey Shale and Siltstone	3.5	7.0	4.0	2.0	0.5	—	—	0.5	16.5	—	—	7.5
Red Shale and Siltstone	—	—	—	—	—	—	—	—	0.5	—	—	0.5
Black Shale	2.0	7.5	4.5	1.0	3.5	1.0	1.5	0.5	0.5	—	—	0.5
Quartz Sandstone	—	0.5	—	—	—	—	—	—	—	—	—	—
Dolomite	—	—	0.5	—	1.0	1.0	—	0.5	—	—	—	—
Precambrian Limestone	—	—	—	—	—	—	—	—	—	—	—	—
Acid Igneous Rocks	3.0	6.5	5.5	8.5	4.0	1.5	2.0	4.5	3.5	14.5	13.5	1.0
Basic Igneous Rocks	1.5	1.0	1.0	1.5	0.5	1.0	2.0	3.0	1.5	9.0	7.0	0.5
Hematite-Limonite	—	0.5	—	—	—	—	—	—	—	—	—	—
Biotite	—	—	—	0.5	—	0.5	0.5	—	—	0.5	0.5	—
Muscovite	—	—	—	—	—	—	—	—	—	—	—	—
Hornblende	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.5	0.5	2.0	2.0	0.5
Pyroxene	0.5	—	—	—	—	—	—	0.5	0.5	—	—	1.5
Garnet	—	0.5	0.5	0.5	0.5	—	0.5	0.5	0.5	—	1.0	0.5
Magnetite	0.5	—	—	—	—	—	—	—	—	—	—	—
Unidentified	—	—	—	0.5	—	—	—	—	—	—	—	0.5
Cemented Aggregates	—	1.0	3.0	1.0	—	—	—	—	—	—	—	—

Mineralogical Composition of Sand in South-Central and Southeastern Ontario

(Continued)

Property No. in this Report and on map No. 2038	(250)	(252)	(253)	(254)	(255)	(256)	(258)	(259)	(261)		
Locality or Company operation	R. H. Black, Innisfil Twp.	Uxbridge Sand and Gravel, Goodwood	W. Finch and Sons, Bracebridge	Fowler Constr. Co. Ltd., Blanchard Pit, Monck Twp.	Fowler Constr. Co. Ltd., Ruttan Pit, Macaulay Twp.	Fowler Constr. Co. Ltd., Nicholson Pit, Macaulay Twp.	Hall's Pit, Parry Sound	Bee Jay Sand and Gravel, Terra Cotta	Pax Sand and Gravel, Westwood	Havelock	Pelee Island, dredged sand
Quartz	32.0	37.0	46.5	46.0	47.0	58.5	47.0	35.5	14.0	22.0	21.5
Feldspar	16.0	12.5	31.0	41.0	28.0	30.0	26.0	17.5	12.5	27.5	19.5
Paleozoic Limestone	41.0	42.0	0.5	0.5	—	—	—	28.5	60.0	22.0	21.5
Grey Shale and Siltstone	—	0.5	—	—	—	—	—	5.5	0.5	14.5	11.5
Red Shale and Siltstone	—	—	—	—	—	—	—	—	—	—	—
Black Shale	—	1.5	—	—	—	—	—	1.0	—	—	1.0
Quartz Sandstone	—	—	—	—	—	—	—	—	0.5	—	0.5
Dolomite	0.5	0.5	—	—	—	—	—	0.5	—	—	2.0
Precambrian Limestone	—	—	—	—	—	—	—	—	—	—	—
Acid Igneous Rocks	7.5	4.0	15.0	6.5	16.5	5.0	12.5	6.5	9.5	5.5	11.5
Basic Igneous Rocks	2.0	1.0	3.5	2.5	3.0	1.5	7.0	4.0	1.0	7.0	9.5
Hematite-Limonite	—	—	—	—	—	—	—	—	—	—	—
Biotite	—	—	0.5	1.0	0.5	1.5	0.5	—	—	—	—
Muscovite	—	—	—	—	—	—	—	—	—	—	—
Hornblende	0.5	0.5	2.0	1.5	2.5	2.5	5.0	0.5	2.0	1.5	1.0
Pyroxene	—	0.5	—	0.5	0.5	—	0.5	—	—	—	—
Garnet	0.5	—	1.0	0.5	2.0	0.5	1.0	0.5	—	—	0.5
Magnetite	—	—	—	—	—	0.5	0.5	—	—	—	—
Unidentified	—	—	—	—	—	—	—	—	—	—	—
Cemented Aggregates	—	—	—	—	—	—	—	—	—	—	—

PROSPECTING FOR SAND AND GRAVEL

MAPS AND REPORTS

In prospecting for sand and gravel deposits in Ontario, a knowledge of Pleistocene geology is helpful. This knowledge will assist in predicting and evaluating the type and distribution of gravel deposits to be expected in an area. Several types of maps, indicating the Pleistocene or surficial geology, may be available. For most of southern Ontario, the physiographic maps accompanying the book by L. J. Chapman and D. F. Putnam, "The Physiography of Southern Ontario" (University of Toronto Press, 1951), show the surficial deposits, including such features as kames, eskers, beaches, moraines, etc.

Reports and maps describing the Pleistocene geology of specific areas in Ontario are available from the Geological Survey of Canada, Ottawa, and from the Ontario Department of Mines, Toronto. The following is a partial list of such reports now available.

Coleman, A. P.
1937: Lake Iroquois; accompanied by map No. 45f; Ontario Dept. Mines, Vol. XLV, 1936, pt. 7.

Deane, R. E.
1950: Pleistocene geology of the Lake Simcoe district, Ontario; Geol. Surv. Canada, Mem. 256.

Gravenor, C. P.
1957: Surficial geology of the Lindsay-Peterborough area; Geol. Surv. Canada, Mem. 288.

Johnston, W. A.
1917: Pleistocene and recent deposits in the vicinity of Ottawa; Geol. Surv. Canada, Mem. 101.

Karrow, P. F.
1959: Pleistocene geology of the Hamilton map-area; Ontario Dept. Mines, Geol. Circ. No. 8.
1961: Pleistocene geology of the Galt map-area; Ontario Dept. Mines, Geol. Circ. No. 9.
1962: Preliminary report on the Pleistocene geology of the Scarborough area; Ontario Dept. Mines, P.R. 1962-1.

Owen, E. B.
1951: Pleistocene and recent deposits of the Cornwall-Cardinal area, Stormont, Dundas, and Grenville counties, Ontario; Geol. Surv. Canada, Paper 51-12

Terasmae, J.
1960: Surficial geology of the Cornwall map-area; Geol. Surv. Canada, Paper 60-28.

Watt, A. K.
1957: Pleistocene geology and ground-water resources of the township of North York, York county; Ontario Dept. Mines, Vol. LXIV, 1955, pt. 7.

These reports and maps show the distribution of various types of glacial and recent deposits in the map-areas. Where maps of the surficial geology are not available, county soil surveys are very helpful in indicating distribution of deposits of sand and gravel. A large part of southern Ontario is covered by such surveys.

A complete reference list of publications used in presenting this Industrial Mineral Report is contained in the Bibliography, which will be found on pages 146 and 147 of this report.

SURFACE EXPRESSION

One of the most ready guides to the occurrence of sand and gravel deposits in an area is surface expression. Eskers commonly stand up as long narrow winding ridges. Most kames form hills or large mounds; some kames form a large elevated area, a mile or more in width, with a flat top, as in the case of the Fonthill kame in Welland county. Deltaic deposits of sand will also be found as extensive flat-topped areas, some of which may be elevated above the surrounding plain, especially if the deltas mark the location of an elevated abandoned shoreline. Kame moraines are characterized by rough and hummocky topography.

Beach and bar deposits are linear in character and are generally associated with abandoned shore-cliffs and beach lines. Spillway deposits will be found in valleys and may be present as terraces in such valleys.

Geological interpretation of topographic maps can be very helpful in certain areas in locating surface features of interest to the prospector for sand and gravel. A portion of the Tweed topographic sheet is reproduced in Figure 5; this shows the part of the Tweed esker that forms a long narrow sinuous ridge extending south from Thomasburg. Drumlins are readily identifiable as elongate oval hills. In some areas, beach gravels may be associated with reworking of the tills of the drumlins, and such features may be of commercial interest. A third interesting topographic feature

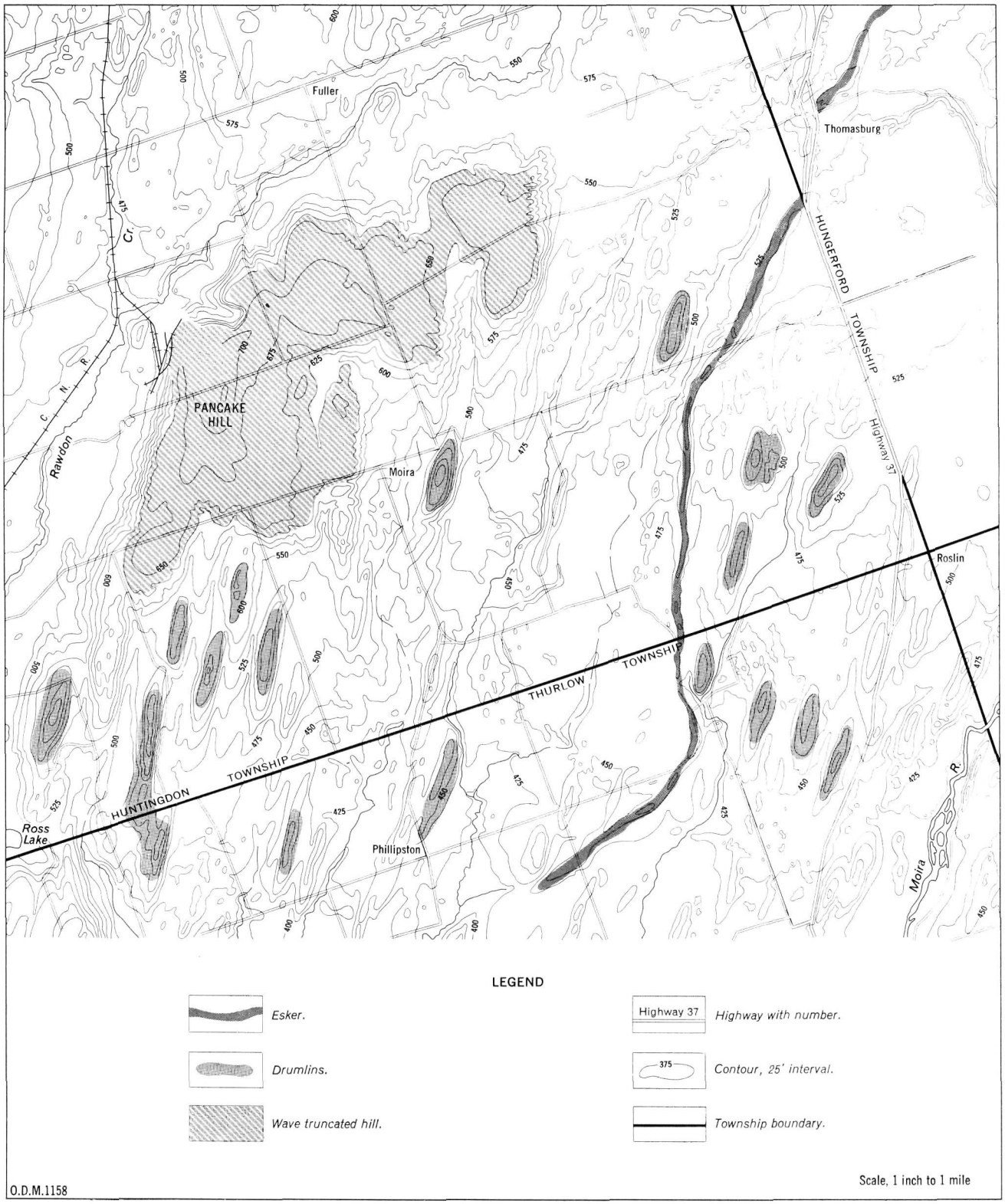


Figure 5 — Glacial features of Thomasburg area, Hastings county.

shown in Figure 5 is Pancake Hill. This moraine hill was truncated by wave action in glacial Lake Iroquois at an elevation of approximately 675 feet, and a gravel deposit was built up on the lee or northwest side composed of gravel eroded from the hill and carried to the northwest or lee slope of the hill. The direction of prevalent wind and wave action was from the southeast. Other gravel deposits are found in the area on the lee slope of similar wave-truncated hills.

Air photographs are of great assistance in interpreting the land features present in an area to be prospected, and the preliminary step of stereoscopic airphoto interpretation may be of great assistance to the prospector.

GEOLOGICAL ASSOCIATIONS

Sand and gravel deposits may be expected in certain geological associations even when the characteristic surface expression is obscure. This is particularly true where features were buried by later ice-advances. An example of this is the Brampton esker which was overridden by ice and buried under a thin cover of glacial till. The characteristic surface expression of the esker was not readily recognizable, but after an examination of the material exposed in cuts confirmed that the deposit is an esker, geologic associations suggested that the north-trending ridge marks the esker course.

Similarly, kame deposits of sand and gravel may be suspected in hills overidden by ice and capped by till, as in the case of the Markham sand and gravel deposit. The surface expression of such deposits may be confused with drumlins. The close association of beach and bar deposits of sand and gravel with shorelines leads to the examination of all shorelines at given elevations in an area under scrutiny. In the Cornwall area, for example, most beach gravel deposits are found on the north and northwest flanks of drumlins.

Spillways, where they are recognized in front of moraines, provide good prospecting ground for gravel deposits.

There is also a general association of coarse ablation deposits of sand and gravel (kames, eskers, outwash) with coarse-textured tills. For example, the sandy Wentworth Till has many kames and eskers deposited on it in the Galt–Guelph district, and in contrast, the silty to clayey Halton Till, which lies east of the Niagara Escarpment near Lake Ontario, has few of these features.

SOURCE-MATERIALS AND DIRECTION OF TRANSPORT

The quality of sand and gravel will depend largely on the nature and environment of the rock formations that supplied materials to the agents of transportation. In prospecting for sand and gravel it is necessary to have some idea of the bedrock formations that supplied detrital material, and to have information on the agents and direction of transportation. In the Toronto area, for example, where the bedrock formation is shale with abundant hard layers of calcareous laminated siltstone of dubious value as an aggregate, and where the direction of transport by the Lake Ontario ice-lobe was from east to west, gravel deposits on or immediately west of the area of outcrop of the Meaford–Dundas Shale can be expected to carry appreciable quantities of siltstone. Similarly in southwestern Ontario, areas west of the cherty Bois Blanc Limestone Formation may be expected to contain chert.

Shingle beaches developed on formations carrying deleterious materials can be expected to contain an abundance of such material.

PROSPECTING METHODS

After having assembled all available geologic maps, reports, and topographic maps in the area to be prospected, and having gained some knowledge of the geologic history of the area during the period when the gravel deposits were formed, the actual field work mainly involves interpretation of physiographic forms in the area, and examination of any exposures and excavations. Water-well records for the townships examined may give information on presence of sand and gravel below the surface.

Some geophysical methods have been successfully applied in prospecting for sand and gravel (Wilcox 1944; Jacobson 1955; Johnson 1959).

The existence of a sizeable deposit of sand and gravel having been proven, tests should be made on samples to determine the grading and physical characteristics of the material. Tests for sand and gravel are described in pages 8-10 of this report.

Essential information includes: depth of overburden to be stripped; thickness of the gravel deposit; areal extent; percentages of sand, gravel, silt, and clay present; variation in sand and gravel content in the deposit; water-table and drainage conditions; availability of water for washing aggregates; facilities for disposal of wastes; availability of transportation; access; location with respect to markets and zoning restrictions in the municipality.

Gravel deposits should be, normally, at least 20 feet thick; however, some beach deposits as thin as 8 feet are worked. For a permanent commercial plant of modest size, a minimum of 1,000,000 tons of gravel should be present, although commercial exploitation of smaller deposits is possible with portable equipment. In 1960 in the

area within 60 miles of Toronto, 64 sand and gravel operations were producing, and these averaged an annual production of 290,000 tons per operator. An average producer would therefore require at least 3,000,000 tons of reserves for a ten-year production period. The largest producers have annual productions of 750,000 to 1,000,000 tons. The sand-to-gravel ratio in the deposit is an important factor because certain sizes of sand, particularly fines, have limited markets. A ratio of 40 percent sand to 60 percent gravel would be considered ideal. Where an excessive amount of gravel is present, marketable sizes can be produced by crushing.

SAND AND GRAVEL PITS IN SOUTH-CENTRAL AND SOUTHEASTERN ONTARIO

BY

D. F. Hewitt

A large number of sand and gravel pits are described in this part of the report, by County or District. The bracketed number following the name or location of the pit refers to the location number given the pit on map No. 2038 (*see* back pocket).

WELLAND COUNTY

Niagara Falls

A buried valley extends from the Whirlpool of the Niagara River to St. Davids. Two miles south of St. Davids this valley, which cuts into the Niagara Escarpment, is filled with well-stratified well-sorted glaciofluvial and glaciolacustrine sand. Sand pits are operated by Calaguiro Brothers, and by Braas Brothers, in these deposits near Stamford in Stamford township.

CALAGUIRO BROTHERS (1)

The sand pits operated by Calaguiro Brothers are on both sides of highway No. 8 at Mountain Road, ½ mile north of Stamford in Stamford township, Welland county. The pit on the west side of the highway is worked on two levels. The 30-foot face on the upper level is composed of well-bedded well-sorted fine sand containing some reddish silt and clay derived from the Queenston Shale. The 20-foot face on the lower level is composed of fine gravel (30 percent) and coarse sand (70 percent). The maximum size of pebbles is 3 inches, and 40 percent exceed 1 inch. The deposit is well-stratified and shows little or no cross-bedding.

The pits on the east side of the highway have been extensively worked for a distance of 1,200 feet. A 20-foot face exposes interstratified fine gravel and sand, coloured by reddish Queenston silt and clay. Fine pea gravel is exposed at the north end of the pit.

A pebble count of the gravel from the west pit gives the following assemblage: Ordovician limestone; Silurian dolomite; maroon and brown siltstone; red Queenston Shale, (scarce); white Medina Sandstone; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of sand from the east pit is given in (XXXI).

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the major constituents are: quartz, 37 percent; feldspar, 19; limestone, 11; grey shale and siltstone, 16.5; and red shale and siltstone, 12 percent.

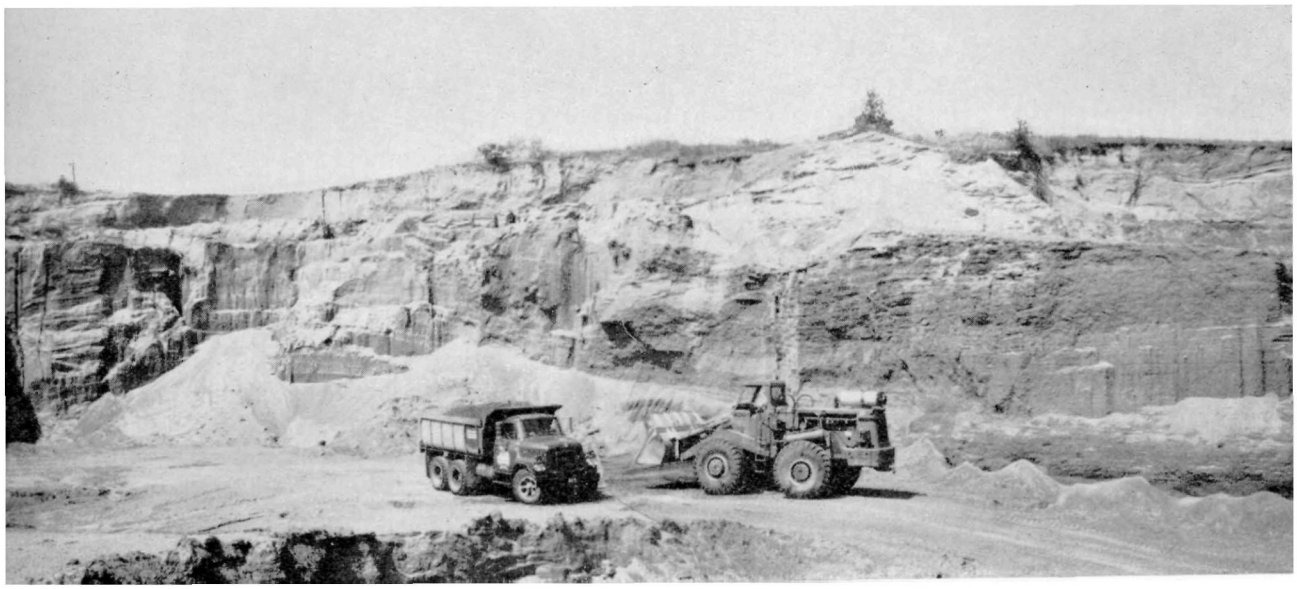
There is no plant on the property; most of the material shipped is pit-run sand and gravel.

BRAAS BROTHERS (2)

One half mile east of Calaguiro Brothers on the northeast side of the C.N.R. tracks, a sand pit is operated by Braas Brothers. The 20- to 30-foot face on the north side of the pit consists of stratified fine sand (90 percent) and fine gravel (10 percent). There is six feet of overburden. No medium or coarse gravel was observed in the pit. Some reddish silt and clay is present with the sand.

The main production from the pit is sand fill, asphalt sand, and brick sand. A small screening and washing plant produces at the rate of about 25 tons per hour.

A sieve analysis of the sand from this pit is given in (XXXII).



Calaguiro Brothers sand pit, Niagara Falls.

(XXXI) CALAGUIRO BROTHERS (EAST PIT) (1)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	nil	nil	nil	0.10	9.35	77.82	10.93	1.80

(XXXII) BRAAS BROTHERS (2)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	0.08	1.48	3.93	9.62	20.53	43.08	15.61	5.67

(XXXIII) FONTHILL SAND AND GRAVEL (3)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	nil	1.0	1.7	28.1	43.4	19.3	1.5	5.0

(XXXIV) MOYER SAND AND GRAVEL LIMITED (4)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	1.3	4.1	10.5	23.4	33.5	20.8	3.5	2.9

Braas Brothers sand pit, Niagara Falls.

A mineralogical analysis of the sand by the Ontario Research Foundation indicates that the major constituents are: quartz, 41.5 percent; feldspar, 19.5; Paleozoic limestone, 11; grey shale and siltstone, 15; and red shale and siltstone, 11.5 percent.

Fonthill

A large flat-topped kame deposit, two miles in length and one mile wide, extends across highway No. 20 west of Fonthill, and stands up about 75 feet above the surrounding country. Fonthill Sand and Gravel, and Moyer Sand and Gravel operate in this kame.

FONTHILL SAND AND GRAVEL (3)

The gravel pit operated by Fonthill Sand and Gravel is on lot 9, concession VII, Pelham township, Welland county, just north of highway No. 20, two miles west of Fonthill. There are extensive workings over 1,000 feet in length. One 20-foot face examined consisted of well-stratified sand and medium to fine gravel. The sand contains reddish clay and silt derived from the Queenston Shale areas to the north.

A pebble count of the gravel from this deposit gives the following assemblage: Silurian dolomite; Ordovician limestone; siltstone; sandstone; shale, (rare); pebble conglomerate; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

There is a considerable proportion of cemented pebble conglomerate. The pebbles are rounded to subrounded.

A sieve analysis of sand from this pit is given in (XXXIII).

The principal products are pit-run sand and gravel, screened sand, 2-inch stone, and $\frac{7}{8}$- and $\frac{5}{8}$-inch crusher-run for granular base course. Two portable crushing plants are employed at the pit.

MOYER SAND AND GRAVEL LIMITED (4)

The gravel pit of Moyer Sand and Gravel Limited is on lots 10 and 11, concession VII, Pelham township, Welland county, just north of highway No. 20, $2\frac{1}{2}$ miles west of Fonthill. Very extensive workings have been opened for nearly $\frac{1}{2}$ mile in an easterly direction. The 20- to 60-foot faces of the pit expose well-bedded well-sorted fine to coarse sand and gravel. The section shows a red coloration due to the presence of red clay and silt from the Queenston Formation. Crossbedding is common.

A 30-foot face examined consists of reddish medium-grained sand (75 percent) and fine gravel (25 percent). Maximum size of stone is 3 inches; 30 percent of the gravel exceeds one inch in size. A 50-foot face examined consists of 20 percent

Kame gravels at Moyer pit, Fonthill.

stone and 80 percent sand. Maximum size of gravel is 6 inches; 20 percent exceeds 4 inches, and 40 percent exceeds 1 inch.

A pebble count of the gravel from this deposit gives the following assemblage: Ordovician limestone; Silurian dolomite; maroon and grey siltstone; grey Medina Sandstone; red Queenston Shale, (rare); Precambrian acid igneous rocks; Precambrian metamorphic rocks; and conglomerate.

Many pebbles are flat. In some parts, the pit is characterized by a large amount of cementation of the fine gravel; many clusters of cemented pebbles appear in the gravel. The presence of appreciable amounts of siltstone and shale renders the gravel unsuitable for concrete aggregate. Jigs are employed in the gravel plant to reduce the amount of shale in the sand fraction.

A sieve analysis of sand from one of the faces is given in (XXXIV).

A mineralogical analysis of the sand by the Ontario Research Foundation gives the following major constituents: quartz, 30.5 percent; feldspar, 16.5; Paleozoic limestone, 11; grey and red shale and siltstone, 38.5 percent.

The plant produces ¾-inch stone, concrete sand, asphalt sand, brick sand, plaster sand, and crusher-run gravel. Concrete sand is the main product. Two ¾-cubic-yard shovels load two 15-ton Euclid trucks for haulage to the plant. The sand and gravel from the pit is dumped into a hopper that feeds a conveyor to a two-deck Dillon 3- by 8-foot screen with 2-inch and 1⅛-inch openings. The plus-2-inch and plus-1⅛-inch stone goes to a jaw crusher in closed circuit with the screens. The throughs go to a scrubber and then to a single-deck Tyler 5- by 12-foot screen with ¼-inch openings. The plus-¼-inch stone goes to a two-deck Dillon 3- by 6-foot screen equipped with spray bars. This screen produces ¾-inch stone. The throughs go to a Dore classifier and on to a sand stockpile.

The minus-¼-inch stone and sand from the Tyler screen go to a Telsmith settling tank (6 valves). The products go to two jigs that remove the shale particles from the sand. The jig products go to two Telsmith dewatering screws, then to two Dorr rake classifiers, then to a filter, and on to the sand stockpile. Concrete sand and asphalt sand are not made at the same time.

A portable plant is used to make crusher-run.

WENTWORTH COUNTY

Aldershot

The old beach deposits of glacial Lake Iroquois extend southwest parallel to highway No. 2 near Aldershot. These beach gravels are worked by J. Cooke Concrete Blocks Limited at Aldershot, and an adjoining property was formerly worked by Howard Concrete and Materials Limited.

J. COOKE CONCRETE BLOCKS LIMITED (5)

The gravel deposit and plant of J. Cooke Concrete Blocks Limited are situated northwest of highway No. 2 at Aldershot in East Flamborough township, Wentworth county. The beach

Foreset bedding in kame terrace at DCB gravel pit, Milton.

(XXXV) HAYWARD AND PICKET LIMITED (6)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	5.12 27.0	11.74 21.4	42.06 21.8	29.21 11.5	5.98 7.0	1.31 5.4	0.88 1.8	2.70 4.1

(XXXVI) HALTON COUNTY PIT (6)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	8.28	12.27	20.92	23.03	16.00	10.64	2.41	6.45

(XXXVII) DCB GRAVEL COMPANY (7)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	15.47 7.9	13.93 26.2	36.83 41.1	24.14 18.0	5.11 2.9	1.69 1.0	0.87 0.5	1.96 2.4

(XXXVIII) INDUSTRIAL SAND AND GRAVEL (8)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	17.9	33.8	33.5	10.9	2.1	0.3	0.2	1.3

deposit consists of about 18 feet of medium to coarse imbricated gravel with little sand. The maximum size of gravel is 8 inches; 30 percent exceeds 4 inches, and 60 percent exceeds 1 inch.

A pebble count of the gravel from the beach deposit gives the following assemblage: brown, green, and red siltstone; Black River and Trenton limestones; dolomite; black shale; arkose; cemented conglomerate; Precambrian granitic rocks; and Precambrian basic igneous rocks.

The gravel contains a large proportion of flat siltstone pebbles.

HALTON COUNTY

Milton

Southwest of Milton there is a large outlier or "island" of Lockport Dolomite standing above the surrounding country and detached from the main Niagara Escarpment by a narrow valley. A large kame terrace deposit of gravel was built up at the south end of this narrow valley, just south of Rattlesnake Point on lots 11 and 12, concessions IV and V, Nelson township, by glacial runoff when the ice-front stood east of the Escarpment. There are 4 gravel pits operated in this thick gravel deposit.

HAYWARD AND PICKET LIMITED (6)

A gravel pit is operated by Hayward and Picket Limited on lot 12, concession IV, Nelson township, Halton county, ½ mile southwest of Rattlesnake Point, and 4 miles southwest of Milton. The deposit is part of the thick gravel kame terrace formed at the mouth of the narrow valley between the Niagara Escarpment and the Milton outlier. The gravel in this kame terrace is 60–80 feet deep. A 40-foot face exposes crossbedded poorly-sorted medium to fine gravel (70 percent) and sand (30 percent). The maximum size of gravel is 5 inches. Ten percent of the gravel exceeds 4 inches, and 50 percent exceeds 1 inch. Fine sand is rare, and there is much pea gravel. Some of the gravel shows cementation. Crossbedding indicates a source to the north.

A pebble count of the gravel gives the following assemblage: green and brown Dundas Siltstone; maroon Grimsby Siltstone; Black River and Trenton limestones; Amabel Dolomite; aphanitic grey dolomite; sandstone; cemented conglomerate; Precambrian granitic rocks; and Precambrian metamorphic rocks.

Sieve analyses of two sand samples taken from the pit are given in (XXXV).

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the following major constituents: quartz, 16.5 percent; feldspar, 13; Paleozoic limestone, 27.5; grey shale and siltstone, 25; red shale and siltstone, 2.0; dolomite, 3.5; acid igneous rocks, 9.5 percent.

A small crushing and screening plant produces ¾-inch and ⅜-inch stone, concrete sand, and road sand. Crusher-run gravel is also produced.

HALTON COUNTY PIT (6)

The County of Halton operates a gravel pit on lot 12, concession V, Nelson township, Halton county, across the road from Hayward and Picket. A 20-foot face exposes partially cemented medium gravel (60 percent) and sand (40 percent). Twenty percent of the gravel exceeds 4 inches in size, and 60 percent exceeds 1 inch.

The production is principally crusher-run and pit-run gravel.

A sieve analysis of sand from this pit is given in (XXXVI).

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the following major constituents: quartz, 24.5 percent; feldspar, 10.5; Paleozoic limestone, 23.5; grey shale and siltstone, 20.5; red shale and siltstone, 8.5; acid igneous rocks, 8.0 percent.

DCB GRAVEL COMPANY (7)

The DCB Gravel Company operates a gravel pit in the kame terrace deposit on lot 11, concession IV, Nelson township, Halton county, south of the Hayward and Picket operation. A 20-foot face exposes interstratified and crossbedded medium gravel and sand. Gravel makes up 50–60 percent of the face. Ten percent of the gravel exceeds 4 inches, and 50 percent exceeds 1 inch.

A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; Amabel Dolomite; brown Dundas Siltstone; red siltstone; Potsdam Sandstone; Queenston Shale, (rare); Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

Sieve analyses of two samples of sand from the pit are given in (XXXVII).

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the following major constituents: quartz, 15 percent; feldspar, 15.5; Paleozoic limestone, 21; grey shale and siltstone, 24.5; red shale and siltstone, 10; acid igneous rocks, 8; basic igneous rocks, 2 percent.

A portable plant is employed to produce crusher-run gravel. Pit-run gravel is also produced. There is no permanent plant on the property.

SHERMAN SAND AND GRAVEL LIMITED (231)

In 1962, Sherman Sand and Gravel Limited opened a pit in this kame terrace east of the DCB Gravel property. The gravel deposit is similar to the previous three described.

Georgetown

The Georgetown spillway extends southward across parts of Albion, Caledon, Chinguacousy, and Esquesing townships. Gravel pits operated by Industrial Sand and Gravel, Oriole Block, Armstrong Brothers Company, William R. Greenley Construction Company, and Consolidated Sand and Gravel Limited, are in this spillway.

INDUSTRIAL SAND AND GRAVEL (8)

The gravel pit operated by Industrial Sand and Gravel is on lot 23, concession X, Esquesing township, Halton county, on the east side of the road a mile north of Glen Williams. The deposit consists of 20–30 feet of well-stratified clean medium to coarse gravel. Numerous pebbles of red Queenston Shale present in the face rarely appear in the stockpile owing to attrition. The deposit is a spillway gravel.

A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; dolomite; brown and maroon Dundas and Queenston siltstones; grey sandstone; Queenston Shale, (rare); Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of a sand sample from the pit is given in (XXXVIII).

ORIOLE BLOCK COMPANY (8)

The Oriole Block Company pit is on lot 22, concession X, Esquesing township, Halton county north of Glen Williams, just south of the pit of Industrial Sand and Gravel. The deposit is stratified and crossbedded spillway sand and gravel. A 20-foot face consists of fine gravel (40 percent) and coarse sand (60 percent). The maximum size of boulders is 12 inches; 10 percent of the gravel exceeds 4 inches, and 50 percent exceeds 1 inch. There is some cementation of the gravel.

A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; Dundas Siltstone; red Queenston Shale; dolomite; Potsdam Sandstone; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of sand from the pit is given in (XXXIX).

Crusher-run gravel is produced by a portable plant.

ARMSTRONG BROTHERS COMPANY LIMITED (248) (Glen Williams Pit)

Armstrong Brothers Glen Williams pit is on lot 24, concession XI, Esquesing township, Halton county, in the Georgetown spillway on the west side of the Credit River. There is 6–8 feet of overburden. The upper 15-foot face examined exposes fine to medium stratified gravel (50 percent), sand, silt, and clay. The gravel has a red coloration from clay derived from the Queenston Shale. The maximum size of gravel observed was 6 inches; 20 percent exceeds 4 inches, and 60 percent exceeds 1 inch. The lower 15-foot lift exposes coarser cemented gravel.

W. R. GREENLEY CONSTRUCTION COMPANY (229)

The gravel pit operated in 1962 by W. R. Greenley Construction Company is a mile west of

(XXXIX) ORIOLE BLOCK COMPANY (8)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	1.8	4.1	7.6	17.2	22.3	39.5	5.1	2.4

(XL) W. R. GREENLEY CONSTRUCTION COMPANY (229)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	19.0	16.5	32.7	22.9	4.3	0.9	0.5	3.2

(XLI) ALREX SAND AND GRAVEL (244)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	0.4	1.8	5.0	17.0	33.1	32.6	5.4	3.7

Stewarton on lot 19, concession VII, Esquesing township, Halton County. Stratified gravels of the Georgetown spillway are exposed in an 18-foot face consisting of 40 percent stone and 60 percent sand and red clay. Clay from the red Queenston Shale imparts a red colour to the gravel. The maximum size of gravel is 12 inches; 25 percent of the gravel exceeds 4 inches, and 50 percent exceeds 1 inch. The pebble assemblage consists of limestone, dolomite, siltstone, sandstone, red shale, and Precambrian rocks. There is 1–3 feet of overburden. Poorly-sorted dipping beds of gravel lie at the top of the section and are underlain by fine gravel and coarse sand. A 5-foot band of clay till is present midway up one part of the 18-foot face.

A sieve analysis of sand from the face is given in (XL).

CONSOLIDATED SAND AND GRAVEL LIMITED (228) (McBride Pit, Stewarton)

The McBride pit, operated in 1961 and 1962 by Consolidated Sand and Gravel Limited, is on lot 19, concession VI, Esquesing township, Halton county, one mile west of Stewarton. In a deposit of the Georgetown spillway, the 20-foot faces expose imbricated coarse to fine spillway gravels and sand, coloured reddish by clay derived from the Queenston Shale. One face examined is coarse imbricated gravel (60 percent) and coarse sand (40 percent). Maximum size of boulders is 24 inches; 30 percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch. A second face is of 30 percent gravel and 70 percent sand and red clay; the maximum size of gravel is 4 inches, with 50 percent exceeding 1 inch.

A pebble count of gravel from this deposit gives the following assemblage: Amabel Dolomite; Black River and Trenton limestones; sandstone; siltstone; chert, (rare); Precambrian acid igneous rocks; and Precambrian basic igneous rocks.

Crusher-run gravel is produced by a portable plant.

ALREX SAND AND GRAVEL (244)

The Silver Creek pit of Alrex Sand and Gravel is on lot 27, concession VII, Esquesing township, Halton county on the west side of highway No. 7, four miles northwest of Georgetown. The deposit consists of interstratified sand and medium to coarse gravel with some cementation. A 15-foot face examined is 60 percent gravel and 40 percent sand. Maximum size of gravel is 10 inches; 30 percent exceeds 4 inches, and 70 percent exceeds 1 inch. Other faces show less gravel and more sand.

A pebble count of the gravel gives the following pebble assemblage: Black River and Trenton limestones; reddish siltstone; brownish siltstone; Amabel Dolomite; Potsdam Sandstone; Queenston Shale, (rare); Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of sand from the pit is given in (XLI).

The plant was not operating at the time of the author's visit in 1962.

Limehouse

BROOKS PIT (230)

There is a gravel pit on the farm of Fred Brooks, lot 23, concession V, Esquesing township, Halton county just west of the village of Limehouse. A 25- to 30-foot face on the south side of a hill exposes well-stratified well-sorted medium to fine gravel (50 percent) and coarse sand (50 per cent). The maximum size of boulders is 6 inches; 10 percent of the gravel exceeds 4 inches, and 50 percent exceeds 1 inch.

A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; Amabel Dolomite; brown siltstone; Potsdam Sandstone; red siltstone; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

There is no plant on the property, but portable plants are employed as required.

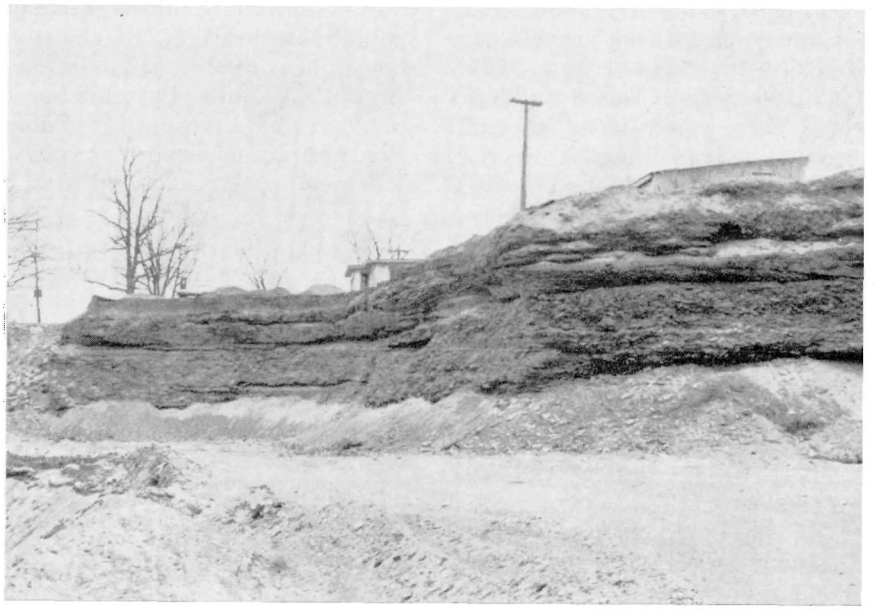
PEEL COUNTY

Clarkson

Half a mile south of Erindale in Peel county, lies a group of gravel pits on the northwest side of the Queen Elizabeth Way. These gravel deposits are in the old beach of glacial Lake Iroquois; they are operated by Sherman Sand and Gravel, Clarkson Sand and Gravel, R. H. Pinchin, and Hughs Haulage. The depth of the gravel in these shallow deposits rarely exceeds 15–20 feet. They are composed of medium to coarse imbricated gravel and minor amounts of sand. The beach crosses the Dundas and Meaford shale formations and the beach shingle contains numerous pebbles of siltstone and shale.

SHERMAN SAND AND GRAVEL LIMITED (9)

The plant of Sherman Sand and Gravel is at the intersection of Springbank Road and Mississauga Road, in Peel county, ½ mile north of the Queen Elizabeth Way. The gravel pits are on lots 12 and 13, range 3 CIR. The beach deposit of stratified gravel and coarse sand is exposed in a 20-foot face in the proportion of 50 percent stone and 50 percent sand. There is 2–4 feet of stripping. Pebbles are flattened, and imbricate structure is common.



Cemented Iroquois beach gravel at Clarkson pit of Hughs Haulage.

(XLII) SHERMAN SAND AND GRAVEL LIMITED (9)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	2.77 12.1	1.81 8.6	3.42 11.1	11.20 21.8	32.69 25.6	46.22 17.1	0.83 2.2	1.06 1.5

(XLIII) CLARKSON SAND AND GRAVEL LIMITED (11)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	3.54	8.36	18.08	31.58	26.74	9.40	0.82	1.48

(XLIV) R. H. PINCHIN (12)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	15.77	24.48	16.58	10.49	14.02	16.15	1.02	1.49

(XLV) FRANCESCHINI BROTHERS CONSTRUCTION LIMITED (13)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	10.33	14.58	21.69	22.44	18.78	7.37	1.54	3.27

The maximum size of boulders is about 10 inches; 20 percent of the material exceeds 4 inches, and 50 percent exceeds 1 inch. There is some cementation of pebbles.

A pebble count of the gravel gives the following assemblage: brownish Dundas Siltstone; Black River and Trenton limestones; Potsdam Sandstone; reddish siltstone; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

Sieve analyses of two samples of sand taken from different faces in the pits are given in (XLII).

These analyses indicate the magnitude of the size-range in beach sands from various sections of this deposit.

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the following major constituents: quartz, 36 percent; feldspar, 17; Paleozoic limestone, 22.5; grey shale and siltstone, 17; acid igneous rocks, 4.5 percent.

The plant has a capacity of approximately 140 tons per hour. Sand and gravel is dumped into a hopper that feeds a 15- by 30-inch Sawyer-Massey jaw crusher discharging to a surgepile. From the surgepile, material is fed to a flow-control hopper in a closed circuit. From this hopper the material is discharged to a single-deck 4- by 8-foot Dillon scalper screen dry (screen opening, 1 inch). Oversize from the 1-inch screen goes to a 3-foot Symons cone crusher and then is discharged, by a conveyor through a scrubber, to a two-deck 3½- by 8-foot Dillon screen that has spray bars and ½- and ¼-inch screen openings. The plus-½-inch stone goes to the ¾-inch crushed-stone stockpile. The plus-¼-inch stone goes to the ⅜-inch crushed-stone stockpile. The throughs (screenings dewatered through an Eagle screw classifier) go to a loading bin.

