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INDUSTRIAL MINERAL RESOURCES OF THE HAMILTON AREA

By

D. F. HEWITT

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ABSTRACT

This report on the Hamilton area is one of a series describing the industrial mineral resources of an area covered by a map of the National Topographic Series. The Hamilton area comprises the Hamilton National Topographic sheet extending between the latitudes 43°15' and 43°30'N and longitudes 79°35' and 80°00'W.

The southeastern part of the map-sheet is occupied by the west end of Lake Ontario. The Niagara Escarpment extends up the west side of the area from Dundas to the Milton Heights outlier. It is capped by Lockport and Amabel Dolomites which are quarried for crushed stone. Two of the largest crushed stone quarries in Ontario are near Dundas and Nelson on the Escarpment. Rocks of the Clinton and Cataract Groups lie beneath the Lockport or Amabel Dolomite in the face of the Escarpment and are exposed in several roadcuts in the Escarpment. The Whirlpool Sandstone, which is the basal member of the Silurian section in this area, does not outcrop extensively, but was once quarried at Waterdown for ganister and silica grit for iron foundries and steel plants.

Below the Whirlpool Sandstone lies the red Queenston Shale of Ordovician age, which is quarried for brick, tile and sewer pipe manufacture at Aldershot and Tansley. The Queenston Shale extends eastward from the base of the Niagara Escarpment to Oakville. Here along the lake shore the Meaford-Dundas Shale outcrops beneath the Queenston Shale.

There are spillway and kame gravels in the northwest part of the area between Campbellville and Kilbride. Farther south on the Escarpment west of Waterdown are extensive deposits of outwash sand. The major central part of the Hamilton sheet is till with rare coverings of stratified varved clay and silt.

The Lake Iroquois shoreline runs diagonally in a northeasterly direction across the map-area from two to three miles from the Lake Ontario shoreline. The Lake Iroquois shorecliff is mainly cut in Queenston Shale, but at the west end of Hamilton Harbour, the Aldershot and Hamilton bars have been built up. Some lacustrine sand occurs between the Lake Iroquois shoreline and the Lake Ontario shore.

There are few sand and gravel deposits in the area.

INDUSTRIAL MINERAL RESOURCES

OF THE HAMILTON AREA

By

D. F. Hewitt[1]

INTRODUCTION

This report on the Hamilton area is one of a series describing the industrial mineral resources of an area covered by a map of the National Topographic Series. The Hamilton area comprises the Hamilton National Topographic sheet (30 M/5) extending between latitudes 43°15' and 43°30'N and longitudes 79°35' and 80°00'W. This includes portions of the townships of Toronto, Trafalgar, Nelson, East Flamborough, West Flamborough, Ancaster, Barton and Saltfleet. The principal city and towns are Hamilton (283,345), Burlington (65,376), Oakville (52,560), and Dundas (15,178).

Overburden is of moderate thickness, and outcrops are abundant in some areas, particularly along the Niagara Escarpment, along the Lake Iroquois shoreline, and in the river valleys. The Niagara Escarpment extends up the west side of the map-area from Dundas to the Milton Heights outlier, and is the most noteworthy topographic feature of the area. On top of the Escarpment elevations range from 1,075 feet above sea level at the Milton Heights outlier to 750 feet in the vicinity of Dundas. At the foot of the Escarpment elevations average 600 feet in the north and 400 feet in the south giving a relief for the Escarpment of about 350 to 475 feet. The cap rock of the Escarpment from Dundas to approximately Waterdown is the Lockport Dolomite. Near Waterdown there is a facies change and the even-bedded, brown, aphanitic Lockport Dolomite is replaced by the Amabel Dolomite, a reefy, irregularly to massive-bedded, light-grey, fossiliferous, medium to coarsely crystalline dolomite. The Amabel Dolomite extends north from Waterdown to the northern limits of the map-area near Milton. The Lockport Dolomite is quarried near Dundas by Canada Crushed and Cut Stone Limited. The Amabel Dolomite is quarried two miles northwest of Nelson by King Paving & Materials Limited (Nelson Crushed Stone Division). There are inactive quarries at Clappisons Corners, Waterdown and Mount Nemo.

Rocks of the Clinton and Cataract Groups lie beneath the Lockport or Amabel Dolomite in the face of the Escarpment, and are exposed in road cuts cutting the Escarpment. These formations, with the exception of the Whirlpool Sandstone, have not been quarried commercially to any extent. The Whirlpool Sandstone was formerly quarried at Waterdown for ganister and silica grit for iron foundries and steel plants. The Whirlpool Sandstone is the basal formation of the Silurian section in this area.

Below the Whirlpool Sandstone lies the red Queenston Shale of Ordovician age, which outcrops along the base of the Escarpment and eastward to Oakville. This formation is quarried for the manufacture of brick, tile and sewer pipe at Aldershot and Tansley. From Oakville east along the lake shore and in creeks there are outcrops of Meaford-Dundas Shale which underlies the Queenston Shale.

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There are spillway and kame gravels in the northwest part of the area between Campbellville and Kilbride. Farther south on the Escarpment west of Waterdown are extensive deposits of outwash sand. The major and central part of the Hamilton sheet is till with rare coverings of stratified varved clay and silt.

The Lake Iroquois shoreline runs diagonally in a northeasterly direction across the map-area from two to three miles from the Lake Ontario shoreline. The Lake Iroquois shorecliff is mainly cut in Queenston Shale, but at the west end of Hamilton Harbour, the Aldershot and Hamilton gravel bars have been built up. Some lacustrine sand occurs between the Lake Iroquois shoreline and the Lake Ontario shore.

There are few sand and gravel deposits in the area.

Mineral Production

Mineral production in the area consists of crushed stone, brick, tile and sewer pipe, and sand and gravel. There are 2 stone producers, 5 plants using Queenston Shale for brick, tile and sewer pipe, and 7 sand and gravel pits. Total mineral production from the Hamilton area in 1966 was $9,290,102. Due to the small numbers of producers in the various categories it is impossible to give figures for individual commodities.

Access

A grid of roads at approximately one mile intervals crosses the map-sheet providing excellent access to the entire area. Provincial highways 2, 5, 6, 8, 25, 401 and the Queen Elizabeth Way cross the area, as well as several paved county roads.

Topography

The maximum elevation is 1,075 feet above sea level on top of the Milton Heights outlier of the Niagara Escarpment. From here elevations on the Escarpment fall off gradually to the south to 700 feet in the vicinity of Dundas. The relief of the Escarpment is from 350 to 475 feet. The till plain below the Escarpment has an elevation of 675 feet near Milton and falls off gently southward to an elevation of 375 feet at the Lake Iroquois shoreline near Burlington. The Lake Ontario elevation is about 246 feet.

Drainage

The west end of Lake Ontario occupies the southeast half of the map sheet. The area drains into Lake Ontario via Oakville Creek, Bronte Creek, and numerous smaller creeks. The drainage is described by Karrow (1963, p. 2-3).

Previous Work

The Pleistocene geology of the Hamilton area was mapped by P.F. Karrow (1963), and his report and map form the basis for a large part of the work here reported. The bedrock geology of the area is described by Caley (1940). More recently a study of the Silurian was made by Bolton (1957). A study of the limestone deposits was made by Hewitt (1960). The clay products industry of the area was described by Guillet (1967). Sand and gravel deposits were described by Hewitt and Karrow (1963). Pleistocene geology of parts of the area are described by Coleman (1937a, 1937b).

Field Work

Field work was done during parts of the summers of 1967 and 1968.

