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SOIL & LANDSCAPE CONSULTANCY

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13th April 2023
Our Ref: TOHA/23/7891/2/SS
Your Ref: PO 114361

Dear Sirs

Subsoil Analysis Report: WH Subsoil

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

The purpose of the analysis was to determine the suitability of the sample for use as subsoil for general landscape purposes (trees, shrubs, amenity grass). In addition, this sample has been assessed to determine its compliance with the requirements of the British Standard for Subsoil *(BS8601:2013 – Specification for subsoil and requirements for use – Table 1, Multipurpose Subsoil),* including analysis of potential contaminants.

This report presents the results of analysis for the sample submitted, and it should be considered 'indicative' of the subsoil 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 application, especially after the subsoil has left the Bourne Amenity site.

SAMPLE EXAMINATION

The sample was described as a yellowish brown (Munsell Colour 10YR 5/6), slightly moist, friable, non-calcareous SAND with a single grain structure. The sample was stone-free and no unusual odours, deleterious materials, roots or rhizomes of pernicious weeds were observed.

Plate 1: WH 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, 20-50mm, >50mm);
- saturated hydraulic conductivity;
- pH and electrical conductivity values;
- calcium carbonate;
- exchangeable sodium percentage;
- organic matter content;
- visible contaminants (>2mm);
- heavy metals (Sb, As, B, Ba, Be, Cd, Cr, Cr(VI), 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.

RESULTS OF ANALYSIS

Particle Size Analysis and Stone Content

The sample fell into the *sand* texture class. 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 lower proportion of *fine sand* (0.15-0.25mm) and *coarse sand* (0.50-1.0mm). This is acceptable for subsoil in general landscape applications as porosity levels are maintained in a compacted state and the risk of particle interpacking is minimised. However, such soils can possess poor water retention capacities and as a consequence they often have a greater risk of drought, particularly during prolonged dry periods.

The sample was stone-free and, as such, stones should not restrict the use of the soil for use as subsoil in general landscape purposes.

Saturated Hydraulic Conductivity

The saturated hydraulic conductivity result (100 mm/hr) recorded for the sample is moderate and would be considered suitable for a general landscape subsoil.

pH and Electrical Conductivity Values

The sample was strongly alkaline in reaction (pH 8.3) 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 high sand and very low organic matter contents. As such, this pH value should not restrict the use of the subsoil for general landscape purposes.

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

The electrical conductivity value by $CaSO_4$ extract (*BS8601* requirement) fell below the maximum specified value (2800 µS/cm) given in *BS8601:2013 – Table 1*.

Organic Matter Content

The organic matter content was low (0.5%) and compliant with *BS8601:2013 – Table 1*.

Potential Contaminants

With reference to *BS8601:2013 – Section 4.2: Note 2*, there is a requirement to confirm levels of potential contaminants in relation to the subsoil'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 of selected potential contaminants that affect human health have been assessed for the concentrations that affect human health have been assessed for *residential* 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 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 *BS8601:2013 – Table 1*.

CONCLUSION

The purpose of the analysis was to determine the suitability of the sample for use as subsoil in general landscape purposes (trees, shrubs, amenity grass). In addition, this sample has been assessed to determine its compliance with the requirements of the British Standard for Subsoil *(BS8601:2013 – Specification for subsoil and requirements for use – Table 1, Multipurpose Subsoil),* including analysis of potential contaminants.

From the soil examination and subsequent laboratory analysis, the sample was described as a strongly alkaline non-saline, non-calcareous, stone free sand with a single grain structure. The organic matter content was low

and consistent with subsoil. Of the potential contaminants determined, none exceeded their respective guideline values.

To conclude, based on our findings, the subsoil represented by this sample would be considered suitable landscape applications where a free-draining subsoil is required or where there will be a low drought risk.

The sample was largely compliant with the requirements of the British Standard for Subsoil *(BS8601:2013 – Specification for subsoil and requirements for use – Table 1, Multipurpose Subsoil)* with the exception of the high sand content. On this occasion, this non-compliance is considered minor provided the landscape application proposed for this subsoil requires a free-draining subsoil.

