ECONOMIC GEOLOGY REPORT ER85-1

# Dolomite Resources of Southern Manitoba

By B.B. Bannatyne

**Manitoba**
**Energy and Mines**
Geological Services

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## Errata: Economic Geology Report ER85-1

**Pages 8 and 9:** Certain contour values have been transposed. The values **780** and **740** in the eastern part of Figure 8a should appear in the equivalent positions in Figure 8b. The values **60**, **20** and **40** in the upper part of Figure 8b, and **40** in the southwest corner, should appear in the equivalent positions in Figure 8a.

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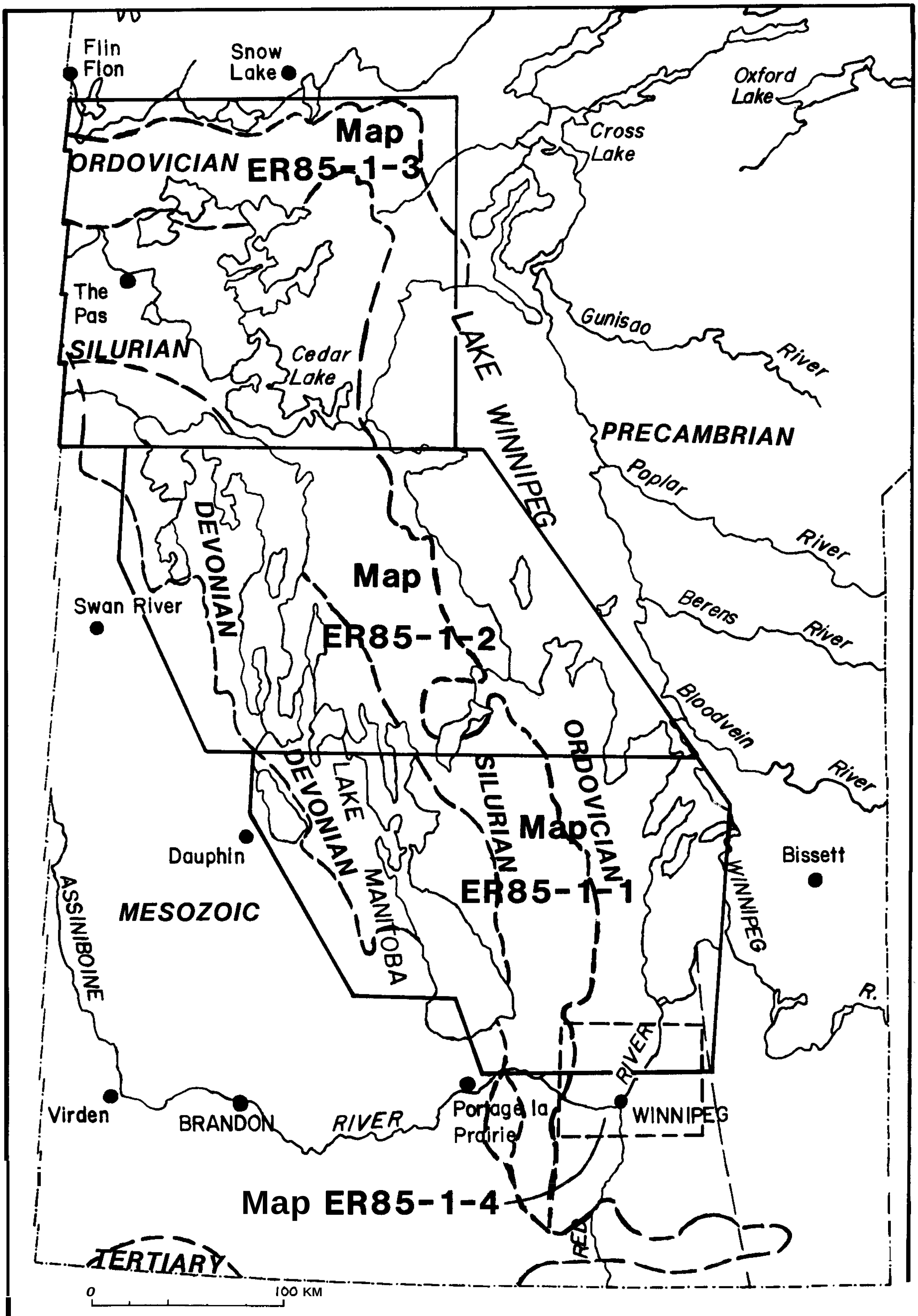



*Figure 1:* *Index map: Paleozoic outcrop belt and location of maps ER85-1-1 to -4 (in folder).*

# INTRODUCTION

Dolomite and dolomitic limestone form the major part of the Lower Paleozoic sequence that outcrops between Winnipeg and The Pas, along the northeastern edge of Williston Basin. Dolomite from several formations is quarried as a raw material for crushed stone aggregate, dolomitic lime, and riprap; dolomitic limestone is quarried for dimension stone and flagstone.

The main objective of the present study is to outline the dolomite resources available in southern Manitoba (Fig. 1; Maps ER85-1,-2,-3,-4). The rocks have been the subject of numerous geological studies, but the latest major industrial minerals report is that by Goudge (1944). Since 1944, much additional data on Ordovician, Silurian and Devonian dolomite and related rocks have become available from many new quarries, recent extensive geological mapping of outcrop belts, and acquisition of a few thousand metres of drill core.

## PRESENT WORK

Field work on this project began in 1975, although much information had already been accumulated in previous years as part of the data base on industrial minerals in Manitoba. Some specific studies related to this project were:

1) Aggregate resources of the Winnipeg region — a 1976 study by Underwood McLellan and Associates (UMA) under contract with Aggregate Resources section of the Mines Branch, that included assessment of sand and gravel resources of the Winnipeg region; a hammer-seismic survey determined depth to bedrock at each section corner within Rockwood Municipality, and was extended southward to the Perimeter Highway north of Winnipeg.
2) Geological Services stratigraphic and industrial minerals core hole program, which was initiated in 1969, used a Winkie drill to obtain core of Paleozoic carbonates; since 1975, a JKS 300 wireline drill has been used. For this dolomite project, specific sites were drilled, based on the UMA seismic survey and on recently reported outcrops.
3) Aggregate resources of the Southern Interlake area (1980), James F. MacLaren Limited — sites were selected for additional fill-in data on depth to bedrock, particularly in the Stony Mountain-Stonewall area, and were tested with backhoe and rotary drilling. Tests of physical properties of rock from designated quarries also were reported.
4) Quality of aggregate resources of Manitoba — an on-going program, funded by Aggregate Resources, under which 25 samples of dolomite were tested in 1982-1983; 40 kg samples, representative of the different carbonate units, were collected by the writer and C.W. Jones, who has published a separate report, AR86-1, on the results. Standard physical tests were performed under contract by Underwood McLellan and Associates Limited. Thin sections and chemical analyses for each sample were made by the Petrological Laboratory, under D. Berk, and by the Analytical Laboratory, under J. Gregorchuk, respectively.

## A NOTE ON DOLOMITE RESOURCES

The accompanying report and maps contain much data on the dolomite resources of Manitoba, but because of the large area covered of about 100 000 km², the following qualifications are noted:

1) The samples collected for physical properties and chemical analyses represent only a small portion of the total stratigraphic section, and are of limited geographic distribution. Changes that can affect the quality of the rock should be expected in other parts of the stratigraphic units.
2) In the southern part of the region, the near-surface bedrock contours are based primarily on depth to bedrock as reported in water wells, and consequently little or no data are available for undeveloped areas. Water well data for recent years is available at Water Resources Branch.
3) In the northern part of the region, the near-surface bedrock contours are based primarily on the areas indicated on soils maps that show 100% of the area as being underlain either by bedrock, or bedrock within 30 cm of the surface. Numerous other areas within the northern region can have anywhere from 10 to 90% near-surface bedrock, but as the specific areas of bedrock are not shown, these areas are not indicated on Maps ER85-1-2 and -3. Further information would have to be obtained from the soils maps and/or from examination of aerial photographs.
4) As the northern area has been mapped only on a reconnaissance basis, primarily from exposures along roads and shorelines, large areas of exposed bedrock that are known to exist are not indicated on the maps in this report. Examination of aerial photographs is advised to locate these outcrops.
5) Before any new quarries are opened, a detailed examination of the selected site is advisable; this should include tests to determine the quality of the rock.


## ACKNOWLEDGEMENTS

The writer was ably assisted during the field work for this project by C.W. Jones, D. Parbery, G. Weaver and P.H. Yamada. The drill crew, under the direction of D. Berk, with G. Benger and N. Young also as drillers, provided valuable data, a result of the excellent core recovery that was obtained. The maps for this report were drafted by Clayton Sandy. The base maps for the dolomite maps are derived from National Topographic Series 1:250 000 and 1:50 000 sheets produced by Surveys and Mapping Branch, Energy Mines and Resources, Ottawa.

The writer is indebted to Hugh McCabe, stratigrapher with Manitoba Energy and Mines, for many discussions on problems of southern Manitoba stratigraphy, and for h's cooperation in the Stratigraphic and Industrial Minerals Core Hole Program, which resulted in valuable new data on dolomite resources.

The Mineral Inventory (M.I.) cards, reproduced on microfiche in Appendix I, were prepared by C.W. Jones and N.L. Limoge, under supervision of the writer, as part of a Province-wide industrial minerals program in 1978 and 1979; it was funded under the Canada-Manitoba Natural Resources Evaluation Program. The originals of the cards are on file with Manitoba Energy and Mines.

Editorial comments and constructive criticism by W.D. McRitchie and W.R. Gunter are acknowledged; any shortcomings are the responsibility of the writer.

# REGIONAL SETTING

The outcrop belt of Paleozoic rocks is within Manitoba Lowland, or 'First Prairie Level', and extends from Winnipeg and Garson, through the Interlake and Dawson Bay regions, to the Precambrian Shield from Lake Athapapuskow to Ponton (Fig. 1).

Topographic relief is usually low, and altitudes range from 217 m at Lake Winnipeg to 320 m south of Lake St. Martin. Locally, escarpments occur within the outcrop belt, but some rock ridges have been partially or completely buried beneath glacial overburden. Known outcrop areas are shown on regional maps accompanying this report (Maps ER85-1-1,2,3 and 4); also shown are localities where dolomite is present beneath a thin cover of drift, some of which are potential sites for quarries. As noted on the maps, these areas of near-surface bedrock are based on interpretations of various sources of data; it should be expected that other areas of near-surface bedrock exist in each area, and that thick overburden is probably present in some parts of the outlined areas. Delineation of specific sites for quarrying would require detailed exploration.

## TABLE 1

**LOWER PALEOZOIC STRATIGRAPHY, SOUTHERN MANITOBA**

| AGE | GROUP/FORMATION/MEMBER | LITHOLOGY |
|---|---|---|
| Devonian | Souris River Fm. | Limestone, calcitic, dolomite, red beds |
| | Dawson Bay Fm. | Limestone, dolomite |
| | Winnipegosis Fm. | Dolomite, limestone |
| | Elm Point Fm. | Limestone |
| | Ashern Fm. | Argillaceous dolomite, dolomitic shale |
| Silurian | Interlake Group: | |
| | Cedar Lake Fm. (including Chemahawin Member) | Dolomite |
| | East Arm Fm. | Dolomite |
| | Atikameg Fm. | Dolomite |
| | Moose Lake Fm. | Dolomite, micritic |
| | Inwood Fm. | Dolomite, micritic, rounded blebs |
| | Fisher Branch Fm. | Dolomite, fossiliferous |
| Silurian/ Ordovician | Stonewall Fm. | Dolomite, marker beds |
| Ordovician | Stony Mountain Fm. | |
| | Williams Member | Dolomite, argillaceous, arenaceous |
| | Gunton | Dolomite |
| | Penitentiary | Argillaceous dolomite |
| | Gunn | Calcareous shale, to argillaceous dolomite |
| | Red River Fm. | |
| | Fort Garry | Dolomite; limestone |
| | Selkirk | Dolomitic limestone; cherty, limestone |
| | Cat Head | Dolomite |
| | Dog Head | Dolomitic limestone |
| | Winnipeg Fm. | Sandstone, shale |

A simplified stratigraphy of the region is listed in Table 1. A useful cross-section illustrating the relationships and variations in thickness of Ordovician and Silurian strata along the outcrop belt from Winnipeg to Wekusko Lake has been compiled by McCabe (1980), and is reproduced as Figure 2.

### REGIONAL GEOLOGY

The predominantly carbonate rocks of southwestern Manitoba were deposited in shallow epeiric tropical seas that inundated weathered Precambrian basement: Several cycles of transgression and regression have been interpreted from variations in texture, composition and fauna of lower Paleozoic rocks.

During the first transgression of Ordovician seas, sandstone and interbedded sand and shale of the Winnipeg Formation were deposited. Cambrian strata were deposited earlier but occur only in subsurface.

Carbonate deposition began with rocks of the Red River Formation, divided into the following members: Dog Head dolomitic mottled limestone; Cat Head dolomite and dolomitic limestone with chert nodules; Selkirk dolomitic limestone with abundant megafauna and an upper cherty limestone; and Fort Garry lower micritic dolomite, a central shaly layer, and upper dolomite with two limestone interlayers.

An increase in clastics initiated deposition of the Stony Mountain Formation that consists of: Gunn Member red shale with thin limestone interbeds; Penitentiary Member argillaceous dolomite; Gunton Member dolomite with minor variable argillaceous content; and Williams Member argillaceous and sandy dolomite.

Deposition of carbonates continued across the Ordovician-Silurian boundary, within the Stonewall Formation of dolomite. Carbonates, now completely altered to dolomite, continued to be deposited in the Silurian period. The Fisher Branch, Inwood, Moose Lake, Atikameg, East Arm and Cedar Lake formations of the Interlake Group were deposited. All are dolomites, but variations in texture and composition occur, including micritic, argillaceous, fossiliferous, reefoid, stromatolitic and crystalline dolomites; the sequence includes several prominent marker beds.

Withdrawal of the seas resulted in an erosional period until Middle to Upper Devonian. The next transgression occurred when the Elk Point Basin was established. The basal Middle Devonian Ashern Formation consists of shaly beds and argillaceous dolomite. It is overlain by Elm Point Formation limestone and Winnipegosis Formation dolomite. Prairie Evaporite salt deposits occur only in subsurface; their solution in the area of the Devonian outcrop belt has affected distribution of overlying strata. Cyclic sedimentation of shale, dolomite, limestone and evaporite units followed, and these are preserved in the basin area in Saskatchewan; incomplete cycles that make up both Dawson Bay and Souris River formations are exposed from The Narrows of Lake Manitoba to Dawson Bay, Lake Winnipegosis.

The carbonate rocks of the Paleozoic outcrop belt were subjected to erosion in the post-Devonian to Mesozoic interval and considerable evidence indicates extensive karsting and channeling occurred. Jurassic sediments are present in channels in southern Manitoba (Fig. 1) and the Charleswood-Headingley area (Map ER85-1-4). Sinkholes and/or channels, infilled with sandy kaolinitic shale of Lower Cretaceous age, and locally low grade lignite, are known to occur throughout the area; some sinkholes are indicated on Map ER85-1-4, and a channel-like deposit occurs north of Arborg (Map ER85-1-1). Recently, numerous caves in Paleozoic carbonates have been located and investigated in the Hodgson, Williams Lake and other areas in the Interlake (W.D. McRitchie, pers. comm., 1988).

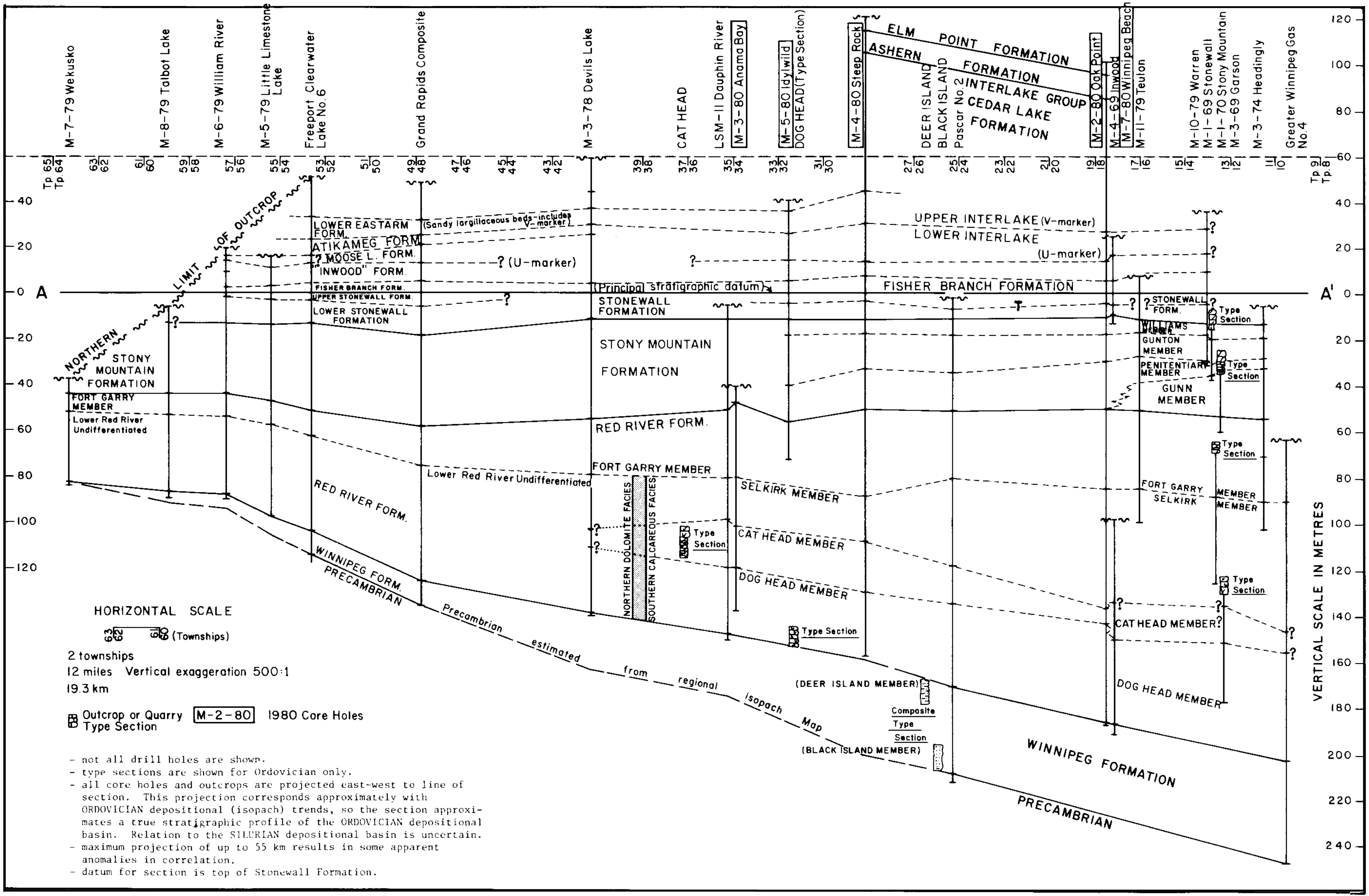



*Figure 2:* *North to south correlation profile of Ordovician and Silurian strata, generally along the outcrop belt from Wekusko to Winnipeg (from McCabe, 1980)*

## RED RIVER FORMATION

SOUTHERN *INTERLAKE* AREA

**DOG HEAD MEMBER**

The dominant rock type south of Lake St. Martin is yellowish grey and brownish grey mottled dolomitic limestone. However, lithology of the Dog Head ranges from magnesian limestone south of Lake Winnipeg to colour-mottled dolomite north from Grand Rapids. The limestone (wackestone) was deposited in a low energy environment. The matrix is a biomicrite; the mottles, emphasized by dolomitization, are very fine grained to microsucrosic dolomite containing abundant calcitic bioclasts.

The basal beds overlying the Winnipeg Formation contain abundant quartz sand grains. The lower part of the member is locally somewhat argillaceous with thin laminae of shale along uneven bedding planes. Slabs of dolomitic rock, from this and overlying members, are abundant along the shores and around the islands of Lake Winnipeg.

The insoluble residue reflects sand and shale impurities, and ranges from 25% in the basal part to 5-10% in the upper layers (Cowan, 1970). Some chalky chert is present in drill core from Petersfield but is rare at Garson.

