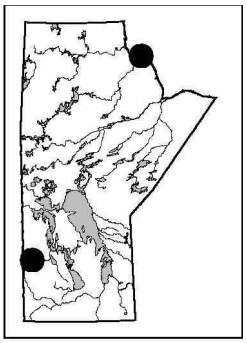
GS-27 AGGREGATE INVENTORIES: CHURCHILL AREA, RURAL MUNICIPALITY OF GRANDVIEW AND SELECTED AREAS OF SPECIAL INTEREST

by H.D. Groom



Groom, H.D. 2001: Aggregate inventories: Churchill area, Rural Municipality of Grandview and selected Areas of Special Interest; *in* Report of Activities 2001, Manitoba Industry, Trade and Mines, Manitoba Geological Survey, p. 172-178.

SUMMARY

Aggregate inventories were carried out in the Churchill area, the Rural Municipality (R.M.) of Grandview and several crown-land parcels (Areas of Special Interest) in southern Manitoba. Office compilation was followed by site inspection and backhoe testing, where required. Samples were field sieved and a representative portion of the fine fraction was sent to Winnipeg for processing. Approximately 300 sites were visited and 100 samples taken. This year, some of the new pits, quarries and access roads were mapped digitally, using a Trimble Geo3 global positioning system (GPS) unit.

CHURCHILL

Since the first European contact in the early 1600s, the Churchill area has been a centre of modern northern activity. First visited by explorers looking for the Northwest Passage, it became an important centre for the fur trade and was a strategic military post in the wars between France and England for control of North America. Later it became a transportation hub with the building of the railroad in 1929, the grain elevator and Port of Churchill in 1931 and the airport during World War II (*see also* Johnson [1987]). Following the war, both Canada and the United States maintained a large military presence, using it as a base for arctic research. The rocket research range was built in the late 1950s and operated until the mid-1980s. Part of these facilities now house the Northern Studies Centre, which is used by scientists doing biophysical, geologic and climate change studies.

The withdrawal of the military left Churchill with a large established infrastructure and a small population to support it. Tourism has become the major industry. Tourists from around the world come to see polar bears and northern lights, beluga whales and birds in a pristine natural environment. One legacy of the construction booms of previous decades is a large number of abandoned gravel pits along all roads in the area. Vegetation growth is very slow in this region and pits that are decades old still have not revegetated. This has led to a conflict between the need to maintain an undisturbed habitat for eco-tourism and species preservation and aggregate extraction, also necessary for tourism and other industries that support the town.

The Town of Churchill and the Manitoba departments of Conservation and Industry, Trade and Mines requested the aggregate inventory that was carried out this summer. The results will become one layer in a land-use planning map that could guide future extraction sites.

Location and Scope

The scope of the study was to inspect all existing aggregate sites and test unopened deposits within a reasonable distance of accessible haulage roads. This defined an area bounded on the west by Churchill River, on the north by Hudson Bay, extending eastward approximately 26 km and 20 km south of Hudson Bay. It falls within theoretical townships 110 to 113, ranges 20E prin. mer. to 2E of 2nd mer. (Fig. GS-27-1) on NTS map sheets 54K and 54L.

Previous Works

Many geological investigations have been carried out in the Churchill region since R. Bell of the Geological Survey of Canada visited the area in 1879. There are comprehensive accounts of earlier works in Dredge and Nixon (1992) and Bamburak (2000).

The surficial geology and glacial history of northeastern Manitoba, including the Churchill area, is detailed in Dredge and Nixon (1992). Maps of the surficial geology of Churchill are presented at 1:500 000 in Dredge and Nixon (1992) and at 1:250 000 in Dredge and Nixon (1980a, b). A biophysical map, at a scale of 1:50 000, was prepared by Terrain Analysis Services for Manitoba Hydro (Manitoba Hydro, unpub. rept., 1994). This map outlines potential aggregate deposits and other surficial units.

