

November 25, 2014
Our File: 210099

Cuesta Planning Consultants
978 – 1st Avenue West
Owen Sound, ON N4K 4K5

Attention: Genevieve Scott

Re: Karst Investigative Study - Kurita Property
584022 Sideroad 60 - Lot 28, Concession 7
Former Holland Township
Township of Chatsworth

Dear Ms. Scott:

This letter is being provided in response to comments received by the Ministry of Environment and Climate Change (MOECC) in correspondence to Cuesta Planning Consultants (dated September 19, 2014) stating that they believed it was reasonable to have the proponent complete a Karst Investigation Study.

In addition (and inferred to be in relation to the MOECC comment), this letter provides response to concerns provided to Scott Taylor, Senior Planner, County of Grey by Anne and Naohiko Kurita. The Kuritas interpreted the potential for karst features to exist on their property located on Part of Lot 28, Concession 7 in the Former Holland Township, Township of Chatsworth.

The Kurita property is located directly to the south of the proposed Bumstead Pit and is situated within 500 meters of the proposed extraction area. The Kurita property encompasses an area of approximately 10 hectares (25 acres) within which are several man-made ponds. Of particular concern to the property owners is a suspected karst feature which has been described by the Kuritas as follows:

'One of those ponds, the largest, about 20,000 sq. ft. never holds water. Spring run-off fills it to about 4 or 5 feet deep and then by May or June, the entire pond drains to empty. In one corner we suspect that there is a karst formation. An 8 x 10 foot circular depression in the ground, always damp.'

In response to these comments, the undersigned conducted a site visit of the Kurita property on November 11th, 2014. The site visit included surficial inspections of the property, the topography and its pond features, observation of the suspected karst features identified, and a preliminary assessment of the groundwater/surface water features and interactions. This information was evaluated in correlation with background geological information to assess the potential for karst occurrence on the Kurita property and more specifically, the pond of interest. Further, this assessment evaluates the potential for impacts to the water quantity and/or quality from the proposed aggregate extraction pit located to the north of the subject property.

Background information for this report is gathered from the *Hydrogeological Study, 584015 Sideroad 60, Former Township of Holland, Township of Chatsworth* (Gamsby and Mannerow Limited, September 2013) and the *Addendum to Hydrogeological Study, 584015 Sideroad 60, Former Township of Holland, Township of Chatsworth* (Gamsby and Mannerow Limited, June 2014). It is noted that potential impacts to the drilled well and the dug well on the Kurita property were discussed in detail within the Addendum. Although the dug well was observed during the Site visit, no changes to our interpretation provided in the aforementioned report was made, therefore these wells are not discussed further herein.

GEOLOGICAL AND HYDROGEOLOGICAL SETTING

The subject property is located within the physiographic region known as the Horseshoe Moraines (Chapman and Putnam, 1984). In general, the former Holland Township is reportedly covered by a complex of till ridges, kame moraines, outwash plains, and spillways, interspersed with more smoothly moulded till plains and drumlinized areas.

The physiographic maps indicate that there are two drumlins (or drumlinoid features) located within Lot 28 Concession 7 in the former Holland Township, directly to the south of the proposed Bumstead Pit. One of the drumlins is shown to encompass the majority of the Kurita property and extend northerly onto the southwest portion of the Bumstead property (the property under application for aggregate extraction), as shown on Figure 1 and Figure 2 (enclosed). Mapping available, both physiographic and soil, indicates that the soils associated with the drumlinized features in the area are characterized by a stone poor sandy silt to silty sand textured till (Surficial Geology of Southern Ontario, Ontario Geological Survey, 2010). The drumlins lead into the spillways which are described as glaciofluvial sand and gravel outwash deposits. These coarser grained deposits were identified on northern portion of the Bumstead property and are shown to extend around the northern toe of the drumlin feature to the west and southwest of the Bumstead property. A transitional area, characterized by massive to well laminated silt and clay with minor sand and gravel, lies between the base of the drumlin in the vicinity of the pond of interest and the sand and gravel deposit to the west. It is noted that these maps provide approximate and interpreted geologic conditions.

Consistent with the presence of a drumlin feature on the Kurita property, the topographic contours for the site, obtained from available mapping, indicate that the Kurita property generally slopes gently to the northwest with an approximate elevation of 425 m above sea level (masl) in the southeast corner of the property to between 410 and 415 masl along the northern property boundary and generally less than 410 masl along the western property boundary. It is noted that the pond of interest is situated within the lowest area of the subject property.

The bedrock underlying the site is reported to be brown, medium bedded dolostone of the Guelph Formation and, based on the bedrock surface elevation presented in the Grey and Bruce Groundwater Study (Waterloo Hydrogeologic Inc., July 2003) and a review of available MOECC well records, is at an elevation of approximately 390 to 400 m asl. Comparison of the bedrock elevation to the topographic contours suggests that the overburden thickness is generally in the range of 10 to 25 meters.