South of Winnipeg, where it is at least 40 m thick, the Dog Head is difficult to distinguish from the overlying Cat Head Member. The Dog Head Member is identifiable as a separate unit along the outcrop belt from Scanterbury to Devils Lake (tp. 16 to 41). Thickness from Gypsumville to Devils Lake is consistently about 30 m. North of Devils Lake, the Dog Head/Cat Head subdivision has not been determined because both units are colour-mottled and dolomitized.

*Figure 3:* Dolomitic mottles in the Dog Head Member, accentuated by weathering; Hecla Northwest quarry, Hecla Island.

Figure ***4.*** 'Thin, flaggy beds of Dog Head dolomitic limestone; the cleared area at centre right is the floor of the old quarry north of Hecla, now a picnic site.

## TABLE 2

CHEMICAL AND PHYSICAL PROPERTIES OF DOG HEAD MEMBER

Sample: 3.5 m mottled dolomitic limestone, from southwest corner of quarry in N1/2 25-25-6E, Hecla Island

| | | | |
|---|---|---|---|
| $SiO_2$ | 9.74% | Los Angeles Abrasion | Bulk Specific Gravity |
| $Al_2O_3$ | 1.84 | Loss: 32.7% | 2.60 |
| $Fe_2O_3$ | 1.92 | | |
| CaO | 41.4 | Soundness Loss | Apparent Specific Gravity |
| MgO | 5.5 | 1.50"-0.75": 22.8% | 2.74 |
| $Na_2O$ | 0.03 | 0.75"-0.50": 21.5 | |
| $K_2O$ | 1.18 | 0.5"-0.375": 47.7 | |
| $TiO_2$ | 0.10 | | Absorption |
| $P_2O_5$ | 0.08 | | 2.0 |
| MnO | 0.07 | | |
| LOI | 37.15 | | Porosity |
| Total | 99.01 | | 5.2 |

Potential Uses: Surface gravel, base course A, base course B; flagstone; (was once used locally for lime, but too impure for commercial production)

Additional Tests:
Drill core: University of Manitoba heat flow test hole HF-7, mottled dolomitic limestone, 136.2-136.9 m; Unconfined compressive strength: 3810 kg/cm$^2$.

Sources: Chemical analyses: Energy and Mines Analytical Laboratory; Physical tests and potential uses: UMA Group; Additional tests: J. Oosterveen (1981).

Figure 5: Thick bedded, porous, mottled dolomite of the Cat Head Member, from a quarry in *l.s.* 5-22-24-4E north of Riverton.

Dog Head dolomitic limestone outcrops along Brokenhead River near Scanterbury. It outcrops also on the southwestern part of Elk Island in Lake Winnipeg, where it was quarried at one time (Baillie, 1951); the island is now a heritage park.

Some dolomitic limestone has been quarried on Black Island immediately north of the silica sand quarry operated by Steel Brothers Canada Limited (Frank Pearson, pers. comm.); it was used in construction of the quarry dock on the southeast shore.

The Dog Head has been quarried at several localities in the Hecla Island-Grindstone Point area. It was quarried primarily for rubble from 1911 to about 1917 in l.s. 6, sec. 27-26-6E, along the northwestern shore of Hecla Island (Fig. 3); the size of the quarry indicates that an extensive quantity of stone was removed, and most of it was barged down Lake Winnipeg to the city of Winnipeg (M.I. card 62P/2:LST-1). A quarry near the NE corner, sec. 24-25-6E, north of Hecla village, was once worked for lime (Goudge, 1944); physical and chemical tests on a sample from that quarry (Fig. 4) are listed in Table 2. Parks Branch has operated a quarry in recent years west of Gull Harbour in N1/2 sec. 25-25-6E (M.I. card 62P/2:LST-2); thin bedded dolomitic limestone is a source of flagstone for ornamental walls in Hecla Provincial Park, and unconsolidated sand from the Winnipeg Formation is also recovered. In Grindstone Point Recreational Area, a quarry was opened northwest of the road in sec. 21-26-6E, as a source of crushed stone aggregate for road construction. Goudge (1944) reported the remains of pot kilns for lime south of Grindstone Point.

A quarry for aggregate, probably from the Dog Head Member, was opened in 1981 in secs. 3 and 10, 31-5E near Pine Dock, beside Provincial Road 234.

### CAT HEAD MEMBER

The Cat Head Member occurs between dolomitic limestone of the Dog Head and Selkirk members, and has a greater but variable degree of dolomitization. Locally, the member contains abundant chert nodules, e.g., at the type section at Cat Head west of McBeth Point, Lake Winnipeg. The rock is colour-mottled calcitic dolomite in southern Manitoba, and colour-mottled dolomite (Fig. 5) along the outcrop belt north from Riverton.

Where the Cat Head forms the bedrock surface between Lake Win-

## TABLE 3

CHEMICAL AND PHYSICAL PROPERTIES OF CAT HEAD MEMBER

Sample: 3 m, south quarry, S1/2 22-24-4E, northeast of Riverton.

| | | | |
|---|---|---|---|
| $SiO_2$ | 3.39% | Los Angeles Abrasion Loss: 37.1% | Bulk Specific Gravity 2.34 |
| $Al_2O_3$ | 0.59 | | |
| $Fe_2O_{3T}$ | 0.52 | | |
| CaO | 30.6 | Soundness Loss | Apparent Specific Gravity 2.64 |
| MgO | 19.2 | 1.50"-0.75": 7.4% | |
| $Na_2O$ | 0.05 | 0.75"-0.50": 7.3 | |
| $K_2O$ | 0.36 | 0.5"-0.375": 18.5 | |
| $TiO_2$ | 0.05 | | Absorption 4.8% |
| $P_2O_5$ | 0.06 | | |
| MnO | 0.03 | | |
| LOI | 45.35 | | Porosity 11.2% |
| Total | 100.2 | | |

Potential Uses: Surface gravel, base course A and B, concrete aggregate, asphalt aggregate; large blocks were used as armour coat for Hecla Island causeway, and as riprap.

Additional Tests:
Sample: Mottled calcitic dolomite (packstone); drill hole HF-7, 98-100 m; unconfined compressive strength: 293.2 $kg/cm^2$.

Sources: Chemical analyses: Energy and Mines Analytical Laboratory; Physical tests and potential uses: UMA Group; Additional tests: J. Oosterveen (1981).

nipeg and Garson, and also extending south to Highway 15, the rock is generally covered by 12 m or more of glacial drift (Bannatyne and Jones, 1979, Preliminary Maps 1979DR-3 to 6, 11, 12). Exceptions are along the fringes of the large bedrock high in the Garson area, east of Walkeyburg and in the Libau area (Map ER85-1-4).

The Cat Head has been quarried northeast of Riverton. In 1970, two large quarries in l.s. 13 and 14, sec. 22-24-4E were opened to supply riprap and armour coat for the Hecla Island causeway. Small quantities of rock have since been quarried intermittently for local use, e.g., as crushed stone for driveways. In 1982/83, a large quarry was opened south of the previous ones, in the south half of sec. 22-24-4E. Physical and chemical properties of a sample from that quarry are listed in Table 3. In 1977, a quarry was opened in the east half of sec. 35-24-4E as a source of crushed stone for roads in Grindstone Point recreational area and also additional armour coat for the causeway (Fig. 6). These are the only quarries known in the Cat Head Member.

The type section of the member is exposed at Cat Head on Lake Winnipeg. There, scattered to abundant chert nodules occur in saccharoidal to crystalline bedded dolomite, generally along bedding planes (Baillie, 1952). The member ranges in thickness from 60 to 90 m; the sections exposed in the quarries north of Riverton are probably lower in the member than the type section, as a drill hole in the floor of the first quarry intersected Dog Head dolomitic limestone at a depth of only 0.9 m.

### SELKIRK MEMBER

The Selkirk Member is the source of Tyndall stone, a high quality dimension stone used in public and commercial buildings across Canada, notably in the Parliament Buildings at Ottawa and the Legislative Building in Winnipeg. The stone is quarried at Garson from about ten thick beds of dolomitic limestone that occur 10 m above the Cat Head Member. It was once quarried at East Selkirk and north of Lockport.

Figure 6: Cat Head dolomite in large blocks of *riprap* protecting the causeway along the road to Hecla Island (replacing the 'ferry route' shown in Map *ER85-1-1)*.

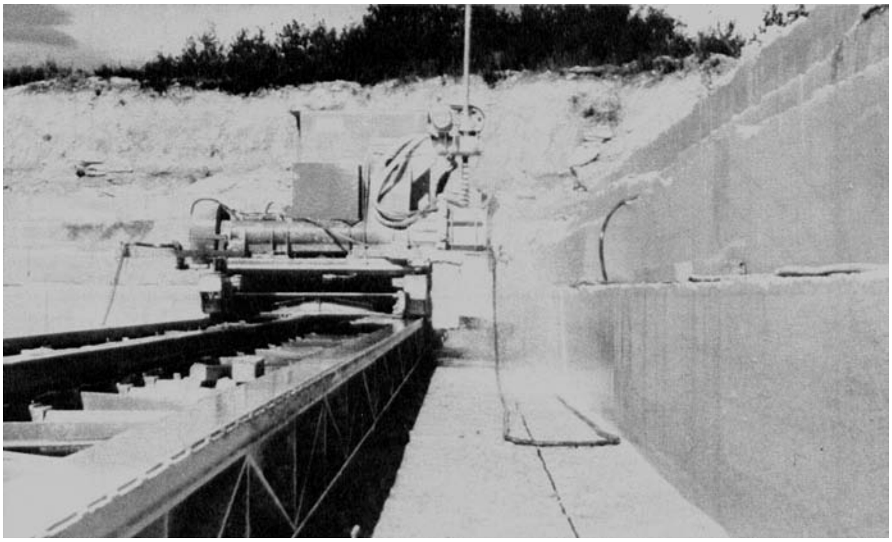


Figure 7a: Edge-on view of diamond saw, mounted on rails, cutting a layer of Tyndall stone from the thick bedded Selkirk Member. The cut slab is separated from the underlying layer by wedging along the bedding plane.

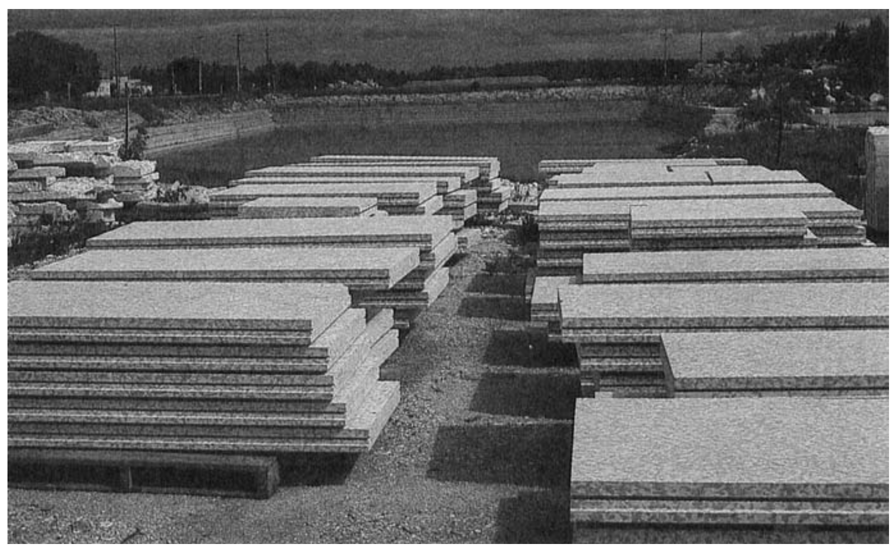


Figure 7b: Slabs of Tyndall stone ready for shipment; the older, flooded section of the quarry, in the town of *Garson,* is shown in the background.

The general geology has been described by Baillie (1952). Specific references to Tyndall stone, with detailed accounts of its production and use, include Parks (1916), Wallace and Greer (1927), and Goudge (1933, 1944). Kendall (1977) has described the distinctive mottling, and proposed theories for its origin, elaborating on earlier papers by Wallace (1913), Birse (1928) and others. The abundant and striking megafauna is described by Whiteaves (1897), Westrop and Ludvigsen (1983) and others.

An examination of available drill core indicates that the typical thick bedded Tyndall stone section represents only a portion of the Selkirk Member. In a drill hole near Netley (hole M-3-79, SE corner of l.s. 3-25-16-3EPM). the member consists of:

| Depth | Lithology |
|---|---|
| 3.0- 5.2 m | Micritic dolomite of Fort Garry Member. Contact with Selkirk Member at 5.2 m. |
| 5.2-13.6 m | High-calcium limestone, abundant chert; magnesian limestone, cherty. |
| 13.6-18.7 m | Dolomitic limestone, irregularly mottled, thin bedded. |
| 18.7- 42? m | Dolomitic limestone, thick bedded, minor chert nodules; contains the interval quarried for "Tyndall stone". |
| 42?-52.75 m | Dolomitic limestone |
| 52.75 m | Contact with calcitic dolomite of Cat Head Member. |

The first use of diamond saws (Fig. 7a) in 1962, by Garson Limestone Ltd. and shortly thereafter by Gillis Quarries Limited, greatly increased production by replacement of the older channeling machines. Gillis Quarries Limited moved its dressing plant operation from Winnipeg to the Garson quarry site in 1972 and finished stone (Fig. 7b) is now prepared there. Production of Tyndall stone is currently confined to one quarry south of Highway 44 at Garson, operated by Gillis Quarries Limited. Production in 1986 was reported as 26 868 tonnes.

Chemical analyses and physical properties are listed in Table 4. Additional chemical analyses are reported by Goudge (1944) and Bannatyne (1975). Physical properties have been reported also by Parks (1916) and James F. MacLaren Limited (1980).

Maps have been prepared for the southern Interlake region on a 1:50 000 scale (Bannatyne and Jones, 1979) on which outcrops, quarries, and known areas with less than 6 m of overburden are shown. That information is included in Map ER85-1-4 in this report, and indicates:

1) A bedrock high with 4 m of drift cover at SW1/4-11-10-7E near Monominto.
2) Several near-surface bedrock occurrences between Monominto and Anola, and between Anola and Garson.
3) A large area of shallow overburden around Garson and extending 8 km north from Tyndall.

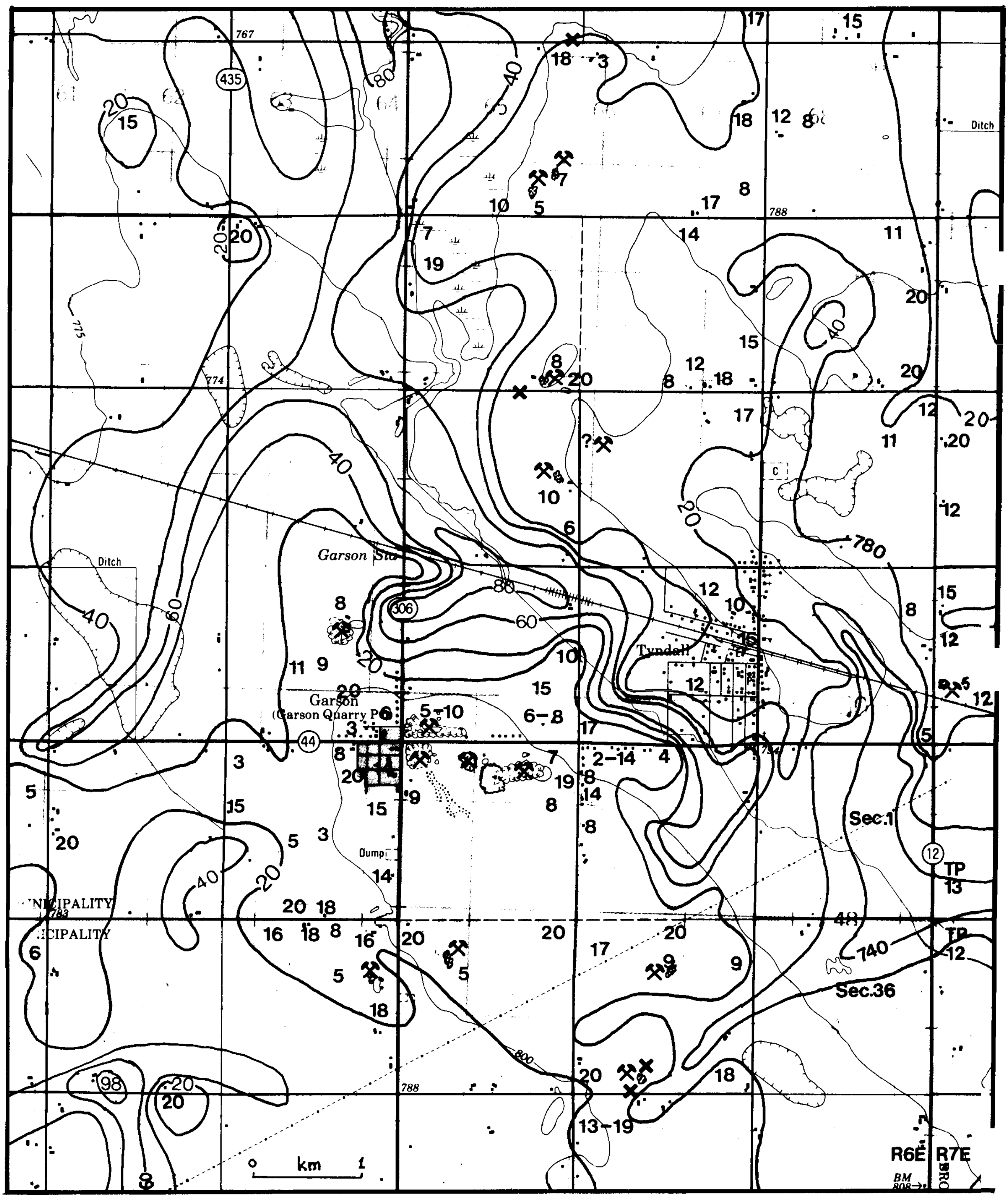



*Figure 8a:* ***Location of quarries and drift thickness in the Garson-Tyndall area. Bold figures are reported depths to bedrock in feet, at selected locations; contour interval is 20 feet (about 6 m). Modified from Preliminary Map 1979 DR-3, Bannatyne and Jones (1979).***

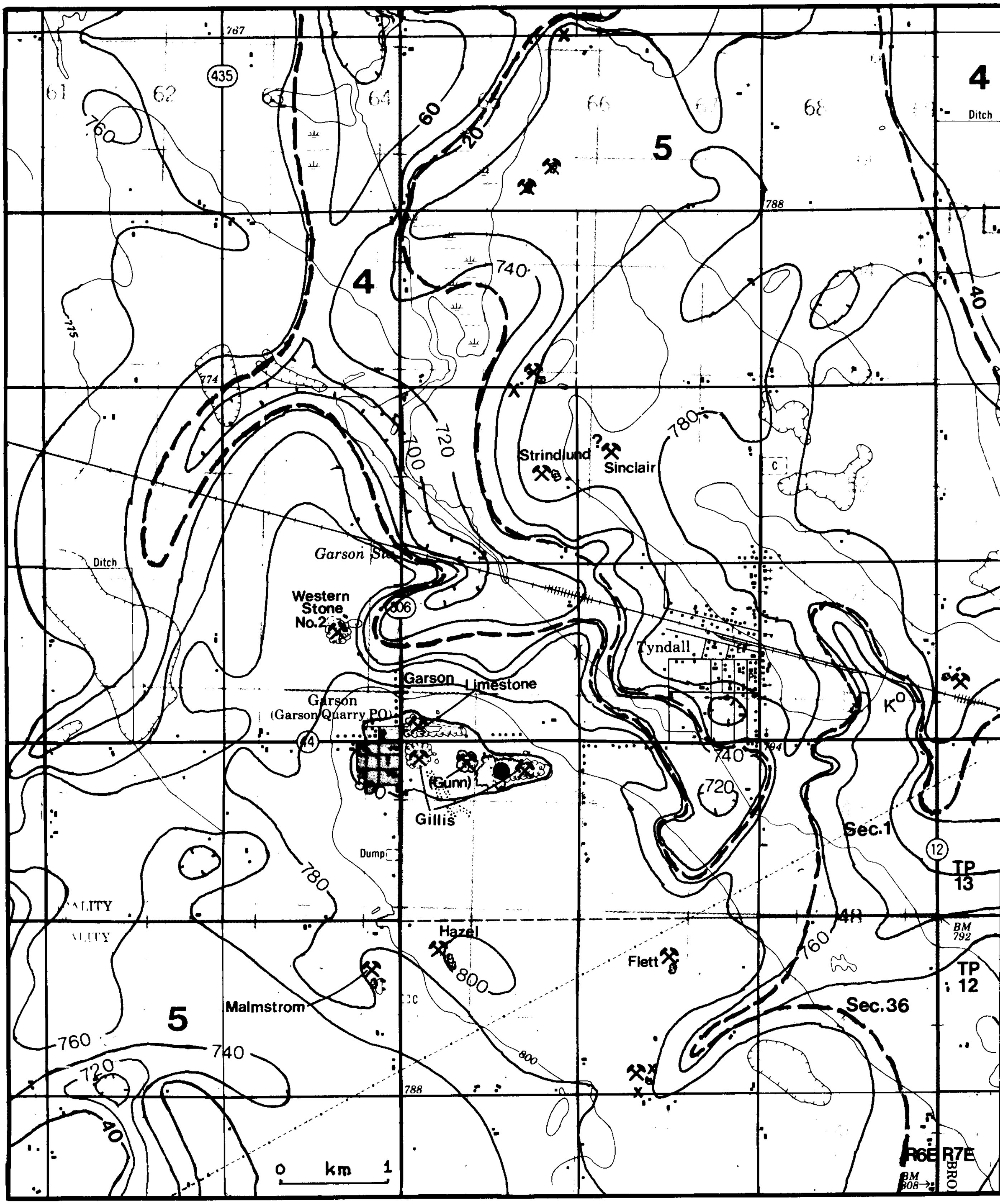



*Figure 8b:* *Geology and bedrock topography in the Garson-Tyndall area. Geological units are: (4) Cat Head Member; and (5) Selkirk Member. Bedrock elevations are in feet, and the contour interval is 20 feet (about 6 m). Modified from Preliminary Map 1979 DR-4, Bannatyne and Jones (1979).*

