TIM O'HARE ASSOCIATES
SOIL & LANDSCAPE CONSULTANCY

Mr Richard Chinn
Boughton Loam Ltd
12 Telford Way
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Kettering
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6th October 2022
Our Ref: TOHA/22/7671/SS
Your Ref: PO0000004201

Dear Sirs

Urban Tree Soil Analysis

We have completed the analysis and testing of the sample recently submitted, referenced *Urban Tree Soil,* and have pleasure reporting our findings.

The purpose of the analysis was to determine the suitability of the rootzone sample for use as urban tree soil 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 rootzone 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 rootzone has left the Boughton Loam Ltd site.

SAMPLE EXAMINATION

The sample was described as a dark brown (Munsell Colour 10YR 3/3), slightly moist, friable, very slightly calcareous SAND with a single grain structure*. The sample was virtually stone-free and contained a low proportion of organic fines and very occasional woody fragments. No unusual odours, deleterious materials, roots or rhizomes of pernicious weeds were recorded.

* This appraisal of soil structure was made from examination of a disturbed sample(s). Structure is a key soil characteristic that may only be accurately assessed by examination in an in-situ state.

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 value;
- exchangeable sodium percentage;
- major plant nutrients (N, P, K, Mg);
- organic matter content;
- C:N ratio;

Environmental Properties

- heavy metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Se, Zn, B);
- total cyanide and total (mono) phenols;
- aromatic and aliphatic TPH (C5-C35 banding);
- speciated PAHs (US EPA16 suite);
- benzene, toluene, ethylbenzene, xylene (BTEX);
- asbestos.

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 acceptable for tree soils as sufficient porosity levels are maintained in a compacted state and the risk of particle interpacking is minimised.

The sample was virtually stone-free and as such, stones should not restrict the use of the rootzone for landscape purposes.

Permeability and Porosity

The permeability of the sample when in a compacted state (Standard Compaction) was moderately high (128 mm/hr) and indicates that the rootzone should demonstrate good drainage performance for tree planting in hard landscape situations.

The sample displayed a satisfactory 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. However, the sample contains less large, air-filled pores, which indicates that, in its compacted state, there could be reduced aeration for root function.

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 13%. 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 (9%)).

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 13%, 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 strongly alkaline in reaction (pH 8.7). Analysis of the calcium carbonate (lime) content of the soil found the level to be low by 'acid' test during the visual examination of the sample. Therefore, the high pH recorded is likely to be due to the very low buffering capacity of the high sand content material. This pH value would be considered suitable for use as a tree soil in urban landscape situations providing species with a wide pH tolerance or those known to prefer alkaline soils are selected for planting.

The electrical conductivity (salinity) value (water extract) was moderate, which indicates that soluble salts should not be present at levels that would be harmful to plants.

The electrical conductivity value by $CaSO_4$ extract fell below our maximum recommended value (3300 µS/cm).

Organic Matter and Fertility Status

The sample was adequately supplied with organic matter and all major plant nutrients in relation to use as urban tree soil. The organic matter content is slightly above that considered desirable for a load bearing substrate; however, this does not appear to adversely affected other physical properties in this instance.

The C:N ratio was acceptable for landscape purposes.

Potential Contaminants

With reference to *BS3882:2015 – Table 1*: Notes 3 and 4, there is a recommendation to confirm levels of potential contaminants in relation to the topsoil's proposed end use. This includes human health, environmental protection and metals considered toxic to plants. In the absence of site-specific assessment criteria, the concentrations that affect human health have been compared with the *residential without home grown produce* land use in the Suitable For Use Levels (S4Uls) presented in *The LQM/CIEH S4Uls for Human Health Risk Assessment* (2015) and the DEFRA SP1010: *Development of Category 4 Screening Levels* (C4SLs) *for Assessment of Land Affected by Contamination – Policy Companion Document* (2014).

Of the remaining potential contaminants determined, none exceeded their respective guideline values.

Phytotoxic Contaminants

Of the phytotoxic (toxic to plants) contaminants determined (copper, nickel, zinc), none was found at levels that exceeded the maximum permissible levels specified in *BS3882:2015 – Table 1*.

CONCLUSION

The purpose of the analysis was to determine the suitability of the rootzone sample for use as urban tree soil for tree planting in hard landscape situations.

From the visual examination and laboratory analysis undertaken, the sample can be described as strongly alkaline, non-saline, very slightly calcareous, virtually stone-free SAND with a suitably narrow particle size distribution. The material contained sufficient levels of organic matter and major plant nutrients.