Paleozoic Geology

The following is the table of bedrock formations for the Hamilton area

Table of Formations

		Formations	
Paleozoic			
Silurian	Groups	Southwest of Waterdown	North of Waterdown
		Guelph Dolomite	
	Albemarle Group:	Lockport Dolomite	Amabel Dolomite
	Clinton Group:	Rochester Shale	
		Irondequoit Limestone	
		Reynales Dolomite	Reynales Dolomite
		Thorold Shale	
	Cataract Group:	Grimsby Sandstone	
		Cabot Head Shale	Cabot Head Shale
		Manitoulin Dolomite	Manitoulin Dolomite
		Whirlpool Sandstone	Whirlpool Sandstone
Ordovician		Queenston Shale	Queenston Shale
		Meaford-Dundas Shale	Meaford-Dundas Shale

Ordovician

Meaford-Dundas Shale

The Meaford-Dundas Shale underlies the area north, south and east of Oakville, outcropping as far west as the Queen Elizabeth Way. The disposition of outcrops of Meaford-Dundas Shale and the lower contact of the Queenston Shale are shown on Figure 1. The Meaford-Dundas Shale consists of thin to medium-bedded, grey-green shale interlayered with grey beds of limestone or calcareous sandstone up to 6 inches thick. These hard layers are more common toward the top of the formation. The contact between the Meaford-Dundas Shale and the overlying red Queenston Shale is gradational over about 10 feet. The Meaford-Dundas Shale has a thickness of about 650 to 750 feet (Sanford 1961, p.14), only the upper part of which may be seen in the map-area.

The Dundas Shale is utilized for the manufacture of brick and tile in the Brampton area immediately to the north of the Hamilton map-area (Hewitt, in press), at the Cooksville plant of Domtar Construction Materials Limited and the Etobicoke plants of Booth Brick Limited and the Ontario Reformatory.

The ceramic properties, mineral composition and chemical composition of the Dundas Shale are given by Guillet (1967, p. 34-35). The Dundas Shale has just sufficient workability for modern extrusion equipment. It burns red and has a short firing range.

Queenston Shale

The Queenston Shale underlies a large part of the Hamilton area from the base of the Niagara Escarpment eastward to Oakville. The formation is Upper Ordovician in age and consists of brick red, thinly-bedded, fissile shale with interbeds of greenish sandy or calcareous layers. Within the red shale sequence are seams and bands of green shale following bedding planes or crosscutting the sequence along fractures. Round or oval green "eyes" frequently appear in the red shale and these sometimes have centres of calcite or carbonaceous material. Seams and concretions of yellowish gypsum are common in some places.

In the Hamilton area the Queenston Shale is 500 to 600 feet thick, thinning to the north. It is overlain by the Whirlpool Sandstone of Silurian age and underlain by the grey-green Meaford-Dundas Shale. Queenston Shale readily breaks down under weathering processes to form a red clay soil which is characteristic of the area below the Niagara Escarpment at Waterdown and Aldershot, and along the Lake Iroquois shoreline from Burlington to Oakville. Excellent sections of Queenston Shale are exposed in the valleys of Bronte Creek and Oakville Creek.

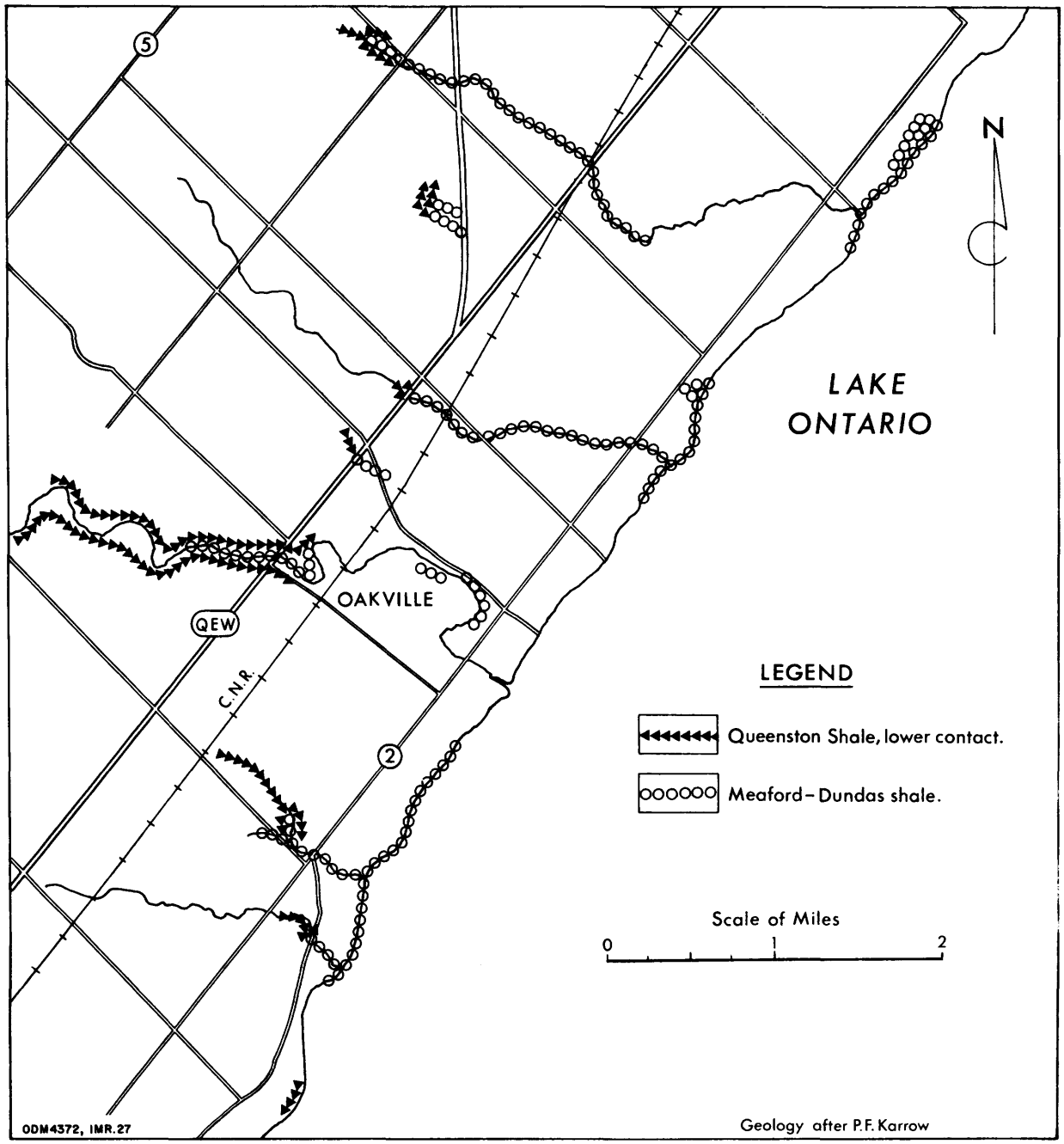

Figure 1 — Contact of Queenston and Meaford–Dundas Shales

The upper part of the Queenston Shale is exposed below the overlying Cataract Group in creek valleys cutting the Niagara Escarpment between Websters Falls at Bullock Corners, near Dundas, and Waterdown. Northeast of Waterdown along the base of the Escarpment to Mount Nemo the Queenston Shale is generally covered by till. The Queenston Shale is again exposed at Cedar Springs on the headwaters of Bronte Creek. Queenston Shale is also exposed in another tributary of Bronte Creek about two miles northwest of Lowville. The Queenston Shale on the southeast flank of the Milton Heights outlier is covered by till.

Areas of Queenston Shale outcropping or lightly covered with overburden in the Oakville area are shown in Figure 2. These are areas where shale could be quarried for brick manufacture. At locality 1 on Figure 2, Queenston Shale outcrops at the surface at the corner of the Eighth Line road and the Upper Middle Road. There is a good section of Queenston Shale on the Sixth Line road south of Highway 5. The area northeast of the Fourth Line road, southwest of Oakville Creek provides shale suitable for a brick plant. At locality 2 on Figure 2 there is a good section of Queenston Shale on the Upper Middle Road. Queenston Shale outcrops on the Trafalgar Road north and south of the Upper Middle Road. At locality 3 on Figure 2 there is a 10-foot section of Queenston Shale on a creek on the Sixth Line road south of Highway 5. At locality 4, Queenston Shale outcrops in ditches with little overburden. At locality 5, there is a section of 6 to 8 feet of Queenston Shale in a stream.

The lower contact of the Queenston Shale with the underlying Meaford-Dundas Shale is exposed in a creek at Suffolk Park, southwest of Oakville, and in Oakville Creek near the Queen Elizabeth Way. The same contact may be seen on a small creek northwest of the Ford plant north of Oakville.

The chemical and mineral composition of the Queenston Shale of the area has been investigated by Guillet (1967, p. 58-59). Chemical analyses of shale samples from various pits in the Hamilton and Brampton areas are given in Table 1, from Guillet (1967, p.59).

