

August 18, 2017

David Straddia
GDK Future-Home Enterprises
Box 4, Site 5, RR1
Didsbury, AB
T0M 0W0

Dear Mr. Straddia:

RE Aggregate Volume Estimate
NE 36-32-6-W5M

Mr. Straddia of GDK Future Homes Enterprises requested Twerdoff & Associates Inc. to determine a rough estimate of the sand and gravel reserves available for mining within a parcel of land located within NE 36-32-6-W5M.

Area Available for Excavation

The parcel of land is 95.02 acres in size on the south side of Secondary Highway 584, approximately 2 miles west of the Town of Sundre, AB.

Since the land is immediately adjacent to a secondary highway, Alberta Transportation (AT) will likely require a buffer from the highway right of way. Although highway buffers vary depending upon long range planning, it can be assumed that AT would want a buffer of 30 m or less, based on past experience.

Mountain View County currently requires a 165 m (541 feet) buffer from the foundation of any adjacent dwelling. A dwelling is present in the northwest corner of the land within a subdivision. There is also a church present on the northeast corner of the land within a subdivision. One more potential dwelling was identified just southwest of the 90 acre parcel (Figure 1). Mountain View County may require an addition buffer from the developed road allowance on the east side of the property.

Alberta Environment requires a 3 m property boundary to ensure property line stability. An extraction setback (1.5 x excavation depth) may also be required to ensure there is enough material available to ensure a 3:1 slope from property boundaries upon reclamation.

A rough estimate of the area that can be mined outside of buffers would be approximately 70 acres.

Geology

The Alberta Geological Survey (AGS) identifies clean sand and gravel in the area that is 80% gravel and 20% sand. It is the highest quality rating of all AGS ratings (Figure 2).¹ The AGS also says the deposit is 3.3 m. The dataset best portrays sand and gravel potential that occurs at the land surface or in the very near surface, and does not attempt evaluate the sub-surface distribution of sand and gravel units. Based on adjacent pits in the area and water well records, it appears that sand and gravel extends much deeper than the AGS depth of 3.3 m.

A number of water well records were pulled on the land and surrounding ¼ sections (See attached Water Well Records).

NE 36

The water well search returned 7 records with 3 having lithological logs associated with them. The other 4 wells had no details about subsurface conditions. 2 wells recorded a depth of gravel of 94 feet before bedrock was encountered. Another well was drilled to 42 feet and no bedrock was encountered indicating that the gravel extended deeper than what was drilled.

NW 31

The water well search returned 3 records and 2 had lithological logs. One well was drilled to 35 feet through gravel and the other well was drilled to 42 feet through gravel. Both wells did not encounter bedrock indicating that the gravel extended deeper than what was drilled.

NW 36

The water well search returned 1 record with lithological logs. The well was drilled to 86 feet into bedrock and sand and gravel were encountered to a depth of 84 feet.

SE 1

The water well search returned 3 records with lithological logs. The wells were drilled to 33 feet, 34 feet and 43 feet. All wells encountered sand and gravel did not encounter bedrock indicating the sand and gravel may extend deeper.

SW 1

The water well search returned 3 records and 2 had with lithological logs. One well was drilled to a depth of 70 feet through sand and gravel and did not encounter bedrock. The other well was drilled to a depth of 47 feet but did not encounter gravel until 38 feet. Further analysis of the landowner map indicates that the well is likely located on the far north side of SW 1. This may indicate that the northern edge of the gravel deposit is near this location as identified by AGS.

SW 6

The water well search returned 1 record and it had a lithological log. The well was drilled to a depth of 68 feet and encountered 64 feet of gravel below 4 feet of topsoil. The well did not encounter bedrock which indicates the gravel may extend deeper.

SW 31

The water well search returned 4 records and 3 had lithological logs. One well encountered bedrock at 32 feet and was drilled through gravel. The other 2 wells were drilled to 24 and 37 feet through gravel (except first 5, 6 feet) and did not encounter bedrock (i.e. the bottom of gravel).