Based on our findings, the horticultural and geotechnical properties of the rootzone represented by this sample would be considered suitable for an urban tree soil for tree planting in hard landscape, provided species tolerant of alkaline soil conditions are selected.

In order to minimise the risk of anaerobic (oxygen depleted) soil conditions developing within the tree pit, this rootzone should not be placed deeper than 600mm. A suitable washed sand, preferably with the same particle size distribution as this sample, should be used beneath the urban tree soil.

RECOMMENDATIONS

Soil Conditioner

To improve the water and nutrient retention capacities of this soil, we recommend application and incorporation of a suitable soil conditioner, e.g. *TerraCottem "Complement"*, at the manufacturers recommended rate into each layer of the rootzone prior to consolidation.

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

Yours faithfully

Harriet MacRae
BSc MSc
Graduate Soil Scientist

Ceri Spears
BSc MSc MISoilSci
Senior Associate

For and on behalf of Tim O'Hare Associates LLP

TIM O'HARE ASSOCIATES
SOIL & LANDSCAPE CONSULTANCY

Client:	**Boughton Loam Ltd**
Project	**Urban Tree Soil Analysis**
Testing:	**Geotechnical Properties**
Date:	**06/10/2022**
Job Ref No:	**TOHA/22/7671/SS**

Sample Reference			**Urban Tree Soil**
		Accreditation	
Clay (<0.002mm)	%	UKAS	4
Silt (0.002-0.05mm)	%	UKAS	2
Very Fine Sand (0.05-0.15mm)	%	UKAS	4
Fine Sand (0.15-0.25mm)	%	UKAS	13
Medium Sand (0.25-0.50mm)	%	UKAS	61
Coarse Sand (0.50-1.0mm)	%	UKAS	16
Very Coarse Sand (1.0-2.0mm)	%	UKAS	0
Total Sand (0.05-2.0mm)	%	UKAS	94
Texture Class (UK Classification)	--	UKAS	S
Stones (2-20mm)	% DW	GLP	0
Stones (20-50mm)	% DW	GLP	0
Stones (>50mm)	% DW	GLP	0

Determination of Permeability and Porosity - K H Volume 10.7 method			
Initial Height	mm	UKAS	129.4
Initial Diameter	mm	UKAS	100.0
Particle Density	Mg/m^3	UKAS	2.56
Initial Bulk Density	Mg/m^3	UKAS	1.65
Final Bulk Density	Mg/m^3	UKAS	1.88
Initial Moisture Content	%	UKAS	9
Final Moisture Content	%	UKAS	26
Initial Dry Density	Mg/m^3	UKAS	1.51
Final Dry Density	Mg/m^3	UKAS	1.50
Total Porosity (Initial)	%	UKAS	40.8
Total Porosity (Final)	%	UKAS	41.4
Air Filled Porosity (Initial)	%	UKAS	27.1
Air Filled Porosity (Final)	%	UKAS	3.2
Capillary Porosity (Initial)	%	UKAS	13.7
Capillary Porosity (Final)	%	UKAS	38.2
Permeability	mm/hr	UKAS	128

California Bearing Ratio - BS 1377-4:1990:Method 7.4			
Moisture Content (Initial)	%	UKAS	9
Moisture Content (Top)	%	UKAS	9
Moisture Content (Base)	%	UKAS	9
Moisture Content (Mean)	%	UKAS	9
Initial Bulk Density	Mg/m^3	UKAS	1.68
Initial Dry Density	Mg/m^3	UKAS	1.55
CBR Top	%	UKAS	13
CBR Base	%	UKAS	15

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) : 48N
Applied Seating Load (base) : 48N
Applied Surcharge : 10.0kg

S = SAND

Visual Examination

The sample was described as a dark brown (Munsell Colour 10YR 3/3), slightly moist, friable, very slightly calcareous SAND with a single grain structure. The sample was virtually stone-free and contained a low proportion of organic fines and very occasional woody fragments. No unusual odours, deleterious materials, roots or rhizomes of pernicious weeds were recorded.