Table 1. Chemical Variations in the Queenston Formation (quantities in percent)

	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Na_2O	K_2O	TiO_2	CO_2	H_2O+	SO_3
TOP OF FORMATION											
Milton Brick Ltd., Milton	50.91	14.9	6.53	7.41	4.40	0.36	4.02	0.73	6.67	2.93	0.27
National Sewer Pipe Ltd., Waterdown	52.02	14.5	6.57	6.81	3.75	0.32	4.12	0.76	5.88	2.91	0.28
Natco Clay Products Ltd., Aldershot	49.67	14.3	6.27	10.2	3.15	0.58	3.64	0.76	8.64	2.42	0.28
Diamond Clay Products Ltd., Tansley	45.10	11.9	4.57	14.3	2.63	0.81	2.99	0.67	12.47	2.13	0.32
Brampton Brick Ltd.,Brampton	55.00	14.0	6.17	7.25	3.23	0.90	3.23	0.72	5.81	2.64	0.31
McFarren Brick Ltd., Streetsville	55.97	13.4	6.58	6.34	2.68	0.76	3.25	0.80	5.24	2.53	0.20
BOTTOM OF FORMATION											

These analyses are taken from the top of the formation at Milton to the bottom of the formation at Streetsville, and include analyses at Waterdown, Aldershot and Tansley in the Hamilton area.

It is apparent from the table that there is a section in the central part of the formation in which lime greatly exceeds iron oxides; the analyses from Natco Clay Products Limited (now Natco Building Products Limited) at Aldershot and Diamond Clay Products Limited at Tansley indicate 10.2 and 14.3 percent CaO respectively. These sections contain more green beds and burn to a buff colour. Unweathered Queenston Shale usually has a light red fired colour and a fairly short firing range. Weathered Queenston Shale in which the lime has been leached has a longer firing range and a deeper red fired colour. Guillet (1967, p.58) states that the plasticity of the unweathered shale is barely adequate for modern extrusion equipment. Natural weathering and fine grinding result in some improvement in plasticity. Ceramic properties of Queenston Shale are given by Guillet (1967, p.58).

Utilization of the Queenston Shale

The Queenston Shale is quarried for the manufacture of brick by Diamond Clay Products Limited at Tansley. The Waterdown quarry of National Sewer Pipe Limited supplies shale to Kitchener Brick Company Limited, Natco Building Products Limited, Hamilton Brick Limited and its own plant at ~~Waterdown~~ Hamilton.

Clay from Queenston Shale

In the Aldershot area a red clay has been developed from the weathering of the underlying Queenston Shale. It has been widely utilized for sewer pipe and tile. It is described as follows by Guillet (1967, p. 178-179):

> "The best quality surface clay, and the only one suitable for sewer pipe in southern Ontario, is the Aldershot red clay. Clay of this type was derived from the Queenston Shale that formed the shoreline of Lake Iroquois 12,000 years ago (Karrow 1963, p.56). It was deposited in quiet lagoonal waters separated from Lake Iroquois by the Aldershot Bar, a beach deposit of sand and gravel that extends from the mouth of Cootes Paradise eastward almost to King Road. Similar clay was also laid down behind the Hamilton Bar, a gravel ridge that overlaps the Aldershot Bar at Cootes Paradise and extends southward through the west end of Hamilton. The clay was formerly used extensively in the manufacture of brick, structural and drain tile, sewer pipe, flower pots, and art pottery. Urban construction and zoning regulations have effectively withdrawn any red clay remaining in the Hamilton deposit from industrial use. The recently completed Hamilton by-pass, highway no. 403, covers most of the remaining clay in the eastern end of the Aldershot deposit, while that towards the west has already been removed for brick and tile.
>
> Thickness of the red clay in the Hamilton deposit was typically 6-7 feet (Coleman 1937, p.6); somewhat less in the Aldershot deposit. The deposit thins rapidly east of the Aldershot Bar, and becomes silty and lighter coloured as a result of contamination from materials derived from a till terrace that formed the old shoreline east of the shale outcrops.

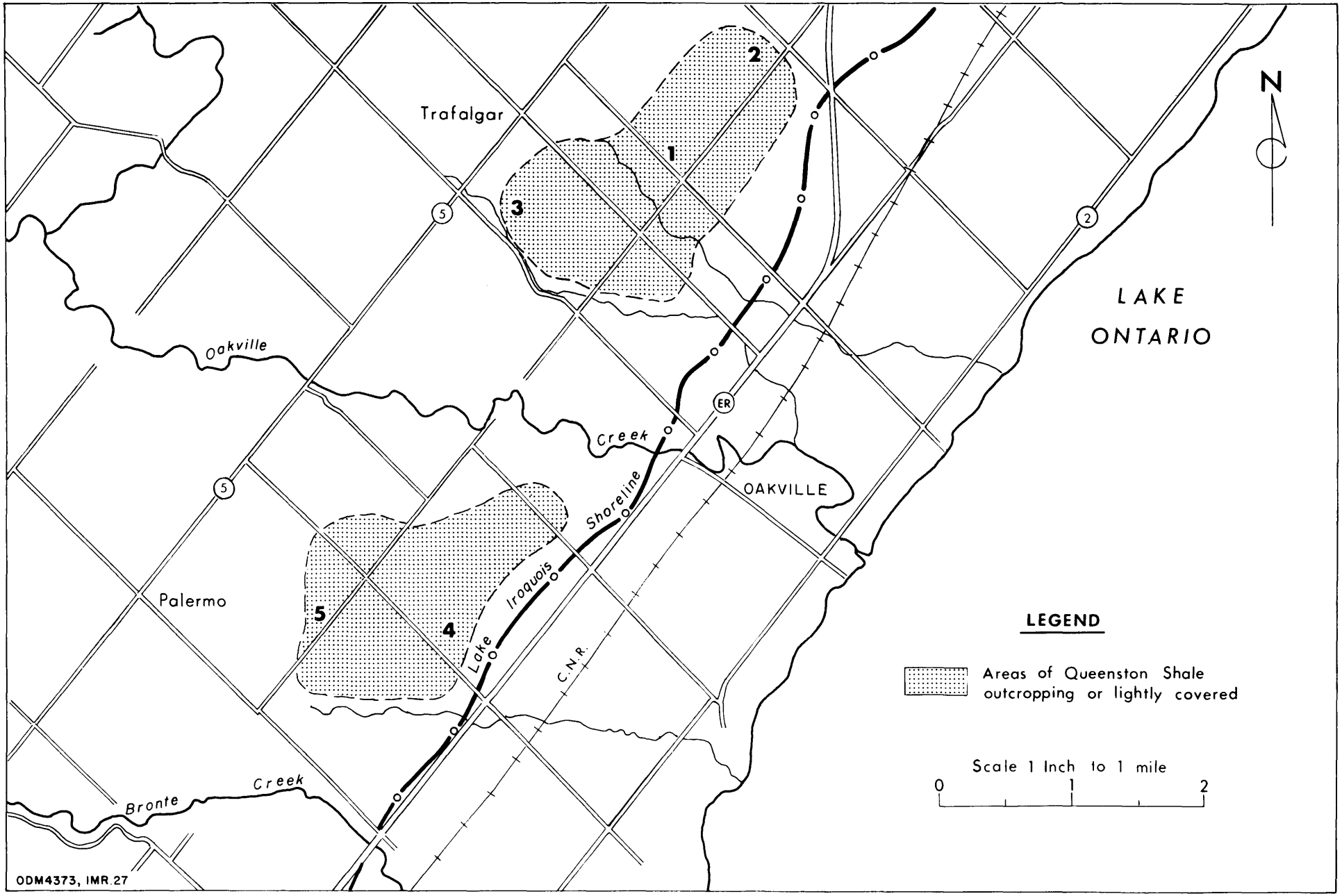

Figure 2 – Areas of Queenston Shale with light overburden

National Sewer Pipe Limited recovers red clay on the west side of King Road along, and immediately south of highway no. 403. After stripping a few inches of topsoil and grass, the red clay is bulldozed into piles for subsequent loading and trucking to the Clarkson and Hamilton plants. Thickness of clay at this point is rarely more than 3 feet and commonly is about 1 foot. However, a section exposed in a creek bank several hundred feet west of the clay workings consists of 5 feet of red clay. This section is illustrated in figure 44 and described in the accompanying notes. The results of chemical, mineralogical, and ceramic testing of a bulk sample of the clay in one of the small stockpiles awaiting shipment to the plant are given in tables 182, 183, 184.