The minus-1-inch from the 4- by 8-foot Dillon scalper is discharged by conveyor to a two-deck 3½ by 10-foot Dillon screen. Screens are 4-mesh and 55-mesh. The plus-4-mesh is discharged through an Eagle log washer to a 3-deck 3½- by 8-foot Dillon sizing screen with spray bars. The plus-55-mesh goes through a Dorr rake classifier to a concrete-sand stockpile, and the throughs from the 55-mesh screen go to a 5-foot Wemco dewatering screw to a brick-sand stockpile.

The three-deck sizing screen uses 4-mesh, ½-inch, and ¾-inch screen cloth to produce special grit, ⅜-inch round roofing stone, ⅝-inch round, and ¾-inch round stone, all of which is stored in bins.

HUGHS HAULAGE (10)

The gravel pit worked by Hughs Haulage is on the north side of the Queen Elizabeth Way at Clarkson Road, in Peel County. A 20-foot face exposes imbricated gravel, flattened pebbles, and poorly-sorted sand. Seventy percent of the face is gravel, and 30 percent is sand. The maximum size of boulders is 12 inches; angular flat slabs of siltstone are common. Sixty percent of the gravel exceeds 4 inches in size, and 80 percent exceeds 1 inch. Dundas Shale and Siltstone are exposed in the bottom of the pit. Much of the gravel shows strong cementation, and the pebbles are encrusted with varied amounts of carbonate. Some of the coarse gravel shows strong crossbedding; fine gravel, pea gravel, and coarse sand also are present in the deposit.

The production from this pit is mainly crusher-run gravel.

CLARKSON SAND AND GRAVEL LIMITED (11)

The northwest part of the pit worked by Hughs Haulage, in Peel county, is worked by Clarkson Sand and Gravel. The gravel deposit is similar to that already described.

A pebble count of the gravel gives the following assemblage: cemented conglomerate; brown Dundas Siltstone; Black River and Trenton limestones; dolomite; and Precambrian acid igneous rocks.

There is a large number of flattened siltstone pebbles.

A sieve analysis of sand from this pit is given in (XLIII).

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the following major constituents: quartz, 26 percent; feldspar, 16; Paleozoic limestone, 27; grey shale and siltstone, 18.5; black shale, 3.5; acid igneous rocks, 6.5 percent.

The production of this pit is mainly crusher-run gravel.

A second pit is operated by Clarkson Sand and Gravel Limited on the northeast side of Springbank Road, less than ¼ mile from the Queen Elizabeth Way. A 15-foot face exposes well-stratified well-sorted, medium and coarse, crossbedded gravel. Sand is not common, and much of the finer aggregate is pea gravel. One section of the face examined is 80 percent gravel and 20 percent sand. Twenty percent of the gravel exceeds 4 inches in size, and 60 percent exceeds 1 inch.

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the following major constituents: quartz, 22.5 percent; feldspar, 16; Paleozoic limestone, 27; grey shale and siltstone, 21.5; red shale and siltstone, 2; black shale, 2.5; acid igneous rocks, 6.5; basic igneous rocks, 2 percent.

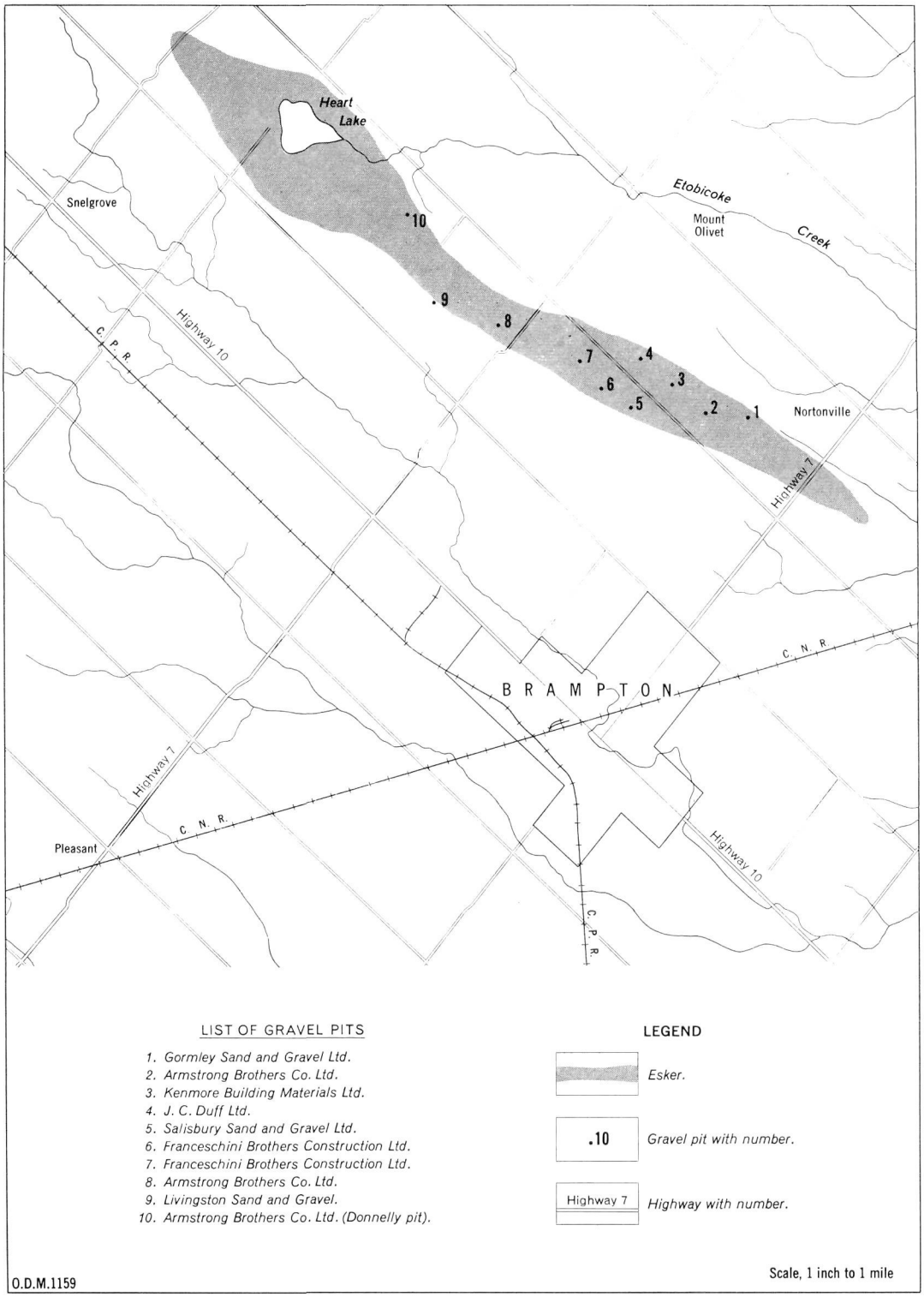


Figure 6—Sketch-map showing location of gravel pits in Brampton esker, Peel county.

R. H. PINCHIN (12)

The R. H. Pinchin pit south of Sherman Sand and Gravel on Springbank Road in Peel county is worked by Franceschini Brothers Construction Company. A twenty-five foot face exposes stratified coarse and medium gravel (50 percent) and coarse sand (50 percent). There are many flattened pebbles and imbricate structure is common. Twenty percent of the gravel exceeds 4 inches in size, and 50 percent exceeds 1 inch.

A sieve analysis of sand from this pit is given in (XLIV).

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the following major constituents: quartz, 35 percent; feldspar, 21; Paleozoic limestone, 23; grey shale and siltstone, 12.5; acid igneous rocks, 5.5 percent.

Erindale

FRANCESCHINI BROTHERS CONSTRUCTION LIMITED (13)

Franceschini Brothers operate a gravel pit on the west side of the Credit River just northwest of Erindale, on the east side of the Streetsville road, in Peel county. This gravel deposit is similar to the beach gravel deposits on Springbank Road to the south. The pit has an uneven floor of Dundas Shale. The 15- to 25-foot face exposes stratified gravel, sand, and silt. One section examined is 80 percent gravel and 20 percent sand. Twenty percent of the gravel exceeds 4 inches in size, and 60 percent exceeds 1 inch. Long flat slabs of siltstone are common. There is considerable cementation of the gravel.

A pebble count of the gravel from this pit gives the following assemblage: brownish Dundas siltstone; Black River and Trenton limestones; grey and white sandstone; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

Most of the gravel is derived locally from the Dundas Formation.

A sieve analysis of sand taken from the pit face is given in (XLV).

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the following major mineral constituents: quartz, 25.5 percent; feldspar, 20.5; Paleozoic limestone, 26.5; grey shale and siltstone, 16; acid igneous rocks, 5.5 percent.

Production is mostly crusher-run gravel.

Cooksville

There are two gravel pits north of Cooksville in Toronto township east of highway No. 10.

FRANCESCHINI BROTHERS CONSTRUCTION LIMITED (221)

Franceschini Brothers Construction Limited operates a sand pit on the farm of Stewart Scott, on lot 2, concession IE, Toronto township, Peel county. A 25-foot face exposes well-stratified fine sand, but no gravel.

A sieve analysis of sand taken from the face is given in (XLVI).

The material is mainly used for sand fill.

MINERAL INDUSTRIES SAND AND GRAVEL LIMITED (222)

A gravel pit is operated by Mineral Industries Sand and Gravel on lot 3 or 4, concession II E, Toronto township, Peel county. The gravel forms a beach deposit resting on Dundas Shale bedrock. Many of the pebbles are flattened, and imbricate structure is evident. A 15-foot face exposes 50 percent gravel and 50 percent sand. The maximum size of stone is 10 inches; 40 percent exceeds 4 inches and 60 percent exceeds 1 inch. Shale and siltstone pebbles are present in the gravel.

Brampton

North of Brampton in Peel county, a partly buried esker extends northwest for a distance of more than three miles, from Nortonville on highway No. 7 two miles northeast of Brampton, to Heart Lake. The esker consists of variable deposits of coarse, medium, and fine gravel with stratified sand and, in places, silt and clay. The deposits, having been laid down by a stream within or beneath the ice-sheet, are extremely variable and show rapid changes of lithology over short distances. Because the stream flowed across an area underlain mainly by the Meaford–Dundas Shale, there are numerous pebbles of Meaford–Dundas laminated siltstone in the gravels. In places, the siltstone constitutes more than 30 percent of the gravel. A considerable amount of cementation and encrustation also is present in places.

Nine sand and gravel pits have been opened in this esker. Their locations are indicated on Figure 6, from southeast to northwest, as follows: Gormley Sand and Gravel (lot 7, concession IIIE, Chinguacousy township, Peel county), Armstrong Brothers, Kenmore Building Materials, J. C. Duff, Salisbury Sand and Gravel, Franceschini Brothers, Armstrong Brothers (lot 11, concession IIE), Livingston Sand and Gravel, and Armstrong Brothers (Donnelly pit, lot 13, concession IIE). These operators produce mainly pit-run sand and gravel, fill, and crusher-run gravel.

GORMLEY SAND AND GRAVEL LIMITED (15)

Gormley Sand and Gravel operates the most southerly gravel pit in the Brampton esker in Peel county. A 40- to 50-foot face is 80 percent sand and 20 percent stone. The maximum size of stone is 4 inches, and 50 percent of the pebbles exceed 1 inch. A 3-foot cap of clay till that overlies parts of the pit was deposited on the esker by an overriding ice-sheet.

A sieve analysis of sand from the face is given in (XLVII).

The main products are pit-run gravel, sand fill, and crusher-run gravel. There is no permanent plant at the pit.

ARMSTRONG BROTHERS COMPANY (15)

A small inactive gravel pit lies east of the Armstrong Brothers Ready Mix plant on the east side of the road, ¾ mile north of highway No. 7, in Peel county. The 20-foot face exposes poorly-sorted dirty gravel (70 percent) and sand (30 percent). The maximum size of boulders is 10 inches. Fifty percent of the gravel exceeds 4 inches, and 80 percent exceeds 1 inch. The gravel is rounded to subangular, and many pebbles of flat siltstone are present. The east face of the pit contains much silt. There is considerable cementation and encrustation of the gravel.

A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; Dundas Siltstone; sandstone; cemented conglomerate; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

KENMORE BUILDING MATERIALS LIMITED (16)

The gravel pit worked by Kenmore Building Materials lies north of Armstrong Brothers Ready Mix plant, on lot 8, concession III E, Chinguacousy township, Peel county. The pit faces expose a heterogeneous assemblage of interstratified sand and gravel. A portable crushing plant is employed to produce crusher-run. Fill is also produced.

A sieve analysis of sand from the face is given in (XLVIII).

J. C. DUFF LIMITED (17)
(Clarkson Pit)

A large gravel pit is operated north of Kenmore Building Materials pit on the east side of the road on lot 9, concession III E, Chinguacousy township, Peel county. The pit was operated in 1962 by J. C. Duff Limited.

The variable character of this esker deposit is shown well in this pit. The 30-foot north face grades from massive coarse cemented gravel on the west, to medium gravel overlain by stratified sand and gravel, and then to well-bedded stratified sand and gravel on the east. The 30-foot face of coarse cemented gravel is 90 percent gravel and 10 percent sand. Boulders up to 18 inches in size are found. Sixty percent of the gravel exceeds 4 inches, and 90 percent exceeds 1 inch. The pebble assemblage contains much siltstone and some shale and white Potsdam Sandstone. There is a capping of till on the gravel. The gravel is cemented and poorly-sorted, and contains subangular to subrounded pebbles, many of which are flattened.

A 25-foot face on the east side of the pit is composed of stratified sand and fine gravel. Current bedding and pebble imbrication indicates the source of material was in the south. Some silt beds are present in the sand.

(XLVI) FRANCESCHINI BROTHERS CONSTRUCTION LIMITED (221)

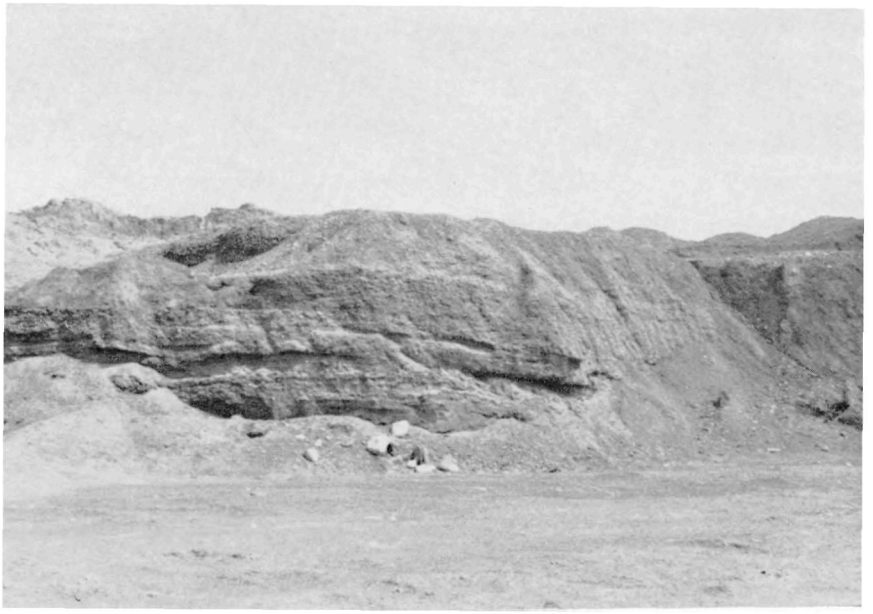
Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	0.03	nil	0.02	1.03	17.03	68.45	8.30	5.14

(XLVII) GORMLEY SAND AND GRAVEL LIMITED (15)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	7.8	3.0	4.5	10.8	20.0	27.8	14.1	12.0

(XLVIII) KENMORE BUILDING MATERIALS LIMITED (16)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	0.9	1.7	6.3	12.8	22.8	41.3	11.2	3.0



Buried esker exposed at Clarkson pit, Brampton.

Another 25-foot face, farther south, consists of fine stratified gravel (70 percent) and sand (30 percent). The maximum size of pebbles is 4 inches, with 70 percent of the pebbles exceeding 1 inch.

Crusher-run gravel is produced by portable crushing and screening plants.

A pebble count of gravel from this pit gives the following assemblage: Black River and Trenton limestones; brownish Dundas Siltstone; white Potsdam Sandstone; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

Portable crushing and screening plants produce 2-inch and ¾-inch stone, and crusher-run gravel. Sand fill and pit-run gravel are also produced.

A sieve analysis of sand from the north face is given in (XLIX).

SALISBURY SAND AND GRAVEL COMPANY (18)

West of the pit operated by J. C. Duff, on the west side of the road, pits have been opened by Salisbury Sand and Gravel on lot 8, concession II E, Chinguacousy township, Peel county. The esker channel has a width of about ½ mile, and the Salisbury deposits lie on the west side of the channel. For this reason coarse gravels are absent, and the deposits consist mainly of medium to fine gravel, and stratified sand.

A 30-foot face consists of 20 feet of crossbedded stratified sand containing some silt, underlain by 10 feet of gravel that is 80 percent stone and 20 percent sand. Five percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch. The gravel is well-rounded and well-sorted. Coarse sand and granule gravel is present in a face opened west of the main pit.

A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; brownish Dundas Siltstone; white Potsdam Sandstone; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

Sieve analyses of two sand samples taken from the faces are given in (L).

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the following major mineral constituents: quartz, 28.5 percent; feldspar, 14; Paleozoic limestone, 38.5; grey shale and siltstone, 7.5; acid igneous rocks, 5.5 percent.

Sand fill, pit-run gravel, crushed stone, and brick sand are produced.

FRANCESCHINI BROTHERS CONSTRUCTION LIMITED (19)

North of Salisbury Sand and Gravel, Franceschini Brothers Construction Limited has opened a pit on lot 8, concession II E, Chinguacousy township, Peel county. Overburden is 6–10 feet deep. The north face of the pit exposes 25 feet of stratified sand and gravel grading laterally into poorly-sorted medium gravel (60 percent) and sand (40 percent). The maximum size of boulders is 8 inches.

Stratified sand and gravel on the west flank of the Brampton esker; Salisbury Sand and Gravel.

(XLIX) J. C. DUFF (CLARKSON PIT) (17)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	3.9	3.6	7.3	14.4	28.0	31.8	7.9	3.1

(L) SALISBURY SAND AND GRAVEL COMPANY (18)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	nil nil	0.76 0.2	3.36 1.4	11.66 10.1	27.42 38.8	43.48 45.0	9.93 2.9	3.39 1.6

(LI) FRANCESCHINI BROTHERS CONSTRUCTION LIMITED (19)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	nil nil	0.49 0.3	2.78 1.8	14.20 11.2	40.10 37.7	34.04 40.2	6.22 6.8	2.17 2.0

(LII) ARMSTRONG BROTHERS COMPANY LIMITED (BOUVAIRD PIT) (21)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	nil 4.1	0.59 3.5	5.21 7.6	19.54 16.8	27.80 24.1	33.30 35.4	9.45 6.3	4.09 2.2

Twenty percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch. To the east this material grades into stratified fine sand with gravel lenses. The variable character of the deposit is characteristic of ice-contact deposits.

A pebble count of the gravel from this deposit gives the following assemblage: Black River and Trenton limestones; dolomite; brownish Dundas Siltstone; Potsdam Sandstone; cemented conglomerate; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

Sieve analyses of two sand samples taken from the faces are given in (LI).

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the following major mineral constituents: quartz, 38 percent; feldspar, 16; Paleozoic limestone, 24; grey shale and siltstone, 10; black shale, 2.5; acid igneous rocks, 5.5 percent.

The main products are pit-run gravel, fill, crusher-run gravel, and granular base course. Portable crushing and screening plants are employed as required.

COOPER'S PIT (20)

Cooper's pit lies immediately north of the pit operated by Franceschini Brothers Construction Limited, on lot 8, concession II E, Chinguacousy township, Peel county. The pit was operated by J. C. Duff Limited in 1961, and by Franceschini Brothers Construction Limited in 1962. The deposit consists of extremely variable stratified sand and poorly-sorted gravel, similar to the material in other pits in this esker.

ARMSTRONG BROTHERS COMPANY LIMITED (21) (Bouvaird Pit)

Armstrong Brothers operated a gravel pit on lot 11, concession II E, Chinguacousy township, Peel county, on the sideroad 2 miles north of Brampton. The esker deposit here consists of stratified and irregularly distributed lenses and pods of poorly-sorted gravel containing silt and clay. The gravel beds generally show cementation.

A pebble count of the gravel from this deposit gives the following assemblage: Black River and Trenton limestones; grey aphanitic dolomite; sandstone; brownish Dundas Siltstone; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

Sieve analyses of two samples of sand taken from the faces are given in (LII).

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the following major mineral constituents: quartz, 23 percent; feldspar, 3.5; Paleozoic limestone, 36.5; grey shale and siltstone, 22.5; black shale, 3.5; acid igneous rocks, 6; basic igneous rocks, 2.5 percent.

The small permanent plant consists of feed hopper, screens, and jaw and cone crushers. The products from this pit are mainly fill, pit-run, and crusher-run gravel.

ARMSTRONG BROTHERS COMPANY LIMITED (22) (Donnelly Pit)

The Donnelly pit is operated by Armstrong Brothers on lot 13, concession II E, Chinguacousy township, Peel county, a mile south of Heart Lake. It is the most northerly of the pits in the esker. The deposit is overlain by till and consists predominantly of fine to medium sand containing minor amounts of gravel. The pit has been opened for a length of more than 1,000 feet.

A pebble count of the gravel from this property gives the following assemblage: Black River and Trenton limestones; brown Dundas Siltstone; dolomite; white Potsdam Sandstone; cemented conglomerate; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

There is considerable cementation in the gravel. Sand fill is the main product of this pit.

Sieve analyses of two sand samples from the Donnelly pit are given in (LIII).

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the following major mineral constituents: quartz, 37.5 percent; feldspar, 8; Paleozoic limestone, 21.5; acid igneous rocks, 2; cemented aggregates, 18; gray shale and siltstone, 9.5 percent.

LIVINGSTON SAND AND GRAVEL (249)

A sand pit is operated by Livingston Sand and Gravel on lot 12, concession II E, Chinguacousy township, Peel county. This pit is in the west flank of the Brampton esker and, consequently, is in fine stratified sand.

A sieve analysis of sand from the 20-foot face is given in (LIV).

This is fine-grained glaciofluvial outwash sand from the esker. It is used principally for sand fill.

ACE SAND AND GRAVEL (227)

Ace Sand and Gravel operates a gravel pit on lot 13, concession III W, Toronto township, Peel county, 4 miles south of Brampton. The deposit consists of a shallow gravel terrace, 4–6 feet thick, resting on clay. It appears to be an imbricated beach gravel containing some sand. Pebbles of limestone, siltstone, and red shale were noted. A portable plant is employed to produce crusher-run gravel.

Malton

CONSOLIDATED SAND AND GRAVEL LIMITED (14)

Consolidated Sand and Gravel Limited operates a sand pit and plant on lot 10, concession V, Chinguacousy township, Peel county. The property is 6 miles northwest of Malton and 1½ miles north of highway No. 7. Brampton lies 5 miles southwest of the property.

The glaciofluvial outwash deposit consists of well-sorted well-stratified sand containing minor interstratified fine to medium gravel. A 25-foot face at the north side of the pit consists of bedded and crossbedded fine sand and silt. A 25-foot face at the northeast end of the pit consists of 50 percent gravel and 50 percent sand. Ten percent of the gravel exceeds 4 inches, and 50 percent exceeds 1 inch. The coarse aggregate produced from the local material is supplemented by clear gravel brought in from the Caledon area.

A pebble count of gravel from this pit gives the following assemblage: Black River and Trenton limestones; white Potsdam Sandstone; siltstone; black shale, (rare); clay balls, (scarce); Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of sand from the north face is given in (LV).

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the following major constituents: quartz, 33 percent; feldspar, 24; Paleozoic limestone, 27.5; grey shale and siltstone, 4.5; acid igneous rocks, 7.0 percent.

The plant produces ¾-inch gravel, ⅜-inch pea gravel, concrete sand, and brick sand. The plant consists of a grizzly, hopper, conveyor, and a two-deck Dillon 5- by 12-foot screen. The oversize goes to two cone crushers in closed circuit with the screen. The throughs go to a surgepile. A reclaiming conveyor carries the gravel to a 3-deck Cedarapids 4- by 14-foot screen equipped with spray bars. The plus-⅝-inch and plus-½-inch stone go to a 24-inch by 15-foot Eagle stone scrubber to eliminate clay balls that may be present in the gravel. The product is ¾-inch stone; the plus-¼-inch gravel goes to a second Eagle stone scrubber and then to the pea-gravel stockpile. The minus-¼-inch material goes to a 6-valve settling tank. From this tank, the coarser fraction goes to a 30-inch by 24-foot Eagle twin dewatering screw, and then to the concrete-sand stockpile. The finer fraction goes to a 36-inch by 24-foot Eagle dewatering screw and then to the brick-sand stockpile.

Terra Cotta

BEE JAY SAND AND GRAVEL (259)

The sand pit operated by Bee Jay Sand and Gravel Limited is on lot 27, concession V, Chinguacousy township, Peel county, on the south side of the Credit River, ½ mile northeast of Terra Cotta. A 40-foot face of medium to coarse stratified sand is exposed on the northwest face of a hill. There is very little fine gravel.

A sieve analysis of a sand sample from this pit is given in (LVI).

A dry screening plant produces brick sand and asphalt sand.

(LIII) ARMSTRONG BROTHERS COMPANY LIMITED (DONNELLY PIT) (22)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	nil nil	nil nil	0.11 0.1	0.26 0.9	3.79 16.7	44.72 67.6	39.76 12.1	11.36 2.6

(LIV) LIVINGSTON SAND AND GRAVEL (249)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	nil	nil	nil	nil	1.2	53.6	35.3	9.9

(LV) CONSOLIDATED SAND AND GRAVEL LIMITED (14)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	0.75	1.29	4.20	13.10	25.10	36.33	13.80	5.43

A second pit is operated by the company ¼ mile north of Glen Williams, where a 25-foot face of fine stratified sand is exposed. A sieve anlysis of this sand is given in (LVII).

Caledon

A well-developed spillway runs from Caledon to Brantford; gravel terraces and sheets associated with this spillway are important sources of gravel in the Caledon area of Peel county. Four gravel pits, operated by Caledon Sand and Gravel Limited, C. Smythe for Sand Limited, Armstrong Brothers Company, and Scott-Jackson Construction Limited, are on highway No. 10 south of Caledon. Three gravel pits, operated by Franceschini Brothers Construction Limited, Eastern Gravel and Crushed Stone Limited, and Premier Building Materials Limited, are west of Caledon near the Credit River.

CALEDON SAND AND GRAVEL LIMITED (23)

The gravel pit operated by Caledon Sand and Gravel Limited is on the east side of highway No. 10, a mile south of Caledon, on lot 13, concession I E, Caledon township, Peel county. The terrace gravel deposit is exposed along a 30- to 40-foot face, and it is 60 percent gravel, 30 percent sand, and 10 percent silt and clay. The maximum size of gravel is 6 inches.

A pebble count of the gravel from this deposit gives the following assemblage: Black River and Trenton limestones; Dundas Siltstone; sandstone; dolomite; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

The gravel is rounded to well-rounded. The pebbles of laminated Dundas Siltstone are frequently flattened.

A sieve analysis of a sand sample from the face is given in (LVIII).

The gravel plant has a capacity of approximately 170 tons per hour and produces ¾- and ⅜-inch stone, concrete sand, and block sand. The sand and gravel excavated from the pit goes to a feed hopper, then to a set of Cedarapids two-deck 4- by 12-foot screens, with 2-inch and 1-inch openings. The plus-2-inch stone goes to a jaw crusher and the plus-1-inch stone goes to a set of rolls. The products from the crushers are returned to the screens. The minus-1-inch material from the screens goes to a set of Cedarapids 3-deck 4- by 12-foot screens equipped with spray bars for washing the aggregates. The oversize (plus-7/16-inch stone) from the upper two decks goes to a screw-type classifier and on to the ¾-inch stockpile. The oversize (plus-¼-inch stone) from the third screen goes to a screw-type classifier, and to the ⅜-inch stockpile. The minus-¼-inch material goes to a sand classifier, where concrete sand and block sand are split off. These products go to dewatering screw classifiers and are stockpiled.

C. SMYTHE FOR SAND LIMITED (24)

The gravel pit operated by C. Smythe for Sand Limited is on lot 13, concession I W, Caledon township, Peel county, on the west side of highway No. 10, one mile south of Caledon. The deposit adjoins that of Caledon Sand and Gravel and is part of the same gravel terrace. Overburden is about 5 feet deep. The coarse well-sorted gravel face is 40–50 feet high and is 50 percent gravel,

(LVI) BEE JAY SAND AND GRAVEL (NORTHEAST OF TERRA COTTA) (259)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	1.2	2.6	2.8	21.5	61.8	9.3	0.3	0.5

(LVII) BEE JAY SAND AND GRAVEL (NORTH OF GLEN WILLIAMS) (259)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	nil	nil	0.2	1.0	29.7	53.2	11.8	4.1

(LVIII) CALEDON SAND AND GRAVEL (23)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	1.2	3.1	6.1	8.0	14.7	34.2	20.1	12.6

40 percent sand, and 10 percent silt and clay. The maximum size of gravel is 10 inches.

A pebble count of the gravel from this deposit gave the following assemblage: Black River and Trenton limestones; brownish Dundas Siltstone; white Potsdam Sandstone; dolomite; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of sand from the face is given in (LIX).

The grading in the analysis indicates a good range for the production of concrete sand.

The plant has a capacity of approximately 350 tons per hour, and produces ¾- and ⅜-inch stone, concrete sand, and block sand. The sand and gravel from the pit are hauled to the feed hopper where the feed is split into 2 lines and proceeds to 2 sets of decked primary screens with 2-inch and 1 1/16-inch openings. The throughs (minus-1/16-inch material) go to 2 sets of decked screens equipped with spray bars. The openings are 7/16-inch and ¼-inch. The plus-7/16-inch stone is stockpiled as ¾-inch stone; the plus-¼-inch stone is stockpiled as ⅜-inch stone. The minus-¼-inch material goes to twin sand classifiers that produce concrete sand and block sand.

The plus-2-inch stone from the primary screens goes to a cone crusher, then to a 2-deck screen with 1 1/16- and ¼-inch openings. The plus-1 1/16-inch and minus-¼-inch material returns to the primary screens. The plus-¼-inch material is stockpiled. The plus-1 1/16-inch stone goes to a second cone crusher and on to a 2-deck screen with ½-inch and ¼-inch openings. The plus-½-inch and minus-¼-inch material returns to the primary screen circuit. The plus-¼-inch material is stockpiled.

ARMSTRONG BROTHERS COMPANY LIMITED (25) (McCormick Pit)

The gravel pit operated by Armstrong Brothers Company is immediately north of the Smythe operation on the west side of highway No. 10 south of Caledon in Peel county.

The terrace gravel deposit is part of that worked by Smythe and by Caledon Sand and Gravel. The 30-foot face examined consists of medium to fine gravel (60 percent), sand (30 percent), and minor silt and clay (10 percent).

The pebble assemblage is as follows: Black River and Trenton limestones; brownish Dundas Siltstone; dolomite; sandstone; Precambrian granitic rocks; Precambrian basic igneous rocks; and Precambrian metamorphic gneisses.

A sieve analysis of sand taken from the face is given in (LX).

Portable crushing and screening plants produce 7/8-, ¾-, and ⅜-inch stone, concrete sand, crusher-run gravel, etc., as required.

SCOTT-JACKSON CONSTRUCTION LIMITED (25)

Scott-Jackson Construction Limited operates a gravel pit adjacent to Armstrong Brothers Company McCormick pit.

FRANCESCHINI BROTHERS CONSTRUCTION LIMITED (243) (Dodd Pit)

The Dodd gravel pit operated by Franceschini Brothers Construction Company is on the south side of highway No. 51, just west of Caledon, on lot 15, concession I W, Caledon township, Peel county. Overburden is 3–5 feet deep. The well-stratified medium to coarse spillway gravel is exposed in a 20-foot face that is 70 percent stone and 30 percent sand. The maximum size of boulders is about 6 inches; 30 percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch.

A pebble count indicates the following assemblage: Black River and Trenton limestones; brownish Dundas Siltstone; Amabel Dolomite; white Potsdam Sandstone; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

Sieve analysis of sand from the deposit is given in (LXI).

(LIX) C. SMYTHE FOR SAND LIMITED (24)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	6.8	4.1	13.8	33.9	24.7	10.9	0.2	5.6

(LX) ARMSTRONG BROTHERS COMPANY LIMITED (McCORMICK PIT) (25)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	12.6	9.7	16.4	25.1	22.3	8.8	1.6	3.5

Pit-run gravel, crusher-run gravel, granular base course, pit-run screened stone, and asphalt sand are produced.

EASTERN GRAVEL AND CRUSHED STONE LIMITED (26)

The gravel pit operated by Eastern Gravel and Crushed Stone Limited is on lot 15, concession III W, Caledon township, Peel county, on the south side of highway No. 51, on the east bank of the Credit River. The sheet of sand and gravel is part of the Caledon spillway. A 25-foot face exposes stratified sand (60 percent) and medium to fine gravel (40 percent). The maximum size of gravel is 5–6 inches; 30 percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch. The gravel is rounded to well-rounded, but many flat siltstone pebbles are present. Overburden 2–5 feet deep overlies the gravel.

A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; brown Dundas Siltstone; Amabel Dolomite; sandstone; Precambrian acid igneous rocks; Precambrian basic igneous rocks;. and Precambrian metamorphic rocks.

A sieve analysis of sand from this pit is given in (LXII).

The main products from this deposit are pit-run gravel, brick sand, concrete sand, pea gravel, and "oversize" gravel. The plant consists of a feed hopper, a 3-deck 4- by 12-foot set of screens with 9/16-inch, 1/4- by 1-inch, and 1/8-inch openings. The plus-9/16-inch stone goes to the "oversize" stockpile. The minus-9/16-inch, and plus-1/4 by 1-inch, material goes to the 3/8-inch stockpile. The plus-1/8-inch material goes through a paddle-type sand classifier, then to the concrete-sand stockpile. The minus-1/8-inch sand goes to the brick-sand stockpile.

PREMIER BUILDING MATERIALS LIMITED (27)

The gravel pit operated by Premier Building Materials Limited is on lots 18 and 19, concession III W, Caledon township, Peel county, on the east side of highway No. 24, 2 miles south of Alton. The gravel deposit is on the west bank of the Credit River and forms part of the Caledon spillway. The deposit consists of stratified sand and gravel, and a few isolated pods and bands of silt. A pit 900 feet wide and 1,200 feet long has been excavated near the plant and is worked by a suction dredge. The face in this pit extends 30 feet above the water-level and approximately 20 feet below. On the northern part of the property, a second pit, operated by shovel and trucks, is about 1,000 feet square and shows faces 25–30 feet in height. One face examined is 50 percent gravel and 50 percent sand. The maximum size of gravel is 8 inches; only 5 percent exceeds 4 inches, and 50 percent exceeds 1 inch.

A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; dolomite (mainly Amabel); brown Dundas Siltstone; sandstone; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

The main products are 1-inch, 3/4-inch, and 3/8-inch stone, and 3 grades of sand produced from 2 parallel series of 4 water-washed trommel screens. A Cedarapids impactor crushes the oversize stone in closed circuit with the screens.

Mono Mills

MINERAL INDUSTRIES SAND AND GRAVEL LIMITED (223)

A gravel pit is operated by Mineral Industries Sand and Gravel Limited on lot 23, concession VI E, Caledon township, Peel county, on the south side of highway No. 9, just west of the village of Mono Mills.

A 20-foot face exposed is 40 percent stone and 60 percent sand. The maximum size of boulders is 8 inches; 30 percent of the stone exceeds 4 inches, and 60 percent exceeds 1 inch.

A pebble count of the gravel from this deposit gives the following pebble assemblage: Black River and Trenton limestones; Amabel Dolomite; Dundas Siltstone; red Queenston Shale, (rare); white Potsdam Sandstone; Precambrian granitic rocks; and Precambrian metamorphic rocks.

(LXI) FRANCESCHINI BROTHERS CONSTRUCTION LIMITED (DODD PIT) (243)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	10.0	14.3	14.2	19.2	27.9	10.8	1.3	2.3

(LXII) EASTERN GRAVEL AND CRUSHED STONE LIMITED (26)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	5.4	0.8	1.6	3.7	12.1	66.2	9.4	0.8

A few feet of clay till overlies the gravel deposit, which is part of a kame moraine forming the knob-and-kettle topography of the Mono Mills area.

A small portable crushing and screening plant produces crusher-run gravel.

DUFFERIN COUNTY

Orangeville

HYCO READY MIX LIMITED (28)

The Hyco gravel pit is on lot 5, concession I E, Mono township, Dufferin county, 1 mile east of highway No. 10, 2 miles north of Orangeville. The gravels were laid down in a glaciofluvial spillway that passed through Orangeville. The 20-foot face on the southwest side of the pit is composed of stratified gravel containing some interstratified sand. Considerable proportions of pea gravel are intermixed with coarse and medium gravel. The deposit is well-sorted and well-sized for production of ¾-inch gravel. One face examined is 60 percent gravel and 40 percent sand; 30 percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch.

A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; dolomite; brown Dundas Siltstone; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

No plant was in operation at the property at the time of the writer's visit.

MONO SAND AND GRAVEL (58)

The gravel pit operated by Mono Sand and Gravel is on lot 10, concession VIII, Mono township, Dufferin county, about 4 miles north of Mono Mills and 2 miles south of Hockley. The area has the knobby topography that is characteristic of the kame moraine in this vicinity. The deposit consists of crossbedded well-stratified sand and medium gravel. Some parts of the face contain good gravel; other parts are composed of medium and fine sand. The main face, located on the south side of a knobby hill, is 40 feet high and is 30 percent gravel and 70 percent sand. Twenty percent of the gravel exceeds 4 inches and 60 percent exceeds 1 inch.

A pebble count of the gravel from this deposit gives the following assemblage: Black River and Trenton limestones; dolomite; brownish Meaford-Dundas Siltstone; sandstone, (mainly grey Medina); Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of sand from the face is given in (LXIII).

The Parker plant consists of a hopper feeding a single-deck 4- by 8-foot screen. The oversize material goes to a jaw crusher. The undersize material goes to a drum washer that discharges to a set of screens producing ¾-inch and ⅜-inch stone and sand. The sand goes to a dewatering screw. The overflow and fines go to a settling pond.

YORK COUNTY

Kleinburg

MONARCH SAND AND GRAVEL COMPANY (29)

The sand pit operated by Monarch Sand and Gravel is on lot 20, concession IX, Vaughan township, York county, on the west side of high-

(LXIII) MONO SAND AND GRAVEL (58)

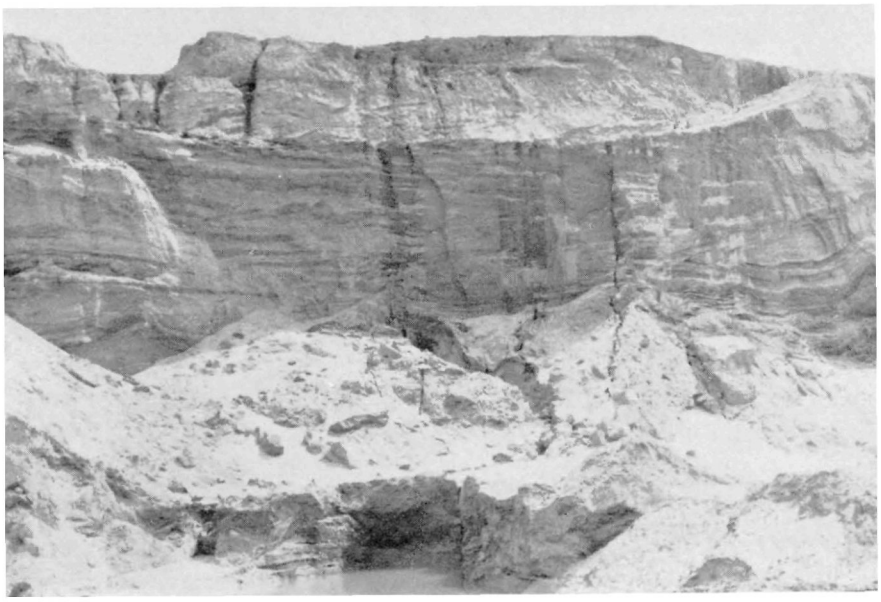
Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	0.3	1.1	3.4	22.7	66.1	6.1	0.1	0.2

(LXIV) MONARCH SAND AND GRAVEL COMPANY (29)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	nil nil	0.70 0.3	1.64 1.0	3.79 2.0	18.45 9.6	47.16 37.3	20.14 34.2	8.12 15.6

(LXV) SUPERIOR SAND, GRAVEL, AND SUPPLIES LIMITED (30)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	nil	nil	0.1	1.7	24.8	68.3	4.1	1.0



Fine stratified sand at Monarch Sand and Gravel pit.

way No. 27, one mile south of Kleinburg. The sand deposit forms a bluff on the west bank of the Humber River. The 40-foot face exposes a uniform deposit of fine to medium stratified sand containing less than 5 percent gravel in streaks and patches. Up to 15 feet of till overlies the sand. The deposit appears to be a glaciofluvial outwash-sheet.

A small screening and washing plant produces concrete, asphalt sand, and brick sand. Pit-run material is also produced.

Sieve analyses of sand samples taken from the face are given in (LXIV).

A mineralogical analysis of the sand by the Ontario Research Foundation gives the following major mineral constituents: quartz, 34.5 percent; feldspar, 18; Paleozoic limestone, 30; grey shale and siltstone, 5; black shale, 4; acid igneous rocks, 4; hornblende, 2 percent.

Maple

A finger of the Oak Ridges kame moraine extends southwest through Oak Ridges to Maple. Northeast of Maple, the topography is hilly and displays typical knob-and-kettle features. Near Maple, the sand deposits laid down between the ice-front and the kame moraine are mainly fine sands of glaciolacustrine origin. The coarse glaciofluvial gravels are rare or lacking. Seven sand and gravel pits are operated in the Maple area.

SUPERIOR SAND, GRAVEL, AND SUPPLIES LIMITED (30)

Extensive sand and gravel pits have been opened on lots 21 and 22, concession III, Vaughan township, York county, by Superior Sand, Gravel, and Supplies Limited. These pits are north of the road ¼ mile east of Maple. The deposit consists of stratified fine sand and minor amounts of fine to medium gravel of glaciolacustrine origin. The deposit has been opened in several places, and faces, from 20–50 feet high, are being worked. One 30-foot face examined is 35 percent gravel and 65 percent sand. The maximum size of gravel is 3 inches; 40 percent exceeds 1 inch. Another face consisted wholly of sand.

