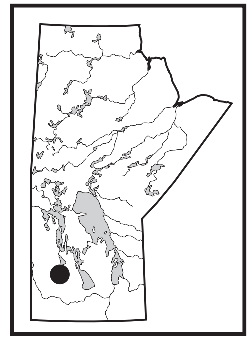
GS-19 Aggregate resources in the Rural Municipality of Park, Manitoba (NTS 62J12, K9)

by H.D. Groom



Groom, H.D. 2007: Aggregate resources in the Rural Municipality of Park, Manitoba (NTS 62J12, K9); *in* Report of Activities 2007, Manitoba Science, Technology, Energy and Mines, Manitoba Geological Survey, p. 195–201.

Summary

The Rural Municipality (R.M.) of Park was mapped in 2007 to update aggregate information for land-use planning in the area. The landscape of small lakes and rolling hills, as well as proximity to Riding Mountain National Park, has resulted in increased recreational development, which has put increasing land-use pressure on aggregate deposits in some parts of the municipality. The last study of this rural municipality was completed in 1980 and current information is required for sound land-use planning decisions. The information gathered will be included in municipal development plans and used for resource management within Manitoba Science, Technology, Energy and Mines.

The R.M. of Park has large reserves of aggregate in glaciofluvial deposits spread across the municipality. The deposits were formed during deglaciation as ice stagnated and aggregate was deposited over and within melting blocks of ice. As a result, the deposits are characteristically quite variable in depth and sediment type over short distances. Shale and ironstone concretions eroded from the underlying bedrock are significantly deleterious and lower the quality of the aggregate. The gravel is best suited to low-end products, such as traffic gravel, which tolerates a moderate percentage of shale.

There are only four active pits in the municipality, which reflects the low quality of the deposits. Two of them were active in 1980, when the last aggregate study was carried out, and are still not depleted after years of extraction. This reflects the substantial depth of material in some parts of the deposits and the sheer volume of aggregate per quarter section in those areas. The greatest demand for sand and gravel is in the eastern part of the municipality, near the south gate of Riding Mountain National Park. Cottage developments and recreational facilities, such as golf courses, are on the increase there and they are being built on aggregate deposits, however, the volume of aggregate in the areas of the nearby active pits (HD245 and HD222) is more than adequate to meet the needs for the foreseeable future. Land-use planning decisions should be based on maintaining a buffer around these pits to prevent any development from limiting their expansion in the future.

Introduction

An aggregate inventory of the R.M. of Park was carried out in the summer of 2007. The information gathered is included in municipal development plans, used for resource management within Manitoba Science, Technology, Energy and Mines and is available to other government departments and outside clients on request. The municipality was originally mapped in 1980 as part of the South Riding Mountain area (Groom, 1980a–c).

The R.M. of Park is located in west-central Manitoba, adjacent to the south boundary of Riding Mountain National Park (Figure GS-19-1). Until recently, the R.M. of Park comprised two discrete blocks of land. The northern block covers three townships, parts of Twp. 29 and 30, Rge. 28–29, W 1st Mer., and lies adjacent to the R.M. of Shell River; it was incorporated into that municipality on January 1, 2007. The southern block forms the current R.M. of Park; it covers approximately six townships, parts of Twp. 19 and 20, Rge. 18–22, W 1st Mer., and is located on NTS sheets 62J12 and K9.

Provincial highway 10, Provincial roads 250, 262, 270, 354, 470 and 566, and a network of section roads give good access to most of the area. The largest village in the municipality is Onanole but the major service centre is the city of Dauphin, which is accessed by Highway 10 through the park. The primary industries have historically been mixed farming and forestry. However, the landscape of small lakes and rolling hills, as well as proximity to the national park, has resulted in an increase in seasonal cottagers and tourists so that recreational-related service industries now form an important part of the local economy.

