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February 19, 2023

Mr. Peter Drankowsky
Fine Home Design
367 Edgeworth Ave.
London ON
N5W 5C3

Dear Sir:

RE: Soil Testing and On-Site Sewage Servicing Assessment for Two Residential Lots, to be created at 1176 Crumlin Road, City of London

1. Background

The subject property is Part of Lots 15 & 17, Registered Plan No. 17(C), (Geographic Township of North Dorchester), in the City of London. Two lots being severed from a property known municipally as 1176 Crumlin Road. Parcel "1" is proposed to be 1.03 ha in size while Parcel "2" is to be 0.74 ha in size. Parcel "1" contains an existing dwelling and on-site septic system that is to be retained. Parcel "2" is to be developed with a future new residence. A third retained parcel (Parcel "3") approximately 1.63 ha in size, is to remain undeveloped.

Investigations were carried out to assess the proposed severances in the context of:

1. The Ontario Building Code for wastewater treatment system sizing in respect of existing residential sewage load, minimum setbacks to structures, lot lines and water wells in addition to native soil and slopes.

2. An Impact Assessment with respect to either isolation of sewage effluent from groundwater and/or dilution of contaminants to the existing water supply aquifer.

Since sewage servicing is highly dependent on the native soils and site drainage, shallow subsurface investigations were completed and a plan was prepared. All site data and proposed modifications are indicated on Sketch1 in Appendix C.

2. Existing Subsurface

On July 21st, a site visit was carried out, accompanied by a backhoe and operator provided by the client. Six test pits were formed as indicated on the enclosed drawing. The test pit logs and locations are presented on sketch 1 in Appendix C and are summarized below:

TEST PIT	DEPTH (cm)	SOIL TYPE
TP 1	0 - 41	TOPSOIL& SILT
Elev: 266.40	41 - 107	Silty Fine SAND (T = 8 min/cm) Silt Lenses
	107 - 183	Gr. Coarse SAND (T = 8 min/cm)
	Dry to Base	
TP 2	0 - 23	TOPSOIL
Elev: 266.90	23 - 71	Silty Fine SAND
	71 - 92	Compacted Organic Silty SAND
	92 - 203	Gr. Coarse SAND (T = 8 min/cm)
	Dry to Base	
TP 3	0 - 41	TOPSOIL & SILT
Elev: 268.40	41 - 107	Silty Fine SAND Silt Lenses
	107 - 211	Gr. Coarse SAND (T = 8 min/cm)
	Dry to Base	
TP 4	0 - 25	TOPSOIL
Elev: 267.95	25 - 112	Silty Fine SAND (Tested: T = 8 min/cm)
	112 - 155	Compacted Organic Silty SAND
	155 - 196	Gr. Coarse SAND (Tested: T = 8 min/cm)
	Dry to Base	
TP 5	0 - 24	TOPSOIL
Elev: 267.40	24 - 137	Silty Fine SAND (Tested: T = 10 min/cm) Silt Lenses
	137 - 203	Gr. Coarse SAND (Tested: T = 8 min/cm)
	Dry to Base	
TP 6	0 - 41	TOPSOIL
Elev: 265.60	41 - 76	SILT
	76 - 155	Gr. Coarse SAND (T = 8 min/cm)
	SEEPAGE @ 102cm (Elev: 264.58)	

Topsoil depth at all test pits ranges from 23 to 41cm underlain by brown and grey silty SAND generally down to approximately 107 to 137cm in depth. Below this, coarse grey SAND was documented to termination depths ranging from 155 to 211cm. The coefficient of permeability of the sand is estimated to be in the order of 10^{-3} cm/s.

All test pits were dry to termination depth except TP 6 located at the lowest southwest corner of Parcel 2 where seepage occurred at a depth of 1.02m (elevation 274.58).

The slowest documented percolation time for sewage system design purposes is 10 min/cm. Soil grain size analyses are presented in Appendix A and on the sketch in Appendix C.

3. Topography

A partial topographical survey was conducted by AGM Surveyors at the time of testing as presented on sketch 1 in Appendix C.

4. Proposed Servicing

The home on parcel"1" is currently serviced by a private on-site septic system that will be retained. The home is serviced with an onsite well.

Parcel "2" will host a future home proposed to have a sewage design load in the order of 3000 L/day. That design load would serve a 4-bedroom home with 300m^2 in living area.

Based on these assumptions, the required septic tank capacity will need to be 6800 L. Based on the native soils, the proposed filter bed for adequate effluent distribution would need to be 4m x 10m in size.