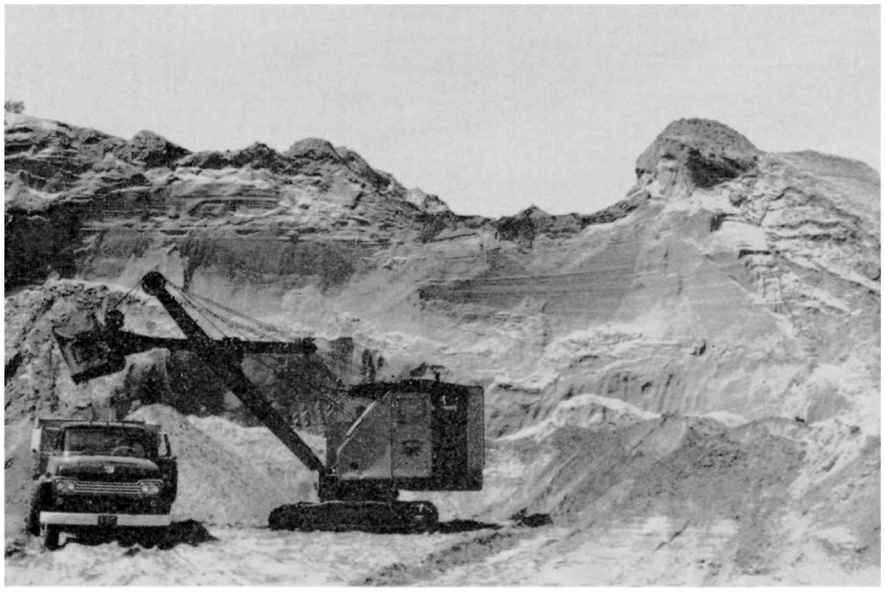
A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; dolomite; Potsdam Sandstone; brownish Dundas Siltstone; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

The pebbles are rounded to well-rounded.

A sieve analysis of sand from one of the faces is given in (LXV).

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the following major mineral constituents: quartz, 42.5 percent; feldspar, 22; Paleozoic limestone, 25; grey shale and siltstone, 2; acid igneous rocks, 5 percent.

The plant has a capacity of approximately 600 tons per hour. The main products are ¾-inch



Stratified outwash sand at Superior Sand and Gravel, Maple.

Stratified outwash sand at Ontario Sand and Gravel, Maple.

and ⅜-inch gravel, concrete sand, brick sand, and pit-run gravel. Sand and gravel is dumped into a feed hopper; the feed is split into two lines and the material is conveyed to 2 sets of Dillon two-deck 5- by 14-foot screens having 1½- and ⅞-inch openings. The plus-1½-inch stone goes to a 10- by 24-inch jaw crusher. The plus-⅞-inch stone goes to a set of 20- by 40-inch rolls. The products of these crushers go to a Dillon 4- by 12-foot screen with ⅞-inch openings. The oversize material is returned to the rolls. The minus-⅞-inch material goes to a 30-foot Eagle double-screen washer. The feed from this washer is split and goes to two sets of Dillon two-deck screens that have 7/16- and ¼-inch openings. The plus-7/16-inch stone goes to the ¾-inch crushed-stone stockpile. The plus-¼-inch stone goes to the ⅜-inch crushed-stone stockpile. The throughs go to a settling tank.

The minus-⅞-inch sand and gravel from the two sets of Dillon 5- by 14-foot screens goes to 2 sets of Dillon single-deck screen equipped with spray bars. The screens have ¼-inch openings. The plus-¼-inch stone goes to dewatering screws and then to 2 sets of Dillon 2-deck screens with ⅝-inch and ⅛- by 3-inch openings. The plus-⅝-inch stone goes to the ¾-inch round-stone stockpile. The plus-⅛-inch stone goes to the ⅜-inch round-stone stockpile. The throughs are discarded as waste. The minus-¼-inch material from the ¼-inch screens goes to the settling tank mentioned above. Concrete sand and brick sand are drawn from appropriate cocks in the settling tank. After passing through dewatering screws, the sands are stockpiled.

ONTARIO SAND AND GRAVEL COMPANY LIMITED (31)

The pits operated by Ontario Sand and Gravel are on lots 22 and 23, concession III, Vaughan township, York county, ½ mile north of Maple. The area worked by the company shows the typical knobby topography of ice-contact deposits. The deposit consists primarily of fine to medium well-stratified well-sorted sand. The proportion of gravel is small, rarely exceeding about 25 percent. Most of the gravel is fine, less than 20 percent exceeding 1 inch in size.

A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; brownish aphanitic dolomite; brownish Dundas Siltstone; white Potsdam Sandstone; black shale, (very rare); Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of sand from one of the faces is given in (LXVI).

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the following major mineral constituents: quartz, 42.5 percent; feldspar, 19.0; Paleozoic limestone, 25; grey shale and siltstone, 3; black shale, 2.5; acid igneous rocks, 5.5 percent.

The main products are brick sand, concrete sand, block gravel, asphalt sand, and pit-run fill.

PINEWOOD AGGREGATES LIMITED (32)

The sand pit operated by Pinewood Aggregates Limited is ¾ mile north of Maple on lot 25, concession III, Vaughan township, York county. Most of the deposit is fine stratified sand. The 20-foot south face consists of well-bedded coarse to fine sand; it shows some cut-and-fill crossbedding. The 25-foot north face is 80 percent well-bedded sand and 20 percent fine gravel; only 20 percent of the gravel exceeds 1 inch.

A sieve analysis of sand from one of the faces is given in (LXVII).

The company produces brick sand, asphalt sand, concrete sand, and pit-run material. There is a small screening plant on the property.

J. CHEFERO SAND AND GRAVEL LIMITED (33)

The sand pit operated by J. Chefero Sand and Gravel Limited is on lot 25, concession III, Vaughan township, York county, on the first sideroad north of Maple. At the north end of the

(LXVI) ONTARIO SAND AND GRAVEL COMPANY LIMITED (31)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	1.4	1.7	4.7	11.6	25.8	43.9	9.3	1.6

(LXVII) PINEWOOD AGGREGATES LIMITED (32)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	nil	nil	0.1	0.9	10.5	57.2	25.5	5.8

Well-stratified fine sand at Kenmore Building Materials pit, Maple.

(LXVIII) J. CHEFERO SAND AND GRAVEL LIMITED (33)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	0.5	0.4	1.4	5.7	32.8	53.6	4.7	0.9

(LXIX) AVONDALE SAND AND GRAVEL (34)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	nil	nil	nil	0.02	4.83	67.09	21.76	6.20

(LXX) KENMORE BUILDING MATERIALS LIMITED (36)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	nil	nil	0.07	3.34	29.02	53.23	11.47	2.87

(LXXI) BAKER SAND AND GRAVEL (39)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	nil	nil	0.2	2.05	15.05	51.90	22.55	8.25

property, a 20-foot face consists of well-stratified medium to coarse sand and fine gravel. The face is 60 percent sand and 40 percent gravel; only 30 percent of the gravel exceeds 1 inch. The south face of the pit consists of 35 feet of well-bedded well-sorted sand.

A pebble count of the gravel from this deposit gives the following assemblage: Black River and Trenton limestones; dolomite; brownish Dundas Siltstone; white Potsdam Sandstone; black shale, (very rare); Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of sand from one of the faces is given in (LXVIII).

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the following major mineral constituents: quartz, 36.5 percent; feldspar, 23.5; Paleozoic limestone, 28.5; grey shale and siltstone, 2; black shale, 2.5; acid igneous rocks, 3.5; basic igneous rocks, 2.5 percent.

A small screening plant produces ¾-inch stone, concrete sand, and brick sand. Pit-run fill is also produced.

AVONDALE SAND AND GRAVEL (34)

The sand pit of Avondale Sand and Gravel is 2 miles north of Maple in lot 27, concession III, Vaughan township, York county. The deposit consists of 50–60 feet of well-stratified fine sand containing minor amounts of silt.

A sieve analysis of the sand is given in (LXIX).

The grading in the analysis indicates the fine well-sorted character of the sand.

A small screening plant produces brick sand. Pit-run sand is also produced.

DE SANTE SAND AND GRAVEL (35)

The De Sante Sand and Gravel pit is on concession III, Vaughan township, York county and is reached by driving north 2 miles from the Maple–Richmond Hill road on the Third Concession line. The pit is west of the road.

A 35-foot ridge of sand extends in an east-west direction across the property. Faces that are 10–25 feet high have been opened in the deposit in three places, exposing well-stratified fine sand and silt with minor amounts of gravel.

There is no plant on the property, and the main production is pit-run sand.

KENMORE BUILDING MATERIALS LIMITED (36)

The sand pit of Kenmore Building Materials Limited is in concession II, Vaughan township, York county, and is reached by going north 2¼ miles on the Third Concession line, from the Maple–Richmond Hill road. The pit is on the east side of the road.

The deposit consists of well-stratified fine sand with some interbeds of silt. A 50-foot face that was examined consists wholly of fine sand, the sieve analysis of which is given in (LXX).

The main products are pit-run sand and brick sand.

Ansnorveldt

YORK SAND AND GRAVEL (37)

York Sand and Gravel operates a gravel pit on lot 5, concession III, King township, York county, on the edge of the Bradford Marsh, a mile south of Ansnorveldt. The pit has a face 800 feet long and 6 feet high consisting of poorly-sorted silty gravel; 25–30 percent of the material is gravel. The maximum size of boulders is 30 inches. The size of the gravel averages 1–3 inches; 20 percent exceeds 4 inches and 60 percent exceeds 1 inch. The large boulders are mainly in overlying till. The chief production is crusher-run and pit-run gravel.

Kettleby

SPRAGGES PIT (38)

Spragges gravel pit is on lot 23, concession III, King township, York county, 3 miles southeast of Kettleby. The pit measures approximately 500 by 200 feet, and has an 8- to 10-foot face that exposes coarse gravel (60 percent) and sand (40 percent). The maximum size of gravel is 10 inches; 40 percent of the gravel exceeds 4 inches, and 70 percent exceeds 1 inch. Sorting is fair to poor. The gravel is rounded to subrounded, and contains some subangular material.

A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; dolomite; black shale, (very rare); Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

Production is mainly crusher-run gravel.

Aurora

Three small gravel pits are operated south of Aurora within the Oak Ridges kame moraine. These deposits are in glaciofluvial outwash deposits associated with the kame moraine.

BAKER SAND AND GRAVEL (39)

The sand pit operated by Baker Sand and Gravel is on lot 68, concession I, Whitchurch township, York county, just north of Wilcocks Lake. It is in an area of hummocky knob-and-kettle topography. The deposit is well-stratified fine sand containing minor gravel. The sand beds are capped by thin till in places, and overburden ranges between 0 and 6 feet. A 25-foot face exposes well-stratified crossbedded sand.

A sieve analysis of a sample of sand from this pit is given in (LXXI).

There is a small screening plant on the property. Sand fill and brick sand are the main products.

GEORGE A. WHITE (40)

A small gravel pit has been opened by George A. White Sand and Gravel on lot 11, concession II, Whitchurch township, York county. The pit is on the north side of the road, 2 miles east of highway No. 11. The deposit of sand and gravel is overlain by 3–6 feet of overburden. A 12-foot face exposes 6 feet of well-stratified sand that contains less than 20 percent gravel, underlain by 6 feet of sand and gravel, running 70 percent gravel. The maximum size of gravel is 6 inches; 30 percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch.

A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; dolomite; black shale, (rare); Potsdam Sandstone; brownish siltstone; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

A small plant consisting of hopper, jaw crusher, conveyor, and 3- by 6-foot screen (Niagara), produces crusher-run gravel.

Pit-run gravel and fill are the main products. Some concrete sand and brick sand are also produced.

A sieve analysis of the sand is given in (LXXII).

VALLEY SAND AND GRAVEL (41)

Valley Sand and Gravel operates a small sand and gravel pit on lot 10, concession II, Whitchurch township, York county, 2 miles east of highway No. 11. The deposit consists of well-stratified sand containing little gravel. A 10-foot face consists of fine sand. A 15-foot face examined is 90 percent sand and 10 percent gravel.

A sieve analysis of sand taken from the face is given in (LXXIII):

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the following major mineral constituents: quartz, 33 percent; feldspar, 21; Paleozoic limestone, 36; black shale, 2; acid igneous rocks, 3.5 percent.

Thornhill

J. SABISTON LIMITED (42)

The sand pit operated by J. Sabiston Limited is 2 miles east of Thornhill in the valley of a tributary of the Don River, on lots 3 and 4, concession II, Markham township, York county. On the west bank of the river valley, a 40- to 50-foot face of well-stratified fine sand is exposed. The sand is free of pebbles. A till-sheet, up to 5 feet thick, covers the sand deposit.

A screening plant is employed to size the sand. Brick sand, sand for sand-lime brick, plaster sand, and sand fill are produced.

A sieve analysis of the sand is given in (LXXIV).

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the following major mineral constituents: quartz, 35.5 percent; feldspar, 25.5; Paleozoic limestone, 26.5; grey shale and siltstone, 3; acid igneous rocks, 5.5 percent.

Mount Albert

HOPKINS PIT (43)

The Hopkins gravel pit is on lot 12, concession VII, East Gwillimbury township, York county, 1 mile west of the village of Mount Albert. A 50-

(LXXII) GEORGE A. WHITE (40)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	2.5	2.8	12.8	42.1	31.9	6.2	0.4	1.3

(LXXIII) VALLEY SAND AND GRAVEL (41)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	1.4	1.7	1.9	5.8	27.0	46.1	13.1	3.0

(LXXIV) J. SABISTON LIMITED (42)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	nil	nil	0.12	1.77	6.68	74.83	15.89	0.71

foot face exposes well-stratified medium and coarse gravel and sand. The deposit is approximately 50 percent gravel and 50 percent sand. The maximum size of boulders is 10–12 inches in diameter. Thirty percent of the gravel exceeds 4 inches, and 50 percent exceeds 1 inch. The pebbles are subangular to rounded.

A portable plant produces crusher-run.

HARRISON'S PIT (43)

The Harrison pit is immediately south of the Hopkins pit and is in similar material. A sieve analysis of sand from the face is given in (LXXV).

Crusher-run gravel is produced by Fred J. Newton.

LOTS 28 AND 29, CON. VI, EAST GWILLIMBURY TOWNSHIP (237)

A sand and gravel deposit, which appears to be an esker, exists on the east side of a hill on lots 28 and 29, concession VI, East Gwillimbury township, York county. There is a 3- to 6-foot capping of till. A 20-foot face exposes well-sorted stratified medium gravel (60 percent) and sand (40 percent). The maximum size of gravel observed was 8 inches; 30 percent exceeds 4 inches, and 60 percent exceeds 1 inch. There is no plant on the property.

Stouffville

One of the most productive sand and gravel areas in the vicinity of Toronto exists north of Stouffville in Whitchurch and Uxbridge townships (York and Ontario counties, respectively). The deposits are within the Oak Ridges kame moraine. The gravel is of good quality.

GORMLEY SAND AND GRAVEL LIMITED (235)

Gormley Sand and Gravel Limited operates a gravel pit on lot 8, concession V, Whitchurch township, York county, in the hummocky kame moraine area of the Oak Ridges moraine. A 35-foot face exposes interstratified sand (80 percent) and medium to fine gravel (20 percent). The maximum size of pebbles is 3 inches; 30 percent of the gravel exceeds 1 inch.

A pebble count of gravel from this pit gives the following assemblage: Black River and Trenton limestones; Potsdam Sandstone; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of sand from this pit is given in (LXXVI).

There is no plant at this property.

GORMLEY SAND AND GRAVEL LIMITED (236)

Gormley Sand and Gravel Limited operates a pit on lot 9, concession VII, Whitchurch township, York county, northwest of Stouffville. The deposit consists of well-sorted well-stratified sand and medium gravel. A 25-foot face examined is 30 percent stone and 70 percent sand. Maximum size of boulders observed is 8 inches; 30 percent of the gravel exceeds 4 inches, and 50 percent exceeds 1 inch. Two 25-foot lifts of gravel are worked. Three to six feet of clay till has been stripped.

A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; Potsdam Sandstone; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of sand from the pit is given in (LXXVII).

(LXXV) HARRISON'S PIT (43)

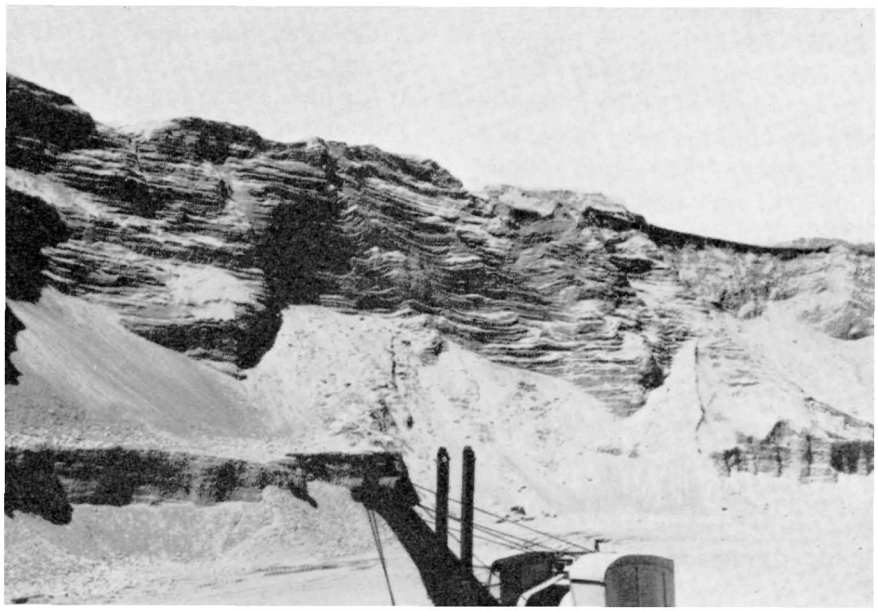
Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	26.3	5.1	6.8	13.5	20.0	23.3	4.2	0.8

(LXXVI) GORMLEY SAND AND GRAVEL LIMITED (235)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	nil	0.3	0.5	1.8	15.2	68.5	12.3	1.4

(LXXVII) GORMLEY SAND AND GRAVEL LIMITED (236)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	1.9	2.9	14.5	48.0	26.4	5.0	0.5	0.8



Stratified sand and gravel of Oak Ridges kame moraine;
Western Sand and Gravel, Stouffville.

(LXXVIII) UXBRIDGE SAND AND GRAVEL (45)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	nil	0.3	0.6	6.2	42.4	46.9	2.9	0.7

(LXXIX) LEE SAND AND GRAVEL LIMITED (46)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	42.7	4.4	5.1	10.0	17.5	14.9	3.4	2.0

(LXXX) F. H. ROBERTS AND SONS (47)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	19.5	4.3	5.1	10.0	42.9	16.0	0.7	0.5

(LXXXI) WESTERN SAND AND GRAVEL LIMITED (48)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	8.0	1.2	1.5	3.5	24.3	46.4	12.3	2.8

The crushing and screening plant produces 7/8- and 3/4-inch stone, asphalt sand, concrete sand, and brick sand. The dry-process plant consists of two sets of two-deck screens, a jaw crusher, and 24- by 16-inch rolls. Plant capacity is 100–120 tons per hour.

COMMERCIAL SAND AND GRAVEL CO. (44)

The processing plant of Commercial Sand and Gravel is on lot 9, concession VIII, Whitchurch township, York county, on highway No. 48, two miles north of Ringwood. Gravel is hauled in from pits in Uxbridge township. The plant produces 2-inch, 3/4-inch, 5/8-inch, and 3/8-inch stone, concrete sand, brick sand, and 3/4-inch crusher-run. The sand and gravel goes from the feed hopper by conveyor to a 2-deck Dillon 4- by 12-foot screen with 3 1/2- by 5-inch and 1-inch openings. The oversize material goes to a 15- by 30-inch jaw crusher and a 36-inch Telsmith standard cone crusher that are in closed circuit with the screens. The throughs are conveyed to a surgepile. From there they are conveyed to a set of 3-deck Cedarapids 4- by 14-foot screens equipped with spray bars. These screens have 7/8-, 7/16-, and 1/4-inch openings and produce 7/8-inch, 5/8-inch, and 3/8-inch stone. The throughs go to a Dorr classifier and then to the sand stockpile.

UXBRIDGE SAND AND GRAVEL (45)

The sand pit and plant of Uxbridge Sand and Gravel are on lot 12 or 13, concession IX, Whitchurch township, York county, 3 miles north of Stouffville. The 40-foot face of the sand pit exposes crossbedded fine to medium sand. A small amount of fine gravel is present in parts of the pit. Gravel is hauled to the plant from pits near Goodwood in Uxbridge township.

A sieve analysis of sand from the pit is given in (LXXVIII).

A small crushing, screening, and washing plant produces 3/4-inch stone, 3/8-inch stone, concrete sand, and block sand.

LEE SAND AND GRAVEL LIMITED (46)

The gravel pit operated by Lee Sand and Gravel is on lot 14, concession IX, Whitchurch township, York county, 3 1/2 miles north of Stouffville. The kame deposit consists of 60–80 feet of stratified sand containing gravel in lenses and streaks. Crossbedding indicates the source was to the east. A 20-foot face examined is 35 percent gravel and 65 percent sand. The maximum size of gravel is 5 inches; 5 percent exceeds 4 inches, and 50 percent exceeds 1 inch.

A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

The pebbles are subrounded to well-rounded.

A sieve analysis of sand from the face is given in (LXXIX).

F. H. ROBERTS AND SONS (47)

The pit of F. H. Roberts and Sons Sand and Gravel is on lot 10, concession VIII, Whitchurch township, York county, 3 miles northwest of Stouffville. The deposit consists of stratified sand and fine to medium gravel of glaciofluvial origin. A 30-foot face examined is 60 percent gravel and 40 percent sand. The maximum size of boulders is 12 inches; 20 percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch. A thin capping of till overlies the gravel.

A pebble count of the gravel from this deposit gives the following assemblage: Black River and Trenton limestones; black shale, (very rare); Potsdam Sandstone; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of sand from the face is given in (LXXX).

The plant consists of a feed hopper, conveyor, Dillon single-deck 4- by 10-foot screen in closed circuit with a Cedarapids 20- by 20-inch impact breaker, and a 2-deck Dillon 4- by 12-foot screen with 1/2- and 3/16-inch openings. The products from these screens are 7/8- and 3/8-inch stone, and concrete sand. A Cedarapids portable crushing and screening plant is also employed.

WESTERN SAND AND GRAVEL LIMITED (48)

An extensive deposit of sand and gravel, up to 80 feet thick, is worked on lot 14, concession IX, Whitchurch township, York county, 4 miles north of Stouffville. The deposit consists of stratified sand and medium gravel; the lateral changes from sand to gravel are abrupt. The gravel exists in streaks and lenses. The deposit is of glaciofluvial origin and lies within the Oak Ridges Kame moraine. A 50-foot face examined is 50 percent stone and 50 percent sand; other sections contain a higher proportion of sand. Maximum size of boulders observed was 8 inches; 30 percent exceeds 4 inches, and 60 percent exceeds 1 inch.

A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; dolomite; black shale, (rare); siltstone; sandstone; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of sand from this pit is given in (LXXXI).

Stratified kamey sand and gravel at Stouffville Sand and Gravel pit.

(LXXXII) STOUFFVILLE SAND AND GRAVEL LIMITED (49)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	13.5	2.9	4.7	11.1	25.8	28.2	6.9	6.9

(LXXXIII) MILLER PAVING LIMITED (224)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	nil	nil	nil	0.22	11.51	57.43	23.09	7.75

(LXXXIV) J. BLAKE SAND AND GRAVEL COMPANY LIMITED (51)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	2.54	5.29	6.60	11.03	30.32	41.44	2.29	0.49

(LXXXV) CRAWFORD SAND AND GRAVEL LIMITED (233)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	0.3	3.3	4.3	6.6	23.7	51.5	9.1	1.2

Dry-process crushing and screening plants produce granular A (crusher-run), ¾-inch stone, ⅜-inch stone, asphalt sand, and concrete sand. The main plant consists of feed hopper, 15- by 36-inch jaw crusher, 2-deck screen, 3-foot Symons standard cone crusher, surge bin, and single-deck screen. A portable screening unit is also employed.

STOUFFVILLE SAND AND GRAVEL LIMITED (49)

East and north of Western Sand and Gravel, workings have been opened by Stouffville Sand and Gravel. One plant and pit are on lot 16, concession I, Uxbridge township, Ontario county, 4 miles north of Stouffville, and another pit is across the road in Whitchurch township, York county. The glaciofluvial outwash deposit consists of stratified sand containing streaks and lenses of gravel. The nature of the deposit is quite variable; coarse and medium gravel, sand, and silt are present. There is abrupt transition from sand to gravel.

A 50-foot face examined is interstratified medium to coarse sand (60 percent) and well-sorted medium gravel (40 percent). The maximum size of boulder seen is 8 inches; 20 percent exceeds 4 inches, and 40 percent exceeds 1 inch.

A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; black shale, (rare); Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of sand from this pit is given in (LXXXII).

Washing and Screening Plant

The washing and screening plant of Stouffville Sand and Gravel is on lot 11, concession VI, Whitchurch township, York county. Sand and gravel are dumped into a feed hopper feeding a 5- by 14-foot single-deck 1⅛-inch screen. The oversize material goes to a 4¼-foot Symons standard cone in closed circuit with the screen. The undersize material goes to a surgepile and is taken by conveyor to a 3-deck Link Belt 5- by 14-foot screen with spray bars. The screen sizes are ⅞-inch, 7/16-inch, and 3/16-inch. The plus-⅞-inch material goes to the 1-inch stockpile; the plus-7/16-inch material to the HL6 stockpile; the plus-3/16-inch material goes to the ⅜-inch bin, and the minus-3/16-inch material goes to an 8-valve settling tank whose products go to a rake classifier producing concrete sand and to an Eagle dewatering screw producing brick sand.

Brillinger Pit

Stouffville Sand and Gravel operate the Brillinger pit on lot 9, concession IV, Whitchurch township, York county. Up to 5 feet of till overlies the gravel deposit. A 25-foot face exposes well-stratified coarse sand (60 percent) and medium gravel (40 percent). Maximum size of gravel seen is 8 inches; 20 percent exceeds 4 inches, and 50 percent exceeds 1 inch. There is some cementation of the gravel.

A portable Cedarapids crushing plant produces crusher-run gravel.

Markham

MARKHAM SAND AND GRAVEL (50)

The sand and gravel deposit operated by Markham Sand and Gravel is on lots 6 and 7, concession IV, Markham township, York county, 5 miles southwest of Markham village. The deposit is a kame that stands up as a hill 25–40 feet above the surrounding country. The kame gravels, which are up to 80 feet in thickness, are underlain and overlain by till. The south end of the pit exposes 70 feet of stratified sand and gravel. The average size of the gravel ranges between 1 and 4 inches; maximum size is 8 inches. Clay balls are present in the gravel. The north end of the pit exposes poorly-sorted silty gravel and sand. Large angular boulders of shale were noted in the gravel.

A pebble count of the gravel from the 1-inch stockpile gives the following assemblage; Black River and Trenton limestones; dolomite; Potsdam Sandstone; black and grey shale, (rare); brown siltstone (Meaford–Dundas); Precambrian acid igneous rocks; Precambrian metamorphic rocks.

A 350-ton-per-hour crushing and screening plant produces ¾-inch stone, ⅞-inch crusher-run, ⅜-inch crusher-run, oversize material, and sand.

Scarborough

MILLER PAVING LIMITED (224)

An interstadial deltaic sand deposit is being worked by Miller Paving southwest of the intersection of Military Trail and Morningside Drive in Scarborough Township, York county. On the west side of the pit, a few feet of gravelly sand from Lake Iroquois overlies several feet of sandy till (Leaside Till) which, in turn, overlies more than 35 feet of stratified fine sand. Eastward, the till layer pinches-out, and the Lake Iroquois gravelly sand unconformably overlies the interstadial sand.

A mechanical analysis of the sand is given in (LXXXIII).

J. BLAKE SAND AND GRAVEL COMPANY LIMITED (51)

The gravel pit operated by J. Blake Sand and Gravel is on Conlins Road in West Hill, in concession II, Scarborough township, York county; the pit is in an old beach deposit of glacial Lake Iroquois.

A 10-foot face examined consists of stratified

sand (80 percent) and medium gravel (20 percent). The maximum size of gravel is 3 inches; 30 percent exceeds 1 inch.

A pebble count of gravel from this deposit gives the following assemblage: Black River and Trenton limestones; siltstone; black shale, (very rare); sandstone; Precambrian acid igneous rocks; and Precambrian metamorphic rocks. The pebbles are well-rounded.

A sieve analysis of sand from the pit is given in (LXXXIV).

A crushing, screening, and washing plant produces ¾-inch stone, concrete sand, and brick sand.

CRAWFORD SAND AND GRAVEL LIMITED (233)

The gravel pit operated by Crawford Sand and Gravel is in West Hill on Conlins Road, in concession II, Scarborough township, York county. The deposit is an ancient beach deposit of Lake Iroquois. The 10-foot face examined consisted of stratified sand (90 percent) and fine gravel (10 percent). The maximum size of gravel observed was 3 inches; 30 percent exceeds 1 inch.

A sieve analysis of sand from this deposit is given in (LXXXV).

The principal production is pit-run sand fill.

JOHN B. REGAN COMPANY LIMITED (226)

A gravel pit operated by John B. Regan Company Limited is on lot 6, concession IV, Scarborough township, York county, on the west side of the Little Rouge River just east of the intersection of Passmore Avenue and Reesor Road. The deposit is a kame consisting of interstratified sand and medium gravel. A 20-foot face examined is 20 percent stone and 80 percent sand. The maximum size of boulders is 6 inches; 20 percent of the gravel exceeds 4 inches, and 50 percent exceeds 1 inch. The gravel lens is overlain and underlain by sandy till.

The gravels are generally poorly-sorted and rounded but they tend to be better-sorted and less abundant on the north side of the kame; this suggests a nearby source to the south, probably at the ice-edge. There tends to be abrupt variation in the materials as is characteristic of kame deposits. A pebble count of the gravel from the north side of the pit gives the following assemblage: Black River and Trenton limestones; dolomite; Precambrian metamorphic rocks; and Precambrian acid igneous rocks.

No shale was noted in the gravel.

The main production is crusher-run gravel produced by portable crushing plants.

BAXTER SAND AND GRAVEL (226)

Immediately east of the John B. Regan pit on lot 6, concession IV, Scarborough township, York county, a gravel pit is operated by Baxter Sand and Gravel in the same kame deposit. The production is mainly sand fill and pit-run gravel.

SIMCOE COUNTY

Hockley

BOLTON SAND AND GRAVEL (57)

The gravel pit operated by Bolton Sand and Gravel is 3 miles north of highway No. 9, on lot 9, concession I, Adjala township, Simcoe county, 2 miles southwest of Hockley; it is in a hilly area of knobby kame moraine. A sand pit south of the plant measures 200 by 300 feet and has a 20-foot face. The deposit consists of stratified sand and fine gravel and contains some beds of silt. Depth of overburden ranges between 1 and 3 feet. The deposit is more than 90 percent sand.

One half mile northwest of the plant, a gravel pit has been opened on the west side of a knoll. The 20-foot face exposes poorly-sorted coarse and medium gravel, and sand, with some interbedded clay and silt. The face is 40 percent gravel and 60 percent sand. The pebbles are angular to subrounded. Thirty percent of the gravel exceeds 4 inches in size, and 50 percent exceeds one inch. A pebble count of the gravel from this deposit gives

(LXXXVI) BOLTON SAND AND GRAVEL (57)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	nil	0.18	1.47	19.25	52.49	23.35	2.27	0.49

(LXXXVII) R. H. BLACK (250)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	7.0	3.1	3.8	10.3	65.2	10.1	0.1	0.4

the following assemblage: Ordovician limestone; brownish Meaford-Dundas Siltstone; dolomite; sandstone; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

The large percentage of siltstone is noteworthy.

A sieve analysis of sand from the face is given in (LXXXVI).

The plant, which has a capacity of 150–200 tons per hour, consists of a grizzly, hopper, scalping screen, hammermill, conveyors, screens with spray bars, and rake classifiers. The oversize material from the scalping screen goes to the hammermill for crushing. The screen plant makes 2-inch, ¾-inch, and ⅜-inch stone. The sand is discharged to two rake classifiers that produce concrete sand and block sand.

Bond Head

W. J. SUTHERLAND (59)

A small gravel pit is operated on lot 12, concession VI, Tecumseth township, Simcoe county, by W. J. Sutherland of Bond Head. The 8- to 10-foot face of the pit exposes stratified sand (70 percent) and fine gravel (30 percent). None of the gravel exceeds 4 inches; 50 percent of the gravel exceeds 1 inch in size. There is no plant at the property, and production is mainly pit-run gravel.

Barrie

Four gravel pits are operated in the Barrie area. Three of these are in old beach deposits of glacial Lake Algonquin, and one is a kame deposit.

R. H. BLACK (250)

A small gravel pit is operated by R. H. Black on lot 25, concession XI, Innisfil township, Simcoe county. The pit is in a shallow beach deposit of glacial Lake Algonquin and consists of stratified medium gravel (50 percent) and sand (50 percent). Maximum size of pebbles is 6 inches; 20 percent exceeds 4 inches, and 60 percent exceeds 1 inch. The pebbles are limestone and Precambrian rocks.

A sieve analysis of sand from this pit is given in (LXXXVII).

A portable crusher produces crusher-run gravel.

INNISFIL GRAVEL SUPPLIES (67)

The gravel pit operated by Innisfil Gravel Supplies is on lot 25, concession XII, Innisfil township, Simcoe county, 5 miles east of highway No. 11. The gravel deposit is an old beach of glacial Lake Algonquin and consists of 15 feet of stratified and foreset sand and gravel. Where examined, the deposit is 40 percent gravel and 60 percent sand. The maximum size of gravel is 6 inches; 20 percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch.

A pebble count of the gravel gives the following assemblage: Black River Limestone; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of the sand in this pit is given in (LXXXVIII).

A portable plant is employed to make crusher-run gravel. Pit-run gravel is also produced.

McCOLGAN SAND AND GRAVEL LIMITED (68)

The gravel pit operated by McColgan Sand and Gravel is on lot 3, concession XIII, Innisfil township, Simcoe county, 2½ miles southwest of Barrie. The property is on the brow of a hill overlooking the valley to the north. The deposit is a kame consisting of stratified medium gravel and sand. The workings extend for more than 1,000 feet into the hillside, and the pit is worked on 2 levels. One 20-foot face examined is 40 percent gravel and 60 percent sand; 20 percent of the gravel exceeds 4 inches, and 50 percent exceeds 1 inch.

The pebble assemblage of the gravel is as follows: Black River and Trenton limestones; dolomite; basal arkose; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of sand from the face is given in (LXXXIX).

(LXXXVIII) INNISFIL GRAVEL SUPPLIES (67)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	8.15	2.85	6.88	42.53	38.37	0.50	0.13	0.59

(LXXXIX) McCOLGAN SAND AND GRAVEL LIMITED (68)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	8.3	13.9	24.6	31.2	16.7	4.2	0.4	0.7

Well-stratified beach gravels of Lake Algonquin; Varcoe Brothers pit, Barrie.

VARCOE BROTHERS LIMITED (69)

Varcoe Brothers operated a sand and gravel pit and plant on lots 13 and 14, concession IV, Vespra township, Simcoe county, 3 miles north of Barrie on the east side of highway No. 27. The beach deposit at the plant consists of interstratified sand and gravel. A 20-foot face examined is 50 percent sand and 50 percent gravel; 20 percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch. This deposit is almost worked-out, and most of the gravel is now obtained from another pit.

The second pit is a mile west of the plant on lot 13, concession VI, Vespra township. This beach deposit consists of well-stratified well-sorted sand and gravel. The extensive gravel-sheet has been opened for a length of more than 1,500 feet and a width of 500 feet. The 15-foot face exposed is 40 percent gravel and 60 percent sand; 15 percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch.

The pebble assemblage of this gravel is as follows: Black River and Trenton limestones; white sandstone; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of sand from the face is given in (XC).

The crushing and screening plant of Varcoe Brothers has a capacity of approximately 90 tons per hour and produces $\frac{7}{8}$-inch gravel, HL8 (minus-1-inch plus-$\frac{1}{2}$-inch), HL4 (minus-$\frac{3}{4}$-inch plus-$\frac{1}{2}$-inch), HL3 (minus-$\frac{1}{2}$-inch plus-$\frac{3}{16}$-inch), concrete sand, block sand, and screenings.

From the feed hopper, the feed goes to a 2-deck Cedarapids 4- by 12-foot screen having 1-inch and $\frac{1}{4}$-inch openings. The plus-1-inch stone goes to a 10- by 36-inch jaw crusher and a Symons cone crusher. The plus-$\frac{1}{4}$-inch stone goes to a 30-inch by 25-foot Eagle dewatering screw and is stockpiled for concrete sand or block sand. The crusher products go to a 3-deck 4- by 12-foot screen where HL8, HL3, or HL4, screenings, or $\frac{1}{2}$-inch stone are made as required.

Orillia

In the Orillia area of Simcoe county, beach deposits of sand and gravel are mainly associated with abandoned shorelines of glacial Lake Algonquin. Several gravel pits have been opened in these beach deposits.

(XC) VARCOE BROTHERS LIMITED (69)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	26.2	15.9	12.3	23.4	18.8	2.1	0.3	1.0

R. H. STEWART CONSTRUCTION COMPANY LIMITED (61)

The gravel pit operated by R. H. Stewart Construction Company is on lot 1, concession VI, Orillia township, Simcoe county, 3 miles north of Orillia. The beach deposit is at the south end of a hill in a moraine; it is composed of coarse stratified gravel dipping to the south and contains some interstratified sand. The gravel face has been opened for about 600 feet, and the deposit is rather uniform. This is a large deposit of good-quality gravel.

One 25-foot face exposed is of 75 percent gravel and 25 percent sand. Boulders are up to 7 inches in diameter; 30 percent of the gravel exceeds 4 inches, and 70 percent exceeds 1 inch.

A pebble count of the gravel from this deposit gives the following assemblage: Black River and Trenton limestones; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

There is no plant on the property. A portable plant is employed as required to produce crusher-run gravel.

ELLETTS SAND AND GRAVEL (62)

Elletts Sand and Gravel operates a gravel pit in a kame deposit on lot 3 or 4, concession III, Orillia township, Simcoe county, about 2 miles northwest of Orillia. The deposit consists of medium gravel and interstratified sand. The sand and gravel is irregularly distributed as is common in some kame deposits close to the ice-contact. A 15-foot face is 50 percent gravel and 50 percent sand; the maximum size of boulders is 6 inches. Thirty percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch.

A pebble count of gravel from this deposit gives the following assemblage: Black River and Trenton limestones; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

There is no plant on the property and production is mainly pit-run sand and gravel.

COLE AND DAVEY GRAVEL COMPANY (63)

The gravel pit operated by Cole and Davey Gravel Company is on lot 3, concession III, Orillia township, Simcoe county, about 1 mile north of highway No. 12, 1½ miles west of Orillia. The 50-foot face exposes a deposit of interstratified sand and medium to coarse gravel that forms a beach deposit on the north flank of a hill of moraine. The stratification is rather irregular. The face is 40 percent gravel and 60 percent sand. The maximum size of boulders is about 7 inches; 30 percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch.

A pebble count of gravel from this deposit gives the following assemblage: Black River and Trenton limestones; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

There is no plant on the property, but a portable plant is employed to produce concrete sand and crusher-run gravel as required.

ACME SAND AND GRAVEL (64)

The gravel pit operated by Acme Sand and Gravel is on lot 10, concession II, Orillia township, Simcoe county, 2 miles southwest of Orillia and ½ mile west of highway No. 11. The deposit consists of interstratified coarse and fine gravel, and sand. An 18-foot face is 50 percent gravel and 50 percent sand. The maximum size of boulders is about 6 inches; 30 percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch.

A pebble count of the gravel from this deposit gives the following assemblage: Black River and Trenton limestones; basal arkose; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

A permanent plant produces washed fine and coarse aggregates. The main products are ¾-inch stone, concrete sand, and crusher-run gravel. A portable plant is employed to produce crusher-run. The plant supplies a ready-mix concrete operation on the property.

J. AND B. ENNIS SAND AND GRAVEL (65)

The gravel pit operated by J. and B. Ennis Sand and Gravel is on lot 12, concession II, Orillia township, Simcoe county, just east of highway No. 11. The beach deposit, of interstratified coarse and fine gravel, sand, and silt, is poorly sorted. The pit is operated on 2 levels over a length of nearly 1,000 feet and is almost worked-out. A 20-foot face exposed is 50 percent gravel and 50 percent sand. The maximum size of boulders is 7 inches; 20 percent of the gravel exceeds 4 inches and 50 percent exceeds 1 inch.

A pebble count of the gravel from this deposit gives the following assemblage: Black River and Trenton limestones; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

Three-quarter-inch and ⅜-inch washed stone and concrete sand are produced by a Cedarapids plant equipped with a 4- by 8-foot 2-deck screen equipped with spray bars. The throughs from the screens go to a rake classifier. A Thompson portable crushing unit is also employed as required to produce crusher-run gravel.

LOT 13, CONCESSION XIV, ORO TOWNSHIP (66)

A small gravel pit has been opened on lot 13, concession XIV, Oro township, Simcoe county,

about 3 miles southwest of Orillia. The pit is in a beach deposit, and the 12-foot face exposes well-stratified sand (50 percent) and gravel (50 percent). The maximum size of gravel is 4 inches, and 60 percent exceeds 1 inch in size.

A pebble count of the gravel from this deposit gives the following assemblage: Black River and Trenton limestones; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

Waubaushene

LOT 6, CONCESSION IX, TAY TOWNSHIP (60)

A substantial deposit of sand and gravel exists on lot 6, concession IX, Tay township, Simcoe county, about 2 miles south of Waubaushene. The deposit is an old beach on the northwest flank of a hill of moraine. A 20-foot face exposes medium gravel interstratified with coarse and fine sand having beds foreset to the northwest. One face is 40 percent gravel and 60 percent sand. The maximum size of boulders is 6 inches; 25 percent of the gravel exceeds 4 inches, and 40 percent exceeds 1 inch.

Waverley

Beach deposits of sand and gravel associated with abandoned beaches of glacial Lake Algonquin are worked for sand and gravel in the vicinity of Waverley in Tiny township, Simcoe county, 9 miles south of Midland.

TEEDON SAND AND GRAVEL (54)

The gravel pit operated by Teedon Sand and Gravel is ¼ mile west of highway No. 27 about 1 mile north of the village of Waverley in Simcoe county. The gravel deposit is a beach on the north side of a moraine hill. The 20-foot face exposes medium gravel and interstratified sand. One part of the face examined is 30 percent gravel and 70 percent sand. The maximum size of boulders is 10 inches. Twenty percent of the gravel exceeds 4 inches, and 50 percent exceeds 1 inch.