Previous work

The bedrock of the area has been described in many regional studies, including those by Wickenden (1945), Bannatyne (1970) and McNeill and Caldwell (1981).

The municipality is covered by two reports on groundwater availability: Neepawa area (NTS 62J; Betcher, 1989) and Riding Mountain area (NTS 62K; Sie, 1978). 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.

Klassen (1979) outlined the glacial history and mapped the surficial geology of NTS sheets 62K (Riding Mountain) and 62N (Duck Mountain) at a scale of 1:250 000; the western portion of the municipality is included in this report. The R.M. of Park was mapped at a scale of 1:50 000 as part of a surficial geology and aggregate mapping project that included five municipalities (Groom, 1980a–c). During that study, 97 sites were examined in the R.M. of Park; 82 of these were

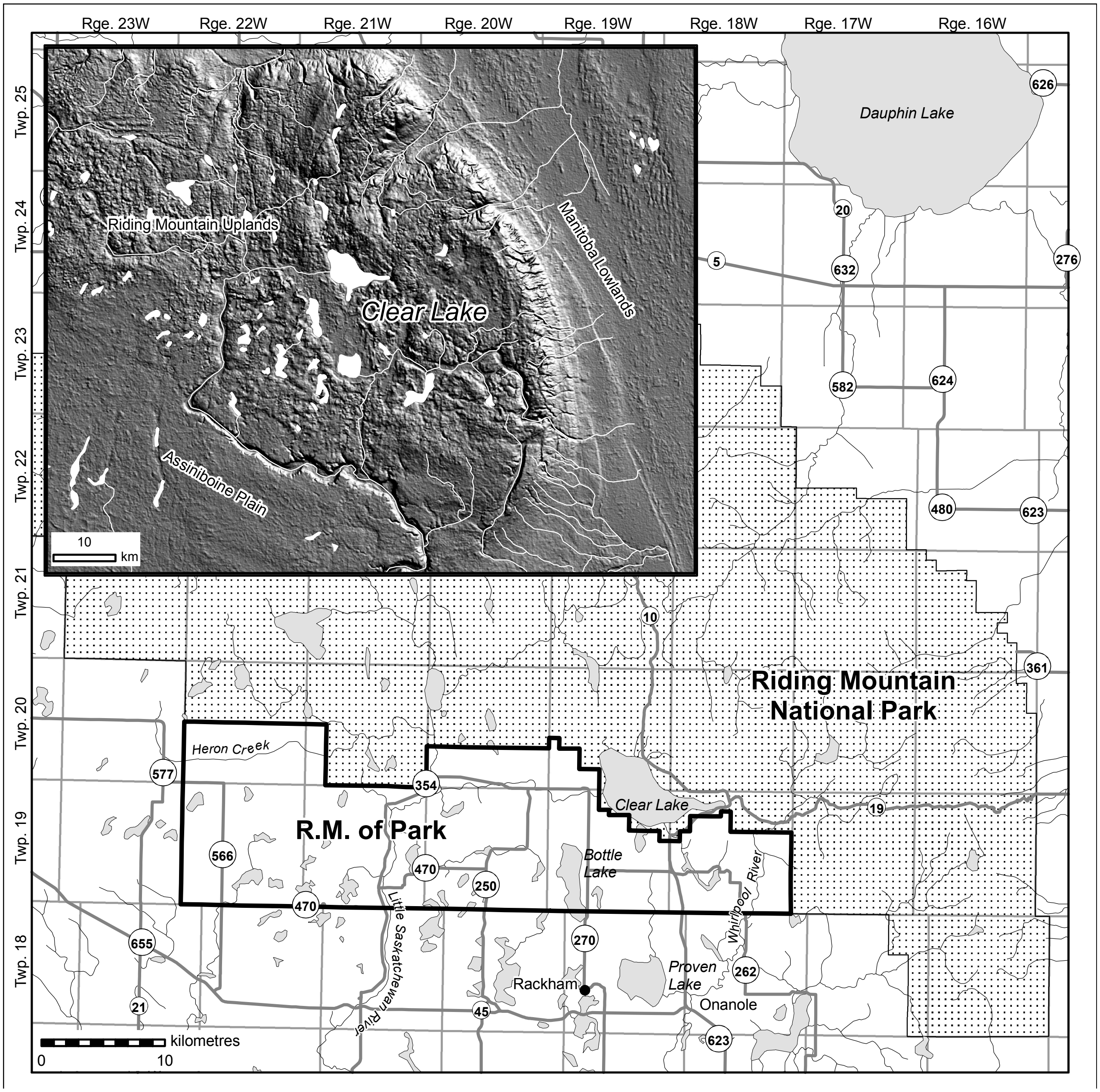


Figure GS-19-1: *Location map of the Rural Municipality of Park, Manitoba. Inset figure shows hummocky terrain of Riding Mountain uplands.*

aggregate sites. Thirteen backhoe pits were dug in the municipality. Aggregate data from that project was published as an open file report accompanied by a 1:100 000 scale aggregate map (Young, 1983). The municipality is also included on two recent 1:250 000 scale Surficial Geology Compilation Maps: SG-62J (Matile and Keller, 2004a) and SG-62K (Matile and Keller, 2004b). On these maps, the surface units have been draped over topographic relief maps and landforms are very clearly shown.

Geology

Bedrock geology

The municipality is underlain by the Odanah Member of the Upper Cretaceous Pierre Shale (Bannatyne, 1970). Bannatyne included the Odanah Member, along with the underlying Millwood Member, as part of the Riding Mountain Formation. However, McNeill and Caldwell (1981) rejected the Riding Mountain Formation nomenclature and placed the Odanah and Millwood members into the Pierre Shale. The Odanah Member consists of hard, grey, siliceous shale; ironstone concretions are common and iron or manganese staining often occurs on fractures or bedding planes. The bedrock is overlain by 20 to >125 m of Quaternary sediment (Sie, 1978; Betcher, 1989) and there were no bedrock outcrops observed in the municipality. The bedrock section reported by Bannatyne (1970) in Sec. 18, Twp. 19, Rge. 18 W 1st Mer.