The well record for the Kurita supply well (i.e. MOE Well No. 2503209) reports a depth to bedrock of 57 feet or 17.3 meters. This corresponds to a bedrock elevation of approximately 395 m asl. The Kurita drilled well is located approximately 150 m from the pond of interest. Approximately 175 m to the southwest of the pond of interest (at 495413 Veteran's Road South), the well record reports the bedrock to be 21.6 m bgs. This corresponds to a bedrock elevation of approximately 398 m asl. Approximately 160 m to the north of the pond of interest (at the applicants property), the depth to bedrock is reported to be 17.3 m bgs. This corresponds to a bedrock elevation of approximately 396 m asl. The bedrock elevation appears to be relatively consistent in the area, with no evidence of significant buried bedrock topographical features.

Based on the Grey County constraint mapping (schedule A Map 3), no karst constraints are identified in the area. Based on the occurrence of carbonate bedrock associated with the Paleozoic Era beneath the area, the paper title "Karst of Southern Ontario and Manitoulin Island (Ontario Geological Survey Groundwater Resources Study No. 5, 2008) identifies the overall area, as having the potential for Karst.

During site reconnaissance activities associated with the Hydrogeological Study (Gamsby and Mannerow Limited, 2013) and this investigation, no evidence of karst features were noted during field reconnaissance or excavation of testholes. No bedrock outcrop is noted in the direct area of the subject property, and no suspect depression or drainage features, typical of karst, were noted.

FIELD REVIEW: General Site Overview and Description

As previously discussed, the subject property encompasses an area of approximately 25 acres within which several man-made dug ponds have been historically established. In general, there are five (5) primary ponds, with several smaller associated ponds and surface water features. Consistent with the topographical mapping, the area of the ponds generally slopes from the southeast towards the west and northwest. The central portion of the property (surrounding the ponds) is characterized by open and hummocky terrain with grasses and scrub, generally surrounded by treed areas. During the site visit, the open areas were observed to have saturated to near saturated soil conditions, and groundwater seepage was observed in some areas. Consequently, a high water table is interpreted to exist in these areas. These saturated soil conditions are consistent with the low permeability soils reported to occur in association with the drumlin feature on the Kurita property.

The ponds observed are situated on the western portion of the property. The upper ponds appear to be fed by both groundwater seepage and surface water drainage in the vicinity of the ponds. Surface water drainage appears to occur from the most easterly pond(s) towards the west and northwest through a series of surface water channels and seepage areas, eventually into the most northwesterly pond (i.e. the pond of interest). The pond of interest has no apparent outlet and has a berm that separates it from the drainage swales along Veteran's Road South, approximately 20 m to the west.

The drainage along Veteran's Road South, south of Sideroad 60 flows primarily in a northerly direction, a culvert then directs surface water flows westerly across Veteran's Road South onto the adjacent property. The road side swales appear to be at a similar elevation to the upper elevations of the pond bottom in the pond of interest. Based on the exposed banks along the cut swales, the shallow soils consisted of a mixture of sand, gravel, and silt and clay (refer to site photographs).

Based on comparison to the physiographic mapping, the three most easterly ponds are situated within the drumlinized feature and are generally separated by a series of berms. The two northwesterly ponds, separated from each other by a berm, are located approximately 40 meters west of the three upper ponds and appear to be, at least in part, situated within the spillway feature rather than the drumlin. During the site visit, no exposed bedrock, or bedrock outcropping was noted. The specific areas of interest were located at the deepest areas of the pond and were evident by the lack of vegetation, noted to exist within these features (refer to Photo 3).

The areas of interest are shown on the attached photographs. These areas are evident as low-lying areas within the pond of interest and are void of grassy vegetation noted within other areas of the pond bottom. During the site investigation, the pond of interest contained standing water. To assist the investigation, some of the bottom areas with suspected Karst, were probed manually with a steel push probe. These areas suggested the existence of soils containing sand and gravel to a depth of at least 0.3 m below the bottom of the pond. Although these features appear to be lower in elevation than the rest of the pond, no evidence of subsidence, or 'sinking' was noted. The surface water in the area of interest appeared to be stagnant, with no evidence of water currents or rapid surface water infiltration (even upon disruption of bottom sediment in pond).

In addition, the Kurita property was inspected for geologic features associated with karst topography such as rock outcrops and depressions, which may be indicative of sinkhole features. No such geologic features associated with karst topography were observed.

DISCUSSION OF FINDINGS

Karst is created through the chemical weathering (i.e., dissolution) of bedrock, subsequently forming a network of voids. In karstic areas, these voids are sometimes evident as irregular or hummocky rock outcrops, fissures, crevasses, and/or sinkhole patterns. Although karstic bedrock can occur at depth, karst topography is generally found in areas where carbonate rock, such as limestone or dolostone, are exposed at surface or lies beneath shallow surficial sediment or overburden.

