



TIM O'HARE ASSOCIATES  
SOIL & LANDSCAPE CONSULTANCY

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21<sup>st</sup> February 2023  
Our Ref: TOHA/23/7816/SS  
Your Ref: PO 4972

Dear Sirs

**Soil Analysis Report: Lightweight Subsoil**

We have completed the analysis of the soil sample recently submitted, referenced *Lightweight Subsoil*, and have pleasure reporting our findings.

The purpose of the analysis was to determine the suitability of the material for use as a lightweight subsoil in a rooftop or podium garden environment.

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, or for any project specific applications, especially after the soil has left the Boughton Loam Limited site.

**SAMPLE EXAMINATION**

The sample was described as a dark yellowish brown (Munsell Colour 10YR 4/6), slightly moist, friable, slightly calcareous, single grain SAND. The sample was free of stone-sized material, with the exception of lightweight expanded clay aggregate particles (leca). No deleterious materials, unusual odours, roots or rhizomes of pernicious weeds were observed.

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Plate 1: Lightweight Subsoil Sample

### **ANALYTICAL SCHEDULE**

The sample was submitted to a UKAS and MCERTS accredited laboratory for a range of physical and chemical tests to confirm the composition and fertility of the soil, and the concentration of selected potential contaminants. The following parameters were determined:

- detailed particle size analysis (5 sands, silt, clay);
- stone content (2-20mm, 20-75mm, >75mm);
- saturated bulk density;
- saturated hydraulic conductivity;
- pH and electrical conductivity values;
- exchangeable sodium percentage;
- organic matter content;
- heavy metals (As, B, Cd, Cr, Cr VI, Cu, Pb, Hg, Ni, Se, Zn);
- total cyanide and total (mono) phenols;
- aromatic and aliphatic TPH (C5-C35 banding);
- speciated PAHs (US EPA16 suite);
- benzene, toluene, ethylbenzene, xylene (BTEX);
- asbestos screen.

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

### **RESULTS OF ANALYSIS**

#### **Particle Size Analysis & Stone Content**

The sample fell into the *sand* texture class and would be described as light in texture. Further detailed particle size analysis revealed the sample to have a narrow particle size distribution and a predominance of *medium sand* (0.25-0.50mm) and a lower proportion of *fine sand* (0.15-0.25mm) and *coarse sand* (0.50-1.0mm). This is acceptable for subsoil for podium or roof garden environments as porosity levels are maintained under a degree of consolidation and the risk of particle interpacking is minimised.

With the exception of 'leca' particles, the sample was free of 'stone' sized material (>2mm).

### **Bulk Density and Saturated Hydraulic Conductivity**

The sample displayed slightly lower bulk density values compared to those typically recorded for the base material without the addition of leca. The suitability of the bulk density results for the requirements of the recipient site should be confirmed by the project engineer.

The saturated hydraulic conductivity of the sample was very high (433 mm/hour) and would be described as 'very free-draining'. The appropriateness of this drainage rate will depend on the specifics of any particular roof garden design (e.g. overall soil depths, topsoil media performance, plant species selection, irrigation provision, environmental conditions).

### **pH and Electrical Conductivity Values**

The sample was strongly alkaline in reaction (pH 8.6). This pH value would be considered suitable as subsoil for general landscape purposes providing species with a wide pH tolerance or those known to prefer alkaline soils are selected for planting, turfing and seeding.

The electrical conductivity (salinity) values (water and CaSO<sub>4</sub> extracts) were low, which indicates that soluble salts should not be present at levels that would be harmful to plants.

### **Organic Matter**

The organic matter content was low (<0.5%).

### **Potential Contaminants**

In the absence of site-specific criteria, the concentrations that affect human health have been assessed for *residential with homegrown produce* end-use against 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 for Assessment of Land Affected by Contamination – Policy Companion Document (2014).

Of the potential contaminants determined, none was found at levels that exceed their guideline values.

### **Phytotoxic Contaminants**

Of the phytotoxic (toxic to plants) contaminants determined (copper, nickel, zinc), none was found at levels that exceeded their guideline values.