## TABLE 4

CHEMICAL AND PHYSICAL PROPERTIES OF DOLOMITIC LIMESTONE, **SELKIRK** MEMBER

Sample: a) Beds A to D; b) Beds E to H: Gillis quarry, 15-3-16-3E, Garson (Tyndall stone).

| | a | b | | |
|---|---|---|---|---|
| $SiO_2$ | 1.11% | 0.73% | Los Angeles Abrasion | Bulk Specific Gravity |
| $Al_2O_3$ | 0.13 | 0.12 | Loss: a) 51.1 | a) 2.38 |
| $Fe_2O_{3T}$ | 0.29 | 0.23 | b) 48.4 | b) 2.42 |
| CaO | 43.60 | 47.80 | Soundness Loss | Apparent Specific Gravity |
| MgO | 10.00 | 5.70 | 1.50''-0.75'':8.0, 3.5 | a) 2.64 |
| $Na_2O$ | 0.01 | 0.01 | 0.75''-0.50'':10.4,12.2 | b) 2.65 |
| $K_2O$ | 0.06 | 0.05 | 0.5''-0.375'':18.6,21.2 | |
| $TiO_2$ | 0.01 | 0.00 | | Absorption |
| $P_2O_5$ | 0.01 | 0.01 | | a) 4.0 |
| MnO | 0.02 | 0.02 | | b) 3.5 |
| LOI | 45.09 | 44.51 | | Porosity |
| Total | 100.33 | 99.18 | | a) 9.6 |
| | | | | b) 8.5 |

Potential Uses: Dimension stone; surface gravel; base course B; marginal for concrete aggregate (the differing hardness of dolomite mottles and lime. stone matrix may cause problems in crushing).

Additional Tests:
Sample: Mottled dolomitic limestone, drill hole HF-7, 74.7-75.3 m; Unconfined compressive strength: 353.6 kg/cm² (average of 2 samples).

Sources: Chemical analyses: Energy and Mines Analytical Laboratory; Physical tests and potential uses: UMA Group; Additional tests: J. Oosterveen (1981).

4) Isolated near-surface occurrences southwest from Garson to Dugald, and elsewhere.
5) Old quarries and an outcrop in the East Selkirk area. Because of the regional dip of the strata at 1:300 to the southwest, and the decrease in elevation between Garson and East Selkirk, it is estimated that the strata at East Selkirk are close to the same position within the Selkirk Member as the beds at the Garson quarries.
6) Outcrops along Red River in the Lockport-Lower Fort Garry area.
7) Bedrock highs along Highway 8 between St. Andrews and Winnipeg Beach. Part of this area is known to have a thin capping of dolomite of the basal part of Fort Garry Member (e.g., at M-3-79, described above; 3 m of overburden).

**Garson** quarries

Tyndall stone is currently quarried only by Gillis Quarries Limited, along the north-central part of sec. 3-13-6E. The company has reported they have adequate reserves for a few to several decades at the present site, and they hold rights to other potential quarry sites nearby.

In the past, several other quarries have been operated in the Garson-Tyndall area, some for building stone and some for rubble and for lime. Quarry locations and depth to bedrock are shown in Figure 8a; bedrock topography and geology are shown in Figure 8b. The locations and known histories of development of these quarries are described in the Mineral Inventory cards:

62-112:LST-1 — Sinclair quarry: 12-14-13-6E; lime.
62-112:LST-2 — Malmstrom quarry: l.s. 9 and 10, 33-12-6E; lime.
62-112:LST-3 — Strindlund quarry: 9-15-13-6E; lime.
62-112:STN-1 — Gillis Quarries, Garson: 13-3-13-6E; stone.
62-112:STN-2 — Garson Limestone Ltd.: l.s. 3 and 4, 10-13-6E; stone.
62-112:STN-3 — Gillis Quarries, Garson East: l.s. 15 and 16, 3-13-6E; stone.
62-112:STN-4 — Gunn quarry: 14-3-13-6E; stone.
62-112:STN-5 — Western Stone No. 2: 10-9-13-6E; stone.
62-112:STN-6 — Hazel quarry: NW1/4-34-12-6E; stone.
62-112:STN-7 — Flett's quarry: NE1/4-35-12-6E; stone.

Other small kilns and/or quarries were operated in 5-6-14-5E, east of Tyndall, and in 3-35-12-6E, south of Flett's quarry. Other quarries are present in southeast parts of sec. 22 and 27, 13-6E (Fig. 8a).

Winnipeg Beach area

In 1979, a previously unknown bedrock high was located by a contractor in the area west of Winnipeg Beach, in l.s. 14, sec. 6-18-4E. A quarry was opened for crushed stone, and exposes 4.7 m of a colour-mottled dolomite. A drill hole beside the quarry (Fig. 9) intersected an estimated 36 m of the Selkirk Member and 16.3 m of the Cat Head, although the exact contact is uncertain because of the completely dolomitized nature of the Selkirk Member (McCabe, 1980). The physical tests (Table 5) indicate that the stone is superior to Tyndall stone for use as aggregate, probably because of its more uniform hardness and lack of a softer limestone component. Water well data suggest that the bedrock high is of limited extent, but detailed exploration is required to determine the limit of near-surface dolomite.

FORT GARRY MEMBER

In the Winnipeg region the member consists of a lower micritic dolomite, a thin central red argillaceous layer, and an upper crystalline dolomite that has thin (1-3 m) central and upper interbeds of high-calcium limestone.

The rock was first quarried in 1960, when Mulder Bros. Ltd. began production of crushed stone for aggregate from an outcrop area in l.s. 10, sec. 27-13-3E, 10 km northeast of Stony Mountain (MI card 62-113:DOL-9). Production continued until 1982, and about 6 m of dolomite was excavated from the quarry, which is normally water-filled. The section exposed consists of the central part of the member. Stone with variable properties is present: the lower micritic dolomite, the red, argillaceous, microfaulted marker bed, and the upper crystalline, locally cherty, fossiliferous dolomite (Fig. 10).

Examination of drill core from this member suggests the rock is a sound dolomite that would probably be suitable for most uses of aggregate. Analyses and tests of both the lower and upper parts, from samples collected from the Mulder Bros. quarry, are listed in Tables 6 and 7. Most of the member has not been tested, as only the central 4 m of this 30 m thick unit is exposed in that quarry.

Only a few other outcrops of this member are known — one located 4 km south of Arborg, and several in the Sylvan-Rosenberg region (Map ER85-1-2). The member has not been mapped as an individual unit in the

Figure 9: Geological Services drill in operation at the edge of the Winnipeg Beach quarry, in dolomitized Selkirk Member.

Upper part, Fort Garry Member

Central, shaly marker bed

Lower part, Fort Garry Member

Figure 10: Red shale marker bed separating the Fort Garry Member into upper crystalline dolomite and lower micritic dolomite; Mulder Brothers No. 12 quarry, northeast of Stony Mountain. Approximately 4.5 m of rock is exposed.

## TABLE 5

CHEMICAL AND PHYSICAL PROPERTIES OF SELKIRK MEMBER

Sample: 4 m mottled dolomite, quarry in 14-6-18-4E, Winnipeg Beach area

| | | | |
|---|---|---|---|
| $SiO_2$ | 1.41% | Los Angeles Abrasion | Bulk Specific Gravity |
| $Al_2O_3$ | 0.25 | Loss: 41.2% | 2.51 |
| $Fe_2O_{3T}$ | 0.26 | | |
| CaO | 30.80 | Soundness Loss | Apparent Specific Gravity |
| MgO | 20.40 | 1.50"-0.75": 8.0 | 2.71 |
| $Na_2O$ | 0.02 | 0.75"-0.50": 8.3 | |
| $K_2O$ | 0.13 | 0.5''-0.375'': 16.8 | |
| $TiO_2$ | 0.01 | | Absorption |
| $P_2O_5$ | 0.02 | | 3.0% |
| MnO | 0.02 | | |
| LOI | 46.81 | | Porosity |
| Total | 100.13 | | 7.5 |

Potential Uses: Surface gravel, base course A, base course B, concrete aggregate; marginal for asphalt aggregate

Additional Tests:
None.

Sources: Chemical analyses: Energy and Mines Analytical Laboratory; Physical tests and potential uses: UMA Group

## TABLE 6

CHEMICAL AND PHYSICAL PROPERTIES OF LOWER FORT GARRY MEMBER

Sample: 2.5 m, south wall, base, Mulder Brothers Pit No. 12., sec. 27-13-3E; lower part of member, micritic dolomite

| | | | |
|---|---|---|---|
| $SiO_2$ | 1.98% | Los Angeles Abrasion | Bulk Specific Gravity |
| $Al_2O_3$ | 0.42 | Loss: 32.5% | 2.64 |
| $Fe_2O_{3T}$ | 0.29 | | |
| CaO | 30.50 | Soundness Loss | Apparent Specific Gravity |
| MgO | 20.10 | 1.50''-0.75'': 23.8% | 2.80 |
| $Na_2O$ | 0.01 | 0.75"-0.50": 27.2 | |
| $K_2O$ | 0.18 | 0.5"-0.375": 34.2 | |
| $TiO_2$ | 0.03 | | Absorption |
| $P_2O_5$ | 0.01 | | 2.2% |
| MnO | 0.02 | | |
| LOI | 46.31 | | Porosity |
| Total | 99.85 | | 5.9% |

Potential Uses: Surface gravel; base course A and B

Additional Tests:
Sample: Micritic dolomite (mudstone), drill hole HF-7, 28.9-29.6 m; Unconfined compressive strength: 1091.6 kg/cm²

Sources: Chemical analyses: Energy and Mines Analytical Laboratory; Physical tests and potential uses: UMA Group; Additional tests: J. Oosterveen (1981).

area from Lake St. Martin to The Pas. However, several outcrops along 'Mitchell Lake road', near the northwest shore of Cormorant Lake, are believed to be Fort Garry equivalent, based on their stratigraphic position, as they occur below and northeast of an escarpment of Stony Mountain dolomite. The outcrop surfaces exhibit well developed crescentic gouges, caused by glaciation (Fig. 11).

Some beds of the upper part of this member take a good polish, as determined from samples obtained from an excavation site for the Winnipeg Floodway inlet structure, southeast of St. Norbert. The tested samples were of a varicoloured, predominantly mauve and buff, dolomite.

GRAND RAPIDS-PONTON-SIMONHOUSE LAKE AREA

The Red River Formation has never been subdivided into members in the northern Interlake area as the units are completely dolomitized; however, in outcrops northwest of Cormorant Lake, rocks that are probably equivalent to the Fort Garry Member are believed to have been identified. Outcrops, quarries and areas of near-surface bedrock are shown in Map ER85-1-3.

Dolomite of the Red River Formation has been quarried at numerous localities:

1) *north of* Minago River — dolomite (Fig. 12) that is bluish grey, bleached to buff along bedding planes and fractures (M.I. card 63J/3:DOL-1). The physical and chemical properties of the dolomite are listed in Table 8.

## TABLE 7

CHEMICAL AND PHYSICAL PROPERTIES OF UPPER FORT GARRY MEMBER

Sample: 1.5 m vuggy cherty dolomite, Mulder Brothers Pit No. 12, sec. 27-13-3E; northwest corner of quarry, upper part of member.

| | | | |
|---|---|---|---|
| $SiO_2$ | 1.68% | Los Angeles Abrasion | Bulk Specific Gravity |
| $Al_2O_3$ | 0.17 | Loss: 32.7% | 2.52 |
| $Fe_2O_{3T}$ | 0.26 | | |
| CaO | 31.00 | Soundness Loss | Apparent Specific Gravity |
| MgO | 20.00 | 1.50"-0.75": 15.3% | 2.73 |
| $Na_2O$ | 0.02 | 0.75"-0.50": 19.8 | |
| $K_2O$ | 0.07 | 0.5"-0.375": 30.7 | |
| $TiO_2$ | 0.01 | | Absorption |
| $P_2O_5$ | 0.01 | | 3.1% |
| MnO | 0.03 | | |
| LOI | 46.74 | | Porosity |
| Total | 99.99 | | 7.7% |

Potential Uses: Surface gravel, base course A and B

Additional Tests:
Sample: Very fine grained dolomite, drill hole ASD-1 (SW13-29-11-2E), 38.7-39.3 m, 4.1 m below top of Fort Garry Member.
Unconfined compressive strength: 619.1 kglcm², average of 2 samples.

Sources: Chemical analyses: Energy and Mines Analytical Laboratory; Physical tests and potential uses: UMA Group; Additional tests: J. Oosterveen (1981).

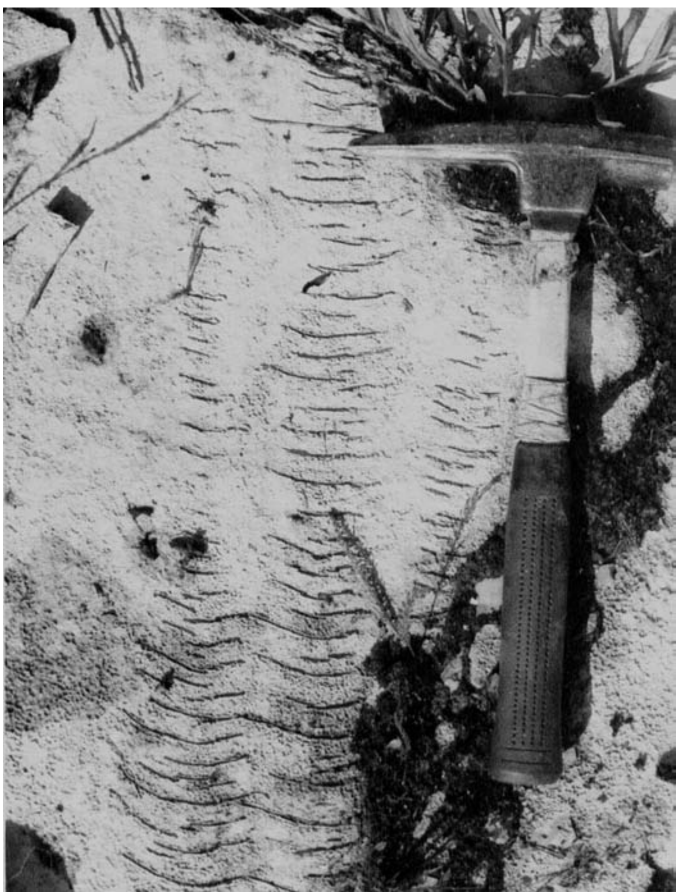


Figure 11: Welldeveloped crescentic gouges on glaciated surface of Ordoviciandolomite (Fort *Garry* Member equivalent, upper part), between Mitchell Lake *road* and *northwest shore* of Cormorant Lake, near the centre of township *61-24W*.

2) south of Ponton — two large quarries south of Hudson Bay Railway; colour-mottled dolomite (Fig. 13), with patterns of mottles locally resembling that of Tyndall stone, but with a 'patchy' rather than a 'tapestry' aspect. Originally used by Canadian National Railways for ballast; now used by Department of Highways for crushed stone aggregate (M.I. card 63J/11:DOL-1). A quarry was once worked north of Ponton (M.I. card 63J/11:DOL-2).
3) Sunday Lake-Wekusko area — 3 quarries in colour-mottled, nodular dolomite, possibly an outlier of Stony Mountain Formation dolomite (Fig. 14); used for aggregate for roads; rock takes a good polish (M.I. cards 63J/12:DOL-1,2). The physical and chemical properties of a sampled section from the Sunday Lake quarry are listed in Table 9.
4) South of Wekusko Lake — 3 quarries opened in 1982-1983 for aggregate for Provincial Road 391 (now Highway 39); dolomite locally has colour mottling in tapestry pattern (Fig. 15); locally contains chert in thin irregular patches and nodules in some quarries; buff to purplish, slabby dolomite (Fig. 16) in quarry near junction of Highway 39 and P.R. 392 to Snow Lake (M.I. cards not available; see descriptions in Appendix 2).
5) Snow Lake road quarry — on either side of P.R. 392; a hard dolomite that proved difficult to blast and crush has been quarried for aggregate for both the old and present P.R. 392; a high wall of dolomite has been left between the quarries and the road (Fig. 17); the quarry represents an outlier of Ordovician dolomite (formation has not been positively identified); deep maroon to orange and buff dolomite, in places nodular; takes a good polish; finely colour-laminated patches with bulbous layers may be stromatolite remnants (M.I. card 63J/12:DOL-4).
6) *Tramping Lake quarry* — a large quarry, about 500 m long, exposes 2-3 m of buff, mottled dolomite; Receptaculites and other fossils (cephalopods, corals, trilobites) occur on bedding planes; the rock differs from the Tyndall stone of southern Manitoba as it occurs in thin, flaggy beds, but could be a possible northern equivalent of the Selkirk Member; a large amount of rock has been removed for aggregate for road construction (M.I. card 63K/9:DOL-1).
7) Reed Lake — at the eastern boundary of Grass River Provincial Park, and north of Highway 39, an excavated drainage ditch 4 m wide exposes 2.5 m of medium bedded (12-20 cm), very tough dolomite with an overall purplish colour; tapestry-type mottling is visible on the bedding plane surface south of the excavated area; rock takes a good polish (Sabina, 1972).

# TABLE 8

### CHEMICAL AND PHYSICAL PROPERTIES OF RED RIVER FORMATION DOLOMITE

Samples: a) Red River Fm., Minago River North quarry; sec. 22-60-12W.
b) Red River Fm., Snow Lake Road quarry, SW28-66-17W (no chemical analysis)

| | a |
|---|---|
| $SiO_2$ | 1.58% |
| $Al_2O_3$ | 0.36 |
| $Fe_2O_{3T}$ | 0.45 |
| CaO | 30.00 |
| MgO | 20.80 |
| $Na_2O$ | 0.01 |
| $K_2O$ | 0.12 |
| $TiO_2$ | 0.03 |
| $P_2O_5$ | 0.02 |
| MnO | 0.02 |
| LOI | 46.58 |
| Total | 100.00 |

Los Angeles Abrasion
Loss: a) 25.8%
b) 22.1
Soundness Loss
1.50"-0.75": 2.2; 0.18%
0.75"-0.50": 1.3; 0.37%
0.5"-0.375": 2.2, 1.17%

Bulk Specific Gravity
a) 2.75
b) 2.80
Apparent Specific Gravity
a) 2.83
b) 2.81

Absorption
a) 1.06%
b) 0.50%
Porosity
a) 2.96%
b) 1.41%

Potential Uses: Concrete aggregate, asphalt aggregate, base course A and B, surface gravel; sample b, also: ballast

Additional Tests: None

Sources: Chemical analyses: Energy and Mines Analytical Laboratory; Physical tests and potential uses: UMA Group; Snow Lake Road sample, Jones (1986).


Figure 12: Minago River North quarry, showing buff, bedded dolomite with grey cores and central layers that have resulted from bleaching along bedding planes and fractures. Cores are outlined by dashed lines.

