

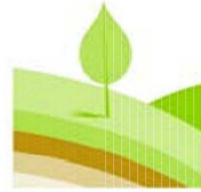


TIM O'HARE ASSOCIATES
SOIL & LANDSCAPE CONSULTANCY

Trial Hole Record

Client: English Heritage
Site: Marble Hill Park
Job: Soil Resource Survey
Date: November 2016
Our Ref: TOHA/16/3995/CS

<u>TH1 (Profile 1)</u> GL – 0.20m 0.20 – 0.70m 0.70m	P1 Topsoil P1 Subsoil No further progress	<u>TH8 (Profile 2)</u> GL – 0.06m 0.06 – 0.18m 0.18 – 1.0m	Humic Layer P2 Topsoil P2 Subsoil
<u>TH2 (Profile 1)</u> GL – 0.21m 0.21 – 0.45m 0.45m	P1 Topsoil P1 Subsoil No further progress	<u>TH9 (Profile 3)</u> GL – 0.38m 0.38 – 1.0m	P3 Topsoil P3 Subsoil
<u>TH3 (Profile 1 with Profile 3 Subsoil)</u> GL – 0.51m 0.51 – 1.0m	P1 Topsoil P3 Subsoil	<u>TH10 (Profile 3)</u> GL – 0.20m 0.20 – 1.0m	P3 Topsoil P3 Subsoil
<u>TH4 (Profile 1)</u> GL – 0.21m 0.21 – 0.38m 0.38m	P1 Topsoil P1 Subsoil No further progress	<u>TH11 (Profile 3)</u> GL – 0.39m 0.39 – 1.0m	P3 Topsoil P3 Subsoil
<u>TH5 (Profile 2)</u> GL – 0.04m 0.04 – 0.19m 0.19 – 0.40m 0.40m	Humic Layer P2 Topsoil P2 Subsoil No further progress	<u>TH12 (Profile 1 with Profile 3 Subsoil)</u> GL – 0.40m 0.40 – 1.0m	P1 Topsoil P3 Subsoil
<u>TH6 (Profile 2)</u> GL – 0.06m 0.06 – 0.18m 0.18 – 1.0m	Humic Layer P2 Topsoil P2 Subsoil	<u>TH13 (Profile 1)</u> GL – 0.28m 0.28 – 0.40m 0.40m	P1 Topsoil P1 Subsoil No further progress
<u>TH7 (Profile 2)</u> GL – 0.06m 0.06 – 0.14m 0.14 – 1.0m	Humic Layer P2 Topsoil P2 Subsoil	<u>TH14 (Profile 1)</u> GL – 0.28m 0.28 – 0.40m 0.40m	P1 Topsoil P1 Subsoil No further progress
		<u>TH15 (Profile 2)</u> GL – 0.05m 0.05 – 0.10m 0.10 – 1.0m	Humic Layer P2 Topsoil P2 Subsoil



