Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

August 22, 2016

File No. 7-16-4082-46
Stoney Creek Office

Greenland Consulting Engineers
120 Hume Street
Collingwood, Ontario L9Y 1V5

Attention: Mr. Josh Maitland, P.Eng.

**RE: LAKEWOOD BEACH DEVELOPMENT
SEPTIC SERVICING PRELIMINARY DESIGN BRIEF AND SUMMARY
17165 LAKESHORE ROAD
WAINFLEET, ONTARIO**

Dear Sir:

Terraprobe Inc. was retained by Lakewood Beach Properties Ltd. to conduct a hydrogeological review of the above site in order to provide recommendations to support the evaluation of water and septic servicing alternatives and submission of a Draft Plan of Subdivision Application for the proposed residential community consisting of 41 residential units along the shoreline of Lake Erie at 17165 Lakeshore Road in Wainfleet.

The purpose of this letter report is to provide a summary of previous hydrogeologic investigations completed at the site by others and to provide preliminary septic design based on the current projected wastewater flows utilizing subsurface sewage disposal through a Class IV septic system at the site, to assist with further evaluation of sub-surface disposal servicing alternative in the Class EA for the site.

1.0 INTRODUCTION

The proposed development plan consists of 41 detached residential units serviced with communal water and wastewater infrastructure. The subject property is irregular in shape covering approximately 14.3 ha (35.3 acres), located along the northern shore of Lake Erie immediately south of Lakeshore Road between Belleview Beach Road and Station Road in the Township of Wainfleet. The legal description of the property is part of Lots 16 and 17, Concession 1, Township of Wainfleet, Regional Municipality of Niagara.

The potable water option being considered as part of the Class EA involves the supply of potable water via connection to established lake-based communal water supplies to provide treated water to the Lakewood Beach Development.

A review of previous investigations pertaining to sewage servicing at the site is provided in Section 2.2 below. Sub-surface septic servicing options currently being considered include construction of a tile disposal bed(s) in the northeast corner of the subject property, immediately south of Lakeshore Road. Preliminary tile field design considerations are further discussed in Section 3.2 below, based on the projected wastewater flows from the proposed development.

2.0 REVIEW OF PREVIOUS INVESTIGATIONS

A review of previously completed investigations at the subject property was completed. Investigations included as part of this review included:

- 72-Hour Aquifer Test Program, Proposed Lakewood Beach Development, Lakewood Beach, Wainfleet dated March 2009 completed by Jagger Hims Ltd.
- PTTW Application, Lakewood Beach Properties Ltd., MOE Ref. No. 1045-8DWSXG, dated June 28, 2011 completed by Genivar.
- Lakewood Beach Development, Wainfleet Ontario, Proposed Water and Wastewater Infrastructure for Lakewood Beach Development, dated October 29, 2008 completed by ASI Group.
- Lakewood Beach Residential Development, Sanitary Servicing Study, Phase 2 Class EA Schedule B, Part Lots 16 and 17, Concession 1, Township of Wainfleet, Regional Municipality of Niagara, dated August 2009 completed by Jagger Hims Ltd.
- Lakewood Beach Development, Application for Certificate of Approval, Sewage Disposal System, Part Lots 16 and 17, Concession 1, Township of Wainfleet, Niagara Region, dated December 2010 (Draft) completed by Genivar.
- MOE Correspondence (Various) dated January 28, 2015 and December 17, 2015.

A brief summary of findings from the above reporting relating to both water and septic servicing for the proposed development is provided below.

2.1 Summary of Water Servicing

Water servicing is proposed to be supplied through utilizing residual capacity at existing lake-based water works to provide treated water to the Lakewood Beach Development. The existing facility currently has a Permit in place allowing water taking in the maximum amount of 389,000 L/day, with a treatment capacity of approximately 327,000 L/day (ultraviolet filters). It is estimated the firm capacity for the existing facility, assuming one of the three ultraviolet filters is offline, would be approximately 218,000 L/day. A review of water demands for the existing facility was conducted by Greenland as part of the Class EA reporting for the 2015 operating year. The following summarizes the findings of the review:

- Seasonal usage was observed over 2015 for the equivalent population of 676 persons;
- The highest maximum day demand (MDD) was recorded on August 18th with a volume of 219,800 L;
- The highest monthly average demand occurred in August with an average daily demand of 181,800 L/day;
- The difference between the operation capacity (327,000 L/day) and the MDD (219,800 L/day) is 107,000 L/day;
- The average daily demand of the Lakewood Beach development is 31,900 L/day with a MDD of 101,700 L/day.

To mitigate risk of overuse of the existing facility an onsite storage tank and booster pumping system will be required to supplement peak demand and fire flow scenarios. Completion of a 1.0 km watermain is also required to provide a service connection to the Lakewood Beach Development.

