



# **APPENDIX B**

**Soakaway Test Report** 



Bloom Bridge LLP

c/o

Hill Street Holdings

F.A.O. Lauren Bates

Our Ref: 15860/SA

16th November 2016

Dear Lauren

Thomas Telford House Sun Valley Business Park Winnall Close Winchester SO23 0LB

01962 673 330 soilslimited.co.uk

RE: Results of Soakaway Testing and Geotechnical Ground Investigation at Phase 1A & 1B Bicester Gate.

We are writing in regards to the ground investigation and soakaway testing undertaken at the above site

#### Brief

Soils Limited were commissioned following the acceptance of fee proposal Q18062 Rev3, dated 15th November 2015, to undertake a ground investigation on the site to collect information on the underlying ground conditions in the form of trial holes and the collection of geotechnical samples.

Soakaway testing was also undertaken to determine the level of natural drainage present under the site on the site. These works were undertaken to aid in the future development of the site.

#### Standards

The site works, soil descriptions and geotechnical testing was undertaken in accordance with the following standards:

- BS EN 1997-1:2004+A1:2013 Eurocode 7. Geotechnical design
- BS EN ISO 14688-1:2002+A1:2013 Geotechnical investigation and testing Identification and description
- BS EN ISO 14688-2:2004+A1:2013 Geotechnical investigation and testing Principles for a classification

The geotechnical laboratory testing was performed by GEO Site & Testing Services Ltd (GSTL) in accordance with the methods given in BS 1377:1990 Parts 1 to 8 and their UKAS accredited test methods.

For the preparation of this report, the relevant BS code of practice was adopted for the geotechnical laboratory testing technical specifications, in the absence of the relevant Eurocode specifications (ref: ISO TS 17892).

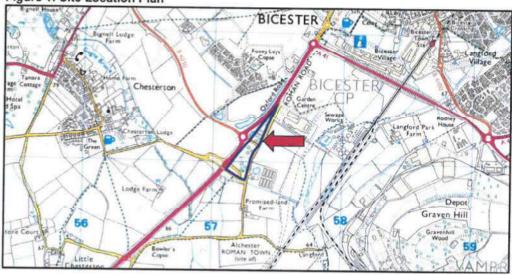
General

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The site was located on the A41 at OS Land Ranger Grid Reference of SP 573 211. At the time of reporting the site was open fields that sloped down towards to the east.

A site location plan is presented in Figure 1.

Figure 1: Site Location Plan



### **Proposed Development**

It is understood that the site is to be developed into a 150 bed hotel and office buildings.

#### **Ground Conditions**

On the 27th October 2016 a total of 10 trial holes TP101 – TP107 (including soakaway test locations TP102A, TP103A and TP106A) were excavated on the site by a back acting excavator to depths ranging between 0.60m and 2.90m bgl. The maximum depths of trial holes have been included in Table 1.

All trial holes were scanned with a Cable Avoidance Tool (C.A.T.) and GENNY prior to excavation to ensure the health and safety of the operatives.

Table 1 Final Depth of Trial Holes

Trial Hole	Depth (m bgl)	Trial Hole	Depth (m bgl)
TPIOI	2.10	TP104	2.50
TP102	0.80	TP105	2.70
TPI02A	0.60	TP106	2.70
TP103	2.90	TP106A	1.50
TP103A	1.20	TP107	2.50

The approximate trial hole locations are shown on Figure 2.

The soil conditions encountered were recorded and soil sampling commensurate with the purposes of the investigation was carried out. The depths given on the trial hole logs and quoted in this report were measured from ground level.

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The soils encountered from immediately below ground surface have been described in the following manner. Where the soil incorporated an organic content such as either decomposing leaf litter or roots, or has been identified as part of the in-situ weathering profile, it has been described as Topsoil both on the logs and within this report. Where man has clearly either placed the soil, or the composition altered, with say greater than an estimated 5% of a non-natural constituent, it has been referred to as Made Ground both on the log and within this report.

For more complete information about the soils encountered within the general area of the site reference should be made to the detailed records given within Appendix A, but for the purposes of discussion, the succession of conditions encountered in the trial holes in descending order can be summarised:

# Topsoil River Terrace Deposits Kellaways Clay Member Kellaways Sand Member

The ground conditions encountered are summarised in Table 2 below.

