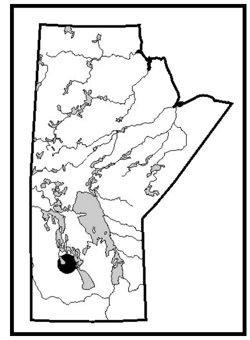
GS-22 Aggregate resources in the Rural Municipality of Ste. Rose, Manitoba (NTS 62J13 and 14, 62O3 and 4)

by H.D. Groom



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Summary

The Rural Municipality of Ste. Rose was mapped this year as part of an ongoing project to update aggregate information in the province. The last study of this rural municipality was completed in 1978. The aggregate resources are contained in beach ridges formed by glacial Lake Agassiz. There are two major beach complexes: the Ste. Amelie ridge, which has been a long-standing source of aggregate, and a second ridge along the eastern boundary of the municipality which, due to inaccessibility, has only one pit. The material in the complexes ranges from sandy coarse pebble gravel to fine sand. The gravel is of very high quality, with a pebble lithology averaging 75% carbonate and 25% Precambrian clasts and a good range of grain sizes. There is no shale in the aggregate and the only deleterious material was some carbonate cementation.

While many of the pits in the Ste. Amelie ridge are near depletion, it still contains large reserves of aggregate. The eastern deposits will become more important as the Ste. Amelie ridge becomes depleted.

Introduction

An aggregate inventory of the Rural Municipality (R.M.) of Ste. Rose was carried out this summer. The municipality was originally mapped for aggregate in 1978. The information gathered is included in municipal development plans, used for resource management within the MGS and is available to other government departments and outside clients on request.

The R.M. is located in west-central Manitoba, southeast of Dauphin Lake (Figure GS-22-1). The municipality covers approximately six townships, townships 22 to 25 in ranges 14 to 16 W 1st Mer., and is located on NTS sheets 62J13 and 14, 62O3 and 4.

Provincial highways 5 and 68, Provincial roads 276, 360 and 480, and a network of section roads give good access to most of the area. The major village in the municipality is Ste. Rose du Lac but the major service centre is the city of Dauphin, 30 km to the west. The primary industry is mixed farming.

Previous work

There is very little bedrock outcrop in the municipality. However, Bamburak and Christopher present two sections and two borehole logs from the R.M. in their field trip guidebook (Bamburak and Christopher, 2004). References to early work and other regional studies are also found in this guidebook.

The municipality is covered by two reports on groundwater availability: Neepawa area (NTS 62J; Betcher, 1989) and Dauphin Lake (NTS 62O; Betcher, 1987). These reports contain 1:250 000 scale maps of bedrock geology, surficial geology and overburden thickness as well as maps more directly related to water resources.

The surficial geology of the R.M. was mapped at a scale of 1:50 000 by Gartner Lee Associates (1978) as part of an aggregate mapping project that included ten municipalities. The emphasis was on aggregate deposits and much of the mapping of other surface materials was based on soil reports and airphoto interpretation. The area is also included on two recent 1:250 000 scale surficial geology compilation maps: SG-62J (Matile and Keller, 2004a) and SG-62O (Matile and Keller, 2004b). On these maps, the surface units have been draped over topographic relief maps and landforms, many that are ice-flow directional indicators, are very clearly shown.

Geology

Bedrock geology

The R.M. of Ste. Rose is underlain by Mesozoic and Paleozoic rocks (Figure GS-22-2). The majority of the municipality is underlain by Cretaceous and Jurassic sedimentary rocks while Devonian carbonate strata underlie the northern and eastern edges of the area. There is very little outcrop in the area and the bedrock information here has been taken primarily from Bamburak and Christopher (2004), who compiled existing information for their field trip guidebook.