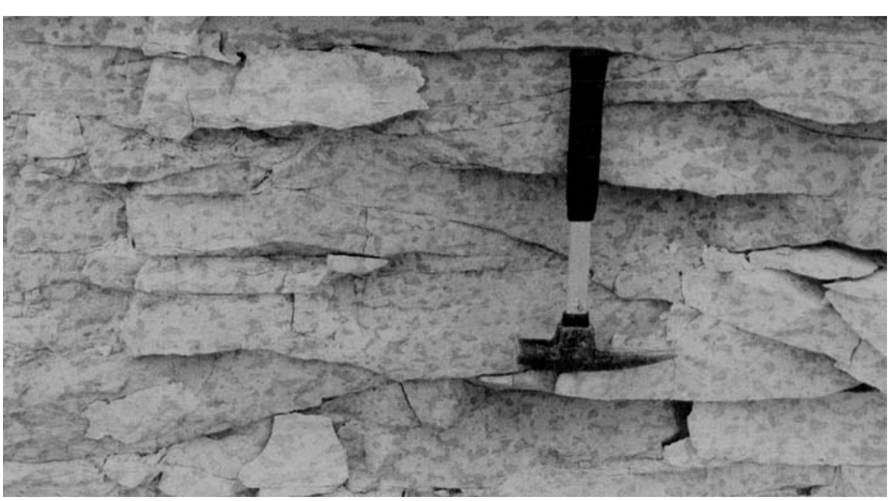
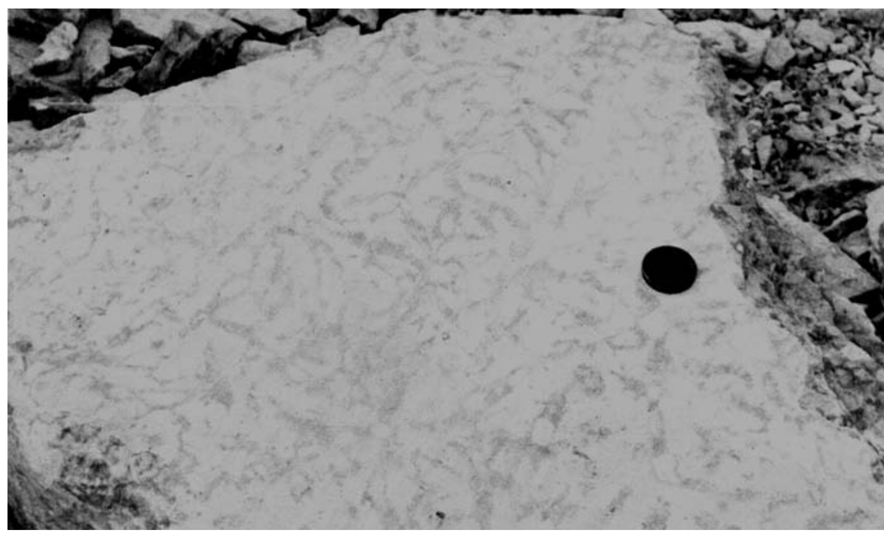


Figure 13: East quarry at Ponton, exposing Red River Formation dolomite with a patchy mottling.

*Figure 14:* *Nodular dolomite in the Sunday Lake quarry north of the hamlet of Wekusko. The stone takes a good polish and occurs in shades of red, purple and buff; (?)Stony Mountain Formation.*

*Figure 15.* *Mottled texture along bedding plane of probable Red River Formation dolomite, in quarry in **SW20-65-16W**, south of Wekusko Lake.*



## TABLE 9

**CHEMICAL AND PHYSICAL PROPERTIES OF ORDOVICIAN DOLOMITE, WEKUSKO AREA**

*Sample: 5.4 m dolomite, southeast corner, quarry west of Sunday Lake, SW¼ 30-64-15W; possibly Stony Mountain Formation*

| | | | |
|---|---|---|---|
| $SiO_2$ | 1.51% | *Los Angeles Abrasion* | *Bulk Specific Gravity* |
| $Al_2O_3$ | 0.20 | *Loss: 22.9%* | *2.82* |
| $Fe_2O_{3T}$ | 0.18 | | |
| CaO | 30.00 | *Soundness Loss* | *Apparent Specific Gravity* |
| MgO | 20.90 | *1.SO"-0.75": 1.9%* | *2.86* |
| $Na_2O$ | 0.02 | *0.75"-0.50":1.7* | |
| $K_2O$ | 0.13 | *0.5"-0.375":2.5* | |
| $TiO_2$ | 0.01 | | *Absorption* |
| $P_2O_5$ | 0.01 | | *0.50%* |
| MnO | 0.02 | | |
| LOI | 46.73 | | *Porosity* |
| *Total* | 99.71 | | *1.14%* |

*Potential Uses: Suitable for ballast, concrete aggregate, asphalt aggregate, and highway aggregate; takes a polish*

*Additional Tests: None*

*Sources: Chemical analyses: Energy and Mines Analytical Laboratory; Physical tests and potential uses: UMA Group.*

Figure 16: *Slabby* beds of buff dolomite, to the right, grading to purplish red dolomite to the left, in quarry near junction of Highway *39* and P.R. *392* to Snow Lake; formation uncertain.

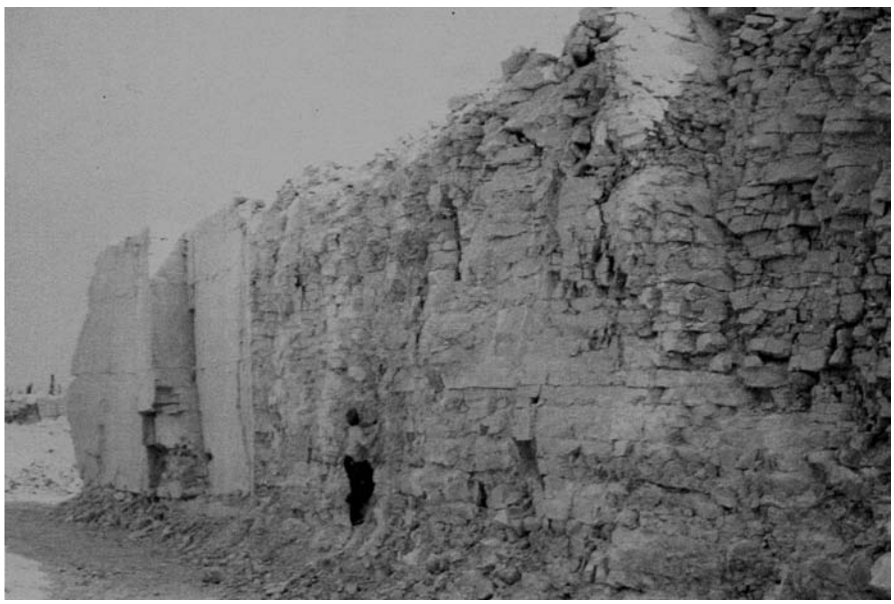


Figure 17: An Ordovician outlier of probable Red River Formation along P.R. *392* to Snow Lake; a very tough, thin bedded, varicoloured (in shades of red and buff) dolomite.

8) Iskwasum Lake quarry — is located north of 'Mile 25' on Highway 39, measured from the junction with Highway 10, and about 1 km west of turn-off to Iskwasum Lake campground; in 1980, the quarry was 200 m long, 45 m wide and from 6 to 7 m deep (Fig. 18); the rock is a medium bedded grey, crystalline dolomite with no evidence of mottling; chert nodules and fossils were not observed during a brief examination of the quarry; numerous boulders of Winnipeg sandstone are present in the area, although the quarry floor is composed of dolomite (M.I. card 63K/10:DOL-1). The quarry is located in Paleozoic strata immediately south of the Precambrian Shield.

9) Simonhouse Lake quarry — exposes 6 m of thin to medium bedded, finely crystalline, greyish buff dolomite; it is located south of Highway 39 at 'Mile 10' from the junction with Highway 10; the quarry is about 150 m long and 110 m wide; the rock lacks diagnostic features such as chert or readily visible fossils, but contains some coarse vugs in grey dolomite about 1 m below the top.

10) Goose Lake — a small quarry has been opened in sec. 36-62-27W, west of Highway 10, as a source of crushed stone for road construction. The quarry has been rehabilitated and the original quarry walls are obscured. It is located in the outcrop belt of the Red River Formation, and dolomite is exposed in a low escarpment in a roadcut on the highway immediately north of the entrance road to the quarry.

Large cliffs of dolomite (Fig. 19) are exposed immediately inland from the south shore of Wekusko Lake. The rock is locally present in huge blocks separated by deep crevices that contain remnants of ice even in midsummer. One of the most accessible areas is by trail to an 'Observation Point', along the side road extending northeast from Herb Lake Landing. At least four different dolomite units, based on colour and texture, are exposed in layers along the trail to the top of the cliffs. West of Herb Lake Landing, at least two outcrops of weathered Precambrian rock occur along the south shore of Wekusko Lake; they consist of somewhat stiff, brownish red and greyish green clayey regolith and outcrop along the shoreline of a small bay immediately west of the Spencer farm.

Figure 18: *Iskwasum Lake quarry, in Red River dolomite; an attempt has been made at rehabilitation.*

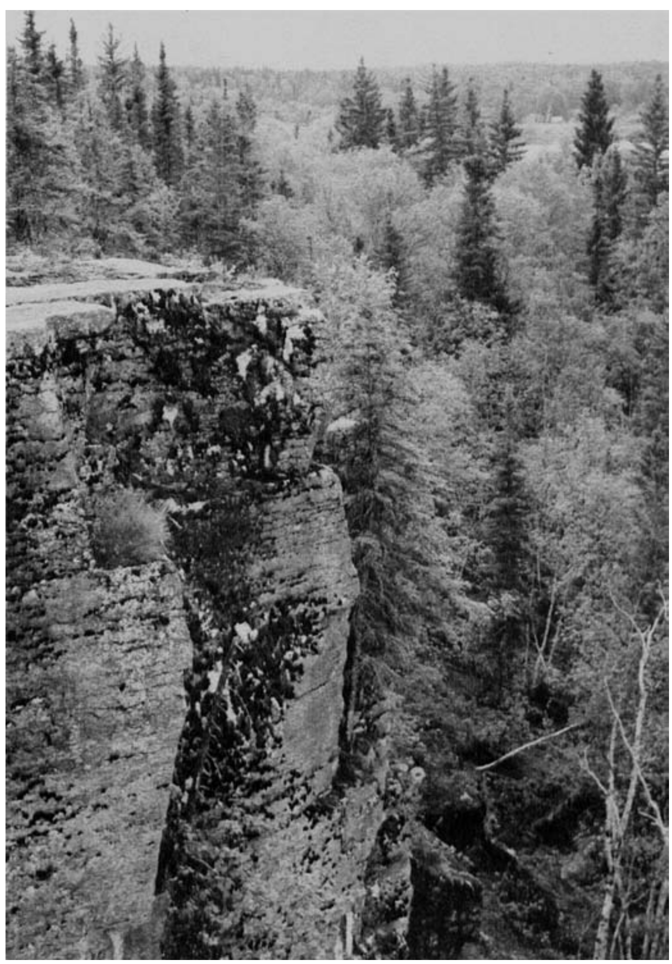


Figure 19: *Cliffs of Ordovician dolomite at Observation Point, 'Hales Landing', southeast shore of Wekusko Lake. Locally these cliffs exceed 10 m in height.*

## STONY MOUNTAIN FORMATION

Dolomite of the Stony Mountain Formation has been a primary raw material for lime, crushed stone and other uses since the early days of the settlement of Manitoba. In particular, the Gunton Member dolomite in the Stony Mountain-Stonewall area has supplied much of the aggregate used in the city of Winnipeg and surrounding areas. Four members have been recognized in southern Manitoba — the Gunn, Penitentiary, Gunton and Williams — but the formation is undivided in the region north of Lake St. Martin.

SOUTHERN *INTERLAKE* AREA

**GUNN MEMBER**

This unit, in southern Manitoba, consists of red calcareous shale interbedded with thin limestone layers. A lateral facies change from Gunn-type (calcareous, argillaceous) to Penitentiary-type (slightly argillaceous dolomite) lithology occurs northward from the Stonewall area, and the unit is neither argillaceous nor calcareous north of Inwood.

Figure 20: Dolomite of the *Gunton* Member, argillaceous dolomite of the Penitentiary Member, and interbedded shale and limestone of the Gunn Member are exposed in the north wall of the southeast quarry operated by the City of Winnipeg at Stony Mountain.

### TABLE 10

**CHEMICAL AND PHYSICAL PROPERTIES OF GUNN MEMBER**

Sample: 1.6 m of upper part of member, from pit northeast of crusher, Stony Mountain quarry, 14-13-2E.

| | | | |
|---|---|---|---|
| $SiO_2$ | 7.70% | Los Angeles Abrasion Loss: 45.7% | Bulk Specific Gravity 2.56 |
| $Al_2O_3$ | 2.66 | | |
| $Fe_2O_3$ | 1.54 | | |
| CaO | 42.5 | Soundness Loss | Apparent Specific Gravity 2.74 |
| MgO | 4.90 | 1.50''-0.75'': 69.5% | |
| $Na_2O$ | 0.04 | 0.75''-0.50'': 69.8 | |
| $K_2O$ | 1.05 | 0.5''-0.375'': 79.8 | |
| $TiO_2$ | 0.13 | | Absorption 2.6% |
| $P_2O_5$ | 0.04 | | |
| MnO | 0.04 | | |
| LOI | 38.75 | | Porosity 6.6% |
| Total | 99.35 | | |

Potential Uses: Surface gravel, base course B

Additional Tests: None.

Sources: Chemical analyses: Energy and Mines Analytical Laboratory; Physical tests and potential uses: UMA Group.

*Figure* 21: Oldkiln at the *Birse* quarry, built from one thick bed of vuggy dolomite exposed at the top of the quarry; *Gun*-ton Member, Stony Mountain Formation. An extensive quarry has been operated by Mulder Brothers Limited since 1982 to the northwest of the kiln.

A small amount of upper part of the Gunn Member has been excavated locally in the City of Winnipeg quarry at Stony Mountain (Fig. 20). The unit is not considered to be a source of dolomite. A sample of calcareous rock, consisting of limestone and shale, was tested (Table 10).

PENITENTIARY MEMBER

Argillaceous dolomite of this member is quarried at Stony Mountain and used for low quality aggregate (e.g., low quality crushed stone for back lanes); physical and chemical properties are listed in Table 11. It has also been quarried in parts of the Standard Limestone, Northwest, and D. Munroe quarries, listed under the Gunton Member. The Penitentiary Member has been identified as a mappable unit only in the area south of Lake St. Martin.

**GUNTON** MEMBER

The Gunton Member is economically the most important unit, as it is the major source of crushed stone aggregate for the Winnipeg-southern Interlake region. Numerous quarries have been operated in the Winnipeg-Stony Mountain-Stonewall region (Fig. 21, 22), and at Gunton (Fig. 23), to supply raw material for both aggregate and dolomitic lime. A quarry was opened in 1986 southwest of Komarno in Gunton dolomite (Map ER85-1-2).

The unit has a maximum thickness of 11 m. It is present in a series of topographic highs, as outliers, from Winnipeg to Stony Mountain (Map ER85-1-4) and occurs as an escarpment, locally breached or notched, extending from south of Stonewall to Gunton (Map ER85-1-1). The unit is predominantly dolomite but contains a low, variable argillaceous content (e.g., 0.78% $SiO_2$, 0.14% $Al_2O_3$ east of Stonewall, compared with 2.95%

## TABLE 11

CHEMICAL AND PHYSICAL PROPERTIES OF PENITENTIARY MEMBER

Sample: 2.1 m argillaceous dolomite southeast of crusher, Stony Mountain quarry, sec. 12-13-2E

| | | | |
|---|---|---|---|
| $SiO_2$ | 12.00% | Los Angeles Abrasion | Bulk Specific Gravity |
| $Al_2O_3$ | 3.94 | Loss: 58.0% | 2.38 |
| $Fe_2O_{3T}$ | 2.13 | | |
| CaO | 26.70 | Soundness Loss | Apparent Specific Gravity |
| MgO | 18.40 | 1.50"-0.75": 100% | 2.76 |
| $Na_2O$ | 0.09 | 0.75"-0.50": 100 | |
| $K_2O$ | 1.56 | 0.5"-0.375": 100 | |
| $TiO_2$ | 0.20 | | Absorption |
| $P_2O_5$ | 0.05 | | 5.6% |
| MnO | 0.04 | | |
| LOI | 38.23 | | Porosity |
| Total | 100.34 | | 13.7% |

Potential Uses: Surface gravel, base course B

Additional Tests:
Sample: Argillaceous dolomite (mudstone), drill hole ASD-2 (NE1-8-12-1E), 33.8-34.7 m, 3.9 m below top of member
Unconfined compressive strength: 293.5 km/cm², average of 2 samples.

Sources: Chemical analyses: Energy and Mines Analytical Laboratory; Physical tests and potential uses: UMA Group; Additional tests: J. Oosterveen (1981).

*Figure* 22: General Stone Products quarry in *Gunton* dolomite, *SW5-14-2E;* this is one of five or more quarries east and northeast of Stonewall from which about two million tons of crushed stone is produced annually.

$SiO_2$ and 1.02% $Al_2O_3$ at Lilyfield; see Table 12). The variation is sufficient to alter the quality of the stone, as at some localities it is suitable for concrete aggregate and at others it is not. The variations are a reflection of different depositional environments that existed between Stonewall and Stony Mountain (Wallace, 1979). Farther north at Gunton (Fig. 23), the stone is of high quality and was used in 1963 in runway construction at Gimli.

Location of quarries and depth to bedrock in the Stony Mountain-Stonewall area are shown in Figure 24a; bedrock topography and geology are shown in Figure 24b. Numerous quarries are periodically or continuously active in the area, although accessible Gunton dolomite at Stony Mountain is almost depleted. Quarries in the area are listed in Table 13.

## TABLE 12

CHEMICAL AND PHYSICAL PROPERTIES OF GUNTON MEMBER, STONY MOUNTAIN AREA

Samples: a) Lilyfield quarry, l.s. 6-28-12-2E; 1.8 m dolomite, north wall.
b) Stony Mountain, sec. 11-13-2E; 4 m dolomite, SE of crusher.
c) Lillies Farm quarry, l.s. 13-32-13-2E; 5.5 m dolomite, north wall.
d) Gunton south, l.s. 6-28-15-2E; 6.85 m dolomite, composite section from north and east walls

| Sample: | a | b | c | d |
|---|---|---|---|---|
| $SiO_2$ | 2.95% | 1.35% | 0.78% | 1.54% |
| $Al_2O_3$ | 1.02 | 0.39 | 0.14 | 0.33 |
| $Fe_2O_{3T}$ | 0.48 | 0.26 | 0.21 | 0.26 |
| CaO | 30.00 | 30.90 | 30.50 | 30.60 |
| MgO | 19.60 | 20.30 | 20.40 | 20.00 |
| $Na_2O$ | 0.03 | 0.02 | 0.01 | 0.01 |
| $K_2O$ | 0.38 | 0.16 | 0.06 | 0.16 |
| $TiO_2$ | 0.05 | 0.02 | 0.01 | 0.02 |
| $P_2O_5$ | 0.01 | 0.01 | 0.00 | 0.01 |
| MnO | 0.03 | 0.03 | 0.02 | 0.02 |
| LOI | 45.51 | 46.81 | 47.10 | 46.55 |
| Total | 100.06 | 100.25 | 99.23 | 99.50 |

Los Angeles Abrasion
Loss: 27.5%, 27.7,
29.3, 30.3
Soundness Loss
1.50"-0.75": 17.1,
4.5, 12.7, 9.6
0.75"-0.50": 16.5,
5.2, 13.3 10.3
0.5"-0.375": 27.0,
8.5, 20.9, 15.0

Bulk Specific Gravity
2.59, 2.62, 2.59,
2.62
Apparent Specific
Gravity
2.77, 2.76, 2.75, 2.75

Absorption
2.5, 1.9, 2.2, 1.9

Porosity
6.4, 5.0, 5.8, 5.0

Potential Uses: All except sample a (Lilyfield) are suitable for concrete aggregate and asphalt aggregate; all are suitable for base course A and B, and surface gravel. Sample b (Stony Mountain) is marginal for ballast. See M.I. cards for earlier uses, e.g. lime, curbstone, local use as building stone.