The estimated existing septic bed location on parcel "1" and the proposed new building envelope and septic system on parcel"2" are presented on Sketch 1 in Appendix C. A proposed onsite drilled well is also identified that meets required OBC setbacks.

5. Sewage Impact Assessment

In the context of a multi-lot development, municipalities often require assessment of groundwater impacts in accordance with MECP Procedure D5-4. This procedure outlines a typical multi-step process to gauge the effects of the combined effluent discharges from individual sewage systems in a development, usually based on nitrogen as an indicator of groundwater impact potential. The assessment procedure has recently been adopted by many municipalities to assess impacts of individual consent applications and will be used here. Following are the steps in this assessment.

5.1 Definition of Minimum Lot Size

Generally, if the average lot size is larger than 1.0 ha in size with no lot being smaller than 0.8 ha, then a hydrogeological assessment is not required provided that the area is not hydrogeologically sensitive. Since Parcel 2 is slightly smaller than 0.8ha, the next step was carried out. An impact assessment (dilution assessment) was carried out as presented below.

5.2 Dilution Calculations

The following Guideline D5-4 Predictive Assessment was completed to assess tolerable environmental impacts at the property boundaries for each of the severed lots and to provide any necessary recommendations to minimize identified risks.

Calculations are presented in spreadsheet format in Appendix B.

5.2.1 Nitrates and Maximum Acceptable Concentration

Residential sewage systems for treatment of domestic wastewater generally produce nutrients and bacteria in their effluent waters for treatment and uptake by the soil and vegetation. Bacteria and phosphorus are adequately removed where soils exist that reasonably treat the effluent. However, nitrate is a potential contaminant that remains in solution after effluent treatment by conventional systems and can be transmitted to groundwater and laterally to off-site properties. Nitrate is considered the critical parameter for analysis of domestic sewage system impacts on groundwater in sandy soils.

In the Ontario Drinking Water Objectives, the maximum acceptable concentration of nitrates is set at 10 mg/L as N. This parameter has been found in conventional septic tank effluent at concentrations of 40 mg/L, in studies conducted by MECP. At concentrations above the Ontario Drinking Water Guidelines, 2001, (i.e. 10 mg/L), nitrates in drinking water have been found to be hazardous to the health of infants.

It must be shown that sufficient dilution of this effluent takes place to ensure that the effluent concentration does not exceed the Drinking Water Quality Objective of 10 mg/L for downstream ecosystems or wells. Although Nitrate is the Nitrogen species of concern, assessment is normally made based on Total Nitrogen due to the complexities of nitrification/denitrification in the natural environment. Precipitation and infiltration through the soil to groundwater normally provide dilution and provide the basis for the following impact calculations.

5.2.2 Estimated Effluent Flow

The average daily design sewage load per residence is 1000 L/day, based on techniques suggested by the MECP in Guideline D-5-4 “Technical Guideline for Individual On-Site Sewage Systems – Water Quality Impact Risk Assessments”.

Following is an annual load estimate of the total effluent volume for each lot:

(1000 L/day) x 365 days/year = 365,000 L/year

TOTAL ANNUAL SEWAGE LOAD: 365,000 L/year

5.2.3 Precipitation Recharge

The mean annual precipitation for this area is 1012 mm based on Environment Canada precipitation records for London.
The recharge capacity of the property is based on topography, soils and vegetative cover on the site. The amounts of infiltration and runoff are of course, directly dependent on the total precipitation in conjunction with the above factors.

5.2.4 Surplus Water Estimation

Evaporation/evapotranspiration for this area was assumed to be average in this area at approximately 50% of the precipitation or 506 mm. The surplus water that is available for runoff or infiltration is:

1012 mm/yr – 506 mm/yr = 506 mm/yr

5.2.5 MOE Infiltration Factors

Surplus water may either infiltrate the ground to recharge groundwater or it may leave the site as surface water. MOE has compiled a set of factors to quantify the percentage of surplus water that will infiltrate to the subsurface. These factors are presented in the following table:

Area Characteristic	Infiltration Factor "I"
TOPOGRAPHY	
- Flat (average slope < .6 %)	0.30
- Rolling (ave. slope of 0.6 to 2.0%)	0.20
- Hilly land (ave. slope of 2.0 to >5.0%)	0.10
SOIL	
- Tight Impervious Clay	0.10
- Medium (combinations of clay and loam)	0.20
- Open Sandy Loam	0.40
VEGETATIVE COVER	
- Cultivated Lands	0.10
- Woodland or grassland	0.20

The land is rolling Therefore, the percentage of surplus water that is estimated to infiltrate is the sum of the factors for each of the categories in the above table:

I = 0.20 + 0.20 + 0.10 = 0.50

Therefore, 50% of the surplus water (net of evaporation/transpiration) is expected to infiltrate.