Similarity of the red Aldershot clay to the parent Queenston shale can be seen by comparing the chemical and mineral analyses of the clay with that of the typical shale. The leaching that attended the erosion and re-deposition of the shale fragments all but removed the carbonate minerals. The low lime content of the clay is largely responsible for its superior ceramic qualities."

Silurian

Rocks of the Clinton and Cataract Groups are only exposed in the face of the Niagara Escarpment, particularly in roadcuts.

Cataract Group

Whirlpool Sandstone

The basal member of the Silurian resting on the Ordovician Queenston Shale is the Whirlpool Sandstone of the Cataract Group. It outcrops in places at the base of the Niagara Escarpment, but within the map-area is generally covered. It is a thin to massive-bedded, medium to fine-grained, grey to red, crossbedded, compact, unfossiliferous quartzose sandstone. In the map-area its thickness is about 12 feet.

The Whirlpool Sandstone is widely quarried from Milton to Inglewood as a building stone under the trade name of "Credit Valley Sandstone". It has not been quarried as a building stone in the Hamilton area, but was quarried at Waterdown for ganister and silica grit for iron foundries and steel plants. The quarry area is now built over by a subdivision.

Physical properties of the Whirlpool Sandstone for use as a building stone are given by Hewitt (1964, p. 18-38).

The Whirlpool Sandstone in the Hamilton area is not sufficiently well exposed for commercial quarry operations. Any exploitation of the formation would probably have to be done by underground mining.

Manitoulin Dolomite

Overlying the Whirlpool Sandstone in the face of the escarpment is the Manitoulin Dolomite, a formation from 11 to 15 feet thick (Bolton 1957, p.15). The Manitoulin Dolomite consists of thin-to medium-bedded, blue-grey, buff-weathering, aphanitic to medium crystalline dolomite with shaly partings. The contact with the overlying Cabot Head Shale is gradational through a few feet of interbedded shale and dolomite. The Manitoulin Dolomite outcrops sparingly along the Escarpment and is generally covered by overburden. The formation is not utilized commercially in the area.

Cabot Head Shale

Overlying the Manitoulin Dolomite in gradational contact is the Cabot Head Shale. The formation consists of thin-bedded, fissile grey shale with thin interbeds of grey to rusty-weathering, dense, calcareous sandstone and limestone. Bolton (1957, p.17) reports some thin beds of red sandstone and shale in the upper 12 to 13 feet of the Cabot Head Formation which may represent early advances of the southern Grimsby facies into the section. Bolton reports the thickness of the Cabot Head Shale as 34 feet at Hamilton.

At Clappisons Cut the Cabot Head Formation is overlain by the Grimsby Sandstone and Thorold Shale. These formations pinch out to the north and the Cabot Head Shale is overlain by the Reynales Dolomite.

Grimsby Sandstone

In the area southwest of Waterdown the Grimsby Sandstone overlies the Cabot Head Shale. To the north the red beds are included in the upper part of the Cabot Head Shale. The Grimsby Formation consists of red shale and interbedded red sandstone. At Clappisons Cut, the Grimsby Formation has a thickness of 12 feet (Bolton 1957, p.93). The Grimsby equivalent in the Cabot Head Shale is 5 feet thick at Limehouse in the Brampton area (Bolton 1957, p.19).

Clinton Group

Thorold Shale

In the area southwest of Waterdown the Grimsby Sandstone is overlain by Thorold Shale. At Clappisons Cut the Thorold Shale is 13.5 feet thick (Bolton 1957, p.93), and consists of greenish-grey shale with interbeds of fine-grained, grey sandstone. The Thorold Shale has not been definitely recognized north of Waterdown.

Reynales Dolomite

In the area southwest of Waterdown the Thorold Shale is overlain by the Reynales Dolomite. In the area north of Waterdown the Reynales Dolomite overlies the Cabot Head Shale. The Reynales Dolomite is a medium-buff to grey mottled, buff-weathering, aphanitic, medium-bedded dolomite with green shaly partings. At Nelson Crushed Stone quarry it is 7.5 feet thick; at Clappisons Cut it is 8 feet thick. This formation forms the quarry floor at Nelson Crushed Stone quarry. It was the basal unit quarried at the Clappisons Cut Quarry (Hewitt 1960, p.112), where it is underlain by Thorold sandstone.

Irondequoit Limestone

In the area southwest of Waterdown the Reynales Dolomite is overlain by the Irondequoit Limestone. North of Waterdown the Irondequoit Formation is either missing, or represented by the basal section of the Amabel Dolomite. At the Clappisons Cut quarry (Hewitt 1960, p.112) the Irondequoit Limestone is 5.8 feet thick and is a medium-grey, crinoidal, medium-crystalline, medium-bedded, dolomitic limestone, with white gypsum nodules and dolomitic shale fragments in the upper beds. Some marcasite is present. There are grey shale partings. The Irondequoit is dolomitic in the old Nelson quarry in Nelson Township (Hewitt 1960, p.113).

Rochester Shale

In the area southwest of Waterdown the Irondequoit Limestone is overlain by the Rochester Shale. The Rochester Shale pinches out north of Waterdown and is absent in the section. At the Clappisons Cut quarry (Hewitt 1960, p.112) the Rochester Shale is represented by 2.2 feet of grey shale and thin-bedded medium-grey argillaceous dolomite. There are 5 feet of Rochester Shale at Dundas.

Albemarle Group

Lockport Dolomite

In the area southwest of Waterdown the Rochester Shale is overlain by the Lockport Dolomite of the Albemarle Group. The Lockport Formation is divided into three members, in ascending order the Gasport Dolomite, the Goat Island Dolomite and the Eramosa Dolomite.

Gasport Dolomite

The basal member of the Lockport Formation, the Gasport Dolomite, is exposed in the Clappisons Cut quarry (Hewitt 1960, p.112). It consists of 12 feet of medium-grey, light-grey to buff-weathering, coarse-to medium-crystalline, crinoidal, medium-bedded, even-bedded, fossiliferous, porous dolomite. The dolomite was formerly quarried at the Clappisons Cut quarry for the production of crushed stone. The same member is quarried at Queenston under the trade name of Queenston Limestone.

Goat Island Dolomite

The Goat Island Dolomite rests on the Gasport Dolomite and is recognized by a change of colour, bedding, and crystallinity. The Goat Island Dolomite exposed in the Clappisons Cut quarry (Hewitt 1960, p.112) is light-buff, buff-weathering, medium-crystalline, thick- to massive-bedded, even-bedded, porous, fossiliferous dolomite. About seven feet are exposed in this quarry. The total thickness of the Goat Island Member is probably about 40 feet (Bolton 1957, p.92). The dolomite was formerly quarried at the Clappisons Cut quarry for the production of crushed stone. Some chert is present in the Goat Island Member especially in the Ancaster area. Chert is present in the Clappisons Cut and the Sydenham roadcut near Dundas.

Eramosa Dolomite

The Eramosa Dolomite rests on the Goat Island Dolomite and is recognized by its dark-brown colour and bituminous and shaly partings. Forty-four feet of Eramosa Dolomite are exposed in the new quarry of Canada Crushed and Cut Stone at Dundas. The member consists of medium dark-brown to light-brown, buff- to brown-weathering, aphanitic, medium-to thick-bedded, even-bedded dolomite with thin colour laminations and black shaly partings in the lower part of the section. There is occasional marcasite, gypsum, sphalerite, celestite and fluorite present. The member has a thickness of 58 feet in the old quarry of Canada Crushed and Cut Stone. It is overlain by Guelph Dolomite.

This stone is quarried by Canada Crushed and Cut Stone Limited on the north side of Highway 5 in West Flamborough Township. The quarry is one of the largest in Canada, producing over a million and a half tons a year.

The stone is a high purity dolomite suitable for flux stone. Chemical analyses supplied by the company are given in Table 2 (Hewitt 1960, p.107).