A pebble count of the gravel from this deposit gives the following assemblage: Black River Limestones; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

B. PILON SAND AND GRAVEL (55)

A small gravel pit is operated by B. Pilon on lot 71, Penetang Road, in Flos township, Simcoe county, a mile west of Orr Lake. The gravel is a beach deposit of glacial Lake Algonquin, and the pit is on the north side of the Tenth Concession line. A 20-foot face exposes well-stratified fine gravel and silty sand; the face is 30 percent gravel and 70 percent sand. Maximum size of gravel is 4 inches; fifty percent of the gravel exceeds one inch. Crusher-run gravel and pit-run gravel are produced.

FLOS TOWNSHIP PIT (56)

On lot 70, Penetang Road, Flos township, Simcoe county, a gravel pit has been opened across the road from [south of] the pit operated by B. Pilon. This gravel pit supplies pit-run gravel and crusher-run gravel for the township. The gravel deposit is similar to that in the Pilon pit, but is somewhat coarser. A 20-foot face is 50 percent gravel and 50 percent sand. Thirty percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch. There is about 1 foot of overburden.

Penetanguishene

Gravel pits are operated in the Penetanguishene area of Simcoe county by Penetang Concrete Products, and Lafontaine Sand and Gravel.

PENETANG CONCRETE PRODUCTS LTD. (52)

The gravel pit of Penetang Concrete Products is in a beach deposit on Church Street in the northeast part of the town of Penetanguishene. The deposit consists of stratified sand and fine gravel dipping to the west. A 12-foot face examined is 40 percent gravel and 60 percent sand. The gravel is rounded to subangular and consists of approximately 60 percent Precambrian crystalline rocks and 40 percent Black River Limestone.

There are ready-mix concrete and concrete block plants on the property.

LAFONTAINE SAND AND GRAVEL (53)

The gravel pit operated by Lafontaine Sand and Gravel is about 3 miles northwest of Penetanguishene on the north side of the Lafontaine road in lot 9, concession XVI, Tiny township, Simcoe county. The 15-foot face exposes stratified sand and fine gravel with an abundance of small-size stone and granules. One face is 40 percent gravel and 60 percent sand. The maximum size of gravel is 5 inches; 20 percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch. The pebbles are rounded to subangular.

A pebble count of the gravel from this deposit gives the following assemblage: Black River Limestone; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

ONTARIO COUNTY

Brougham

The old beach of glacial Lake Iroquois runs across Pickering township, in Ontario county, south of Brougham. Beach gravels are worked by Valley Sand and Gravel, Miller Paving Limited, Highland Creek Sand and Gravel Limited, Orrell Limited, Cooper Concrete Supply Limited, Consolidated Sand and Gravel, Kinsale Sand and Gravel, and I. A. Hess.

VALLEY SAND AND GRAVEL
(Not shown on map No. 2038)

A small gravel pit is operated by Valley Sand and Gravel on lot 21 or 22, concession II, Pickering township, Ontario county, a mile west of the Brock road. This is a beach deposit consisting of interstratified medium to fine sand and fine gravel. A 15-foot face exposed is 20 percent stone and 80 percent sand. The maximum size of gravel is 4 inches, and 25 percent of the gravel exceeds 1 inch in size. The main products are pit-run gravel and sand fill.

HIGHLAND CREEK SAND AND GRAVEL LIMITED (239)

Highland Creek Sand and Gravel Company Limited operates a pit in the old Iroquois beach on lots 20 and 21, concession IV, Pickering township, Ontario county. A shallow face, 8 to 10 feet high, exposed stratified sand (80 percent) and medium gravel (20 percent).

A pebble count of the gravel from this pit gives the following assemblage: Black River and Trenton limestones; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

Sand and gravel are hauled to the main plant for processing.

MILLER PAVING LIMITED (238)

A gravel pit on lot 21, concession IV, Pickering township, Ontario county, on the westward extension of the beach deposit worked by Highland Creek Sand and Gravel is worked by Miller Paving Limited. The face is 6–8 feet high.

ORRELL LIMITED (71)

A small gravel pit is operated by Orrell Limited on the west side of Brock road, 2 miles south of Brougham in Ontario county. The deposit consists of stratified sand and gravel. A 12-foot face is composed of 70 percent gravel and 30 percent sand. The maximum size of gravel is 8 inches; 10 percent exceeds 4 inches, and 80 percent exceeds 1 inch.

A pebble count of the gravel from this deposit gives the following assemblage: Black River and Trenton limestones; sandstone; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

A Pioneer portable crushing unit is employed to make crusher-run gravel. A Parker washing and screening unit produces ¾-inch and ⅜-inch stone and concrete sand.

CONSOLIDATED SAND AND GRAVEL LIMITED (72)

South Pit

A gravel pit has been opened in the old Iroquois beach on lot 16, concession IV, Pickering township, Ontario county, by Consolidated Sand and Gravel Limited. The 12- to 15-foot face consists of crossbedded stratified sand and gravel. One section is 60 percent gravel and 40 percent sand. The maximum size of gravel is 8 inches; 30 percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch. Considerable amounts of granule-sized gravel and coarse sand are present.

A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; siltstone; sandstone; dolomite; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of sand from the face is given in (XCI).

A mineralogical analysis of this sand by the Ontario Research Foundation gave the following major mineral constituents: quartz, 33 percent; feldspar, 20.5; Paleozoic limestone, 34; acid igneous rocks, 7.5 percent.

North Pit

A second pit has been opened on the north side of the road, across from the plant. This pit is on the lagoon side of the Iroquois beach, and the deposit is crossbedded, stratified sand. A 20-foot face has been opened.

(XCI) CONSOLIDATED SAND AND GRAVEL LIMITED (SOUTH PIT) (72)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	4.35	5.23	14.26	14.83	27.62	28.65	2.21	2.85

(XCII) CONSOLIDATED SAND AND GRAVEL LIMITED (NORTH PIT) (72)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	6.76	3.73	3.98	6.85	22.38	43.94	11.20	1.16

Iroquois beach deposit operated by Consolidated Sand and Gravel, Pickering.

A sieve analysis of sand from this pit is given in (XCII).

A mineralogical analysis of this sand by the Ontario Research Foundation gave the following major mineral constituents: quartz, 32.5 percent; feldspar, 20.0; Paleozoic limestone, 33.5; black shale, 4.0; acid igneous rocks, 4.0 percent.

Crushing Plant

Sand and gravel is trucked from the pit and dumped into a hopper; an apron feeder discharges to a 4-inch stationary grizzly. The oversize material goes to a Cedarapids 25- by 40-inch primary crusher. The crusher product, plus the throughs from the grizzly, are conveyed to a double-deck Dillon 4- by 12-foot screen. The throughs are minus-1-inch material which is conveyed to a surgepile. The oversize material from the screens goes to 2 Symons 3-foot standard cone crushers in closed circuit with the screens.

Screening and Washing Plant

The minus-1-inch material is taken from the surgepile by feeder and reclaiming tunnel conveyor to a double-deck 5- by 12-foot Dillon screen with ½-inch and ⅛-inch openings. The oversize material goes to a log washer and then to a 5- by 14-foot double-deck screen that separates sand and stone.

The coarse sand is removed by a 5- by 12-foot Dillon screen that also receives the throughs from the double-deck 5- by 12-foot screen. The coarse sand is conveyed to a stockpile. The fine and medium sand pass to a 48-inch Wemco classifier. The medium sand is removed and conveyed to a stockpile. The fine sand and silt go to a 60-inch Wemco classifier. The fine sand goes to a stockpile, and the silt and water go to a settling pond.

The stone that is separated from the sand on the 5- by 14-foot screen goes to a double-deck 5- by 10-foot screen, where it receives additional washing, and is conveyed to a 4- by 8-foot Allis-Chalmers screen over the loading bins. This screen separates the ¾- and ⅜-inch stone.

MILLER PAVING LIMITED (72)

A gravel pit is operated in the old Iroquois beach by Miller Paving Limited on lot 14, concession IV, Pickering township, Ontario county. A 20-foot face exposed consists of crossbedded stratified sand (80 percent) and fine gravel (20 percent). Most of the gravel is less than 3 inches in size, and 20 percent exceeds one inch. The principal product is crusher-run gravel.

PICKERING TOWNSHIP PIT (73)

The Township of Pickering operates a small gravel pit on the south side of highway No. 7, a mile east of Brougham in Ontario county. This deposit is a kame overlain by thin glacial till. The 20-foot face consists of well-stratified medium to fine gravel (40 percent) and sand (60 percent). The maximum size of gravel is 5 inches; 10 percent of the gravel exceeds 4 inches, and 50 percent exceeds 1 inch.

A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones;

black shale; siltstone; Precambrian granitic rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

Portable crushing units are employed to produce crusher-run gravel for roads.

A sieve analysis of sand from the pit is given in (XCIII).

HIGHLAND CREEK SAND AND GRAVEL LTD. (234)

A gravel pit is operated by Highland Creek Sand and Gravel Company Limited on lot 13 or 14, concession V, Pickering township, Ontario county. A 10-foot face exposes interstratified sand (80 percent) and fine gravel (20 percent).

A sieve analysis of sand from this deposit is given in (XCIV).

Kinsale

KINSALE SAND AND GRAVEL (75)

The gravel pits operated by Kinsale Sand and Gravel are on lots 4 and 5, concession V, Pickering township, Ontario county, ½ mile south of highway No. 7, near Kinsale. The deposits are beach gravels laid down along the old beachline of glacial Lake Iroquois. They are quite shallow at at this locality; rarely are they deeper than 8–10 feet. One 10-foot face consists of stratified and crossbedded sand (70 percent) and gravel (30 percent). The maximum size of gravel is 5 inches. Ten percent of the gravel exceeds 4 inches, and 40 percent exceeds 1 inch.

Production is confined to crusher-run and pit-run gravel.

A sieve analysis of sand from this pit is given in (XCV).

I. A. HESS (76)

A mile east of Kinsale, on the south side of highway No. 7, a sand and gravel pit is operated by Ivan A. Hess on lot 33, concession V, Whitby township, Ontario county. The deposit is part of the old beachline of glacial Lake Iroquois. The 15-foot face examined consists of stratified crossbedded sand and minor gravel.

A pebble count of the gravel from this deposit gives the following assemblage: Black River and Trenton limestones; black shale, (very rare); white sandstone (Potsdam); dolomite; Precambrian granitic rocks; and Precambrian metamorphic rocks.

The production from this pit is mainly pit-run and crusher-run gravel.

Whitevale

GIORDANO SAND AND GRAVEL (70)

The gravel pit operated by Giordano Sand and Gravel Limited is on lot 31, concession V, Pickering township, Ontario county, ¼ mile north of the village of Whitevale. The sand and gravel deposit is a kame on the east bank of West Duffin Creek, several miles north of the old Iroquois beach.

The 40-foot face exposes lensy and irregularly stratified sand, and medium to coarse gravel. One section examined is 30–40 percent gravel and 60–70 percent sand. The maximum size of gravel in this section was 8 inches, but boulders up to 20 inches are found elsewhere in the deposit. Twenty percent of the gravel exceeds 4 inches, and 50 percent exceeds 1 inch. Overburden is 3–5 feet deep.

A pebble count of the gravel from this deposit gives the following assemblage: Black River and

(XCIII) PICKERING TOWNSHIP PIT (73)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	2.09	7.57	15.45	26.78	32.34	14.44	0.91	0.43

(XCIV) HIGHLAND CREEK SAND AND GRAVEL LIMITED (234)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	9.6	4.6	7.5	10.7	21.8	32.1	10.0	3.7

(XCV) KINSALE SAND AND GRAVEL (75)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	16.25	23.98	22.41	26.76	7.85	1.10	0.48	1.17

Trenton limestones; sandstone; siltstone; Precambrian granitic rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks;

A portable crushing and screening plant produces ¾- and ⅜-inch stone, concrete sand, and crusher-run gravel. Pit-run gravel is also produced.

A sieve analysis of sand from the face of the pit is given in (XCVI).

A mineralogical analysis of the sand by the Ontario Research Foundation gave the following major mineral constituents: quartz, 28.5 percent; feldspar, 17.5; Paleozoic limestone, 34.5; dolomite, 2.5; acid igneous rocks, 13 percent.

Oshawa

Several small gravel pits have been operated in Whitby township, Ontario county, north of Oshawa in old beach deposits of glacial Lake Iroquois. None of these deposits now supports a commercial plant. Deposits were examined on lots 20 and 21, concession IV, Whitby township and on lot 15, concession IV, East Whitby township. The latter deposit is characteristic of these beach deposits and is therefore briefly described below.

LOT 15, CONCESSION IV, EAST WHITBY TOWNSHIP (74)

In lot 15, concession IV, East Whitby township, Ontario county, the beach deposit is shallow, having been worked only to a depth of 8 feet. The face exposes well-sorted stratified crossbedded fine gravel and sand. Twenty five percent of the face is gravel and 75 percent is sand. The maximum size of pebbles is 3 inches, and 30 percent of the gravel exceeds 1 inch. The pebbles are subangular to well-rounded.

A pebble count of a sample of the gravel from this pit gives the following assemblage: Black River and Trenton limestones; sandstone; pink siltstone; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of the sand from this deposit is given in (XCVII).

A mineralogical analysis of this sand by the Ontario Research Foundation indicates the following major mineral constituents: quartz, 29.5 percent; feldspar, 19; Paleozoic limestone, 45; acid igneous rocks, 2 percent.

Uxbridge-Whitchurch Township Line

Western Sand and Gravel Limited, Stouffville Sand and Gravel Limited, and Commercial Sand and Gravel Company, all operate pits 4 miles north of Stouffville on the Uxbridge–Whitchurch township line, Ontario county, in the same glaciofluvial sand and gravel deposit within the Oak Ridges kame moraine.

COMMERCIAL SAND AND GRAVEL COMPANY (49)

A pit operated by Commercial Sand and Gravel Company is on lot 16, concession I, Uxbridge township, Ontario county, just east of the plant of Stouffville Sand and Gravel Limited. A 40-foot face exposes interstratified medium sand (65 percent) and medium gravel (35 percent). Maximum size of boulders observed is 8 inches; 20 percent of the gravel exceeds 4 inches, and 50 percent exceeds 1 inch.

A sieve analysis of sand from this pit is given in (XCVIII).

The sand and gravel is hauled from this pit to the plant of Commercial Sand and Gravel Company.

(XCVI) GIORDANO SAND AND GRAVEL (70)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	11.11	10.33	11.13	11.76	19.94	21.85	9.06	4.82

(XCVII) LOT 15, CONCESSION IV, EAST WHITBY TOWNSHIP (74)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	2.63	3.19	4.93	2.67	23.12	54.89	3.17	5.43

(XCVIII) COMMERCIAL SAND AND GRAVEL COMPANY (49)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	5.5	6.5	12.7	21.8	24.3	19.8	4.8	4.6

Stratified outwash sand and gravel at Goodwood, Ontario.

Goodwood

Several sand and gravel pits are operated in the Goodwood area, which lies within the Oak Ridges kame moraine. The area appears to be a good one for prospecting for further deposits of sand and gravel.

LOT 20, CONCESSION II, UXBRIDGE TOWNSHIP (77)

In 1962, Stouffville Sand and Gravel Limited operated a gravel pit on lot 20, concession II, Uxbridge township, Ontario county, across the road from the Hall pit, in the same deposit of well-stratified medium gravel and coarse sand.

LOT 21, CONCESSION II, UXBRIDGE TOWNSHIP (77)

Hall's pit is on lot 21, concession II, Uxbridge township, Ontario county, a mile north of Goodwood village. The gravel pit measures 150 by 300 feet. The 15-foot face exposes a very good deposit of well-bedded coarse and medium gravel, and sand. The face examined is 60 percent gravel and 40 percent sand. The maximum size of boulders is 6 inches; 20 percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch. There is no cementation, but some carbonate encrustation was noted.

A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; sandstone; black shale (rare); Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

The deposit was worked in 1961 by Stouffville Sand and Gravel Limited; the gravel was trucked to their plant 4 miles southwest.

UXBRIDGE SAND AND GRAVEL (252) (Bunker Pit)

The Bunker pit, on lot 15, concession III, Uxbridge township, Ontario county, ¼ mile south of Goodwood village, is operated by Uxbridge Sand and Gravel. The deposit consists of well-stratified sand and medium gravel. A 25-foot face examined is 40 percent stone and 60 percent sand. The maximum size of gravel observed is 6 inches; 20 percent exceeds 4 inches, and 50 percent exceeds 1 inch. There is 1 to 3 feet of stripping.

LOT 15, CONCESSION IV, UXBRIDGE TOWNSHIP (79)

A small gravel pit has been opened on lot 15, concession IV, Uxbridge township, Ontario county. The 10-foot face exposes interstratified sand and fine gravel.

LOT 17, CONCESSION IV, UXBRIDGE TOWNSHIP (79)

A gravel pit has been opened on lot 17, concession IV, Uxbridge township, Ontario county, a mile east of Goodwood. There is 10–12 feet of overburden. A 25-foot face exposes interstratified medium gravel and sand. The maximum size of gravel is 8 inches; the face examined is 50 percent stone and 50 percent sand. Thirty percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch.

A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; sandstone; black shale (rare); Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

Some of the pebbles of metamorphic gneiss are weathered and crumbly.

The gravel is trucked to the plant of Commercial Sand and Gravel Limited near Stouffville.

LOT 20, CONCESSION IV, UXBRIDGE TOWNSHIP (78)

A small gravel pit has been opened on the south side of highway No. 47, 2 miles northeast of Goodwood, on lot 20, concession IV, Uxbridge township, Ontario county. The 15-foot face exposes a well-bedded deposit of fine gravel and coarse sand. Where examined, it is 30 percent gravel and 70 percent sand. The maximum size of gravel is 6 inches; 20 percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch. Clay balls, which are difficult to remove, are present in this gravel.

A pebble count of the gravel from this pit gives the following assemblage: Black River and Trenton limestones; Potsdam Sandstone; Precambrian acid igneous rocks; Precambrian metamorphic rocks; Precambrian basic igneous rocks; and black shale (rare).

There is some carbonate encrustation on pebbles.

A sieve analysis of sand from this pit is given in (XCIX).

Gravel from this deposit is trucked to the plant of Stouffville Sand and Gravel Limited.

COPPINS PIT (80)

Coppins gravel pit is on lot 16, concession V, Uxbridge township, Ontario county, 3 miles east of Goodwood. The pit is on the west slope of a hill and has been opened for a length of about 600 feet. The 15-foot face exposes well-stratified sand and fine to medium gravel. The face examined is 50 percent gravel and 50 percent sand. Twenty percent of the gravel exceeds 4 inches, and 50 percent exceeds 1 inch. Overburden is 3–5 feet thick. Pebbles are subangular to well-rounded.

A pebble count of the gravel from this pit gives the following assemblage: Black River and Trenton limestones; Black shale (very rare); Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of sand from the pit face is given in (C).

LOT 14, CONCESSION VII, UXBRIDGE TOWNSHIP (81)

In August 1961, Holman Construction Company was operating a gravel pit on lot 14, concession VII, Uxbridge township, Ontario county, 5 miles southeast of Uxbridge. The deposit consists of stratified sand and medium to coarse gravel. A 15-foot face is 60 percent gravel and 40 percent sand; 30 percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch. The maximum size of gravel is 8–10 inches in diameter.

Uxbridge

LOT 5, CONCESSION X, REACH TOWNSHIP (82)

A small gravel pit has been opened on lot 5, concession X, Reach township, Ontario county, 3½ miles east of Uxbridge, on the north side of highway No. 47. The deposit consists of cross-bedded stratified medium gravel and coarse sand. The 12- to 15-foot face examined is 50 percent gravel and 50 percent sand. Maximum size of boulders is 8 inches; 30 percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch.

A pebble count of the gravel from this deposit gives the following assemblage: Black River and Trenton limestones; Potsdam Sandstone; Precam-

(XCIX) LOT 20, CONCESSION IV, UXBRIDGE TOWNSHIP (78)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	26.9	9.8	17.5	32.6	12.1	0.5	0.1	0.5

(C) COPPINS PIT (80)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	7.5	0.9	3.9	25.0	56.3	4.9	0.4	1.1

(CI) SUNDERLAND SAND AND GRAVEL LIMITED (83)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	44.4	5.7	7.0	10.6	11.7	14.4	3.8	2.4

brian acid igneous rocks; and Precambrian metamorphic rocks.

A portable crushing plant was operated in the pit in 1961 by King Paving Company to produce crusher-run gravel.

Mount Albert

LOT 20, CONCESSION II, SCOTT TOWNSHIP (251)

In a small gravel pit on lot 20, concession II, Scott township, Ontario county, a 20-foot face exposes poorly-sorted medium gravel, coarse sand, and clay. One face examined is 50 percent stone and 50 percent sand. Maximum size of gravel is 8 inches; 20 percent exceeds 4 inches, and 60 percent exceeds 1 inch. A pebble count of the gravel indicates an assemblage of Black River and Trenton limestones, Precambrian acid igneous rocks, and Precambrian metamorphic rocks.

Sunderland

A large esker runs in a southerly direction across Brock township, Ontario county, for a distance of more than 10 miles and crosses highway No. 7 just north of Blackwater. Hancock Sand and Gravel, and Sunderland Sand and Gravel, operate in this esker deposit.

SUNDERLAND SAND AND GRAVEL LIMITED (83)

The gravel plant and initial pit operated by Sunderland Sand and Gravel are just east of highway No. 7, one mile south of Sunderland, on lot 12, concession IV, Brock township, Ontario county. Other pits are operated east of the plant along the Fifth Concession road. One pit examined exposes a ridge of poorly-sorted sand and gravel. A 20-foot face is 50 percent stone and 50 percent sand. Maximum size of stone observed is 6 inches; 20 percent exceeds 4 inches, and 50 percent exceeds 1 inch.

A pebble count of gravel from the stockpile gave the following pebble assemblage: Black River and Trenton limestones; sandstone; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of sand from one of the pits is given in (CI).

The main products are ¾-inch, ½-inch, and ⅜-inch stone, concrete sand, and brick sand, all of which are produced in a screening and washing plant. From the feed hopper, sand and gravel go to a 2-deck Dillon 4- by 12-foot scalping screen with 2-inch and 1-inch openings. The upper and lower screens are in closed circuit respectively with a 20- by 20-inch Cedarapids impact breaker and a set of 20- by 24-inch rolls. The throughs go to a surge bin which feeds to a 2-deck 4- by 12-foot Cedarapids screen equipped with spray bars for washing. The oversize from the ⅝-inch and ¼-inch screens goes to a log washer and on to a set of 3-deck 4- by 12-foot screens equipped with spray bars. These screens produce ¾-, ½- and ⅜-inch stone. The throughs from this screen and from the previously described 2-deck screen go to a settling tank. Two Eagle dewatering screws produce concrete sand and brick sand.

HANCOCK SAND AND GRAVEL LIMITED (84)

Hancock Sand and Gravel Limited operates gravel pits in the Sunderland esker on lots 9 to 11, concession III, Brock township, Ontario county. The deposit consists of irregularly stratified sand and gravel. A 30-foot face examined is 30 percent gravel and 70 percent sand; 20 percent of the gravel exceeds 4 inches in size, and 50 percent exceeds 1 inch.

A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; sandstone; Precambrian acid igneous rocks; Precambrian basic igneous rocks; Precambrian metamorphic rocks.

A sieve analysis of sand from one face is given in (CII).

A screening and washing plant produces ¾-, ⅝-, and ⅜-inch stone, concrete sand, and brick sand. Sand and gravel goes from the feed hopper to a 2-deck Dillon scalping screen in closed circuit with a 20- by 20-inch Cedarapids impact breaker and a set of 24- by 30-inch rolls. The minus-1-inch material that passes the screens goes to a 3-deck 4- by 10-foot Cedarapids screen equipped with spray bars for washing. The screen-sizes are ¾-, 7/16-, and ¼-inch; ¾-, ⅝-, and ⅜-inch stone are produced. The throughs from the ¼-inch screen go to a 6-valve settling tank discharging to 2 Eagle dewatering screws producing concrete sand and brick sand. Plant capacity is approximately 160 tons per hour.

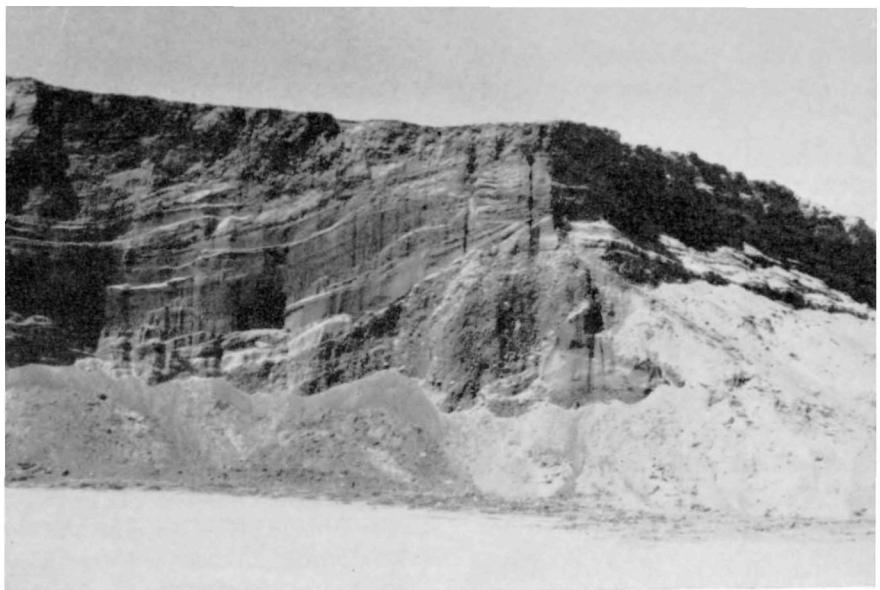
Port Bolster

EASTERN SAND AND GRAVEL (85)

The pit operated by Eastern Sand and Gravel is on lot 8, concession XIV, Brock township, Ontario county, 3 miles east of Port Bolster. The 20-foot face exposes well-sorted medium gravel (50 percent) and sand (50 percent). The maximum size of boulders is 8 inches; 30 percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch. The deposit is a kame.

A pebble count of the gravel from this deposit gives the following assemblage: Black River and Trenton limestones; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

The main products are crusher-run and pit-run gravel. A portable plant is employed for crushing and screening as required.



Stratified sand and gravel in the Sunderland esker; Hancock Sand and Gravel.

M.L. AVERY SAND AND GRAVEL (86)

The gravel pit operated by M. L. Avery Sand and Gravel is on lot 6, concession XIII, Brock township, 3 miles east of Port Bolster. This pit is ¾ mile southwest of Eastern Sand and Gravel and is in the same kame deposit.

A 20-foot face exposes interstratified medium gravel (50 percent) and sand (50 percent). The gravel rarely exceeds 7 inches in size and contains only a few erratics up to 24 inches in diameter; 30 percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch.

A pebble count of the gravel from this deposit gives the following assemblage: Black River and Trenton limestones; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of the sand from this deposit is given in (CIII).

Gravel is excavated by a front-end loader. Crushing and screening is done by a portable plant. The main products are pit-run and crusher-run gravel, block sand, and ¾-inch stone.

VICTORIA COUNTY

Fenelon Falls

The Fenelon Falls esker extends in a southeasterly direction across Fenelon township south of Cameron Lake. Gravel pits are operated in this esker 2 miles west of Fenelon Falls.

H. G. GRAHAM (88)

The gravel pit operated by H. G. Graham is on lot 21, concession VII, Fenelon township, Victoria county, 2 miles west of Fenelon Falls at the junction of highways No. 35 and 35A. The 60-foot-high esker ridge extends westward on the south side of highway No. 35. Two faces on different levels have been opened in the esker. The lower 15-foot face, which was in operation in August 1961, exposes stratified sand (80 percent) and fine gravel (20 percent). None of the pebbles exceeds 4 inches in size, and 30 percent of the gravel exceeds 1 inch. The pebbles are limestone and Precambrian crystalline rocks.

A sieve analysis of sand from this deposit is given in (CIV).

The equipment at the pit consists of a front-end loader and portable crusher. The main products are pit-run and crusher-run gravel.

Two other gravel pits have been opened in the esker west of the Graham property.

Bobcaygeon

LOT 10, CONCESSION X, VERULAM TOWNSHIP (89)

Gravel pits have been opened 2 miles south of Bobcaygeon in an esker that crosses lot 10, concession X, Verulam township, Victoria county, south of the bend in highway No. 36. The deposit, where examined in a small inactive pit, consists of poorly-sorted medium and coarse gravel and sand. A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; basal arkose; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

Omemee

OMEMEE ESKER (87)

The Y-shaped Omemee esker lies mostly within Emily township, Victoria county, west of the village of Omemee. Its shape and extent are indicated on Map 1050A of the Geological Survey of Canada (Gravenor 1959). The east and main branch of the esker extends southward for a distance of 12 miles from lot 15, concession VIII through the southwest corner of the township, and 3 miles into Manvers township. Throughout its length, it forms a discontinuous ridge 50–75 feet high. The west branch is vague in form and extends southward from lot 7, concession X, Emily township, to join the east branch in lot 4, concession V.

A gravel pit has been opened in the esker at the north end of the east branch on lot 12, concession VIII, Emily township, Victoria county, a mile north of Fee Landing. The 25-foot face of the pit exposes well-sorted medium to coarse gravel, with interstratified sand. The pebbles, which range between 1 and 6 inches in size, are well-rounded to subrounded.

A gravel pit has been opened in the west branch of the esker on lots 3 and 4, concession V, Emily township, Victoria county. The deposit consists of well-sorted medium to coarse gravel and interstratified medium sand.

Just south of highway No. 7 gravel pits have been opened in the Omemee esker on lot 3, concessions III and IV, Emily township, Victoria county, 1½ miles west of Omemee village. A 20-foot face exposes poorly-sorted coarse gravel, sand, and silt. The face is 30 percent gravel and 70 percent sand and silt; 40 percent of the gravel exceeds 4 inches in size, and 60 percent exceeds 1 inch. Boulders up to 20 inches in diameter also are present, and many boulders are 5–10 inches in size. The pebbles are mainly Paleozoic limestone with a minor percentage of Precambrian crystalline rocks. A pebble count gives the following assemblage: Black River and Trenton limestones; Precambrian acid igneous rocks; and Precambrian metamorphic rocks. The pebbles are rounded to subrounded.

There are no plants in these gravel pits, production being mostly pit-run material. Portable plants are used as required.

DURHAM COUNTY

Bethany

HIGHLAND CREEK SAND AND GRAVEL COMPANY LIMITED (90)

A large gravel pit operated by Highland Creek Sand and Gravel Company Limited is on lot 2, concession VII, Cavan township, Durham county. This extensive deposit of good-quality sand and gravel is a kame on the north edge of the Oak Ridges kame moraine.

The pit has been worked on two levels. One 20-foot face examined is medium coarse gravel and sand, of which 60 percent is stone and 40 percent is sand. Forty percent of the gravel exceeds 4 inches in size, and 70 percent exceeds 1 inch; maximum size is about 10 inches. The gravel is well-sorted and is rounded to subrounded.

A pebble count of the gravel gave the following assemblage: Black River and Trenton limestones; white Potsdam Sandstone; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

(CII) HANCOCK SAND AND GRAVEL LIMITED (84)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−220
Weight percent	nil	nil	0.7	6.8	30.4	40.8	11.9	9.4

(CIII) M. L. AVERY SAND AND GRAVEL (86)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	4.68	5.10	9.00	32.25	34.75	9.88	1.50	2.85

(CIV) H. G. GRAHAM (88)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	8.87	4.55	11.73	29.20	30.81	11.31	2.01	1.54

Kamey gravel at Highland Creek Sand and Gravel pit, Bethany.

A sieve analysis of sand from the pit is given in (CV).

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the following major mineral constituents: quartz, 25.5 percent; feldspar, 18.5; Paleozoic limestone, 43; acid igneous rocks, 5; and basic igneous rocks, 5 percent.

A crushing, screening and washing plant produces 2-, 1-, ¾-, and ⅜-inch stone, and sand.

Pontypool

JACKSON SAND AND GRAVEL (91)

A gravel pit has been operated on the west side of highway No. 35, a mile north of Pontypool, in concession III, Manvers township, Durham county. The pit is approximately 150 feet in diameter. An 18-foot face exposes well-sorted medium gravel and coarse sand. Fifty percent of the face is gravel and 50 percent is sand. The maximum size of boulders is 5 inches; 10 percent of the gravel exceeds 4 inches, and 50 percent exceeds 1 inch. The pebbles are rounded to well-rounded.

A pebble count of the gravel from this deposit gives the following assemblage: Black River and Trenton limestones; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

The gravel deposit is on the north edge of the Oak Ridges kame moraine.

TAYLOR PIT (260)

The Taylor gravel pit is on the south side of highway No. 115, two miles northeast of the junction of highway No. 35 with the First Concession road of Manvers township in Durham county. The gravel deposit is within the Oak Ridges kame moraine. A 20-foot face examined is 50 percent stone and 50 percent sand. Maximum size of gravel is 6 inches; 30 percent exceeds 4 inches, and 60 percent exceeds 1 inch.

A pebble count indicates the pebble assemblage of the gravel to be Black River and Trenton limestones, Precambrian acid igneous rocks, and Precambrian metamorphic rocks.

A small portable plant produces crusher-run gravel.

Bowmanville

Two commercial sand and gravel producers, Bowmanville Sand and Gravel, and General Aggregates, operate pits in beach deposits of glacial Lake Iroquois in Darlington and Clarke townships north of Bowmanville in Durham county.

(CV) HIGHLAND CREEK SAND AND GRAVEL LIMITED (90)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	9.6	4.6	7.5	10.7	21.8	32.1	10.0	3.7

BOWMANVILLE SAND AND GRAVEL (92)

The gravel pit operated by Bowmanville Sand and Gravel is ½ mile south of the Fifth Concession line, 4 miles north of Bowmanville, on lot 6, concession IV, Darlington township, Durham county. The gravel deposit is in an old beach of glacial Lake Iroquois. A 12-foot face exposes well-stratified well-sorted sand and medium to fine gravel; 20 percent of the face is gravel, and 80 percent is sand. The maximum size of gravel is 6 inches; 10 percent of the gravel exceeds 4 inches, and 30 percent exceeds 1 inch.

A pebble count of the gravel from this deposit gives the following assemblage: Black River and Trenton limestones; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of the sand from this pit is given in (CVI).

A mineralogical analysis of the sand by the Ontario Research Foundation indicated the following major mineral constituents: quartz, 25.5 percent; feldspar, 19.5; Paleozoic limestone, 49 percent.

A small screening plant produces ¾-inch and ⅜-inch stone, concrete sand, and asphalt sand.

GENERAL AGGREGATES LIMITED (93)

The gravel pit and plant of General Aggregates is on lot 32, concession VI, Clarke township, Durham county, just north of the Sixth Concession line, 2 miles northwest of Orono. The shallow gravel deposit, 6–10 feet deep, lies on clay and is an old beach of glacial Lake Iroquois. The face exposes rather poorly-sorted medium gravel and sand. The maximum size of boulders is 8 inches, with an occasional larger erratic. The face is 60 percent gravel and 40 percent sand. Twenty percent of the gravel exceeds 4 inches, and 50 percent exceeds 1 inch. The pebbles are angular to rounded. The pit measures approximately 600 by 1,300 feet. Overburden is either shallow or lacking.

A pebble count of gravel from this pit gives the following assemblage: Black River and Trenton limestones; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of sand from this pit is given in (CVII).

A mineralogical analysis of the sand by the Ontario Research Foundation indicated the following major mineral constituents: quartz, 36 percent; feldspar, 22; Paleozoic limestone, 35; acid igneous rocks, 4.5 percent.

A crushing plant (capacity about 200 tph) and a washing plant (capacity about 150 tph) produce ¾- and ⅜-inch stone, concrete sand, asphalt sand, and crusher-run gravel. The crushing plant consists of a grizzly, conveyor, screen, jaw crusher, and rolls and screen. The washing plant has 3 sets of deck screens equipped with spray bars, log washers, a 5-valve settling tank, and classifiers to dewater the sand.

Port Hope

SLEEMAN BROTHERS (94)

The only gravel pit operating in the Port Hope area is that of Sleeman Brothers on lot 9, concession II, Hope township, Durham county, 1½ miles northwest of Port Hope, and 1 mile east of Welcome.

The beach deposit is on the west side of a low hill and consists of well-sorted stratified coarse to medium gravel and sand. A 20-foot face examined is 60 percent stone and 40 percent sand; 30 percent of the gravel exceeds 4 inches in size, and 60 percent exceeds 1 inch. The maximum size of gravel is 8 inches. There is 1–2 feet of topsoil and overburden on the gravel.

A pebble count of the gravel gave the following assemblage: Black River and Trenton limestones; Precambrian acid igneous rocks; Precambrian basic igneous rocks; Precambrian metamorphic rocks.

A portable crushing and screening plant is used to produce 1¼-, ¾-, and ⅜-inch stone, and crusher-run.

(CVI) BOWMANVILLE SAND AND GRAVEL LIMITED (92)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	nil	nil	0.41	16.96	71.40	9.96	0.29	0.98

(CVII) GENERAL AGGREGATES LIMITED (93)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	8.39	10.70	9.85	15.07	24.26	23.87	5.36	2.23

PETERBOROUGH COUNTY

Peterborough

The gravel deposits being worked in the Peterborough area of Peterborough county are mainly in two eskers, the Douro esker on the Warsaw road in Douro township northeast of Peterborough, and the Bridgenorth esker in Smith township north and west of Lakefield (Gravenor 1959).

Douro Esker

The Douro esker extends for approximately 6 miles in Douro township, Peterborough county, in a southeasterly direction from lot 10, concession IV, to lot 1, concession X. The esker, throughout its length, is close to the Warsaw road. It forms a low narrow discontinuous ridge that rises 25–40 feet. It is not a pronounced feature of the landscape because it passes through a hilly drumlin field. A series of small abandoned gravel pits in the esker expose poorly-sorted medium to coarse gravel and sand.

DUNFORD BROTHERS (103)

Dunford Brothers operate a sand pit on the north side of the Warsaw road on lot 4, concession IX, Douro township, Peterborough county. The deposit of well-stratified fine to medium sand is on the north flank of the esker ridge.

A sieve analysis of sand from the face is given in (CVIII).

A mineralogical analysis of this sand by the Ontario Research Foundation indicates the following major mineral constituents: quartz 28.5 percent; feldspar, 29; Paleozoic limestone, 24; grey shale and siltstone, 3.5; acid igneous rocks, 10; basic igneous rocks, 3.5 percent.

Pit-run sand is produced, and there is no plant on the property. A small gravel pit in the esker is operated on the south side of the road.

REGAL WASHED SAND AND STONE LIMITED (104)

Regal Washed Sand and Stone operates the McMahon pit on lot 2, concession IX, Douro township, Peterborough county, just south of the Warsaw road. The shallow gravel deposit is a thin sheet of glaciofluvial outwash in a glacial spillway on the south side of the Douro esker. The 10-foot face exposes well-sorted stratified medium to fine gravel and sand. Where examined, the deposit is 40 percent stone and 60 percent sand. The gravel has a maximum size of 4 inches, and 50 percent exceeds 1 inch. A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; Potsdam Sandstone; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of sand from the face is given in (CIX).

A mineralogical analysis of this sand by the Ontario Research Foundation indicated the following major mineral constituents: quartz, 18 percent; feldspar, 20.5; Paleozoic limestone, 36; grey shale and siltstone, 5; dolomite, 2; acid igneous rocks, 14; basic igneous rocks, 2.5 percent.

The plant on the property consists of a hopper, a Pioneer impact crusher, and a washing trommel that produces ¾-inch stone, pea stone, and sand at the rate of about 50 tons per hour. The sand goes to a dewatering screw and is then stockpiled.

ROSS PIT (105)

The Ross gravel pit, operated by the County of Peterborough, is on lot 5, concession VII, Douro township, Peterborough county, on the south side of the Warsaw road. The pit is in the Douro esker that consists, at this site, of poorly-sorted medium to coarse gravel, sand, and clay. The gravel deposit is overlain by 1–4 feet of patchy clay overburden. A 12-foot face is 30 percent stone and 70 percent sand and clay. Thirty percent of the stone exceeds 4 inches in size, and 60 percent exceeds 1 inch. Glacial erratics of large size are present. The gravel is poor in quality owing to the clay content. However, it is suitable for pit-run gravel, and crusher-run road material is also produced.

(CVIII) DUNFORD BROTHERS (103)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	nil	0.09	0.46	17.71	45.07	30.74	4.34	1.59

(CIX) REGAL WASHED SAND AND STONE LIMITED (104)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	1.63	12.56	21.34	29.48	22.72	9.14	1.59	1.54

Stratified sand on the south flank of the Bridgenorth esker; C. C. Doughty pit, Lakefield.

Bridgenorth Esker

The Bridgenorth esker extends in a southwesterly direction across Smith township, Peterborough county, from the vicinity of Youngs Point to Bridgenorth on Chemong Lake. The esker forms a low ridge which, in places, is up to ½ mile wide, being considerably broader than the usual esker ridge. Where the esker widens, the material deposited is slightly better sorted and finer in size than is normal in the narrow esker ridges.

Four gravel pits are operated in the Bridgenorth esker by Max Kidd, T. F. Doughty, C. C. Doughty, and Fred Nelson and Sons.

MAX KIDD PIT (106)

The gravel pit operated by Max Kidd is on lot 33, concession XI, Smith township, Peterborough county, on the south side of the road 2 miles southwest of Youngs Point. A 15-foot face exposes poorly-sorted coarse and medium gravel and interstratified sand. The face is approximately 50 percent sand and 50 percent gravel. Forty percent of the gravel exceeds 4 inches in size and 70 percent exceeds 1 inch. The maximum size of boulders is 8–10 inches. The pit produces mainly pit-run gravel, which is loaded by a front-end loader.

T. F. DOUGHTY LIMITED (107)

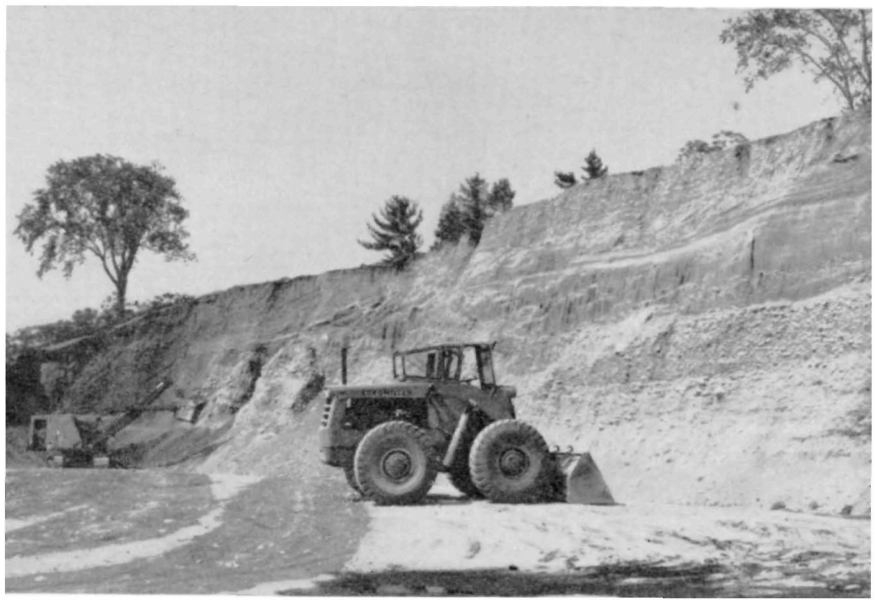
T. F. Doughty Limited operates a gravel pit on lot 26, concession IX, Smith township, Peterborough county, 1 mile northwest of Lakefield. The esker deposit is composed of well-sorted coarse and medium gravel with some interstratified sand. The gravel is subangular to rounded. The 15-foot face of the gravel pit examined is 60 percent stone and 40 percent sand. Fifty percent of the gravel exceeds 4 inches in size, and 75 percent exceeds 1 inch. The maximum size of boulders is 10 inches. Finer material, mainly stratified fine gravel and sand, is found in the western part of the gravel pit. A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

A crushing and washing plant, consisting of an impact breaker, classifier, screens, and bins, produces sand and ⅜-, ¾-, and 1½-inch crushed stone.