(abbreviated 18-19-18-W1) is no longer exposed. McNeill and Caldwell (1981) describe the Odanah Member sedimentary rocks in sections north, south and west of the study area. Bannatyne (1970) describes the chemical properties and economic potential of the unit. Odanah Member shale clasts are a common component in the till and gravel of the R.M. of Park.

Surficial geology and late glacial history

The surficial sediment in the municipality is primarily till, glaciofluvial sand and gravel (including ice-contact and outwash deposits), and glaciolacustrine sand, silt and clay. The units are shown on Figure GS-19-2**.**

The surface till in Riding Mountain uplands is the Zelena Formation. The till has a brownish clay-silt matrix with moderate carbonate content and contains a pebble lithology of shale, Precambrian and carbonate clasts. It is generally 3–15 m thick but locally can be much thicker (Klassen, 1979). The till forms a hummocky stagnation moraine with hummocks ranging between 5 and 15 m high. The till is a lateral equivalent of the Lennard Formation, which is the surface till on the Assiniboine River plain. These tills overlie the Early Wisconsinan Minnedosa Formation. The Minnedosa Formation till is an olive-brown, clayey till that is usually more compacted and less calcareous than the tills of the Zelena and Lennard formations.

Glaciofluvial deposits form the majority of the surficial sediment in the municipality. These deposits consist of three types: ice-contact kame-esker complexes, outwash plains deposited over stagnant ice and outwash terrace deposits along meltwater channels. The sediment consists of a wide range of grain size (from sand to boulders) and of varying depths (>18 m for some deposits). The sand and gravel is most often crossbedded, the beds are often faulted and seams of flow till are common, indicating fluvial deposition in close contact with ice. Shale content ranges from 10 to 90% and is present in all of the deposits; ironstone concretions and weathered Precambrian clasts are also present in most of the gravel pits examined.

