Friesen DRILLERS

October 13, 2020

Mr. Nathan Mehling
Project Manager
Waterside Development Corp
3605 Roblin Blvd.
Winnipeg, MB R3R 0C6

Dear Nathan,

Subject **Hydrogeological Report of Groundwater Resource Potential**
Lots 85,95,96, 120, 121, 122, 131, 132 and 133 Plan 433 WLTO within Section 29-10-4EPM
Plessis Road 19E - Rural Municipality of Springfield, Manitoba

Friesen Drillers Limited (FDL) is pleased to present this report to detail the results of the hydrogeological review of groundwater resource potential around the Planned Industrial Subdivision at the above noted site.

Project Background and Scope of Work

Waterside Development Corp (Waterside) has submitted an application to develop a 269.7 acre parcel of land into an 82 lot industrial subdivision. As part of the proposed development agreement, Waterside is required to provide a Hydrogeological Report of groundwater resource potential in the area. The report was require to include the following considerations:

- Review existing hydrogeological literature and databases to obtain information that pertains to the study area.
- Highlight relevant site background and historical groundwater development in the area.
- Review the available well logs and delineate the local geology and hydrogeological conditions.
- Generate a report to summarize the expected availability and geochemistry of groundwater supplies in the study area and to provide recommendations for further development potential.

Site Setting

Physical Setting

The subject site is located immediately north of the Transcanada Highway, along the east side of Plessis Road (19 E). The property lies along the boundary between the City of Winnipeg and the Rural Municipality of Springfield. The site location is shown on the following page as Figure 1.

The site is located within the floodplain of the Red River valley, with a surface elevation of approximately 235 m geodetic. Topographic relief is very low, consistent with the surrounding prairie landscape; although some undulating topography associated with the Birds Hill Glaciofluvial Complex is present about 10 miles northeast of the site. The Red River Floodway is located approximately 2.5 miles east of the site.

Current development within the area includes a mixture of residential, agricultural, and industrial land uses. The suburban residential development of Transcona South lies within 0.5 miles of the northeast site boundary. The Transcona Golf Club is located approximately 0.5 miles north of the development site. No buildings or structures are presently on the title area. The Canadian National's, Symington Yard intermodal facility is located directly across Plessis Road and the Greater Winnipeg Water District Rail Line is located along the northern boundary of the site.

Physical Setting (Cont'd)

Figure 1 – Proposed subdivision along the eastern boundary of Winnipeg. (Source – Google Earth, 2020)

Geological and Hydrogeological Setting

The geology and hydrogeology of the Springfield region has been discussed in detail in previous works (Betcher et al., 1995; Render, 1970; and Friesen Drillers, 2019). A summary of the regional hydrogeological conditions is provided here.

From surface down, the geology of the region includes mostly clay and till overburden, Red River Formation carbonate bedrock, Winnipeg Formation shale and sandstone, and finally, Precambrian granite. Based on well logs from the area, the upper surface of the carbonate bedrock is irregular and ranges from less than 20 ft. to more than 90 ft. below grade, with an average depth of 50 ft. below grade. The sandstone typically lies at depths of approximately 250 ft. below grade, while the Precambrian granite lies at depths of approximately 300 ft. below grade (GWDRILL, 2018).