Young (1982a, b) mapped the sand and gravel deposits of the area, as well as testing Precambrian outcrops for their aggregate capabilities. The report by Bamburak (2000) on the industrial mineral potential of the area excluded sand and gravel but noted the use of bedrock quarries as aggregate sources.

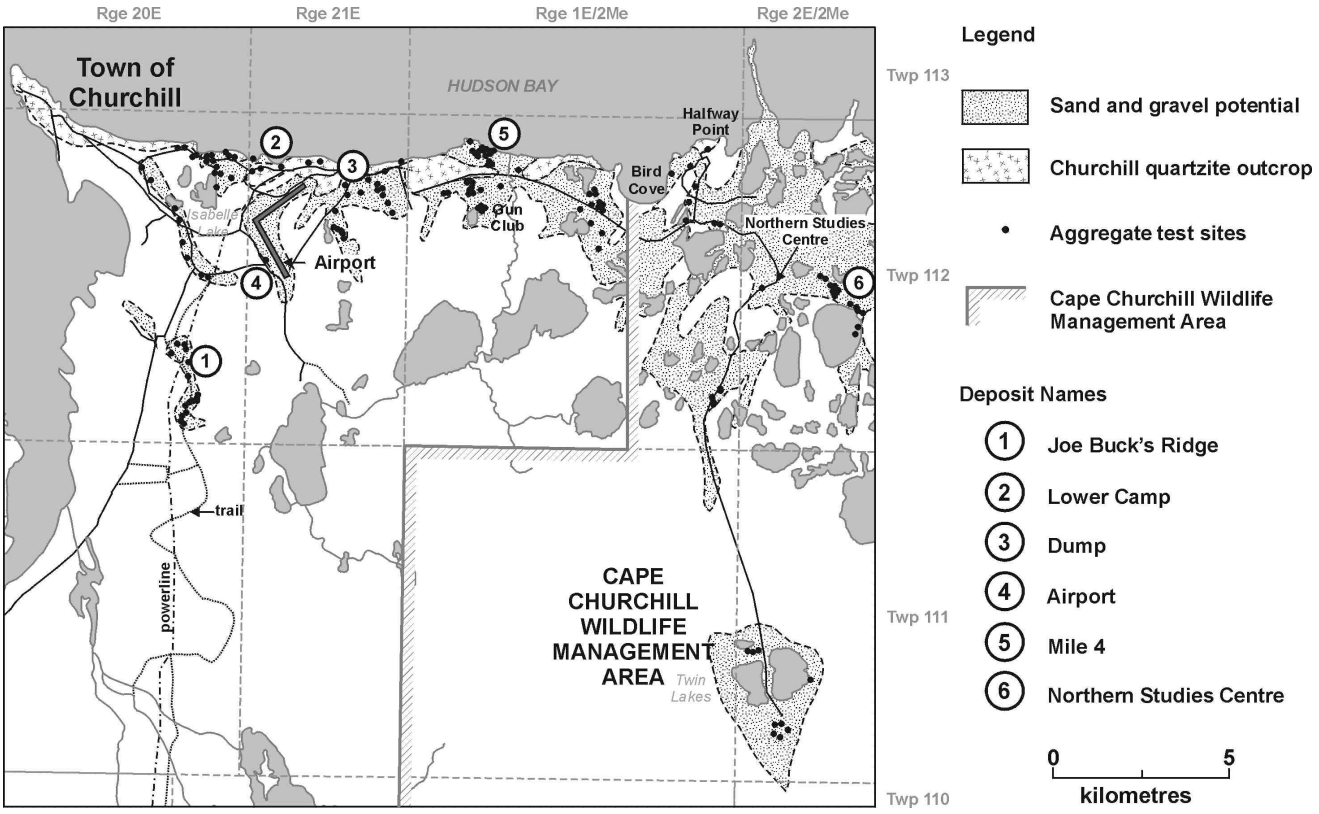


Figure GS-27-1: Location map of the Churchill area; showing potential aggregate deposits and quartzite outcrop.