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Trial Hole Record

Client: English Heritage
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<u>TH16 (Profile 2)</u> GL – 0.05m 0.05 – 0.22m 0.22 – 1.0m	Humic Layer P2 Topsoil P2 Subsoil	<u>TH24 (Profile 1)</u> GL – 0.32m 0.32 – 1.0m	P1 Topsoil P1 Subsoil
<u>TH17 (Profile 2)</u> GL – 0.05m 0.05 – 0.29m 0.29 – 1.0m	Humic Layer P2 Topsoil P2 Subsoil	<u>TH25 (Profile 1)</u> GL – 0.36m 0.36 – 1.0m	P1 Topsoil P1 Subsoil
<u>TH18 (Profile 2)</u> GL – 0.05m 0.05 – 0.26m 0.26 – 1.0m	Humic Layer P2 Topsoil P2 Subsoil	<u>TH26 (Profile 1)</u> GL – 0.22m 0.22 – 0.43m 0.43m	P1 Topsoil P1 Subsoil No further progress
<u>TH19 (Profile 1)</u> GL – 0.22m 0.22 – 0.60m 0.60m	P1 Topsoil P1 Subsoil No further progress	<u>TH27 (Profile 1)</u> GL – 0.39m 0.39 – 1.0m	P1 Topsoil P1 Subsoil
<u>TH20 (Profile 3)</u> GL – 0.29m 0.29 – 1.0m	P3 Topsoil P3 Subsoil	<u>TH28 (Profile 1)</u> GL – 0.36m 0.36 – 1.0m	P1 Topsoil P1 Subsoil
<u>TH21 (Profile 1 with Profile 3 Subsoil)</u> GL – 0.33m 0.33 – 1.0m	P1 Topsoil P3 Subsoil	<u>TH29 (Profile 1)</u> GL – 0.31m 0.31 – 1.0m	P1 Topsoil P1 Subsoil
<u>TH22 (Profile 1)</u> GL – 0.35m 0.35 – 0.60m 0.60m	P1 Topsoil P1 Subsoil No further progress	<u>TH30 (Profile 1)</u> GL – 0.23m 0.23 – 1.0m	P1 Topsoil P1 Subsoil
<u>TH23 (Profile 1)</u> GL – 0.23m 0.23 – 0.70m 0.70m	P1 Topsoil P1 Subsoil No further progress	<u>TH31 (Profile 1)</u> GL – 0.34m 0.34 – 1.0m	P1 Topsoil P1 Subsoil
		<u>TH32 (Profile 1)</u> GL – 0.36m 0.36 – 0.40m 0.40m	P1 Topsoil P1 Subsoil No further progress

Appendix 3

Laboratory Analysis Results



Client:	English Heritage
Project:	Marble Hill Park, Twickenham
Job:	Soil Resource Survey
Soil Type:	Topsoil
Date:	November 2016
Job Ref No:	TOHA/16/3995/CS

Sample Reference	Soil Type	Accreditation
Clay (<0.002mm)	%	UKAS
Silt (0.002-0.063mm)	%	UKAS
Sand (0.063-2.00mm)	%	UKAS
Texture Class (UK Classification)	--	UKAS
Stones (2-20mm)	% DW	GLP
Stones (20-50mm)	% DW	GLP
Stones (>50mm)	% DW	GLP

pH Value (1:2.5 water extract)	units	UKAS
Electrical Conductivity (1:2.5 water extract)	uS/cm	UKAS
Electrical Conductivity (1:2 CaSO ₄ extract)	uS/cm	UKAS
Exchangeable Sodium Percentage	%	UKAS

Organic Matter (LOI)	%	UKAS
Total Nitrogen (Dumas)	%	UKAS
C : N Ratio	ratio	UKAS
Extractable Phosphorus	mg/l	UKAS
Extractable Potassium	mg/l	UKAS
Extractable Magnesium	mg/l	UKAS

SL = SANDY LOAM
CL = CLAY LOAM

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

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TH1+2+3	Profile 1 Topsoil
---------	-------------------

15
14
71
SL
4
7
4

5.9
64
2011
0.4

5.4
0.23
14
10
92
104

TH5+17	Profile 2 Topsoil
--------	-------------------

11
15
74
SL
4
0
0

4.9
117
2088
1.4

7.4
0.31
14
60
190
82

TH9+10+11+20	Profile 3 Topsoil
--------------	-------------------

32
27
41
CL
1
0
0

7.9
261
2102
0.4

7.6
0.36
12
14
107
76

TH12+13+14	Profile 1 Topsoil
------------	-------------------

16
17
67
SL
6
5
14

6.8
215
2079
0.4

6.8
0.31
13
13
79
69

TH19+21+23+26	Profile 1 Topsoil
---------------	-------------------

14
17
69
SL
1
2
3

7.1
232
2092
0.4

5.3
0.25
12
13
68
47

TH24+25	Profile 1 Topsoil
---------	-------------------

12
15
73
SL
4
5
0

5.5
74
2023
1.2

4.8
0.22
13
22
55
62

TH29+30+31	Profile 1 Topsoil
------------	-------------------

10
15
75
SL
1
3
0

6.3
99
2044
0.7

3.8
0.18
12
10
49
50

C. Spears
Ceri Spears
BSc MSc M/SoilSci
Senior Associate



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SOIL & LANDSCAPE CONSULTANCY