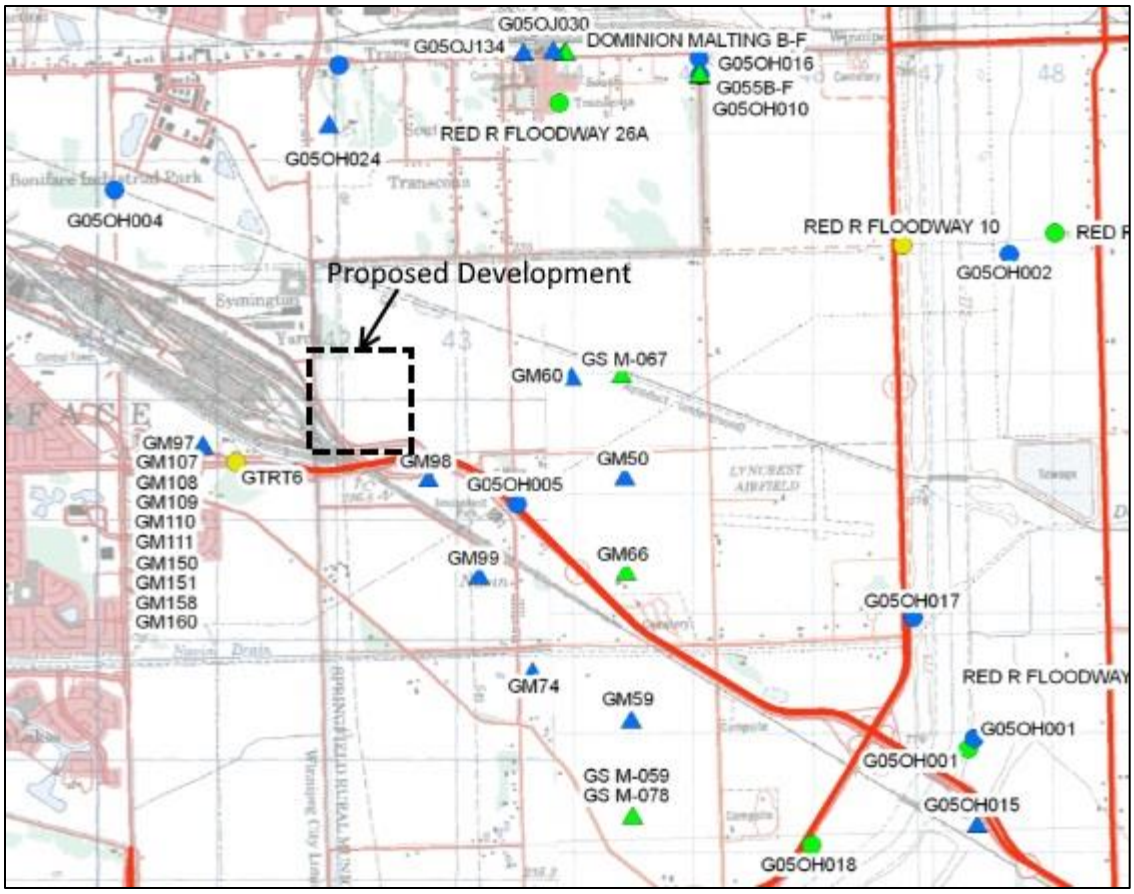
Two regional aquifer systems are present within the bedrock under the study area (Betcher et al., 1995). These aquifers are known as the Carbonate Aquifer and the Sandstone Aquifer. Another, less extensive, aquifer system is also present as unconsolidated sand and gravel contained within the overburden. The most notable example would be the Birds Hill Complex north of the study area.

Aquifer conditions within the Carbonate and Sandstone aquifers appear to be confined throughout the study area. The confining material for the Carbonate Aquifer is composed of variable amounts of clay and till overburden (GWDRILL, 2018). These confining layers limit the downward migration of surface impacts and provide some protection to the local aquifers. The overburden thickness is shown to vary throughout the area and, as a result, the overall level of aquifer protection will also vary by location.

The Province maintains a network of groundwater monitoring wells across Manitoba. These monitoring wells allow for the measurement of long term groundwater level fluctuations and geochemical analyses. A map showing the well locations within the study area is shown on the following page as Figure 2. Active monitoring stations within the area include G05OH004, G05OH005, and G05OH024. A composite plot of the hydrographs from G05OH004 and G05OH005 is shown on the following page as Figure 3.