Geology

Bedrock

The Precambrian Churchill quartzite outcrops as a discontinuous ridge in the study area. The ridge runs eastward along the coast for approximately 20 km then continues southwest of the study area on the west side of Churchill River. It is approximately 10 m high, up to 0.5 km wide in places and has been strongly moulded by glacial action. The rock is predominantly a grey, massive, medium- to fine-grained quartzite; in places crossbedded structures are preserved. Where the rock is fractured, it has weathered to a rusty orange.

Paleozoic rocks of Silurian and Ordovician age flank the quartzite ridge on both the north and south sides. Where seen in outcrop, the rocks are generally buff-coloured dolomite or limestone; commonly they are highly fossiliferous. In 1998, the world's largest trilobite fossil was found near Churchill (Bamburak, 2000).

Refer to Bamburak (2000) and Dredge and Nixon (1992) for more detailed bedrock descriptions.

Quaternary

Dredge and Nixon (1992) provides a detailed description of Quaternary events and surficial materials in the Churchill area. The following history is summarized from that work.

During the Wisconsinan glaciation, ice flow from the north (Keewatin) and the east (Hudson/Labradorean) affected northeastern Manitoba. Tills deposited by eastern ice are silty and carbonate rich. Tills deposited by the northern ice, are normally sandy and contain predominantly Precambrian clasts. By the time the glaciers reached Churchill, the tills had become carbonate enriched through the incorporation of Paleozoic bedrock and earlier carbonate-rich tills. The margin between these ice sheets fluctuated considerably over time but the main Late Wisconsinan ice flow in the Churchill area was from the north (Dredge and Nixon, 1992). Eskers with a north orientation, such as the Christmas Lake esker east of Churchill, support the presence of south flowing ice at the end of the last glaciation.

During deglaciation, freshwater glacial Lake Agassiz formed at the ice front, originally along the suture between the two ice masses. It is not clear that glacial Lake Agassiz ever extended over the Churchill area. As the Hudson ice retreated into Hudson Bay, ocean waters flowed in front. The ice front may have been west and south of Churchill at this time (Dredge and Nixon, 1992).

Because the land surface had been depressed by the weight of the ice, marine waters of the Tyrell Sea rose to elevations of greater than 165 m above sea level (a.s.l.) approximately 7700 years BP. Due to isostatic rebound, the Tyrell Sea gradually regressed towards present day Hudson Bay and the marine beaches that form the major aggregate deposits in current use were formed less than 2000 years BP (Dredge and Nixon, 1992).

Aggregate Inventory

The aggregate inventory consisted of office compilation and three weeks of fieldwork. Office compilation was carried out by:

- Compiling active pit and quarry locations, as well as quarry lease and withdrawal locations, from the Mines Branch quarry database
- Compiling pit and sample locations from the Department of Transportation and Government Services Block files
- Compiling depleted pit and identified rehabilitation sites from Inspection and Rehabilitation Services, Mines Branch
- Transferring data to a 1:50 000 digital biophysical base map provided by Manitoba Hydro; this map had potential sand and gravel deposits and bedrock outcrops delineated
- Airphotos from 1993 (1:20 000 scale) and 1974 (1:35 000 scale) were used in conjunction with the above map to design the field program

Fieldwork was carried out in conjunction with Irv Hiller of the Materials and Research Branch of Manitoba Department of Transportation and Government Services. Fieldwork began with site inspection of all known pits and quarries. Pits were examined for type of material, degree of depletion and active/inactive/depleted status. A Trimble Geo3 GPS unit, which has mapping capabilities and an accuracy of 1 to 5 m, was used to record the perimeters of active pits and quarries. Unopened portions of deposits were inspected and land uses or physical properties that would limit extraction noted.

Due to the environmental and tourism issues that prompted this inventory, several people led field trips to highlight areas of concern to various stakeholders. Cam Elliot and Glenn Sugget, Department of Conservation, showed us areas used by the tour operators, particularly within the Cape Churchill Wildlife Management Area. Darren Ottaway, CEO of the Town of Churchill, showed us sites related to both the need for aggregate for public works and for recreational use by local residents, such as Lion's Park playground at Isabelle Lake. Peter Scott of the Northern Studies Centre took us to plots laid out by scientists for their ongoing studies. These factors were kept in mind when determining the backhoe program.