Additional Tests:
Sample: Dolomite, drill hole ASD-8 (Lot 23-24, Parish of St. Francois Xavier), 46.6-47.2 m, 10.9 m below top of Gunton.
Unconfined compressive strength: 933.0 $kg/cm^2$, average of 2 samples.

Sources: Chemical analyses: Energy and Mines Analytical Laboratory; Physical tests and potential uses: UMA Group; Additional tests: J. Oosterveen (1981).

## TABLE 13

QUARRIES IN WINNIPEG-STONY MOUNTAIN-
STONEWALL EAST AREA

| | |
|---|---|
| Little Mountain* | SW1/4 34-11-2E<br>NW1/4 26-11-2E |
| Lilyfield | l.s.2 and l.s. 6, 28-12-2E |
| Stony Mountain | sec. 11 and 14, 13-2E<br>12-13-2E |
| Stonewall East | Kleysen's: l.s. 7, 33-13-2E<br>Riverside: l.s. 7, 33-13-2E<br>H. Munro: l.s. 7, 33-13-2E<br>Northwest: 33-13-2E<br>Standard: l.s. 14 and 15, 33-13-2E<br>Birse, Mulder Bros.: l.s. 2, 4-14-2E<br>Lillies' farm: l.s. 13, 32-13-2E<br>General Stone: l.s. 3, 5-14-2E<br>Riverside: l.s. 11, 4-14-2E<br>Bison Rock Products: l.s. 14, 4-14-2E |
| Gunton | l.s. 6, 7 and 14, 28-15-2E (3 quarries)<br>D. Munroe: l.s. 15 and 16, 21-12-2E |

*Formerly known as Little Stony Mountain.

Figure 23: East *wall of* the quarry south of *Gunton,* east of the railway; an almost complete section of the *Gunton* Member dolomite is exposed. The Penitentiary Member forms the floor of the quarry. About 8 *m* of dolomite is exposed.

Dolomite of the Stony Mountain Formation, probably of the Gunton Member, was once quarried for 'marble' in the Hodgson area, in NE18-25-1W, by Winnitoba Marble Quarries, Limited in the early 1930s. Three pits were worked, one along an escarpment and two on a plateau area to the south. The southwestern pit (Fig. 25) can be dry at times, and several thick layers have been sampled; they exhibit a variety of colours and textures. The lower 2 to 3 m of the pit is filled with rubble. Details of the quarry operation and test pitting are given in Mineral Inventory Card 62P/4:STN-1. Somewhat similar dolomite extends eastward and southeastward for about 20 kilometres and forms an escarpment known locally as Marble Ridge.

### WILLIAMS MEMBER

The Williams Member, separating the Gunton Member and the Stonewall Formation, consists of argillaceous dolomite, and contains some beds with abundant quartz sand grains. In the outcrop belt, it is recognized mainly in the Stonewall area where it is exposed in a pit in the floor of the northwest quarry at Stonewall. It is considered of overall poor quality and is not quarried. A sample of greenish grey arenaceous dolomite (grainstone), from 14-17 m in drill hole ASD-2 (NE1-8-12-1E) in the upper part of the member, was tested by Oosterveen (1981); unconfined compressive strength is 349.2 kg/cm².

### NORTHERN *INTERLAKE* AREA

In the region north from Lake St. Martin, the Gunn, Penitentiary and Williams members have not been mapped as separate units, although their equivalents may be present; the section is composed entirely of a Gunton-like dolomite. It may be either slabby and buff or thick bedded and in shades of rose, orange and purple. Clay and sand contents are low.

The rock has been quarried for crushed stone aggregate south of Minago River, east of Highway 6 (Map ER85-1-3 and M.I. card 63J/3:DOL-2). Physical and chemical properties of that rock are listed in Table 14. Some of the dolomite that has been quarried in the Wekusko area is of uncertain age, as noted in the section on the Red River Formation. Hard, medium to thick bedded dolomite that takes a good polish has been quarried as 'marble' at two locations along Hudson Bay Railway: south of the Narrows at Cormorant Lake ('Mile 39') and near Paterson ('Mile 69'). Both quarries operated for a few years in the 1930s, but have been inactive since 1936. The history of operations and detailed descriptions of the quarries are included in M.I. cards 63K/2:STN-1 and 63K/8:STN-1. By 1936, 6 beds in the 'Mile 39' quarry had been worked, and the quarry was 61 m long and extended 30.4 m back into the escarpment (Fig. 26); the face was 3.6 m high. Production figures are not available, but the dimensions indicate that between 10 000 and 15 000 tonnes of stone was quarried. The 'rose ivory' stone from the quarry was used as decorative trimstone in the Buller Biological Building at the University of Manitoba.

Ordovician dolomite, probably of the Stony Mountain Formation, was quarried from 1930 to 1931 at 'Mile 69 1/2' of the Hudson Bay Railway, near Paterson, by Hudson Bay Marble and Granite Quarries Limited. Goudge (1944) reported the mottled red and buff dolomite, in beds up to 0.75 m thick and exposed in a 5 m escarpment, "takes an excellent polish... but exhibits a tendency to pluck on sawing and polishing because of the presence of extremely thin films of red shaly material throughout much of the stone." It was used as decorative trimstone in the Tier Building at the University of Manitoba. Ground access to the quarry is difficult, except by railway.

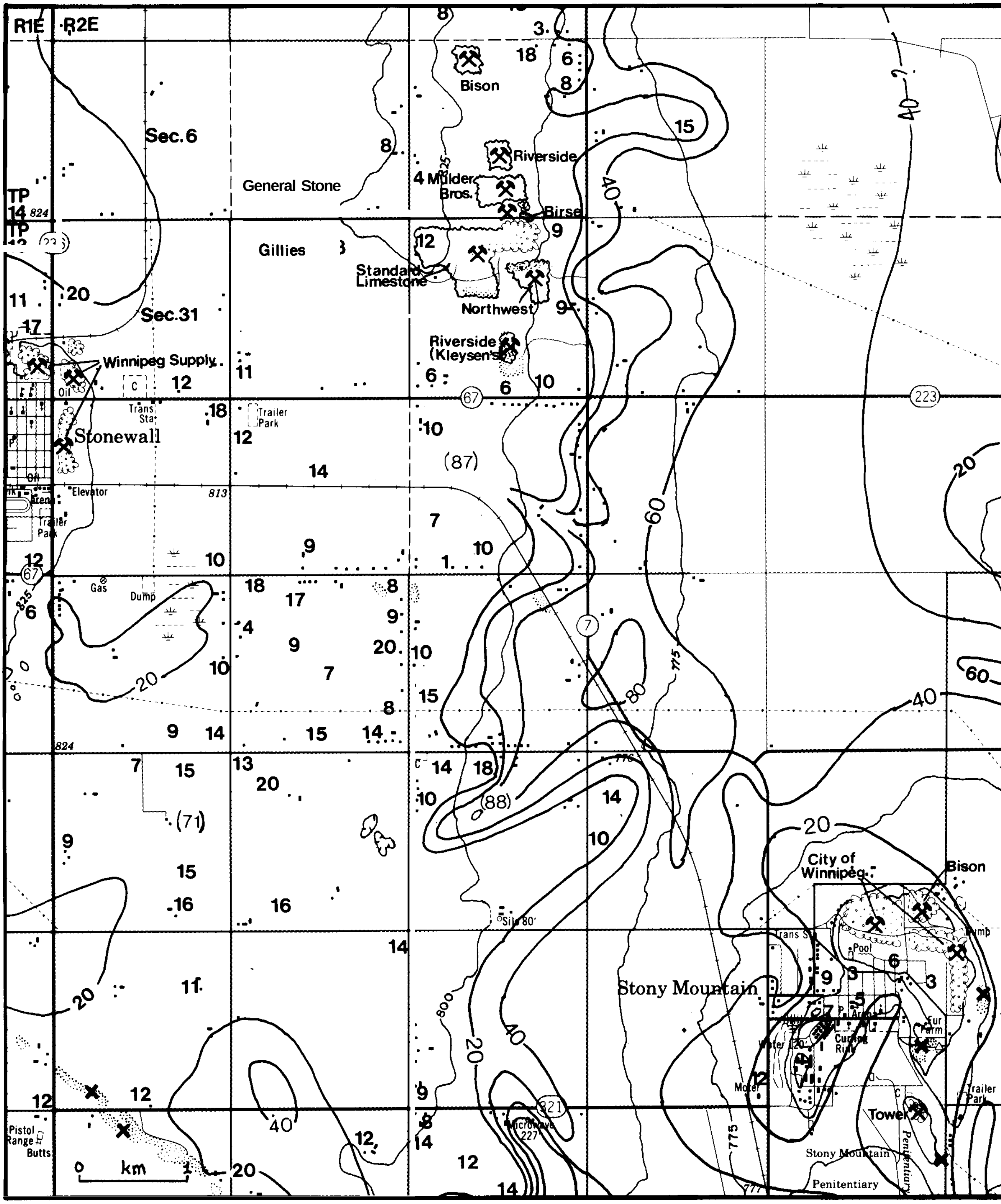



*Figure 24a:* *Location of quarries and depth to bedrock in the Stony Mountain-Stonewall area. The bold figures are depth to bedrock, in feet, for selected locations; contour interval is 20 feet (about 6 m). Modified from Preliminary Map 1979 DR-7, Bannatyne and Jones (1979).*

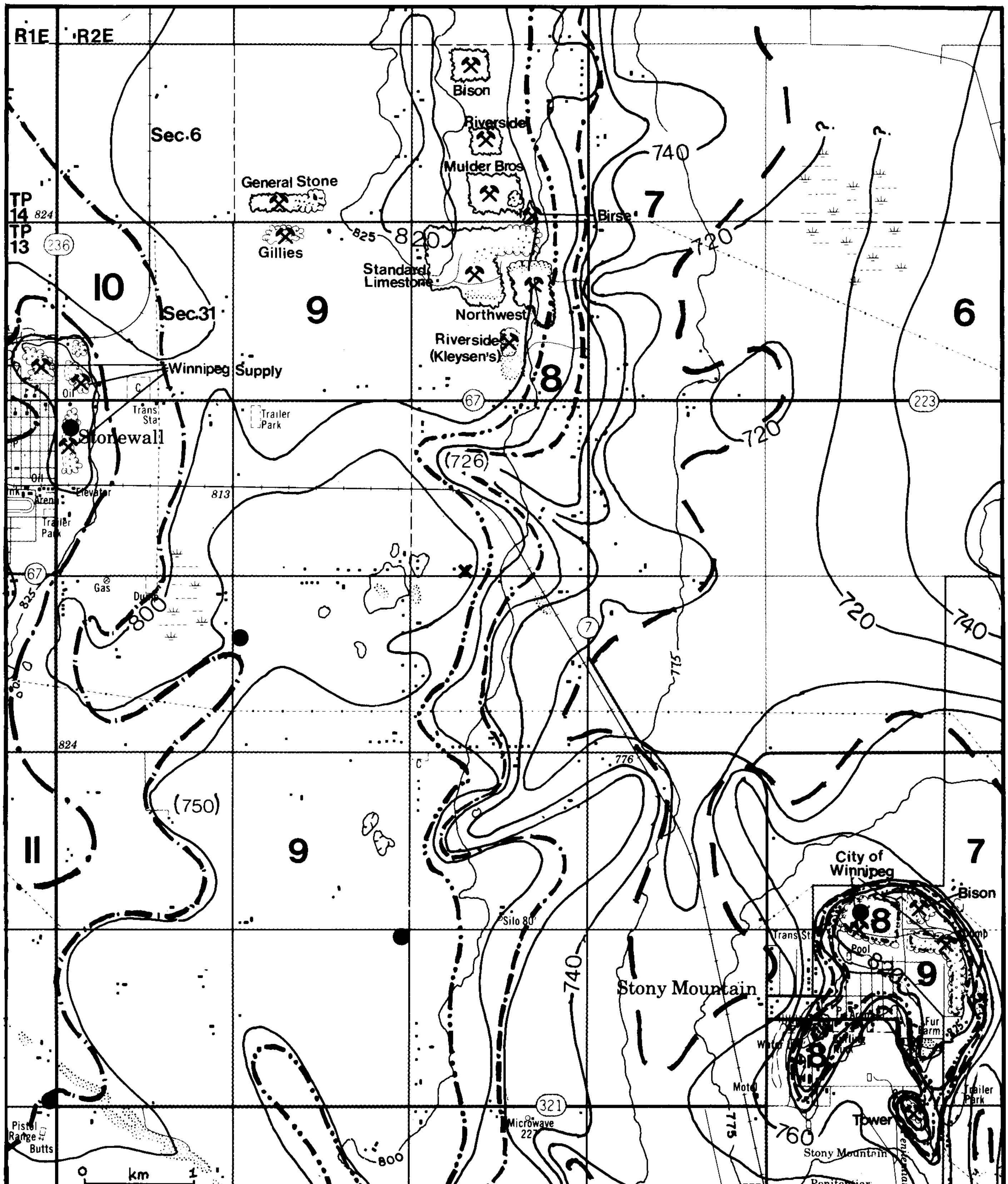



Figure 24b: Geology and bedrock topography of the Stony Mountain-Stonewall area. Geological units are: (6) Fort Garry Member; (7) Gunn Member; (8) Penitentiary Member; (9) Gunton Member; (10) Williams Member; and (11) Stonewall Formation. Bedrock elevations are in feet, and the contour interval is 20 feet (about 6 m). Modified from Preliminary Map 1979 DR-8, Bannatyne and Jones (1979).

# TABLE 14

**CHEMICAL AND PHYSICAL PROPERTIES OF STONY MOUNTAIN FM., MINAGO RIVER**

*Sample: 3 m thin bedded dolomite, 2.2 km south of Minago River, 0.9 km east of Highway 6*

| | |
|---|---|
| $SiO_2$ | 0.94% |
| $Al_2O_3$ | 0.20 |
| $Fe_2O_{3T}$ | 0.18 |
| CaO | 30.30 |
| MgO | 21.30 |
| $Na_2O$ | 0.01 |
| $K_2O$ | 0.07 |
| $TiO_2$ | 0.02 |
| $P_2O_5$ | 0.01 |
| MnO | 0.00 |
| LOI | 47.17 |
| Total | 100.20 |

*Los Angeles Abrasion*
*Loss:* 36.1%

*Soundness Loss*
1.50''-0.75'': *7.9%*
*0.75"-0.50": 9.1*
*0.5"-0.375": 11.5*

*Bulk Specific Gravity*
*2.59*

*Apparent Specific Gravity*
*2.79*

*Absorption*
*2.71%*

*Porosity*
*7.02%*

*Potential Uses: Suitable for base course A and B, and for surface gravel.*

*Additional Tests: None*

*Sources: Chemical analyses: Energy and Mines Analytical Laboratory; Physical tests and potential uses: UMA Group.*

*Figure 25: The southwest pit at the stone quarries south of Hodgson, formerly worked by Manitoba Marble Quarries, Limited; Stony Mountain Formation varicoloured dolomite in mixed shades of rose, purplish orange and buff.*

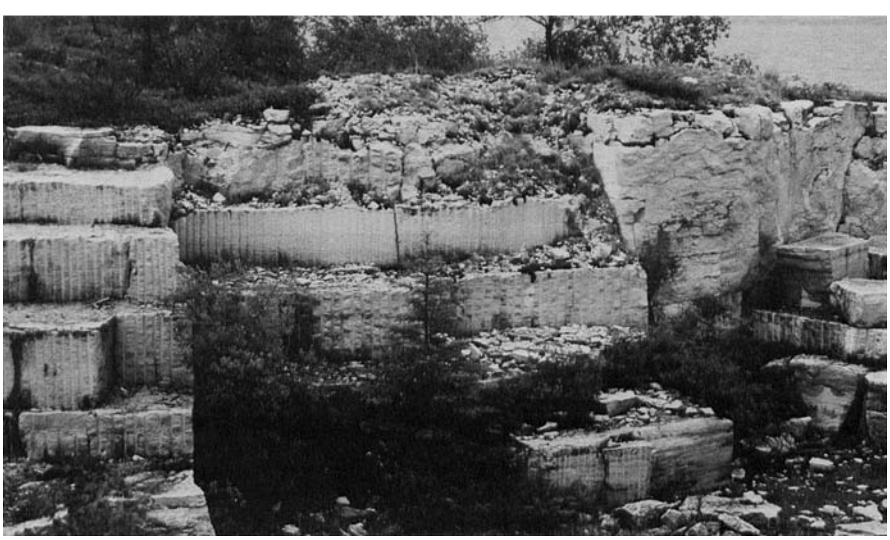


*Figure 26: Thick bedded (up to 0.9 m) dolomite quarried as 'marble' from 1929 to 1936 by Manitoba Marble Quarries, Limited; Mile '39' of Hudson Bay Railway, near shore of Cormorant Lake, in Stony Mountain Formation.*

## STONEWALL FORMATION

The Stonewall Formation contains several varieties of dolomite and includes arenaceous and argillaceous marker beds. Generally the rock is a dense, finely crystalline, somewhat mottled dolomite; locally, e.g., in the southeast quarry at Stonewall, reefoid or biohermal, vuggy dolomite is present. Elsewhere, conglomeratic dolomite is interbedded with dense dolomite. The 't' marker bed, possibly at the Ordovician-Silurian boundary (Brindle, 1960), occurs near the middle of the formation and consists of arenaceous dolomite and shale that can be light grey, red and green.

The lower part of the formation is exposed in several inactive quarries at the town of Stonewall (Fig. 27a). The rock was quarried from about 1880 to 1966 mainly for production of dolomitic lime. The thicker beds have also been used locally for building stone, as seen in several structures in Stonewall (Fig. 27b). Some of the dolomite has been crushed for aggregate (see M.I. card 62-I/3:DOL-2). Chemical and physical properties of the dolomite quarried at Stonewall are listed in Table 15.

About 3 to 4 m of dolomite was excavated from the quarries. The floor of the quarries is located 2.1-2.7 m above the base of the formation. A 2.1 m bed of dolomite is exposed in a pit in the floor of the northwest quarry; tests of one sample of this layer (Table 15, sample b) indicate its quality is marginally better than the quarried rock (sample a).

The t-marker bed in the Stonewall Formation is exposed in a rock face behind the power house at Grand Rapids, and also in a quarry in sec. 19-59-26W, south of the southern road to Rocky Lake, west of Highway 10 (Map ER85-1-3). The Stonewall Formation is exposed in a roadcut on a ridge 3.5 km west of Cormorant (Fig. 28). As it is overlain there by the Silurian Fisher Branch Formation and underlain by the Ordovician Stony Mountain Formation (H. McCabe, pers. comm., 1987), a complete section is exposed.

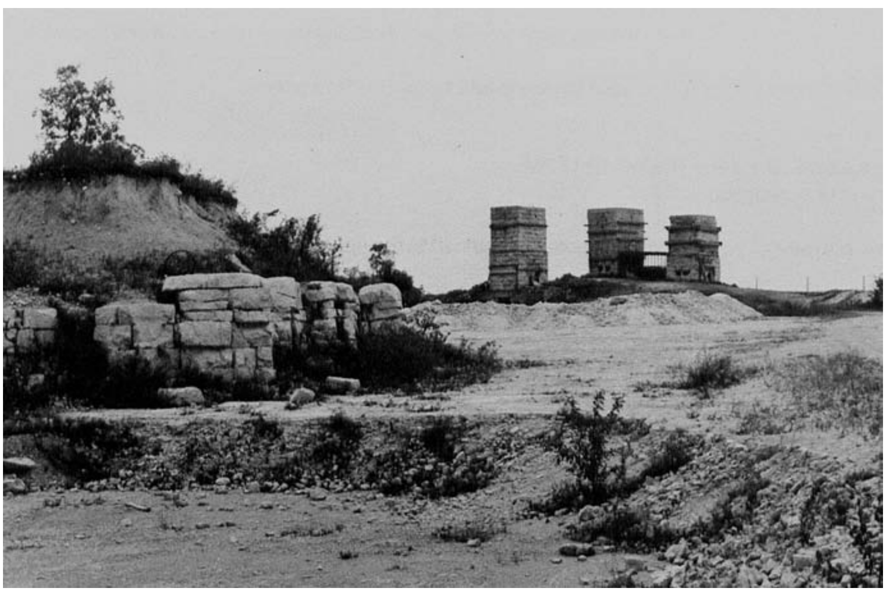


Figure 27a: *Stonewall Formation* and old lime kilns in northwest quarry at Stonewall.