Client:	English Heritage
Project:	Marble Hill Park, Twickenham
Job:	Soil Resource Survey
Soil Type:	Topsoil
Date:	November 2016
Job Ref No:	TOHA/16/3995/CS

Sample Reference		
Soil Type		
		Accreditation
Clay (<0.002mm)	%	UKAS
Silt (0.002-0.05mm)	%	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 - 2.00mm)	%	UKAS
Texture Class (UK Classification)	--	UKAS
Stones (2-20mm)	% DW	GLP
Stones (20-50mm)	% DW	GLP
Stones (>50mm)	% DW	GLP

TH4+27+28
Profile 1 Topsoil

14
14
23
24
19
4
2
72
SL
1
0
0

pH Value (1:2.5 water extract)	units	UKAS
Electrical Conductivity (1:2.5 water extract)	uS/cm	UKAS
Electrical Conductivity (1:2 CaSO ₄ extract)	uS/cm	UKAS
Exchangeable Sodium Percentage	%	UKAS

5.0
68
2005
1

Organic Matter (LOI)	%	UKAS
Total Nitrogen (Dumas)	%	UKAS
C : N Ratio	ratio	UKAS
Extractable Phosphorus	mg/l	UKAS
Extractable Potassium	mg/l	UKAS
Extractable Magnesium	mg/l	UKAS

4.4
0.20
13
13
69
76

SL = SANDY LOAM

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Client:	English Heritage
Project:	Marble Hill Park, Twickenham
Job:	Soil Resource Survey
Soil Type:	Subsoil
Date:	November 2016
Job Ref No:	TOHA/16/3995/CS

Sample Reference	Accreditation	
Soil Type		
Clay (<0.002mm)	%	UKAS
Silt (0.002-0.063mm)	%	UKAS
Sand (0.063-2.00mm)	%	UKAS
Texture Class (UK Classification)	--	UKAS
Stones (2-20mm)	% DW	GLP
Stones (20-50mm)	% DW	GLP
Stones (>50mm)	% DW	GLP

pH Value (1:2.5 water extract)	units	UKAS
Electrical Conductivity (1:2.5 water extract)	uS/cm	UKAS
Organic Matter (LOI)	%	UKAS

SL = SANDY LOAM
CL = CLAY LOAM
C = CLAY

TH1+2+4	TH3	TH9+12	TH10+11+20	TH21	TH23+25	TH24+27+28	TH29+30	TH31
Profile 1 Subsoil	Profile 3 Subsoil	Profile 3 Subsoil	Profile 3 Subsoil	Profile 3 Subsoil	Profile 1 Subsoil	Profile 1 Subsoil	Profile 1 Subsoil	Profile 1 Subsoil
13	24	34	42	29	19	16	13	12
14	27	29	37	27	25	20	21	18
73	49	37	21	44	56	64	66	70
SL	CL	CL	C	CL	SCL	SL	SL	SL
3	1	1	1	0	5	1	1	0
0	0	0	0	0	2	0	0	1
0	0	0	0	0	0	0	0	0
5.5	6.7	7.9	8.3	8.4	7.9	6.4	6.6	6.3
56	52	159	175	135	169	56	58	57
3.1	3.2	2.7	3.3	2.1	2.2	2.0	2.1	1.8

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Client:	English Heritage
Project:	Marble Hill Park, Twickenham
Job:	Soil Resource Survey
Soil Type:	Subsoil
Date:	November 2016
Job Ref No:	TOHA/16/3995/CS