Merv Walkoski, of Merv's Excavating Co., was hired for the backhoe program. He is a long-term resident, the only local aggregate operator in the area and has been the backhoe operator for most of the previous testing programs. As such he has extensive knowledge of the aggregate and had already tested some of the deposits selected for this backhoe program. Given the local sensitivity against disturbing vegetation due to its long regrowth period, we did not retest deposits that M. Walkoski had recently excavated. For these we used a GPS unit to determine the location of each old hole and recorded the approximate depth and material type as he recalled it. Twenty-five such holes were recorded.

Fifty new testholes were dug. The backhoe had a reach of greater than 8 m but most holes were 1 to 3 m deep as permafrost was often the limiting factor. Testholes were deeper in the base of old pits where the removal of the insulating peat layer resulted in the lowering of the permafrost level. (Fig. GS-27-2). Backhoe site locations were noted using a Garmin 12 XL GPS unit as well as the Trimble in order to test the relative accuracy of the much more affordable Garmin.

Sixty-six gravel samples were shipped to Winnipeg for sieve analysis by the Department of Transportation and Government Services. In addition, five samples were taken to be analyzed for salt content.

Aggregate Deposits

There are four bedrock quarries in the study area; one in the Churchill quartzite and three in limestone outcrops. The three active quarries, the quartzite and two of the limestone quarries, are operated by M. Walkoski in an area locally referred to as

Figure GS-27-2: Backhoe testing at the base of old pit; Twin Lakes deposit.

the “lower camp” site (sec.30 and 31, twp. 112, rge. 21, E prin. mer.). They are a major aggregate source. The third limestone quarry is near the Northern Studies Centre and has not been used since the project to reactivate the Rocket Launch site was abandoned.

There are six active sand and gravel areas, informally referred to as: 1) Joe Buck’s Ridge, 2) Lower Camp, 3) Dump, 4) Airport Pit, 5) Mile 4 and 6) Northern Studies Centre (Fig. GS-27-1).

While the Joe Buck’s Ridge and Dump deposits both have remaining gravel reserves, it is the sand in each deposit that is important. The sand at the south end of Joe Buck’s Ridge has a low salt content making it one of the few deposits in the area that can meet specifications for concrete. The Dump pit is the only known source of VMA sand — an important element for asphalt production (D. Kernot, Mulder Construction, pers. comm., 2001). This resource is currently being sterilized by the dumping of chaff from railway boxcars.

The aggregate portion of the Lower Camp deposit is nearing depletion. The best gravel remaining is under the trail, which is being rerouted to the depleted portions of the pit to allow access to this reserve.

The material in the Airport Pit is very high-quality aggregate. Minor amounts have been removed recently but it has not been a major source because it is on federal land and there are reports that live shells, leftover from the military days, were found in one of the old pit areas recently.

The Mile 4 pit has been in use for many years and portions have been rehabilitated. It was a source of gravel for recent airport repairs. The Town is currently using stockpiles of sand left after screening for stone was completed.

Material from the Northern Studies Centre deposit, which is actually 1.5 km east of the Centre, was also used in the airport repairs. The pit face shows 4 m of gravel with a high crushable content. The deposit continues to the southeast of the pit. Backhoe pits in the unopened portion of this deposit revealed 2 to 2.5 m of coarse gravel (Fig. GS-27-3) with permafrost at the base. This deposit contains enough reserves for several major construction projects in the future.

Several inactive deposits were examined. Of these, the Twin Lakes deposit contains a large reserve of coarse material that would be suitable for rip-rap. The area behind the Gun Club had been previously tested and contains a large reserve of material suitable for traffic gravel. Areas southeast of Halfway Point and on both sides of Bird Cove have reserves of good quality gravel and near-surface limestone, however these areas are heavily used by the tourist industry. The deposit at Isabelle Lake is also an excellent source of aggregate; however the area is important recreationally to the Town. These areas were not tested but existing pits were sampled.