The Cretaceous Swan River Formation is formed primarily of sandstone with minor shale beds. However, in the R.M. of Ste. Rose only the shale beds are exposed in quarries and coreholes. The shale is plastic and fairly soft and was used in brick manufacturing. There are two quarries, a large one in NE¼, Sec. 4, Twp. 23, Rge. 15, W 1st Mer. (NE-4-23-15-W1) and a much smaller one in SE-4-23-15-W1 (Figure GS-22-2). Both are inactive and flooded thus strata are not currently exposed. Both quarries have old stockpiles from which material is occasionally removed. The Swan River Formation strata

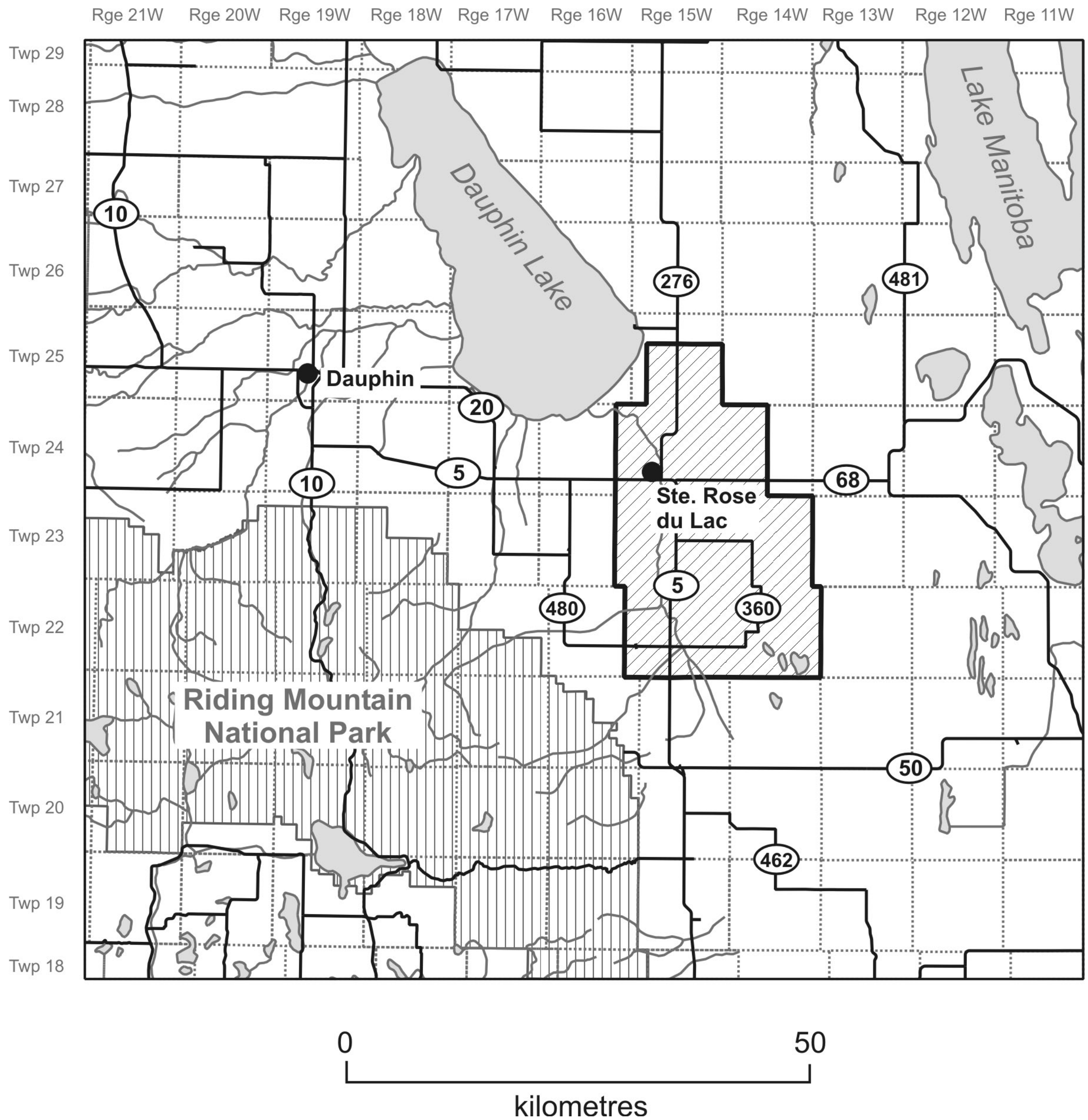

Figure GS-22-1: *Location map of the R.M. of Ste. Rose.*

are described in Stop 19 in Bamburak and Christopher (2004). There is some discrepancy in the identification of the beds of the Swan River Formation. M. Shayna's quarry description ascribed the lower kaolinitic shale and the red clay bed to the Jurassic Melita Formation (Shayna, 1975). H.R. McCabe's corehole description ascribed all the beds to the Swan River Formation (McCabe, unpublished data, 1978). J. Bamburak (pers comm, 2006) includes the kaolinitic shale within the Swan River Formation beds but considers the red clay bed to be the top of the Melita Formation.