There are two kame-esker complexes in 19-20-W1 (Figure GS-19-2). The complexes are broadly curvilinear features formed of ridges that are up to 30 m high; the complexes are 0.5–1.5 km wide. One segment runs broadly east-west for 12 km; the other, approximately perpendicular to the first, runs south along Bottle Lake for 8 km. A narrow band of outwash, oriented southeast, separates the two segments. The outwash plains have hummocky surfaces with local relief of 3–9 m. The outwash terrace deposits occur as flat benches along Little Saskatchewan and Whirlpool rivers and Heron Creek.

Glaciolacustrine sediment (fine sand, silt and clay) occurs near Bottle and Proven lakes. Much of this material was deposited over stagnant ice in short-lived glacial lakes; hummocks of flat-bedded silt are exposed near the town of Rackham just south of the study area. This 'inverted topography' resulted when silt, originally deposited in holes between ice blocks, was left as hills when the ice melted away.

Late glacial history

Klassen (1979) outlined the general sequence of events during the Wisconsinan glaciation in the Duck and Riding mountains area. During the Late Wisconsinan, the Riding Mountain area was glaciated by ice flowing from northwest centres of outflow. Klassen states that the Zelena till was deposited on the uplands (above the 580 m asl contour) by ice that flowed from a slightly more northerly centre than the ice that deposited the laterally equivalent Lennard till on the adjacent Assiniboine River plain. During deglaciation, ice began to stagnate on the

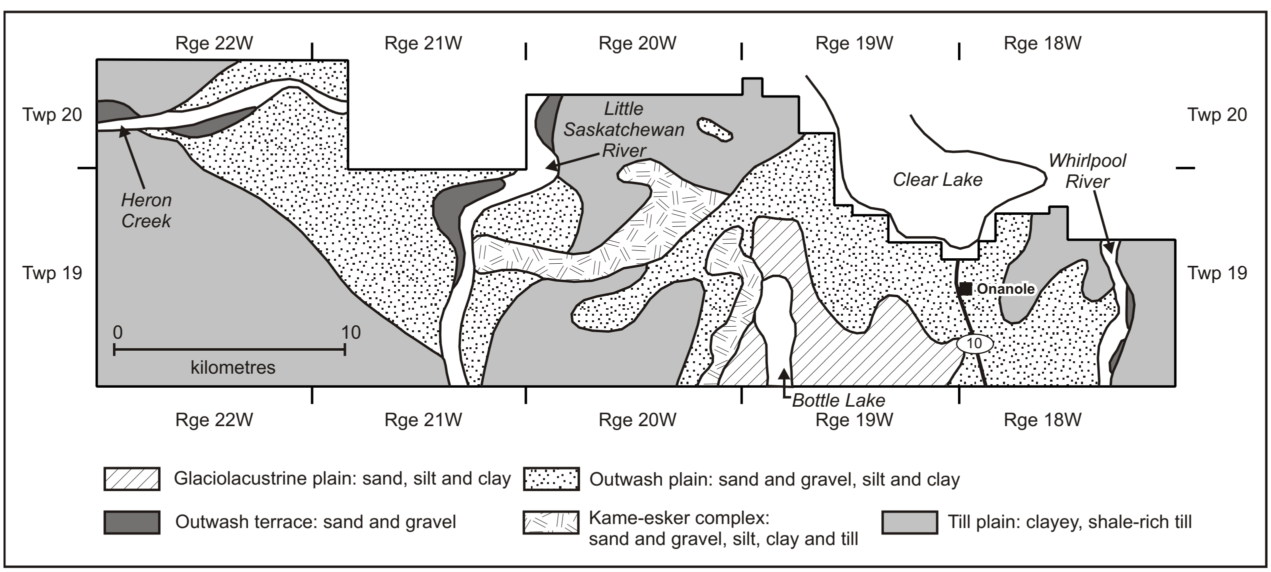


Figure GS-19-2: *Surficial geology of the Rural Municipality of Park, Manitoba.*

upland area while active ice continued flowing at the lower elevations on both the east and southwest sides of the mountain.