RURAL MUNICIPALITY OF GRANDVIEW

The R.M. of Grandview lies in the valley between Riding Mountain and Duck Mountain in twp. 23 to 27 and rge. 23 to 25, W prin. mer. (Fig.GS-27-4). The area is primarily agricultural although tourism is also economically important due to the proximity of Duck Mountain Provincial Park and Riding Mountain National Park. Highway 5, Provincial Road 366 and section roads give good access to most of the municipality.

Gartner Lee Associates (1978) originally mapped the area as part of a regional aggregate study carried out for the Department of Energy and Mines. The Gartner Lee study is now more than 20 years old but the Department has been updating the aggregate maps on a municipality by municipality basis, usually as required for inclusion in municipal development plans but also as other needs arise. The R.M. of Grandview was selected for remapping this year as the municipality has initiated a development plan and current aggregate data is needed for the plan.

Figure GS-27-3: Coarse gravel, Northern Studies Centre deposit.

Geology

The R.M. is underlain by Cretaceous shale of the Pierre Formation but no shale is used as aggregate in the municipality.

The glacial history is outlined by Klassen (1979). Late in the Wisconsinan, ice flowing from the north deposited till of the Zelena Formation across the area. This ice sheet stagnated, resulting in the hummocky till deposits found on

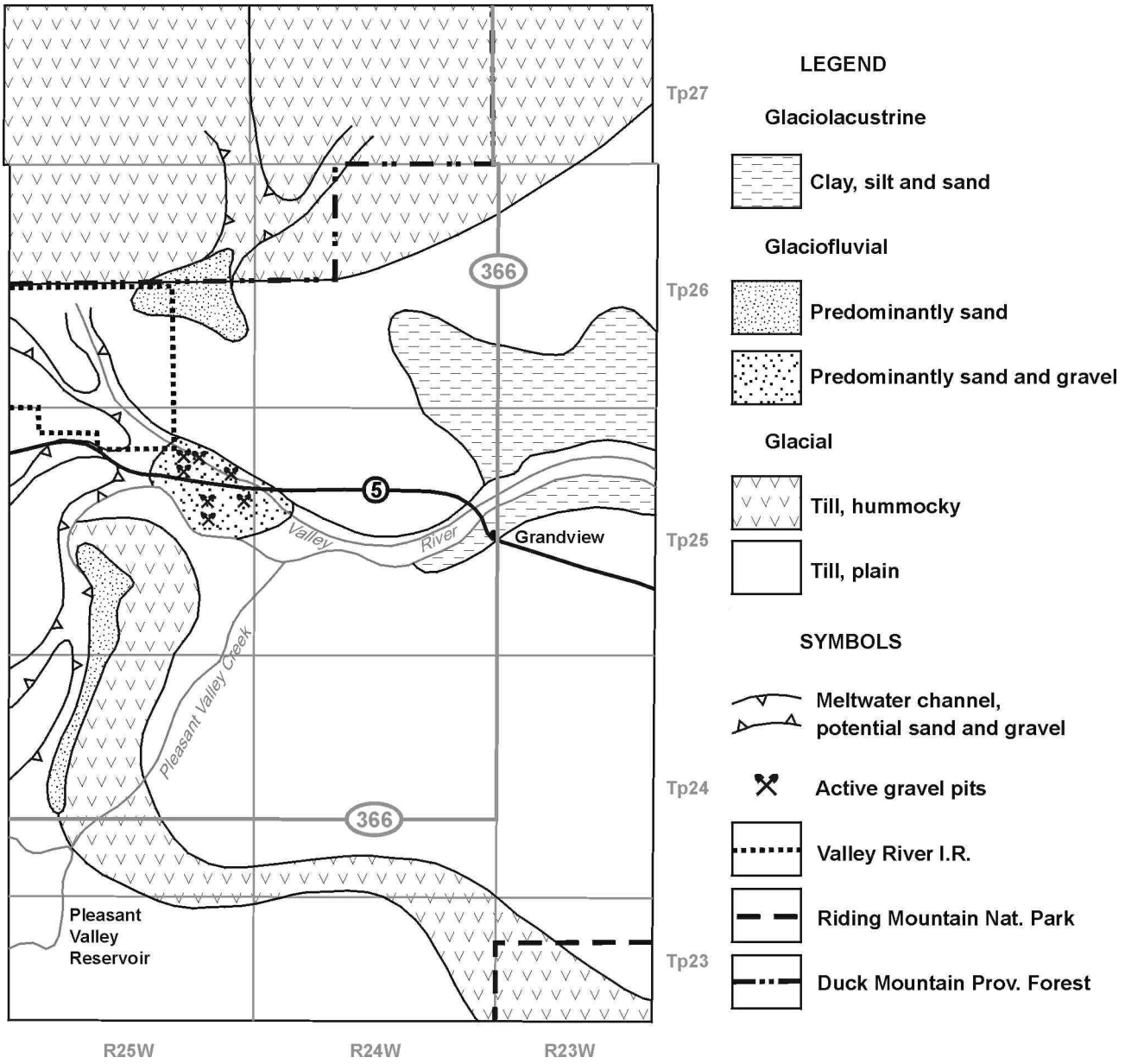


Figure GS-27-4: Location map of the Rural Municipality of Grandview, showing areas of aggregate potential (after Klassen, 1979).

Duck and Riding mountains. The Valley River sublobe, an offshoot of the active ice sheet in the Manitoba Interlake, then flowed westward up the valley between the two mountains, depositing the silty Arran till. The Petlura end moraine marks the west and southern extent of this ice advance. As the Valley River sublobe receded, meltwater ponded on the mountains and flowed downslope, creating meltwater channels and depositing the fan and channel aggregate deposits.

Aggregate Inventory