The Jurassic Melita Formation is composed of shale and calcareous sandstone. It is encountered in coreholes and exposed in the two quarries in the municipality, as described above.

The Jurassic Reston Formation is composed of interbedded calcareous shale and limestone. It is seen in outcrop in a riverbank exposure (4-24-15-W1) and encountered in one corehole in 22-23-15-W1. The Reston Formation section and corehole are described in Stop 18 in Bamburak and Christopher (2004).

The Devonian Souris River Formation consists primarily of limestone and dolomite. Overburden thicknesses range from 20 to 40 m in this area (Betcher, 1987) and the Devonian strata were not seen in outcrop in the municipality.

Surficial geology and glacial history

Overburden thicknesses range from 4 m, where the

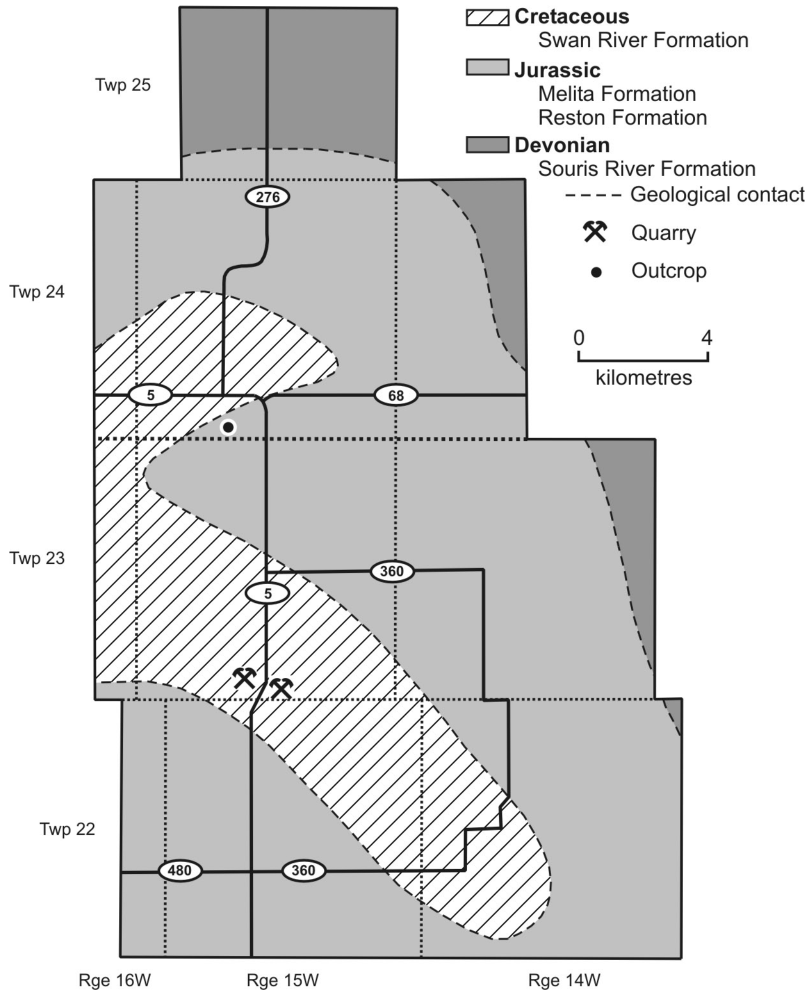

Figure GS-22-2: *Bedrock geology of the R.M. of Ste. Rose, showing quarry and outcrop locations (*modified from *Betcher, 1987, 1989; Bannatyne, 1971).*

quarries are located (4-23-15-W1), to 40 m in the west (Betcher, 1987, 1989). The surficial sediments in the municipality comprise glacial till, glaciolacustrine gravel, sand, silt and clay and modern organics (Figure GS-22-3).