As the ice sheet stagnated, a chaotic landscape resulted from debris melting out of the ice and meltwater trying to escape to lower elevations, but being prevented by thick ice still occupying those areas. There were blocks of ice with crevasses between and debris was slumping off into the crevasses while water was flowing or ponding. These processes formed hummocks of till, gravel, silt or a mixture of all three. The kame-esker complexes formed in openings within the ice or against margins of stagnant ice blocks. Outwash plains formed as water escaped across the ice, depositing sand and gravel. The large amount of silt and clay around Proven and Bottle lakes was deposited over the ice in glacial Lake Proven, the largest of many short-lived supraglacial lakes formed when surrounding ice and debris prevented meltwater from flowing.

As drainage became established, Little Saskatchewan River, Whirlpool River and Heron Creek became the major channels carrying meltwater from the area. Sand and gravel deposits, referred to as glaciofluvial or outwash terraces, formed along the edges of these waterways.

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 a 1:50 000 photo base of the municipality created from 1998 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 shapefiles;
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) existing aggregate maps and reports.

Gravel 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. Special note was taken of shale content as it can make a deposit unsuitable for certain end uses (e.g., concrete). 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. No bedrock outcrops were located during the survey. During the 1980 study of the Riding Mountain area (Groom, 1980a–c), gravel deposits were extensively sampled. Forty-five samples were collected in the R.M. of Park and returned to Winnipeg for sieve analysis and pebble lithology counts. Grain sizes greater than pebbles (>50 mm) were not included in the sieve analysis, but a visual estimate of that fraction was made on site. Sieve results are summarized in Table GS-19-1. Sample sites are shown on Figure GS-19-3; for clarity the two letter prefix (HG) of the sample sites has been omitted on the diagram. Pebble lithology was done on the 4–16 mm size fraction; pebbles were divided into shale, carbonate and Precambrian classifications and not further subdivided. It is very difficult to accurately determine the shale content of a sample because shale breaks so easily. Pebble counts can give an estimate of the shale content, but it is not a really accurate method. A weight percent of the shale in the 4–16 mm fraction was also determined. As expected, pebble counting overestimates the percent shale, but the relationship was not consistent.

Aggregate resources

Aggregate resources in the R.M. of Park are found in three types of deposits: kame-esker complexes, outwash plains and outwash terraces. These deposits form the surface material for at least one-half of the municipality (Figure GS-19-2). All the deposits contain shale; ironstone concretions and weathered Precambrian clasts are also common. There are four active gravel pits. The aggregate in these pits is privately owned and the pits are spaced evenly across the municipality: SW-5-19-18-W1 (HD245), NE-32-19-19-W1 (HD222), SW-21-19-20-W1 (HD229) and NW-19-19-21-W1 (HD233). Two of these pits were active in 1980 (HD222 and HD233) and the other two are in the same quarter-sections as pits that were visited in 1980. Most of the sand and gravel rights in the municipality are privately held. There are only two quarry leases, both in W-15-19-18-W1. There are no exposures in the lease areas but ditch exposures indicate 2–3 m sandy fine pebble gravel overlying till.