H.MacRae

Harriet MacRae
BSc MSc
Graduate Soil Scientist

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

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Client:	**Boughton Loam Ltd**
Project	**Urban Tree Soil Analysis**
Testing:	**Horticultural and Environmental Properties**
Date:	**05/10/2022**
Job Ref No:	**TOHA/22/7671/SS**

Sample Reference			**Urban Tree Soil**
		Acreditation	
pH Value (1:2.5 water extract)	units	UKAS	8.7
Electrical Conductivity (1:2.5 water extract)	uS/cm	UKAS	782
Electrical Conductivity (1:2 $CaSO_4$ extract)	uS/cm	UKAS	2943
Exchangeable Sodium Percentage	%	UKAS	4
Organic Matter (LOI)	%	UKAS	3.8
Total Nitrogen (Dumas)	%	UKAS	0.18
C : N Ratio	ratio	UKAS	12
Extractable Phosphorus	mg/l	UKAS	37
Extractable Potassium	mg/l	UKAS	806
Extractable Magnesium	mg/l	UKAS	95
Total Arsenic (As)	mg/kg	MCERTS	2.3
Total Cadmium (Cd)	mg/kg	MCERTS	< 0.2
Total Chromium (Cr)	mg/kg	MCERTS	4.2
Hexavalent Chromium (Cr VI)	mg/kg	MCERTS	< 1.8
Total Copper (Cu)	mg/kg	MCERTS	5.2
Total Lead (Pb)	mg/kg	MCERTS	6.4
Total Mercury (Hg)	mg/kg	MCERTS	< 0.3
Total Nickel (Ni)	mg/kg	MCERTS	4
Total Selenium (Se)	mg/kg	MCERTS	< 1.0
Total Zinc (Zn)	mg/kg	MCERTS	23
Water Soluble Boron (B)	mg/kg	MCERTS	0.8
Total Cyanide (CN)	mg/kg	MCERTS	< 1.0
Total (mono) Phenols	mg/kg	MCERTS	< 1.0
Naphthalene	mg/kg	MCERTS	< 0.05
Acenaphthylene	mg/kg	MCERTS	< 0.05
Acenaphthene	mg/kg	MCERTS	< 0.05
Fluorene	mg/kg	MCERTS	< 0.05
Phenanthrene	mg/kg	MCERTS	< 0.05
Anthracene	mg/kg	MCERTS	< 0.05
Fluoranthene	mg/kg	MCERTS	< 0.05
Pyrene	mg/kg	MCERTS	< 0.05
Benzo(a)anthracene	mg/kg	MCERTS	< 0.05
Chrysene	mg/kg	MCERTS	< 0.05
Benzo(b)fluoranthene	mg/kg	MCERTS	< 0.05
Benzo(k)fluoranthene	mg/kg	MCERTS	< 0.05
Benzo(a)pyrene	mg/kg	MCERTS	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	MCERTS	< 0.05
Dibenzo(a,h)anthracene	mg/kg	MCERTS	< 0.05
Benzo(g,h,i)perylene	mg/kg	MCERTS	< 0.05
Total PAHs (sum USEPA16)	mg/kg	MCERTS	< 0.80
Aliphatic TPH >C5 - C6	mg/kg	MCERTS	< 0.001
Aliphatic TPH >C6 - C8	mg/kg	MCERTS	< 0.001
Aliphatic TPH >C8 - C10	mg/kg	MCERTS	< 0.001
Aliphatic TPH >C10 - C12	mg/kg	MCERTS	< 1.0
Aliphatic TPH >C12 - C16	mg/kg	MCERTS	< 2.0
Aliphatic TPH >C16 - C21	mg/kg	MCERTS	< 8.0
Aliphatic TPH >C21 - C35	mg/kg	MCERTS	< 8.0
Aliphatic TPH (C5 - C35)	mg/kg	MCERTS	< 10
Aromatic TPH >C5 - C7	mg/kg	MCERTS	< 0.001
Aromatic TPH >C7 - C8	mg/kg	MCERTS	< 0.001
Aromatic TPH >C8 - C10	mg/kg	MCERTS	< 0.001
Aromatic TPH >C10 - C12	mg/kg	MCERTS	< 1.0
Aromatic TPH >C12 - C16	mg/kg	MCERTS	< 2.0
Aromatic TPH >C16 - C21	mg/kg	MCERTS	< 10
Aromatic TPH >C21 - C35	mg/kg	MCERTS	< 10
Aromatic TPH (C5 - C35)	mg/kg	MCERTS	< 10
Benzene	mg/kg	MCERTS	< 0.001
Toluene	mg/kg	MCERTS	< 0.001
Ethylbenzene	mg/kg	MCERTS	< 0.001
o-xylene	mg/kg	MCERTS	< 0.001
MTBE (Methyl Tertiary Butyl Ether)	mg/kg	MCERTS	< 0.001
Asbestos	ND/D	ISO 17025	Not-detected

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