Sample Reference		
Soil Type		
		Accreditation
Clay (<0.002mm)	%	UKAS
Silt (0.002-0.05mm)	%	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 - 2.00mm)	%	UKAS
Texture Class (UK Classification)	--	UKAS
Stones (2-20mm)	% DW	GLP
Stones (20-50mm)	% DW	GLP
Stones (>50mm)	% DW	GLP
pH Value (1:2.5 water extract)	units	UKAS
Electrical Conductivity (1:2.5 water extract)	uS/cm	UKAS
Organic Matter (LOI)	%	UKAS

TH5+8+15
Profile 2 Subsoil

TH19+22+26
Profile 1 Subsoil

18
18
27
19
14
3
1
64
SL
5
0
0

17
17
24
17
17
5
3
66
SL
6
0
0

4.6
89

7.4
266

2.1

2.2

SL = SANDY LOAM

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Appendix 4

Indicative Imported Topsoil and Subsoil Specification

1.0 INTRODUCTION

This Imported Soil Specification document sets out the suggested requirements for imported topsoil and washed sand (subsoil), and the measures and techniques for sampling and testing soils to be sourced for soft landscape purposes at Marble Hill Park, Twickenham, London.

All imported soil should be obtained which complies with both the horticultural requirements (as detailed in Section 2.0) and environmental requirements (as detailed in Section 3.0).

This document specifies the imported soil requirements for soft landscape works construction only. The soil requirements for any associated sports pitch or event space improvement works are outside the scope of this specification.

This specification are intended as a guide at this stage and would be governed by the specific requirements of the proposed landscape scheme once this has been produced (e.g. selected species, stock sizes etc).

1.1 Soil Types

The soil materials covered by this specification document are:

- Imported Topsoil
- Imported Washed Sand (*subsoil*)

1.2 Soil Materials Generally

Purity: Free of pests, disease, and fungus.

Foreign matter: On visual inspection, free from non-soil or sand material, brick, wire/rebar and other building materials and wastes, sharps, hydrocarbons, plant matter, invasive weeds, and any other foreign matter or material or substance that would render the soil or sand unsuitable for landscape use.

Contamination: Do not use topsoil or sand contaminated with rubbish or other materials that are:

- Corrosive, explosive or flammable.
- Hazardous to human or animal life.
- Detrimental to healthy plant growth.

Give notice: If any evidence or symptoms of soil contamination are discovered on the site or in soils, sand or compost or other planting media to be imported.

Soil Structure: all soils shall have sufficient soil structure once placed and settled to enable healthy root growth and adequate soil function (drainage and aeration capacity)

2.0 HORTICULTURAL SOIL REQUIREMENTS

2.1 Imported Topsoil

Imported Topsoil should meet the following criteria:

Visual Examination

The topsoil shall be free from non-soil material, brick, wire/rebar and other building materials and wastes, sharps, hydrocarbons, plant matter, invasive weeds, and any other foreign matter or material or substance that would render the topsoil unsuitable for landscape use.

Parameter	Unit	Lower Limit	Upper Limit
Clay (<0.002mm)	%	5	18
Silt (0.002-0.05mm)	%	5	35
Sand (0.05-2.0mm) Of which at least 45% shall fall into fine sand (0.15-0.25mm) to medium sand (0.25-0.50mm) range	%	55	85
Stones (2-20mm)	%DW	--	15
Stones (20-50mm)	%DW	--	10
Stones (>50mm)		--	0
pH Value	Unit	6.0	8.5
Electrical Conductivity (1:2.5 water extract)	µS/cm	--	1500
Electrical Conductivity (CaSO ₄ extract)	µS/cm	--	3300
Exchangeable Sodium Percentage	%	--	9
Organic Matter	%	4.0	8.0
Total Nitrogen	%	0.20	--
Extractable Phosphorus	mg/l	26	140
Extractable Potassium	mg/l	240	1500
Extractable Magnesium	mg/l	50	600
Calcium Carbonate	%	--	5

2.2 Imported Washed Sand

Imported Washed Sand for use as subsoil should comprise a quarried washed sand material that should meet the following criteria. It should not comprise a marine-dredged sand or recycled sand.