Aggregate deposits

There are two kame-esker complexes in the municipality, both in 19-20-W1 (Figure GS-19-2). The sediment forming the deposits is not well exposed. The thickest exposure is 7 m of sediment, while the total height of the feature exceeds 30 m in places. Four exposures in the south-trending segment along Bottle Lake and 12 exposures in the east-trending segment indicate that at least the upper portions of the complexes are primarily formed of crossbedded sand and sandy fine pebble gravel; shale content is very high. Silt beds and lenses of till are also common in the sediment. Faulting of the beds and the close association of beds of greatly different grain size indicate the ice-contact origin of these features. There is one active pit (HD229 in SW-21-19-20-W1) in these deposits. The pit is up to 7 m deep in places. The material

Table GS-19-1: Summary table of sieve data and shale content of aggregate samples, Rural Municipality of Park, Manitoba (Groom 1980a–c).

Twp.-Rge.	Site	Deposit type	% Pebbles[1]	% Granules[2]	% Sand[3]	% Silt/Clay[4]	% Shale[5]	Wt % Shale[6]
19-20W1	HG002	kame-esker	19	16	63	2	60	81
19-20W1	HG006	kame-esker	38	11	50	1	54	27
19-20W1	HG008	kame-esker	36	13	49	2	32	12
19-20W1	HG009	kame-esker	4	3	90	3		
19-20W1	HG067	kame-esker	40	18	37	5	24	24
19-20W1	HG068	kame-esker	59	10	29	2	13	11
19-20W1	HG090	kame-esker	3	4	91	2	81	
19-20W1	HG098	kame-esker	13	6	79	2	22	23
19-20W1	HG109	kame-esker	49	13	36	2	11	
20-20W1	HG108	kame-esker	37	10	46	7		
19-18W1	HG151	outwash plain	18	10	70	2	33	29
19-18W1	HG152	outwash plain	30	10	52	8		
19-18W1	HG154	outwash plain	29	16	53	2	10	
19-18W1	HG162	outwash plain	49	10	37	4		
19-18W1	HG170	outwash plain	37	13	46	4	20	6
19-18W1	HG173	outwash plain	25	15	58	2		
19-18W1	HG174	outwash plain	40	14	43	3		
19-18W1	HG188	outwash plain	52	15	31	2	10	3
19-19W1	HG003	outwash plain	21	15	63	1	52	50
19-19W1	HG004	outwash plain	15	8	76	1	52	39
19-19W1	HG005	outwash plain	54	10	34	2		
19-19W1	HG014	outwash plain	62	9	27	2	56	33
19-19W1	HG080	outwash plain	31	13	55	1	17	47
19-19W1	HG081	outwash plain	50	9	40	1	15	11
19-19W1	HG146	outwash plain	41	18	39	2		
19-19W1	HG149	outwash plain	14	8	76	2	71	71
19-19W1	HGB14	outwash plain	29	12	54	5	43	33
19-21W1	HG010	outwash plain	41	9	46	4	9	4
19-21W1	HG011	outwash plain	51	8	29	12	7	5
19-21W1	HG012	outwash plain	55	17	25	3	57	40
19-21W1	HG013	outwash plain	44	18	30	8	11	6
19-22W1	HG054	outwash plain	20	6	73	1	29	10
19-22W1	HG073	outwash plain	46	22	30	2	5	3
19-22W1	HG074	outwash plain	19	10	69	2	20	17
20-19W1	HG096	outwash plain	44	14	40	2	6	4
20-21W1	HG049	outwash plain	36	13	49	2	46	38
20-22W1	HG050	outwash plain	57	9	33	1	5	1
20-22W1	HG051	outwash plain	49	14	34	3	5	10
20-22W1	HG052	outwash plain	52	14	31	3	14	10
20-22W1	HG059	outwash plain	24	15	59	2	22	11
19-18W1	HG200	terrace	45	12	36	7	8	2
19-21W1	HG079	terrace	30	5	62	3	14	8
20-20W1	HG069	terrace	22	11	66	1	12	10

Notes: [1] 4.7–50.0 mm; [2] 2.3–4.7 mm; [3] 0.07–2.3 mm; [4] <0.07 mm; [5,6] 4–16 mm fraction