C. C. DOUGHTY (108)

The gravel pit operated by C. C. Doughty is in the Bridgenorth esker on lot 21, concession VIII, Smith township, Peterborough county, on the north side of the road 2 miles west of Lakefield. The 40-foot face exposes interstratified sand and fine to medium gravel, and consists of 30 percent stone and 70 percent sand. Twenty percent of the gravel exceeds 4 inches in size, and 50 percent exceeds 1 inch. The maximum size of boulders is 6 inches. The gravel is well-sorted, and rounded to well-rounded. There are substantial reserves of sand and fine gravel in this deposit.

A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; Precambrian acid igneous rocks; Precambrian



Norwood esker, Norwood.

(CX) C. C. DOUGHTY (108)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	0.39	9.69	14.01	21.39	24.21	22.54	6.50	1.27

(CXI) NORWOOD ESKER (110)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	5.45	10.90	12.20	12.30	12.10	20.45	15.30	11.30

(CXII) PAX SAND AND GRAVEL (261)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	8.6	3.8	13.6	41.6	25.5	5.1	0.8	1.0

(CXIII) LOT 7, CONCESSION VIII, BELMONT TOWNSHIP

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	3.42	1.76	7.30	23.99	46.25	14.92	1.36	1.00

basic igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of a sand sample taken from this pit is given in (CX).

A mineralogical analysis of the sand by the Ontario Research Foundation indicated the following major mineral constituents: quartz, 23.0 percent; feldspar, 37.5; Paleozoic limestone, 24; acid igneous rocks, 6; basic igneous rocks, 2.5; Precambrian limestone, 2; hornblende, 2; biotite, 1.5 percent.

The plant, which consists of a crusher, conveyor, 3-deck screens equipped with spray bars, conveyors and an Eagle dewatering screw for the sand, produces ¾-inch and ⅝-inch stone and concrete sand. This plant supplies coarse and fine concrete aggregate to Doughty Concrete Products Limited.

FRED NELSON AND SONS (109)

The gravel pit operated by Fred Nelson and Sons is on lot 19, concession VII, Smith township, Peterborough county, on the south side of the road ½ mile west of the C. C. Doughty gravel pit. The esker ridge is composed of poorly-sorted coarse and medium gravel with some sand. The 30-foot face examined is 50 percent stone and 50 percent sand; 30 percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch. The maximum size of boulders is 7–10 inches. A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; basal arkose; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

A portable crushing plant produces crusher-run gravel.

Norwood

NORWOOD ESKER (110)

One of the largest eskers in Southern Ontario is the Norwood esker in Peterborough county; it extends from Round Lake in a southwesterly direction through Norwood and Westwood to Rice Lake. This esker contains a large reserve tonnage of sand and gravel for the Norwood area; up to the present, it has been exploited only partly.

In 1961, a gravel pit was opened in the esker on the east outskirts of Norwood by E. and E. Seegmiller. The 25-foot face exposes irregularly-interstratified medium sand (40 percent) and medium to coarse gravel (60 percent). The maximum size of boulders is 14 inches; 30 percent of the gravel exceeds 4 inches in size, and 60 percent exceeds 1 inch. The pebbles are mostly Black River and Trenton limestones, and Precambrian crystalline rocks.

A sieve analysis of sand from the face of this pit is given in (CXI).

A gravel pit was opened in 1962 in the esker on the west outskirts of Norwood by Warren Bituminous Paving Company.

Westwood

The Norwood esker extends southwest, through Westwood, to Rice Lake.

PAX SAND AND GRAVEL (261)

A gravel pit is operated in the Norwood esker a mile west of Westwood, on lot 9, concession I, Asphodel township, Peterborough county, by Pax Sand and Gravel. The esker consists of stratified sand and medium to coarse gravel. A 25-foot face examined is 60 percent stone and 40 percent sand. Maximum size of gravel is 8 inches; 30 percent exceeds 4 inches, and 60 percent exceeds 1 inch. The pebbles are Black River and Trenton limestones, and Precambrian rocks. The gravel grades southward into stratified sand on the flanks of the esker.

A sieve analysis of sand from the pit is given in (CXII).

A portable crushing and screening plant produces ¾- and ⅜-inch stone, crusher-run gravel, and sand.

Havelock

Two gravel pits were visited in the Havelock area.

LOT 3, CONCESSION VIII, BELMONT TOWNSHIP (Not shown on map No. 2038)

A gravel pit, a mile southeast of Havelock on lot 3, concession VIII, Belmont township, Peterborough county, exposes 15 feet of stratified coarse sand and medium gravel; this was being excavated as pit-run gravel. The face is 30 percent stone and 70 percent sand. The maximum size of boulders is 6 inches; 10 percent of the stone exceeds 4 inches, and 50 percent exceeds 1 inch.

LOT 7, CONCESSION VIII, BELMONT TOWNSHIP (Not shown on map No. 2038)

The pit on lot 7, concession VIII, Belmont township, Peterborough county, a mile east of Havelock on the south side of the Belmont Lake road, is almost worked-out. The deposit is a kame gravel consisting of irregularly-bedded, variable, poorly-sorted, medium to coarse gravel in patches and layers, interstratified with sand and medium gravel. Ice-contact features are numerous. An 18-foot face is 30 percent stone and 70 percent sand. The maximum size of boulders is 6 inches; 30 percent exceeds 1 inch in size.

The pebbles are angular to subrounded and

Iroquois beach at Trent Valley Sand and Stone pit, near Brighton.

consist of: Black River and Trenton limestones; sandstone; red basal arkose; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks. Many of the Precambrian pebbles are of poor quality, being weathered and crumbly.

A sieve analysis of a sand sample taken from the pit is given in (CXIII).

A mineralogical analysis of the sand by the Ontario Research Foundation indicated the following major mineral constituents: quartz, 22 percent; feldspar, 27.5; Paleozoic limestone, 22; grey shale and siltstone, 14.5; acid igneous rocks, 5.5; basic igneous rocks, 7.0; hornblende, 1.5 percent.

NORTHUMBERLAND COUNTY

Baltimore

HARNDEN AND KING CONSTRUCTION LTD. (262)

A beach deposit of sand and gravel has been opened a mile west of Baltimore in concession III, Hamilton township, Northumberland county. A 15-foot face exposes stratified sand (70 percent) and medium gravel (30 percent). Maximum size of gravel is 5 inches; 10 percent exceeds 4 inches, and 30 percent exceeds 1 inch. There is little stripping.

HARNDEN AND KING CONSTRUCTION LTD. (263)

Half a mile south of Baltimore, on the east side of highway No. 45, a gravel pit is operated by Harnden and King Construction Limited, in concession II, Hamilton township, Northumberland county. The beach deposit consists of stratified sand (60 percent) and medium gravel (40 percent). A 20-foot face is exposed in the pit. Maximum size of gravel is 10 inches; 30 percent exceeds 4 inches, and 60 percent exceeds 1 inch. A sieve analysis of sand from the face is given in (CXIV).

Brighton

TRENT VALLEY SAND AND STONE LIMITED (95)

One of the largest gravel pits in Ontario is operated by Trent Valley Sand and Stone Limited, 4 miles west of Brighton on highway No. 2, on lots 14 and 15, concession II, Cramahe township, Northumberland county. The rather uniform 25- to 30-foot thick sheet of gravel forms part of the old Iroquois beach in this area. The 25-foot face

(CXIV) HARNDEN AND KING CONSTRUCTION LIMITED (263)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	2.8	3.3	4.8	9.7	42.5	31.1	3.2	2.6

consists of well-sorted well-stratified sand and gravel that is 60–70 percent stone and 30–40 percent sand. The maximum size of gravel is 6 inches; 20 percent exceeds 4 inches, and 60 percent exceeds 1 inch. The pebbles are well-rounded, and some are flattened.

The gravel is of good quality, consisting mainly of Black River and Trenton limestone pebbles. A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; Potsdam Sandstone; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

The sand and gravel plant has a capacity of 425–450 tons per hour and produces ¾-inch gravel, ⅜-inch pea gravel, ⅜-inch chips, concrete sand, asphalt sand, and crusher-run gravel. Approximately 90 percent of the production is used for concrete aggregate, and this is generally composed of a mixture of crushed gravel (50 percent) and round stone (50 percent).

The plant has a hopper feeding a 2-deck Dillon 5- by 10-foot set of screens with 3-inch and 1-inch openings; the plus-3-inch and plus-1-inch stone go to a 4¼-foot Symons standard cone. The minus-1-inch round stone goes to one of a pair of Dillon 3-deck, 4- by 14-foot screens with ¾-, 7/16-, and ⅜-inch screens equipped with spray bars for washing. Here, ¾-inch round, ⅜-inch round, and sand are produced. The sand goes to a 14-foot Dorr classifier and is then conveyed to stockpiles.

The product from the Symons cone is conveyed to a 2-deck Dillon 4- by 14-foot set of screens with 1½-inch and 1-inch openings. The plus-1½-inch and plus-1-inch stone go to a 4-foot Symons short-head cone in closed circuit with the screens. The minus-1-inch throughs go to a surgepile and then are conveyed to one of the pair of Dillon 3-deck 4- by 14-foot screens with ¾-, 7/16-, and ⅜-inch openings. The products are ¾-inch crushed stone, ⅜-inch chips, and sand. The sand passes through a 14-foot Dorr classifier and is stockpiled.

The overflow from both Dorr classifiers goes to a settling tank and then is pumped to two 12-inch Dorrclones to retain the plus-200-mesh. This product can be kept separate or blended back with the concrete sand or asphalt sand. The round stone and crushed stone streams may be blended as required.

Trenton

Three small gravel deposits are operated in an esker ½ mile north of highway No. 2, from 1 to 3 miles west of Trenton in Northumberland county. The esker, which forms a ridge 30–50 feet high and a few hundred feet wide, extends eastward for approximately 3 miles from the Smithfield moraine to the outskirts of Trenton.

TRENTON AGGREGATES (96)

The most westerly gravel pit examined is that of Trenton Aggregates, on lot 13, concession I, Murray township, Northumberland county. The pit is on Taite Road, ½ mile north of highway No. 2.

The esker ridge, approximately 30 feet high, has a 20-foot face opened on its south side. The deposit consists of well-sorted stratified medium gravel and sand. Maximum size of boulders is 7 inches. The exposed face is approximately 60 percent gravel and 40 percent sand. Thirty percent of the gravel is larger than 4 inches in size, 70 percent is larger than 1 inch.

The gravel is about 90 percent Black River and Trenton limestone pebbles; less than 10 percent is Precambrian acid igneous and metamorphic pebbles. A pebble count gives the following assemblage: Black River and Trenton limestones; Precambrian acid igneous rocks; and Precambrian metamorphic gneisses. There is no plant on the property.

TRENTON GRAVEL PRODUCTS (97)

Trenton Gravel Products operates a gravel pit on lot 10, concession I, Murray township, Northumberland county, on McMaster road, ¾ mile north of highway No. 2.

The gravel pit is in the south slope of a 30-foot esker ridge. One 20-foot face exposes well-sorted stratified fine and coarse sand and fine gravel. The face is 80 percent sand and 20 percent gravel; the maximum size of boulders is 5 inches; 10 percent of the gravel exceeds 4 inches in size, 40 percent of the gravel exceeds 1 inch in size. Coarser gravel is present at the east end of the pit. A second 20-foot face on the west side of the pit exposes 60 percent gravel and 40 percent sand. In this face, 30 percent of the gravel exceeds 4 inches in size, and 60 percent exceeds 1 inch in size.

About 90 percent of the gravel consists of rounded to well-rounded Black River and Trenton limestone pebbles; less than 5 percent is Precambrian igneous and metamorphic rocks. A pebble count gives the following assemblage: Black River and Trenton limestones; arkosic sandstone; Precambrian acid igneous rocks; Precambrian metamorphic rocks.

A sieve analysis of a sand sample taken from the deposit is given in (CXV).

A mineralogical analysis of the sand by the Ontario Research Foundation indicated the following major mineral constituents: quartz, 19.5 per-

Coarse esker gravel on left grading to stratified sand on the flanks (to the right); Meier Sand and Gravel, Campbellford.

cent; feldspar, 16; Paleozoic limestone, 57; grey shale and siltstone, 1.5; Precambrian limestone, 1.5; acid igneous rocks, 3.5 percent.

A portable plant is used to produce crusher-run, ¾-inch crushed gravel, concrete sand, and brick sand. Pit-run gravel is also produced.

HOWARD BASSETT (98)

The most easterly of the gravel pits in the Trenton esker is that of Howard Bassett on lot 6, concession I, Murray township, Northumberland county, ½ mile west of Trenton, on the second Dug Hill road ½ mile north of highway No. 2.

The esker ridge, approximately 40 feet high, has been opened on its south face. The pit exposes interstratified sand and medium gravel. There is no plant on the property.

Campbellford

Four gravel pits are operated in the Campbellford area. Two of these, Seymour Sand and Gravel, and J. Meier Sand and Gravel, are in the Campbellford esker, which runs in a southwesterly direction from lot 18, concession X, Rawdon township, Northumberland county, across the Trent River, 2 miles north of Campbellford, to lot 4, concession V, Seymour township (Chapman and Putnam 1951, map).

The other two gravel pits, operated by Thomson Brothers Construction Company, and Trent Valley Sand and Stone Limited, are in a beach deposit on the west side of a flat-topped hill of till.

SEYMOUR SAND AND GRAVEL (99)

The gravel pit of Seymour Sand and Gravel is on lot 7, concession VI, Seymour township, Northumberland county, on the south side of highway No. 30, ½ mile west of Campbellford. This esker ridge is more than 1,000 feet long, 300–400 feet wide, 50–80 feet high, and trends southwest. The 25-foot face in the north side of the esker ridge exposes well-sorted coarse stratified gravel that is 70 percent stone and 30 percent sand. Forty percent of the gravel exceeds 4 inches in size, and 70 percent exceeds 1 inch; the maximum size of boulders is about 8 inches.

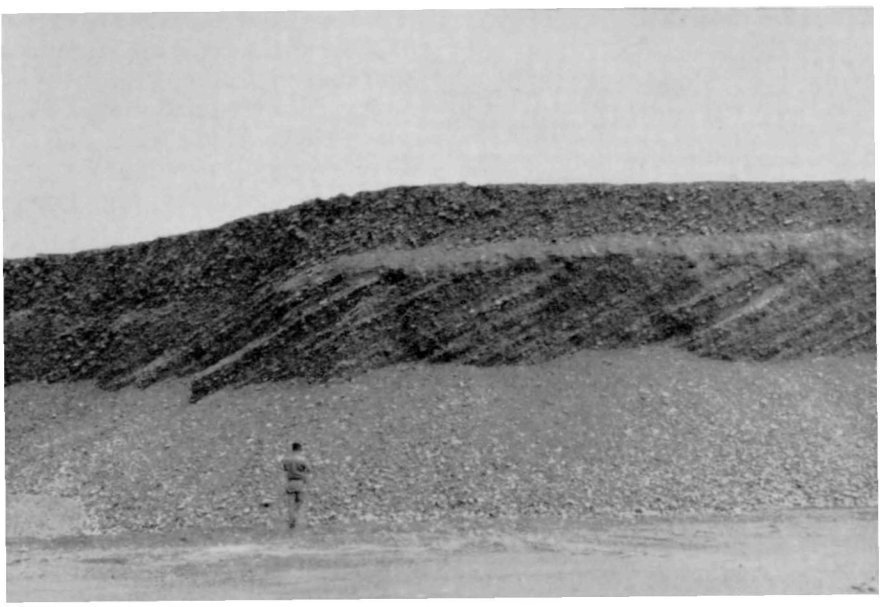
The pebbles are mainly Black River and Trenton limestones. A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; red shaly Pamelia Limestone, (rare); Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

There are substantial reserves of good quality gravel in the deposit.

A Cedarapids portable crushing, screening, and washing plant is employed to produce ¾-, ½-, and ¼-inch stone, and sand. Crusher-run gravel is also produced.

(CXV) TRENTON GRAVEL PRODUCTS (97)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	nil	0.03	0.32	3.28	7.52	52.03	28.92	7.90



Foreset beach gravel at Thomson Brothers pit, Campbellford.

JACK MEIER SAND AND GRAVEL (100)

The gravel pit operated by Jack Meier Sand and Gravel is on lots 11 and 12, concession VII, Seymour township, Northumberland county, in the Campbellford esker on the north side of the Trent River, ½ mile north of Campbellford.

The gravel pit has been opened on the north side of the esker ridge that is narrower here than at Seymour Sand and Gravel; the gravel is coarser and poorly-sorted. A 30-foot face exposes poorly-sorted coarse gravel that is 70 percent gravel and 30 percent sand. Fifty percent of the gravel exceeds 4 inches in size, and 70 percent exceeds 1 inch; the maximum size of boulders is 12 inches. Some of the boulders and pebbles are flattened.

On the north flank of the esker ridge, about 20 feet of stratified fine sand and fine gravel has been deposited. These beds have been opened to produce sand.

A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

There is no permanent plant on the property.

THOMSON BROTHERS CONSTRUCTION CO. LTD. (101)

The gravel pit of Thomson Brothers Construction Company Limited is 2 miles east of Campbellford on lot 15, concession VI, Seymour township, Northumberland county. The uniform well-sorted gravel beds form a beach deposit on the west side of a series of truncated drumlin hills. The gravel beds dip to the west at 30 degrees. A 25-foot face exposes well-sorted subangular to rounded gravel with some carbonate encrustation. Sixty percent of the face is gravel, and 40 percent is sand. Thirty percent of the gravel exceeds 4 inches, and 50 percent exceeds 1 inch; the maximum size of gravel is 6 inches.

A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

A Cedarapids crushing, screening, and washing plant produces washed gravel and sand for concrete aggregate. Pit-run and crusher-run are also produced.

TRENT VALLEY SAND AND STONE LIMITED (102)

Trent Valley Sand and Stone Limited have operated a gravel pit on lot 15, concession V, Seymour township, Northumberland county. This gravel pit is also in a beach deposit on the west edge of a series of truncated drumlin hills. The beach gravels were formed by reworking of the coarse bouldery till of the drumlins. The gravel is coarse and rather poorly-sorted; maximum size of boulders is 12 inches. The workings extend for more than 1,000 feet along the edge of the hill. The gravel pit was not in operation in 1961, but it had chiefly supplied railroad ballast.

HASTINGS COUNTY

Frankford

Three gravel pits are operated in the Frankford area of Hastings county. One of the pits is in a beach deposit on the west side of a flat-topped ridge; the other two are in the Frankford–Marlbank esker. This esker, described by Chapman and Putnam (1951, p. 61), is the longest in southern Ontario, being traced for more than 50 miles from near Codrington, north of Brighton, through Frankford and Marlbank, to north of Beaver Lake in Sheffield township, Lennox and Addington county.

H. E. COOKE (113)

The gravel pit operated by H. E. Cooke is in Sidney township, Hastings county, on the east side of the Trent River, on the northern outskirts of Frankford village. The deposit is part of the Frankford–Marlbank esker. One 20-foot face exposes stratified fine sand and medium to coarse gravel. The beds of gravel are composed of 60 percent stone and 40 percent sand; maximum size of boulders is 6 inches. Thirty percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch.

Most of the exposed face indicates an excess of sand. There is 6–10 feet of clay overburden in places. There is no plant in operation at this pit and production is mainly pit-run material.

COONEY SAND AND GRAVEL (114)

The Cooney gravel pit is in Sidney township, Hastings county, on the north side of the Foxboro road, 2 miles east of Frankford. The pit is at the south end of a large drumlin, and the deposit is part of the Frankford–Marlbank esker. The total height of the face is 60–70 feet, and the deposit is composed of sand and fine to coarse gravel. A 35-foot face being worked in the bottom of the pit consists of 10 feet of sand and 25 feet of coarse gravel; 80 percent is stone and 20 percent is sand. The maximum size of boulders in this face is 8 inches; 30 percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch. In the bottom of the pit is a 10-foot face of granule gravel and coarse sand.

A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

A small plant on the property consists of a hopper, screen, and conveyors.

FROST PIT (115)

The largest gravel pit in the Frankford area is the Frost pit operated by H. J. McFarland Construction Company to supply aggregate for the Foxboro ready-mix concrete plant, and for asphalt paving. The pit is on lot 17, concession IV, Sidney township, Hastings county, 6 miles west of highway No. 14, and 3½ miles east of Frankford. The gravel deposit forms a beach along the west edge of a flat-topped ridge. The gravel is well-bedded and well-sorted and forms an extensive deposit. A 15-foot face exposes coarse sand and medium gravel. The maximum size of boulders is 8–10 inches. The deposit is 50 percent gravel and 50 percent sand. Thirty percent of the gravel exceeds 4 inches in size and 60 percent exceeds 1 inch. There is 3–4 feet of overburden.

The gravel consists mostly of Black River and Trenton limestone pebbles. A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of a sand sample taken from this pit is given in (CXVI).

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the following major constituents: quartz, 23 percent; feldspar, 25.5; Paleozoic limestone, 43; grey shale and siltstone, 1.5; acid igneous rocks, 3; basic igneous rocks, 3 percent.

A portable plant is in operation in the pit.

(CXVI) FROST PIT (115)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	10.24	10.83	11.32	18.27	27.90	17.77	1.63	2.04

(CXVII) BANCROFT CONCRETE PRODUCTS (116)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	nil	nil	nil	0.80	41.5	55.2	1.5	0.9

Foxboro

Two small sand pits are operated 2 miles northwest of Foxboro in Hastings county, on the south side of the valley of Chrysal Creek.

HOPKINS SAND AND GRAVEL (111)

The sand pit operated by C. E. Hopkins Sand and Gravel of Foxboro is on lot 35, concession VII, Sidney township, Hastings county, and is reached from Foxboro by driving west for ¾ mile on highway No. 14, turning north on a township road, and proceeding for a distance of 1¼ miles. The sand pit exposes a 15-foot face of fine sand. There is no plant on the property.

LORNE REID PIT (112)

Adjacent to the Hopkins pit on the west side of the township road is a second small sand pit operated by Lorne Reid. The pit exposes stratified fine sand. Sand fill is produced. There is no plant on the property.

Bancroft

BANCROFT CONCRETE PRODUCTS (116)

The pit operated by Bancroft Concrete Products is located at L'Amable in Dungannon township, Hastings county, on the east side of highway No. 62. The glacial outwash deposit consists of coarse and fine well-sorted stratified sand with some gravel. Boulders up to 8 inches in size are present in irregular channels in the deposit. A 25-foot face consists of 80 percent sand and 20 percent gravel. The pebble assemblage is entirely Precambrian, approximately 60 percent being acid igneous rocks and 40 percent being metamorphic rocks.

A sieve analysis of a sand sample from this property is given in (CXVII).

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the following major mineral constituents: quartz, 39.5 percent; feldspar, 53.5; acid igneous rocks, 4; hornblende, 1.5 percent.

PRINCE EDWARD COUNTY

Picton

There are several small gravel pits southwest of Picton in Hallowell township, Prince Edward county, along an esker that extends 4 miles southwest from Picton, toward Sandbanks. The road from Picton to Sandbanks runs along the top of the esker ridge, which rises 50–75 feet above the surrounding country. In August 1961, two of these gravel pits were being operated.

PRINCE EDWARD COUNTY PIT (117)

A gravel pit, operated by the County of Prince Edward, is on the north side of the road to Sandbanks, 1½ miles southwest of Picton, on lot 22, concession II M.T., Hallowell township, Prince Edward county.

The pit is on the north side of the esker ridge, which has an elevation 60 feet above that of the surrounding area. A 30-foot face exposes well-sorted medium gravel that is 50 percent gravel and 50 percent sand. The maximum size of boulders is 6 inches; 20 percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch.

The gravel consists mainly of Black River and Trenton limestone pebbles, but also contains a substantial number of pebbles of white Potsdam Sandstone, and Precambrian acid, basic, and metamorphic rocks.

A portable plant produces crusher-run. Pit-run fill is also produced.

The results of a sieve analysis of a sand sample from this property are given in (CXVIII).

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the following major mineral constituents: quartz, 56.5 percent; feldspar, 20.5; Paleozoic limestone, 15; grey shale and siltstone, 2; acid igneous rocks, 2 percent.

H. J. McFARLAND CONSTRUCTION CO. (118)

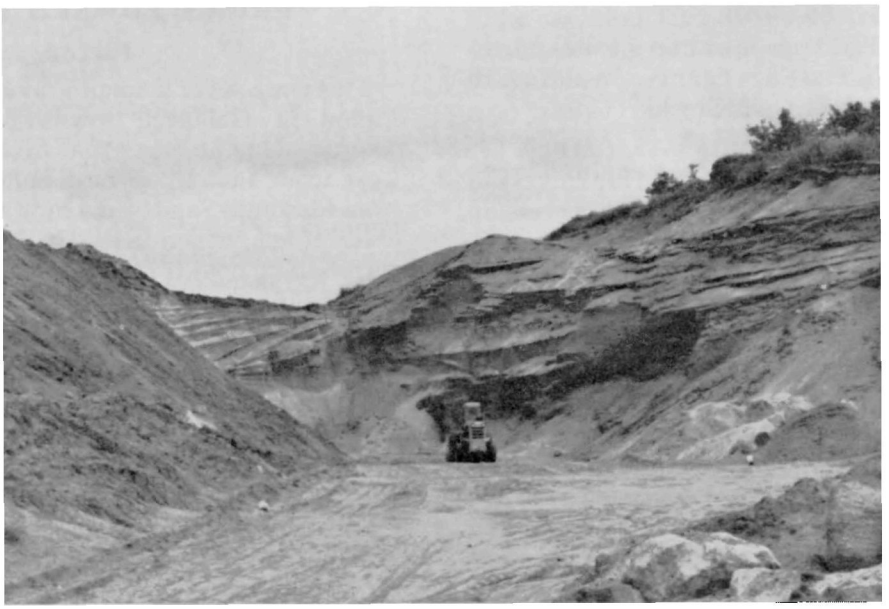
A mile southwest of the Prince Edward County Pit, along the road that runs along the esker ridge,

(CXVIII) PRINCE EDWARD COUNTY PIT (117)

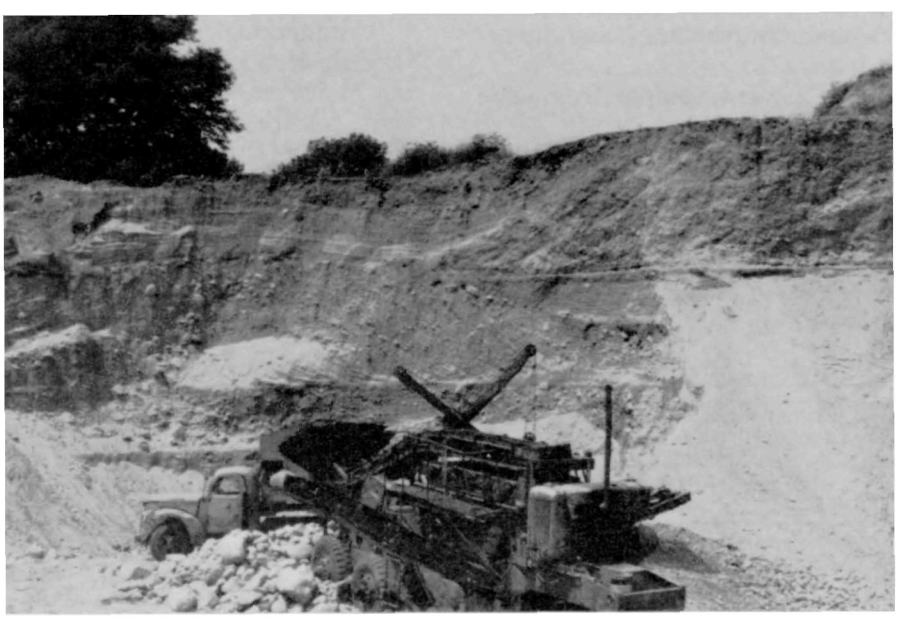
Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	0.08	0.60	3.24	9.68	31.95	50.43	2.76	1.26

(CXIX) LOT 1, CONCESSION IV, LOUGHBOROUGH TOWNSHIP (119)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	2.89	5.02	13.51	27.28	37.53	11.83	0.65	0.29



Outwash sand at R. H. Richardson pit, Sydenham.



Kame gravel in Washburn pit operated by J. W. McKendry, near Kingston.

is a second gravel pit operated by H. J. McFarland Construction Company. This pit exposes interstratified sand and medium gravel. A shovel and portable crushing plant are used to produce crusher-run.

FRONTENAC COUNTY

Sydenham

Two small sand and gravel pits have been operated in the Sydenham area.

LOT 1, CONCESSION V, LOUGHBOROUGH TOWNSHIP (119)

This gravel pit is a mile west of Sydenham on lot 1, concession V, Loughborough township, Frontenac county. A 10-foot face exposes a beach deposit of coarse sand (60 percent) and gravel (40 percent). The maximum size of boulders is 6 inches. Twenty percent of the gravel exceeds 4 inches and 60 percent exceeds 1 inch in size. A pebble count indicates the following assemblage: Black River and Trenton limestones; Potsdam Sandstone; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of a sand sample taken from this pit is given in (CXIX).

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the following major constituents: quartz, 62.5 percent; feldspar, 16.5; Paleozoic limestone, 4.5; grey shale and siltstone, 5; dolomite, 2.5; acid igneous rocks, 2; basic igneous rocks, 2; hematite and limonite, 2 percent.

R. H. RICHARDSON SAND SUPPLY (120)

The sand pit operated by R. H. Richardson Sand Supply is 1½ miles northwest of Sydenham on lot 1, concession VI, Loughborough township, Frontenac county. The well-bedded sand deposit fills the Knowlton Valley and is probably a kame or outwash deposit. The 30-foot face consists of cross-bedded sand (80 percent) and fine gravel (20 percent). A few erratics up to 12 inches in size are present, but the pebbles are mainly of granule size; 5 percent of the pebbles exceeds 4 inches, and 15 percent exceeds 1 inch. A sieve analysis of a sand sample taken from this pit is given in (CXX).

The principal product is pit-run sand.

A mineralogical analysis of the sand by the Ontario Research Foundation indicated the following major constituents: quartz, 45 percent; feldspar, 31; Paleozoic limestone, 8; Precambrian limestone, 5.5; acid igneous rocks, 3.5; hornblende, 2 percent.

A new pit is being opened by this company at Harrowsmith, on lot 7, concession V, Portland township, Frontenac county.

Kingston

In the Kingston area, several small sand and gravel pits are operated in Kingston, Storrington, and Pittsburgh townships, Frontenac county. The Kingston township deposits are sandy outwash or beach deposits; those in Storrington and Pittsburgh township in the vicinity of Joyceville are kame deposits.

KINGSTON SAND AND GRAVEL LIMITED (121)

The pit operated by Kingston Sand and Gravel is just west of Hemlock Park Farm on lot 32, concession V, Kingston township, Frontenac county. The deposit is stratified crossbedded sand that contains few pebbles. A sieve analysis of a sand sample from this deposit is given in (CXXI).

The face of the pit is 10–15 feet in height. A small screening plant produces concrete sand and brick sand.

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the following major constituents: quartz, 54.5 percent; feldspar, 24; grey shale and siltstone, 1.5; dolomite, 1.5; Precambrian limestone, 8.5; acid igneous rocks, 4; basic igneous rocks, 3.5 percent.

(CXX) R. H. RICHARDSON SAND SUPPLY (120)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	0.26	1.02	3.52	34.57	58.10	2.37	0.02	0.14

(CXXI) KINGSTON SAND AND GRAVEL LIMITED (121)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	3.69	0.31	2.09	26.14	43.04	20.61	2.57	1.58

J. W. McKENDRY (122)
(Glenburnie Pit)

A small sand pit is operated on the north side of the road in concession VI, Kingston township, Frontenac county, by J. W. McKendry. A 6-foot face exposes a deposit of stratified sand. The pit is operated principally for asphalt sand and fill. There is no plant on the property.

A sieve analysis of the sand from this deposit is given in (CXXII).

A mineralogical analysis of the sand by the Ontario Research Foundation indicated the following major constituents: quartz, 62 percent; feldspar, 33 percent.

JOHNSON PIT (123)

The Johnson gravel pit is on lot 19, concession VII, Storrington township, Frontenac county, ¾ mile west of Washburn. This kame deposit consists of interstratified sand and gravel, and is mostly worked-out. A 20-foot face is 50 percent gravel and 50 percent sand. Sparse erratics up to 24 inches in size are present in the gravel. Twenty percent of the gravel exceeds 4 inches in size, and 40 percent exceeds 1 inch.

A pebble count of the gravel gives the following assemblage: Potsdam Sandstone; Black River Limestone; Beekmantown Dolomite; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

J. W. McKENDRY (124)
(Washburn Pit)

The McKendry gravel pit is north of the Johnson pit, on lot 20, concession VII, Storrington township, Frontenac county. Two to four feet of overburden overlies a kame deposit of crossbedded coarse sand and gravel. The large pit measures approximately 200 by 500 feet, and a 30-foot face exposes 40 percent gravel and 60 percent sand. Erratics up to 10 inches in diameter are found in the gravel; 20 percent of the gravel exceeds 4 inches and 50 percent exceeds 1 inch.

A pebble count of the gravel gives the following assemblage: Potsdam Sandstone; Ordovician limestone; Beekmantown Dolomite; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of sand from this kame deposit is given in (CXXIII).

A mineralogical analysis of the sand by the Ontario Research Foundation indicated the following major constituents: quartz, 50.5 percent; feldspar, 29; Paleozoic limestone, 10.5; grey shale and siltstone, 3; Precambrian limestone, 2; acid igneous rocks, 2 percent.

Joyceville

A group of 8 gravel pits has been opened in modified kame deposits on concessions VI, VII and VIII, Pittsburgh township, Frontenac county, northeast of Joyceville.

LOT 22, CON. VI, PITTSBURGH TOWNSHIP (125)

A sand pit has been opened in a deposit of stratified outwash sand on lot 22, concession VI, Pittsburgh township. The property was inactive in July 1961. A sieve analysis of the sand from this deposit is given in (CXXIV).

A mineralogical analysis of the sand by the Ontario Research Foundation indicated the following major constituents: quartz, 52.5 percent;

(CXXII) J. W. McKENDRY (GLENBURNIE PIT) (122)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	nil	0.07	0.08	3.61	55.23	37.44	2.43	1.14

(CXXIII) J. W. McKENDRY (WASHBURN PIT) (124)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	8.61	3.44	5.20	18.46	45.85	17.08	0.54	0.82

(CXXIV) LOT 22, CONCESSION VI, PITTSBURGH TOWNSHIP (125)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	0.28	0.13	1.13	5.70	39.17	49.56	3.09	0.94

feldspar, 38; Paleozoic limestone, 1.5; acid igneous rocks, 3; hornblende, 2 percent.

MARKER BLOCK AND TILE LIMITED (126)

Marker Block and Tile operates a gravel pit on lot 25, concession VI, Pittsburgh township, Frontenac county, 1 mile east of highway No. 15. The pit is in a kame deposit of irregularly stratified sand and gravel showing good to medium sorting.

The 30-foot face is 70 percent sand and 30 percent gravel. Silt is present in some sections of the pit. A pebble count of the gravel gives the following assemblage: Potsdam Sandstone; Ordovician limestone; Beekmantown Dolomite; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of sand from this deposit is given in (CXXV).

A mineralogical analysis of the sand by the Ontario Research Foundation indicated the following major constituents: quartz, 47.5 percent; feldspar, 32; Paleozoic limestone, 7; grey shale and siltstone, 2.5; acid igneous rocks, 7; basic igneous rocks, 2.5 percent.

East of the Marker pit, on the same lot, another gravel pit has been opened in the same deposit.

LOT 26, CON. VI, PITTSBURGH TOWNSHIP (127)

A gravel pit has been opened on lot 26, concession VI, Pittsburgh township, Frontenac county. A 20-foot face exposes coarse poorly-sorted gravel with many boulders up to 20 inches in size. Seventy percent of the material in the face is gravel, and 30 percent is sand. Forty percent of the gravel exceeds 4 inches in size, and 60 percent exceeds 1 inch.

LOT 31, CON. VII, PITTSBURGH TOWNSHIP (128)

An abandoned gravel pit lies on the east side of the road on lot 31, concession VII, Pittsburgh township, Frontenac county. The 20-foot face exposes well-sorted coarse sand and fine-granule gravel with some boulders. Twenty percent of the face is gravel, and 80 percent is sand.

LOT 32, CON. VII, PITTSBURGH TOWNSHIP (129)

A small gravel pit south of the road on lot 32, concession VII, Pittsburgh township, Frontenac county, exposes 15 feet of fine-granule gravel and coarse sand, grading laterally into coarse gravel. A pebble count of the gravel at this deposit gives the following assemblage: Potsdam Sandstone; Ordovician limestone; Beekmantown Dolomite; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

LOT 34, CON. VIII, PITTSBURGH TOWNSHIP (130)

An abandoned gravel pit lies south of the road on lot 34, concession VIII, Pittsburgh township, Frontenac county, 2 miles east of Brewers Mills. A 15-foot face exposes coarse kame gravel overlain to the south by stratified sand. Seventy percent of the face is gravel, and 30 percent is sand. The maximum size of boulders is 10 inches. Thirty percent of the gravel exceeds 4 inches in size, and 60 percent exceeds 1 inch.

A pebble count of the gravel from this deposit gives the following assemblage: Potsdam Sandstone; Ordovician limestone; Beekmantown Dolomite; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks. The pebbles are subrounded to well-rounded.

A sieve analysis of a sand sample from this pit is given in (CXXVI).

A mineralogical analysis of the sand by the Ontario Research Foundation indicated the following major constituents: quartz, 34.5 percent; feldspar, 39.5; acid igneous rocks, 14.5; basic igneous rocks, 9; hornblende, 2 percent.

LEEDS COUNTY

Gananoque

Two small gravel pits are operated in the Gananoque area of Leeds county in beach and

(CXXV) MARKER BLOCK AND TILE LIMITED (126)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	0.41	1.57	7.76	35.26	42.48	10.47	0.73	1.32

(CXXVI) LOT 34, CONCESSION VIII, PITTSBURG TOWNSHIP (130)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	3.67	0.95	3.78	21.03	50.31	17.43	0.96	1.87

J. B. Boyle pit, Gananoque.

(CXXVII) J. B. BOYLE (138)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	24.90	9.12	10.50	18.79	26.76	7.68	0.98	1.28

(CXXVIII) DIXON PIT (139)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	0.57	1.15	4.03	12.52	33.15	37.57	9.20	1.84

(CXXIX) LOT 12, CONCESSION VII, REAR OF LEEDS AND LANSDOWNE TOWNSHIP (131)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	1.58	8.79	21.25	33.20	22.19	7.61	2.37	3.01

(CXXX) SWEETS SAND AND STONE LIMITED (133)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	3.93	6.02	17.17	22.48	29.20	19.77	0.57	0.86

glacial outwash deposits. Larger gravel deposits are worked near Joyceville and Seeleys Bay.

J. B. BOYLE (138)

The gravel deposit operated by J. B. Boyle lies on the west side of highway No. 32, one mile north of Gananoque in Leeds county. The gravel pit is in an old beach deposit composed of stratified crossbedded coarse sand and fine gravel. The 20-foot face is 20 percent gravel and 80 percent coarse sand. None of the pebbles exceeds 4 inches in size, but 40 percent exceeds 1 inch in size.

A pebble count indicates the following pebble assemblage: Potsdam Sandstone; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of a sample of sand from this pit is given in (CXXVII).

This grading indicates a coarse poorly-sorted sand that would be suitable concrete sand.

A mineralogical analysis of the sand by the Ontario Research Foundation indicated the following major constituents: quartz, 56.5 percent; feldspar, 33; Paleozoic limestone, 1.5; acid igneous rocks, 5.0 percent.

DIXON PIT (139)

The Dixon gravel pit on the south side of the Marble Lake road in Leeds county, 1 mile east of highway No. 32, is mostly worked-out. The stratified sand and gravel flanks a northeast-trending rock ridge. A 20-foot face is 80 percent sand and 20 percent gravel. Ten percent of the gravel exceeds 4 inches in size, and 40 percent exceeds 1 inch. The pebbles are subangular to rounded, and the pebble assemblage is a restricted one consisting mainly of Precambrian acid igneous and metamorphic rocks, and Potsdam Sandstone.

A sieve analysis of a sample of sand from this pit is given in (CXXVIII).

Seeleys Bay

In Leeds township, in the vicinity of Seeleys Bay, are several kame deposits of sand and gravel that have been worked to supply road material for highway No. 15.

LOT 12, CON. VII, REAR OF LEEDS AND LANSDOWNE TOWNSHIP (131) (Sweets Sand and Stone Limited)

On the east side of highway No. 32, just south of the junction with highway No. 15, is a sand and gravel deposit on lot 12, concession VII, Rear of Leeds and Lansdowne township, Leeds county. The deposit is a kame. A 40-foot face exposes stratified sand (70 percent) and gravel (30 percent). Ten percent of the gravel exceeds 4 inches in size, and 30 percent exceeds 1 inch. A pebble count of the gravel indicates the following assemblage: Potsdam Sandstone; Black River Limestone; Beekmantown Dolomite; Precambrian acid igneous rocks; Precambrian metamorphic rocks; and Precambrian basic igneous rocks.

A sieve analysis of a sand sample from this pit is given in (CXXIX).

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the following major constituents: quartz, 48 percent; feldspar, 30; Paleozoic limestone, 9.5; grey shale and siltstone, 1.5; dolomite, 2.5; acid igneous rocks, 3; basic igneous rocks, 2.5 percent. There is no plant on the property.

GALWAY PIT (132)

The Galway gravel pit is on the east side of highway No. 15, one mile south of Morton, on lot 13 or 14, concession X, Rear of Leeds and Lansdowne township, Leeds county. The deposit is a modified kame consisting of stratified gravel and coarse sand. A 30-foot face is 80 percent gravel and 20 percent sand. The maximum size of boulders is 8 inches; 30 percent of the gravel exceeds 4 inches and 50 percent exceeds 1 inch. The pebbles are rounded to subangular. A pebble count of the gravel indicates the following assemblage: Potsdam Sandstone; Black River and Trenton limestones; Beekmantown Dolomite; Precambrian acid igneous rocks; and Precambrian metamorphic rocks. There is no plant on the property.