As with the Churchill area, the aggregate inventory was carried out in two stages; office compilation followed by field-work. Previously mapped deposits were transferred onto 1:20 000 township photomosaics (1991 orthophotos). The township mosaics were used as a base on which to compile aggregate information from several sources:

- Active pit locations – Mines Branch quarry database
- Quarry lease and withdrawn locations – Mines Branch plat books
- Crown versus private ownership – Manitoba Crown Lands Branch database
- Pit and sample locations – Department of Highways block files
- Water-well records — Manitoba Conservation (GWDrill)

Pits, roadcuts and natural exposures were examined during the first part of the field examination. Pits 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.

Aggregate samples were processed in two stages. In the field, samples that weighed between 75 and 100 kg were passed through 6-inch (15.2 cm), 3-inch (7.5 cm), 1½-inch (3.8 cm) and ¾-inch (1.9 cm) screens. The weights of the 3-, 1½-, ¾- and less than ¾-inch fractions were recorded. In addition, the relative abundance of less than 6-inch material, as well as deleterious material (e.g., shale, concretions), was noted. Pebble counts on the 1 ½-to 3-inch fraction were done in the field. A representative sample of the less than ¾-inch fraction was taken for processing by the Material and Research Branch of the Department of Transportation and Government Services, under the terms of the cooperative agreement initiated in 1998.

Aggregate Deposits

The aggregate deposits are of three main types: end moraine, fan and meltwater channel deposits.

End moraine

The western terminus of the Petlura end moraine, locally known as Rose Ridge, is a north-trending ridge in twp. 24 and 25, rge. 25, W prin. mer. It is about 10 km long, 1 km wide and 15 to 30 m high. There are no gravel pits in this feature. The material exposed in ditch sections is crossbedded, medium to fine sand although Klassen reports silt and gravel are also constituents of this part of the moraine (Klassen, 1979). The ridge was drilled by Prairie Farm Rehabilitation Administration (P.F.R.A.) and found to be an excellent source of groundwater. The aquifer contains more than enough water to supply the town of Grandview but has not been exploited due to the cost of piping the water to the town.