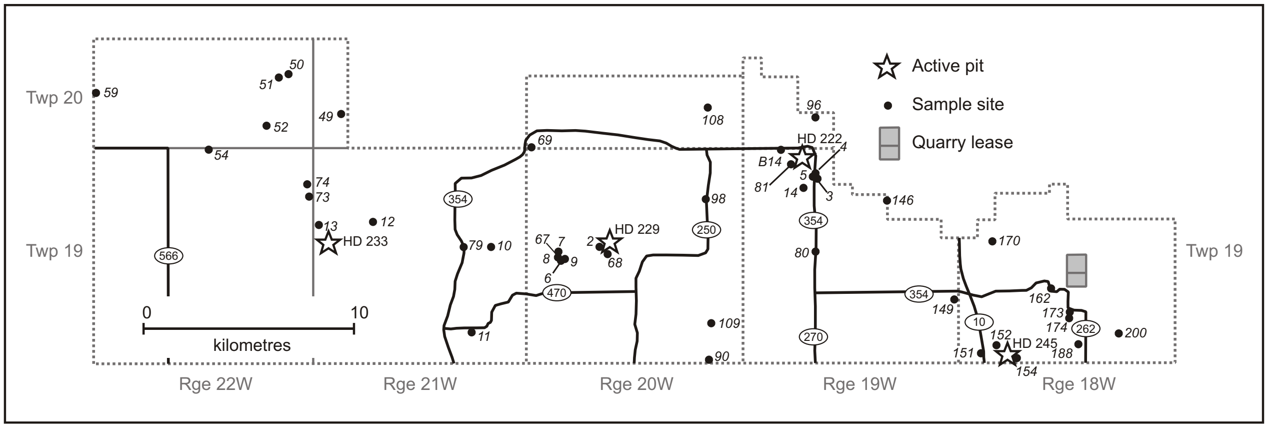


Figure GS-19-3: *Gravel pit and sample sites, Rural Municipality of Park, Manitoba (Groom 1980a–c).*

ranges from shaly sandy coarse pebble gravel to faulted beds of coarse sand interbedded with thin silt beds; there are large lenses of till in the walls and there are stockpiles of cobble-size shale clasts on site. In 1980, a pit (HG002) in the same quarter-section was 6 m deep but has been rehabilitated and is now a shallow depression. Lithology and grain size analysis for two samples from this quarter section (HG002 and HG068) are given in Table GS-19-1.

The outwash plains are the most extensive aggregate deposits in the R.M. of Park. There is one large deposit lying between Heron Creek and Little Saskatchewan River and another along the south shore of Clear Lake (Figure GS-19-2). In addition, there are numerous small patches of outwash throughout the municipality. All the sediment was deposited over stagnating ice resulting in a hummocky surface expression with local relief up to 9 m, and quite variable depths and types of material in close association with each other. Shale content is variable but is present in all sites. For the two large outwash deposits, there appears to be a broadly overall trend to fining to the southeast in each deposit, indicating a proximal-distal relationship of the sediment within the deposits. However, the chaotic nature of sediment deposited through ice stagnation, makes any such distinction quite tenuous. Three of the four active pits in the municipality are in these outwash deposits.

The pit at site HD233 in NW-19-19-21-W1 was active in 1980 and is still a major source of aggregate. The pit has greatly expanded; the active area is now at the west end of the pit. The pit face exposes 3 m of crossbedded sandy fine pebble gravel. Clay seams, till balls, shale and iron concretions form the deleterious fraction of the aggregate. There are some boulders on site but cobbles up to 20 cm are the majority of the coarsest fraction. Lithology and grain size analysis are reported under site HG013 in Table GS-19-1. This year, two different gravel companies were crushing aggregate to produce traffic gravel for local roads. Klassen (1979) reported 18 m of coarse gravel in a water well in the adjacent quarter-section (NE-19-19-21-W1).