Groundwater flow within the Carbonate and Sandstone Aquifers generally follows a westerly flow path, from the primary recharge areas east of the RM to the discharge areas along the Red River and Red River floodway (Betcher et al., 1995). From Figure 3, the groundwater elevation within the Carbonate Aquifer fluctuates between about 221 and 227 m geodetic, which is approximately 8 to 14 m (26-46 ft.) below grade. The general water level fluctuations measured at both stations were similar. However, over the period of observation (1960s-2010s), groundwater levels in G05OH004 rose from about 5 m below G05OH005 to within 1 m of G05OH005. This change is likely a result of the significant groundwater level recovery observed in eastern Winnipeg, due to the shutdown of the major meatpacking facilities which used large amounts of groundwater (Bell and Neufeld, 2017). Overall, groundwater levels appear to be relatively stable since about over the past couple decades, with no evidence of long term progressive lowering of the groundwater level.

Geological and Hydrogeological Setting (Cont'd)



Legend: blue – active; red – abandoned; yellow – inactive; black – unknown.
Figure 2 – Provincial monitoring stations in the study area. (Modified source – Hydata, 2014)

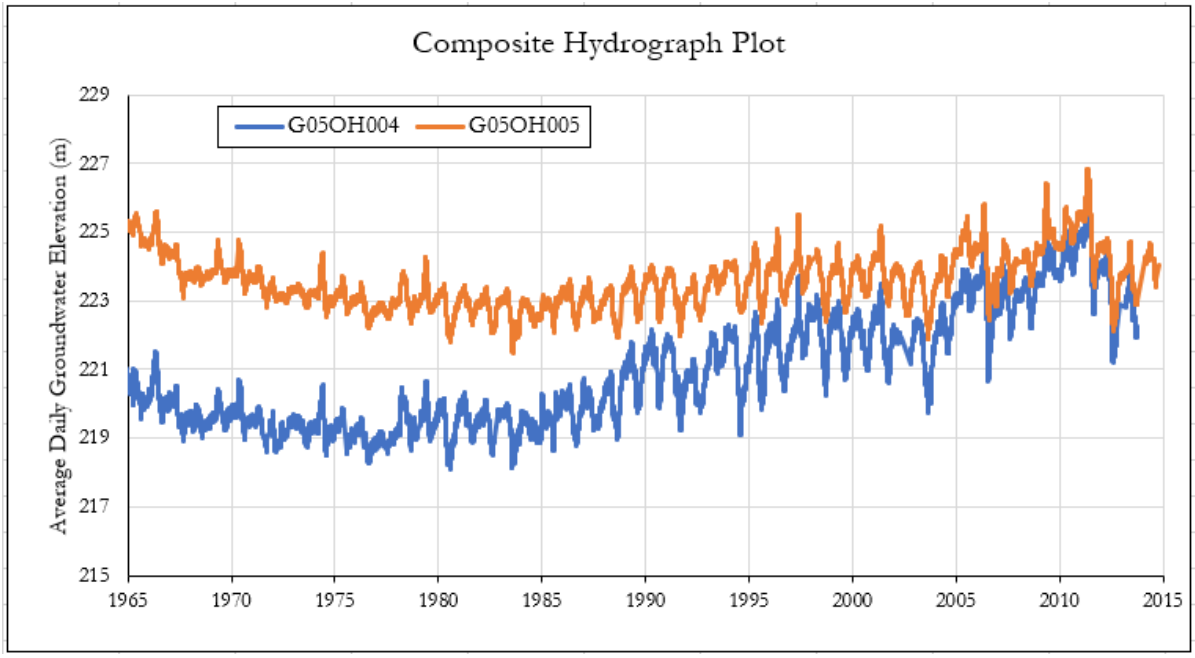


Figure 3 – Composite hydrograph record - Carbonate Aquifer. (Data source – Hydata, 2014)

Geological and Hydrogeological Setting (Cont'd)

The transmissivity of the Carbonate Aquifer in the study area is estimated to be approximately 50,000-100,000 U.S.G.P.D./ft. (Baracos et al., 1983). Based on these conditions, well yields could be relatively strong. However, it should be noted that the fractured nature of the Carbonate Aquifer results in significant variability in well yield across short distances. In addition, the amount of available drawdown could be a limiting factor, especially in locations where the bedrock is shallow. Test drilling would be required to determine well capacity at a specific site.