Soil Handling Recommendations

Reference should be made to Section 6.0 of *BS8601:2013* with regard to the handling and management of the subsoil:

"Soils generally lose strength and become less resistant to damage as they become wetter; therefore, it is essential that they are stripped, handled and trafficked only in the appropriate conditions of weather and soil moisture, and with suitable machinery. If sustained heavy rainfall (e.g. >10 mm in 24 h) occurs during soil stripping operations, work should be suspended and not restarted until the ground has had at least one dry day or until a suitable moisture content has been reached. A soil can be considered to have a suitable moisture content for stripping and handling if the whole thickness of the subsoil layer being stripped and/or handled is at a moisture content below the plastic limit as determined in accordance with BS 1377-2:1990 (incorporating Amendment No. 1).

Machinery should be selected and routed to minimise soil compaction."

Further guidance is provided in Clauses 6.1–6.5.

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

H.MacRae

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For & on behalf of Tim O'Hare Associates LLP

TIM O'HARE ASSOCIATES
SOIL & LANDSCAPE CONSULTANCY

Client:	**Bourne Amenity Ltd**
Project:	**WH Subsoil**
Job:	**Subsoil Analysis (BS8601:2013)**
Date:	**13/04/2023**
Job Ref No:	**TOHA/23/7891/2/SS**

Sample Reference			**WH Subsoil**
		Accreditation	
Clay (<0.002mm)	%	UKAS	6
Silt (0.002-0.05mm)	%	UKAS	2
Very Fine Sand (0.05-0.15mm)	%	UKAS	5
Fine Sand (0.15-0.25mm)	%	UKAS	12
Medium Sand (0.25-0.50mm)	%	UKAS	51
Coarse Sand (0.50-1.0mm)	%	UKAS	18
Very Coarse Sand (1.0-2.0mm)	%	UKAS	6
Total Sand (0.002 - 2.0mm)	%	UKAS	92
Texture Class (UK Classification)	--	UKAS	S
Stones (2-20mm)	% DW	GLP	0
Stones (20-50mm)	% DW	GLP	0
Stones (>50mm)	% DW	GLP	0
Visible Contaminants: Plastics >2.00mm	%	UKAS	0
Visible Contaminants: Sharps >2.00mm	%	UKAS	0
Saturated Hydraulic Conductivity	mm/hr	A2LA	100
pH Value (1:2.5 water extract)	units	UKAS	8.3
Calcium Carbonate	%	UKAS	< 1.0
Electrical Conductivity (1:2.5 water extract)	uS/cm	UKAS	112
Electrical Conductivity (1:2 $CaSO_4$ extract)	uS/cm	UKAS	2079
Exchangeable Sodium Percentage	%	UKAS	0.9
Organic Matter (LOI)	%	UKAS	0.5
Total Antimony (Sb)	mg/kg	MCERTS	< 1.0
Total Arsenic (As)	mg/kg	MCERTS	9
Total Barium (Ba)	mg/kg	MCERTS	13
Total Beryllium (Be)	mg/kg	MCERTS	0.26
Total Cadmium (Cd)	mg/kg	MCERTS	< 0.2
Total Chromium (Cr)	mg/kg	MCERTS	16
Hexavalent Chromium (Cr VI)	mg/kg	MCERTS	< 1.8
Total Copper (Cu)	mg/kg	MCERTS	4
Total Lead (Pb)	mg/kg	MCERTS	3
Total Mercury (Hg)	mg/kg	MCERTS	< 0.3
Total Nickel (Ni)	mg/kg	MCERTS	11
Total Selenium (Se)	mg/kg	MCERTS	< 1.0
Total Vanadium (V)	mg/kg	MCERTS	32
Total Zinc (Zn)	mg/kg	MCERTS	15
Water Soluble Boron (B)	mg/kg	MCERTS	< 0.2
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 (SO_4)	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

S = SAND

Visual Examination

The sample was described as a yellowish brown (Munsell Colour 10YR 5/6), slightly moist, friable, non-calcareous SAND with a single grain structure. The sample was stone-free and no unusual odours, deleterious materials, roots or rhizomes of pernicious weeds were observed.

H.MacRae

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