TIM O'HARE ASSOCIATES
SOIL & LANDSCAPE CONSULTANCY

Mr Drew Wetherell
Bourne Amenity Ltd
The Wharf
Newenden
Cranbrook
Kent TN18 5QG

30th January 2019
Our Ref: TOHA/19/7885/SS
Your Ref: PO42790

Dear Sirs

Structural Subsoil Analysis Report – Grade D Sand

We have completed the analysis and testing of the sample recently submitted, referenced *Grade D,* and have pleasure reporting our findings.

The purpose of the analysis was to determine the suitability of the sample for use as a 'structural subsoil' for tree planting in hard landscape situations.

This report presents the results of analysis for the sample submitted to our office, and it should be considered 'indicative' of the soil source. The report and results should therefore not be used by third parties as a means of verification or validation testing or waste designation purposes, especially after the material has left the Bourne Amenity Ltd site.

SAMPLE EXAMINATION

The sample was described as a brownish yellow (Munsell Colour 10YR 6/8), slightly moist, friable, non-calcareous SAND with a single grain structure. The sample was virtually stone-free and no unusual odours, deleterious materials, roots or rhizomes of pernicious weeds were recorded.

ANALYTICAL SCHEDULE

The sample was submitted to the laboratory for a range of physical and chemical analyses in accordance with the following schedule:

Geotechnical Properties

- permeability;
- total, air-filled and capillary porosity;
- bulk density;
- California Bearing Ratio (CBR).

Horticultural Properties

- detailed particle size distribution;
- stone content;
- moisture content;
- pH value;
- electrical conductivity values;
- organic matter content;

The results are presented on the attached Certificate of Analysis and an interpretation of the results is given below.

RESULTS OF ANALYSIS

Particle Size Distribution and Stone Content

The sample fell into the *sand* texture class. The grading of the sand indicates a sufficiently narrow particle size distribution and a predominance of *medium sand* (0.25-0.50mm). This is ideal for 'structural soils' as sufficient porosity levels are maintained in a compacted state and the risk of particle interpacking is minimised.

The stone content of the sample was very low and as such, stones should not restrict the use of the sand for landscape purposes.

Permeability and Porosity

The permeability of the sample when in a compacted state (Standard Compaction) was high (484mm/hr) and indicates that the sand would demonstrate satisfactory drainage performance for tree planting in hard landscape situations.

The sample displayed a reasonable total porosity value in a compacted state, comprising mainly capillary pores. This indicates that the sample has a good water-holding capacity, and given its particle size distribution, a significant proportion of the water is likely to be plant available.

California Bearing Ratio

A re-compacted California Bearing Ratio (CBR) was completed as part of the engineering testing undertaken on the sample. The sample was re-compacted using the 2.5kg rammer at the as received moisture content and the sample returned a minimum CBR of 18%. Assuming that the in-situ compaction method selected during installation provides similar levels of compaction to that of the laboratory test, the in-situ performance of the material should be able to achieve a similar result (provided it is compacted at the same moisture content (3%)).

As the performance of the soil will be linked to the moisture content at time of compaction, further work may be required in order to correlate the change in engineering performance of the material over the range of moisture contents at which the soil is likely to be placed and compacted.

We recommend a more conservative approach with the performance of the material, and as opposed to a CBR of 37%, we would quote "should achieve a CBR in excess of 5%..." The 5% CBR is important as this is the lower limit for the sub-grade for the minimum construction thickness.

pH and Electrical Conductivity Values

The sample was slightly acid in reaction (pH 6.4), with a pH value that would be considered ideal for landscape purposes.

The electrical conductivity (salinity) values (water and $CaSO_4$ extracts) were low, which indicates that soluble salts were not present at levels that would be harmful to plants.

Organic Matter and Fertility Status

The sample contained a low organic matter content, which is appropriate for 'subsoil' material.

CONCLUSION

The purpose of the analysis was to determine the suitability of the sample for use as a 'structural subsoil' for tree planting in hard landscape situations.

From the visual examination and laboratory analysis undertaken, the sample can be described as a slightly acid, non-saline, virtually stone-free SAND with a sufficiently narrow particle size distribution and low organic matter content. The permeability rate was high, with sufficient porosity recorded.