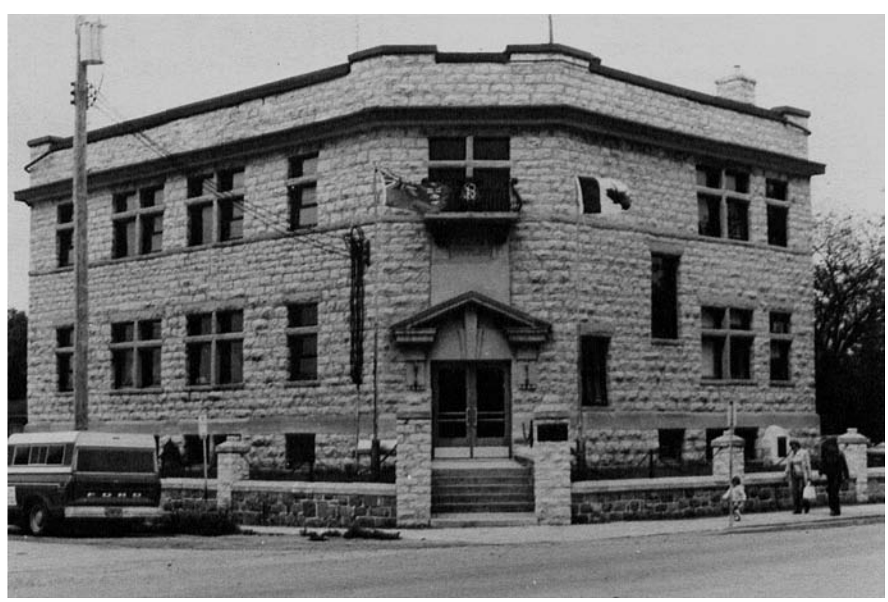


*Figure 27b:* Thick beds of Stonewall dolomite the local quarries have been used construction *of this* public building the town of Stonewall.

## TABLE 15

### CHEMICAL AND PHYSICAL PROPERTIES OF STONEWALL FORMATION, LOWER PART

Samples: a) 2.65 m dolomite, northwest quarry, Stonewall; sec. 36-13-1E.
b) 2.1 m mottled dolomite, from pit in floor of same quarry.

| Sample | a | b |
|---|---|---|
| $SiO_2$ | 0.21% | 0.34% |
| $Al_2O_3$ | 0.11 | 0.17 |
| $Fe_2O_{3T}$ | 0.11 | 0.16 |
| CaO | 31.10 | 31.20 |
| MgO | 20.80 | 20.70 |
| $Na_2O$ | 0.01 | 0.02 |
| $K_2O$ | 0.02 | 0.05 |
| $TiO_2$ | 0.00 | 0.01 |
| $P_2O_5$ | 0.01 | 0.02 |
| MnO | 0.01 | 0.02 |
| LOI | 47.54 | 47.37 |
| Total | 99.92 | 100.06 |

Los Angeles Abrasion
Loss: 27%, 23.8%

Soundness Loss
1.50"-0.75": 10.8%, 6.4%
0.75"-0.50": 10.9, 6.6
0.5"-0.375": 22.9, 16.2

Bulk Specific Gravity
2.56, 2.61

Apparent Specific Gravity
2.77, 2.76

Absorption
3.0%, 2.2%

Porosity
7.6%, 5.6%

Potential Uses: a) Quarry rock: was used for dolomitic lime and some local use as building stone; meets specifications for surface gravel and base course A and B.
b) Pit rock: suitable for ballast, concrete and asphalt aggregate, base course A and B, and surface gravel.

Additional Tests:
Sample: Dolomite, in part vuggy (mudstone); drill hole ASD-2, 9.1-9.8 m (NE1-8-12-1EPM)
Unconfined compressive strength: 347 $kg/cm^2$, average of 2 samples.

Sources: Chemical analyses: Energy and Mines Analytical Laboratory; Physical tests and potential uses: UMA Group; Additional tests: J. Oosterveen (1981).

Figure 28: *Roadcut* in ridge 3.3 km west of village of Cormorant; the Fisher Branch, Stonewall and Stony Mountain formations are exposed from top to base of the ridge.

## SILURIAN DOLOMITE (INTERLAKE GROUP)

Rocks of Silurian age in Manitoba are predominantly dolomite, with minor argillaceous or arenaceous marker beds. The dolomite is characterized by a generally low content of impurities. The rocks are poorly exposed in that part of the outcrop belt south of township 18. From Inwood northwest to The Pas, numerous areas of outcrop are present in the Interlake region and in the Grand Rapids-Moose Lake-The Pas region (Maps ER85-1-2, 3).

Variations in dolomite texture and composition are useful in distinguishing the formations of the lower part of the Interlake Group. The upper part of the Silurian rocks are lumped together into the Cedar Lake Formation, with reefoid facies being referred to as the Chemahawin Member (Stearn, 1956); in the Grand Rapids area, Stearn named a biostromal dolomite in the basal part the Cross Lake Member. For this report, it is better to describe the rocks from the southern and northern parts of the area, rather than by ascending stratigraphic order, in part because of correlation problems involving the Inwood Formation (discussed by McCabe, 1980).

### SOUTHERN INTERLAKE: Inwood-Lundar to *Gypsumville*

### FISHER BRANCH FORMATION

The lowermost Silurian unit, other than the upper part of the Stonewall Formation, is the Fisher Branch Formation. It outcrops extensively in the Fisher Branch-Hodgson area. The dolomite is fossiliferous and contains the index brachiopod Virgiana decussata; it is yellowish grey and fine- to medium-grained. The rock has not been quarried in this area, nor were samples taken for analysis because of a lack of outcrop sections suitable for sampling. The dolomite is visibly of high purity, but is vuggy to porous in fossiliferous beds. Detailed tests should be made before any of the many potential quarry sites is opened. The known outcrops are shown on Map ER85-1-1, based mainly on data from Baillie (1951) and Stearn (1956). A complete section of the Fisher Branch Formation was cored in drill hole M-10-79 near Warren, in l.s. 13-31-13-1W.

### INWOOD FORMATION

Dolomite of the Inwood Formation at quarries north of Inwood (Fig. 29) was burned in on-site kilns for lime from 1942 to 1966. It has been quarried intermittently since then as a source of aggregate. Four separate quarries are located in sec. 11-18-1W, three of them west of the railway track and one large quarry to the east. The two main rock types present are dense micritic greyish dolomite, locally containing distinctive small spheres and blebs of white to cream dolomite, and finely crystalline dolomite. Physical tests and chemical analyses (Table 16) were made for samples taken from the south central quarry, south of the dismantled Ellernan kilns. Large piles of fines (crushed stone) and of rejects from the kilns were left in the quarries around the kilns. The fines have been removed in recent years for use in aggregate.

Large stromatolitic lenses are present (Fig. 30); locally a red shale lens (Fig. 31) may represent a karstic infill along a bedding plane, deposited in a post-Silurian to pre-Ashern (Middle Devonian) erosional interval.

Speckled dolomite of the Inwood Formation was once quarried at Broad Valley and was burned for lime in a small kiln beside the quarry (see M.I. card 62-I/13:DOL-1).

### OTHER SILURIAN FORMATIONS, INCLUDING CEDAR LAKE FORMATION

Other Silurian rocks, younger than the Fisher Branch Formation, outcrop in the Mantagao Lake-Fisher Branch area, but have not been formally identified as to formation (Map ER85-1-2). A large area of near-surface bedrock containing scattered outcrop of Silurian dolomite occurs southeast of Lake St. Martin, along and north of the 'Idlewyld road', but the formations present have not been identified. The rocks in both of these areas appear to be fairly pure dolomite; none of them have been quarried. One occurrence of impure dolomite is exposed in an excavated road ditch in the northeast corner of sec. 13-24-4W; the dolomite contains abundant, reddish brown, argillaceous material and resembles the Atikameg Formation in the Grand Rapids area, described below.

*Figure 29:* North wall of Inwood quarry showing *stromatolite* lenses overlain by *micritic* dolomite, Inwood Formation. About *4 m* of section is exposed.

## TABLE 16

CHEMICAL AND PHYSICAL PROPERTIES OF INWOOD FORMATION, INWOOD

Sample: a) Basal 2 m finely crystalline and stromatolitic dolomite;
b) Upper 2 m dense 'porcellanous' dolomite

| | a) | b) |
|---|---|---|
| $SiO_2$ | 0.10% | 0.09% |
| $Al_2O_3$ | 0.07 | 0.02 |
| $Fe_2O_3$ | 0.13 | 0.08 |
| CaO | 31.10 | 30.40 |
| MgO | 20.70 | 20.50 |
| $Na_2O$ | 0.01 | 0.00 |
| $K_2O$ | 0.01 | 0.00 |
| $TiO_2$ | 0.00 | 0.00 |
| $P_2O_5$ | 0.00 | 0.00 |
| MnO | 0.01 | 0.00 |
| LOI | 47.56 | 47.57 |
| Total | 99.69 | 98.66 |

Los Angeles Abrasion
Loss: 33.5%; 36.4%

Soundness Loss
0.50"-0.75": 7.9%; 9.7%
0.75"-0.50": 17.1; 11.6
0.5"-0.375": 29.9; 26.9

Bulk Specific Gravity
2.43; 2.58

Apparent Specific Gravity
2.77; 2.82

Absorption
5.1%; 3.3%

Porosity
12.3%; 8.6%

Potential Uses: Surface gravel, base course A and B; marginal for concrete aggregate and asphalt aggregate. Was used at Inwood and Broad Valley for dolomitic lime.

Additional Tests: None

Sources: Chemical analyses: Energy and Mines Analytical Laboratory; Physical tests and potential uses: UMA Group.

Figure *30:* Stromatolite lens in Inwood quarry, overlain by *lami*nated *micritic* dolomite.

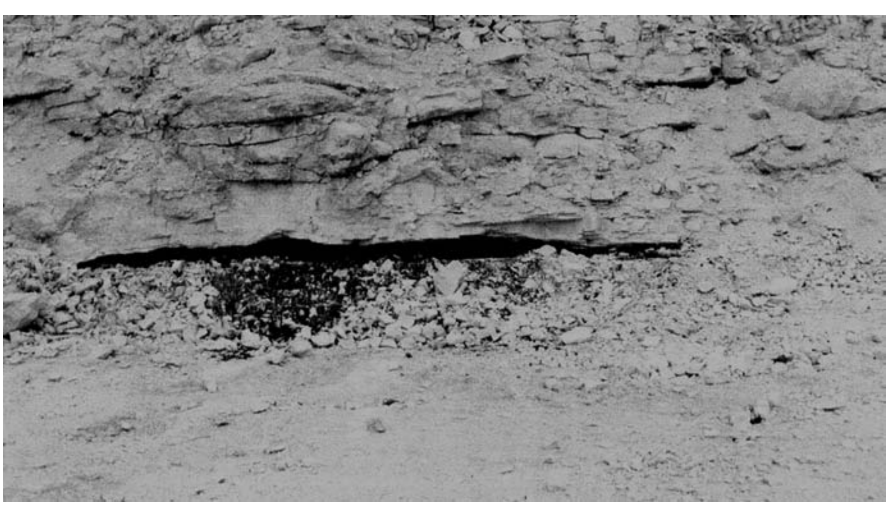


Figure 31: Lens of deep red shale enclosed in Inwood Formation dolomite, immediately east of the stromatolite lens shown in Figure 30.

The upper part of the Interlake Group is the Cedar Lake Formation. It has been quarried for aggregate at several localities along Highway 6: at Lundar (3 quarries), Deerhorn, Mulvihill, north of Camper, south of Moosehorn, Grahamdale, Hilbre, south of Fairford, and at 2 quarries north of the radar station north of Fairford (Map ER85-1-1, and M.I. cards). Physical tests and chemical analyses were made on samples of finely crystalline, fossiliferous dolomite from the Mulvihill quarry, and of dense, brittle micrite from the quarry north of Fairford and east of Highway 6 (Table 17). A sample of dolomite from Lundar was tested by James F. MacLaren Limited (1980).

Numerous areas of near-surface bedrock occur between Deerhorn and Fairford, and would probably be suitable for crushed stone aggregate or, if pure enough, for lime. Dolomite from the Hilbre quarry is the raw material in dolomitic lime production in the kiln at the Steel Brothers Canada Ltd. lime plant at the Faulkner quarry (Fig. 32).

Outcrops of dolomite from the lower part of the Interlake Group occur along Highway 6 between Gypsumville and Grand Rapids, including some at Devils Lake and south of The Pas moraine (Map ER85-1-2).

NORTHERN INTERLAKE: Grand Rapids-The Pas area

The currently used subdivision of Silurian strata in this area was established by Stearn (1956). Outcrops, near-surface outcrop areas and quarries are shown in Map ER85-1-3.

FISHER BRANCH FORMATION

Outcrops of Fisher Branch Formation are known only from the original course of Saskatchewan River south of Grand Rapids, and in the Clearwater (Atikameg) Lake area.

The dolomite was quarried in the early 1980s in sec. 15-60-22W on the crest of a ridge 3.5 km west of Cormorant (see Appendix II: Cormorant Lake Northwest quarry, 63K/2:DOL-4). The rock in that quarry has been identified as Fisher Branch Formation (H. McCabe, pers. comm., 1987).

MOOSE LAKE (?INWOOD FORMATION)

The Moose Lake Formation, possibly equivalent to the Inwood Formation as defined farther south (McCabe, 1980), is well exposed in a large quarry at Grand Rapids (Fig. 33) that was the source of much of the concrete aggregate for the Grand Rapids Hydroelectric Development, completed in 1968. Samples from the south end of the quarry were tested (Table 18), but the rocks had been weathered for many years. Either better quality

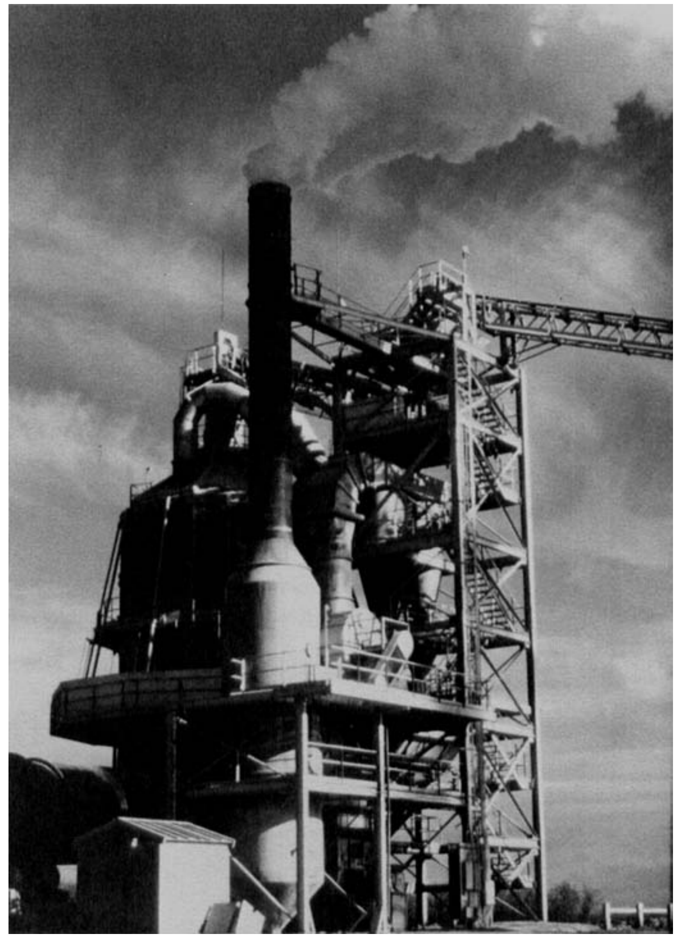


Figure 32: Lime plant at Faulkner quarry (in Elm Point limestone) operated by Steel Brothers Canada Limited. Dolomite from the Hilbre *quarry* is burned here to produce high-magnesia lime (dolime).

## TABLE 17

### CHEMICAL AND PHYSICAL PROPERTIES OF CEDAR LAKE FORMATION

Sample: a) Mulvihill; b) Fairford

| | a) | b) |
|---|---|---|
| $SiO_2$ | 0.14% | 0.17% |
| $Al_2O_3$ | 0.08 | 0.04 |
| $Fe_2O_3$ | 0.10 | 0.10 |
| CaO | 31.00 | 30.70 |
| MgO | 21.90 | 21.40 |
| $Na_2O$ | 0.03 | 0.01 |
| $K_2O$ | 0.01 | 0.04 |
| $TiO_2$ | 0.00 | 0.01 |
| $P_2O_5$ | 0.01 | 0.01 |
| MnO | 0.01 | 0.00 |
| LOI | 47.95 | 47.54 |
| Total | 101.23 | 100.00 |

Los Angeles Abrasion
Loss: 44.1%; 29.0%.

Soundness Loss
1.50"-0.75": 1.1; 1.3
0.75"-0.50": 0.6; 1.1
0.5"-0.375": 7.3; 3.3

Bulk Specific Gravity
2.54%; 2.83%

Apparent Specific Gravity
2.69; 2.73

Absorption
2.25%; 1.03%

Porosity
5.71%; 2.80%

Potential Uses: Base course A and B, surface gravel.
Sample 2 (Fairford): also suitable for concrete aggregate and asphalt aggregate

Additional Tests: None.

Sources: Chemical analyses: Energy and Mines Analytical Laboratory; Physical tests and potential uses: UMA Group.

## TABLE 18

CHEMICAL AND PHYSICAL PROPERTIES OF MOOSE LAKE FORMATION

Sample: 6.0 m of finely crystalline to micritic dolomite, south end of Grand Rapids quarry.

| | | | |
|---|---|---|---|
| $SiO_2$ | 0.64% | Los Angeles Abrasion<br>Loss: 30.4% | Bulk Specific Gravity<br>2.73 |
| $Al_2O_3$ | 0.12 | | |
| $Fe_2O_3$ | 0.19 | | |
| CaO. | 30.30 | Soundness Loss | Apparent Specific Gravity |
| MgO | 21.00 | 1.50"-0.75": 15.6% | 2.82 |
| $Na_2O$ | 0.02 | 0.75"-0.50": 15.9 | |
| $K_2O$ | 0.09 | 0.5"-0.375": 26.6 | |
| $TiO_2$ | 0.01 | | Absorption |
| $P_2O_5$ | 0.01 | | 1.18% |
| MnO | 0.00 | | |
| LOI | 47.18 | | Porosity |
| Total | 99.60 | | 3.23% |

Potential Uses: Base course A and B; surface gravel. Crushed stone from elsewhere in the quarry has been used as concrete aggregate (see text).

Additional Tests: None

Sources: Chemical analyses: Energy and Mines Analytical Laboratory; Physical tests and potential uses: UMA Group.

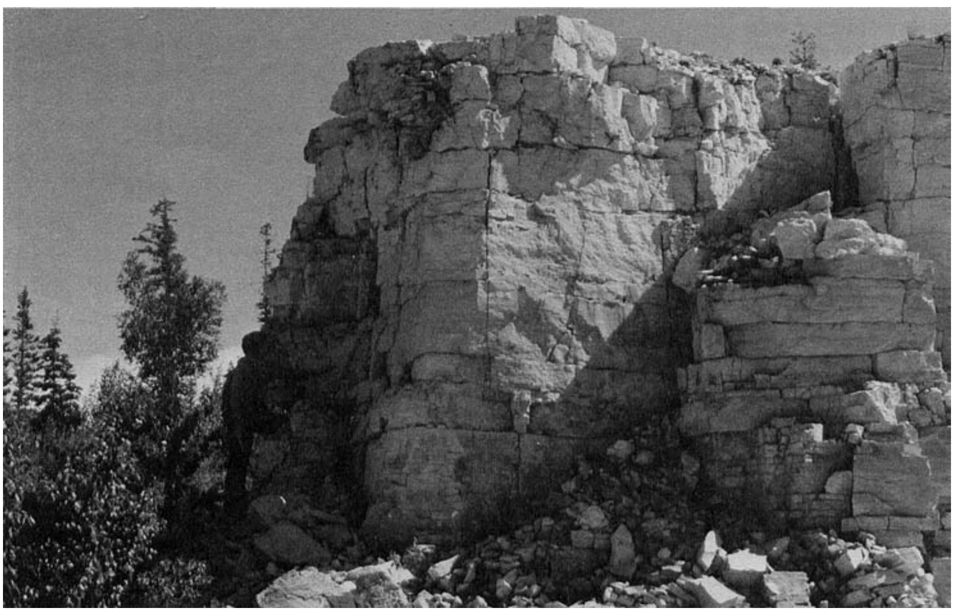


*Figure 33:* Cliff of *micritic* dolomite of the Moose Lake Formation, at the entrance to the Grand Rapids aggregate quarry.

rock must have been obtained from the other parts of the quarry, or else the very fine grained to micritic dolomite deteriorates after exposure. The chemical analysis indicates the carbonate content of the tested sample is about 99%.