Visual Examination

The washed sand shall be free from non-sand material, topsoil, other subsoil types, brick, wire/rebar and other building materials and wastes, sharps, hydrocarbons, plant matter, invasive weeds, and any other foreign matter or material or substance that would render the sand unsuitable for landscape use.

Parameter	Unit	Lower Limit	Upper Limit
Clay & Silt (less than 0.05mm)	%	0	0
Very Fine Sand (0.05 – 0.15mm)	%	0	5
Fine Sand (0.15 – 0.25mm)	%	5	15
Medium Sand (0.25 – 0.50mm)	%	50	75
Coarse Sand (0.50 – 1.0mm)	%	25	45
Very Coarse Sand (1.0 – 2.0mm)	%	0	5
Stones (2-10mm)	%DW	0	10
Stones (>10mm)	%DW	0	0
Saturated Hydraulic Conductivity	mm/hr	150	--
pH Value	Unit	5.0	8.5
Electrical Conductivity (1:2.5 water extract)	µS/cm	--	600
Calcium Carbonate	%	--	2

3.0 ENVIRONMENTAL REQUIREMENTS

The following Generic Assessment Criteria (GAC) shall be used as Tier 1 screening values for the assessment of *imported topsoil* to be used, unless Site-Specific Assessment Criteria (SSAC) are available for the site where the soil(s) is to be used.

In circumstances where any of these values are exceeded, further risk assessment and/or testing should be undertaken to confirm the significance of the non-compliance.

Parameter	Unit	GAC*
Inorganic Arsenic	mg/kg	37
Boron (soluble)	mg/kg	290
Cadmium	mg/kg	11
Chromium (III)	mg/kg	910
Chromium (IV)	mg/kg	6
Copper	mg/kg	100
Lead	mg/kg	200
Mercury	mg/kg	1.2
Nickel	mg/kg	60
Selenium	mg/kg	250
Zinc	mg/kg	200
Phenol	mg/kg	280
Benzene	mg/kg	0.087
Toluene	mg/kg	130
Ethylbenzene	mg/kg	47
Xylene - m	mg/kg	59
Xylene - o	mg/kg	60
Xylene - p	mg/kg	56
Aliphatics C5-C6	mg/kg	42
Aliphatics C6-C8	mg/kg	100
Aliphatics C8-C10	mg/kg	27
Aliphatics C10-C12	mg/kg	130
Aliphatics C12-C26	mg/kg	1100
Aliphatics C16-C35	mg/kg	65,000
Aromatics C5-C7	mg/kg	70
Aromatics C7-C8	mg/kg	130
Aromatics C8-C10	mg/kg	34
Aromatics C10-C12	mg/kg	74
Aromatics C12-C16	mg/kg	140
Aromatics C16-C21	mg/kg	260
Aromatics C21-C35	mg/kg	1100
Acenaphthene	mg/kg	210
Acenaphthylene	mg/kg	170
Anthracene	mg/kg	2400
<i>Continued...</i>		

Parameter	Unit	GAC*
Benzo(a)anthracene	mg/kg	7.2
Benzo[a]pyrene	mg/kg	2.2
Benzo(b)fluoranthene	mg/kg	2.6
Benzo(g,h,i)perylene	mg/kg	320
Benzo(k)fluoranthene	mg/kg	77
Chrysene	mg/kg	15
Dibenzo[a,h]anthracene	mg/kg	0.24
Fluoranthene	mg/kg	280
Fluorene	mg/kg	170
Indeno(1,2,3-cd)pyrene	mg/kg	27
Naphthalene	mg/kg	2.3
Phenanthrene	mg/kg	95
Pyrene	mg/kg	620
Asbestos screen	Detected / Not Detected	Not Detected

* GAC values derived from LQM CIEH S4ULs (2015), DEFRA SP1010, BS3882:2015 and HSE Control of Asbestos Regulations 2012. Based on SOM of 1% and pH of 6.0 where applicable.