Table 2 - Summary of Ground Conditions Encountered

Strata	Depth Enco	ountered	Typical Description				
	Тор	Base					
Topsoil	0.00	0.25 - 0.65	Dark brown slightly gravelly sandy SILT				
River Terrace Deposits	0.25 - 0.65	0.80 - 2.10	Light yellow orange very sandy slightly GRAVEL Light yellow orange very sandy gravelly CLAY				
Kellaways Clay Member	1.10 - 2.90	2.00 - 2.90	Dark grey blue black silty CLAY				
Kellaways Sand Member	2.00 - 2.80	2.30 - 2.90	Dark blue grey SILTSTONE				

With the exception of soakaway trial pit TP102A, which encountered a ceramic field drain pipe at 0.60m bgl, no Made Ground was encountered.

#### Groundwater

Groundwater was encountered within all the trial holes at depths between 0.80m bgl to 2.90m bgl. When encountered, groundwater in TP103, TP104, TP105 and TP107 was observed to quickly fill the trial pits and rise to between 2.40m and 1.10m bgl. The details of the groundwater strikes are presented in Table 3 below.

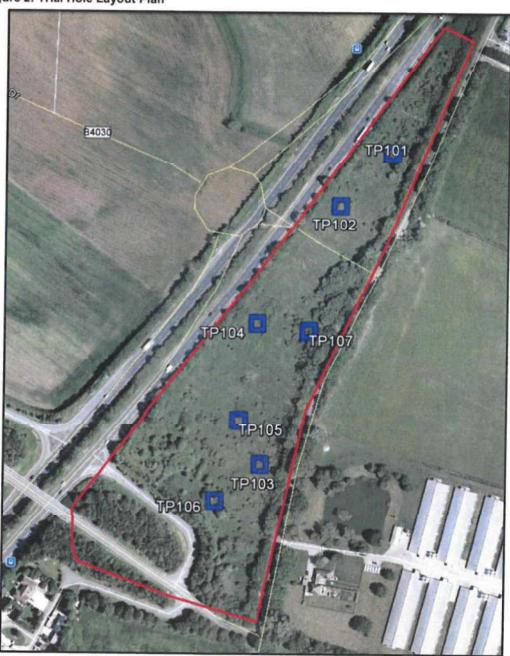
Table 3 - Groundwater Levels

Depth (m bgi)	Groundwater standing level after recorded time (m					
2.10	Standing water at 2.10m					
0.80	Standing water at 0.80					
2.90	1.10m (after 2 hours)					
2.30	2.20m (after 10 minutes)					
2.70	2.40m (after 10 minutes)					
	0.80 2.90 2.30					

Trial Hole	Groundwater Strike Depth (m bgl)	Groundwater standing level after recorded time (m bgl)
TP106	1.60	Standing water at 1.60m
TP107	2.50	2.40m (after 10 minutes)

The groundwater, with the exception of TP102 originated from the Kellaways Sand Member.

Figure 2: Trial Hole Layout Plan



### Geotechnical Testing

A total of 4 samples from the cohesive soils of the Kellaways Clay Formation were submitted to the laboratories of GSTL for 4 Point liquid & Plastic Limit testing. The results of the analysis are presented in Appendix B of this letter and summarised in Table 4 below.

Table 4 - Results of Geotechnical Testing

Stratum	Moisture Content (%)	Plasticity Index (%)	Passing 425μm Sieve	Modified Plasticity Index	Soil Classification	Volume Change Potentia BRE	
			(%)	(%)			
Kellaways Clay	28 - 38	25 - 31	92 - 100	23.75 - 31	CI - CH	Medium	
Formation							

Notes:

BRE Volume Change Potential refers to BRE Digest 240 (based on Atterberg results)

Soils Classification based on British Soil Classification System

The most common use of the term clay is to describe a soil that contains enough clay-sized material or clay minerals to exhibit cohesive properties. The fraction of clay-sized material required varies, but can be as low as 15%. Unless stated otherwise, this is the sense used in Digest 240. The term can be used to denote the clay minerals. These are specific, naturally occurring chemical compounds, predominately silicates. The term is often used as a particle size descriptor. Soil particles that have a nominal diameter of less than 2  $\mu$ m are normally considered to be of clay size, but they are not necessarily clay minerals. Some clay minerals are larger than 2  $\mu$ m and some particles, 'rock flour' for example, can be finer than 2  $\mu$ m but are not clay minerals.

(The Atterberg Limit Tests were undertaken in accordance with BS 1377:Part 2:1990 Clauses 3.2, 4.3 and 5)

### **Soakaway Testing**

Soakaway tests were undertaken within TP102A, TP103A and TP106A. The tests comprised piping water via a water tanker into the open trial hole, the drop in water level over time was then recorded to give an indication of soakage potential.