Fans

There is one major fan deposit located in twp. 26, rge.25, W prin. mer. The deposit is primarily pebbly sand and in the past minor amounts of material have been removed for local use. Along the northwestern edge of the deposit the material is medium to coarse sand, blown into dunes. There is pebble gravel at the base but the depth of the overlying sand makes it uneconomic as an aggregate source.

Meltwater channel deposits

There are several meltwater streams that flowed off the mountains; the largest meltwater channels are those that now contain Valley River and Pleasant Valley, Bear and Silver creeks. All have potential for gravel deposits along their length but it is the Valley River channel that contains the only large deposits in the municipality.

While there are small deposits and old pits all along the Valley River channel through the municipality, the main deposit occurs in twp. 25, rge. 25, W prin. mer. This deposit is up to 2.5 km long and about 1.5 km wide. It is bisected by Valley River and much of the deposit is sterilized by Highway 5 and farmsteads. This deposit was active in 1978 when Gartner Lee carried out their study and it is still the major source of aggregate for the municipality in 2001. There are seven active pits and several old pits that either have been abandoned or are being used for minor local use. All the aggregate is privately owned and the pits are used by either the R.M. or local gravel contractors, under agreement with the landowner.

The deposit is a series of linear gravel ridges with intervening areas of sand or pebble gravel. The ridges are 3 to 5 m high with undulating surfaces. The aggregate is generally sandy, coarse pebble gravel with a good crushable content. The amount of sand varies along the length and occasionally across the width of each ridge. Pebble lithology averages 75% Paleozoic and 25% Precambrian. Ironstone concretions, eroded from shale bedrock, make up most of the deleterious content. Despite the presence of the concretions, there is virtually no shale in the sand and gravel. The aggregate overlies stony clay in most places although till was noted occasionally at the base of some pits.

AREAS OF SPECIAL INTEREST

Areas of Special Interest (ASIs) are parcels of land put forward as candidate sites for Manitoba's Protected Areas Initiative. Under this initiative, representative portions of each of Manitoba's natural regions are set aside for biodiversity protection; mining (including aggregate extraction), forestry and hydro development are excluded activities. Eleven candidate areas required site inspection this summer.

Six of the ASIs have low to moderate economic potential for aggregate extraction because of high sand content, previous depletion or difficulty of haulage from the deposit.

Two ASIs contain Precambrian outcrops that are suitable for aggregate and have good road access. There are quarry leases in one of these sites. These two ASIs are several square kilometres and the portions with high quarry potential are relatively small.

There are three ASIs with high aggregate potential. Horseshoe Ridge ASI in the Interlake, has both high-quality gravel

and near-surface bedrock. The gravel is in a large esker and a small beach deposit. Both deposits have active pits. The unopened portion of the esker is under quarry lease. The bedrock, of the Paleozoic Stony Mountain Formation, is not road accessible and has no quarries opened in it. Shoal Lake ASI has an active gravel pit in a small beach deposit. The size of the aggregate area in relation to the total size of the ASI is very small. The Rivers ASI is a quarter section adjacent to the Rivers Provincial Park. The parcel is underlain by a good-quality gravel deposit. The vegetation is a remnant of mixed grass prairie. The site is on one of the few lakes in the area and is used by campers. As the land has both mineral and environmental values, all stakeholders should have an opportunity to comment before a final disposition is made.

ACKNOWLEDGMENTS

The Churchill study benefited greatly from the assistance of the following people: Irv Hiller, Department of Transportation and Government Services, whose experience in aggregate testing was invaluable and whose cooking skills made the stay a pleasure; Merv Walkoski, who provided backhoe services and shared his extensive knowledge of the aggregate deposits around Churchill; Roy Bukowski, Manitoba Hydro, who generously provided airphotos and the biophysical map; and Kyle Canning, who provided field assistance and geographic information system (GIS) expertise.

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