SWEETS SAND AND STONE LIMITED (133)

The Sweets pit is on the north side of highway No. 15, one half mile east of Seeleys Bay, on lot 7, concession VII, Rear of Leeds and Lansdowne township, Leeds county. The kame deposit forms a ridge of irregularly-stratified sand and gravel. A 40-foot face is 50 percent gravel and 50 percent sand. The maximum size of boulders is 10 inches; 30 percent exceeds 4 inches and 50 percent exceeds 1 inch.

A pebble count of the gravel from this pit gives the following assemblage: Potsdam Sandstone; Black River and Trenton limestones; Beekmantown Dolomite; Precambrian acid igneous rocks; Precambrian metamorphic rocks; and Precambrian basic igneous rocks.

A sieve analysis of the sand from this deposit is given in (CXXX).

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the following major constituents: quartz, 43.5 percent; feldspar, 23.5; Paleozoic limestone, 7; grey shale and siltstone, 6.5; dolomite, 4.5; Precambrian limestone, 2.5; acid igneous rocks, 5.5; basic igneous rocks, 4 percent.

Lyndhurst

Two small gravel pits were being operated in the summer of 1961 near Lyndhurst in Leeds county.

J. ROBERTSON (134)

The gravel pit operated by J. Robertson of R.R. No. 2, Lyndhurst, is ¼ mile north of the former site of Lyndhurst station, 3 miles north of the village of Lyndhurst in Leeds county. The gravel pit is in a glacial outwash deposit of stratified gravel and sand. Crossbedded fine sand may be seen on the south side of the pit, and medium stratified gravel on the north side. A 15-foot face examined is 60 percent gravel and 40 percent sand. The maximum size of boulders is 10 inches; 15 percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch.

A pebble count of the gravel gives the following assemblage: Potsdam Sandstone; Ordovician limestone; Beekmantown Dolomite; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of a sand sample taken from this pit is given in (CXXXI).

A mineralogical analysis of this sand by the Ontario Research Foundation indicated the following major constituents: quartz, 45.5 percent; feldspar, 24.5; Paleozoic limestone, 14.5; grey shale and siltstone, 8.5; acid igneous rocks, 3 percent.

SWEETS PIT (135)

Sweets gravel pit, on the Grippen road on lot 22, concession X, Rear of Leeds and Lansdowne township, is operated by the County of Leeds. A stratified deposit of glacial sand and gravel outwash has been opened, and a 25-foot face is 75 percent gravel and 25 percent sand. The maximum size of boulders is 10 inches, the average size being 1–3 inches. Forty percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch. The pebbles are subangular to well-rounded. The pit measures approximately 450 by 120 feet.

A pebble count of the gravel at this pit gives the following assemblage: Potsdam Sandstone; Ordovician limestone; Beekmantown Dolomite; Precambrian acid igneous rocks; Precambrian metamorphic rocks; and Precambrian basic igneous rocks.

Lyn

LYN SAND PIT (136)

The village of Lyn, in Elizabethtown township, Leeds county, is situated on a plain of flat-lying Potsdam Sandstone. South of the village lies a northeast-trending valley floored by Precambrian quartzite; on the northwest side of this valley is a prominent northeast-trending scarp of Potsdam Sandstone. Flanking this scarp on the south is a deposit of beach or terrace sand and gravels that has been opened over a length of ¾ mile.

A 40-foot face consists of 20 feet of till and stratified sand overlying 20 feet of stratified gravel that is 70 percent coarse material and 30 percent sand. The maximum size of boulders is 8 inches; 30 percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch. A pebble count of the gravel from this locality gives the following assemblage: Beekmantown Dolomite; Black River and Trenton limestones; Potsdam Sandstone; Pre-

(CXXXI) J. ROBERTSON (134)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	nil	0.31	5.86	14.04	13.96	31.93	22.43	11.47

(CXXXII) LYN SAND PIT (136)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	5.92	11.20	15.81	17.96	22.74	19.07	4.49	2.82

(CXXXIII) A. L. GOULD (157)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	11.01	16.16	25.75	23.27	11.05	7.88	2.84	2.04

cambrian acid igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of sand from this deposit is given in (CXXXII).

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the following major constituents: quartz, 33 percent; feldspar, 17; Paleozoic limestone, 34; grey shale and siltstone, 5.5; acid igneous rocks, 2.5 percent.

Mallorytown

GLEN LAWRENCE CONSTRUCTION COMPANY (137)

A gravel deposit operated in 1960 by Glen Lawrence Construction Company is in concession I, Yonge township, Leeds county, 1½ miles north of Mallorytown Landing and ½ mile east of the Mallorytown road. The gravel deposit is a poorly-sorted coarse spillway deposit lying in a valley between northeast-trending rocky ridges. The gravel is dirty, containing much silt and clay. The deposit is a heterogeneous assemblage of coarse boulders, gravel, sand, and silt. Boulders up to 24 inches in diameter are common. Approximately 40 percent of the deposit is gravel, and 60 percent is sand. Fifty percent of the gravel exceeds 4 inches, and 80 percent exceeds 1 inch. The gravel deposit has been worked for a length of 700 feet and a width of 400 feet. Working faces are up to 60 feet in height.

The main production was crusher-run material produced by a portable plant. The property was inactive in 1961.

LANARK COUNTY

Lanark

B. J. LEACY (140)

Gravel pits are operated on the properties of B. J. Leacy of Lanark on lot 4, concession V, on lot 5, concession VI, and on lot 6, concession VII, Lanark township, Lanark county, about 4 miles northeast of Lanark village. A kame ridge 50–75 feet high crosses the property from northeast to southwest.

A 30-foot face in one pit exposes ice-contact deposits of stratified and faulted sand and gravel. The material is 30 percent gravel and 70 percent sand. None of the gravel exceeds 4 inches in size, and 30 percent exceeds 1 inch.

A second pit, also with a 30-foot face, is 30 percent gravel and 70 percent sand. The maximum size of gravel is 5 inches. Ten percent of the gravel exceeds 4 inches, and 30 percent exceeds 1 inch.

A pebble count of the gravel gives the following assemblage: limestone; dolomite; sandstone; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

Pit-run sand and gravel and crusher-run gravel are the chief products. A small sand pit is operated by J. Closs west of the Leacy pit.

RENFREW COUNTY

Renfrew

North of the city of Renfrew, in the County of Renfrew, on the north side of the Bonnechere River valley, is a highland area of Precambrian crystalline rocks. Northwest of Renfrew, on the south flanks of this highland area, are glaciofluvial deposits of sand and gravel. Three of these gravel deposits are being operated.

LORNE TOTTEN (155)

The gravel pit operated by Lorne Totten is on lots 13 and 14, concession II, Horton township, Renfrew county, on the northern outskirts of Renfrew.

The glaciofluvial deposit consists of well-bedded interstratified sand and fine gravel. A 50-foot face is operated. Pit-run, fill, and screened stone for concrete aggregate, are produced. The pebble assemblage consists of over 95 percent Precambrian crystalline rocks. A pebble count gives the following assemblage: Paleozoic limestone; Paleozoic sandstone; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

G. M. JOHNSTON (156)

The gravel pit operated by G. M. Johnston is on lot 16, concession I, Horton township, Renfrew county, ¾ mile northwest of Renfrew. The deposit of glaciofluvial sand and gravel lies on the south flank of a hill of Precambrian rock. The pit has been opened in the side of the hill on 2 levels, one on a 20-foot face, and one on a 30-foot face. The faces are composed of well-bedded sand and coarse gravel. The production is confined to pit-run material. More than 90 percent of the gravel is Precambrian crystalline rocks.

A. L. GOULD (157)

Gould's gravel pit is on lot 17, concession I, Horton township, Renfrew county, 1½ miles northwest of the town of Renfrew. The glaciofluvial deposit of sand and gravel lies on the southwest flank of a range of Precambrian hills, north of the Bonnechere River flats. The gravel pit is worked on 3 levels that are excavated in stratified sand and medium to coarse gravel. One 20-foot face examined is 30 percent stone and 70 percent sand. Boulders up to 12 inches in size

are present; 30 percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch.

A pebble count of the gravel gives the following assemblage: Paleozoic limestone; Paleozoic dolomite; Paleozoic sandstone and basal arkose; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of sand taken from this pit is given in (CXXXIII).

A mineralogical analysis of the sand by the Ontario Research Foundation indicated the following major constituents: quartz, 26 percent; feldspar, 29; Paleozic limestone, 7.5; grey shale and siltstone, 4.5; Precambrian limestone, 3.5; acid igneous rocks, 15; basic igneous rocks, 7; biotite, 1.5; hornblende, 4 percent.

CARLETON COUNTY

Arnprior

Three small gravel pits have been operated east of Arnprior along highway No. 17.

PEEL CONSTRUCTION COMPANY LTD. (151)

A gravel pit has been opened on lot 26, concession III, Fitzroy township, Carleton county, on the south side of highway No. 17, a mile east of Arnprior, by Peel Construction Company. The deposit is a sheet of stratified sand and fine gravel overlain by up to 6 feet of till. A 15-foot face is 30 percent gravel and 70 percent sand. None of the gravel exceeds 4 inches in size, and 30 percent exceeds 1 inch. Pit-run and crusher-run gravel for roads are the main products.

W. A. JAMES (150)

A gravel pit is operated by W. A. James on lot 24, concession IV, Fitzroy township, Carleton county, on the north side of highway No. 17, 2½ miles east of Arnprior. The sand and gravel forms a linear ridge extending southeast. A 25-foot face on the north side of the ridge exposes stratified sand and granule gravel. The production is mainly pit-run gravel.

MILTON BLAIR (152)

A gravel pit is operated by Milton Blair on lot 22, concession IV, Fitzroy township, Carleton county, on the northeast side of highway No. 17, 3 miles east of Arnprior. The sand and gravel deposit is part of the same linear ridge in which the James pit is situated. The 20- to 25-foot face consists of stratified sand and granule gravel with some coarse gravel patches.

A pebble count of the gravel gives the following assemblage: limestone; dolomite; red siltstone; sandstone; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

The production from the pits on this property is mainly pit-run and crusher-run gravel, but it is planned to produce concrete and asphalt sand and concrete aggregate.

Galetta

F. J. WILSON (153)

The Wilson gravel pit is on lot 20, concession VI, Fitzroy township, Carleton county, ½ mile east of the village of Galetta. The deposit of stratified sand and fine gravel is 30 percent gravel

(CXXXIV) SPRATT SAND AND GRAVEL (141)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	1.55	12.38	13.92	24.79	35.86	9.99	0.51	1.00

(CXXXV) FRAZER DUNTILE LIMITED (142)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	1.24	3.58	15.62	31.87	30.51	11.32	1.57	4.29

(CXXXVI) FRAZER DUNTILE LIMITED (146)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−100 −200
Weight percent	nil	0.03	0.03	0.61	12.52	57.83	23.58	5.40

and 70 percent sand; it was operated by Peel Construction as a source of pit-run and crusher-run gravel.

A. L. RIDDELL (154)

The Riddell pit is on lot 19, concession VI, Fitzroy township, Carleton county, ½ mile east of the village of Galetta. The deposit consists of stratified coarse gravel, fine gravel, and sand. A 40-foot face is 40–60 percent gravel and 40–60 percent sand. The maximum size of gravel is 8 inches, the average size being 3–4 inches; 30 percent of the gravel exceeds 4 inches, and 70 percent exceeds 1 inch. There is no permanent plant on the property.

Ottawa

Sand and gravel deposits being worked in the Ottawa area of Carleton county are mainly beach deposits laid down along the margins of the Champlain Sea, which covered the area after the withdrawal of the Pleistocene ice-sheet.

The main sand and gravel pits in the area are operated by Spratt Sand and Gravel, Frazer Duntile Limited, Moffats Equipment Rental Limited, and Billie Construction Limited in beach deposits lying south of Ottawa in Gloucester and Osgoode townships. Sand deposits are worked by Dibblee Construction Limited, and Frazer Duntile Limited, southwest of Ottawa in Nepean township near Bells Corners.

SPRATT SAND AND GRAVEL (141)

Spratt Sand and Gravel operates a plant on the east side of highway No. 31, three miles south of Billings Bridge in Carleton county; the sand and gravel pit supplying the plant is 6 miles south at South Gloucester, ½ mile west of highway No. 31, on lot 29, concession IV, Gloucester township, Carleton county.

A 20-foot face on the south side of the pit exposes well-sorted coarse gravel that is 70 percent stone and 30 percent sand. The maximum size of boulders is 10 inches; 30 percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch. To the east there is interstratified sand and fine gravel.

A pebble count of the gravel gives the following assemblage: Black River and Trenton limestones; dolomite; grey Nepean Sandstone; black shale, (rare); Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of sand from the pit face is given in (CXXXIV).

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the following major constituents: quartz, 32.5 percent; feldspar, 41.5; Paleozoic limestone, 6.5; grey shale and siltstone, 5.0; acid igneous rocks, 10; basic igneous rocks, 1.5 percent.

Gravel is loaded at the pit by a front-end loader. The gravel plant produces concrete sand, brick sand, and 1-, ⅝-, and ⅜-inch stone.

The plant consists of a feed hopper, a 10- by 24-inch jaw crusher, and a set of 3-deck Dillon 3- by 10-foot screens equipped with spray bars. These screens have 1¼-, ⅞-, and 3/16-inch openings. The plus-1¼-inch stone goes to a 3-foot cone crusher and the crusher product is returned to the screens. The plus-⅞-inch stone is stockpiled as 1-inch stone. The plus-3/16-inch material goes to a 2-deck Dillon 2- by 6-foot screen with ⅝- and ⅜-inch openings, to make ⅝- and ⅜-inch stone.

The minus-3/16-inch material is split on a stationary plate screen. The material over the screen goes to a 6- by 20-foot Dorr classifier as concrete sand, and the throughs go to a Wemco screw classifier as brick sand.

FRAZER DUNTILE LIMITED (142)

The Frazer Duntile pit is on the west side of highway No. 31, one half mile south of South Gloucester in lot 2 or 3, concession V, Osgoode township, Carleton county.

The deposit consists mainly of fine sand and a little gravel. A 20-foot face examined on the south side of the pit is composed of stratified fine sand with minor amounts of medium to fine gravel. Ten percent of the material is gravel, and 90 percent is sand. There is no permanent plant on the property; a portable plant is used as required. The main product is sand.

A sieve analysis of a sand sample from the face is given in (CXXXV).

A mineralogical analysis of this sand by the Ontario Research Foundation indicated the following major constituents: quartz, 35.5 percent; feldspar, 42; Paleozoic limestone, 4.5; grey shale and siltstone, 4; acid igneous rocks, 5.5; basic igneous rocks, 3; hornblende, 3.5 percent.

MOFFATS EQUIPMENT RENTALS LIMITED (143)

The gravel pit operated by Moffats Equipment Rentals Limited is on lot 28, concession IV, Gloucester township, Carleton county, just north of the Spratt pit. The beach deposit, in which these gravel pits have been opened, runs in a northwesterly direction, from highway No. 31 in the vicinity of the Frazer Duntile pit, toward Gloucester station.

Both coarse stratified gravel and stratified sand are present in this deposit. A 25-foot face examined at the south end of the property consists of well-sorted coarse stratified gravel that is 70 percent

stone and 30 percent sand. The maximum size of boulders is approximately 8 inches; 30 percent of the gravel exceeds 4 inches, and 60 percent exceeds 1 inch. A 15-foot section to the north and below the coarse gravel consists of stratified medium to fine sand.

A pebble count of the gravel gives the following assemblage: Paleozoic limestone; Paleozoic dolomite; white Nepean Sandstone; black shale, (rare); Precambrian acid igneous rocks; Precambrian basic igneous rocks; Precambrian metamorphic rocks.

A Cedarapids portable crushing and screening plant is employed to produce crusher-run material. Pit-run gravel and sand are also produced. Other pits are operated by the company in Gloucester and Osgoode townships.

BILLIE CONSTRUCTION COMPANY LIMITED (144)

Another pit operated in this beach deposit is that of Billie Construction Company Limited, on lot 22 or 23, concession III, Gloucester township, Carleton county, 1½ miles northwest of the Moffat pit and a mile northwest of Johnston Corners.

The shallow deposit of interstratified medium gravel and sand is about 12 feet thick. One 12-foot face examined is 40 percent stone and 60 percent sand. The maximum size of gravel is 6 inches; twenty percent of the gravel exceeds 4 inches, and 50 percent exceeds 1 inch. The gravel is subangular to subrounded.

A pebble count of the gravel from this deposit gives the following assemblage: Paleozoic limestone; Paleozoic dolomite; grey Nepean Sandstone; black shale, (rare); Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

The main products of this pit are pit-run gravel and crusher-run.

The presence of appreciable amounts of black shale and soft brown dolomite in the beach gravels of Gloucester township is detrimental to their use in concrete aggregate.

DIBBLEE CONSTRUCTION COMPANY LIMITED (145)

A sand pit is operated by Dibblee Construction Company Limited in Nepean township, Carleton county, on the north side of highway No. 15, ¾ mile southwest of the junction with highway No. 17 on the western outskirts of the city of Ottawa. A 30-foot face exposes stratified medium to fine sand. The main production is pit-run sand.

FRAZER DUNTILE LIMITED (146)

Frazer Duntile Limited operates a sand pit on lot 34, concession III, Nepean township, Carleton county, 1 mile east of Bells Corners. The very extensive deposit of sand is almost worked-out. A 20-foot face exposed stratified fine sand.

A sieve analysis of a sand sample from this deposit is given in (CXXXVI). These results indicate the very fine-grained and well-sorted character of the sand. The sand is too fine to be used for concrete sand or brick sand.

A mineralogical analysis of the sand by the Ontario Research Foundation indicates the following major constituents: quartz, 44.5 percent; feldspar, 45.5; Paleozoic limestone, 1.5; acid igneous rocks, 3.5; basic igneous rocks, 2; hornblende, 1.5 percent.

Fallowfield

South of Fallowfield on concessions IV and V, Nepean township, Carleton county, are several small beach deposits of sand and gravel. South of the Jock river, on the Fifth Concession line, gravel pits are operated by Dibblee Construction Company and Charles Burnside Limited.

DIBBLEE CONSTRUCTION COMPANY LIMITED (218)

A 15-foot face in the Dibblee pit on the east side of the road exposes poorly-sorted coarse boulder gravel that is 30 percent stone and 70 percent sand and clay. Boulders up to 30 inches in diameter are present. Sixty percent of the pebbles exceeds 4 inches in size, and 80 percent exceeds 1 inch.

CHAS. BURNSIDE LIMITED (219)

In the Burnside pit on the west side of the road, 30 feet of crossbedded stratified sand are exposed. The face is 85 percent sand and 15 percent gravel.

Stittsville

Northwest of Old Stittsville, in Huntley township, Carleton county, on the road to Carp, is a series of northwest-trending marine beaches of the Champlain Sea at elevations of 400–430 feet. Sand and gravel pits are operated in these beach deposits by W. J. Bell and Son, A. H. McCoy Construction Company, and Spratt Sand and Gravel.

W. H. BELL AND SON CONSTRUCTION COMPANY LIMITED (147)

Gravel pits are operated by W. H. Bell and Son Construction Company on the west side of the Carp road 1½ miles north of Old Stittsville on highway No. 15, on lots 3 and 4, concession III, Huntley township, Carleton county.

The beach deposits are shallow, and the faces of the gravel pits rarely exceed 10–12 feet in height. The Allen pit, which is one of several operated by W. H. Bell, exposes a 10-foot face of stratified medium gravel and sand. A pebble count of the gravel gives the following assemblage: Paleozoic limestone; Paleozoic dolomite; Paleozoic siltstone; white Nepean Sandstone; Precambrian acid igneous rocks; and Precambrian metamorphic rocks.

A portable crushing and screening plant is employed to produce crusher-run gravel.

A. H. McCOY CONSTRUCTION COMPANY LIMITED (148)

Northwest of the pits operated by W. H. Bell and Son, a gravel pit on lot 5, concession III, Huntley township, Carleton county, is operated by A. H. McCoy Construction Company. The beach deposit is shallow, rarely exceeding 8–10 feet in thickness. One 10-foot face examined consists of poorly sorted medium gravel and sand, in the proportion of 40 percent stone and 60 percent sand. The maximum size of boulders is 12 inches; 30 percent of the gravel exceeds 4 inches in size, and 60 percent exceeds 1 inch.

Pit-run gravel and crusher-run are produced using a portable crushing plant.

SPRATT SAND AND GRAVEL (149)

Spratt Sand and Gravel Limited operates a new crushing and washing plant on lot 3, concession II, Huntley township, Carleton county, near Stittsville, to supply the western part of the Ottawa area. It produces concrete sand, brick sand, and 1-, 5/8-, and 3/8-inch stone.

The plant consists of a Jeffrey 36-inch by 8-foot vibrating feeder that feeds a Parker 18- by 30-inch jaw crusher. The material goes to a 4- by 10-foot, 2-deck Dillon screen with 7/8-inch screen. Oversize is crushed in a 6- by 36-inch Parker jaw crusher in closed circuit. All material is washed on a 4- by 12-foot, 2-deck Dillon screen and the stone is sized on a 3- by 8-foot 2-deck Dillon screen. The minus-3/16-inch material is fed with water to a 20-foot Wemco Sand-Sort. Concrete sand and brick sand from the Sand-Sort are dewatered respectively in 30- by 24-inch Parker Sand-O-Wheels.

The foregoing description of the new plant was kindly provided by Mr. G. H. Spratt of Spratt Sand and Gravel Limited.

STORMONT COUNTY

Cornwall

There are many small gravel deposits in the Cornwall area of Stormont county, and these are mainly beach deposits and near-shore bars associated with the withdrawal of the Champlain Sea. Beach gravels are normally developed on the northwest flank of clay till ridges.

The Pleistocene and Recent deposits of the Cornwall–Cardinal area have been described by E. B. Owen (1951), whose report covers five townships fronting on the St. Lawrence River in Grenville, Dundas, and Stormont counties from Cardinal to Cornwall; these 5 townships are Edwardsburg, Matilda, Williamsburg, Osnabruck, and Cornwall.

Owen (1951, p.13) describes the beach deposits as follows:

> Raised beaches with their accompanying deposits of marine sand and gravel occur in numerous localities at elevations ranging from 241 to 363 feet above sea-level. They are best developed on the north and northwest flanks of clay till drumlins. The location of these deposits in relation to the higher ground against which they were formed suggests that the winds were prevailingly westerly during their formation. The best developed beaches occur where the winds had the widest sweep from the west and northwest. It is difficult to trace individual beaches for more than a few hundred yards, as most of them were developed locally around "islands" of till that emerged as the sea withdrew.
>
> There appear to be few elevations at which the raised beaches are stronger and better developed than at others. This would suggest that the withdrawal of the marine waters was a slow, continuous process with few pauses during their retreat, and that the elevations of the emerging beaches depended more upon the relief of the emerging land and the resistance of the material to wave erosion than to any lengthy pause in the retreat of the marine waters.
>
> The material ranges from coarse sand and fine gravel in the terraces to extremely coarse, bouldery gravel higher up on the beach. The finer material is well stratified and mostly contains numerous whole marine shells, whereas the bedding in the coarser gravel is poor and the shells in fragments. The floor and back of the deposits are of clay till or reworked clay till with bedrock often only a few feet below the till.

Owen states that the best gravel is found in terraces built up below emerged bluffs. These terraces may be up to 200 feet wide, and the gravel has a depth of 3–12 feet.

Large boulders have been accumulated, or are exposed, on many of the crests of emerged ridges possibly owing to the erosion of the finer materials of the clay till having left the boulders behind. These boulder accumulations have been described by R. H. Picher (1920). They have been used as a source of material for crushed stone.

E. B. Owen's report has a very useful appendix that lists 79 gravel deposits in the Cardinal–Cornwall area, and gives the location, type of deposit, description of materials, estimated yardage of material removed and available, use, and remarks on the deposit. It will be noted that 75 of the deposits are marine beaches or bars, while only 4 of the deposits are of glaciofluvial origin.

Kame and outwash deposits of glaciofluvial origin exist in the area. Owen states that the outwash deposits appear to be confined mainly to valleys between the higher clay till ridges. "They do not appear on surface, being buried beneath a covering of marine sand, silt and clay" (Owen 1951, p. 8).

Owen (1951, p. 9) describes the outwash deposits as follows:

> Except in the case of Lachapelle pit, outwash materials occur in most gravel pits as long, narrow, irregular deposits

situated along the lower edges of the larger clay till drumlins. Because of the reworking of the top part by the waters of the Champlain Sea it is difficult to identify outwash deposits from surface indications. However, they can be easily observed underlying the marine deposits in the lower part of the faces of some gravel pits. The material forming the marine beach deposits along the sides of the larger drumlins was, in part, derived from these outwash deposits, and it was noted that the most satisfactory gravel pits are constructed on marine beach deposits in localities where large quantities of outwash material were at one time present.

Excellent sections exposing glaciofluvial sand and gravel occur in the Lachapelle pit in lots 20 and 21, concessions VIII and IX, Osnabruck township, and in the MacIntosh pit in lot 25, concession V, Edwardsburg township, about 1½ miles southeast of Spencerville. The Lachapelle pit is on an esker-like ridge of glaciofluvial material the relief of which has been modified by the subsequent invasion of marine waters. From 8 to 10 feet of outwash material overlain by 2 to 4 feet of marine sand and gravel is exposed in the pit. A well drilled on the top of the ridge is reported to have encountered 95 feet of sand and gravel and to be yielding a large supply of water. The contact between the two deposits is well defined. In places it can be identified by an accumulation of fairly large boulders, chiefly of crystalline rocks, ranging up to 12 inches in diameter. Marine fossils occur in the overlying material that occupies the surface but not in the underlying deposits of glaciofluvial origin. The marine sand and gravel are apparently beach deposits formed during the withdrawal of the Champlain Sea. The deposits in the MacIntosh pit are comparable to those in the Lachapelle, except that here the outwash material occurs along the north and northwest flank of a clay till drumlinoidal structure and bedrock is exceedingly close to surface. Sections in MacIntosh pit show 3 to 4 feet of marine fossil-bearing sand and gravel overlying 8 to 12 feet of outwash material. The contact between the two deposits presents a distinct disconformity, with the overlying marine beach deposits sloping gently to the northwest and the crossbedded glaciofluvial deposits arranged with their foreset beds dipping in a general southwest direction.

A map showing the location of gravel beaches and bars in the Cornwall area has been recently published by the Geological Survey of Canada (Terasmae 1960).

In August 1961, commercial gravel pits were being operated in the Cornwall area by Coleman Munro Limited, and by the Cornwall Gravel Company. The Coleman Munro pits are now operated by Dibblee Construction Company Limited.

MOSS PIT, COLEMAN MUNRO LIMITED (158) (now Dibblee Construction Company Ltd.)

The Moss gravel pit operated by Coleman Munro Limited is on lots 32 and 33, concession VI, Cornwall township, Stormont county, approximately 2 miles north of Long Sault.

The deposit is a marine beach gravel extending for more than a mile on the northwest flank of a clay till knoll. The 18-foot face exposes coarse stratified gravel composed mainly of Black River and Trenton limestone pebbles. There is 5–6 feet of overburden. The deposit is 85 percent stone and 15 percent sand; 70 percent of the gravel exceeds 4 inches in size, and 90 percent exceeds 1 inch. A pebble count indicates that the gravel is composed of 99 percent Black River and Trenton limestone and 1 percent Precambrian metamorphic rocks.

A Cedarapids portable crushing and screening plant, consisting of two 4- by 12-foot Cedarapids

(CXXXVII) NYC PIT, COLEMAN MUNRO LIMITED (159)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	+100	+200	−200
Weight percent	12.05	7.75	12.31	18.51	31.17	16.20	0.77	1.24

(CXXXVIII) W. FINCH AND SONS (253)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	nil	1.0	8.3	16.9	41.3	31.1	1.1	0.3

(CXXXIX) FOWLER CONSTRUCTION COMPANY LIMITED (NICHOLSON PIT) (256)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	0.3	0.8	1.4	2.4	25.5	66.5	2.9	0.2

(CXL) FOWLER CONSTRUCTION COMPANY LIMITED (RUTTAN PIT) (255)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	11.9	3.1	10.0	36.3	32.8	4.9	0.4	0.6

2-deck screens, an 18- by 36-inch jaw crusher and a set of 24- by 40-inch rolls, produces 1½-, 1-, ¾-, ½-, and ⅜-inch stone, and screenings and crusher-run as required. The plant capacity is approximately 100 tons per hour.

NYC PIT, COLEMAN MUNRO LIMITED (159) (now Dibblee Construction Company Ltd.)

The New York Central gravel pit operated by Coleman Munro Limited is on lots 34 and 35, concession VIII, Cornwall township, Stormont county, 2 miles northwest of Harrisons Corners.

The deposit is a marine beach gravel at the west end of a north-facing clay till bluff. The gravel beach deposit extends for about 2 miles in an east-west direction. Overburden is shallow. A 15-foot face exposes coarse poorly-bedded gravel showing medium to poor sorting, interbedded with sand. The face is 65 percent stone and 35 percent sand; 40 percent of the gravel exceeds 4 inches in size, and 70 percent exceeds 1 inch.

A pebble count of the gravel indicates the following assemblage: Black River and Trenton limestones; dolomite; white Nepean Sandstone; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

A sieve analysis of a sample of sand from this deposit is given in (CXXXVII).

A mineralogical analysis of the sand by the Ontario Research Foundation gave the following major constituents: quartz, 41 percent; feldspar, 20.5; Paleozoic limestone, 27; grey shale and siltstone, 3.5; black shale, 2; acid igneous rocks, 3; basic igneous rocks, 1.5 percent.

A Cedarapids portable washing and screening plant, consisting of a feed hopper, a 3-deck Cedarapids 4- by 14-foot screen equipped with spray bars, an Eagle twin dewatering screw and conveyors, produces 1- and ⅜-inch stone and concrete sand. A portable crushing unit is brought in as required, and ⅞-inch crusher run is produced.

CORNWALL GRAVEL COMPANY (160) (Parent Pit)

The Parent pit, operated by Cornwall Gravel Company, is 1½ miles southwest of St. Andrews in Cornwall township, Stormont county.

The shallow deposit is a marine beach gravel, and it extends about ½ mile in a northeasterly direction. The 13-foot face being worked at the time of the writer's visit exposed poorly-sorted coarse gravel that is 50 percent stone, and 50 percent sand, clay, and silt. Forty percent of the gravel exceeds 4 inches in size, and 70 percent exceeds 1 inch in size. Many large erratics up to 24 inches in size are present. The deposit is of limited size and shallow depth.

A pebble count of the gravel gave the following assemblage: black limestone of the Black River and Trenton groups; dolomite; white Nepean Sandstone; Precambrian acid igneous rocks; Precambrian basic igneous rocks; and Precambrian metamorphic rocks.

A portable crushing plant is used to make crusher-run gravel.

The Cornwall Gravel Company also operates the McLaughlin gravel pit in concession VIII of Charlottenburgh township, Glengarry county, 1½ miles west of St. Raphael West. Several other pits are also operated by this company.

DISTRICT OF MUSKOKA

Bracebridge

W. FINCH AND SONS (253)

A sand and gravel pit operated by W. Finch and Sons is on the Purbrook road on the eastern outskirts of Bracebridge in the District of Muskoka. A 20-foot face exposes stratified sand (80 percent) and medium gravel (20 percent). Maximum size of gravel is 5 inches; 10 percent of the gravel exceeds 4 inches, and 40 percent exceeds 1 inch in size.

The pebbles are 100 percent Precambrian crystalline rocks. The pit is several hundred feet in length and has a 40-foot face at its west end.

A sieve analysis of a sand sample from the pit is given in (CXXXVIII).

FOWLER CONSTRUCTION COMPANY LTD. (256) (Nicholson Pit)

The Nicholson pit, owned and operated by Fowler Construction Limited, is on lot 8, concession III, Macaulay township, District of Muskoka, a mile east of Bracebridge. A 12-foot face exposes stratified sand (70 percent) and medium gravel (30 percent). Maximum size of gravel is 6 inches; 20 percent exceeds 4 inches, and 50 percent exceeds 1 inch in size. The pebbles are wholly Precambrian crystalline rocks, mainly granite and gneiss.

A sieve analysis of sand from this pit is given in (CXXXIX).

FOWLER CONSTRUCTION COMPANY LTD. (255) (Ruttan Pit)

The Ruttan pit, operated by Fowler Construction Limited, is on lots 11 and 12, concession VII, Macaulay township, District of Muskoka, on the north side of highway No. 118. An 18-foot face exposes poorly-stratified coarse sand (50 percent) and medium gravel (50 percent). The maximum size of gravel is 6 inches; 30 percent exceeds 4 inches, and 50 percent exceeds 1 inch. The gravel is wholly made up of Precambrian crystalline

rocks, mainly granite and gneiss. A portable plant produces crusher-run gravel.

A sieve analysis of a sand sample from the pit face is given in (CXL).

Milford Bay

FOWLER CONSTRUCTION COMPANY LTD. (254) (Blanchard Pit)

The Blanchard pit, owned and operated by Fowler Construction, is ½ mile east of Milford Bay on lot 25, concession X, Monck township, District of Muskoka. A 30-foot face exposes stratified fine sand (70 percent) and medium gravel (30 percent). Maximum size of gravel is 10 inches; 20 percent exceeds 4 inches, and 50 percent exceeds 1 inch. The pebbles are 100 percent Precambrian crystalline rocks, mainly granites and gneisses.

A sieve analysis of sand from this pit is given in (CXLI).

This is an unusually fine sand.

Torrance

R. BUCKFLECK (257)

R. Buckfleck operates a small gravel pit ½ mile north of Torrance in Wood township, District of Muskoka. A 20-foot face exposes stratified fine sand (70 percent) and medium gravel (30 percent). The maximum size of gravel observed is 10 inches; 30 percent exceeds 4 inches in size, and 60 percent exceeds 1 inch.

Huntsville

G. A. WILKINSON (247)

The Wilkinson gravel pit is on the eastern outskirts of Huntsville on the Mary Lake road in the District of Muskoka. A 25-foot face exposes stratified sand (75 percent) and medium gravel (25 percent). The maximum size of gravel observed is 8 inches; 10 percent exceeds 4 inches in size, and 30 percent exceeds 1 inch. The pebbles are 100 percent Precambrian.

A sieve analysis of sand from the property is given in (CXLII).

DISTRICT OF PARRY SOUND

Parry Sound

Two gravel pits are operated on the east side of the highway No. 69 by-pass at Parry Sound, District of Parry Sound, just north of the Mill Lake bridge.

(CXLI) FOWLER CONSTRUCTION COMPANY LIMITED (BLANCHARD PIT) (254)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	0.4	nil	nil	nil	0.3	25.1	52.7	21.5

(CXLII) G. A. WILKINSON (247)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	6.8	2.6	2.2	6.4	32.4	47.8	1.7	0.1

(CXLIII) HALL'S PIT (258)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	nil	0.5	0.9	5.0	27.4	49.3	12.9	4.0

(CXLIV) J. A. THOMPSON (246)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +100	−100 +200	−200
Weight percent	7.78	4.68	9.13	38.12	35.10	4.25	0.56	0.38

HALL'S PIT (258)

The Hall pit, just north of the Mill Lake bridge, exposes 25 feet of stratified fine sand (80 percent) and medium gravel (20 percent). The maximum size of gravel observed is 10 inches; 10 percent exceeds 4 inches, and 30 percent exceeds 1 inch in size. The pebbles are 100 percent Precambrian crystalline rocks.

A sieve analysis of sand from the pit is given in (CXLIII).

ALFRED PARTON (268)

The Parton pit, ¼ mile north of the Hall pit, exposes 30 feet of stratified fine sand (80 percent) and medium to fine gravel (20 percent). The maximum size of gravel is 10 inches; 10 percent exceeds 4 inches, and 30 percent exceeds 1 inch in size.

Powassan

GILBERT YOUNG (245)

A gravel pit on the west side of highway No. 11 at Powassan, in the District of Parry Sound, is operated by Gilbert Young Construction Limited. The pit is on the northeast side of a rocky hill. A 30-foot face exposes stratified sand (70 percent) and medium gravel (30 percent). The maximum size of gravel is 7 inches; 30 percent of the gravel exceeds 4 inches in size, and 60 percent exceeds 1 inch. Some erratics up to 24 inches in diameter are found. The pebbles are entirely Precambrian granitic crystalline rocks and are rounded to subrounded.

A portable crushing and screening plant produces gravel for concrete aggregate, and crusher-run road gravel.

Burk's Falls

J. A. THOMPSON (246)

A small gravel pit on the west side of highway No. 11 on the southern outskirts of Burk's Falls, in the District of Parry Sound, is operated by J. A. Thompson. The 40-foot face consists of stratified sand with some medium to coarse gravel.

A sieve analysis of sand from this deposit is given in (CXLIV).

A mineralogical analysis of the sand by the Ontario Research Foundation indicated the following major constituents: quartz, 34.5 percent; feldspar, 39.5; acid igneous rocks, 14.5; basic igneous rocks, 9; hornblende, 2 percent.

SAND AND GRAVEL PITS IN SOUTHWESTERN ONTARIO

BY

P. F. KARROW

A large number of sand and gravel pits are described in this part of the report, by County. The bracketed number following the name or location of the pit refers to the location number given the pit on map No. 2038 (*see* back pocket).

ESSEX COUNTY

Leamington

SPINKS GRAVEL LIMITED (203)

This pit is in a beach deposit on the Leamington moraine. The gravel mass is probably tabular. Stratification shows that the currents have come from the east. It is in lot 12, concession III, Gosfield South township, Essex county.

Two to four feet of soil and clay overlies up to 30 feet of material that is 25 percent gravel (in seams), which in turn overlies clay and the water-table. Pebbles range between 5 inches and ¼ inch in size, with an average diameter of 1 inch. Flat pebbles constitute less than 5 percent; most of the pebbles are subangular to well-rounded, tabular to ellipsoidal. Although clay and silt constitute less than 5 percent, the gravel requires washing. A pebble count on a face sample showed the following assemblage: dolomite; limestone; chert; siltstone; green shale; black shale; granite; basic igneous rocks; and metamorphic rocks.

A screen analysis of sand from this pit is given in (CXLV).

Excavation is done by two 2½-yard Payloaders; haulage is by one truck with a 5-yard capacity. After washing, the gravel is passed through a vibrating inclined screening unit; the fines go to a settling pond. The products are stockpiled. Transportation is by truck. Plant capacity is 50 tons per hour in a 10- hour day.

WOOLATT INDUSTRIES LIMITED (204)

This pit is on the Leamington moraine about 1¾ miles west of Leamington in lots 1 and 2, concession II, Mersea township, Essex county. The large reserves of sand are horizontally bedded.

Two to ten feet of overburden comprises soil and silt, and this overburden overlies material that is 25 percent gravel in seams between sand layers. Pebbles range between 5 inches and ¼ inch in size, with an average of 1 inch. They are subangular to well-rounded, tabular to ellipsoidal. Flat pebbles constitute less than 5 percent. Hardpan exists up to 70 feet below the top. Present operations are exploiting gravel from below the water-table.

A count on 1-inch pebbles showed the following assemblage: dolomite; limestone; chert; siltstone; black shale; sandstone; metamorphic rocks; granitic rocks; and basic igneous rocks.

Excavation is by a Northwest ¾-yard shovel. A washing and sizing plant uses a hydraulic method to size the sand. Material is screened on an inclined 6- by 6-foot 3-deck vibrating screen. Transportation is generally by truck although the Chesapeake and Ohio Railway has a siding on the property.

KENT COUNTY

Chatham

THAMES VALLEY GRAVEL COMPANY (199)

A formerly active dredging operation near Kent Bridge, Kent county, removed sediment from the Thames River. The material was mostly sand but included wood and mud that were removed by screening. Much of the stone present is shale.

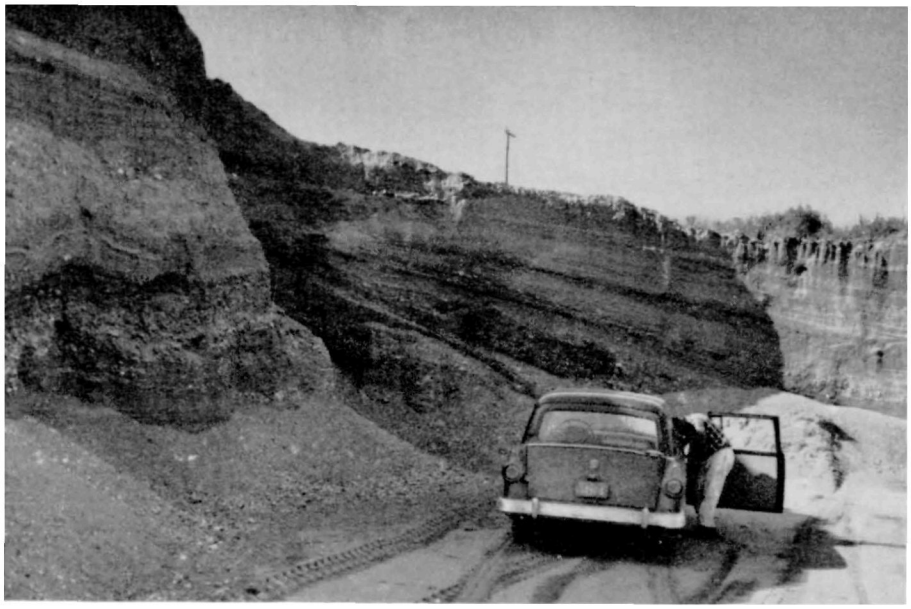
A homemade ¾-yard dredge loaded two 5-yard trucks for haulage to a homemade screening and washing plant that yielded sand, gravel, and coarse stone. Transportation was by truck.

This operation is now inactive.

ADAMS SAND AND GRAVEL LIMITED (200)

An extensive deltaic deposit is being worked in lot 16, concession XII, Harwich township, Kent county; this is about 5 miles east of Chatham. The delta is believed to have formed in glacial Lake Warren over 12,000 years ago.

The deposit is almost entirely below the water-table and consists of 55 feet of gravel over rock. Overburden is 2–8 feet thick. Pebbles are rounded and discoidal to spheroidal. A count on 1-inch screened stone showed the following assemblage: dolomite; limestone; siltstone; chert; black shale; granite; basic igneous rocks; and metamorphic rocks.



Wave-washed sand and gravel, Spinks Sand and Gravel pit, Leamington.

Gravel is removed by an underwater dragline (two 2-yard Sauerman drag scrapers). An 11-yard and a 6-yard truck haul material to the plant, where it passes through a 10-yard hopper to a single-deck Dillon horizontal 4- by 12-foot vibrating screen and a Sawyer-Massey 12- by 30-inch jaw crusher. It then passes through a rotary screening unit. Oversize goes to a Cedarapids 10- by 30-inch roll crusher, and fines pass through a 25- by 24-inch double-screw Eagle washer. All products are stockpiled. Plant capacity is 100 tons per hour in a 10- hour day. Shipment is by truck.