Table 2. CHEMICAL ANALYSES—CANADA CUT AND CRUSHED STONE LIMITED

(Analyses supplied by the company)

Depth	SiO_2	Fe_2O_3	Al_2O_3	CaO	MgO	L. O. I.
feet	percent	percent	percent	percent	percent	percent
7	0.48	0.16	0.49	34.08	18.51	46.28
12	0.24	0.16	0.23	33.62	19.22	46.53
17	0.39	0.15	0.39	32.82	19.91	46.34
22	0.83	0.14	0.26	32.74	18.80	47.23
25	0.10	0.16	0.22	32.20	20.72	46.60
30	0.16	0.16	0.39	34.16	18.31	46.82
35	0.68	0.21	0.22	34.84	16.97	47.08
40	0.26	0.14	0.27	34.08	17.95	47.30
45	0.76	0.16	0.38	34.98	16.26	47.46
50	5.27	0.21	0.63	33.21	14.31	46.36
55	1.08	0.16	0.80	33.13	18.19	46.64
60	0.49	0.21	0.51	32.59	19.60	46.60
65	2.23	0.16	1.18	32.59	17.38	46.46

The Lockport Dolomite makes an excellent crushed stone. Los Angeles abrasion tests run from 22 to 30 percent loss. Magnesium sulphate soundness runs from 0.3 to 5.4 percent loss. Absorption averages 1.2 to 1.8 percent.

Amabel Dolomite

Throughout the Niagara Peninsula and as far as Clappisons Cut, the Lockport Dolomite is divided into three members: Gasport, Goat Island and Eramosa. However northeast of Clappisons Cut in the Waterdown area there is a noteworthy facies change, and the Lockport is replaced by a reefy, medium-crystalline, light-buff dolomite which extends from Waterdown through Georgetown to the Bruce Peninsula. This facies, which is the lateral equivalent of the Lockport, is named Amabel by Bolton (1957, p.51).

The first appearance of the Amabel Dolomite facies is in the old Nelson quarry on the brow of the Escarpment in Nelson Township (Hewitt 1960, p.113). The Amabel Dolomite is quarried by Nelson Crushed Stone, 2 1/2 miles north of Nelson Corners on Highway 5. Here the Amabel Dolomite is underlain by the Reynales Dolomite which forms the quarry floor. Some 50 to 70 feet of Amabel Dolomite are exposed in the quarry face above the Reynales Dolomite. The Amabel Dolomite is light-grey, buff-weathering, medium-crystalline dolomite which ranges from even-bedded to irregularly bedded. Chemical analyses indicate that the Amabel Dolomite is a high purity dolomite with over 97 percent total carbonates.

The Amabel Dolomite makes a good aggregate. Los Angeles abrasion tests in the area run from 26 to 32 percent loss. Magnesium sulphate soundness runs from 1.2 to 9.8 percent loss, averaging about 2.4 percent. Absorption ranges from 1.07 to 1.98 percent.

Guelph Dolomite

The Guelph Dolomite, which overlies the Lockport and Amabel Dolomites, consists of light-creamy-buff, light-buff-weathering, aphanitic to fine-or medium-crystalline, porous dolomite, generally thick-bedded. The lower contact of the Guelph with the underlying Eramosa is marked by a change to the medium-brown to dark-brown bituminous dolomite with dark-grey shaly streaks.

The Guelph Dolomite is also characterized by reefy facies. These consist of medium-to coarsely-crystalline, irregularly bedded or massive areas of highly fossiliferous, porous dolomite standing out as mounds within the surrounding bedded dolomite.

The contact of the Guelph Dolomite and the underlying Eramosa Member of the Lockport Formation is seen at Canada Crushed and Cut Stone quarry at Dundas where 7 feet of Guelph overlies 43 feet of Eramosa along the north quarry face.

PLEISTOCENE GEOLOGY

Glacial History

The last ice sheet to spread over Ontario was called the Wisconsin ice sheet and all of the deposits in the Hamilton area are associated with the advance and retreat of this ice sheet. By 27,000 years ago the last major ice advance was under way and by 20,000 years ago the ice had spread to its maximum extent, reaching southern Ohio. As far as is known, all of southern Ontario was covered by glacial ice until about 14,000 years ago, when a retreat of the ice fronts began. As the ice retreated one ice lobe occupied the Lake Ontario basin and another lobe occupied the Lake Simcoe basin.

As Karrow (1963, p.56) points out, when the ice retreated to a line near the Escarpment, partial drainage occurred and Lake Warren I was formed. Further ice retreat drained the Lake Erie basin to a low-water stage. A new advance of the ice, from a position perhaps as far east as Toronto, reblocked the Erie drainage, caused the formation of Lake Warren II, and built several small moraines, called by Karrow the Waterdown moraines, on the Escarpment northwest of Waterdown. This ice readvance deposited the Halton till and is considered to be late Mankato in age. Glacial spillways formed between the Escarpment and the ice lobe and on the Escarpment. The Georgetown spillway and the spillways around Campbellville and Cedar Springs probably formed at this time. South of Carlisle extensive thin outwash deposits of sand formed from the south-flowing melt-waters emptying into Lake Warren II.

At the ice lobes retreated, the Lake Ontario lobe held a small glacial lake ponded against the south side of the Oak Ridges moraine. This is called the "Peel ponding" by Chapman and Putnam (1951). Thin varved clays and silty sands were laid down in this lake, but its duration was short and depositional features associated with it are not extensive.

A major ice retreat associated with a temporary warming of the climate caused the ice to withdraw from part of the Lake Ontario basin, and glacial Lake Iroquois was formed about 12,000 years ago with its outlet down the Hudson valley. Glacial Lake Iroquois was somewhat larger than present Lake Ontario and its shoreline is a few miles inland from the present shore. This abandoned shoreline of glacial Lake Iroquois is an important source of sand and gravel in places where bars were built up.

Physiographic Features

The three principal physiographic features in the map area are:

(1) The Niagara Escarpment,
(2) The Halton till plain,
(3) The Lake Iroquois shoreline.

The Niagara Escarpment

The Niagara Escarpment occupies a band, up to seven miles wide, along the western side of the map-area from Dundas to the Milton Heights outlier. The Milton Heights outlier is separated from the main part of the Escarpment by a narrow, deep valley which was a glacial spillway when the ice front stood just to the east. There is a re-entrant in the Escarpment at Lowville, and south of the Milton Heights outlier a large kame terrace of gravel formed where the spillway debouched onto the plain below Rattlesnake Point. The Dundas valley is a major buried valley forming a prominent re-entrant in the Escarpment.

On top of the Niagara Escarpment the Pleistocene deposits consist of coarse boulder till, clay till, kame and outwash gravels and outwash sand.

The Halton Till Plain

A major part of the map-area northwest of the Lake Iroquois shoreline is occupied by the Halton till plain which extends to the base of the Escarpment. Halton till is also found on top of the Escarpment from Dundas to Mount Nemo where it forms the Waterdown moraines. The Halton till plain consists mainly of a bevelled till plain with some drumlins. The Trafalgar moraine extends

across the map-area from the Escarpment south of Mount Nemo in a northeasterly direction north of Trafalgar.

The till plain is dissected by Oakville and Bronte Creeks.

The Lake Iroquois Shoreline

The abandoned shoreline of glacial Lake Iroquois extends in a northeasterly direction from Dundas across the map-area just northwest of Oakville, to leave the map-area on the north boundary four miles northeast of Oakville. The most noteworthy feature of the Lake Iroquois shoreline in the Hamilton area is two large gravel bars, the Hamilton bar, which cuts off Dundas Bay and a later bar, the Aldershot bar, which cuts off a bay at the foot of the Escarpment. The Hamilton bar rises 116 feet above the present lake at an elevation of approximately 362 feet. It is composed of well-stratified sand and fine and coarse gravel cemented in places into a conglomerate. This gravel bar was worked for sand and gravel in the early days. The Aldershot bar has been worked almost continually for sand and gravel. It has an elevation of 350 feet.

Between Burlington and Oakville, the Lake Iroquois shoreline runs nearly straight and is parallel to the Lake Ontario shore about two miles inland. The shore cliff is mainly cut in Queenston Shale. Small bars occur northeast of Oakville where the Iroquois shoreline cuts the Queen Elizabeth Way. There is no development of sand and gravel along the shoreline between Burlington and Oakville.

