TIM O'HARE ASSOCIATES
SOIL & LANDSCAPE CONSULTANCY

Mr Trevor Parsons
Parsons Landscapes Limited
Dairy House Farm
Stoke St Mary
Taunton
Somerset TA3 5BY

30th August 2017
Our Ref: TOHA/17/7283/SS
Your Ref: see below

Dear Sirs

Topsoil Analysis Report: Cranbrook, Exeter

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

The purpose of the analysis was to determine the suitability of the sample 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 Topsoil *(BS3882:2015 – Specification for Topsoil – Table 1, Multipurpose Topsoil).*

This report presents the results of analysis for the sample submitted to our office, and it should be considered 'indicative' of the topsoil source. The report and results should therefore not be used by third parties as a means of verification or validation testing.

SAMPLE EXAMINATION

The sample was described as a dark brown (Munsell Colour 10YR 3/3), slightly moist, slightly plastic, non-calcareous CLAY LOAM with a moderately developed, fine to coarse granular structure*. The sample was virtually stone-free and no unusual odours, deleterious materials, roots or rhizomes of pernicious weeds were observed.

*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 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:

- particle size analysis (sand, silt, clay);
- stone content (>2mm, >20mm, >50mm);
- permeability;
- pH value;
- electrical conductivity values (water and $CaSO_4$ extracts);
- exchangeable sodium percentage;
- organic matter content;
- C:N ratio;
- heavy metals (As, B, Cd, Cr, Cu, Pb, Hg, Ni, Se, Zn);
- total cyanide and total (mono) phenols;
- speciated PAHs (US EPA16 suite);
- aromatic and aliphatic TPH (C5-C35 banding);
- benzene, toluene, ethylbenzene, xylene (BTEX).

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 *heavy clay loam* texture class. Such soils usually have good water and nutrient retention capacities, but after disturbance and reinstatement they tend to be slow-draining and can suffer from seasonal waterlogging following periods of prolonged or heavy rainfall. They are also prone to structural degradation and compaction during handling, and especially when plastic in consistency. Any damage to the structural condition of this soil is likely to further reduce its drainage and aeration properties.

This texture class may be considered suitable for general landscape applications, including trees and shrubs and amenity grass, provided the physical condition of the soil is maintained and provided species tolerant of moisture retentive soil are selected. The soil would not be ideally suited to more demanding planting environments or plant species that require or prefer light or free-draining soil. In addition, smaller plant stock, such as whips and transplants, would be more suited than containerised or rootballed stock, as they tend to be more tolerant of adverse soil conditions.

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

Permeability

The permeability of the sample was 28 mm/hr and may be considered acceptable for general landscape purposes.

pH and Electrical Conductivity Values

The sample was acid in reaction (pH 5.5), with a pH value that would be suitable for general landscape purposes and in particular acid-loving species (calcifuges). This pH value is unlikely to be suitable for species known to specifically require or prefer less acid soil, and in this instance the soil would benefit from further amelioration to raise its pH (e.g. lime application).

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 (*BS3882* requirement) fell below the maximum specified value (3300 µS/cm) given in *BS3882:2015 – Table 1*.

Organic Matter and Fertility Status

The sample was adequately supplied with organic matter and most major plant nutrients.

The recorded level of extractable potassium (74 mg/l) was low and fell below the minimum permissible value given in *BS3882:2015 – Table 1* (121 mg/l). This deficiency can be addressed by a routine fertiliser application.

The C:N ratio of the sample was low and acceptable for general landscape purposes.

Potential Contaminants

With reference to *BS3882:2015 - Table 1*: Notes 3 and 4, there is a requirement 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 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).

Of the potential contaminants determined, none was found at levels that exceeded their 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 sample 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 Topsoil *(BS3882:2015 – Specification for Topsoil – Table 1, Multipurpose Topsoil).*

From the soil examination and laboratory analysis, the sample was described as an acid, non-calcareous, non-saline, virtually stone free heavy clay loam with a moderate structure. The sample contained sufficient reserves of organic matter and most major plant nutrients, with a deficiency in extractable potassium. Of the potential contaminants determined, none was found at levels that exceeded their guideline values.

Based on our findings, the topsoil represented by this sample would be suitable for general landscape applications (tree and shrub planting, native transplants and amenity grass (low foot traffic only)), provided the following conditions are met:

- the physical condition of the soil is maintained;
- plant species tolerant of moisture retentive soil are selected;
- acid-loving plant species are selected or lime is applied if required;
- the extractable potassium deficiency is addressed.

To minimise the risk of self-compaction and anaerobism, we recommend that this soil is placed to a maximum depth of **300mm**.

The sample was largely compliant with the requirements of the British Standard for Topsoil *(BS3882:2015 – Specification for Topsoil – Table 1, Multipurpose Topsoil)* with the exception of the extractable potassium deficiency. On this occasion, this non-compliance is considered minor when reviewed in the context of all the other results, provided the deficiency is addressed with a routine fertiliser application.

RECOMMENDATIONS

Fertiliser for Planting

To address the extractable potassium deficiency and to help promote effective plant establishment, we recommend applying and incorporating the compound, slow release fertiliser *ICL Enmag CRF* (11%N:21%P_2O_5:9%K_2O:6%MgO) at a rate of 70 g/m^2 and to a depth of 200mm.

Fertiliser for Amenity Grass Establishment

To address the extractable potassium deficiency and to help promote effective grass establishment, we recommend applying and incorporating the pre-seeding grass fertiliser *ICL Sportsmaster Pre-seeder* (8%N:12%P_2O_5:8%K_2O+3%MgO) prior to seeding or turfing at a rate of 35 g/m^2 and to a depth of 100mm.