5.2.6 Volume of Water Available for Dilution

The amount of water available for dilution may be calculated by multiplying the estimated depth of annual surplus water by the area of the property and then by the percentage that is estimated to infiltrate (Infiltration Factor):

1.012 m/year – 0.506 m/year x 50% x Lot Area

= 0.253 x Lot Area

The currently proposed lot areas for the new lots (parcels A & B) respectively are 10315 m^2 and 7387m^2. Therefore, annual dilution volumes for Parcels 1 & 2 respectively are 2609 m^3 and 1869 m^3.

5.3 Impact Calculation-Conventional Septic Systems

The nitrate concentration at the property boundary can be expressed by the following relationship:

Co = [QE (NE) + DW (NB)]/[DW + QE]

Where:
Co = Nitrate Concentration at the property boundary (mg/L);
NE = Nitrate Concentration of the sewage effluent (from the tank) (mg/L);
QE = Yearly volume of effluent produced (L/year);
DW = Dilution Water available (L/yr);
NB = Background Nitrate Concentration in diluting precipitation, (mg/L).

The values for the variables are:
NE = 40 mg/L (from section 5.2.1);
QE = 365,000 L/lot/year (from section 5.2.2);
DW = 2,609,000 & 1,869,000 L/year (from section 5.2.6);
NB = 0.50 mg/L (based on estimated concentration in dilution precipitation).

The spreadsheet in Appendix B provides the above computations and results are summarized as follows:

- The nitrate concentration of effluent at the property boundary of parcel 1 is calculated to be 5.35 mg/L, which is below the Ontario Drinking Water Guideline of 10.0 mg/L.
- The nitrate concentration of effluent at the property boundary of parcel 2 is calculated to be 6.95 mg/L, which is below the Ontario Drinking Water Guideline of 10.0 mg/L.
- Impact calculations with tertiary treatment were not completed since the guidelines were met without such enhanced technology.

6. Conclusions and Recommendations

1. There is adequate space on both proposed parcels for conventional treatment systems with in-ground filter beds and contingency beds of similar size (if necessary) to treat the estimated design flows from the existing (or larger) homes on both parcels.

2. The native soils are sandy with a conductivity of at least 10^{-3} cm/s. Design of septic systems may use a percolation time of 8 to 10 min/cm depending on the receiving soil stratum.

3. Impacts to groundwater of septic systems on these lots are shown to be acceptable.

We trust this meets the requirements of our scope of work.

Sincerely,
BOS Engineering & Environmental Services Inc.

Art W. Bos P. Eng.
Enclosures:
Appendix A: Soil Grain Size Analyses
Appendix B: Nitrate Impact Assessment
Appendix C: Site Sketch