Glacial till is by far the most extensive unit. The till is brownish yellow, silty and calcareous. The pebble fraction contains a high percentage of angular carbonate clasts. Klassen (1979) mapped the area immediately west of the R.M. of Ste. Rose, NTS map sheet 62N, and identified this till as the Arran Formation. The Arran till in the R.M. of Ste. Rose contains 34 to 65% carbonate and is from 2 to 5 m thick.

Glaciolacustrine sand, silt and clay cover most of the northern and western parts of the municipality. Boreholes in the northern part of the R.M. indicate 30 m of till in SW-16-24-14-W1, 1.5 m of sand overlying till in SE-16-24-15-W1 and 5.5 m of clay overlying till in SE-13-24-16-W1 (Betcher, 1987).

Glaciolacustrine sand and gravel is found in beach ridges scattered across the municipality. They are generally oriented in a southeast direction and vary in size from small ridges, 1 to 2 m high, to very large complexes of ridges that are 10 m in height and 1.5 km in width. One large complex runs for approximately 22 km diagonally through the centre of the R.M., starting near the town of Ste. Rose du Lac. It is informally known as the Ste. Amelie ridge. There is a second large complex along the eastern edge of the R.M. Most of this complex is in the adjacent municipality, but part of it runs along the eastern side of 22-14-W1. Smaller beach ridges are situated in the southwest corner of the R.M.

Organic deposits are found in low-lying areas particularly in the southeastern part of the municipality where the eastern beach complex blocks the natural, gentle northeast drainage pattern. The deposits are too small to be shown on Figure GS-22-3.

These surface deposits, except for the modern organics, were formed by glacial processes. The last glacial advance came from the northeast, over carbonate rocks, depositing the calcareous Arran till. During deglaciation, glacial Lake Agassiz inundated the area, ponding between