The pit at site HD222 in NE-32-19-19-W1 was also active in 1980 and is still very productive today. The pit is expanding eastwards; the active face is up to 5 m of crossbedded, very sandy, pebble gravel. Shale is again the most deleterious factor. Lithology and grain size analysis are reported under site HG081 in Table GS-19-1. The pit is owned and operated by one of the largest aggregate companies in the area.

The pit at site HD245 in SW-5-19-18-W1 is unusual in that the aggregate, unlike sites in the other outwash plain deposits, is overlain by 2–3 m of till. This amount of overburden is often considered enough to make gravel extraction uneconomic, however, there is >4 m of gravel under the till cap and this is a very active pit. The aggregate is crossbedded, very sandy, pebble gravel with a high shale content. There are stockpiles of traffic gravel on site. Two pits were sampled in this section during the 1980 study. Lithology and grain size analysis are reported under sites HG152 and HG154 in Table GS-19-1. In 1980, the pit in SE-5-19-18-W1 (HG154) was 5 m deep, it is now rehabilitated. As is common in ice-contact deposits, the gravel beds were faulted and highly contorted and overlain by till.

The outwash terrace deposits form a minor component of the aggregate resources in the municipality. The most well developed terrace deposits are along the Little Saskatchewan River; there are also small terraces along Heron Creek and Whirlpool River (Figure GS-19-2). The material in the deposits is most commonly sandy pebble gravel interbedded with sand. However, an exposure in NW-2-19-21-W1, visited in 1980, revealed 3 m of massive, poorly sorted, cobbly coarse gravel. The gravel was very shaly and ironstone concretions were common. The site is no longer exposed.

Aggregate regulations

Aggregate extraction is regulated through the Quarry Minerals Regulation (Manitoba Regulation 65/92) under *The Mines and Minerals Act* of Manitoba, through policies under *The Planning Act* and through municipal development plans and their zoning by-laws. Policy #9 under *The Planning Act* is designed to protect high quality mineral resources from conflicting land uses until the resource has been extracted. Most development plans include maps showing high quality aggregate deposits. Zoning by-laws identify where extraction is allowed or excluded; the by-laws may set strict land-use controls on mining.

The *Quarry Minerals Regulation* sets standards for such things as safety slopes, setbacks from adjacent property lines and waterways, noise levels and location of petroleum storage, etc. It also provides for the Pit and Quarry Rehabilitation program. Under this program, landowners can apply to have depleted or abandoned gravel pits and quarries rehabilitated to a standard that is "safe, environmentally stable and compatible with adjoining lands." For further information visit our website (http://www.gov.mb.ca/iedm/mrd/mines/acts/index.html).

Economic considerations

The value of aggregate reserves in any specific area depends on three things: abundance of the resources, the demand for the resources and the quality of the aggregate. The presence of shale in the aggregate will limit its potential uses. For many end uses, such as concrete, shale content must be less than 5%. Aggregate is a high-bulk, low-value commodity so haulage costs are an important factor that can cause a lower quality deposit to be used over a more distant higher quality deposit. The R.M. of Park has a large amount of aggregate and it is spread uniformly across the municipality. However, the shale content does lower the quality of the reserves and most of the aggregate is used for end products such as traffic gravel, which tolerates a higher percentage of shale. The fact that there are only four active pits in the municipality reflects the low quality of the deposits. The fact that two of them were active in 1980 and are not yet depleted reflects the substantial depth of material in some parts of the deposits and the sheer volume of aggregate per quarter section. The greatest demand for sand and gravel is in the eastern part of the municipality, near the south gate of Riding Mountain National Park. Cottage development and recreational facilities, such as golf courses, are on the increase there and are being built on aggregate deposits, however, the volume of aggregate in the areas of the nearby active pits (HD245 and HD222) is more than adequate to meet the needs for the foreseeable future. Land-use planning decisions should be based on maintaining a buffer around these pits to prevent any development from limiting their expansion in the future.

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