The Moose Lake Formation is 8.5 m thick in the Grand Rapids area. The lower 4.5 m is a greyish yellow micritic dolomite, with thin fossiliferous interbeds. The upper 4.0 m is stromatolitic, very fine grained to micritic, buff dolomite. Concentrically layered, mounded structures, 5 to 15 cm across, were noted in abundance along certain bedding planes near the entrance to the quarry (Fig. 34). Locally in the quarry a thin cap of Atikameg dolomite is present.

### ATIKAMEG FORMATION

The overlying Atikameg Formation is exposed in the large roadcut on Highway 6 northwest of Grand Rapids, immediately south of the previously described quarry. The formation also outcrops south of Clearwater Lake, west of Atikameg station. A small test pit or quarry in l.s. 9-30-48-13W exposes abundant banded stromatolitic dolomite (Fig. 35) and dolomite breccia; although the ubiquitous orange stain in the dolomite suggests it is Atikameg, the formation has not been positively identified.

The Atikameg Formation is between 5.0 and 5.7 m thick, and is a fine grained, massively bedded dolomite characterized by abundant vuggy porosity. In outcrop, the vugs are lined in many places with brown clay that imparts a distinctive appearance to the formation. Stearn (1956) suggests that the dolomite was formed by reef-building organisms, but that its almost uniform thickness in outcrop indicates it is a biostrome rather than a bioherm.

### EAST ARM FORMATION

The East Arm Formation, containing the diagnostic fossil Leperditia hisingeri, is between 13 and 15 m thick and consists of brecciated, arenaceous, oolitic and fossiliferous dolomite.

A quarry has been operated periodically by Manfor Limited, north of The Pas, in l.s. 6-35-56-26W (Fig. 36; M.I. card 63F/14:DOL-1). The dolo-

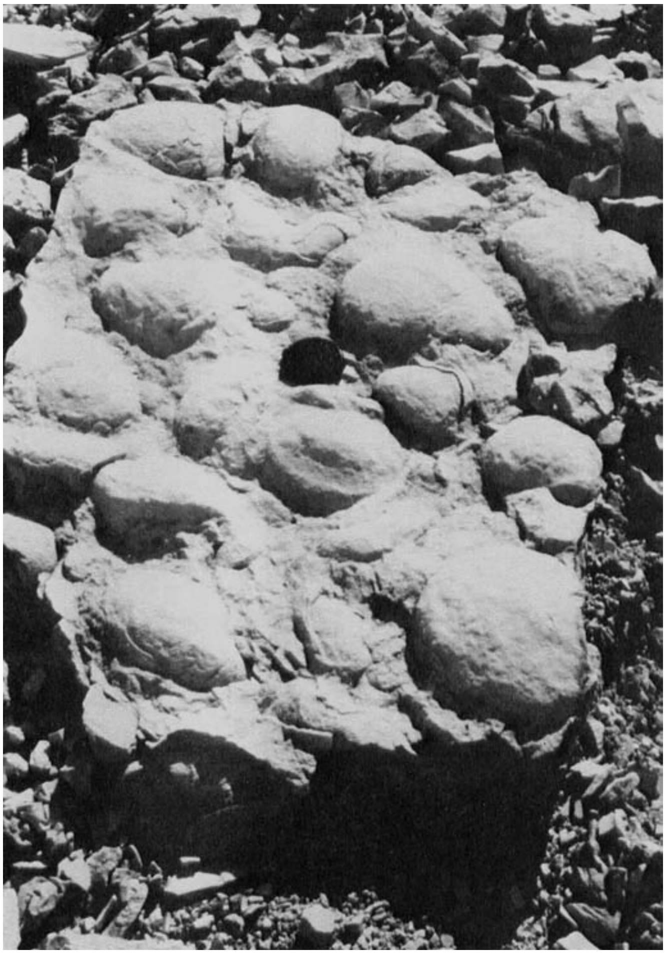


*Figure 34:* *Moose Lake Formation exposed in main aggregate quarry immediately north of Grand Rapids; concentrically layered, mounded structures are profuse along certain bedding planes. Lenscap, 44 mm in diameter, indicates scale.*

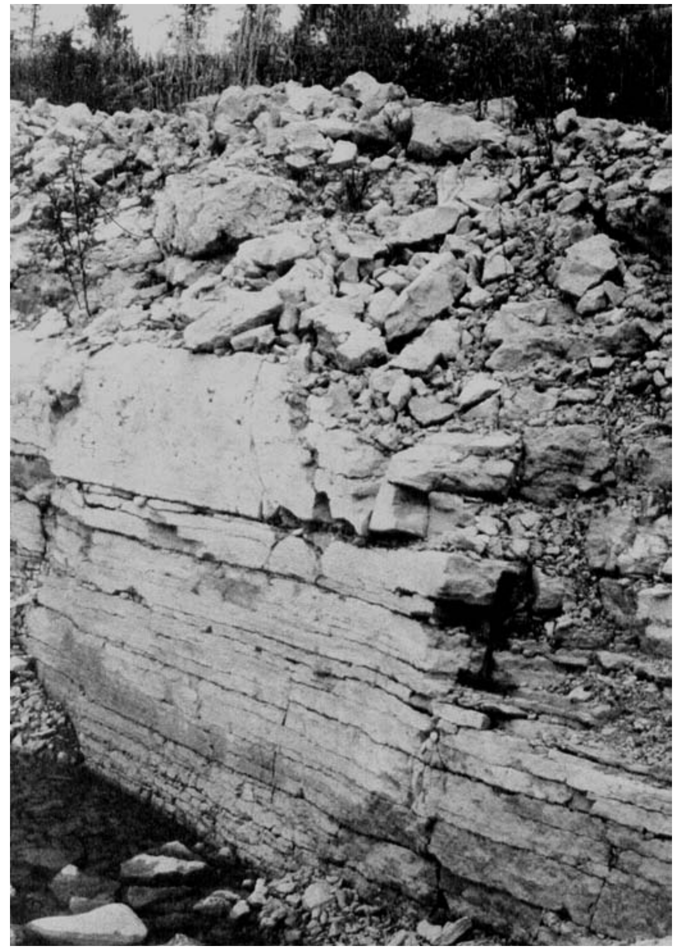


*Figure 36:* *Bedded, laminated dolomite of the East Arm Formation, Manfor quarry north of The Pas. About 3 m of section is exposed below the rocky rubble.*

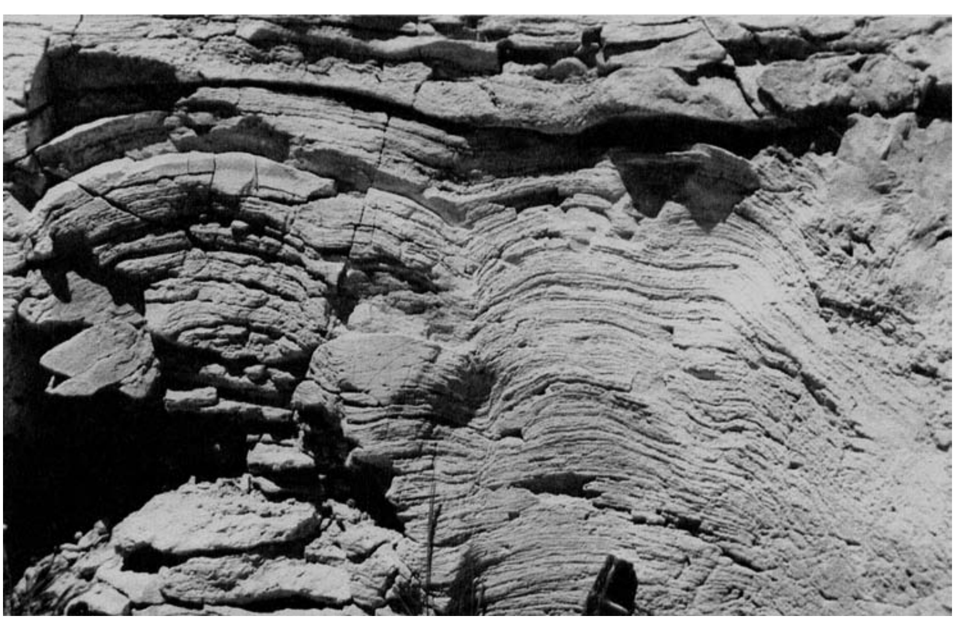


*Figure 35:* *Stromatolitic banding in Atikameg orange-stained dolomite, in test pit along North Dyke road, l.s. 9-30-48-13W.*

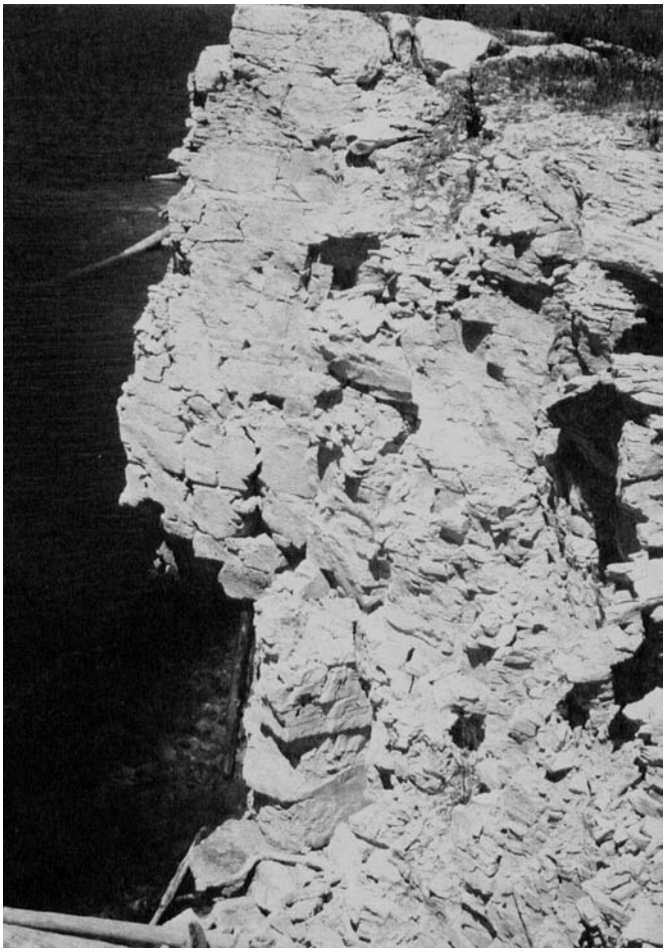


Figure *37:* Silurian dolomite exposed in quarry, now partially flooded, at west end of South Dyke road, Grand Rapids. The formation is not positively identified, but is probably Cedar Lake, at least in upper *micritic* part; 5.2 m is exposed to the water level.

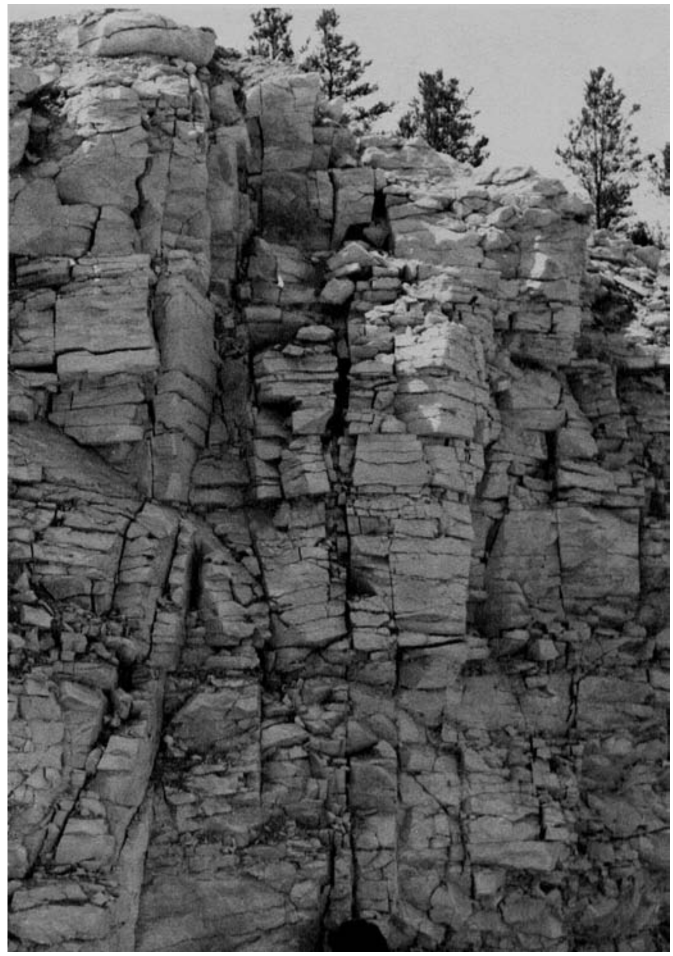


Figure *38:* Cedar Lake Formation dolomite, 4.5 m south wall of *Fairford* North quarry, *l.s. 12, 13-19-31-9W.*

mite is part of the East Arm Formation, and the rock has been used in maintenance of millsite roads at Manfor. When examined in 1980, the quarry was 250 x 55 m and the face ranged in height from 2.4 to 3.0 m. The floor of the quarry is a thin bedded, slabby, orange-buff dolomite with finely porous layers. It is overlain by 0.6 m of very fine grained dolomite and 1.0 m of aphanitic (near-lithographic) dolomite with stromatolite banding with a brecciated layer at the top. It is overlain by a layer of fossiliferous dolomite in which abundant Leperditia *hisingeri* were noted.

**CEDAR LAKE FORMATION**

The Cedar Lake Formation is exposed generally in remote areas between Grand Rapids forebay and the southern end of Moose Lake (Map ER85-1-3). A quarry at the western end of the south dyke road, in sec. 10-48-14W, is now flooded, but is in the outcrop belt of the Cedar Lake Formation (Fig. 37). The lower part of the quarry section is now submerged under Cedar Lake. The upper part consists mainly of dense micritic dolomite considered to be Cedar Lake Formation. Similar dolomite is exposed in a quarry north of Fairford (Fig. 38; M.I. Card 62-0110:DOL-3).

Stearn (1956) designated all the fine grained, thin bedded dolomite beds above the East Arm as the Cedar Lake Formation. As it is the youngest Silurian unit in Manitoba, its total thickness (estimated to be 45 m from subsurface data) may not be exposed. Drill results, as depicted in Figure 2 from McCabe (1980), indicate the total Silurian section thickens from Oak Point northward to Steep Rock; as the lower part of the section thins northward from Steep Rock to Clearwater (Atikameg) Lake, it is probable that the upper part, i.e., the Cedar Lake Formation, also thins to the north. Stearn designated certain subdivisions of the formation:

1) Cross Lake Member — a biostromal dolomite with a coral and stromatoporoid fauna in the basal part; north of Grand Rapids only.
2) Chemahawin Member — consisting of reef dolomite in the upper part of the formation, possibly in non-connected occurrences, e.g., at Chemahawin, now flooded; at Hilbre; and at Lundar.

# DEVONIAN

An impure red argillaceous dolomite, of the Ashern Formation, has been quarried in the Mulvihill-Ashern area, and along P.R. 235 west of Highway 6 (Map ER85-1-3). Some the the quarries extend downward into the Silurian Cedar Lake Formation, below the Devonian/Silurian unconformity. In places, narrow solution channels extend downward below the unconformity (Fig. 39) and may be lined with red clay or end in pockets of red clay. The lowermost layer of the Ashern Formation contains abundant fragments of the underlying Silurian dolomite embedded in red argillaceous dolomite (Fig. 40).

The only major occurrence of relatively pure dolomite in the Devonian outcrop belt is in the Winnipegosis Formation. The rock can occur both as vuggy, fossiliferous reefoid dolomite (Fig. 41; quarries both east and west of The Narrows, Lake Manitoba, along P.R.325), and as crystalline interreef dolomite, e.g., both at Overton (Fig. 42) and west of Overton, along P.R. 325. Rock from this formation has been used for road aggregate, in construction of The Narrows (Campbell) bridge, and as bases for powerline towers in Lake Manitoba at The Narrows. The small Rosehill quarry, in sec. 16-26-64W, was once operated as a source of raw material for dolomitic lime that was produced in adjacent kilns (M.I. card 62-012:DOL-1).

Other outcrops of Winnipegosis dolomite occur south and west of Crane Narrows, along the shores of, and on islands in, Lake Winnipegosis, and east of Highway 10 northeast of Overflowing River (see Maps ER85-1-2 and -3). A sample from the quarry west of The Narrows of Lake Manitoba was tested (Table 19).

Figure 39: Irregular solution microchannels in Silurian Cedar Lake Formation dolomite, south wall of *Ashern* quarry.

Figure *40:* Fragments of Silurian dolomite embedded in reddish brown argillaceous dolomite of the Devonian *Ashern* Formation, at the Devonian/ Silurian contact, *Ashern* quarry.

Some dolomite beds occur beneath two high-calcium limestone zones in the Dawson Bay Formation (Bannatyne, 1975; Norris et al., l980), but both have been intersected mainly in drill holes. One such occurrence consists of dolomite and calcareous dolomite below the lower Dawson Bay limestone zone, intersected from a depth of 5.6 m to 16.7 m in a drill hole (M-8-71) at Kinosota (Tp.22, Rge. 11W). One small outcrop is present in the Paradise Beach area (sec. 20-30-17W).

In the Souris River Formation, an erratically dolomitized limestone of the Sagemace Member has been quarried northwest of the junction of Highway 20 and P.R. 271 (the 'Camperville Junction' quarry), and was used as a source of crushed stone for road construction.

All other quarries in the Devonian outcrop belt are in limestone strata.

Devonian strata are described in detail by Norris et al. (1982).

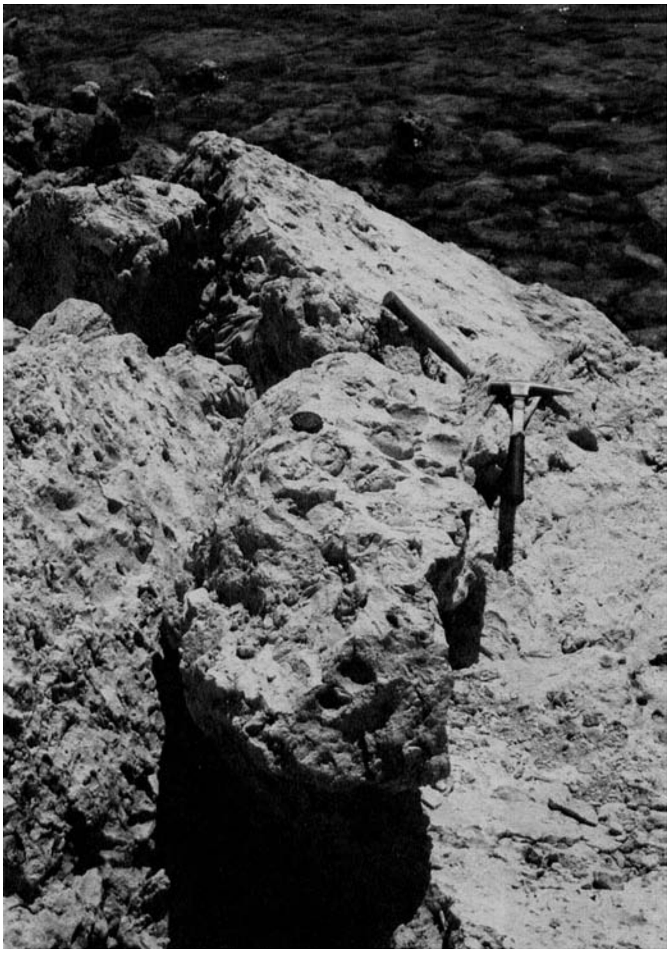


Figure 41: *Vuggy,* tough, reefoid dolomite of the Winnipegosis Formation, The Narrows West quarry, Lake Manitoba.

Figure 42: Sand-filled sinkhole (left side) in interreef dolomite of the Winnipegosis Formation, *Overton* quarry.

