December 14, 2010

Friedman & Associates
250 Ferrand Drive, Suite #802
Toronto, Ontario
M3C 3E5

Attention: Mr. Steven Warsh

RE: Potential for the Occurrence of Karst at the Meaford Highlands Resort Property, Meaford, Ontario.

Dear Mr. Warsh,

Karst Solutions was retained to assess the potential for karst development at a property located approximately 5 km southeast of Meaford, Ontario. This area is identified by the County of Grey as a "Special Policy Area" indicating that there may be the occurrence of karst topography. The property is currently being considered for development as a residential-resort complex called Meaford Highlands Resort. The property is situated east of No. 3 Line and South of Highway 26.

Karst Solutions was provided with the following maps/drawings:

1. "Air Photograph, Lots 9 & 10 3rd Line, Meaford, County of Grey", prepared by Weston Consulting Group Inc., dated October 18, 2010.
2. "Figure 1, Preliminary Environmental Constraint Mapping", prepared by Beacon Environmental, dated November 2010.
3. "Drawing Number C2, Preliminary Development Concept, Meaford Highlands Resort", prepared by Weston Consulting Group Inc., dated November 18, 2010.

The first is an areal photograph of the subject lands illustrating the boundary of the subject lands. The second is a map illustrating areas identified as highly constrained (steep slope, wooded valleys containing watercourses), moderately constrained (open watercourses in agricultural fields) and not constrained (areas available for potential development). The third is a concept drawing for the proposed development.

Normally, a complete karst assessment would involve an inspection of the property. This was not possible given the amount of snow accumulated on the ground that would preclude direct observations. In lieu of a field investigation, the assessment will be based on available geological publications and communication with staff at the Ontario Geological Survey.

Site Geology

Three publications were reviewed regarding the bedrock geology of the area encompassing the property. The first is the "seamless geological map of Southern Ontario" (Armstrong and Dodge, 2007). The second and third publications are resource evaluations of selected shale units in Southern Ontario (Armstrong and Sergerie, 2002; Armstrong, 2001).

The seamless geology map shows that most of the property is underlain by the Queenston Formation. However, the Georgian Bay Formation underlies part of the property along the northern edge where a bluff drops steeply towards Highway 26 and Georgian Bay. The Georgian Bay Formation occurs along the lower portion of the bluff. The elevation of the contact between the units is at approximately 310 m a.s.l. Generally, both bedrock formations consist primarily of shale but also contain thin interbeds of siltstone, sandstone and limestone. An Ontario Geological Survey drill hole (OGS-01-04) was drilled adjacent to the property in 2001 within the No. 10 Sideroad right-of-way, east of No. 3 Line. The drill hole penetrated 13.82 m of the Queenston Formation and 47.26 m of the Georgian Bay Formation (Armstrong and Sergerie, 2002, Table 6-5). The Queenston Formation in the drill core consists primarily of shale with minor siltstone interbeds. The Georgian Bay Formation consists primarily of shale with thin interbeds of siltstone, sandstone and limestone. Although there are limestone interbeds in the latter unit that may be susceptible to karstification, the beds are generally thin (<20 cm thick) and are separated by relatively thick intervals of low-permeability shale. Another OGS drill hole (OGS-00-C1) located a few km to the west penetrated the entire thickness of the Queenston Formation (Armstrong, 2001, Figure 3 and p. 62). The thickness of the Queenston Formation there is approximately 70 m and this should provide a good approximation of the thickness of the Queenston Formation at the property southeast of Meaford. Since the lower contact of the Queenston Formation in the vicinity of the property is at an approximately elevation of 310 m a.s.l. and since the maximum elevation of the property is approximately 360 m a.s.l., therefore the entire thickness of rock above the contact within the property should be the Queenston Formation, and the Manitoulin Formation dolostone should not be present.

Armstrong (2001) noted the occurrence of limestone interbeds within the Queenston Formation in the drill hole located several km west of the property. While most of these interbeds are thin, there is one interval of limestone that is 2.6 m thick that occurs at a depth of approximately 40 to 42 m below the top contact (Armstrong, 2001, p. 62). This interval of limestone may or may not extend to the Meadford Highlands Resort property.

Chapman and Putnam (1984, Map P.2715) describe the area of the property as a shale plain with an adjacent shore bluff at the northern edge. Armstrong and Sergerie (2002) and Armstrong (2001) indicate that the shale plain is an area with a thin cover of glacial drift (less than 1 m thick) on top of the Queenston Formation shales.

Potential for Karst Development

In order for karst to develop, there must be soluble bedrock such as limestone, dolostone or gypsum, and the soluble bedrock must be subjected to the circulation of meteoric water over a sufficiently long period of time.