Groundwater quality in the Carbonate Aquifer is generally fresh, although the overall quality is expected to be marginal, with elevated Total Dissolved Solids (TDS) and hardness values.

The following parameters are reported for the Carbonate Aquifer from G05OH005 (Hydata, 2014):

- TDS - 1,060 mg/L
- Iron - 0.33 mg/L
- Chloride - 102 mg/L
- Hardness – 655 mg/L

Groundwater quality within the deeper Sandstone Aquifer is known to be saline throughout the study area (Betcher et al., 1995). The availability of geochemistry data from the sandstone aquifer in this area is limited although TDS values are expected to be greater than 2,000 mg/L (Betcher et al., 1995).

Groundwater Development

Groundwater levels within the Carbonate Aquifer were influenced by the construction of the Red River Floodway in the 1960s (Render, 1970). This influence is especially apparent on hydrograph records from the mid-1960s to the mid-1980s (Figure 3). In addition, water levels at the site have been influenced by the groundwater intensive, meat packing industry operations that were located in eastern Winnipeg. Based on the available observation data for the area, these historical groundwater influences appear to have mostly diminished and are now overprinted by seasonal and climatic influences.

From a review of the provincial water well and groundwater licensing databases, only a few active licensed groundwater users were noted in the local area. The closest site with an active groundwater license is located one mile northwest of the proposed development, at section NW30-10-4E (Licence no. 2014-090). This licence was approved in 2014, with the water designated for use in, 'Other' purposes.

Another active licence for groundwater use was licence number, 71-035, for industrial purposes. This licence corresponds with the Malteurop Canada site, located along Dugald Road (Highway 15). The site has been in operation for many years, with well logs dating back at least to the 1960s. Consequently, groundwater levels have largely stabilized to the pumping influences and the site now exists as part of the state of nature for the local aquifer. It is speculated that the local groundwater quality has also been influenced to some degree by the Malteurop operations, indicated by the elevated TDS in nearby provincial monitoring stations.

In addition to licensed groundwater users, water wells used for unlicensed domestic and geothermal heating and cooling purposes are noted in the area. The GWDRILL (2018) database contains records for 45 production wells within a one mile radius of the site. A total of 38 these domestic wells are associated with the residential development northeast of the study site. The construction dates for existing wells ranged from 1964 to 2014, with most drilled in the 1980s. The total depth of the wells ranged from 80 to 282 ft., with an average total depth of 150 ft. Static water levels reported in the logs ranged from 25 to 50 ft. below grade, with an average of 41 ft. The actual well locations, conditions, and current state of use for the wells was not confirmed.

Overall, groundwater resource development within the study area appears to be relatively sparse at this time, with groundwater use limited mostly to domestic applications. The Carbonate Aquifer represents the main groundwater source for existing groundwater supplies in the area. None of the wells were noted to be completed into the deeper sandstone aquifer.

Conclusions and Recommendations

Two bedrock aquifers, the Carbonate Aquifer and the Sandstone Aquifer, extend under the proposed development site. The Carbonate Aquifer is the only bedrock aquifer which contains fresh water. The Carbonate Aquifer transmits significant volumes of groundwater as part of a regional, east to west groundwater flow system, and groundwater levels are noted to be relatively stable over the long term. Based on these conditions, the overall availability of groundwater in the study area appears to be sufficient to support additional development. Regular monitoring of groundwater levels and groundwater geochemistry within the area is recommended to observe the potential impacts of further development on local groundwater resources.