Based on our findings, the horticultural and geotechnical properties of the sand represented by this sample would be considered suitable for use as a structural subsoil.

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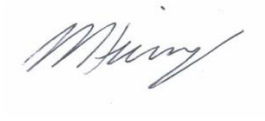
We hope this report meets with your approval. Please call us if you wish to talk through the findings and recommendations.

Yours faithfully



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For and on behalf of Tim O'Hare Associates LLP

TIM O'HARE ASSOCIATES
SOIL & LANDSCAPE CONSULTANCY

Client:	**Bourne Amenity Ltd**
Project	**Sand Analysis - Grade D Sand**
Date:	**30/01/2019**
Job Ref No:	**TOHA/19/7885/SS**

Sample Reference			**Grade D**
		Accreditation	
Clay (<0.002mm)	%	UKAS	1
Silt (0.002-0.05mm)	%	UKAS	1
Very Fine Sand (0.05-0.15mm)	%	UKAS	4
Fine Sand (0.15-0.25mm)	%	UKAS	15
Medium Sand (0.25-0.50mm)	%	UKAS	54
Coarse Sand (0.50-1.0mm)	%	UKAS	20
Very Coarse Sand (1.0-2.0mm)	%	UKAS	5
Texture Class (UK Classification)	--	UKAS	S
Stones (2-20mm)	% DW	GLP	3
Stones (20-50mm)	% DW	GLP	0
Stones (>50mm)	% DW	GLP	0
pH Value (1:2.5 water extract)	units	UKAS	6.4
Calcium Carbonate	%	UKAS	<1.0
Electrical Conductivity (1:2.5 water extract)	uS/cm	UKAS	81
Electrical Conductivity (1:2 $CaSO_4$ extract)	uS/cm	UKAS	2087
Exchangeable Sodium Percentage	%	UKAS	3.0
Organic Matter (LOI)	%	UKAS	<0.5
Determination of Permeability and Porosity - K H Volume 10.7 method			
Initial Height	mm	UKAS	130.0
Initial Diameter	mm	UKAS	100.0
Particle Density	Mg/m^3	UKAS	2.64
Initial Bulk Density	Mg/m^3	UKAS	1.77
Final Bulk Density	Mg/m^3	UKAS	2.01
Initial Moisture Content	%	UKAS	4
Final Moisture Content	%	UKAS	16
Initial Dry Density	Mg/m^3	UKAS	1.71
Final Dry Density	Mg/m^3	UKAS	1.74
Total Porosity (Initial)	%	UKAS	35.1
Total Porosity (Final)	%	UKAS	34.0
Air Filled Porosity (Initial)	%	UKAS	29.3
Air Filled Porosity (Final)	%	UKAS	7.0
Capillary Porosity (Initial)	%	UKAS	5.9
Capillary Porosity (Final)	%	UKAS	27.0
Permeability	mm/hr	UKAS	484
California Bearing Ratio - BS 1377-4:1990:Method 7.4			
Moisture Content (Initial)	%	UKAS	3
Moisture Content (Top)	%	UKAS	3
Moisture Content (Base)	%	UKAS	3
Moisture Content (Mean)	%	UKAS	3
Initial Bulk Density	Mg/m^3	UKAS	1.81
Initial Dry Density	Mg/m^3	UKAS	1.75
CBR Top	%	UKAS	18
CBR Base	%	UKAS	37

Determination of Permeability and Porosity - K H Volume 10.7 method

Notes
Material recompacted at the 'as-received' moisture with a 2.5kg rammer
Sample is assumed to be fully saturated when a rate of steady flow is achieved
Permeability is determined when sample achieved a state of steady flow

Determination of California Bearing Ratio - BS 1377-4:1990:Method 7.4

Notes
Material recompacted at the 'as-received' moisture with a 2.5kg rammer
Sample tested in an unsoaked condition
Applied Seating Load (top) : 52N
Applied Seating Load (base) : 52N
Applied Surcharge : 10.0kg

S = SAND

Visual Examination

The sample was described as a brownish yellow (Munsell Colour 10YR 6/8), slightly moist, friable, non-calcareous SAND with a single grain structure. The sample was virtually stone-free and no unusual odours, deleterious materials, roots or rhizomes of pernicious weeds were recorded.

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Soil Scientist

Results of analysis should be read in conjunction with the report they were issued with