TIM O'HARE ASSOCIATES
SOIL & LANDSCAPE CONSULTANCY

Jonathan Bourne
Bourne Amenity Ltd
The Wharf
Rye Road
Newenden
Kent, TN18 5QG

22nd February 2023
Our Ref: TOHA/23/7818/1/SS
Your Ref: PO 114359

Dear Sirs

Soil Analysis Report: Bioretention Soil (South)

We have completed the analysis of the sample recently submitted, referenced *Bioretention Soil (South)*, and have pleasure reporting our findings.

INTRODUCTION

The purpose of the analysis was to determine the suitability of the sample for use as a bioretention soil. "Bioretention systems", including raingardens and swales, are shallow landscaped depressions that reduce run-off and treat pollution through the use of engineered soils and the vegetation that the soils support. In doing so they are a key element of many Sustainable Drainage Systems (SuDS).

A bioretention system usually has several components including a vegetation layer, a filter medium, a transition layer and a drainage layer, together with inlets, outlets and pipework. The *bioretention soil* represented by this sample is to be used as the "Filter Medium" of a bioretention system. The purpose of this analysis was therefore to determine the suitability of the sample for this use.

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, waste designation purposes, or for any project-specific applications, especially after the soil has left the Bourne Amenity Ltd site.

SAMPLE EXAMINATION

The sample was described as a brownish yellow (Munsell Colour 10YR 6/6), slightly moist, friable, non-calcareous SAND with a single grain structure. The sample was stone free and contained a low proportion of organic fines and occasional woody fragments. No deleterious materials, unusual odours, roots or rhizomes of pernicious weeds were observed.

Plate 1: Bioretention Soil (South) 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, performance and fertility of the soil. The following parameters were determined:

- detailed particle size analysis (5 sands, silt, clay);
- saturated hydraulic conductivity and porosity;
- pH and electrical conductivity values;
- calcium carbonate;
- exchangeable sodium percentage;
- major plant nutrients (N, P, K, Mg);
- organic matter content;
- C:N ratio;
- visible contaminants (>2mm);
- heavy metals (Sb, As, B, Ba, Be, Cd, Cr, Cu, Pb, Hg, Ni, Se, V, Zn);
- total cyanide and total (mono) phenols;
- elemental sulphur, acid volatile sulphur and water soluble sulphate;
- speciated PAHs (US EPA16 suite);
- aromatic and aliphatic TPH (C5-C35 banding);
- 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.

In the absence of site-specific assessment criteria, the concentrations of potential contaminants that affect human health have been compared with the *residential with homegrown 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). Levels of phytotoxic metals determined (Cu, Ni, Zn) have also been compared against threshold values indicated in *BS3882:2015 Specification for Topsoil*.

COMMENTS

A bioretention filter medium is normally sand-based with some source of organic matter and slow-release plant nutrients to maintain healthy plant growth, filter out pollutants and control the rate at which water filters through the system, which is a key influence on the effectiveness. The material should be sufficiently permeable and porous to allow water to be infiltrated, attenuated and drained through it so that the surface does not become waterlogged. It also needs to contain sufficient organic matter and plant nutrients to support the vegetation layer.

From the examination and laboratory analysis, the sample was described as a strongly alkaline, non-saline, non-calcareous sand. The sample was stone free and contained moderate reserves of organic matter and most major plant nutrients. The grading of this sample is largely within the desirable range, and the saturated hydraulic conductivity result is what would be expected for a bioretention soil. Of the potential contaminants determined, none exceeded their respective guideline values.

The sample was strongly alkaline in reaction (pH 8.7) with a low calcium carbonate (lime) content. Therefore, the high pH recorded is likely to be due to the very low buffering capacity of the material as a result of its very high sand content. As such, this pH value should not significantly restrict species selection, provided species are reasonably tolerant of alkaline soils.

The nutrient levels are largely acceptable for this specific end-use, although the total nitrogen level is slightly lower than what would be considered ideal. As such, application of an appropriate slow-release fertiliser is recommended at the time of planting. Furthermore, the high sand content of this type of material will increase risk of nutrient leaching over time and so incorporation of a suitable mineral soil conditioner (e.g. TerraCottem) is recommended to support nutrient retention in the longer term.

It is noted that the organic matter content is at the upper end of the range considered appropriate for this type of material. Migration of organic fines could potentially lead to a slight reduction in drainage performance over time.

Soil Handling Recommendations

It is important to maintain the physical condition of the soil and avoid physical degradation during all phases of soil handling (e.g. stockpiling, respreading, cultivating, planting or seeding). As a consequence, soil handling operations should not be carried out in wet conditions.

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 compacted at any stage during the course of soiling or landscaping works, it should be cultivated appropriately to relieve the compaction prior to any planting or seeding.