APPENDIX A

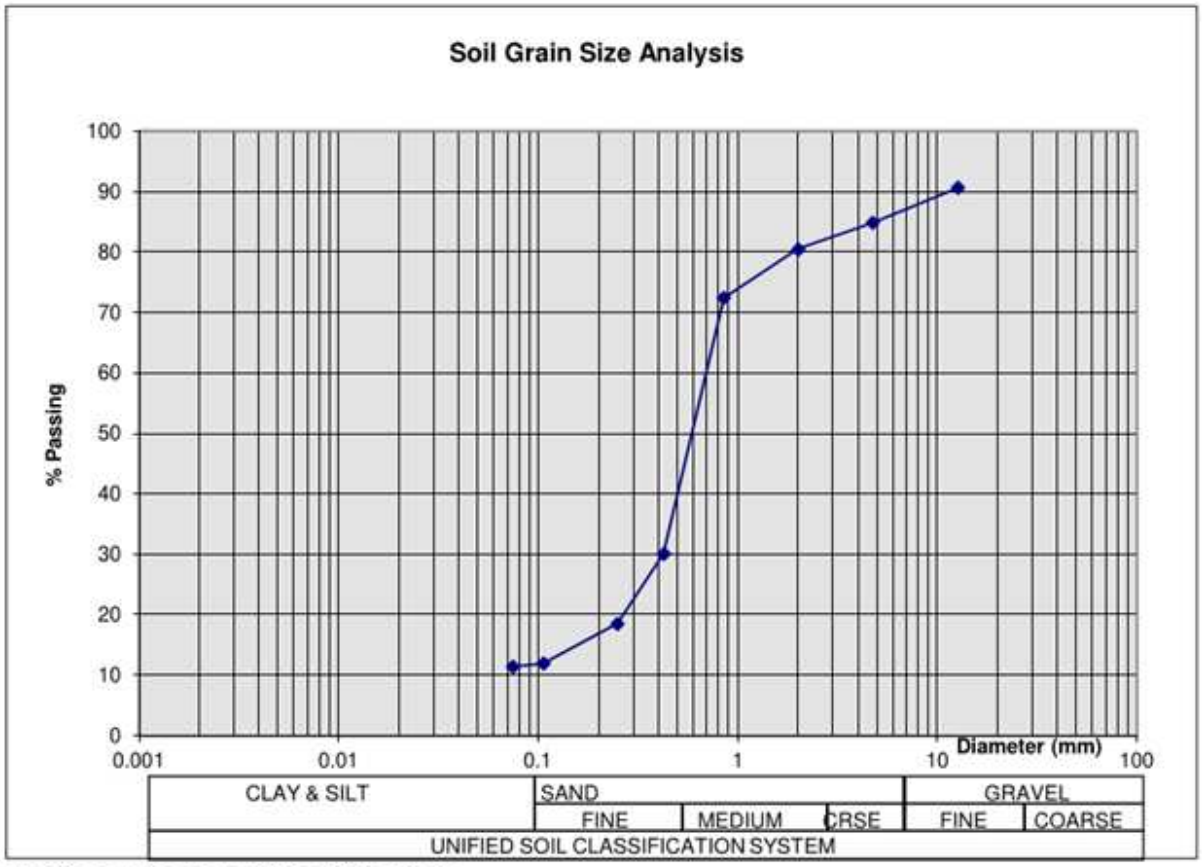
Soi Grain Size Analyses

BOS Engineering Environmental Services

Project :	Crumlin	***Client :***	Fine Home Design
Test Pit :	TP4	***RE:***	Wastewater Treatment System
Depth :	25 to 112cm	***Proj. No.***	2207-16
Dry Mass:	226.3 g	***Date:***	July 25 2022

CHART DATA

Sieve No.	Mass	Cum. Mass	Diam. (d)	% Passing
	21.0	21	12.7	91
4	13.3	34.3	4.75	85
10	9.9	44.2	2	80
20	18.2	62.4	0.85	72
40	95.8	158.2	0.425	30
60	26.2	184.4	0.25	19
140	14.9	199.3	0.106	12
200	1.0	200.3	0.075	11