Lime Application *(if needed)*

Liming is routinely used to raise the pH of inherently acid soil to a more suitable level. A pH value of 6.5 is typically sought after for most plants. We recommend incorporating agricultural grade crushed limestone or chalk at the rate of **400 g/m^2**, and incorporating evenly to a depth of 200mm.

Soil Handling Recommendations

The heavy texture of this soil will make it particularly vulnerable to physical degradation (compaction) during all phases of soiling and landscape works. It is important to ensure that the soil is not unnecessarily compacted by trampling or trafficking, and soil handling should be stopped during and after heavy rainfall, and not continued until the soil has returned to a friable state. If this soil is damaged its potential for re-use will be limited. Therefore, to maintain the physical condition of the soil and avoid structural damage, all phases of soil handling operations (e.g. stockpiling, respreading, cultivating, and planting, seeding or turfing) should only be carried out when the soil is reasonably dry and non-plastic (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.

Further details on soil handling are provided in Annex A of *BS3882:2015.*

Further guidance on the management, preparation and handling of soils is provided in the DEFRA publication *Construction code of practice for the sustainable use of soils on construction sites*, 2009.

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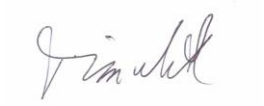
We hope this report meets with your approval and provides the necessary information. Please do not hesitate to contact the undersigned if we can be of further assistance.

Yours faithfully



Rebecca Hollands
BSc MSc AMIAgrE
Soil Scientist

Tim White
BSc MSc MISoilSci CSci
Senior Associate

For & on behalf of Tim O'Hare Associates LLP

TIM O'HARE ASSOCIATES
SOIL & LANDSCAPE CONSULTANCY

Client:	**Parsons Landscapes Limited**
Project	**Cranbrook, Exeter**
Job:	**Topsoil Analysis**
Date:	**30/08/2017**
Job Ref No:	**TOHA/17/7283/SS**

Sample Reference			**Cranbrook Topsoil**
		Accreditation	
Clay (<0.002mm)	%	UKAS	33
Silt (0.002-0.063mm)	%	UKAS	35
Sand (0.063-2.0mm)	%	UKAS	32
Texture Class (UK Classification)	--	UKAS	CL
Stones (2-20mm)	% DW	GLP	1
Stones (20-50mm)	% DW	GLP	0
Stones (>50mm)	% DW	GLP	0
Falling Head Permeability (light tamp)	mm/hr	UKAS	28
pH Value (1:2.5 water extract)	units	UKAS	5.5
Electrical Conductivity (1:2.5 water extract)	uS/cm	UKAS	464
Electrical Conductivity (1:2 $CaSO_4$ extract)	uS/cm	UKAS	2263
Exchangeable Sodium Percentage	%	UKAS	0.7
Organic Matter (LOI)	%	UKAS	6.4
Total Nitrogen (Dumas)	%	UKAS	0.30
C : N Ratio	ratio	UKAS	12
Extractable Phosphorus	mg/l	UKAS	17
Extractable Potassium	mg/l	UKAS	74
Extractable Magnesium	mg/l	UKAS	98
Total Arsenic (As)	mg/kg	MCERTS	13
Total Cadmium (Cd)	mg/kg	MCERTS	< 0.2
Total Chromium (Cr)	mg/kg	MCERTS	28
Hexavalent Chromium (Cr VI)	mg/kg	MCERTS	< 4.0
Total Copper (Cu)	mg/kg	MCERTS	24
Total Lead (Pb)	mg/kg	MCERTS	72
Total Mercury (Hg)	mg/kg	MCERTS	< 0.3
Total Nickel (Ni)	mg/kg	MCERTS	16
Total Selenium (Se)	mg/kg	MCERTS	< 1.0
Total Zinc (Zn)	mg/kg	MCERTS	69
Water Soluble Boron (B)	mg/kg	MCERTS	1.1
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	0.31
Anthracene	mg/kg	MCERTS	0.10
Fluoranthene	mg/kg	MCERTS	0.39
Pyrene	mg/kg	MCERTS	0.37
Benzo(a)anthracene	mg/kg	MCERTS	0.22
Chrysene	mg/kg	MCERTS	0.18
Benzo(b)fluoranthene	mg/kg	MCERTS	0.24
Benzo(k)fluoranthene	mg/kg	MCERTS	0.14
Benzo(a)pyrene	mg/kg	MCERTS	0.25
Indeno(1,2,3-cd)pyrene	mg/kg	MCERTS	0.52
Dibenzo(a,h)anthracene	mg/kg	MCERTS	0.15
Benzo(g,h,i)perylene	mg/kg	MCERTS	0.52
Total PAHs (sum USEPA16)	mg/kg	MCERTS	3.39
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	< 10.0
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	< 10.0
Aromatic TPH >C21 - C35	mg/kg	MCERTS	< 10.0
Aromatic TPH (C5 - C35)	mg/kg	MCERTS	< 10.0
Benzene	mg/kg	MCERTS	< 0.001
Toluene	mg/kg	MCERTS	< 0.001
Ethylbenzene	mg/kg	MCERTS	< 0.001
p & m-xylene	mg/kg	MCERTS	< 0.001
o-xylene	mg/kg	MCERTS	< 0.001
MTBE (Methyl Tertiary Butyl Ether)	mg/kg	MCERTS	< 0.001

CL = CLAY LOAM

Visual Examination

The sample was described as a dark brown (Munsell Colour 10YR 3/3), slightly moist, slightly plastic, non-calcareous CLAY LOAM with a moderately developed, fine to coarse granular structure. The sample was virtually stone-free and no unusual odours, deleterious materials, roots or rhizomes of pernicious weeds were observed.

Rebecca Hollands
BSc MSc AMIAgrE
Soil Scientist

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