The onsite storage tank is to consist of the construction of an in-ground or at grade onsite storage reservoir connected to the internal distribution system for the Lakewood Beach Development and utilizes lift pumps to achieve the pressure and flow rates required for peak mitigation and fire flow scenarios.

2.2 Summary of Septic Servicing

The sewage servicing option under consideration for the Lakewood Beach Development consists of subsurface disposal via raised tile beds.

The following summarizes the results of previous investigations relating to sub-surface disposal of septic effluent at the site:

- A series of 12 test pits were completed across the site (April 4, 2007) from which eight representative soils samples were obtained from depths between 0.2 to 2.6 m below grade. Shallow soils were classified as ML soils (clayey silt to silty clay) with anticipated percolation rates greater than 50 min/cm;
- The seasonal high ground water level at the site is expected at 1.3 m below grades.

Based on correspondence provided by the MOECC the following summarizes the relevant criteria in evaluating sub-surface septic disposal systems for the site:

- The septic disposal field should be designed and subsequent impact analysis should be evaluated using the anticipated maximum daily sewage flows;
- Tertiary treatment systems proposed for use at the site should meet the following effluent quality targets: CBOD5 (10 mg/L), TSS (10 mg/L), BOD5 (15 mg/L), TP (0.5 mg/L), E-coli (100 CFU/100mL). These limits represent the classification of a Class IV treatment system;
- Impact assessments are to consider Lake Erie as the downgradient receptor of septic effluent. Predicted effluent quality at the downgradient property boundary should be determined. Downgradient effluent quality targets for phosphorus should be considered at 0.02 mg/L and for nitrate at 2.93 mg/L. An assessment for un-ionized ammonia is also to be completed.

Preliminary tile field design is further discussed below based on the current plan of development and the associated projected wastewater flows.

3.0 CURRENT WASTEWATER SERVICING REQUIREMENTS

Based on the current proposed draft plan the following summarizes the projected wastewater flows and preliminary tile field design parameters for communal sewage disposal for the proposed development.

3.1 Projected Servicing Demands

The projected wastewater flows from the proposed development were determined based on the following projected demands:

- The development is to consist of 41 single residential units;
- Residency per unit is based on the Township of Wainfleet planning standards and projected at 2.83 persons per unit. An equivalent population of 116 people is projected for the proposed development;
- Per capita sewage flows are projected at 275 L/day with a per capita inflow and infiltration (I/I) allowance of 90 L/day resulting in a projected average daily sewage flow of 42,351 L/day (per capita flows plus allowance) and a peak daily sewage flow rate of 74,259 L/day (twice the per capita flows plus allowance).

3.2 Preliminary Tile Field Design Options

Preliminary design options were developed for the site based on the following technical considerations:

Native Soil	Silty Clay to Clayey Silt, trace sand and gravel
Unified Soil Classification	ML
Estimated Percolation Rate	50 min/cm

Imported Soil	Clean, well graded sand, less than 5% silt
Unified Soil Classification (clean sand fill for bed area)	SW
Estimated percolation rate for sand fill	10 min/cm
Depth to Ground Water Table	Less than 2 m below ground surface
Type of sewage system	Raised bed system designed using percolation rate of imported soil
Design Flow	43,340 L/day (including infiltration) 31,900 L/day

Based on the above design considerations it is recommended a system consisting of the following components could provide viable effluent disposal for the proposed development:

- Septic tank with a capacity of 86,680 L (22,898 gallons), or two times the daily design sanitary sewage flow (residential occupancies) with infiltration and a capacity of 63,800 L (16,845 gallons) without infiltration;
- The tank should be completed such that multiple compartments will be constructed. The first compartment should consist of a minimum volume of approximately 56,432 L (with infiltration) and 41,470 L (without infiltration) with each subsequent tank having a minimum volume of approximately 50% of the first compartment
- Distribution of effluent through a 3,000 gallon (11,230 L) concrete pump chamber to allow for the dosing of 75% of the internal volume of internal piping (assuming 2,475 m of internal piping) within a 15 minutes pumping cycle (pumping rate of 200 USgpm). Tanks should be fitted with a high level alarm.

The site specific design considerations for daily sanitary flow are described in Section 3.1 above, with average daily flows of approximately 43,340 L/d. Given the proposed development plan and using preliminary siting for the septic bed at the northeast corner of property, it is anticipated that setback requirements for the septic disposal field can be met. Setback requirements for the septic tank and distribution pipe are further discussed in Section 3.2.3 below.

A licenced septic installer should be contacted regarding pricing for systems designs described below, for planning purposes the use of tertiary treatment systems and tile beds with reduced footprints generally increases the complexity of the system resulting in higher installation and maintenance costs for the system. Several different options for tile bed design being considered for the site are discussed in additional detail in the following subsections.