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 and on behalf of Tim O'Hare Associates LLP

TIM O'HARE ASSOCIATES
SOIL & LANDSCAPE CONSULTANCY

Client:	**Bourne Amenity Limited**
Project:	**Bioretention Soil (South)**
Job:	**Physical and Horticultural Properties**
Date:	**22/02/2023**
Job Ref No:	**TOHA/23/7818/1/SS**

Sample Reference			**Bioretention Soil (South)**
		Accreditation	
Clay (<0.002mm)	%	UKAS	2
Silt (0.002-0.05mm)	%	UKAS	1
Very Fine Sand (0.05-0.15mm)	%	UKAS	2
Fine Sand (0.15-0.25mm)	%	UKAS	9
Medium Sand (0.25-0.50mm)	%	UKAS	53
Coarse Sand (0.50-1.0mm)	%	UKAS	27
Very Coarse Sand (1.0-2.0mm)	%	UKAS	6
Total Sand (0.05-1.0mm)	%	UKAS	97
Texture Class (UK Classification)	--	UKAS	S
Stones (2-20mm)	% DW	GLP	0
Stones (20-50mm)	% DW	GLP	0
Stones (>50mm)	% DW	GLP	0
Saturated Hydraulic Conductivity	mm/hr	A2LA	146
Total Porosity	%	A2LA	47
Air-filled Porosity	%	A2LA	27
Water-filled Porosity	%	A2LA	20
pH Value (1:2.5 water extract)	units	UKAS	8.7
Calcium Carbonate	%	UKAS	< 1.0
Electrical Conductivity (1:2.5 water extract)	uS/cm	UKAS	717
Electrical Conductivity (1:2 $CaSO_4$ extract)	uS/cm	UKAS	2701
Exchangeable Sodium Percentage	%	UKAS	4.5
Organic Matter (LOI)	%	UKAS	3.5
Total Nitrogen (Dumas)	%	UKAS	0.10
C : N Ratio	ratio	UKAS	21
Extractable Phosphorus	mg/l	UKAS	24
Extractable Potassium	mg/l	UKAS	677
Extractable Magnesium	mg/l	UKAS	91
Visible Contaminants: Plastics >2.00mm	%	UKAS	0
Visible Contaminants: Sharps >2.00mm	%	UKAS	0

S = SAND

Visual Examination

The sample was described as a brownish yellow (Munsell Colour 10YR 6/6), slightly moist, friable, non-calcareous SAND with a single grain structure. The sample was stone free and contained a low proportion of organic fines and occasional woody fragments. No deleterious materials, unusual odours, roots or rhizomes of pernicious weeds were observed.

H.MacRae

Harriet MacRae
BSc MSc
Graduate Soil Scientist

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

TIM O'HARE ASSOCIATES
SOIL & LANDSCAPE CONSULTANCY

Client:	**Bourne Amenity Limited**
Project:	**Bioretention Soil (South)**
Job:	**Chemical Properties**
Date:	**22/02/2023**
Job Ref No:	**TOHA/23/7818/1/SS**

Sample Reference			**Bioretention Soil (South)**
		Accreditation	
Total Antimony (Sb)	mg/kg	MCERTS	1
Total Arsenic (As)	mg/kg	MCERTS	7
Total Barium (Ba)	mg/kg	MCERTS	8
Total Beryllium (Be)	mg/kg	MCERTS	0.22
Total Cadmium (Cd)	mg/kg	MCERTS	< 0.2
Total Chromium (Cr)	mg/kg	MCERTS	11
Hexavalent Chromium (Cr VI)	mg/kg	MCERTS	< 1.8
Total Copper (Cu)	mg/kg	MCERTS	7
Total Lead (Pb)	mg/kg	MCERTS	8
Total Mercury (Hg)	mg/kg	MCERTS	< 0.3
Total Nickel (Ni)	mg/kg	MCERTS	9
Total Selenium (Se)	mg/kg	MCERTS	< 1.0
Total Vanadium (V)	mg/kg	MCERTS	27
Total Zinc (Zn)	mg/kg	MCERTS	23
Water Soluble Boron (B)	mg/kg	MCERTS	0.7
Total Cyanide (CN)	mg/kg	MCERTS	< 1.0
Total (mono) Phenols	mg/kg	MCERTS	< 1.0
Elemental Sulphur	mg/kg	MCERTS	< 5.0
Water Soluble Sulphate (SO4)	g/l	MCERTS	1.7
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	< 0.005
Toluene	mg/kg	MCERTS	< 0.005
Ethylbenzene	mg/kg	MCERTS	< 0.005
p & m-xylene	mg/kg	MCERTS	< 0.005
o-xylene	mg/kg	MCERTS	< 0.005
MTBE (Methyl Tertiary Butyl Ether)	mg/kg	MCERTS	< 0.005
Asbestos Screen	ND/D	ISO 17025	Not-detected

H.MacRae

Harriet MacRae
BSc MSc
Graduate Soil Scientist