ENGLISH HERITAGE

4.0 SOIL SAMPLING AND TESTING

The topsoil and sand material considered for importation shall be independently sampled, tested and approved while stockpiled off site at their source or manufacture location.

4.1 Sampling Protocol

The samples shall be truly representative of the soil/sand to be offered. One *Composite Sample* shall be taken for every 250m³ of soil to be used, with a minimum of 3 No. samples per source.

Each composite sample should be made up of 10 No. sub-samples taken from evenly spaced locations across the stockpile. The sub-samples shall be mixed together and quartered down to form a 5kg composite sample. Each composite sample shall be placed in a clean, strong plastic bag and a 500ml brown glass, wide-necked jar (for organics testing) and each labelled with the source reference and date of sampling. Glass jar samples shall be stored and delivered to the laboratory in a cool box within 24hrs of sampling.

Soils/sands of different types should never be mixed to form a composite sample.

The samples should be analysed on a 6 working day turnaround and the Contractor should incorporate this into their programme.

The sampled soil/sand materials shall be temporarily stockpiled at the source location while the Contractor awaits receipt of the soil/sand analysis results and written approval is provided by the Client's representative on its suitability for use within the project.

4.2 Testing Schedule

The composite samples shall be sent to a UKAS and MCERTS accredited laboratory(s) with a request for each sample to be analysed strictly in accordance with the *Testing Schedules* given below in Clauses 4.2.1 (Topsoil) and 4.2.2 (Washed Sand).

4.2.1 Imported Topsoil Testing Schedule

The following testing parameters shall be requested for the composite *Imported Topsoil* samples (methods in accordance with BS3882:2015 or as indicated):

1. Visual examination to record the presence of any deleterious materials
2. pH Value (1:2.5 soil/water extract)
3. Electrical Conductivity (1:2.5 soil/water extract)
4. Electrical Conductivity (1:2.5 soil/CaSO₄ extract)
5. Exchangeable Sodium Percentage
6. Detailed Particle Size Analysis (clay, silt, 5 sands)
7. Stone Content by % weight (2-20mm, 20-50mm, >50mm)
8. Total Nitrogen (% - Dumas Method)
9. Extractable Phosphorus, Potassium & Magnesium (RB427 Method)
10. Organic Matter (%)
11. Calcium Carbonate (% BS7755:3:10:1995)
12. **Potential Contaminants** – See parameters in **Section 3.0**

4.2.2 Imported Washed Sand Testing Schedule

The following testing parameters shall be requested for the composite *Imported Washed Sand* samples (methods in accordance with BS8601:2013 or as indicated):

1. Visual examination to record the presence of any deleterious materials
2. pH Value (1:2.5 soil/water extract)
3. Electrical Conductivity (1:2.5 soil/water extract)
4. Detailed Particle Size Analysis (clay, silt, 5 sands)
5. Stone Content by % weight (2-10mm, >10mm)
6. Calcium Carbonate (% BS7755:3:10:1995)
7. Saturated Hydraulic Conductivity (*ASTM F1815:2011*. Percolation Test – 40cm tension)

4.3 Reporting

The results of analysis for each proposed source of topsoil and washed sand shall be presented in an interpretive report. Each report shall contain the following information:

- Source name and location
- Date of sampling;
- Description of the soil or sand (and components used if a manufactured topsoil);
- Photographs of the stockpile and the soil / sand;
- Visual examination;
- Certificates of Analysis.
- Interpretation of all results with comments on the suitability of the material for use in the proposed scheme.