## **CONCLUSION**

The purpose of the analysis was to determine the suitability of the material for use as a lightweight subsoil for landscaping purposes in a podium or rooftop garden environment.

From the soil examination and laboratory analysis, the soil represented by this sample was described as a strongly alkaline, non-saline, slightly calcareous sand with a single grained structure and low stone content with leca particles. The sample possessed a very high saturated hydraulic conductivity value and low organic matter content. Of the potential contaminants determined, none exceeded their respective guideline values.

Based on our findings, the substrate represented by this sample should be suitable for use as a lightweight subsoil in a roof garden environment where a free-draining subsoil is required. The suitability of the bulk density and saturated hydraulic conductivity results should be confirmed by the project engineer and landscape designer.

### **Soil Handling Recommendations**

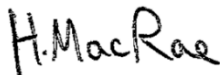
It is important to maintain the physical condition of the soil and avoid structural damage during all phases of soil handling (e.g. stockpiling, respreading, cultivating, planting, seeding or turfing). As a consequence, soil handling operations should be carried out when soil is reasonably dry and non-plastic (friable) in consistency.

It is important to ensure that the soil is not unnecessarily compacted by trampling or trafficking by site machinery, and soil handling should be stopped during and after heavy rainfall and not continued until the soil is friable in consistency. If the soil is structurally damaged and compacted at any stage during the course of soiling or landscaping works, it should be cultivated appropriately to relieve the compaction and to restore the soil's structure prior to any planting, turfing or seeding.

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We hope this report meets with your approval and provides the necessary information. Please do not hesitate to contact the undersigned if we can be of further assistance.

Yours faithfully



**Harriet MacRae**  
BSc MSc  
Graduate Soil Scientist



**Matthew Heins**  
BSc (Hons) MISOilSci  
Senior Soil Scientist

For & on behalf of Tim O'Hare Associates LLP



Client:	Boughton Loam Limited
Project:	Lightweight Subsoil
Job:	Subsoil Analysis
Date:	21/02/2023
Job Ref No:	TOHA/23/7816/SS

Sample Reference		Accreditation
Clay (<0.002mm)	%	UKAS
Silt (0.002-0.063mm)	%	UKAS
Very Fine Sand (0.05-0.15mm)	%	UKAS
Fine Sand (0.15-0.25mm)	%	UKAS
Medium Sand (0.25-0.50mm)	%	UKAS
Coarse Sand (0.50-1.0mm)	%	UKAS
Very Coarse Sand (1.0-2.0mm)	%	UKAS
Total Sand (0.05-2.0mm)		UKAS
Texture Class (UK Classification)	--	UKAS
Stones (2-20mm)	% DW	UKAS
Stones (20-75mm)	% DW	UKAS
Stones (>75mm)	% DW	UKAS

Bulk Density (at Saturation)	mg/cm <sup>3</sup>	A2LA
Bulk Density (as Received)	mg/cm <sup>3</sup>	A2LA
Saturated Hydraulic Conductivity	mm/hr	A2LA

pH Value (1:2.5 water extract)	units	UKAS
Electrical Conductivity (1:2.5 water extract)	uS/cm	UKAS
Electrical Conductivity (1:2 CaSO <sub>4</sub> extract)	uS/cm	UKAS
Exchangeable Sodium Percentage	%	UKAS
Organic Matter (LOI)	%	UKAS

Total Arsenic (As)	mg/kg	MCERTS
Total Cadmium (Cd)	mg/kg	MCERTS
Total Chromium (Cr)	mg/kg	MCERTS
Hexavalent Chromium (Cr VI)	mg/kg	MCERTS
Total Copper (Cu)	mg/kg	MCERTS
Total Lead (Pb)	mg/kg	MCERTS
Total Mercury (Hg)	mg/kg	MCERTS
Total Nickel (Ni)	mg/kg	MCERTS
Total Selenium (Se)	mg/kg	MCERTS
Total Zinc (Zn)	mg/kg	MCERTS
Water Soluble Boron (B)	mg/kg	MCERTS
Total Cyanide (CN)	mg/kg	MCERTS
Total (mono) Phenols	mg/kg	MCERTS