Unified System Classification:
SM Silty SAND

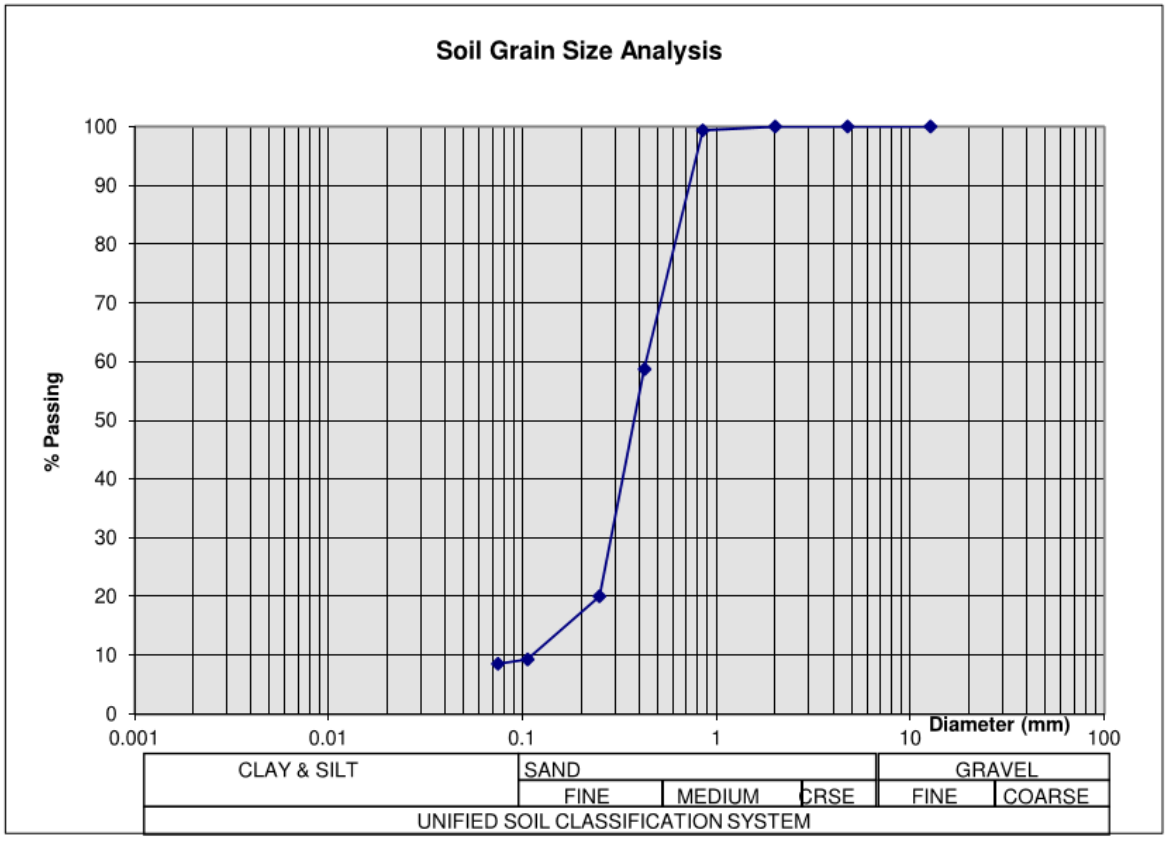
Est. Percolation Time: T = 8 min/cm **Coefficent of Permeability = 0.003 cm/s**

BOS Engineering Environmental Services

Project :	Crumlin	***Client :***	Fine Home Design
Test Pit :	TP4	***RE:***	Wastewater Treatment System
Depth :	155 to 196cm	***Proj. No .***	2207-16
Dry Mass:	187.8 g	***Date:***	July 25 2022