The Carbonate Aquifer has been mapped to be fairly transmissive in the study area. Higher transmissivity values can translate into better well yields for water supply purposes. However, it is important to note that individual well yields will vary based on the fractures intersected during drilling and that well yields from the Carbonate Aquifer are known to vary significantly across short distances. Test drilling will be required to confirm aquifer conditions at any specific site. Further, under higher transmissivity conditions, drawdown influences extend farther away from the pumping site. This could mean increased risks of drawdown impacts reaching nearby groundwater users.

Groundwater quality in the study area is characterized by saline conditions in the Sandstone Aquifer (>2,000 mg/L) and TDS values of about 900-1,300 mg/L in the Carbonate Aquifer. Based on the quality of the groundwater in both bedrock aquifers, water supplies developed in this area might require treatment, depending on the intended use.

The proposed development site falls within an area mapped as moderate aquifer vulnerability (Friesen Drillers, 2019). A downward vertical gradient was noted from surface into the overburden sediments. The amount of aquifer protection from surface impacts will be based in part on the local thickness and permeability of the confining material at each well site. Local well logs indicate the Carbonate Aquifer is under confined conditions, with approximately 50 ft. of predominantly clay overburden. The low permeability of clay will improve the level of protection to the local aquifer from surface impacts by slowing the rate of downward percolation into the subsurface.

To limit the risk of negative impacts to the Carbonate Aquifer, water wells constructed in the study area should not penetrate into the underlying Winnipeg Formation Sandstone Aquifer. While the depth of the Winnipeg Formation is variable across the area, the transition is distinguished by a layer of shale located immediately below the carbonate rock. Industrial operations that have a higher risk of introducing negative impacts to the environment (hazardous materials and wastes) should have safe procedures, such as spill containment and appropriate waste disposal, in place to minimize potential impacts. In addition, the thickness of the overburden clay cover should be maintained to maximize the protective cover.

Any new development sites which use groundwater for commercial or industrial purposes will require a Water Rights Licence from Manitoba Conservation and Climate. The licensing process will be important to ensure that existing groundwater users will not be negatively impacted by any new groundwater supplies developed in the area. In addition, any site which use more than 200 dam^3/year will also require an Environment Act Licence.

As the area is planned to have increased development pressure on the aquifer, it is recommended that long term monitoring be implemented. Groundwater monitoring typically includes an observation well(s) equipped with transducers to automatically measure water levels over time. This data is typically downloaded annually or every few years and reviewed by a qualified hydrogeologist/hydrogeological engineer.

We appreciate the opportunity to be of service to the Waterside Development Corp. Please feel free to call us at 204-326-2485.

Sincerely,

Friesen Drillers Limited

Justin Neufeld, B.Sc.(G.Sc.), P.Geo.
Groundwater Geologist

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J.E. NEUFELD
Member
40183G
Oct. 13/2020
REGISTERED PROFESSIONAL GEOSCIENTIST

APEGM
Certificate of Authorization
Friesen Drillers Limited
No. 4016 Date: October 13, 2020

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Limitations

The scope of this report is limited to the matters expressly covered and is intended solely for the client to whom it is addressed. Friesen Drillers Limited makes no warranties, expressed or implied, including without limitation, as to the marketability of the site, or fitness to a particular use. The assessment was conducted using standard engineering and scientific judgment, principles, and practices, within a practical scope and budget. It is based partially on the observations of the assessor during the site visit in conjunction with archival information obtained from a number of sources, which is assumed to be correct. Except as provided, Friesen Drillers Limited has made no independent investigations to verify the accuracy or completeness of the information obtained from secondary sources or personal interviews. Generally, the findings, conclusions, and recommendations are based on a limited amount of data (e.g. number of boreholes drilled or water quality samples submitted for laboratory analysis) interpolated between sampling points and the actual conditions on the site may vary from that described above. Any findings regarding the site conditions different from those described above upon which this report was based will consequently change Friesen Drillers Limited's conclusions and recommendations.

Disclaimer

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