## TABLE 19

CHEMICAL AND PHYSICAL PROPERTIES OF **WINNIPEGOSIS** FORMATION

Sample: West of the Narrows, Lake Manitoba (3-21-24-1OW)

| | | | |
|---|---|---|---|
| $SiO_2$ | 0.08% | Los Angeles Abrasion Loss: 35.1% | Bulk Specific Gravity 2.42 |
| $Al_2O_3$ | 0.00 | | |
| $Fe_2O_3$ | 0.65 | | |
| CaO | 30.80 | Soundness Loss | Apparent Specific Gravity |
| MgO | 20.80 | 1.50"-0.75": 3.7% | 2.68 |
| $Na_2O$ | 0.02 | 0.75"-0.50": 2.0 | |
| $K_2O$ | 0.00 | 0.5"-0.375": 4.6 | |
| $TiO_2$ | 0.00 | | Absorption |
| $P_2O_5$ | 0.01 | | 4.02% |
| MnO | 0.02 | | |
| LOI | 47.56 | | Porosity |
| Total | 99.90 | | 9.73% |

Potential Uses: Suitable for base course A and B; surface gravel.

Additional Tests: None.

Sources: Chemical analyses: Energy and Mines Analytical Laboratory; Physical tests and potential uses: UMA Group

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## APPENDIX I: MINERAL INVENTORY CARDS: DOLOMITE QUARRIES

The Mineral Inventory cards were prepared mainly in 1979-1980 as a project funded under the Natural Resources Evaluation Program (NREP). They were prepared for all of the industrial mineral deposits in Manitoba. Mineral Inventory cards for dolomite quarries are reproduced on microfiche, enclosed in the pocket. Where new developments have taken place, a short 'update' has been added to the cards, but generally they contain data only to 1980. Short descriptions of some new quarries are listed in Appendix II. Note that in the sections on the cards that describe 'Exploration and Development', many of the dates refer to the reference quoted, rather than to the event described.

| Locality Name | Location | Mineral Inventory Card | Microfiche Page |
|---|---|---|---|
| Hecla Island Northwest | 6-27-25-6E | 62P/2 LST 1 | 1 |
| Gull Harbour | N½ 25-25-6E | 62P/2 LST 2 | 3 |
| Grindstone Point | Sec. 21-26-6E | 62P/7 LST 1* | |
| Pine Dock | Secs. 3, 10; 31-5E | 62P/10 LST 1* | |
| Riverton North | l.s. 13, 14; 22-24-4E | 62P/2 DOL 1 | 5 |
| Riverton Northeast | E½ 35-24-3E | 62P/2 DOL 2 | 7 |
| Gillis, Garson | 13-3-13-6E | 62-112 STN 1 | 9 |
| Garson Limestone | l.s. 3, 4, 10-13-6E | 62-112 STN 2 | 13 |
| Gillis, Garson East | l.s. 15, 16; 3-13-6E | 62-112 STN 3 | 16 |
| Gunn Quarry | 14-3-13-6E | 62-112 STN 4 | 19 |
| Western Store No. 2 | 10-9-13-6E | 62-112 STN 5 | 22 |
| Hazel Quarry et al. | NW¼ 34-12-6E | 62-112 STN 6 | 25 |
| Sinclair Quarry | 12-14-13-6E | 62-112 LST 1 | 27 |
| Malmstrom Quarry | l.s. 9, 10, 33-12-6E | 62-I/1 LST 2 | 29 |
| Strindlund Quarry | 9-15-13-6E | 62-112 LST 3 | 31 |
| East Selkirk | East Selkirk (13-5E) | 62-I/2 STN 7 | 33 |
| Lower Fort Garry | Lower Fort Garry (13-4E) | 62-I/2 STN 8 | 37 |
| Winnipeg Beach | 14-6-18-4E | 62-I/11 DOL 1* | |
| Mulder Bros., Pit No. 12 | 10-27-13-3E | 62-113 DOL 9 | 40 |
| Little Stony Mountain (2) | SW¼ 34, NW¼ 27; 11-2E | 62H/14 DOL 1 | 42 |
| Lilyfield (2) | l.s. 2, 6; 28-12-2E | 62-113 DOL 10 | 44 |
| Stony Mountain (3) | Sec. 11, 12, 14; 13-2E | 62-113 DOL 1 | 46 |
| Lillies Farm | l.s. 13, 14; 32-13-2E | 62-113 DOL 4 | 50 |
| Northwest Quarry | l.s. 9, 10; 33-13-2E | 62-113 DOL 7 | 52 |
| Kleysen's; Riverside; H. Munro | l.s. 7, 8; 33-13-2E | 62-113 DOL 8 | 54 |
| Standard Limestone | l.s. 14, 15; 33-13-2E | 62-113 DOL 6 | 56 |
| Birse Quarry | 2-4-14-2E | 62-113 DOL 5 | 58 |
| General Stone | 3-5-14-2E | 62-113 DOL 3 | 60 |
| Stonewall (3) | Sec. 30, 31; 13-2E and 36-13-1E | 62-113 DOL 2 | 62 |
| Gunton (3) | l.s. 6, 7; 28-15-2E | 62-116 DOL 1 | 67 |
| Inwood (3) | l.s. 3,4, 6; 11-18-1W | 62-1112 DOL 1 | 69 |
| Broad Valley | SE¼ 22-23-2W | 62-1113 DOL 1 | 73 |
| Poplarfield | 3-13-22-2W | 62-1/13 DOL 2 | 76 |
| Hodgson | NE¼ 18-25-1W | 62P/4 STN 1 | 78 |
| Lundar South | 14-16-20-4W | 62J/9 DOL 1 | 80 |
| Lundar North (2) | 3-7-20-4W | 62J/9 DOL 2 | 82 |
| Deerhorn | l.s. 8, 9; 3-21-5W | 62J/16 DOL 1 | 84 |
| Mulvihill West | 15-31-22-6W | 62J/16 DOL 2 | 86 |
| Mulvihill East | l.s. 3, 4; 7-23-5W | 62J/16 DOL 3 | 88 |
| Oatfield | 12-32-22-6W | 62J/16 DOL 4* | |
| Mulvihill | SE¼ 10-23-6W | 62J/16 DOL 5' | |
| Overton | SW¼ 6-23-7W | 62J/16 DOL 6* | |
| Moosehorn South | 2-9-26-7W | 62-011 DOL 1 | 90 |
| Ashern South | l.s. 7, 10, 11; 12-25-7W | 62-011 DOL 2 | 92 |
| Grahamdale South | 16-35-27-8W | 62-O/8 DOL 1 | 94 |
| Spearhill Northwest | Secs. 28, 29; 27-7W | 62-018 DOL 2 | 96 |
| Hilbre | l.s. 6, 11; 24-29-9W | 62-0110 DOL 2 | 98 |
| Fairford Southeast | 14-9-30-9W | 62-0110 DOL 1 | 100 |
| Fairford | Fairford (30-9W) | 62-O/10 DOL 4 | 102 |
| Fairford North (2) | 1-25-31-1OW and l.s. 12, 13; 19-31-9W | 62-0110 DOL 3 | 104 |
| Oakview | 14-16-24-9W | 62-012 DOL 4 | 106 |
| Dog Lake | 9-30-22-8W | 62J/15 DOL 1 | 108 |
| Rosehill | 16-26-24-1OW | 62-012 DOL 1 | 110 |
| Narrows West | 3-21-24-1OW | 62-012 DOL 2 | 112 |
| Narrows East (3) | 2-22-24-10W and 16-15-24-10W | 62-012 DOL 3 | 114 |
| Camperville Junction | 1-5-33-19W | 62N/16 DOL 1* | |

| | | | |
|---|---|---|---|
| Grand Rapids (5) | l.s. 12, 13; 34-48-13W; NW ¼ 17-48-13W; 5-19-48-13W; 9-30-48-13W | 63G/3 DOL 1 | 117 |
| Moose Lake | NE¼ 13-57-19W | 63F/16 DOL 1 | 120 |
| Minago River South | Sec. 2-60-12W | 63J/3 DOL 2 | 122 |
| Minago River North | Sec. 22-60-12W | 63J/3 DOL 1 | 124 |
| Talbot Lake | NW 114, SW¼ 23; 59-17W | 63J/4 DOL 1 | 126 |
| Ponton | Secs. 29, 30; 65-11W | 63J/11 DOL 1 | 128 |
| Ponton Northeast | 14-24-66-12W | 63J/11 DOL 2 | 130 |
| The Pas | 6-35-56-26W | 63F/14 DOL 1 | 132 |
| Atikameg | Sec. 11-58-24W | 63F/15 DOL 1* | - |
| Wekusko North | Sec. 26-64-16W | 63J/12 DOL 1 | 134 |
| Sunday Lake | SW¼ 30-64-15W | 63J/12 DOL 2 | 136 |
| Snow Lake | l.s. 4, 5; 28-66-17W | 63J/12 DOL 4 | 138 |
| Wekusko Lake: Munro 1 | SW¼ 20-65-16W | 63J/12 DOL 5* | |
| Wekusko Lake: Munro 2 | SE¼ 26-65-17W | 63JH2 DOL 6* | |
| Cormorant Lake South | Sec. 19-60-21W | 63K/2 DOL 1 | 140 |
| Cormorant Lake North | Tp. 60-21W | 63K/2 DOL 2 | 142 |
| Cormorant Lake East | Tp. 60-21W | 63K/2 DOL 3 | 144 |
| Cormorant Lake West | Sec. 15-60-22W | 63K/2 DOL 4* | - |
| Cormorant Lake (2) | 15-18-60-21W | 63K/2 STN 1 | 146 |
| Rocky Lake | Sec. 19-59-26W | 63K/3 DOL 1* | |
| Goose Lake | Sec. 36-62-27W | 63K/6 DOL 1* | |
| Simonhouse Lake | Sec. 28-63-25W | 63K/6 DOL 2* | - |
| Paterson (Mile '69 112') | Sec. 6-63-17W | 63K/8 STN 1 | 148 |
| Tramping Lake | Secs. 9, 10; 65-19W | 63K/9 DOL 1 | 150 |
| Iskwasurn Lake | Secs. 1, 2; 65-23W | 63K/10 DOL 1 | 152 |

*Mineral Inventory Card not prepared; these are described in Appendix II

## APPENDIX II: DOLOMITE QUARRIES NOT DESCRIBED ON MINERAL INVENTORY CARDS

Grindstone Point 62P/7 LST-1

Location: Sec. 21-26-6E

The quarry is in the Dog Head Member of the Red River Formation and was a source of aggregate for construction of the road into the Grindstone Point recreational area. The quarry was water-filled when examined in 1979. It is estimated to be 130 x 35 m, and is at least 2 m deep, possibly more in the centre. Actual depth is unknown. Upper 0.2 m consists of thin, slabby beds of mottled grey and brown dolomitic limestone. South of the main quarry is a second shallow quarry, about 20 x 25 m and 0.2 m deep; it could have been worked as a source of flagstone.

Pine Dock 62P/10 LST-1

Location: Sections 3, 10-31-5E

The quarry, in the Dog Head Member, was opened as a source of aggregate for road construction between Riverton turnoff and Matheson Island. The rock is predominantly greyish mottled dolomitic limestone.

Winnipeg Beach 62-I/11 DOL-1

Location: l.s. 14-6-18-4E

A quarry was worked during 1979-80; it is 38 x 49 m and exposes 4.7 m of buff to brownish buff mottled dolomite. The rock is thick bedded, similar in thickness to the Tyndall stone beds at Garson. It represents a dolomitic facies of the Selkirk Member of the Red River Formation. The quarry is owned by E. Bochurka, Winnipeg Beach. This previously unknown near-surface bedrock was discovered in a test-pit of the overlying material. The overburden at the quarry is 1 to 2 m thick and increases to 3 m along the east wall.

The coarser blocks from the quarry were used as riprap at Gimli harbour, and the finer material was used as crushed stone for road construction. The matrix is very fine grained to micritic; the mottles are finely crystalline and contain crinoid fragments. One chain coral specimen was noted. The rock is in part vuggy (some vugs are clay-lined), and contains chert, some as thin bands parallel to the bedding.

Oatfield quarry 62J/16 DOL-4

Location: l.s. 12-32-22-6W

The quarry was opened in 1980 as a source of aggregate for road construction. By August 1980 it was 105 x 105 m and 4.2 m to water level. The upper 1.8 m is Devonian Ashern Formation consisting of slightly earthy dolomite and crystalline dolomite; it is generally brick red, but has been extensively bleached to buff. The lower 0.3 m consists of breccia fragments of the underlying Silurian dolomite, and contains some green and red clay.

The underlying 2.4 m, to water level, consists of buff, finely crystalline dolomite of the Silurian Cedar Lake Formation. The rock has abundant fine to vuggy porosity. Most of it breaks into thin beds but many large, massive blocks have been left beside the roadway into the west side of the quarry.

The uppermost part of the Silurian section exhibits excellent examples of micro-channeling produced by weathering at an unconformity. Many channels are lined with green clay and some end in infilled pockets of green clay.

The quarry is located 150 m east of the road along the west side of section 32.

Mulvihill Northwest 62J/16 DOL-5

Location: SE1/4-10-23-6W

Goudge (1945) reported: "One mile northwest of Mulvihill, ... yellowish brown, porous, finely granular dolomite is exposed in uneven, broken beds in a small quarry formerly worked by John Strindlund for making lime in two pot kilns." The quarry was opened in a small northeast-trending ridge, and exposed 3.5 feet of dolomite. An analysis reported by Goudge indicated a fairly pure dolomite ($SiO_2$: 0.20%; $Fe_2O_3$:0.19%; $Al_2O_3$: 0.02%; carbonate: 99.92% out of a total of 100.43%).

Overton 62J/16 DOL-6

Location: SW1/4-6-23-7W

The quarry was opened in 1979; it is 75 x 90 m and 4.5 m deep. It is in the lower part of the Devonian Winnipegosis Formation and represents the dolomitized basinward equivalent of the Elm Point Formation. The rock is a mottled dolomite. The upper part is medium bedded (0.3-0.6 m) and the lower layers are thinner bedded (0.1-0.3 m).

Exposed in the quarry are five sinkholes generally 2 m across and 2 m deep; they are filled with quartz sand and green to grey kaolinitic clay of probable Lower Cretaceous age. Some sinkholes, especially in the northwest corner of the quarry, taper off into horizontal layers of clay and silty quartz. During excavation, vertical fractures filled with silica sand were reported.

Camperville Junction 62N/16 DOL-1

Location: 1-5-33-19W

The quarry was examined in 1980, when the water level was so low that 4.4 m of rock was exposed. The rocks are possibly the youngest Devonian strata exposed in Manitoba, as they occur near the top of the Sagemace Member of the Souris River Formation and are 28 m above the top of the Point Wilkins Member (Norris et al., 1982). Dolomite and calcitic dolomite occur in a variety of layers — mottled, banded, crystalline, possible conglomerate, fossiliferous, vuggy, and dense. In places coatings of calcite crystals are abundant. Locally the mottles have an orange matrix. The test sample taken from this quarry shows a relatively high calcium content, but represents only the uppermost layers in the quarry as is was collected when the quarry was nearly water-filled.

The quarry is 200 x 60 m and is estimated to be about 5 m deep. The rock was used as a source of aggregate for road construction.

Atikameg 63F/15 DOL-1

Location: Sec. 11-58-24W

Goudge (1945) reported: "A small quarry to obtain rock for fill was opened at Mile 19¼ during construction of the !Hudson Bay† railway. In it 6 feet of yellow-buff, dense-textured, brittle Silurian dolomite is exposed in indistinct and uneven beds. Peculiar, egg-shaped concretions were seen in the bed that forms the floor of this quarry." An analysis of the sample indicated a fairly pure dolomite ($SiO_2$: 0.24%; $Fe_2O_3$: 0.43%; $Al_2O_3$: 0.11%; carbonate: 99.74% out of a total of 100.54%).

Stearn (1956) reported: "The upper contact of the !Moose Lake† formation is exposed in a quarry at Mile 18.6 ... of the railway. The base of the quarry and the lower 2.6 feet of the wall are composed of stromatolitic Moose Lake dolomite, which projects in several domes about 2 feet across, a few inches upward into the porous rock of the overlying Atikameg dolomite. At Mile 19.5 cliffs of Moose Lake dolomite extend for some distance north of the track and exhibit ... stromatolitic bedding."

Cormorant Lake Northwest 63K/2 DOL-4

Location: Sec. 15-60-22W

The quarry is located on the crest of a ridge, 3.5 km west of the junction of the road to Cormorant and the Hudson Bay Railway. It was opened about 1979, and is accessed by a short road bearing northwest from the main curve in the road. The quarry is 27 x 24 m and exposes at least 2.4 m of dolomite. This dolomite is believed to be Silurian Fisher Branch Formation (H. McCabe, pers. comm., 1987).

The upper 1.5 m of dolomite is vuggy, fossiliferous, nodular, and mottled orange and reddish buff with rose-red and purplish patches. The next layer, 0.3 m thick, is a dense, light to orange-buff dolomite containing *Leperditia*. The lower part of the section is obscured by talus. Fossils are abundant and fairly well preserved in the vuggy layers. The floor of the quarry is a tough, dense, brownish buff dolomite.

The rock was used as a source of aggregate for road construction, and possibly for riprap along the road south of Cormorant Lake.

Rocky Lake 63K/3 DOL-1

Location: Sec. 19-59-26W

The quarry is located south of the "South Road" to Rocky Lake, west of Highway 10 and immediately west of the railway track. The quarry is about 60 x 60 m and is 3.5 m deep. The section exposed is within the Stonewall Formation, and the prominent 't' marker bed is well exposed in the middle of the section. Above the marker bed, the dolomite is dense and crystalline, and contains some breccia zones; it weathers to thin flaggy beds. The marker consists mainly of light green dolomitic shale. Below it, the dolomite is dense and micritic, with one fine microbreccia layer; the rock is greyish and slightly argillaceous. A thin clayey layer is present 0.6 m below the marker bed.

Goose Lake 63K/6 DOL-1

Location: Sec. 36-62-27W

The quarry is accessed by a road leading west from Highway 10, a short distance south of a low but prominent rocky escarpment (north-facing) through which the highway has been cut. The rock is dolomite of the Red River Formation. The small quarry has been 'rehabilitated' in such a way that lithologic or stratigraphic information has been mostly obliterated.

Simonhouse Lake 63K/6 DOL-2

Location: Sec. 28-63-25W

The quarry is locally referred to as the "Mile 10" quarry, being located 10 miles (16 km) east of the junction of Highways 10 and 39. A side road south from Highway 39 extends 0.4 km to the quarry. In 1983, the quarry was 105 x 135 m, and 6 m of section was exposed along the north wall. The greyish buff dolomite is uniformly medium bedded and finely crystalline with the upper beds showing a suggestion of a buff and grey mixture. The dolomite is part of the Red River Formation.

Wekusko Lake: Munro Construction (1) 63J/12 DOL-5

Location: SW1/4-20-65-16W

The quarry was worked in 1982-1983 and is 38 x 100 m; it exposes 3.0-3.6 m of varicoloured dolomite, probably of the Red River Formation. The upper layer is thick bedded and strongly mottled; chert nodules are 5-10 cm across and have grey to buff 'eyes' with concentric layers. Patches of ?stromatolite consist of alternating thin buff and ochre-red layers; on a bedding plane, these exhibit concentric rings. On the glaciated surface at the west end of the quarry, the rock exhibits a tapestry mottling similiar to that of Tyndall stone. This layer is a very tough stone and is finely crystalline throughout.

The lower layer is crystalline and varicoloured. The quarry has been 'rehabilitated', obscuring much of the lower part. Some megafauna were noted, particulary *Maclurites* species.

Wekusko Lake: Munro Construction (2) 63J/12 DOL-6

Location: SE1/4-26-65-17W

This quarry is about 90 m square with faces ranging from 1.8 to 3.6 m; it has been 'rehabilitated'. The rock is mainly a thin bedded, slabby, crystalline dolomite containing abundant soft white chert nodules. The slabby layers are generally between 5 and 10 cm thick. A fairly abrupt colour change is present, from purple and olive beds to buff beds (with traces of orange and green), both with chert. Laminated ?stromatolite was noted in the former, but not in the latter.

Wekusko North quarry 63J/12 DOL-1

Location: Sec. 26-64-16W

This old quarry, described in the Mineral Inventory cards, was expanded in 1983. It is 120 x 40 m extending southward from Highway 39, immediately east of the junction with P.R. 392 to Wekusko. The faces range from 5.4 to 6.0 m and expose purplish nodular dolomite with some laminations and fossils. The section is similar to the new quarry at Sunday Lake and is thought to be part of the Stony Mountain Formation.