CHART DATA

Sieve No.	Mass	Cum. Mass	Diam. (d)	% Passing
		0	12.7	100
4	0.0	0	4.75	100
10	0.0	0	2	100
20	1.1	1.1	0.85	99
40	76.4	77.5	0.425	59
60	72.6	150.1	0.25	20
140	20.2	170.3	0.106	9
200	1.4	171.7	0.075	9



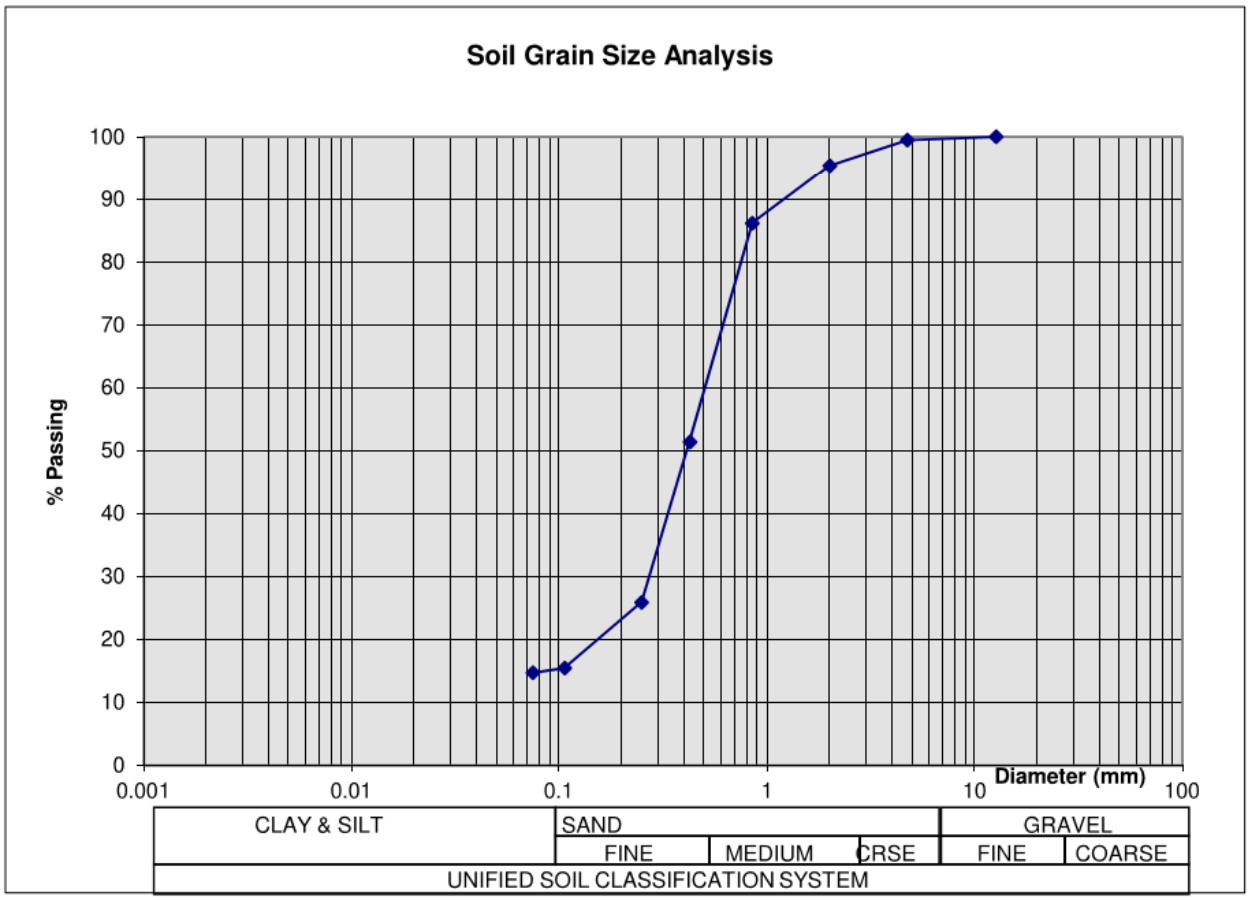
Unified System Classification:
SP Poorly Graded SAND
Est. Percolation Time: T = 8 min/cm Coefficent of Permeability = 0.003 cm/s