3.2.1 Tertiary Treatment using Shallow Buried Trenches

The first option considered consisted of utilizing tertiary treatment systems and shallow buried trenches. The length of distribution tile required for shallow buried trenches was determined based on:

$$L=QT/300$$

Where: L is the minimum required tile length in meters

Q is the peak daily sewage flow in litres per day

T is the percolation time of the leaching bed fill in minutes per centimeter

The series of shallow buried trenches required based on the above flow rates is as follows:

Flow (Q)	T-Time (Fill)	Length of Tile (L)	Tile Runs	Tile Bed Area	Fill Area
42,340 L/d	10 min/cm	1,412 m	48 runs of 30 m	2,256 m^2	4,234 m^2
31,900 L/d	10 min/cm	1,064 m	36 runs of 30 m	1,680 m^2	3,190 m^2

The tile bed area above was determined based on the maximum tile run length of 30 m with tile runs spaced 1.6 m apart. The tile bed fill area was based on a maximum loading rate of 10 L/m^2 for raised bed fill with percolation time of 10 min/cm for the projected effluent flow rates.

Given a tile bed with sand mantle covering approximately 4,234 m^2 the dilution area (downgradient to Lake Erie shoreline) is estimated at 40,000 m^2. The corresponding annual dilution volume (V_A) is calculated at 10,000 m^3 and a total volume of water (V_T) of 25,454 m^3. Given a downgradient nitrate concentration target of 2.93 mg/L effluent quality from the tile bed for nitrate would be required at concentrations of 4.8 mg/L.

3.2.2 Tertiary Treatment Using a Flat Bed Schematic with an Area Bed

An alternate method for sewage disposal which would be suitable within the designated septic envelope would be tertiary treatment system using a flat bed. The area of the flat bed was determined based on:

$$A=QT/850$$

Where: Q is the peak daily sewage flow in litres per day

T is the percolation rate of underlying soil in minutes per centimeters

The resulting area of the area of contact between the base of the sand and underlying soil of the flat bed was determined as follows:

Flow (Q)	T-Time (Soil)	Area (A)
42,340 L/d	50 min/cm	2,491 m^2
31,900 L/d	50 min/cm	1,877 m^2

The depth of the stone layer shall not be less than 0.9 m above soil with a percolation time of 50 min/cm or greater. The underlying filter medium shall have a minimum depth of 0.75 m below the stone layer consisting of clean sand. Where there is more than one filter bed in a leaching bed, the filter beds shall be separated by at least 5 m between the distribution pipes.

The surrounding mantel consisting of sand fill is to extend a minimum of 1.5 m surrounding the flat bed and 15 m in the down-gradient direction of ground water flow.

Given an area bed with sand mantle covering approximately 2,491 m^2 the dilution area (downgradient to Lake Erie shoreline) is estimated at 28,000 m^2. The corresponding annual dilution volume (V_A) is calculated at 7,000 m^3 and a total volume of water (V_T) of 22,454 m^3. Given a downgradient nitrate concentration target of 2.93 mg/L effluent quality from the area bed for nitrate would be required at concentrations of 4.3 mg/L.

3.2.3 Impact Assessment Considerations

The following assumptions should be considered when assessing potential downgradient impact from sub-surface septic disposal beds as detailed in Chapter 22, Large Subsuface Sewage Disposal Systems from the MOE Design Guidelines for Sewage Works (2008):

- The potential for surface water impact increases as the distance to the point of plume discharge to surface water decreases. In most cases, a separation distance of 300 meters between the area of sewage infiltration and the surface water body should be sufficient to insure that there are no appreciable effects to surface water quality with respect to phosphorus and ammonia from septic effluent (Section 22.5.11).

- The native subgrade material is considered a low permeability soil with estimated hydraulic conductivity less than 10^{-5} cm/s. The downgradient receiver is considered Lake Erie which is located downgradient in excess of 100 m from the infiltration area. Subsurface investigations have not encountered higher permeability pathways within the lower permeable material (i.e. sand seams).

Based on tile field placement to the northwest corner of the property the distance from Lake Erie to both the tile bed and area bed was in excess of 300 m. Given the size of Lake Erie, it is generally not considered a sensitive receiver.

3.3 Setback Requirements

The following setbacks must also be observed when siting raised tile fields and septic tanks:

- Septic tank not closer than:
  - 1.5 m to any structure
  - 3 m to the property line
  - 15 m to surface water body or well

- Distribution pipe not closer than:
  - 5 m to any structure
  - 3 m to the property line
  - 15 m to surface water body or a well with a watertight casing to a depth of at least 6 m
  - 30 m to any other well

It should be noted that the above setbacks for the tile fields must be increased by 2 m for each 1 m that the bed(s) are raised above ground level. The septic system area should be graded to divert surface runoff away from the bed. This can be accomplished by crowning the mantle to shed water and constructing perimeter swales and ditches.

We trust this information is sufficient for your present purposes. Should you have any questions concerning the above, please do not hesitate to contact the undersigned.

Yours truly,
Terraprobe Inc.

Paul L. Raepple, P.Geo.

Stoney Creek Office