J. R. NASH AND SON LIMITED (201)

The Nash pit is probably in a Lake Warren delta, the deposit being an extensive sheet. It is about 3 miles southwest of Harwich, in lot 16, concession XIII of Harwich township, Kent county.

Fifty-five feet of gravel directly overlies bedrock and is being dredged from below the water-table. Pebbles average 1 inch in diameter but attain a maximum of 15 inches. The clay and silt content is unknown, but washing is required. Boulders (some shale) are rounded and ellipsoidal. Flat pebbles constitute 10–20 percent. None of the gravel has been cemented. A pebble count in 1½-inch crushed material showed the following assemblage: dolomite; limestone; chert; siltstone; black shale; granite; basic igneous rocks; and metamorphic rocks.

Excavation is by two Sauerman drag scrapers with ¾-yard and 1½-yard capacities, as well as one ¾-yard Lorain dragline. Haulage is by two trucks with 5- and 6-yard capacities. The gravel is fed through a 15-ton hopper to a 2-deck inclined vibrating 30- by 72-inch screen. Oversize goes to a Sawyer-Massey 10- by 30-inch jaw crusher. The material then passes through a 3-deck Dillon 4- by 12-foot inclined vibrating screen. Undersize goes to a 3- by 20-foot Wemco dewatering screw, and the products are stockpiled. Transportation is by truck.

CHATHAM SAND AND GRAVEL (202)

A dredging operation in Kent county in the Thames River upstream from Chatham recovers modern stream deposits. The material is taken by barge to the plant in Chatham. Material is mostly sand and contains many shells. The supply of

(CXLV) SPINKS GRAVEL LIMITED (203)

Mesh	+4	−4 +8	−8 +14	−14 +28	−28 +48	−48 +60	−60 +80	−80 +100	−100 +200	−200
Weight percent	nil	0.03	0.02	0.08	10.07	12.50	36.50	18.70	17.30	4.80

material has generally lessened because of reduced spring floods after the construction of the Fanshawe dam near London.

The barge is unloaded by a ½-yard Quickway clamshell shovel and is shipped by truck.

Merlin

LAKE ERIE SAND AND GRAVEL COMPANY (195)

Modern Lake Erie beach gravels are being exploited ½ mile east of Port Alma in lot 173, Talbot Road, Tilbury East township, Kent county. The gravels are derived from the erosion of till that forms low cliffs along the shore for many miles.

The gravel supply is quite irregular, depending upon currents in the lake. Material ranges between 4 inches and ¼ inch in size, the average being 1 inch. Pebbles are subrounded to well-rounded and tabular to spheroidal. A count on the 1-inch pebbles showed the following assemblage: dolomite; limestone; chert; siltstone; black shale; red shale; sandstone; granitic rocks; metamorphic rocks; basic igneous rocks.

Gravel is recovered from the lake with a 1-yard dredge and taken through a vibrating inclined screen. Stockpiling is handled by a Trojan 1-yard front-end loader. Plant capacity is 90 tons per hour. Shipment is by truck.

Blenheim

DOEY GRAVEL AND CONSTRUCTION LTD. (196)

The Doey pit is in a lengthy beach deposit probably formed by Lake Warren; stratification indicates that the waves were from the south. The pit is in lot 9, west concession IV, Harwich township, Kent county.

Two feet of soil overlies a 25-foot face of material that is 30 percent gravel, sandier near the top and bounded by the water-table at the base. Pebbles range between 2 inches and ¼ inch in size, and average ¾ inch. Clay and silt constitute 5 percent; flat pebbles constitute 5–10 percent; the remaining pebbles are rounded, ellipsoidal to spherical. A pebble count on a face sample shows the following assemblage: dolomite; limestone; siltstone; chert; black shale; sandstone; granite; basic igneous rocks; and metamorphic rocks.

Excavation is by an Erie ⅜-yard shovel; shipment is direct by truck.

G. F. HUFFMAN (197)

The Huffman operation is just east of Cedar Springs on the south side of highway No. 3 on the Raleigh–Harwich township line in Kent county. The deposit was probably a Lake Warren beach.

Soil 2 feet thick overlies 25 feet of material that is 60 percent gravel ranging between 2 inches and ¼ inch in size, and averaging ½ inch. Sand and water underlie the pit. Pebbles are rounded and ellipsoidal to discoidal; 10 percent are flat. Clay and silt content is about 5 percent. Sandy streaks were noted in the upper part of the deposit. The deposit is a ridge of gravel several miles long. Gravel from a face sample showed the following assemblage: dolomite; limestone; siltstone; chert; black shale; granitic rocks; basic igneous rocks; and metamorphic rocks.

Gravel is loaded by a Trojan 1-yard front-end loader and an International ½-yard front-end loader. Pit-run material, the only product, is shipped by truck.

ELGIN COUNTY

Bothwell

JOHNSON AND MOULTON (198)

This pit is in a large, tabular, wave-transported deposit in a Warren beach at the east end of the Blenheim moraine; wave deposition has produced horizontal stratification. The pit is southeast of Bothwell in concession III, Aldborough township, Elgin county.

Two feet of soil overlies an 8-foot face of material that is 20 percent gravel. Although there is 30 feet of sand and gravel over clay, the pit floor is probably near the water-table. Pebbles range between 3 inches and ¼ inch in diameter, with an average of ½ inch. Washing is necessitated by the presence of 5 percent clay and silt. Pebbles are generally subrounded to well-rounded, tabular to ellipsoidal; about 10 percent are flat. There is no cementation of the gravel. A pebble count on 1-inch screen sample showed the following assemblage: dolomite; limestone; chert; siltstone; black shale; granite; basic igneous rocks; and metamorphic rocks.

Excavation is by a General 1-yard shovel, an Insley ½-yard shovel, a Massey Ferguson ¾-yard front-end loader, and an International ¾-yard front-end loader. Material passes through a washing unit to a 3-deck screen; oversize recirculates through a jaw crusher. Shipment is by truck.

St. Thomas

McLAWS GRAVEL AND CRUSHING LIMITED (192)

Beach gravel, deposited by Lake Warren, is exploited in lot 3, concession IV, Yarmouth township, Elgin county. The deposit is south of St. Thomas.

Soil 2–4 feet thick overlies 25 feet of material that is 80 percent gravel which, in turn, overlies

clay. Pebbles range between 6 inches and ¼ inch, and average 2 inches in size; they are subangular to well-rounded, and tabular to ellipsoidal. Clay and silt content is low, but flat pebbles are about 5 percent. The deposit is an east-west ridge with foreset beds dipping to the north. There is slight cementation. A face sample was composed of: dolomite; limestone; chert; siltstone; cemented gravel; granitic rocks; basic igneous rocks; and metamorphic rocks.

Gravel is excavated by a Unit ½-yard shovel and is taken through a Universal Junior portable crusher. Transportation is by truck.

BANNOCKBURN FARMS (193)

A Warren(?) beach deposit on the south side of the Sparta moraine is worked in lot 8, concession V, Yarmouth township, Elgin county.

Overburden is 2–3 feet thick (soil). Gravel, 4–18 feet thick (30 percent of which is gravel), overlies clay. Pebbles are subangular to well-rounded, and tabular to ellipsoidal. Flat pebbles constitute about 5 percent. Size of the gravel ranges between 3 inches and ¼ inch, and averages 1 inch. The deposit is narrow and tabular in shape. Foreset beds dip mainly to the north, indicating waves from the southeast. There is slight cementation in the gravel. A pebble count on a face sample showed the following assemblage: dolomite; limestone; shale; chert; siltstone; granitic rocks; metamorphic rocks.

Two Osgood ½-yard shovels are used in the pit. Two 3-ton trucks haul to a portable homemade crusher and a Cedarapids washer and screener. Transportation is by truck.

K. R. AXFORD (194)

The Axford pit is in a probable Warren beach deposit at the west end of the Sparta moraine. It is in lot 4, concession VI, Yarmouth township, Elgin county.

Soil up to 4 feet thick overlies 20 feet of gravel, mostly under water, which rests on clay. Balls of purple stratified clay and balls of peat up to one foot in diameter have been found in the gravel and would appear to represent erosion of older underlying deposits of unknown age. Pebbles range between 4 inches and ¼ inch in size, and average 1 inch. Flat pebbles and clay and silt each constitute 5 percent. A pebble count on ¾-inch crushed gravel showed the following assemblage: dolomite; limestone; chert; granitic rocks; basic igneous rocks; and metamorphic rocks.

Excavation is by a Linkbelt ¾-yard shovel, which loads a Cedarapids Pitmaster crusher. Shipment is by truck.

LAMBTON COUNTY

Sarnia

KEMSLEY AND BOYER GRAVEL (206)

The Kemsley and Boyer pit is near Blackwell in the northern portion of Sarnia township, Lambton county. The deposit is a wind-reworked Algonquin-Nipissing beach and is several miles long. The material has been wave-transported up to 10 miles.

Two feet of soil is underlain by about 15 feet of sand over a layer of logs and muck; this is in turn underlain by 70 feet of clay over bedrock. Disseminated gravel constitutes 15 percent of the deposit and has pebbles that range between 3 inches to ½ inch in size, with an average of 1½ inches. The pebbles are subrounded to well-rounded, and discoid to tabular. Flat pebbles constitute 5 percent. Although clay and silt constitute less than 5 percent, washing is required. There is no cementation. Sand is recovered from below the water-table. A count on 1-inch gravel showed the following assemblage: dolomite; limestone; chert; non-calcareous black shale; sandstone; granitic rocks; basic igneous rocks; and metamorphic rocks.

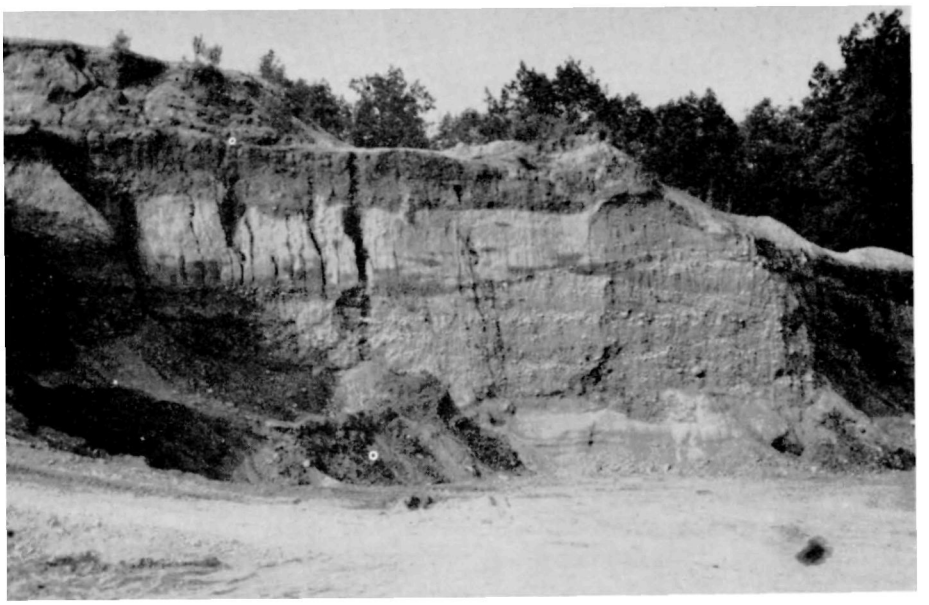
Excavation is by front-end loader (D-4 Caterpillar, 1¼-yard capacity) and a ½-yard dragline. Haulage is by one 6-yard truck to a Simplicity screening unit for which water for washing is obtained from the ponds in the pit. Transportation is by truck.

EDSON CONSTRUCTION LIMITED (207)

This pit is near Blackwell in the northern part of Sarnia township, Lambton county. Like the Kemsley and Boyer pit, this is a wind-reworked Nipissing beach in which the material has been transported up to 10 miles. The deposit is several miles long, and the reserves are large.

Two feet of soil overlies a 20-foot face of gravel to the water-level. Quicksand exists at the base of the face. Gravel constitutes 50 percent of the deposit; pebbles range between 4 inches and ½ inch in size and are subrounded to well-rounded, discoid to tabular. Flat pebbles constitute 5 percent. Although clay and silt content is less than 5 percent, washing is required. There is no cementation. A pebble count on the oversize from the screening unit showed the following assemblage: dolomite; limestone; chert; black shale; sandstone; granite; basic igneous rocks; and metamorphic rocks.

Excavation is by a ¾-yard shovel; haulage is by two front-end loaders (a Michigan 75, one-yard capacity; and a Caterpillar ⅞-yard capacity). A



Kame gravel, McRae pit, Byron.

Cedarapids screening unit is used, and water is taken from ponds in the pit. Transportation is by truck.

Wyoming

EDGEWATER CONSTRUCTION COMPANY LTD. (208)

A beach deposit, probably formed by Lake Warren, is worked in lot 14, concession IV, Plympton township, Lambton county. The deposit is several miles long and lies along the west side of the Wyoming moraine.

Overburden is soil, 1–2 feet thick. A 16-foot face is 10 percent gravel ranging between 1 and 4 inches in size, with an average of 1 inch. Pebbles are subangular to well-rounded, and tabular to discoid in shape. Clay, silt, and flat pebbles constitute about 5 percent of the deposit. Clay underlies the gravel, which extends below the water-table. A count on 1-inch screened gravel indicates the following pebble assemblage: dolomite; limestone; chert; black shale; granitic rocks; basic igneous rocks; and metamorphic rocks.

Gravel is excavated by an American ⅝-yard shovel. Haulage is by a 5-yard and a 7-yard truck to a homemade 3-deck washing-screening unit. Shipment is by truck.

MIDDLESEX COUNTY

London

C. McRAE (217)

This pit is in what are probably kame gravels but whose extent is unknown. The gravels are at the north edge of the Ingersoll moraine in lot 27, concession II, London township, Middlesex county, about 1 mile northwest of Byron. Foreset bedding indicates current deposition from the southeast.

Three to five feet of sand and soil overlies 70 feet of material, 80 percent of which is gravel containing pebbles ranging in diameter between 12 inches and ½ inch, with an average of 3 inches. The pebbles are subangular to rounded, tabular to ellipsoidal, and less than 5 percent are flat. Sand and gravel exist in interbedded lenses. Clay and silt constitute less than 5 percent, but the gravel needs washing. There are a few well-cemented blocks around the north edge of the pit. The lowest part of the pit showed sand for 10 feet; above the sand are two gravel benches. There is no water in the crushing pit. A pebble count indicated the following assemblage: dolomite; limestone; chert; sandstone; siltstone; granitic rocks; basic igneous rocks; and metamorphic rocks.

Excavation is by a Unit 1-yard shovel and 4 front-end loaders (one 2-yard, and three 2½-yard). Haulage is by one 7-yard truck. Crusher feed is put on a 2-deck 4- by 10-foot Dillon horizontal vibrating screen. The 1-inch oversize goes to a jaw crusher and ⅞-inch oversize to a roll crusher. Products are fed to a 4- by 4-foot 3-deck Rogers Joplin vibrating inclined screen equipped with spray bars. After passing through a dewatering screw, the products are stockpiled. Plant capacity is 170 tons per hour in a 10-hour day. Transportation is by truck.

MAX. CAMPBELL (209)

The Campbell pit is in lot 11, concession IX, Lobo township, Middlesex county. This is just east of the Seaforth moraine and could be a spillway gravel. Major foreset bedding dips westward, implying a current from the northeast. A few subaqueous slump folds are present. The deposit, of unknown reserves, is in a ridge trending northeast.

Two feet of soil overlies a 15-foot face, 10 percent of which is gravel. Pebbles range between 2 inches and ¼ inch; the average is 1 inch. The deposit increases in coarseness toward the east. Pebbles are subangular to rounded, tabular to ellipsoidal. Flat pebbles constitute less than 5 percent. The presence of clay and silt (ten percent) necessitates washing. There is no cementation. The water-table is near the base of the pit. A pebble count on a face sample indicates the following assemblage: dolomite; limestone; and chert.

Excavation is by an International front-end loader with ⅝-yard capacity. Transportation is by truck.

A. NEWBIGGING (210)

A large pit with large reserves is situated in gravel and sand from a Lake Whittlesey delta south of the Lucan moraine. The pit is located in lot 8, concession II, Lobo township, Middlesex county.

Two feet of soil overlies 10–25 feet of gravel which, in turn, overlies stratified silts. The face is 40 percent gravel that contains pebbles having diameters ranging between 6 inches and ¼ inch, with an average of 2 inches. The pebbles are subangular to well-rounded, tabular to ellipsoidal. Clay and silt, and flat pebbles both constitute less than 5 percent, but washing is required. There is no cementation. The bottom of the pit is irregular, and about half of it is below the water-table. A pebble count on pit-run showed the following assemblage: dolomite; limestone; chert; siltstone; sandstone; granite; basic igneous rocks; and metamorphic rocks.

A 1-yard Link Belt dragline, a 1¾-yard Hough front-end loader, and a 1¼-yard Michigan front-end loader excavate the gravel, which is hauled by truck. A Cedarapids Junior tandem portable screening unit with ¾-inch screen is used. Transportation is by truck.

W. TUNKS (211)

This pit is in lot 6, concession II, Lobo township, Middlesex county. Gravels were deposited in a Lake Whittlesey delta south of the Lucan moraine. Foreset bedding indicates current deposition from the southeast. The reserves are large because the deposit is in the form of an extensive sheet.

Two to four feet of soil overlies a 25-foot face of which 25 percent is gravel; pebbles range between 4 inches and ½ inch in diameter, with an average of 1 inch. Pebbles are subangular to rounded, tabular to ellipsoidal, and less than 5 percent are flat. Although clay and silt constitute less than 5 percent, the gravel requires washing. There is no cementation. The pit extends almost down to the water-table. A pebble count on pit-run showed the following assemblage: dolomite; limestone; chert; siltstone; granite; basic igneous rocks; and metasedimentary rocks.

Excavation is by a John Deere front-end loader, and haulage to the plant is by a 7-yard truck. Transportation from plant to consumer is by truck.

FRYER PIT (212)

Outwash gravels in a spillway in front of the Ingersoll moraine lie in an extensive sheet along the Thames River. Good foreset bedding indicates a current moving northwestward. It is well-stratified and well-sorted. The reserves are large.

The Fryer pit is in Westminster township, Middlesex county, west of the city of London.

Two to three feet of soil overlies a 20-foot face of which 30 percent is gravel, most of which is at the top. Pebbles range between 6 inches and ¼ inch in diameter, and average 2 inches. They are subangular to well-rounded, tabular to ellipsoidal, and about 5 percent are flat. Clay and silt constitute less than 5 percent, but washing is required. There is no cementation. A pebble count yielded the following assemblage: dolomite; limestone; chert; sandstone; siltstone; granitic rocks; basic igneous rocks; and metamorphic rocks.

Excavation is by a ¾-yard Link Belt shovel, and haulage is by two 10-yard trucks. A Universal crusher and homemade screening unit are used. The pit-run goes through a ¼-inch screen, and the oversize goes through a jaw crusher and roll crusher to a 3-deck screen; the products are stockpiled. Transportation is by truck.

J. F. MARSHALL AND SONS LIMITED (213)

This pit is in lot 4, concession IV, London township, Middlesex county, and is ½ mile south of highway No. 22, east of Clarke sideroad. Outwash gravel in a spillway forms an extensive sheet deposit along the Thames River. The material may have been transported up to 30 miles by a west-flowing current. The reserves are large.

Two feet of soil overlies a 25-foot face of which 75 percent is gravel that contains pebbles ranging between 12 inches and ¼ inch in diameter, with an average of 1½ to 2 inches. The gravel is coarser

to the east, lensing-out and becoming finer to the west. Pebbles are subangular to well-rounded, tabular to ellipsoidal, and less than 5 percent are flat. Clay and silt constitute less than 5 percent, but washing is required. Below the 25-foot gravel face, clay overlies bedrock. There is no cementation. A pebble count yielded the following assemblage: dolomite; limestone; chert; sandstone; siltstone; granitic rocks; basic igneous rocks; and metamorphic rocks.

Excavation is by a 1-yard American shovel and 3 front-end loaders of 2½-, 2-, and 1-yard capacities. Haulage is by 4 Euclid trucks (one 15-yd., two 10-yd., and one 6-yd.). The material is washed by water from the pit ponds. Primary crushing is done by a Pioneer 10- by 36-inch jaw crusher; secondary crushing is done by a Pioneer 40- by 22-inch roll crusher. The ⅜-inch undersize from a 4- by 12-foot 4-deck Pioneer inclined-divided vibrating screening unit goes through a spray to a 4- by 12-foot 2-deck Dillon horizontal vibrating screening unit. The ¼-inch undersize goes to an Eagle sand classifier with a Hydracone centrifugal separating unit that separates sand from silt and clay. The products are stockpiled. Transportation is by truck. Plant capacity is 150 tons per hour in a 10-hour day.

RIVERSIDE CONSTRUCTION COMPANY LTD. (214)

This pit, in lot 5, concession III, on the Clarke sideroad of London township, Middlesex county, exploits gravels from an interlobate spillway in which imbrication indicates current deposition from the east. The deposit, with large reserves, is in an extensive sheet along the Thames River.

Two feet of soil overlies a 15-foot face of which 95 percent is gravel containing pebbles ranging between 10 inches and ½ inch with an average of 3 inches. The pebbles are subangular to well-rounded, tabular to ellipsoidal, and less than 5 percent are flat. Clay and silt constitute less than 5 percent, but the gravel requires washing. There is no cementation. The bottom of the pit is at the water-table. A pebble count indicated the following assemblage: dolomite; limestone; chert; granitic rocks; basic igneous rocks; and metamorphic rocks.

Excavation is by a ¾-yard Bay City front-end loader and a 2-yard Michigan front-end loader. Haulage is by 5 six-yard trucks. The pit-run goes to a 3-deck horizontal screen. The 5/16-inch undersize goes to a homemade washer and to bins. The 7/16-inch oversize goes to a ⅞-inch horizontal vibrating screen. The undersize goes to a bin. The ⅞-inch oversize goes through a Cedarapids Commander jaw crusher to a 3-deck vibrating screening unit. The products are stockpiled. Transportation is by truck.

TOWLAND CONSTRUCTION LIMITED (215)
(London Sand and Gravel)

Two pits, in lots 11 and 12, concession II, West Nissouri township, Middlesex county, are 4.1 miles north of highway No. 2 beside the first sideroad east of Crumlin Airport. This extensive sheet-deposit contains very large reserves; it lies along the Thames River and is an outwash gravel. Currents came down the spillway from the northeast, as indicated by some low foreset beds and imbrication. The beds are essentially horizontal.

Two to four feet of soil overlies a 30-foot gravel face in which pebbles range between 12 inches and ½ inch in diameter and average 3 inches. Pebbles are subangular to well-rounded, tabular to ellipsoidal, and less than 5 percent are flat. There is some cementing toward the middle of the face. A pebble count showed the following assemblage: dolomite; limestone; chert; siltstone; granitic rocks; basic igneous rocks; and metamorphic rocks.

After washing, the pit-run passes through primary and secondary jaw crushers and goes to a 2-deck horizontal screen. The ¼-inch undersize goes to 2 drag classifiers. The products are stockpiled.

OXFORD COUNTY

Princeton

WIGHT SAND AND GRAVEL (173)

A gravel deposit is being worked in lot 13, concession II, Blenheim township, Oxford county. The deposit is a small outwash body just west of the Norwich moraine and is, therefore, of Cary age.

A 10-foot face exposes about 2 feet of (soil) overburden on top of material of which 95 percent is gravel; the gravel overlies clay (till?). The gravel ranges in size between 10 inches and ½ inch, and averages about 2 inches. Pebbles are subangular to rounded, and tabular to ellipsoidal. The gravel contains some clay and silt, and about 5 percent flat pebbles. A pebble count on 1½-inch crushed stone indicates the following assemblage: dolomite; limestone; black calcareous shale; chert; sandstone; granitic rocks; basic igneous rocks; and metasedimentary rocks.

The equipment in the pit consists of a P&H ¾-yard shovel mounted on a 4-wheel-drive GMC truck, a Ford Powermaster 1-yard front-end loader, and a D-4 Caterpillar 1-yard rear-end shovel. Trucks haul to a portable screen and crushing unit. Transportation is by truck.

Woodstock

OXFORD SAND AND GRAVEL LIMITED (184)

Two pits are operated by this company in Oxford county; one is 1½ miles west of Currie, and the other is at the north edge of Woodstock.

Outwash gravel in a spillway deposit, Oxford Sand and Gravel pit, Woodstock.

The south pit is in a spillway in front of the Ingersoll moraine. Soil and clay, 3–4 feet thick, cover 70 feet of gravel. Under the pit lies sand and water. The face is 50 percent gravel ranging in size between 12 inches and ½ inch, and averaging 2 inches. Pebbles are subrounded to well-rounded, and tabular to ellipsoidal. Clay and silt content is 5–10 percent, but flat pebbles are uncommon. Sorting in the deposit is poorer in the upper part where it is kame-like. Foreset bedding indicates current to the northwest. A pebble count on crusher-run indicates the following assemblage: dolomite; limestone; chert; black shale; granitic rocks; basic igneous rocks; and metamorphic rocks.

The north pit is in the Thames River spillway, which cuts across the Woodstock drumlin field. Three feet of soil overlies 40 feet of gravel; size of the gravel ranges between 8 inches and ¼ inch, and averages 1–2 inches. Pebbles are subangular to rounded, and tabular to ellipsoidal. The gravel contains about 5 percent flat pebbles; clay and silt constitute less than 5 percent. The bedding indicates current from the northeast. A pebble count on crusher-run indicates the following assemblage: dolomite; limestone; chert; siltstone; basic igneous rocks; and metamorphic rocks.

A 1½-yard Northwest shovel is used in the south pit. Haulage is by truck to a new plant where gravel passes through a 2-deck Dillon screen. Fines go through a Wemco gravity classifier and a Wemco dewatering screw. Creek water is used for washing. Transportation is by truck.

A new feature of the operation is the use of heavy-media separation for benefication of the gravel (Fuller 1963). Washed and graded gravel is fed to a 7-foot-diameter Wemco cone separator. This separator contains the heavy medium, which is a slurry composed of powdered magnetite and ferrosilicon in a water suspension; slurry proportions can be adjusted to yield any desired specific gravity. Light, deleterious materials are skimmed off the top while the higher-quality material sinks to the bottom and is removed by airlift through a central tube. Both heavy and light fractions are then washed and dewatered on a vibrating screen and stockpiled. The heavy medium is mostly recovered and recycled. Oxford's plant has a capacity of 70–80 tons an hour of high-quality aggregate.

G. B. THORNTON (185)

The Thornton pit is in lot 1, concession III, of West Oxford township, Oxford county, along a spillway at the edge of the Woodstock drumlin field.

A 30-foot face exposes 3–5 feet of soil on top of material that is 50 percent gravel ranging in size between 12 inches and ½ inch, and averaging 3–4 inches. Pebbles are subrounded to rounded and tabular to ellipsoidal. Clay and silt constitute about 5 percent, but flat pebbles are uncommon. Gravel is irregularly distributed in the deposit.

G. B. Thornton pit, Woodstock, showing spillway gravel with a collapse fault (in centre of face).

The nature of the bedding indicates that currents were in all directions, and there are some collapse faults suggesting the ice-front was near when the deposit was formed. A pebble count on 1-inch pebbles showed the following assemblage: dolomite; limestone; siltstone; sandstone; chert; granitic rocks; basic igneous rocks; and metamorphic rocks.

No processing equipment was present at this pit.

TREE SAND AND GRAVEL (186)

This operation is in lot 8, concession XII, East Zorra township, Oxford county. It is in a spillway at the edge of the Woodstock drumlin field.

Overburden is 1–8 feet thick over at least 50 feet of gravel. A 25-foot face is 50 percent gravel ranging in size between 10 inches and ½ inch, and averaging 2 inches. Pebbles are subangular to well-rounded, and tabular to ellipsoidal. Clay and silt may constitute up to 10 percent. There is slight cementation. Large foreset beds all slope south; sorting improves southward and size decreases southward. A count on 1-inch gravel shows the following pebble assemblage: dolomite; limestone; siltstone; chert; sandstone; granitic rocks; basic igneous rocks; and metamorphic rocks.

Most equipment is rented. A ¾-yard Northwest shovel loads a portable Pioneer crusher and screener. Stockpiling is by a 6-yard truck and an Allis-Chalmers 1-yard front-end loader.

DUNN'S HAULAGE (187)

This pit, leased by Hamilton Sand and Gravel Limited, is in lot 4, concession XIII, of East Zorra township, Oxford county. It is in the Thames River spillway.

A 30-foot face is 80 percent gravel ranging between 10 inches and ½ inch, and averaging 1–2 inches. Pebbles are subangular to well-rounded, and tabular to ellipsoidal in shape. Flat pebbles and clay and silt constitute less than 5 percent. Bedding and imbrication indicate current to the south. The material is poorly-sorted. A pebble count on 2-inch stone indicated the following assemblage: dolomite; limestone; sandstone; siltstone; chert; granitic rocks; basic igneous rocks; and metamorphic rocks.

Equipment owned by Hamilton Sand and Gravel Limited is used in the pit. A ⅝-yard Denver Quickway shovel loads a portable crusher that includes a Universal jaw crusher and a Cedarapids roll crusher. Stockpiling is handled by a 10-yard truck and a Massey Ferguson 1-yard front-end loader. Transportation is by truck.

McNAMARA CONSTRUCTION, HART PIT (216)

This pit is on highway No. 19, north of Woodstock in the Woodstock drumlin field, East Zorra township, Oxford county. Foreset bedding indicates a current from the north, the material possibly having been transported as far as 5 miles. The gravels have been overridden by till and may be kame gravels associated with a drumlin. The gravels are mostly on the north side.

Ten feet of till overlies 70 feet of material of which 50 percent is gravel that contains pebbles

Glacial till overlying stratified sand and gravel;
McNamara Construction pit, Woodstock.

ranging between 15 inches and ½ inch in diameter, and averaging 3 inches. Pebbles are subangular to well-rounded, tabular to ellipsoidal, and less than 5 percent are flat. Clay and silt constitute 10 percent, and washing is required. There is no cementation. The reserves are unknown, and no water is present in the pit. A pebble count on a face sample shows the following assemblage: dolomite; limestone; chert; siltstone; granite; basic igneous rocks; and metamorphic rocks.

Excavation is by a 1¼-yard Link Belt shovel and a 2¾-yard Caterpillar front-end loader. Haulage to a Cedarapids screening unit is by front-end loader. Transportation is by truck.

Tillsonburg

R. A. SHELTON AND SONS (188)

This pit is in lot 7, concession I, Dereham township, Oxford county. The deposit, probably a kame, lies along the spillway in front of the Ingersoll moraine.

Three to six feet of soil overlies about 30 feet of material of which 60 percent is gravel; sand and water underlies the gravel. Gravel averages 2 inches in size, with a maximum of 12 inches and a minimum of ½ inch. Pebbles are subangular to well-rounded, and tabular to ellipsoidal. Flat pebbles constitute less than 5 percent, but there are 1-foot clay bands and silt bands near the middle and base of the deposit. Bedding is irregular and lensy.

A Michigan ½-yard shovel and a Unit ¾-yard shovel are used in the pit. The Unit shovel loads a portable Sandy crushing unit. Stockpiling is by a Case front-end loader. Transportation is by truck.

Ingersoll

R. S. CLARK AND SON LIMITED (189)

This operation is in lot 23, Broken Front, West Oxford township, Oxford county. The deposit is in the Thames River spillway in front of the Ingersoll moraine at the western edge of Ingersoll.

Soil 2–4 feet thick covers 15 feet of material, of which 80 percent is gravel that ranges in size between 12 inches and ¼ inch, and averages 2 inches. Pebbles are subangular to well-rounded, and tabular to ellipsoidal. Flat pebbles constitute 5 percent of the gravel, but clay and silt content is low.

Gravel is fed to a Cedarapids Junior Tandem crusher by a ½-yard Unit shovel. The ¾-inch crushed gravel goes to a Rodgers portable washing plant or to a stockpile. The washing plant takes two sizes of stone (¾- and ⅜-inch), and one size of sand that is dewatered by a 24-inch screw. The plant can handle 60–80 tons per hour. Shipment is by truck.

GLENDALE SAND AND STONE LIMITED (191)

Thames River spillway gravels are being removed from a pit in lot 18, concession I, North Dorchester township, Oxford county. The spillway is north of (in front of) the Ingersoll moraine.

E. C. King Contracting Limited, Tara; a kamey outwash deposit.

The face exposes 2 feet of soil over 10 feet of material of which 25 percent is gravel ranging in size between 8 inches and ¼ inch, with an average of 1 inch. Pebbles are subangular to well-rounded, and tabular to ellipsoidal. Flat pebbles, and clay and silt, are each about 5 percent. Foreset beds all indicate stream-flow to the west, down the Thames valley. The base of the pit is at the water-table. A count on crushed gravel indicates the following assemblage: dolomite; limestone; chert; siltstone; sandstone; granitic rocks; basic igneous rocks; and metamorphic rocks.

In the pit, a Drott 9K3 front-end loader loads a 10-yard truck. Crushing and screening are done by contract. Shipment is by truck.

HURON COUNTY

Brussels

DENNIS PIT (172)

This pit is about 10 miles southeast of Brussels in the southeast corner of Grey township, Huron county. It is in an esker that trends west of south, just east of the Mitchell moraine and, therefore, probably originated in the retreat of the Huron ice-lobe.

A 10-foot face shows soil overburden above gravel (30 percent of the material) that has a maximum size of 3 inches, minimum of ¼ inch, and an average of ¾ inches. It is subangular to rounded, and tabular to spheroidal. A pebble count on a face sample showed the following assemblage: dolomite; limestone; chert; basic igneous rocks; and metamorphic rocks.

Gravel is removed by a Northwest ¾-yard shovel, and is transported by truck. No processing plant was present.

Seaforth

FRANK KLING LIMITED (170)

The Kling operation is in lot 22, concession II, McKillop township, Huron county, about 1 mile east of Seaforth. It is in the west end of an esker that extends from the Seaforth moraine, at Seaforth, eastward for about 5 miles to the Mitchell moraine. It is probably Cary in age.

Soil, 2 feet thick, is the only overburden. The deposit is more than 50 feet thick, and 20 percent of the face is gravel ranging in size from 5 feet (boulders) to ¼ inch, with an average of 2 inches. Pebbles are subangular to rounded, and tabular to ellipsoidal. Clay and silt are present in amounts up to 5 percent, making washing necessary. The material is generally poorly-sorted. Flat pebbles constitute less than 5 percent of the gravel. Bedding is irregular, with minor collapse faulting. A pebble count on 1-inch crushed stone indicates the following assemblage: dolomite; limestone; sandstone; chert; granitic rocks; basic igneous rocks; and metasedimentary rocks.

Gravel is removed by an American ¾-yard shovel and is hauled by three 5-yard trucks. Crushing is done by a 15- by 30-inch jaw crusher and a 3-foot cone crusher in circuit; material then goes through the screening plant, which consists

Stratified outwash gravel; Durham Crushed Stone pit, Durham.

of a 3-deck Dillon screen and washer. Sand is processed by an Eagle sand screw. Shipping is by truck.

JOHN H. McILWAIN (171)

This pit is in lot 30, concession VII, McKillop township, Huron county. The deposit is an esker that extends about 7 miles between the Seaforth and Mitchell moraines. The pit is at the west end of this esker, in a broad kamey ridge.

Soil overburden covers more than 50 feet of sand and gravel. Gravel is concentrated at the west end of the ridge, and boulders up to 2 feet in diameter are present there. Pebbles are subangular to rounded, and tabular to spheroidal. Flat pebbles are rare. Foreset beds indicate current from the southwest. A pebble count on a face sample shows the following assemblage: dolomite; limestone; chert; calcareous siltstone; granitic rocks; basic igneous; and metamorphic rocks.

No processing equipment was present in the pit, and apparently only pit-run product is produced; shipment is by truck.

PERTH COUNTY

St. Marys

GRAYDEN LAING (205)

A pit is operated in an esker in lot 7, concession XIII, Downie township, Perth county. The esker is on the till plain between the Milverton and the Easthope moraines and is believed to have been formed by the melting Huron ice-lobe.

Fifty percent of the 20-foot face is gravel, covered by 2–3 feet of soil. Gravel ranges in size between 15 inches and ½ inch, with an average of 2 inches. Pebbles are subrounded, and tabular to ellipsoidal. Flat pebbles constitute less than 5 percent; clay and silt are about 5 percent. There is strong cementation of the gravel in places. Foreset beds slope to the east, and the slump structures that are present are features characteristic of near-ice conditions of deposition. A count on 1½-inch crushed stone indicates the following assemblage: dolomite; limestone; chert; granitic rocks; basic igneous rocks; and metamorphic rocks.

A homemade shovel and dragline feed a Sandy crushing unit. Some hauling is done by a 3-yard truck. Shipment of the product is by truck.

GREY COUNTY

Tara

E. C. KING CONTRACTING LIMITED (169)

Two pits are operated in concessions X and XI, Derby township, Grey county, 3 miles east of Tara. The deposits are kame-outwash gravels associated with small east-west morainic ridges referred to as the "Tara Strands".

The worked gravel is about 20 feet thick over clay (till). About 2 feet of soil is present as overburden. The deposits are 40–60 percent gravel ranging in size between boulders and ½ inch, with an average of 2–3 inches. Pebbles are sub-

angular to rounded, and tabular to spheroid. A small amount of silt and clay are present; flat pebbles constitute less than 5 percent. The depositing stream flowed from the north, as shown by southerly-dipping foreset beds. Pebble composition of 1-inch crushed stone was: dolomite; limestone; granitic rocks; and metasedimentary rocks.

A front-end loader is used in the pit to load a Sandy crushing unit, and two 5½-yard trucks haul gravel to the plant where material goes through an Eagle screw washer, then over a 2-deck Dillon inclined vibrating screen, and to stockpiles. Sand from this screen goes to a Wemco S-H 36- by 20-inch dewatering screw, then to stockpile. The plant can produce 80 tons per hour in a 9-hour day. Transportation is by truck.

Durham

DURHAM STONE AND GRAVEL LTD. (167)

This pit is at the southeastern edge of the town of Durham, in a kame-spillway complex. It is in lot 64, concession II, Glenelg township, Grey county.

Topsoil, 1–4 feet thick, is removed from the 6–30 feet of gravel; the gravel is underlain by clay (till?) that has a very irregular surface. The gravel content of the face varies from 25 to 100 percent; many large boulders are present, but the average size of the gravel is 2–3 inches. Pebbles are mostly rounded and ellipsoidal. Flat pebbles, clay, and silt are present, but the content is low. Bedding is horizontally stratified to massive, or in foresets indicating current from the northeast. The water-table is at the pit floor in some places. Water from an artesian well is used for washing. A pebble count on 1½-inch crushed stone indicates the following assemblage: dolomite; limestone; chert; basic igneous rocks; and metasedimentary rocks.

A ¾-yard Koehring shovel loads gravel into two 10-ton trucks for hauling to the plant. The gravel first passes over a 1-deck Dillon 3- by 8-foot inclined vibrating 2-inch screen. Oversize goes to a Dorr 11- by 36-inch jaw crusher and then, with the undersize, goes to a 2-deck Dillon 4- by 8-foot inclined vibrating screen. Coarse material goes through a Pioneer 18- by 30-inch roll crusher and is recirculated through the last screen unit. Fines go to a scrubber, then through a 2-deck Dillon 4- by 12-foot inclined vibrating screen, and to stockpiles; fines from this screen go to a paddle classifier, then to a concrete-sand stockpile.

The plant capacity is 140 tons per hour in a 10 hour day. Shipment is by truck, and by rail (CPR and CNR).

Meaford

JUNIPER EXCAVATING (168)

Gravel is obtained from a raised beach ridge just south of highway No. 26, two miles west of Meaford, St. Vincent township, Grey county. The beach is a deposit of glacial Lake Algonquin, which existed 10,000 to 12,000 years ago.

Overburden (soil) is 2–4 feet thick on 15–20 feet of gravel that overlies red thin-bedded clay and silt. Ninety-five percent of the pit face is gravel whose maximum size is 12 inches; the minimum is 1 inch, and the average is 3 inches. Pebbles are well-rounded, and have tabular to discoid shapes. About 90 percent of the pebbles are flat. There is good beach imbrication of the pebbles in the beds, which arch with an axis north-south, parallel to the surface of the beach ridge. The pit has been excavated to the water-table. Washing water is obtained from a pond. A pebble count on 1-inch crushed stone indicates the following assemblage: dolomite; limestone; calcareous siltstone; and granitic rocks.

Equipment in the pit includes a ¾-yard Garwood 75B dragline, a D-4 Caterpillar front-end loader, an American ¾-yard backhoe, and two D-7 bulldozers. Three 4-ton trucks haul to a Universal 880 Senior R portable crusher and a Pioneer rotary screen washer. Plant capacity is 100 tons per hour for a 10-hour day. Shipment is by truck.

WATERLOO COUNTY

Kitchener

FORWELL LIMITED (163)

The pit is on the east side of the Grand River and 1 mile south of highway No. 7, in lot 115, Waterloo township, Waterloo County. The gravel is a spillway deposit formed by meltwater flowing southward down the Grand River valley. The deposit is quite extensive.

Topsoil, 1–2 feet thick, is stripped to reveal about 10 feet of gravel that overlies quicksand. About 80 percent of the pit face is gravel that has a maximum size of 10 inches, a minimum of ½ inch, and an average of 2 inches. Pebbles are subrounded to well-rounded, and have tabular to ellipsoidal shapes. Silt and clay content is low, and flat pebbles constitute less than 5 percent. Only slight cementation is present. A pebble count on a face sample shows the following assemblage: dolomite; limestone; siltstone; chert; granitic rocks; basic igneous rocks; metamorphic rocks; and arkose.

Gravel is excavated by a 1½-yard Bucyrus-Erie shovel and is hauled by two 22-ton trucks to a large permanent plant west of the Grand River. At the plant, the material is passed through a 2-deck 3- by 12-foot Cedarapids horizontal vibrating screen. Undersize is wash-screened on a 3-deck 4- by 12-foot Tyler inclined vibrating screen. The various sizes are stockpiled, except for the undersize, which is passed through a rake-type sand classifier to yield concrete sand.

Oversize from the 2-screen unit goes through a 4½-foot Symons cone crusher, then to a 1-deck 3- by 9-foot Cedarapids horizontal vibrating screen. From the 1-deck screen, material over 1 inch goes to a 3-deck Cedarapids 4- by 12-foot horizontal vibrating screen and then to stockpiles; from this same 3-deck screen, undersize goes to a Stevens and Adamson 4- by 6-foot cylindrical turning screen, then to stockpiles; undersize from the turning screen goes to the rake classifier as concrete sand. The plant is rated at 140 tons per hour on a 10-hour day. Transportation from the plant is by truck.