The Georgian Bay Formation does contain some thin interbeds of limestone but these beds are generally less than 20 cm thick and are separated by shale. The shale has low permeability that minimizes the circulation of groundwater thereby preventing any extensive development of solution channel networks within the limestone interbeds. While there may be minor dissolution of the limestone beds where they are exposed at the surface along the shore bluff at the northern edge of the property, and especially along the watercourses, the extent and depth of karstification will be negligible. Thus, any karstification of these limestone beds will only occur within the high constraint areas identified by Beacon Environmental.

Similarly, the Queenston Formation typically contains a few thin limestone interbeds and there may be one interval of limestone that is as much as 2.6 m thick. Dissolution of these limestone beds may occur where they are exposed to weathering at the top of the bedrock surface, since the overlying soils are thin, or where they are exposed directly at the surface along the watercourses. However, once again the limestone interbeds are separated by shale and the low permeability shale will prevent any extensive development of solution channel networks. Therefore, there is no reason to expect any significant development of karstic groundwater flow systems characterized by rapid flow along conduits. It is also noted that any limestone beds exposed along the watercourses will only be exposed for relatively short distances because the orientation of the beds are close to horizontal whereas the watercourses slope gently toward the north, with gradients of approximately 4 to 6 m per 100 m. The relatively short exposures along the watercourses will limit the horizontal extent of karstification within any individual limestone bed. Thus, there may be the localized development of solutional sculpturing (i.e, development of karren) of the limestone beds exposed along the watercourses but the karstification will be limited to the thickness of individual limestone beds and will be largely confined to short reaches along the watercourses.

Brunton and Dodge (2008) documented karst across Southern Ontario and generated a map illustrating known areas of karst and areas with the potential for karst development based on the analysis of karst development as a function of stratigraphy. The map does not indicate any potential for karst development in the area south and east of Meaford since the typical karst rocks of Ontario (e.g., dolostone and limestone) do not occur there.

Two geologists from the Ontario Geological Survey were questioned about the occurrence of karst within the Queenston and Georgian Bay Formations. Frank Brunton (pers. com., 2010) indicated that he is not aware of any karst development in the Queenston or Georgian Bay Formations but suggested contacting Derek Armstrong who has extensive experience with both formations. Derek Armstrong (pers. com., 2010) indicated that he has not noted karst development in the Queenston and Georgian Bay Formations anywhere in Ontario. Furthermore, he is familiar with the property in question as he has undertaken detailed geological investigations of the two formations in close proximity to the property.

Application of the Provincial Policy Statement (2005)

Within the Provincial Policy Statement (PPS, 2005), Section 3.1 applies to natural hazards including karst topography. In addition to the PPS, the development of karstic aquifers may lead to issues that need to be addressed during the planning process for land developments. Karst Solutions has extensive experience conducting detailed assessments of karst-related hazards as

they apply to the PPS and as well as assessing the hydrogeology of karst aquifers and any related implications to land development.

Conclusions

Given the very limited thicknesses of limestone interbeds that may occur beneath the Meaford Highlands Resort property, there is no reason to believe that there will be karst-related hazards at the property. Furthermore, the predominance of shale, and the interbedded nature of the limestone beds within the shale, will not permit the development of significant karstic aquifers on the property.

References Cited

Armstrong, D.K., 2010 (personnal communication). Sedimentary Geoscience Section, Ontario Geological Survey, Sudbury, Ontario.

Armstrong, D.K., 2001. A regional evaluation of the shale resource potential of the Upper Ordovician Queenston Formation, Southern Ontario. Ontario Geological Survey, Open File Report 6058, 148p.

Armstrong, D.K. and Dodge, J.E.P., 2007. Paleozoic geology of Southern Ontario. Ontario Geological Survey, Miscellaneous Release, Data 219. [Seamless geological map of Southern Ontario, ArcGIS-based publication available for download from www.geologyontario.mndmf.gov.on.ca]

Armstrong, D.K. and Sergerie, P., 2002. Data for the comparative resource evaluation of selected shale units, Southern Ontario. Ontario Geological Survey, Open File Report 6094, 160p.

Brunton, F.R. and Dodge, J.E.P., 2008. Karst of Southern Ontario and Manitoulin Island. Ontario Geological Survey, Groundwater Resources Study 5, 99p.

Chapman, L.J. and Putnam, D.F., 1984. The Physiography of Southern Ontario, Third Edition. Ontario Geological Survey, Special Volume 2, 270p. Accompanied by Map P.2715 (coloured), scake 1:600,000.

I trust this meets your current requirements. Should you have any questions regarding this letter, please do not hesitate to contact me.

Sincerely,

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