Depth of Sand and Gravel

Based on water well records, sand gravel within the area extends from at least 24 feet and is as deep as 94 feet below ground level (bgl). Overburden was up to 6 feet deep with most locations having no overburden except for the Evans well (Well ID352109) which is thought to be within another geological setting. The average depth of overburden was 3 feet averaged among all water well records except the Evans well.

Based on field observations of the current pit, there is approximately 10 feet of gravel above the elevation of the water table. Based on water well data, there is at least another 15 feet of gravel and up to 84 feet of gravel below the elevation of the water table. Only 3 water wells encountered the bottom of the gravel layer, 2 at 94 feet and 1 at 84 feet.

Volume Calculation

An estimate of the volume gravel easily attainable on the site would use a gravel depth of 10 m (33 feet) less average overburden depth (approx. 1 m). This would include an excavation of approximately 10 feet above the water table and an additional 23 feet below the water table. Excavations below the water table could be conducted by utilizing a long-armed hoe to bail gravel to a depth of 23 feet. Assuming Water Resource permits could be obtained for excavating gravel below the water table, the total original volume is estimated:

$9 \text{ m} \times 28.3 \text{ ha (70 acres)} \times 10,000 \text{ m}^2/\text{ha} = 2,547,000 \text{ m}^3$. This volume represents bank volume. When earth materials are excavated, they generally increase in volume as they become loose. An estimate of the increase in volume would be 10% for dry sand and gravel.² Therefore:
 $2,547,000 \text{ m}^3 \times 110\% = 2,801,700 \text{ m}^3$

Assume there will be 15% loss due to required slopes for reclamation:
 $2,801,700 \text{ m}^3 \times 85\% = 2,381,445 \text{ m}^3$

Assume 20% reject material (i.e. natural fines eliminated from crushed aggregate to meet construction specifications):
 $2,381,445 \text{ m}^3 \times 80\% = 1,905,156 \text{ m}^3$

Approximately 8.5 ha of the land has already been excavated approximately 3 m to a depth just above the water table.

$8.5 \text{ ha} \times 3 \text{ m} \times 10,000 \text{ m}^2/\text{ha} = 255,000 \text{ m}^3$

Therefore sand and gravel remaining:

$1,905,156 \text{ m}^3 - 255,000 \text{ m}^3 = 1,650,156 \text{ m}^3$

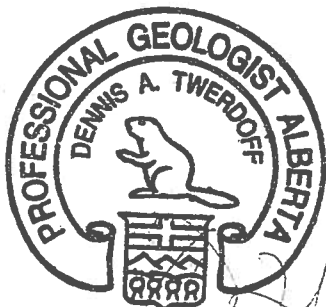
Convert to tonnes $(1.632 \text{ tonnes/m}^3)^3 = 2,693,054 \text{ tonnes}$.

Conclusions

The AGS and Alberta Water Well Records were used to estimate the quality and depth of gravel located within the GDK land. Estimated buffers were incorporated into the calculation. A rough estimate of a 9 m depth of sand and gravel above and below the water table was used. Estimated losses of recoverable volumes included losses due to reclaimed sloping requirement and losses due to a percentage of reject material (natural fines elimination).

A rough calculation derived a volume of approximately 1.65 million m^3 or 2.7 million tonnes.

The estimated volume of sand and gravel that is recoverable is based on obtaining appropriate municipal permits, a Code of Practice for Pits and appropriate Water Act approvals for excavations below the water table. It is assumed that gravel could be bailed at least 23 feet below the elevation of the water table. The gravel likely extends much deeper but more complex water management would be required to excavate deeper gravel.