BOS Engineering Environmental Services

Project :	Crumlin	***Client :***	Fine Home Design
Test Pit :	TP5	***RE:***	Wastewater Treatment System
Depth :	24 to 137cm	***Proj. No.***	2207-16
Dry Mass:	181.3 g	***Date:***	July 25 2022

CHART DATA

Sieve No.	Mass	Cum. Mass	Diam. (d)	% Passing
		0	12.7	100
4	0.9	0.9	4.75	100
10	7.5	8.4	2	95
20	16.7	25.1	0.85	86
40	63.0	88.1	0.425	51
60	46.2	134.3	0.25	26
140	19.0	153.3	0.106	15
200	1.4	154.7	0.075	15



Unified System Classification:
SM Silty SAND

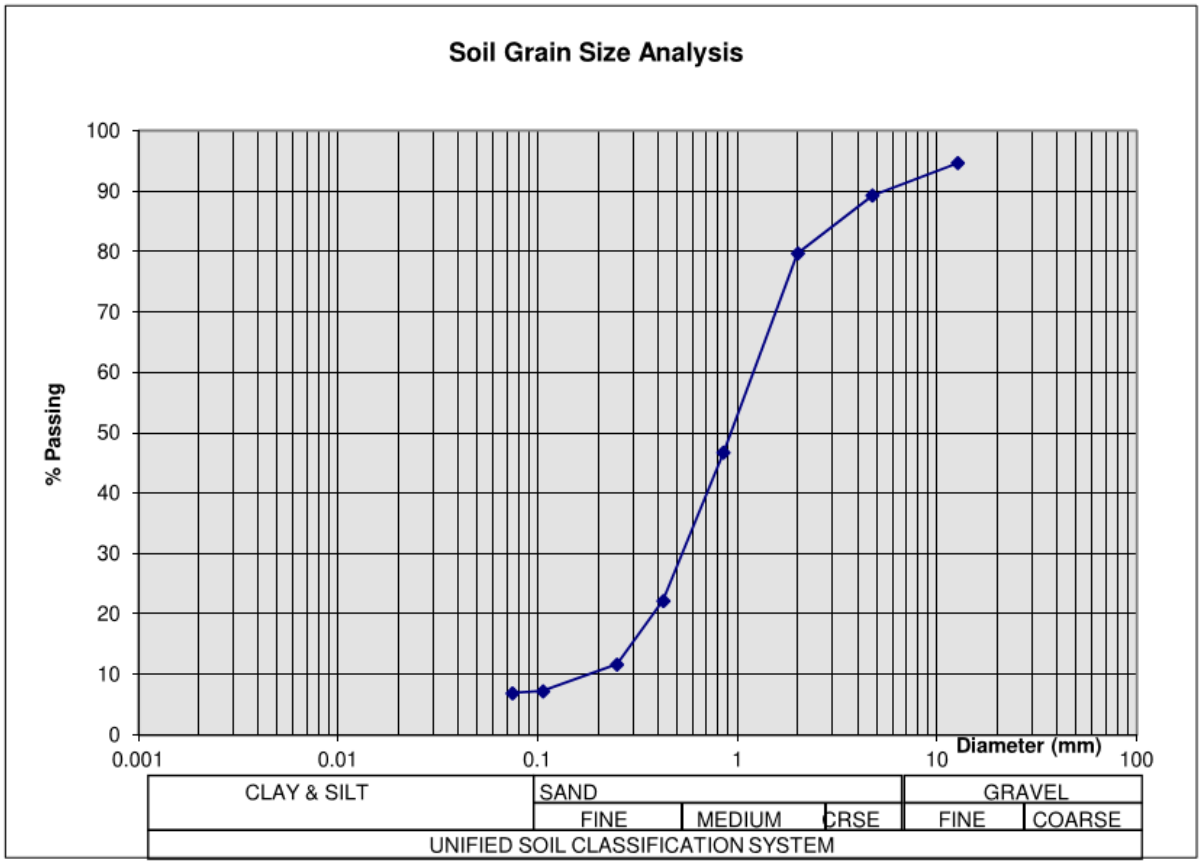
Est. Percolation Time: T = 10 min/cm **Coefficent of Permeability = 0.002 cm/s**