WARREN BITUMINOUS PAVING CO. LTD. (166)

This pit is in lot 133, Waterloo township, Waterloo county, or about 6 miles west of Williamsburg. The deposit is a buried kame that is in the Waterloo moraine. It has an age of about 14,000 years.

Overburden is a brown silt till, low in pebbles, and 0–20 feet thick, which can most likely be correlated with the Port Stanley drift of Cary age. About 40 feet of gravel has been so far exposed in two levels, but a well that was drilled for washing passed through 200 feet of gravel. The water-table is at a considerable depth. About 80 percent of the face is gravel having a maximum size of 4 inches, a minimum of ½ inch, and an average of 1 inch. Pebbles vary from tabular to ellipsoidal, and from subangular to rounded. Flat pebbles and silt and clay are present, but the content is very low. There is minor cementation in the gravel. A pebble count on a face sample shows the following assemblage: dolomite; limestone; siltstone; chert; metasedimentary rocks; and basic igneous rocks.

Excavation in the pit is by a 1¼-yard Dominion shovel, and three 8-ton trucks haul to a Cedarapids portable crushing unit. The crusher-run then goes to a 2-deck Niagara 4- by 12-foot inclined vibrating screen, and to bins, except for sand which is passed through a rake classifier to make concrete sand. The plant yields 180 tons per hour in a 10-hour day. Transportation is by truck.

E. AND E. SEEGMILLER, (FAYE PIT) (190)

This pit is 1 mile north of highway No. 7, on Maryhill Road (east of Breslau) in Waterloo county. The deposit is in a spillway in the Guelph drumlin field.

The 12-foot face reveals 1–2 feet of soil on top of material of which 90 percent is gravel that ranges in size between 12 inches and ½ inch, and averages 2–3 inches. Pebbles are subangular to well-rounded, and tabular to ellipsoidal. Flat pebbles and silt and clay are present, but content is low. A pebble count on a face sample indicates the following assemblage: dolomite; limestone; siltstone; and metamorphic rocks.

A 1½-yard Bucyrus-Erie and a 1-yard Koehring shovel are used in the pit. The plant is a portable Cedarapids Commander crusher. Transportation is by truck.

Preston

MARTINI SAND AND GRAVEL LIMITED (164)

This operation is in lot 5, concession I, Beasley's Lower Block, in Waterloo township, Waterloo county. The deposit is an extensive gravel terrace forming part of the Speed River spillway, which carried glacial meltwaters from the northeast. The pit is just east of Preston and south of the Speed River.

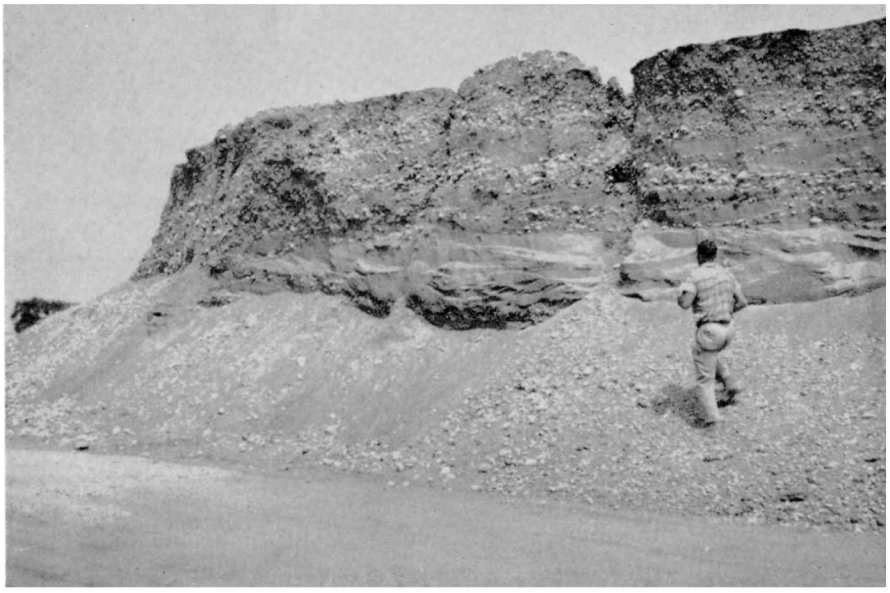
Overburden is 1–2 feet thick (topsoil) and overlies at least 25 feet of gravel. The 12-foot face is 60 percent gravel that has a maximum size of 6 inches, a minimum of ½ inch, and an average of 2 inches. Clay, silt, and flat pebbles are present only in very small amounts. Bedding is mostly horizontal, with minor cross-bedding and channelling, particularly in the sands. The water-table is more than 25 feet from the surface. A pebble count on a face sample indicates the following assemblage: dolomite; limestone; siltstone; chert; sandstone; granite; and metasedimentary rocks.

The pit is worked by a ¾-yard P&H and a Lorrain ½-yard shovel. Haulage is by 8-yard trucks to the plant. The plant consists of a Pioneer jaw crusher that feeds through a 2-inch screen. Oversize goes to a roll crusher. Undersize goes over a 3-deck Tyler screen where water is applied and the sand goes into an Eagle washer. The products then go to stockpiles. Shipping is by truck. Plant capacity is 100–110 tons per hour in a 9-hour day.

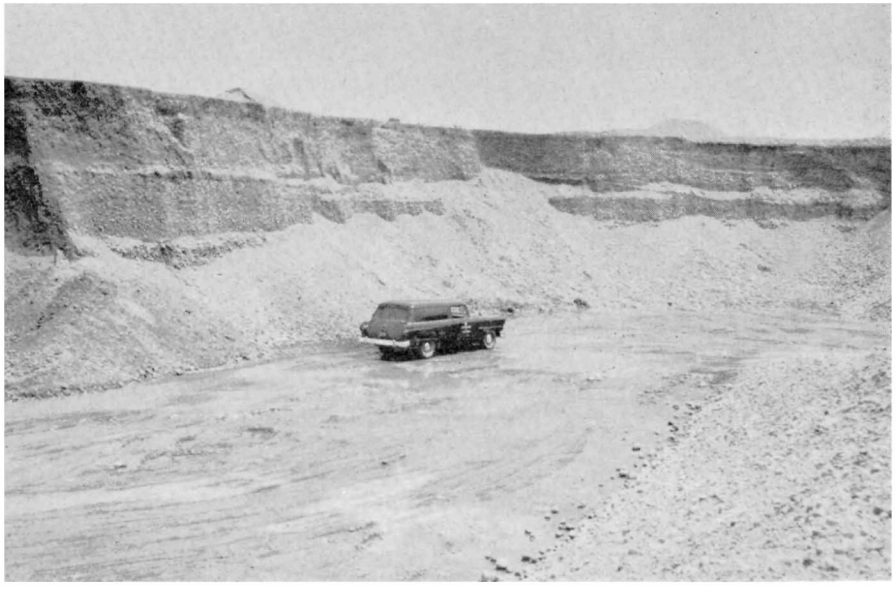
PRESTON SAND AND GRAVEL COMPANY LIMITED (165)

Preston Sand and Gravel is in lot 5, Town of Preston, Waterloo county.

About 2 feet of topsoil is stripped off the gravel, which is more than 20 feet thick. The face is 75



Spillway gravel; Martini Sand and Gravel Limited, Preston.



Uniform stratified gravel; Preston Sand and Gravel, Preston.

Processing plant of Consolidated Sand and Gravel Limited (West Paris).

percent gravel whose maximum size is 10 inches; the minimum is ½ inch, and the average is 2 inches. Pebbles are subangular to well-rounded, and tabular to ellipsoidal. The pit floor is at the water-table. A pebble count on a face sample shows the following assemblage: dolomite; limestone; black shale; chert; siltstone; basic igneous rocks; and metasedimentary rocks.

A 1-yard Lima shovel is operated in the pit; one 10-yard and one 5-yard diesel truck haul the gravel to the plant. The gravel is taken through a 2-deck Seco inclined 4- by 12-foot vibrating screen. Gravel under ¾-inch size is run through a 3-deck Seco inclined 4- by 12-foot vibrating screen, then goes to stockpiles, except for sand which first must go through an Eagle 5-valve settling tank and an Eagle sand washer. This gravel product is 100 percent round gravel.

Oversize from the first screen passes through an 18- by 36-inch Rogers jaw crusher, then through a 4- by 8-foot Seco ¼-inch inclined vibrating screen. Fines go to a screenings bin, and oversize goes through a 3-deck Seco 4- by 12-foot screen unit; all but the oversize goes to stockpiles. The oversize goes through a 42- by 24-inch Rogers roll crusher, then is recirculated through the 3-deck screen. This gravel is 100 percent crushed gravel.

The plant capacity is 200 tons per hour in a 10½-hour day. Transportation is mainly by truck, although a little-used (CNR) siding is also present.

BRANT COUNTY

Paris

CONSOLIDATED SAND AND GRAVEL LIMITED (174) (West Paris)

A large pit is operated at the west edge of Paris in lot 34, concession I, South Dumfries township, Brant county. The deposit is part of the very extensive Grand River spillway system that carried glacial meltwaters during the formation of the Paris and Galt moraines during the Mankato or Port Huron ice-advance. It has an age of about 13,000 years.

Overburden (topsoil) is 3–4 feet thick. Under the gravel is a red clay till (possibly the Port Stanley drift). A 30-foot face is 90 percent gravel ranging in size between 10 inches and ½ inch, and averaging 3–4 inches. Production over the years has been 55 percent gravel, however. The pebbles are subrounded to well-rounded, and tabular to ellipsoidal. Clay and silt constitute less than 5 percent; flat pebbles constitute about 5 percent of the gravel. The pit floor is at the water-table. The composition of 1-inch crushed stone is: dolomite; limestone; siltstone; sandstone; chert; granitic rocks; and metamorphic rocks.

Gravel is excavated by a 3½-yard Lima shovel and is hauled to the plant by conveyor belts. It passes through a 2-deck Tyler 5- by 12-foot screen, and the oversize goes to a 4¼-foot Nordberg Standard cone crusher. Undersize goes through a

Grand River spillway gravel, Consolidated Sand and Gravel Limited (East Paris).

3-deck Tyler 4- by 14-foot screen, and oversize from this screen goes to a 4-foot Nordberg Standard crusher; material that passes the $\frac{3}{16}$-inch middle deck goes to a 3-deck Tyler 4- by 14-foot screen. The two crushed products go to a 3-deck Dillon 5- by 12-foot screen; oversize goes to a 4-foot Symons Shorthead cone crusher and is recirculated to the screen. The $\frac{1}{4}$-inch material from the middle deck goes to a 3-deck Tyler 4- by 14-foot screen. Fines are taken through a Dorr-Oliver 18-foot hydraulic classifier, a 6-inch hydraulic cyclone, and two 8- by 24-foot rake classifiers (DSH and DSFX). All products are then stockpiled by conveyor belt, a Marion 2-yard clam shovel, and a 2-yard Payloader.

Transportation is by truck and rail (CNR). Plant capacity is 500 tons per hour in a 10-hour day.

CONSOLIDATED SAND AND GRAVEL LIMITED (175) (East Paris)

This pit is on the east bank of the Grand River on a high spillway terrace of Mankato age. It is in lot 27, concession I, South Dumfries township, Brant county.

About 3 feet of overburden (topsoil) covers 30 feet of material of which 85 percent is gravel ranging in size between 12 inches and $\frac{1}{2}$ inch, and averaging 3–4 inches; average production has been 65 percent gravel. Pebbles are subrounded to well-rounded, and tabular to ellipsoidal. There is about 5 percent flat pebbles, and 5 percent silt and clay. The gravel overlies sand at the water-table. Some cementation of the gravel exists at the base of the pit. A pebble count on $1\frac{1}{2}$-inch crushed stone indicates the following assemblage: dolomite; limestone; siltstone; chert; sandstone; granitic rocks; basic igneous rocks; and metamorphic rocks.

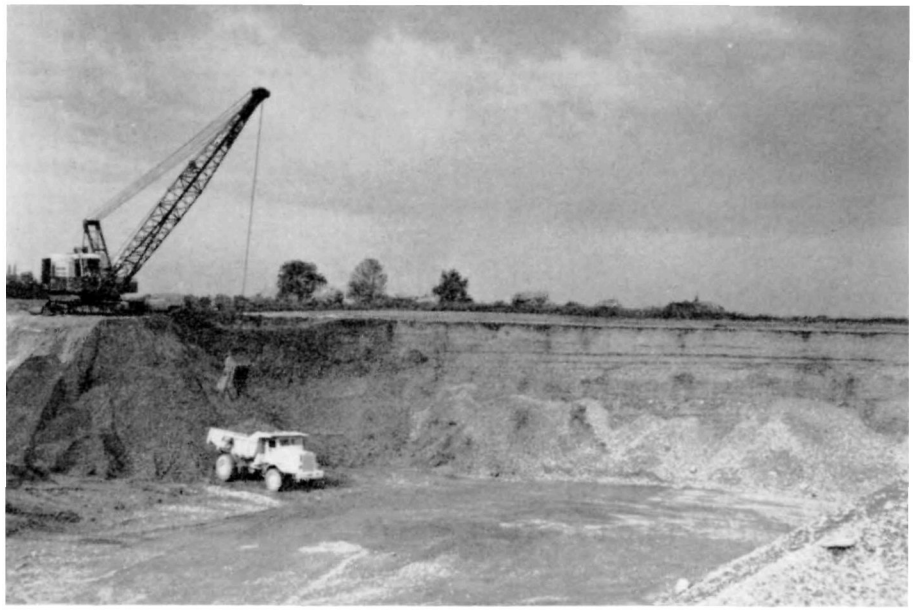
Gravel is removed by a Lima 4-yard shovel, and conveyor belts take it to the plant where it goes through a Nordberg $2\frac{1}{2}$-inch vibrating grizzly; oversize is taken to a 4-foot Traylor cone crusher, and undersize goes to a Nordberg 4- by 16-foot 1-deck screen; oversize goes to a 4-foot Symons Standard crusher, and undersize goes to a 3-deck Dillon 4- by 14-foot screen. From this, the sand goes to a Dorr-Oliver rake classifier and gravity sand cones, and the coarse material goes to a 1-deck Nordberg 4- by 16-foot screen. Oversize goes to a Symons 4-foot Shorthead cone crusher and is recirculated. The intermediate material goes to a Tyler 3-deck 4- by 14-foot screen. Water from the Grand River is used for washing.

The plant can produce 475 tons per hour in a 22-hour day. Shipment is by truck and rail (CNR and CPR).

Brantford

TELEPHONE CITY GRAVEL COMPANY LTD. (176)

This pit is operated in lot 20, concession III, Brantford township, Brant county, on the north



Uniform gravel in flat terrace of the Grand River spillway; Telephone City Gravel Company Limited, Brantford.

side of the Grand River and just west of Brantford. The deposit is a Grand River spillway terrace.

Overburden 2–10 feet thick, consisting of lacustrine silts and sand, overlies 50 feet of gravel; boulders and fine sand are below the gravel. The face is 95 percent gravel whose maximum size is 12 inches, minimum ½ inch, and average 2–3 inches. Pebbles are rounded to well-rounded, and tabular to ellipsoidal. Both silt and clay, and flat pebbles, are less than 5 percent. Bedding indicates that the currents were southerly. Some cementation is present. A pebble count on ¾-inch crushed stone indicates the following assemblage: dolomite; limestone; chert; siltstone; sandstone; granitic rocks; basic igneous rocks; and metamorphic rocks.

Excavation of the gravel is by a 2½-yard Ruston-Bucyrus 54 dragline. Haulage to the plant is by 3 Euclid 16-yard trucks and a 10-yard dump truck. Gravel is fed to a 1-deck Niagara inclined vibrating 5- by 12-foot screen that feeds oversize to a Pioneer 24- by 36-inch jaw crusher; material then goes to a 2-deck Tyrock 5- by 12-foot inclined vibrating screen. Oversize goes to a 4-foot Nordberg Standard cone crusher and middlesize goes to a 3-foot Nordberg crusher; crushed products are combined with undersize to go to a 1-deck Tyler 5- by 10-foot inclined vibrating screen. Oversize returns to the 3-foot cone crusher, and undersize goes to a 2-deck Niagara 5- by 12-foot inclined vibrating screen, and then to stockpiles.

Undersize from the primary screen goes to a scrubber and 4-valve settling tank. Coarse material from the scrubber is sorted on a Spartan 2- by 4-foot horizontal vibrating screen. Fines from the settling tank go to gravity sand cones. River water is used for washing.

Stockpiling is handled by a 2-yard Lima 802 shovel and 2 Payloaders (3- and 3½-yard).

Plant capacity is 400 tons per hour in a 12-hour day. Transportation is by truck and rail (CPR).

FLINTKOTE COMPANY OF CANADA LIMITED (177)

Gravel is obtained from a pit in lot 18, concession II, Brantford township, Brant county, about halfway between Paris and Brantford. The deposit is in the Grand River spillway terrace.

A 30-foot face exposes overburden 4–10 feet thick (lacustrine silts) over material of which 95 percent is gravel ranging in size between 12 inches and ½ inch, and averaging 3–4 inches. Sand and cemented gravel are below the pit. Pebbles are subrounded to well-rounded, and tabular to spheroidal. Flat pebbles, and silt and clay, are present in only small amounts. Bedding shows that the currents were south-flowing in the depositing stream. The water-table is 18 feet below the floor of the pit. A pebble count on 1-inch size indicates the following assemblage: dolomite; limestone; siltstone; granitic rocks; and metamorphic rocks.

Gravel is removed by a 1¼-yard Dominion shovel and is hauled to the plant by two 15-ton

Euclids. There, it passes through a 12- by 13-inch grizzly then to a 2-deck screen. Oversize and middlesize are crushed separately and recirculated; fines go to a watering unit. Passing through a 2-deck screen, fines are dewatered, and all products are stockpiled. Stockpiling is done by a ¾-yard P&H shovel, a 4-yard Michigan loader, three 15-ton Euclids, and a 3¼-yard Pettibone-Mulligan loader. River water is used for washing. Transportation is by rail (CPR, CNR) and trucks.

BROWN SAND AND GRAVEL (178)

A gravel pit is operated in lot 23, concession IV, Brantford township, Brant county, on the west side of the Grand River. The deposit consists of lower terrace gravels of the Grand River formed some time after 12,000 years ago.

Gravel is 15–30 feet thick, covered by 1–4 feet of overburden (topsoil). Stratified clay and silt underlie the gravel. Ninety percent of the deposit is gravel ranging in size between 24 inches and ½ inch, and averaging 3 inches. Pebbles are subangular to well-rounded, and tabular to ellipsoidal. Flat pebbles constitute about 5 percent of the gravel, but clay and silt are present only in small amounts. A pebble count on ¾-inch crushed indicates the following assemblage: dolomite; limestone; siltstone; sandstone; granitic rocks; basic igneous rocks; and metasedimentary rocks.

Gravel is hauled by a 6-yard truck to a 2-deck screen. Oversize goes to an Eagle impact breaker, then to a 2-deck screening unit. All products are stockpiled by conveyor belt and a 1-yard Case 5200 Powerloader. The plant can produce 100 tons per hour in a 10-hour day. Transportation is by truck.

DAIKEN SAND AND GRAVEL LIMITED (179)

Daiken obtains gravel from lot 14, concession V, Brantford township, Brant county, just south of highway No. 53 in a deltaic-spillway deposit.

Soil is 3–4 feet thick on top of more than 20 feet of a deposit of which 30–90 percent is gravel having a range in size from 6 inches to ½ inch, and an average of 3–4 inches. Pebbles are rounded, and tabular to ellipsoidal. Flat pebbles, and silt and clay, are present only in small amounts. Bedding and imbrication indicate current from the north. A count on ¾-inch crushed gravel indicates the following assemblage: dolomite; limestone; siltstone; chert; granitic rocks; basic igneous rocks; and metamorphic rocks.

Most equipment is rented. Shovels (Lima ¾-yard, and Linkbelt 1¼-yard) feed a portable Cedarapids crusher and a portable screening unit. Stockpiling is by a Michigan 175A loader, and one 5-yard and three 10-yard trucks. The plant can produce 100 tons per hour. Products are shipped by truck.

Harley

BURFORD SAND AND GRAVEL (180)

This pit is in lot 6, concession VIII, Burford township, Brant county, in a gravel outwash or spillway deposit.

Overburden (topsoil) is 2 feet thick above 30 feet of gravel that is mostly under water. A low face is about 50 percent gravel that is irregularly distributed; the size ranges between 4 inches and ¼ inch, and averages 1 inch. Pebbles are subrounded to well-rounded, and tabular to ellipsoidal. Flat pebbles, and clay and silt, are present only in small amounts. Cementation exists below the water-table. The gravel (¾-inch) contains: dolomite; limestone; chert; cemented gravel; granitic rocks; and metamorphic rocks.

A dragline recovers gravel that lies under water, then loads two 5-yard trucks for hauling to the plant (a Woodstock screener). Stockpiling is done by an NCK ¾-yard Koehring shovel, and 2 Ford tractors (⅓-yard and ½-yard loaders). Transportation is by truck.

NORFOLK COUNTY

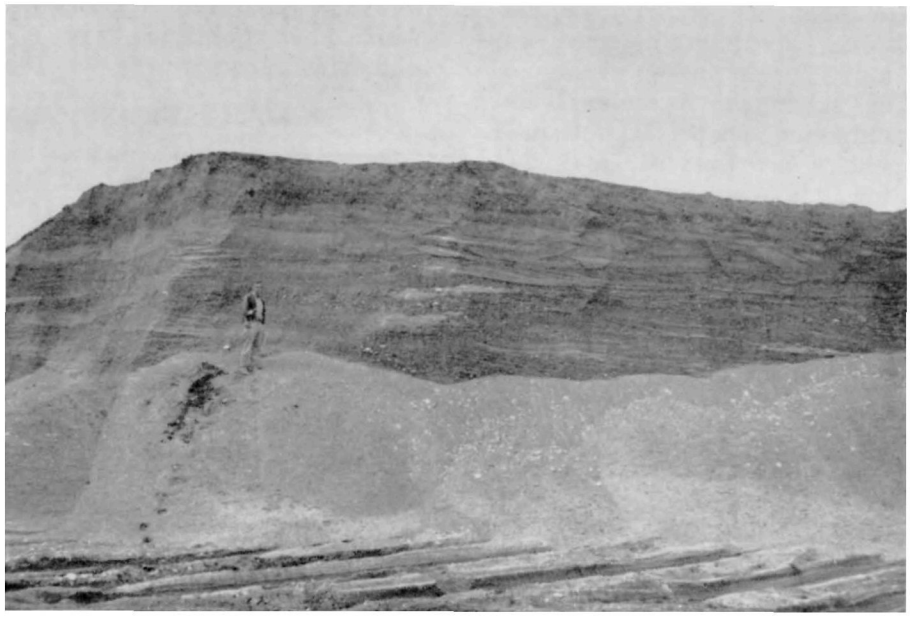
Waterford

WATERFORD SAND AND GRAVEL (181)

A deposit, which may be of outwash origin, is worked in lot 3, concession VII, Townsend township, Norfolk county. It is a short distance west of the Galt moraine.

The deposit is below the water-table; it is 15 feet thick but gets thicker southward. Overburden is 2 feet thick (soil), and purple clay underlies the gravel. The deposit is 20 percent gravel ranging in size between 12 inches and ¼-inch, and averaging 2 inches. Flat pebbles constitute 5 percent of the gravel; silt and clay constitute under 5 percent. Pebbles are subangular to rounded, and tabular to ellipsoidal. One-inch crushed stone has the following composition: dolomite; limestone; siltstone; chert; green shale; and metasedimentary rocks.

A ¾-yard Unit shovel and a 1-yard Dominion dragline load two 6-yard trucks for haulage to the plant. There, gravel passes through a grizzly to a 2-deck screen. Oversize and middlesize go to an Allis-Chalmers cone crusher and are recirculated. Fines go to a 2-deck Dillon washer and screener. Fines from this unit pass through an Eagle dewatering screw, and go by conveyor belt to the stockpile. Transport is by truck.



Speed River spillway gravel; Guelph Sand and Gravel Limited, Guelph.

ROBERTSON SAND AND GRAVEL LIMITED (182)

This pit is in the same deposit as Waterford Sand and Gravel; it is in lot 4, concession VIII, Townsend township, Norfolk county.

There is about 40 feet of material below the water-table, and this is overlain by 4–7 feet of stratified silts. Gravel ranges in size between 12 inches and ½ inch, and averages 2 inches. Flat pebbles, and silt and clay, each constitute 5 percent. A sand pit on the same property shows stream imbrication with current to the south. A count on 1-inch crushed gravel indicates the following assemblage: dolomite; limestone; siltstone; green shale; chert; cemented gravel; sandstone; granitic rocks; basic igneous rocks; and metasedimentary rocks.

A 1½-yard Linkbelt shovel loads gravel into two 5-yard trucks. Gravel goes through a New Holland roll and jaw crusher, is trucked to a screening plant where it goes through a 2-deck Dillon screen, and is then stockpiled. The stockpile is worked by a TD18 bulldozer, a TD6 one-yard front-end loader, and a TD14 1½-yard front-end loader. Products are shipped by truck.

The sand pit is worked by a Niagara screen and portable loader.

A. WALKER (183)

The Walker pit is in the same deposit as Waterford Sand and Gravel. It is in lot 3, concession IX, Townsend township, Norfolk county.

Soil, 3–4 feet thick, overlies more than 20 feet of material of which 20 percent is gravel ranging in size between 6 inches and ¼ inch, and averaging 1 inch. Flat pebbles are scarce, but silt and clay constitute about 5 percent of the material. Pebbles are blocky to discoid. The gravel is under water. A pebble count on 1-inch crushed stone indicates the following assemblage: dolomite; limestone; chert; granitic rocks; metasedimentary rocks.

A ⅜-yard Bucyrus-Erie dragline loads a 6-yard truck for haulage to a 2-deck screen. Stockpiling is by a Ferguson ½-yard front-end loader and a Hough 3-yard Payloader. Shipment is by truck.

WELLINGTON COUNTY

Guelph

GUELPH SAND AND GRAVEL LIMITED (161)

This operation is in Wellington county, on the west edge of the city of Guelph, and north of the Speed River and highway No. 24, in Guelph township, lot 2, concession I, Division E, and lot 21, Division A. The pit is in a gravel terrace deposited by glacial meltwater that flowed southwest down the Speed Valley. The terrace is about equivalent in age to the Paris moraine, which is about 13,000 years old.

Overburden is 2–3 feet thick, consisting of topsoil. Gravel thickness averages 17 feet, and overlies dolomite bedrock or clay (probably till). The water-table lies a few feet above the underlying stratum.

The deposit is an extensive sheet of gravel along the Speed Valley; the depositing stream flowed

from the northeast. About 25 percent of the material is gravel that has a maximum diameter of 6 inches, a minimum of ¼ inch, and an average of 2 inches. Pebbles are subangular to rounded, and have tabular to ellipsoidal shape. Less than 5 percent of the pebbles are flat; silt and clay contents are very low. There are some cut-and-fill channels in the beds, but they are shallow. A pebble count shows the following assemblage: dolomite; limestone; siltstone; sandstone; granitic rocks; basic igneous rocks; and metamorphic rocks.

The gravel is excavated by a 1¾-yard Lorrain L-80 shovel and a 2-yard Koehring 605 dragline and is hauled to the plant by 4 trucks.

A large permanent plant consists of a 2-deck Dillon inclined 4- by 10-foot vibrating screen; material larger than 2½ inches goes to a Sawyer Massey 9- by 40-inch jaw crusher, material 1 inch to 2½ inches goes to a Symons 3-foot cone crusher, and the fines go to a surgepile. Crushed rock passes over a 5- by 14-foot 3-deck Dillon vibrating screen, and the oversize goes to a Symons 2-foot cone crusher; this also goes to the surgepile. From the surgepile, material passes over a 3-deck 5- by 14-foot Dillon inclined vibrating screen and then to stockpiles; the sand fraction is treated by a 60-inch Wemco dewatering screw. The plant works a double shift producing 5,500–6,000 tons daily.

Stockpiling is handled by a Northwest M-6 with a clamshell bucket and by two 2-yard loaders (Hough and Caterpillar). Products are shipped by truck and rail (CNR).

Guelph Sand and Gravel operates an asphalt plant; other companies have readymix and concrete block plants nearby.

MARDEN SAND AND GRAVEL (162)

Gravel is being removed from a pit in Wellington county 1 mile southwest of Marden in Guelph township, lot 14, concession III, Division D. The deposit is irregular, consisting of outwash filling low areas between drumlins. Its extent is not known.

The overburden is 2 feet of topsoil. Clay(till?) underlies the gravel 10–15 feet from the surface. The 10-foot face is 70 percent gravel having a maximum size of 6 inches, a minimum of ¼ inch, and an average of about 1 inch. Sand is concentrated about halfway up the face. Pebbles are subangular to well-rounded and tabular to ellipsoidal. Flat pebbles constitute less than 5 percent, and the silt and clay content is very low. A pebble count shows the following assemblage: dolomite; limestone; grey shale; granitic rocks; basic igneous rocks; and metamorphic rocks.

The pit is worked by a Lorrain ¾-yard shovel and a Bucyrus-Erie ¾-yard dragline. Two 5-yard and one 6-yard trucks haul the gravel to a small permanent plant where it is passed over a 1-inch inclined vibrator screen. Undersize is shipped by rail (CNR). Oversize goes to a Cedarapids 1036 jaw crusher, then over a 3-deck homemade vibrator screen. Oversize from this (over ¾-inch) goes to a Cedarapids roll crusher. Products are then stockpiled. Production is rated at 200–300 yards per day.

APPENDIX

Sand and Gravel Pits Not Described Elsewhere in the Report

The two following pages list sand and gravel operations not described elsewhere in this report. Twenty-seven of the operations are in south-central and south-eastern Ontario, and thirty-one are in southwestern Ontario. The bracketed numbers following the name of the company or operation refer to the locations shown on map No. 2038.

SOUTH-CENTRAL AND SOUTHEASTERN ONTARIO

Halton County
- Campbellville
  - Campbellville Gravel Supply Ltd. (*not on map*)

Simcoe County
- Barrie
  - Mel Browning (280)
  - Frank Griffin Haulage (265)
- Orillia
  - Albert Strachen (279)
- Creemore
  - Harold Martin Construction Ltd. (298)
- Collingwood
  - Collingwood Sand and Gravel (288)

York County
- Scarborough
  - Highland Creek Sand and Gravel Ltd. (232)

Ontario County
- Brougham
  - Cooper Concrete Supply Ltd. (71)
- Goodwood
  - Norton Sand and Gravel (273)

Durham County
- Pontypool
  - Geo. A Jackson (284)

Peterborough County
- Peterborough
  - W. Hargreaves (274)

Northumberland County
- Baltimore
  - Toyne and Son (277)
- Colborne
  - J. G. Eagleson (264)

Lennox and Addington County
- Odessa
  - Sharpe Brothers (276)

Lanark County
- Smiths Falls
  - Smith Construction Co. (282)
  - R. Lightbody (278)

Renfrew County
- Pembroke
  - H. J. McFarland Construction Co. (272)

Carleton County
- Ottawa
  - R. R. Foster and Sons Ltd. (285)

Grenville County
- Kemptville
  - S. A. Price (275)
  - South Mountain Construction Co. Ltd. (220)
- Prescott
  - R. W. Meyers (281)
  - Stewart and Broad Construction Co. (283)

District of Muskoka
- Gravenhurst
  - Coon Brothers (266)
  - A. R. Ferguson (267)
- Bracebridge
  - C. D. Lawrence (269)
  - R. Hammell (270)
  - Patterson Pit (271)

SOUTHWESTERN ONTARIO

Essex County
- Leamington
  - Erie Sand and Gravel Co. (291)

Kent County
- Ridgetown
  - Huron Construction Co. Ltd. (294)
  - Huron Construction Co. Ltd. (295)

Elgin County
- Bothwell
  - Huron Construction Co. Ltd. (293)
  - W. J. Wright (302)

Lambton County
- Grand Bend
  - Patterson Brothers (299)
  - L. H. Turnbull and Son (315)
- Sarnia
  - Carl West Sand and Gravel (300)
- Wyoming
  - Barnes Gravel Supplies (286)

Middlesex County
- London
  - Ridley Construction (311)
  - F. A. Stonehouse (313)
  - Carpenter Sand and Gravel (287)
  - Jack Lake Construction Ltd. (308)

Oxford County
- Woodstock
  - A. F. Hamilton (303)
  - Cecil S. Keyes (296)
  - Gordon Wiseman Ltd. (301)
- Tillsonburg
  - John N. Corbett Gravel Supply (305)
  - Edwin Nichols Gravel Supply (306)
- Embro
  - R. A. Conway (289)

Huron County
- Goderich
  - Huron Concrete Supply Ltd. (240)
  - Huron Concrete Supply Ltd. (241)
  - Lavis Contracting Co. Ltd. (242)
- Wingham
  - Joseph E. Kerr (307)

Bruce County
- Kincardine
  - B. McCue (310)

Perth County
- Stratford
  - Langdon Manufacturing Co. (309)

Waterloo County
- Elmira
  - E. S. Hoffer and Sons (292)
- Kitchener
  - Schneider Sand and Gravel (312)
- Preston
  - Lasby Sand and Gravel (304)
  - Angelstone Ltd. (297)

Brant County
- Oakland
  - R. L. Strickler (314)

Norfolk County
- Simcoe
  - Cookson Construction Ltd. (290)

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Index

Industrial Mineral Report No. 11

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Map 2041
Shale in Gravels

LEGEND

PALEOZOIC

MISSISSIPPIAN

- 20 — Port Lambton Formation: black shale.

DEVONIAN

- 19 — Kettle Point Formation: black shale.
- 18 — Hamilton Formation: grey shale and limestone.
- 17 — Delaware Formation: limestone and dolomite.
- 16 — Columbus Formation: sandy limestone and dolomite.
- 15 — Detroit River Group: limestone and dolomite.
- 14 — Bois Blanc Formation: cherty limestone.
- 13 — Oriskany Formation: sandstone.

SILURIAN

- 12 — Bertie-Akron Formation: dolomite.
- 11 — Salina Formation: dolomite, shale, gypsum, salt.
- 10 — Guelph-Lockport-Amabel Formations: dolomite, Ancaster chert beds.
- 9 — Clinton and Cataract Groups: sandstone, shale, dolomite.

ORDOVICIAN

- 8 — Queenston Formation: red shale.
- 7 — Meaford-Dundas and Blue Mountain (Carlsbad and Russell*) Formations: grey shale.
- 6 — Collingwood (Billings*) Formation: grey and black shale.
- 5 — Trenton and Black River Groups: limestone.
- 4 — Chazy Group: limestone and shale.
- 3 — Beekmantown Group: dolomite, sandstone.

CAMBRO-ORDOVICIAN

- 2 — Potsdam or Nepean Formation: sandstone.

PRECAMBRIAN

- 1 — Precambrian rocks.

*Formations in Ottawa area.

SOURCES OF INFORMATION

Compilation by D. F. Hewitt and P. F. Karrow, 1961, 1962.

Cartography by A. Sedlmaier, Ontario Department of Mines, 1963.

Base map derived from Map 1957A, Ontario Department of Mines.

Billings, Carlsbad, Queenston and Russell shales

Collingwood shale

Meaford-Dundas and Blue Mountain shales

Queenston shale

Kettle Point, Hamilton and Port Lambton shales

5-10 Percentage of shale in gravel.

ONTARIO
DEPARTMENT OF MINES
HON. G. C. WARDROPE, *Minister of Mines*
D. P. Douglass, *Deputy Minister* M. E. Hurst, *Director, Geological Branch*

Map 2041
Distribution of Shale in Gravels of Southern Ontario

Scale 1:1,013,760 or 1 Inch to 16 Miles

50 0 10 20 30 40 50 60 Miles
20 0 20 40 60 80 Kilometres

Published 1963

Map 2038
Sand and Gravel Pits

ONTARIO
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Map 2038
Sand and Gravel Pits in Southern Ontario

Scale 1:1,013,760 or 1 Inch to 16 Miles

10 0 10 20 30 40 50 60 Miles
20 0 20 40 60 80 Kilometres

LEGEND

- *Kame moraines.*
- *Spillways.*
- *Eskers.*
- *Abandoned beaches and shorelines.*

SOURCES OF INFORMATION

Compilation by D. F. Hewitt and P. F. Karrow, 1961, 1962.

Glacial features after L. J. Chapman and D. F. Putnam, "Physiography of Southern Ontario", University of Toronto Press, 1951.

Cartography by A. Sedlmaier, Ontario Department of Mines, 1962.

Base map derived from Map 1957A, Ontario Department of Mines.

INDEX OF SAND AND GRAVEL OPERATORS AND PITS

Published 1963

LEGEND

PALEOZOIC

MISSISSIPPIAN

20 — *Port Lambton Formation: black shale.*

DEVONIAN

19 — *Kettle Point Formation: black shale.*

18 — *Hamilton Formation: grey shale and limestone.*

17 — *Delaware Formation: limestone and dolomite.*

16 — *Columbus Formation: sandy limestone and dolomite.*

15 — *Detroit River Group: limestone and dolomite.*

14 — *Bois Blanc Formation: cherty limestone.*

13 — *Oriskany Formation: sandstone.*

SILURIAN

12 — *Bertie-Akron Formation: dolomite.*

11 — *Salina Formation: dolomite, shale, gypsum, salt.*

10 — *Guelph-Lockport-Amabel Formations: dolomite. Ancaster chert beds.*

9 — *Clinton and Cataract Groups: sandstone, shale, dolomite.*

ORDOVICIAN

8 — *Queenston Formation: red shale.* †

7 — *Meaford-Dundas and Blue Mountain (Carlsbad and Russell*) Formations: grey shale.* †

6 — *Collingwood (Billings*) Formation: grey and black shale.* †

5 — *Trenton and Black River Groups: limestone.*

4 — *Chazy Group: limestone and shale.*

3 — *Beekmantown Group: dolomite, sandstone.*

CAMBRO-ORDOVICIAN

2 — *Potsdam or Nepean Formation: sandstone.*

PRECAMBRIAN

1 — *Precambrian rocks.*

*Formations in Ottawa area.

† Siltstone bearing shales

0-5 — Percentage of siltstone in gravel.

SOURCES OF INFORMATION

Compilation by D. F. Hewitt and P. F. Karrow, 1961, 1962.

Cartography by A. Sedlmaier, Ontario Department of Mines, 1962.

Base map derived from Map 1957A, Ontario Department of Mines.

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Map 2040
Distribution of Siltstone in Gravels of Southern Ontario

Scale 1:1,013,760 or 1 Inch to 16 Miles

10 0 10 20 30 40 50 60 Miles
20 0 20 40 60 80 Kilometres

Published 1963

LEGEND

PALEOZOIC

MISSISSIPPIAN

30 — *Port Lambton Formation: black shale.*

DEVONIAN

19 — *Kettle Point Formation: black shale.*

18 — *Hamilton Formation: grey shale and limestone.*

17 — *Delaware Formation: limestone and dolomite.*

16 — *Columbus Formation: sandy limestone and dolomite.*

15 — *Detroit River Group: limestone and dolomite.*

14 — *Bois Blanc Formation: cherty limestone.*

13 — *Oriskany Formation: sandstone.*

SILURIAN

12 — *Bertie-Akron Formation: dolomite.*

11 — *Salina Formation: dolomite, shale, gypsum, salt.*

10 — *Guelph-Lockport-Amabel Formations: dolomite, Ancaster chert beds.*

9 — *Clinton and Cataract Groups: sandstone, shale, dolomite.*

ORDOVICIAN

8 — *Queenston Formation: red shale.*

7 — *Meaford-Dundas and Blue Mountain (Carlsbad and Russell*) Formations: grey shale.*

6 — *Collingwood (Billings*) Formation: grey and black shale.*

5 — *Trenton and Black River Groups: limestone.*

4 — *Chazy Group: limestone and shale.*

3 — *Beekmantown Group: dolomite, sandstone.*

CAMBRO-ORDOVICIAN

2 — *Potsdam or Nepean Formation: sandstone.*

PRECAMBRIAN

1 — *Precambrian rocks.*

*Formations in Ottawa area.

SOURCES OF INFORMATION

Compilation by D. F. Hewitt and P. F. Karrow, 1961, 1962.

Cartography by A. Sedlmaier, Ontario Department of Mines, 1962.

Base map derived from Map 1957A, Ontario Department of Mines.

44/0 / 23 — % Limestone/% Dolomite / % Precambrian

ONTARIO
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Map 2039
Distribution of Limestone, Dolomite and Precambrian Pebbles in Gravels of Southern Ontario

Scale 1:1,013,760 or 1 Inch to 16 Miles

10 0 10 20 30 40 50 60 Miles
20 0 20 40 60 80 Kilometres

Published 1963

Map 2042
Chert in Gravels

LEGEND

PALEOZOIC

MISSISSIPPIAN

20 — *Port Lambton Formation: black shale.*

DEVONIAN

19 — *Kettle Point Formation: black shale.*

18 — *Hamilton Formation: grey shale and limestone.*

17 — *Delaware Formation: limestone and dolomite.*

16 — *Columbus Formation: sandy limestone and dolomite.*

15 — *Detroit River Group: limestone and dolomite.*

14 — *Bois Blanc Formation: cherty limestone†*

13 — *Oriskany Formation: sandstone.*

SILURIAN

12 — *Bertie-Akron Formation: dolomite.*

11 — *Salina Formation: dolomite, shale, gypsum, salt.*

10 — *Guelph-Lockport-Amabel Formations: dolomite. Ancaster chert beds.†*

9 — *Clinton and Cataract Groups: sandstone, shale, dolomite.*

ORDOVICIAN

8 — *Queenston Formation: red shale.*

7 — *Meaford-Dundas and Blue Mountain (Carlsbad and Russell*) Formations: grey shale.*

6 — *Collingwood (Billings*) Formation: grey and black shale.*

5 — *Trenton and Black River Groups: limestone.*

4 — *Chazy Group: limestone and shale.*

3 — *Beekmantown Group: dolomite, sandstone.*

CAMBRO-ORDOVICIAN

2 — *Potsdam or Nepean Formation: sandstone.*

PRECAMBRIAN

1 — *Precambrian rocks.*

*Formations in Ottawa area.

† Chert bearing formation

Minor occurrences of chert in bedrock formations

SOURCES OF INFORMATION

Compilation by D. F. Hewitt and P. F. Karrow, 1961, 1962.

Cartography by A. Sedlmaier, Ontario Department of Mines, 1962.

Base map derived from Map 1967A, Ontario Department of Mines.

5-10 Percentage of chert in gravel.

Ancaster chert beds

Cherty Bois Blanc limestone

ONTARIO
DEPARTMENT OF MINES

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D. P. Douglass, *Deputy Minister* M. E. Hurst, *Director, Geological Branch*

Map 2042
Distribution of Chert in Gravels of Southern Ontario

Scale 1:1,013,760 or 1 Inch to 16 Miles

10 0 10 20 30 40 50 60 Miles

20 0 20 40 60 80 Kilometres

Publishe 1963