A review of the available mapping for the area, the well records and a site reconnaissance visit at the subject property was completed to establish the presence and/or the potential for karstic features to exist. These investigations indicated the following:

- The depth to bedrock at the Kurita property is in the range of 10 to 20 meters;
- Physiographic mapping and field observations suggest the potential for the occurrence of sand and gravel layers in the vicinity of the pond of interest while less permeable silty till deposits underlie the upper ponds;
- Surface water and shallow groundwater are inferred to flow from the southeast of the Kurita property (in the vicinity of the upper ponds) towards the northwest, and the pond of interest;
- No evidence of rapid infiltration from the pond to the subsurface was observed;
- Shallow groundwater conditions are inferred to exist in the vicinity of the pond features;
- There is no evidence of bedrock outcrop or karst topography features, such as fissures, crevasses or sink holes.

Based on this investigation, there is no evidence of the occurrence of karst features at the Kurita property. The location of the property primarily on a drumlin feature combined with approximately 10 to 20 m of overburden is considered to significantly reduce the potential for karstic features to be exhibited at ground surface. The supposition of Karst is largely based on the inability for an excavated pond to "hold water" throughout the year, where upgradient/upstream ponds, maintain much more consistent waterlevels throughout the year. Based on these investigations, the higher rate of exfiltration from the pond to the groundwater system (i.e., infiltration to the groundwater system from the pond) is interpreted to be associated with more permeable overburden, which has been intersected by excavation in the pond of interest. In contrast, it appears that the less permeable till deposits associated with the drumlin, including the deposits underlying the upper ponds, results in the saturated soil conditions observed (i.e. a high water table). The suspect features within the pond appear to be related to low-lying areas that intersect the watertable through the majority of the year, preventing plant growth similar to that in the bottom of the pond where flooding is seasonal. In other words, the shallow surface and groundwater system appear to be controlled by the overburden, as opposed to the bedrock.

It is important to note that regardless of the nature of this feature, the elevations associated with the ponds is approximately 410 m asl, and above the proposed pit elevations. Additionally, since the proposed maximum extraction of aggregate is to occur above the water table (i.e. not within saturated soils) with no proposed dewatering/groundwater takings or water diversion, changes in the overall groundwater flow regime are not expected. No additional water is being directed towards, nor diverted away, from the pond features which are located at an elevation 'above' the pit. Consequently, it is reasonable to expect that there will be no impacts to the water levels or drainage patterns associated with the ponds on the Kurita property.

With respect to the proposed pit area, surface water infiltration is proposed to remain "diffuse" with no specific direction to a point source area. No direction of surface water to a "point source" is proposed. Therefore, no increases of flows toward the bedrock surface are proposed versus pre-development. As previously concluded in the Hydrogeological Report (September 2013) and its Addendum (June 2014), it is reasonable to expect that the proposed aggregate extraction would not impact shallow groundwater flow regime in the area, the surface water features, or the local water supply wells.

Yours Truly,
GM BLUEPLAN ENGINEERING LIMITED
Per:

A handwritten signature in blue ink, appearing to read 'Matthew Nelson', written over a horizontal line.

Matthew Nelson, M.Sc., P. Eng., P. Geo.
MN/JS/KD
Encl.

cc: Pearl and Brian Bumstead
Anne and Naohiko Kurita
File No. 210099

Figure 1



Predominantly Sand And Gravel

Undifferentiated, Stony-bouldery Till With
Sandy Silt Matrix Or Till With Predominant
Clay-clayey Silt Matrix

Sideroad 60




Pond of Interest

Silt and Clay, minor sand and gravel,
massive to well laminated

Upper Ponds

Veteran's Road South

Surficial Geology of Ontario GEOLOGIC DEPOSIT

-  Glaciofluvial Outwash Deposits
-  Glaciolacustrine Deposits
-  Till

120 60 0 120 Meters

Figure 2



Spillways




Pond of Interest

Drumlins

Upper Ponds

Drumlins

Physiography of Southern Ontario
DESCRIPTION

-  Drumlins
-  Spillways
-  Till Plains (Drumlinized)

120 60 0 120 Meters



Karst Investigative Study—Proposed Bumstead Pit



Photo 1 - View of Pond of Interest during flooded conditions (photo provided by Kurita).



Photo 2 - Looking southwesterly at pond of interest under “partially” flooded conditions (November 11, 2014).

Karst Investigative Study—Proposed Bumstead Pit



Photo 3 - Looking Westerly: View of Pond of Interest. The low-lying circular features that contain water are those suspected to contain karst. (Photo provided by Kurita)



Photo 4 - Looking Southerly: View of Pond directly south of Pond of Interest. This pond is reported to maintain water throughout year.

Karst Investigative Study—Proposed Bumstead Pit



Photo 5 - Looking Northwesterly: View from NW edge of upper pond showing fall towards northwest (November 11, 2014).



Photo 6 - Looking Southerly: View of Veteran's Road South showing swale. Pond of interest is approximately 20 to 30 m left (east) of swale (November 11, 2014).