Pleistocene Deposits

The principal Pleistocene deposits consist of till plains, drumlins, moraines, outwash and spillway deposits, kames, eskers, lake plains and abandoned shorelines.

Till Plains

The principal till plain in the area is the Halton till plain which mainly occupies the area east of the Escarpment and northwest of the Lake Iroquois shoreline. The till sheet extends up onto the Escarpment for a distance of two to four miles from Dundas to Lowville. The surface varies from gently undulating to rolling and relief is limited. Karrow (1963, p.13) states that the till sheet is up to 40 feet thick and rests on shale bedrock. The till takes on the character of the underlying Queenston red shale and is a red clay or silt with abundant red shale pebbles.

In the northwest part of the sheet there are small areas of Wentworth till described by Karrow (1963, p.13).

In places the till is overlain by a thin veneer of varved clays of lacustrine origin.

Drumlins

Drumlins are oval hills usually about 1/4 to 1 mile in length and often not more than 1/4 mile wide. They stand up 50 to 75 feet above the till plain and are generally composed of silty clay till. There are a few drumlins on the Halton till plain between the Lake Iroquois shoreline and the Trafalgar moraine. Two drumlins are indicated by Karrow (1963, map 2033) on the Escarpment southwest of Waterdown.

Moraines

Karrow (1963, p.17) states that "Waterdown moraines is the name applied here to a group of seven moraine ridges that paralled the edge of the Escarpment from north of Dundas to Mount Nemo. Not all are continuous for this distance. The older and more westerly moraines are generally smoother and are mostly covered with sand because of the reworking by the waves of glacial lakes. All are narrow ridges, and most are composed of silty till known as Halton till."

"The youngest moraine in the area is the Trafalgar moraine, which extends as a low ridge from Nelson to Trafalgar. It, also, is composed of silty Halton till."

Outwash and Spillway Deposits

Outwash or spillway gravels are found south of Campbellville on the Escarpment as far south as Carlisle. Details of spillway systems in the Hamilton area are given by Karrow (1963, p.18).

Kames

Kames are irregular accumulations of partly sorted glacial debris deposited by meltwater at the edge of the ice. Some kame gravels are associated with the glacial spillways. A prominent kame terrace south of Rattlesnake Point is the site of extensive gravel operations. A kame deposit

at Campbellville is operated by Campbellville Gravel Supply Limited.

Eskers

Two small eskers occur in an area of kame moraine north of Carlisle.

Lake Plains

A major lake plain formed during the Peel ponding occupied the area east of the Escarpment and north of the Trafalgar moraine. This lake was apparently short-lived and varved clay and silt deposits are not extensive on the Halton till. Karrow (1963, p.22) states that most of this lake plain has an elevation of 600 to 625 feet and prominent shore features are lacking.

The Iroquois lake plain lies between the Lake Iroquois shoreline and Lake Ontario. It is composed mainly of thin sand deposits or reworked Queenston Shale. Hamilton, Burlington and Oakville are situated on this plain.

Karrow (1963, p.22) describes two small lake plains 2 miles southwest of Mill Grove and south of Mount Nemo.

Pleistocene Stratigraphy

The Pleistocene stratigraphy of the area is discussed by Karrow (1963, p. 29-53).

RECENT DEPOSITS

The recent deposits of the area are mainly composed of alluvial stream deposits of silt, sand and gravel, and swamp deposits of bog and muck of organic origin. No peat bogs of potential economic interest were found in the area.

ECONOMIC GEOLOGY

The industrial mineral deposits being exploited in the area include the Queenston Shale, the Amabel and Lockport Dolomites, sand and gravel deposits and clay deposits.

Queenston Shale

Queenston Shale is quarried for brick manufacture by Diamond Clay Products Limited at Tansley and by National Sewer Pipe Limited at their Waterdown quarry for production of sewer pipe at Clarkson, production of brick at Hamilton Brick Limited and Kitchener Brick Company Limited and production of tile by Natco Buildings Products Limited.

Ceramic properties of Queenston Shale are given by Guillet (1967, p.58).

Diamond Clay Products Limited

Diamond Clay Products Limited quarries Queenston Shale in the valley of Bronte Creek near Tansley in lots 3 and 4, concession I, N.D.S., Nelson Township. A 45-foot face exposes interstratified red and green shale with a lime content somewhat higher than usual for Queenston Shale. The shale burns buff. Chemical, mineralogic and ceramic analyses are given by Guillet (1967, p. 69-73). The plant capacity is about 36,000,000 brick per year.

National Sewer Pipe Limited

Waterdown Quarries

The Waterdown quarries are described by Guillet (1967, p.96) as follows:

> "National Sewer Pipe Limited operates several quarries for Queenston Shale on the east side of King Road in lots 1 and 2, concession II, East Flamboro township, Wentworth county. The quarries are located in an area of bare eroded hills of the Queenston Formation, on a gently sloping face of the Niagara Escarpment two miles east of Waterdown. A number of small openings have been made in the shale throughout the 400 acres owned by the company, and much of the soft weathered shale has been scraped from the eroding surfaces and intervening gullies."

The company provides all or part of the Queenston Shale requirements for Hamilton Brick Limited, Kitchener Brick Company Limited and Natco Buildings Products Limited. The main shale quarry has a 35-foot face, 200 feet long. Descriptions of the shale, chemical, mineralogic and ceramic testing are given by Guillet (1967, p. 96-98).

Red clay derived by weathering of the Queenston Shale is quarried by National Sewer Pipe Limited for their Clarkson and Hamilton plants.

Amabel Dolomite

The Amabel Dolomite forms the caprock of the Niagara Escarpment from Waterdown to the north edge of the map-area. The only quarry now operating in this area in the Amabel Dolomite is that of Nelson Crushed Stone. Quarried were formerly operated by Lowville Quarries near Mount Nemo and by Nelson Crushed Stone about a mile and a half east of Waterdown.

King Paving and Materials Limited

Nelson Crushed Stone Division

One of the largest dolomite quarries in Ontario is operated by Nelson Crushed Stone, a division of King Paving and Materials Limited, in lots 1 and 2, concessions II and III, Nelson Township, Halton County. The quarry produces stone largely for road construction and concrete aggregate. Transportation is entirely by truck. The plant, which has a capacity of 500 tons per hour, began production in 1954. The 50-to 80-foot quarry face, with the exception of the lowermost 3.5 feet of Reynales Dolomite consists entirely of light-buff, medium-crystalline Amabel Dolomite. The lower 14.5 feet of the Amabel section is well-bedded, light-grey, buff-weathering, medium-crystalline dolomite. Above this is 40 to 60 feet of massive, reefy to irregularly bedded dolomite. Some mound-like reefs are present in the quarry.

Chemical analyses of chip samples from the quarry face are given in Table 3 (Hewitt 1960, p.115).

Table 3. CHEMICAL ANALYSES—NELSON CRUSHED STONE LIMITED

(Analyses by the Provincial Assay Office, Ont. Dept. Mines, 1959)

Sample No.	Height Above Floor	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	CO_2	P_2O_5	S	Total
	feet	percent	percent	percent	percent	percent	percent	percent	percent	percent
1.....	0–18	0.88	0.21	0.82	21.15	30.30	46.33	0.10	0.42	100.21
2.....	18–38	1.58	0.25	0.47	21.13	29.30	45.30	0.13	0.20	98.36
3.....	38–50	1.74	0.20	0.37	21.11	30.00	45.83	0.09	0.05	99.39

The quarry operation is described by Hewitt (1960, p.115).

Lowville Quarry

The Lowville Quarry was operated in 1958 and 1959 by Lowville Quarries Limited but has since been inactive. The quarry is located on top of the Niagara Escarpment, two miles southeast of Lowville, in lot 2, concession IV, Nelson Township, Halton County. The 70-foot quarry face consists entirely of Amabel Dolomite: this is light-buff to medium-grey in colour, light-buff to light-grey-weathering, medium-to coarsely-crystalline, irregular massive-bedded and reefy to thick-bedded, fossiliferous dolomite. The quarry is described by Hewitt (1960, p.118).

Old Nelson Quarry

The old quarry of Nelson Crushed Stone is located on the brow of the Niagara Escarpment in Nelson Township, just east of the East Flamborough Township line, in lot 24, concession I, S.D.S., 2 miles east of Waterdown and 1 1/2 miles south of Highway 5.