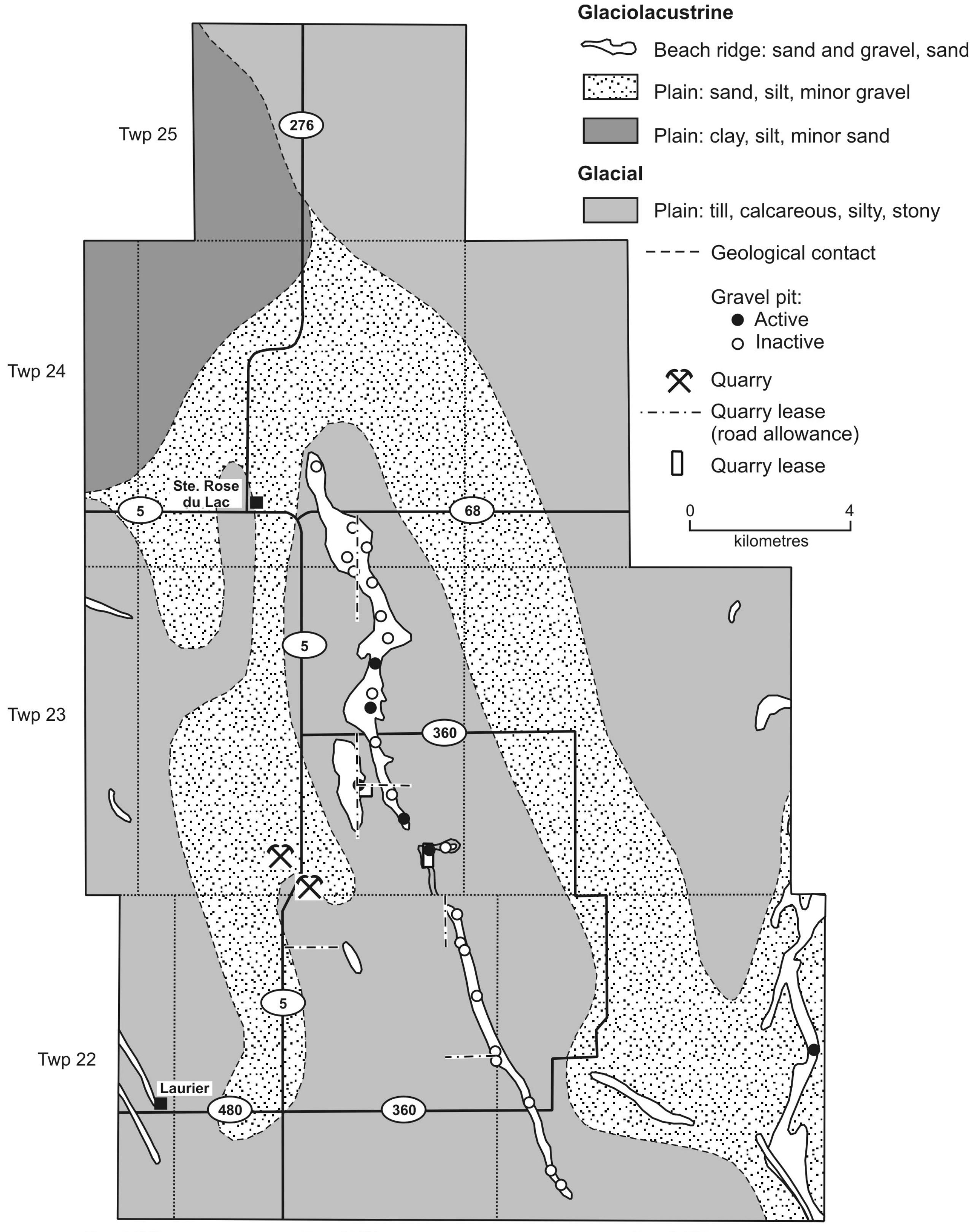

Figure GS-22-3: *Map of the R.M. of Ste. Rose, showing gravel deposits, pit and quarry locations and surficial deposits (*modified from *Matile and Keller, 2004a, b).*

the retreating ice to the east and the height of land to the west. Beach ridges formed discontinuously along the edge of the lake. As the ice retreated, the lake also retreated, with the resulting formation of beaches at successively lower elevations. Working in Manitoba and the adjacent parts of Saskatchewan and Ontario, Johnston (1946) took beach elevations around the former lake and, taking into account differential uplift, recreated shorelines at the various lake levels. The two beach complexes in the R.M. of Ste. Rose record the Gladstone level at 290 m above sea level (asl), the Burnside at 282 m asl and the Ossawa at 272 m asl. The majority of the gravel pits in the Ste. Amelie ridge are about 2 m deep and, from a limited number of exposures, the gravel appears to be underlain by till. Given that the ridge is 10 m high, it is possible that the bulk of the ridge formed either subglacially or at the ice margin before glacial Lake Agassiz entered the area. Once glacial Lake Agassiz formed, the beach deposits formed on the ridge.

Aggregate inventory

Methodology

The aggregate inventory was carried out in two stages: office compilation followed by fieldwork. Previously mapped deposits were transferred onto 1:20 000 township photomosaics and 1:10 000 section photos (1996 orthophotos). The township mosaics were used as a base on which to compile aggregate information from several sources:

1) active pit and quarry locations – Mines Branch quarry database;
2) lease and withdrawn locations – Mines Branch plat books and digital shape files;
3) Crown versus private ownership – Manitoba Crown Lands Branch database;
4) pit and sample locations – Geological Survey Pleistocene database;
5) pit and sample locations – Department of Highways block files; and
6) mineral inventory cards – Manitoba Geological Survey.

Quarries, gravel pits, road cuts and natural exposures were examined during the first part of the field examination. Pits and quarries were examined for type of material, degree of depletion and active/inactive/depleted status. Unopened portions of deposits were inspected and land uses that would limit aggregate extraction noted. Site locations were taken by GPS using UTM co-ordinates, as well as by section-township-range notation. In addition, the GPS co-ordinates of bedrock outcrops were also recorded.