BOS Engineering Environmental Services

Project :	Crumlin	***Client :***	Fine Home Design
Test Pit :	TP5	***RE:***	Wastewater Treatment System
Depth :	137 to 203cm	***Proj. No .***	2207-16
Dry Mass:	244.1 g	***Date:***	July 25 2022

CHART DATA

Sieve No.	Mass	Cum. Mass	Diam. (d)	% Passing
	13.0	13	12.7	95
4	13.2	26.2	4.75	89
10	23.4	49.6	2	80
20	80.5	130.1	0.85	47
40	59.8	189.9	0.425	22
60	25.7	215.6	0.25	12
140	10.8	226.4	0.106	7
200	0.7	227.1	0.075	7



Unified System Classification:
SP Poorly Graded SAND
Est. Percolation Time: T = 8 min/cm **Coefficent of Permeability = 0.003 cm/s**

APPENDIX B

Nitrate Impact Assessment

1176 Crumlin Rd - D5-4 Nitrate Calculations

19-Feb-23

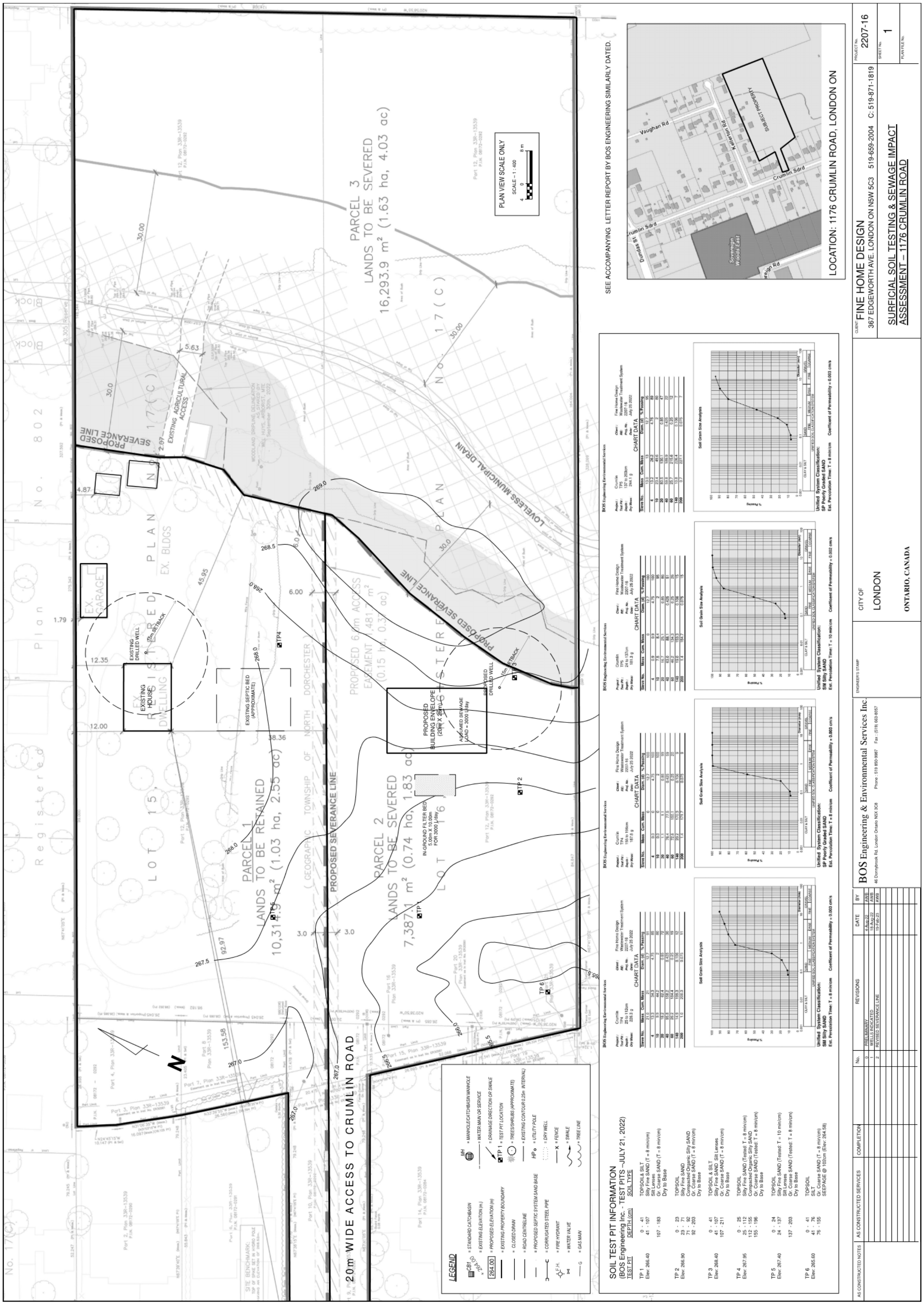
WITH STANDARD SEPTIC TANK PRETREATMENT - 50% natural infiltration

	Lot Size (m^2)	Mean Annual Precip. (mm/yr) [1]	Evapo. (mm/yr) [2]	Infiltration (%) [3]	Dilution Volume (L/yr)	Background NO_3 +NO_2 (mg/L)	Septage Conc. (mg/L)	Reduction Effic. (%)	Treated Conc. (mg/L)	No. of Houses (#)	Sewage Volume (L/yr)	Concentration at Lot Boundary (mg/L)	OWQG (mg/L)
Parcel 1	10315	1012	506	50	2609695	0.5	40	0	40	1	365000	**5.35**	**10**
Parcel 2	7387	1012	506	50	1868911	0.5	40	0	40	1	365000	**6.95**	**10**

1. Note that mean annual precipitation is based on London weather station
2. Evaporation is based on typical stormwater balance calculations in SW Ontario of approximately 50% of precipitation.
3. Natural (un-enhanced) Infiltration was conservatively estimated to be 50% of surplus water for sandy soils.
4. Background Nitrate concentration is estimated at 0.5 mg/L for dilution precipitation.

APPENDIX C

Site Sketch


SEE ACCOMPANYING LETTER REPORT BY BOS ENGINEERING SIMILARLY DATED.
LOCATION: 1176 CRUMLIN ROAD, LONDON ON
FINE HOME DESIGN
367 EDGEWORTH AVE. LONDON ON N5W 5C3 519-659-2004 C: 519-871-1819
SURFICIAL SOIL TESTING & SEWAGE IMPACT ASSESSMENT – 1176 CRUMLIN ROAD
2207-16
CITY OF LONDON
ONTARIO, CANADA
PARCEL 3
LANDS TO BE SEVERED
16,293.9 m² (1.63 ha, 4.03 ac)
PARCEL 2
LANDS TO BE SEVERED
PARCEL 1
LANDS TO BE RETAINED
PROPOSED SEVERANCE LINE
20m WIDE ACCESS TO CRUMLIN ROAD
LOVELESS MUNICIPAL DRAIN
PROPOSED BUILDING ENVELOPE
EXISTING SEPTIC BED (APPROXIMATE)
EXISTING HOUSE
EX. GARAGE
PLAN VIEW SCALE ONLY
LEGEND
SOIL TEST PIT INFORMATION