BRE DG365:2016 states that for an accurate infiltration rate to be obtained a soakage pit needs to be filled three times in quick succession. Each test is completed once 75% of the water present has drained away, in order to determine whether or not the underlying ground conditions may be suitable for surface water drainage.

To avoid encountering groundwater, the depth of these soakaway trial pits were advanced to depths above where groundwater had been observed in neighbouring trial pits - in this case TP102, TP103 and TP106. Due to the infiltration rates observed only one test was undertaken in each trial hole. The test in TP102 was voided as water in the trial pit was escaping into a field drain pipe that had been exposed as the water was emptied into the pit. Table 5 below details the depths of the soakaways and the corresponding strata. The results of the soakaway testing is presented in Appendix C of this letter report.

Table 5 - Summary	y of	Soakaway	/ Test	Locations

Trial Hole	Depth of Soakaways (m bgl)	Strata	Infiltration Rate
TP102A	0.60	Gravel field drain	
TP103A	1.20	Sandy GRAVEL (River Terrace Deposits)	1.382 x10 <sup>-5</sup> m/sec <sup>-1</sup>
TP106A	1.50	Sandy GRAVEL (River Terrace Deposits)	4.499 x10 <sup>-6</sup> m/sec <sup>2</sup>
Notes:	One test undertaken Results of an extrapolat	ed test	

Of the three soakaway trial holes undertaken, only one soakaway test (TP103A) drained sufficiently to calculated an infiltration rate. TP106 did not finish however it was possible to extrapolate and infiltration rate from the data collected. The test completed in TP103A produced a calculated infiltration rate of 1.382 x10<sup>-5</sup> m/sec for the unsaturated sandy GRAVELS of the River Terrace Deposits at a depth of 1.20m. Extrapolation of the test in TP106A produced an infiltration rate of 4.499 x10<sup>-6</sup> m/sec. As the tests were not conducted a further two times it has not been possible to provide an infiltration rate in full compliance accordance with the BRE standard.

#### Conclusions

The ground investigation encountered Topsoil over superficial River Terrace Deposits. The River Terrace Deposits overlie the Kellaways Clay and Sand Member. Groundwater was encountered at depths of between 0.80m and 2.90m bgl.

Geotechnical sampling undertaken recorded the cohesive soils of the Kellaways Clay Formation to have medium volume change potential.

Three trial pit soakaways TP102A, TP103A and TP106A were undertaken on site. The results of the single soakaway test completed in TP103A and the extrapolated test in TP106A indicated an infiltration rates of between 1.382 x10<sup>-6</sup> m/sec and 4.499 x10<sup>-6</sup> m/sec in the shallow sandy GRAVEL of the River Terrace Deposits in the south of the site. Providing that the gravel band encountered in TP103A is laterally continuous across the site and at a suitably shallow depth then it is possible that this stratum will provide suitable infiltration for a SUDS system. It is however, recommended that further testing is undertaken to identify the extent and depth of the gravel band across the site. The infiltration rates provided in this letter report should be used with caution until further testing is undertaken. If no further testing is undertaken, then the more conservative value of 4.499 x10<sup>-6</sup> m/sec should be adopted.

The following attachments make up the remainder of this letter report.

Appendix A - Trial Hole Logs

Appendix B - Geotechnical Analysis

Appendix C - Soakaway Results

Should you have any further questions please do not hesitate to contact the undersigned.

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Yours Sincerely

LAKE

J. Hucklesby BEng (Hons)

Geo environmental Engineer

JSH@soilslimited.co.uk

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Appendix A - Trial Hole Logs

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Projec	t Name:	Phase	1a &	1B			Proje	ct No.:	15860	Method: Plant:			Hole Type TP
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Mill Street Holdings Ltd  Trial Pit Length  Trial Pit Length  Trial Pit Width: m  Tria	oject Name:	Phase 1	a & 1B		Proje	ct No.:	15860				Hole Type		
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ocation:		Pr le	ateway		, roje		10000	Plant:			TP	
Client:	V someti	one or	Secretaria escri				T-1-1-011	Support:			Scale	j
	niii		Holdings Ltd	12 2			Trial Pit Leng		Trial Pit Width:	m	1:25 Logged	Ву
ates:	Sam		10/2016 n Situ Testing	Level:			Co-or	ds:			CF	1.57
Strike Dea		Type	Results	Depth (m)	Level (m)	Legen	d		Stratum Description			
0.2	0	D D		0,65			gravel is	fine to mediun	velly sandy SILT, Sand n, made up of flint. Fre grandy slightly clayey o coarse.	quent roo	tlets	the state of the s
1.5	0	D		1.60		× × × × × × × × × × × × × × × × × × ×		grey CLAYEY	<sup>r</sup> SILT. Frequent shell f	ragments		
2.00	0	D				X X X X X X X X X X X X X X X X X X X	*					
2.50	0	D		2.70		× × × × × × × × × × × ×		******	End of Pit at 2.70m		• • • • • • • • • • • • • • • • • • • •	1
eral Remarks		ı bgl. Gr	oundwater encounte	ered at 1.60m	bgl.						ample Type	- 5
ndwater Rem			or more and the							E	J. Disturbed B. Bulk Jar V. Water	