Naphthalene	mg/kg	MCERTS
Acenaphthylene	mg/kg	MCERTS
Acenaphthene	mg/kg	MCERTS
Fluorene	mg/kg	MCERTS
Phenanthrene	mg/kg	MCERTS
Anthracene	mg/kg	MCERTS
Fluoranthene	mg/kg	MCERTS
Pvrene	mg/kg	MCERTS
Benzo(a)anthracene	mg/kg	MCERTS
Chrysene	mg/kg	MCERTS
Benzo(b)fluoranthene	mg/kg	MCERTS
Benzo(k)fluoranthene	mg/kg	MCERTS
Benzo(a)pyrene	mg/kg	MCERTS
Indeno(1,2,3-cd)pyrene	mg/kg	MCERTS
Dibenzo(a,h)anthracene	mg/kg	MCERTS
Benzo(g,h,i)perylene	mg/kg	MCERTS
Total PAHs (sum USEPA16)	mg/kg	MCERTS

Aliphatic TPH >C5 - C6	mg/kg	MCERTS
Aliphatic TPH >C6 - C8	mg/kg	MCERTS
Aliphatic TPH >C8 - C10	mg/kg	MCERTS
Aliphatic TPH >C10 - C12	mg/kg	MCERTS
Aliphatic TPH >C12 - C16	mg/kg	MCERTS
Aliphatic TPH >C16 - C21	mg/kg	MCERTS
Aliphatic TPH >C21 - C35	mg/kg	MCERTS
Aliphatic TPH (C5 - C35)	mg/kg	MCERTS
Aromatic TPH >C5 - C7	mg/kg	MCERTS
Aromatic TPH >C7 - C8	mg/kg	MCERTS
Aromatic TPH >C8 - C10	mg/kg	MCERTS
Aromatic TPH >C10 - C12	mg/kg	MCERTS
Aromatic TPH >C12 - C16	mg/kg	MCERTS
Aromatic TPH >C16 - C21	mg/kg	MCERTS
Aromatic TPH >C21 - C35	mg/kg	MCERTS
Aromatic TPH (C5 - C35)	mg/kg	MCERTS

Benzene	mg/kg	MCERTS
Toluene	mg/kg	MCERTS
Ethylbenzene	mg/kg	MCERTS
p & m-xylene	mg/kg	MCERTS
o-xylene	mg/kg	MCERTS
MTBE (Methyl Tertiary Butyl Ether)	mg/kg	MCERTS

Asbestos Screen	ND/D	ISO 17025
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#### Visual Examination

The sample was described as a dark yellowish brown (Munsell Colour 10YR 4/6), slightly moist, friable, slightly calcareous, single grain SAND. The sample was free of stone-sized material, with the exception of lightweight expanded clay aggregate particles (leca). No deleterious materials, unusual odours, roots or rhizomes of pernicious weeds were observed.

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

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#### Lightweight Subsoil

1
0
5
16
56
21
1
99
5
0
0
0

1.81
1.61
433

8.6
175
2301
0.6
<0.5

1.9
< 0.2
< 1.8
4
7
3
< 0.3
5.4
< 1.0
14
< 0.2
< 1.0
< 1.0

< 0.05
< 0.05
< 0.05
< 0.05
< 0.05
< 0.05
< 0.05
< 0.05
< 0.05
< 0.05
< 0.05
< 0.1
<.01
< 0.05
< 0.05
< 0.05
< 0.05
< 0.05
< 0.80

< 0.001
< 0.001
< 0.001
< 1.0
< 2.0
< 8.0
< 8.0
< 10
< 0.001
< 0.001
< 0.001
< 1.0
< 2.0
< 10
< 10
< 10

< 0.005
< 0.005
< 0.005
< 0.005
< 0.005
< 0.005

Not-detected
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H. MacRae

Harriet MacRae  
BSc MSc  
Graduate Soil Scientist