Aggregate resources

The aggregate resources of the municipality are all found in sand and gravel beach ridges. Bedrock strata found in the quarries are too soft to be used as aggregate. Gravel ownership is mainly private but there is some crown-owned gravel. Most of the quarry leases are along road allowances, but the lease in NW-1-23-15-W1 is currently the most active extraction area. Figure GS-22-3 shows the location of gravel deposits, pits and quarries.

The Ste. Amelie ridge runs, in discontinuous segments, southeast through the centre of the municipality for over 22 km. The ridge has long been the major source of aggregate for the area. Many of the pits existing today were active when Gartner Lee Associates (1978) did their study. The pits range from 1 to 3 m in depth and till is occasionally exposed at the pit base. The material ranges from sandy coarse pebble gravel to fine sand. The gravel is of very high quality, with a pebble lithology averaging 75% carbonate and 25% Precambrian clasts and a good range of grain sizes. There is no shale in the aggregate and the only deleterious material was some carbonate cementation.

The northern segment of the ridge is virtually one long pit. In some of the older pits, minor amounts of material are being removed, such as in NW-10-24-15-W1. Others have been reactivated such as SW-26-23-15-W1 where there is 1.5 m sandy pebble gravel in the active area. The old part of the pit in NW-26-23-15-W1 is the site of several small stockpiles of screened material. In 23-23-15-W1, the large pit in the northwest contains crown gravel, which had been extensively removed until 2001; in the southwest, the gravel is owned by the municipality and last removed in 2004. In the east half of 11-23-15-W1, the old pit area runs the entire 1.6 km length of Section 11. There has been some limited removal recently with small stockpiles of screened material on site. The municipality holds the leases in the NW-11-23-15-W1 and there has been limited removal recently from the old pit there.

There are two pits in the middle segment of the ridge, 1-23-15-W1. The inactive pit in the northeast quarter is ~3 m deep and primarily sand remains. The active pit in the northwest is operated under a quarry lease. The pit reveals 2 m of high quality sandy pebble gravel with a good amount of crushable clasts. The pit is extensive, rather than deep.

The southern segment of the ridge consists of 1 to 2 m of sandy pebble gravel. It has been extensively mined in the past. Some pits have minor amounts of aggregate being removed, but there are no commercially active pits at present.

The sand and gravel ridges along the east side of 22-14-W1 were backhoe tested by Gartner Lee Associates (1978). There were four sites and the aggregate ranged from 2 m to >6 m of interbedded sandy pebble gravel, pebbly sand and sand. There is one pit (SE-24-22-14-W1) in the deposit from which the municipality removed aggregate in 2003 and has obtained permits to remove more material. The ridges trend northeast out of the municipality, into 23-13-W1. The ridges outside the municipality were backhoe tested in 1998 as part of a study of the Alonsa Wildlife Management Area (H. Groom, unpublished data, 1998). Twenty-one sites were excavated by backhoe. Most of the test pits were ~3 m deep and all pits ended in granular material. The material ranged from beds of cobbly coarse gravel to very good quality sandy pebble gravel to pebbly sand and sand. The gravel was predominantly composed of carbonate clasts and cementation was the only deleterious element.

The small beach ridges near Laurier contain 1 to 1.5 m of pebbly sand and fine pebble gravel. Material has been extracted from them in the past but they are not currently active. The remaining beach ridges are small and predominantly sand. There are also several small ridges of silty, sandy material that were probably formed as offshore bars. They have no economic value, except perhaps as fill.

Economic considerations

Aggregate is a high-bulk, low-value commodity so the haulage cost is often an important factor in the final cost of aggregate for a project. In general, the value of aggregate reserves in any specific area depends on the abundance of the resources and on the demand. Due to the haulage factor, the fewer the resources or the greater the demand, the more important it is to protect those resources from activities, such as building construction, that would prevent them being utilized. The R.M. of Ste. Rose has been very fortunate to have an abundance of high quality aggregate in the beach ridges of the area. While there is still considerable aggregate remaining in the Ste. Amelie ridge, many of the pits have been depleted of the best quality material. As depletion continues, the beach ridges along the east side of 22-14-W1 will be an important source of sand and gravel.

Acknowledgments

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