The quarry is of considerable geological interest as it is in a transition area between the well-bedded Lockport Dolomite of the Niagara Peninsula-Dundas area and the crystalline, irregularly-bedded to well-bedded, reefy dolomite of the Amabel Formation of the Waterdown-Bruce Peninsula area. In the old Nelson quarry the facies is distinctly Amabel in character.

Here also is seen the pinching out of the Rochester Shale, which, with the Decew Dolomite underlies the Lockport Dolomite throughout the Niagara Escarpment. The Irondequoit Limestone also appears to pinch out in the area to the north so that the Amabel Dolomite at the New Nelson quarry three miles to the north rests directly on the medium-grey, mottled, aphanitic Reynales Dolomite.

The quarry section is given in Table 4 (Hewitt 1960, p.113).

Table 4. QUARRY SECTION—OLD NELSON QUARRY

FORMATION	DESCRIPTION	THICKNESS Feet
Amabel	Dolomite: light grey to buff; medium crystalline; medium to thick bedded; in places poorly or irregularly bedded reefy facies appearing; porous; fossiliferous.....	30 +
Rochester	Dolomite and Shale: grey; black shale zone 6–12 inches thick with white gypsum spots marks last vestiges of the Rochester shale.....	2.8
Irondequoit	Dolomite: light-grey to buff, mottled; massive 4-foot bed; marked shale parting and sharp textural and colour break at base.....	4.0
Reynales	Dolomite: light-brownish grey; aphanitic; medium bedded; common shaly partings.	6.0
	Quarry Floor	
Thorold	Buff-weathering sandy and silty aphanitic dolomite and grey-green shale, sulphides.	5.0+

Lockport Dolomite

The Lockport Dolomite forms the cap rock of the Niagara Escarpment from Niagara Falls through Dundas to Waterdown. In the Hamilton map-area the Dundas quarry of Canada Crushed and Cut Stone Limited is the only active quarry. The Clappisons Cut quarry was formerly operated by King City Sand and Gravel, and by Armstrong Brothers Company.

Canada Crushed and Cut Stone Limited

Dundas Quarry

The quarry now being operated by Canada Crushed and Cut Stone Limited is on the north side of Highway 5, in lots 10 and 11, concession III, West Flamborough Township, Wentworth County. This is one of the largest dolomite quarries in Canada and produces stone mainly for road construction, concrete aggregate and flux. Transportation is by truck and rail. The plant has a capacity of 550 to 600 tons per hour. The 50-foot quarry face consists of about 6 feet of Guelph Dolomite underlain by 44 feet of Eramosa Dolomite of the Lockport Formation. The section is described in Table 5 (Hewitt 1960, p.107).

Table 5. SECTION—CANADA CUT AND CRUSHED STONE LIMITED

UNIT	DESCRIPTION	THICKNESS Feet
GUELPH FORMATION	Dolomite: light grey, light buff weathering; aphanitic; medium bedded; shows a distinct colour break with the lower beds and represents a change from clastic sedimentation below to reefy biohermal facies above.....	6
ERAMOSA DOLOMITE (Lockport Formation)	Dolomite: medium dark brown to light brown, buff to brown weathering; aphanitic; medium to thick bedded, even bedded; thin colour lamination with black shaly partings in the lower part of the section; not notably porous or fossiliferous; rare cross-lamination; occasional marcasite, gypsum, sphalerite.....	44

The stone, as indicated by chemical analyses, is a high purity dolomite (Hewitt 1960, p.107). The quarry is described by Hewitt (1960, p. 106-111).

Clappisons Cut Quarry

The Clappisons Cut quarry is located on top of the Escarpment just east of Highway 6 at Clappisons Cut, in lots 12 or 13, concession II, East Flamborough Township, Wentworth County. The quarry floor is Thorold Sandstone; the 35-foot face is made up of 8 feet of Reynales Dolomite, overlain by 5.8 feet of Irondequoit Limestone, 2.2 feet of Rochester Shale, 12.0 feet of Gasport Dolomite and about 7 feet of Goat Island Dolomite. There is no permanent plant at the quarry and its operation is intermittent. The quarry is described by Hewitt (1960, p.112).

Sand and Gravel

The principal sand and gravel operations are in kame and outwash deposits in the western part of the map-area. There were six operations active in 1967.

Franceschini Brothers Construction Company Limited

A gravel pit is operated by Franceschini Brothers Construction Company Limited in a kame terrace deposit on lot 11, concession IV, Nelson Township, Halton County, south of the Hayward and Picket pit. The property is described by Hewitt and Karrow (1963, p.53), under the name DCB Gravel Company. A 30-foot face exposes interstratified and crossbedded medium gravel and sand. Gravel makes up 60 percent of the face, with sand making up 40 percent. The maximum size of boulders is 8 inches, with 30 percent of the stone exceeding 4 inches in size and 60 percent exceeding one inch in size.

A pebble count of gravel from this deposit gave the following assemblage:

	Frequency
Black River and Trenton limestone,	Abundant
Amabel dolomite,	Abundant
Brown Dundas siltstone,	Common
Red siltstone,	Common
Potsdam sandstone,	Very rare
Queenston shale,	Very rare
Precambrian acid igneous rocks,	Rare
Precambrian metamorphic rocks,	Rare

Sherman Sand and Gravel

A gravel pit is operated by Sherman Sand and Gravel on lot 11, concession V, Nelson Township, Halton County, about 4 miles southwest of Milton. A 20-foot face examined consisted of stratified coarse sand and gravel. The gravel is capped by up to six feet of till. The face is composed of approximately 30 percent stone and 70 percent sand. The maximum size of boulders is 10 inches, with 30 percent of the stone exceeding 4 inches and 50 percent exceeding one inch in size.

A portable plant is employed at the pit. The principal products are crusher run and granular B gravel.

Hayward and Picket Limited

The gravel pit operated by Hayward and Picket Limited is located on lot 12, concession IV, Nelson Township, Halton County, 4 miles southwest of Milton. The property is described by Hewitt and Karrow (1963, p.53).

A pebble count of gravel from the pit gives the following assemblage:

	Frequency
Green and brown Dundas siltstone,	Abundant
Maroon Grimsby siltstone,	Scarce
Black River and Trenton limestone,	Common
Amabel dolomite,	Scarce
Aphanitic grey dolomite,	Common
Sandstone,	Rare
Cemented conglomerate,	Common
Precambrian granitic rocks,	Rare
Precambrian metamorphic rocks,	Scarce

Halton County Pit

The county of Halton operates a gravel pit on lot 12, concession V, Nelson Township, Halton County, across the road from Hayward and Picket. The pit is described by Hewitt and Karrow (1963, p.53).

Nelson Crushed Stone

A gravel pit is operated by Nelson Crushed Stone, about a mile south of Kilbride, on lot 7 or 8, concession I, Nelson Township, Halton County. The 20-foot face exposes stratified medium sand and gravel composed of approximately 50 percent stone and 50 percent sand. The maximum size of boulders is 24 inches, with 30 percent exceeding 4 inches and 50 percent exceeding one inch in size. There is a permanent crushing and screening plant. The principal products are granular A and B, and pit run gravel.

Campbellville Gravel Supply Limited

The Campbellville plant and pit of Campbellville Gravel Supply Limited is located on the Campbellville-Kelso road on lots 5 and 6, concessions IV and V, Nassagaweya Township, Halton County. The deposit is a coarse kame gravel composed predominantly of Amabel Dolomite, with some Black River and Trenton Limestone, some Precambrian crystalline rocks and minor siltstone. A 25-foot

face examined consisted of approximately 70 percent stone and 30 percent sand. Maximum size of boulders was 24 inches, with 40 percent of the stone exceeding 4 inches and 70 percent exceeding one inch in size.

A permanent crushing, washing and screening plant makes a complete line of sand and gravel products.

Clay

Red clay consisting of the reworked weathered Queenston Shale was laid down in a lagoon behind the Aldershot bar of Lake Iroquois, see page 7. This clay is used by National Sewer Pipe Limited for the manufacture of sewer pipe at Clarkson (Guillet 1967, p.175).