SOI	İŞ	Ne Tel:	swton House, Ci 01737 814221	oils Limit ross Road, Email: adm	Tadwor	th KT20	0 5SR d.co.uk	Ti	rial Pit Log	j	Trial Pit No. TP106A
Project Na	ame: Pha	sp 1a & 1	B		Drain	at Man	45000	Method:			Sheet 1 of 1
					Proje	Ct No.:	15860	Plant:			Hole Type TP
Location:	Bice	ster Gate	way					Support:	U .		Scale
Client:	Hills	Street Ho	ldings Ltd				Trial Pit Leng	-	Trial Pit Width:	m	1:25
Dates:		27/10	2016	Level:			Co-or				Logged By
ke ë	Samp		itu Testing	Depth	Level	1.0		us.			
Water	Depth	Туре	Results	(m)	(m)	Legen	d		Stratum Description		
				0.65			gravel is	fine to mediur	avelly sandy SILT. Sand in, made up of flint. Freq in, made up of flint. Freq in, made up of flint. Freq in, made up of flint. Sand in, made up of flint. Freq in, made up of flint. Fr	uent root	dets
				1.60					End of Pit at 1.60m		2
											4 5
neral Rema			***************************************		er e					Sa	imple Type
ots observed		bgl. Groun	dwater encounter	ed at 1.60m	bgl.					D B J	Disturbed Bulk Jar Water

soils	2			Soils Lim	ited						Trial Pit	
Softerbridge & Environment	D		wton House, 01737 81422					Tı	rial Pit Lo્	3	TP10	07
ornultants					1		New York Control	12-41-4			Sheet 1	-
Project Name:	2500 70	Down C			Proje	ct No.:	15860	Method: Plant:			Hole Ty	pe
ocation:	Biceste	er Gate	way					Support:	8		Scale	9
Client:	Hill Str	eet Ho	ldings Ltd				Trial Pit Leng	ith: m	Trial Pit Width:	m	1:25	
Dates:		27/10/	2016	Level:			Co-or	ds:			Logged	Ву
ě.	Sample	E-Month	itu Testing	Depth	Level		1	40.			CF	-
Name of the part o	th T	уре	Results	(m)	(m)	Legen			Stratum Description			
0.30 0.60 0.90 1.50 2.00				0.40 1.00		X X X X X X X X X X X X X X X X X X X	Light yello coarse. G rootlets b	ow orange ve travel is fine t ecoming less	ry sandy gravelly CLAY, o medium made up of fi gravelly and less sand; AY. End of Pit at 2.50m	Sand is lint. Frequently with dep	fine to	5
eral Remarks:										8	Sample Type	
ts observed to	1.00m bg	l. Groun	ndwater encoun	tered at 2.50	m bgl, sta	anding at	2.40m bgl after	10 minutes.		- 1	D: Disturbed	
											B. Bulk J. Jar	
dwater Rema	arks:									1	W: Water	

Soils Limited 9 of 11

Appendix B - Geotechnical Analysis





# Contract Number: 32973

Client's Reference: 15860

Report Date: 08-11-2016

Client Soils Limited **Newton House** Cross Road Tadworth Surrey

**KT20 5SR** 

Contract Title: 1a and 1b Gateway Bicester

For the attention of: James Hucklesby

Date Received: 02-11-2016 Date Commenced: 02-11-2016 Date Completed: 08-11-2016

Test Description	Qt
4 Point Liquid & Plastic Limit (LL/PL) 1377: 1990 Part 2: 4.3 & 5.3 - * UKAS	4
Moisture Content 1377: 1990 Part 2: 3.2 - * UKAS	4
Disposal of Samples on Project	1

Observations and Interpretations are outside the UKAS Accreditation Notes:

\* - denotes test included in laboratory scope of accreditation

# - denotes test carried out by approved contractor

@ - denotes non accredited tests

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved Signatories:

Alex Wynn (Associate Director) - Benjamin Sharp (Contracts Manager) - Emma Sharp (Office Manager) Paul Evans (Quality/Technical Manager) - Vaughan Edwards (Managing Director)