Aug 15, 2017

Dennis Twerdoff, P.Geol. P.Ag.
Senior Project Manager

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References:

1. *Alberta Sand and Gravel Deposits*. Alberta Geological Survey. <http://ags-aer.maps.arcgis.com/apps/webappviewer/index.html?id=d85fd3dd5daa424488bd82dfd9033846>
2. *Estimating Earthworks*. homepages.cae.wisc.edu/~cee492/note/L11_EstEarthWk9811.ppt
3. Annual Operating Report (AOR) Surface Materials. February 14, 2017. Alberta Environment and Parks. <http://aep.alberta.ca/forms-maps-services/forms/lands-forms/aep-forms/default.aspx>

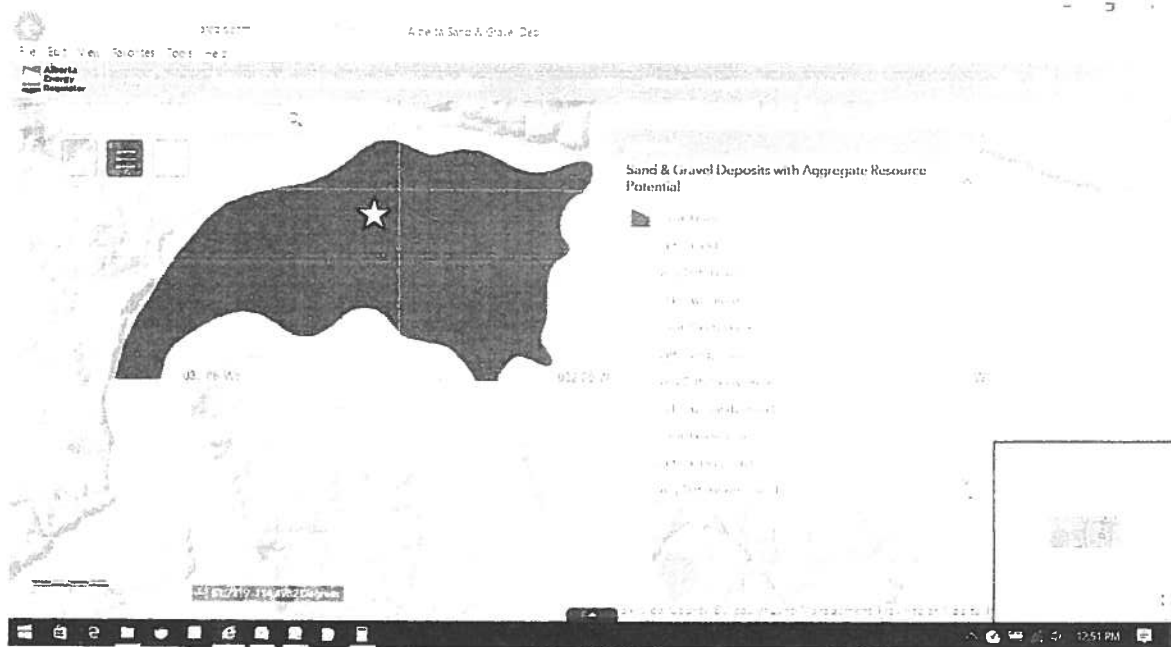


Figure 1: Alberta Geological Survey

GDK LANDS

Subdivision

Subdivision

Subdivision

Subdivision

AER Map Pressure Pipelines and Wells Circuit to Jun 31, 2017 *** Low Pressure Pipelines current to November 1, 2005

LEGEND

Residence Buffer:
Highway Buffer:

Rev.	Description	Date
0	ORIGINAL ISSUE	Jun 5, 2017
	Airphoto Date: May-Sept. 2012	Drawn DT
	TWERDOFF & ASSOCIATES INC.	Checked DT
		File No. 17-104

GDK FUTURE HOMES ENTERPRISES LTD.
THE MCDUGAL PIT
FIGURE 2: AREA PLAN
WITHIN NW 1/4 SEC. 36, TWP. 32, RGE. 6, W.5M
MOUNTAIN VIEW COUNTY, ALBERTA