Drift Thicknesses

In locating a quarry property a very important consideration is drift thicknesses overlying the bedrock to be quarried. One of the maps (P.495) accompanying this report shows spot drift thicknesses determined in wells in the area. The drift thicknesses are contoured on a 25-foot interval. The areas where drift thicknesses are less than 25 feet are of economic interest for bedrock quarry locations.

Consulting the drift thickness map it is apparent that a favourable area for quarrying Queenston Shale occurs in the area between Highway 5 and the Queen Elizabeth Way between Trafalgar and Oakville. Another favourable area for Queenston Shale is south of Oakville Creek from north of Highway 5 to the Queen Elizabeth Way. This area extends to the Palermo-Merton road. Another area where drift thicknesses are relatively thin is between Highway 5 and the Queen Elizabeth Way in the Tansley-Appleby area.

For the quarrying of Amabel Dolomite the area on the Escarpment from Mount Nemo to Highway 5 is generally favourable. Other small areas for Lockport and Guelph Dolomites occur in the vicinity of Clappisons Corners and Harper Corners. Overburden is light on parts of the Milton outlier, and west of Crawford Lake.

After an area of potential interest is chosen further drilling would be required to detail the drift thicknesses and rock sections to be found in the area.

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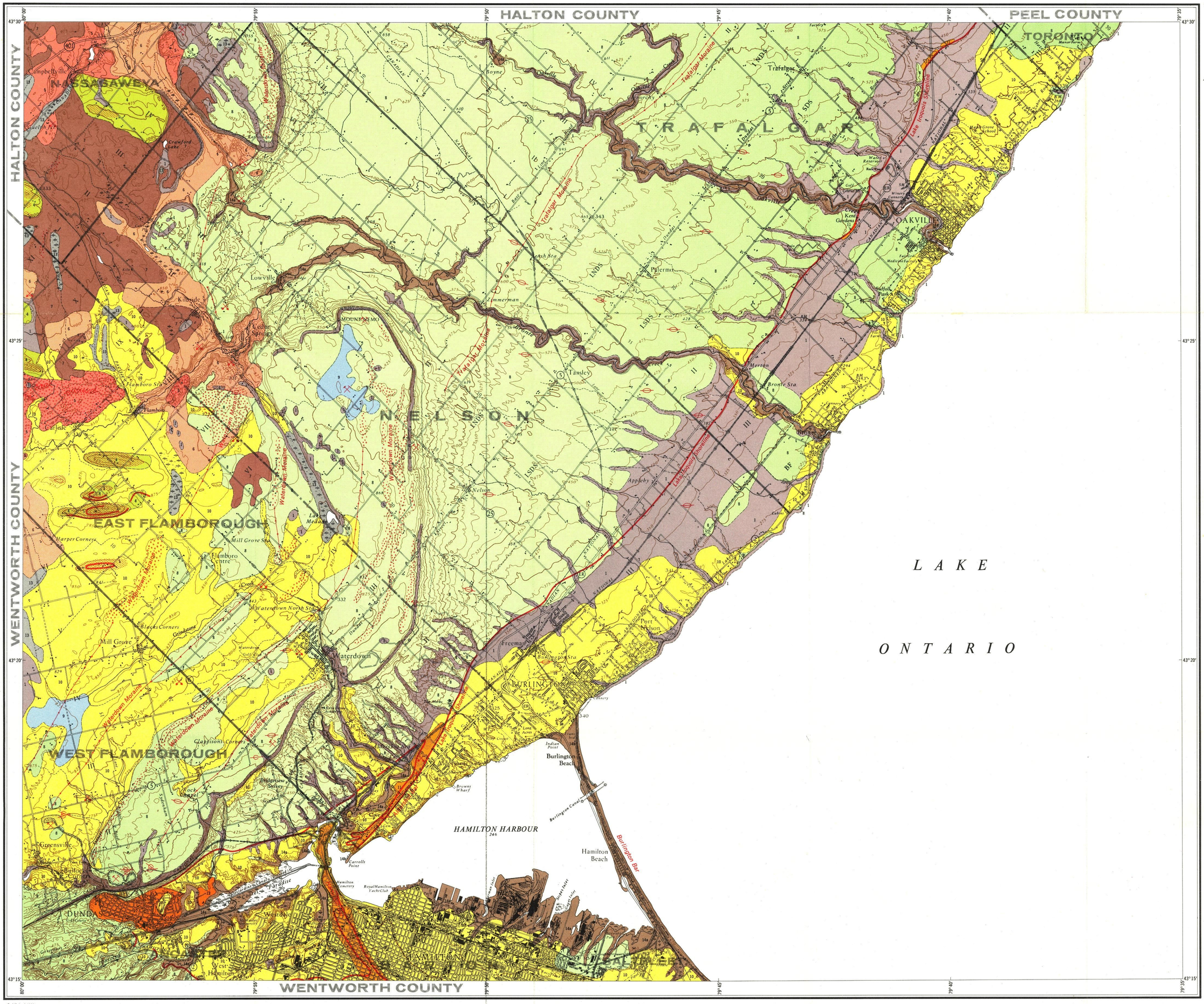
ONTARIO
DEPARTMENT OF MINES

HON. G. C. WARDROPE, *Minister of Mines*
D. P. Douglass, *Deputy Minister* M. E. Hurst, *Director, Geological Branch*

Map 2033
HAMILTON AREA
Pleistocene Geology



Deposits on this sheet are mapped where they reach three feet or more in thickness. Thinner deposits are not shown.

LEGEND

CENOZOIC

PLEISTOCENE

RECENT

- 14a — *Stream deposits. Stratified gravel, sand, silt, and clay.*
- 14b — *Lake Ontario deposits. Stratified sand and gravel.*
- 13 — *Peat and muck.*

WISCONSINAN

- 12 — *Alluvial fan gravel. Moderately rounded cobble gravel and minor sand and fine gravel.*
- 11 — *Beach gravel. Lake Iroquois: stratified, partly cemented flaggy gravel. Lake Whittlesey: well-sorted, angular, medium gravel.*
- 10 — *Sand. Shallow-water lacustrine, kame, and outwash.*
- 9 — *Lake deposits. Stratified to varved clay, silt, and some sand. Mainly deposits of lakes Whittlesey and Warren.*
- 8 — *HALTON TILL: Purple clay or silt till. Grey near Dundas and East of Oakville.*
- 7 — *Outcrop complex. Bouldery till and bedrock ridges.*
- 6 — *Outwash gravel.*
- 5 — *Kame gravel.*
- 4 — *WENTWORTH TILL: Sandy buff till.*
- 3 — *PORT STANLEY DRIFT*: Silt till.*
- 2 — *CATFISH CREEK DRIFT*: Stoney silty sand till.*

PALEOZOIC

ORDOVICIAN AND SILURIAN

- 1 — *Shale and dolomite.*

**These rocks are not mapped in the sheet area.*

Paleozoic formations are covered by thin, patchy soil.

SYMBOLS

- *County boundary.*
- *Township boundary.*
- *Topographic contours.*
- *Glacial striae on bedrock.*
- *Glacial fluting on till plain.*
- *Geological boundary, approximate.*
- *Rock quarry.*
- *Sand and gravel pit.*
- *Hummocky topography.*
- *Trend of moraine crest.*
- *Drumlin.*
- *Esker.*
- *Raised shoreline.*

For other conventional signs refer to 1:50,000 National Topographic Map Series.

SOURCES OF INFORMATION

Geology by P. F. Karrow and assistants, 1958.

Cartography by D. Jupe, Ontario Department of Mines, 1962.

Topography directly from maps 30M5 (East and West sheet) of the National Topographic Series, with additional information from the Ontario Department of Highways.

NOTES

For additional information refer to the following sources:

Aerial photography: Forests Resources Inventory, Ontario Department of Lands and Forests; National Air Photo Library, Department of Mines and Technical Surveys, Ottawa.

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Magnetic declination in the map area approximately 6° W., 1962.

Published 1963

Map 2033
Pleistocene Geology of the
HAMILTON AREA
Southern Ontario

Scale 1 : 63,360 or 1 Inch to 1 Mile

Chains 80 40 0 1 2 3 4 5 Miles
Feet 10,000 0 10,000 20,000 Feet
Metres 1000 0 1 2 3 4 5 6 Kilometres