GEO Site & Testing Services Ltd

Unit 3-4, Heol Aur, Dafen Ind Estate, Dafen, Llanelli, Carmarthenshire SA14 8QN

Client ref:

15860

Location:

1a & 1b Gateway Bicester

**Contract Number:** 

32973

	Sample Number	Туре	Depth (m)	Description of Sample*
TP101		S/B	2.00	Grey silty CLAY
TP103			1.50	Brown fine to medium gravelly SAND
TP105			2.50	Grey silty CLAY. Contains shell fragments
TP107			2.50	Grey silty CLAY. Contains shell fragments
		-/-	2.50	Grey sircy CERT. Contains shell fragments
	-	-		
-		-		
		_		
		_		
_	-+	$\rightarrow$		
		_		
-+		$\rightarrow$		
	-	-		
-+	_	-+		

Note: Results on this table are in summary format and may not meet the requirements of the relevant standards, additional information is held by the laboratory



For and behalf of GEO Site & Testing Services Ltd

Authorised By:

Emma Sharp (Office Manager)

Date:

8.11.16



Test Report: Method of the Determination of the plastic limit and plasticity index

BS 1377: Part 2: 1990 Method 5

Client ref:

15860

Location:

1a & 1b Gateway Bicester

**Contract Number:** 

32973

Hole/ Sample Number	Sample Type	Depth m	Moisture Content % Cl. 3.2	Liquid Limit % Cl. 4.3/4.4	Plastic Limit % Cl. 5.	Plasticity Index % Cl. 6.	% Passing .425mm	Remarks
TP101	S/B	2.00	38	62	31	31	100	CH High Plasticity
TP103	S/B	1.50	8.2		NP		50	
TP105	S/B	2.50	25	43	18	25	95	CI Intermediate Plasticit
TP107	S/B	2.50	28	54	25	29	92	CH High Plasticity

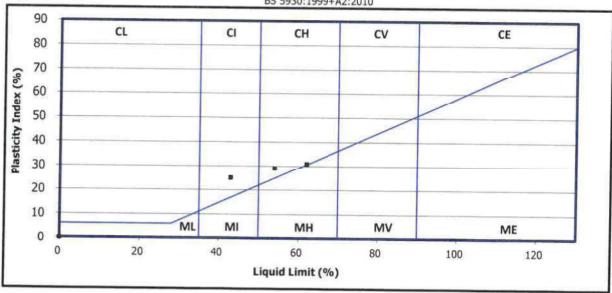
Symbols:

NP : Non Plastic

#: Liquid Limit and Plastic Limit Wet Sieved

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

BS 5930:1999+A2:2010



GS7L GEO SITE & TESTING SERVICES LTD For and behalf of GEO Site & Testing Services Ltd

Authorised By:

Emma Sharp (Office Manager)

Date:

8.11.16





Soils Limited 10 of 11

Appendix C - Soakaway Results

# **Soakaway Calculations**

Soakaway Test No.	TP103	
Contract:	Phase 1a & 1b Bicester Gateway	
Contract No.	15860	

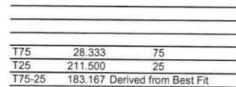
# Field Test

Trial Pit Log (include details of groundwater): See trial Pit record

Depth of Pit	1.20 m
Width of Pit	0.60 m
Length of Pit	2.10 m
Depth of Pit Soaked	0.87 m
ap50	3.609 m2
Vp75-25	0.5481 m3
t75-25	183.2 min
water used	1.0962 m3
E.	1.382E-05 m/sec.

# Field Data

Depth to	Elapsed	Head of	Head of
Water	Time	Water	Water
(m)	(min)	(% of Ho)	(m)
0.33	0	100	0.87
0.35	1.0	98	0.85
0.36	2.0	97	0.84
0.40	5.0	92	0.80
0.42	8.0	90	0.78
0.50	22.0	80	0.70
0.56	30.0	74	0.64
0.61	46.0	68	0.59
0.67	60.0	61	0.53
0.76	90.0	51	0.44
0.82	120.0	44	0.38
0.95	192.0	29	0.25
0.98	210.0	25	0.22
1.01	228.0	22	0.19



# T75 T25 100 90 80 70 60 Head (% of Ho) 30 20 10 0 0 100 200 300 Elapsed Time (min)

#### Comments

# SOILS LIMITED

Newton House, Cross Road, Tadworth Surrey, KT20 5SR

Telephone: Facsimile: 01737 814 221 01737 812 557

# **Soakaway Calculations**

Soakaway Test No.	TP106	
Contract:	Phase 1a & 1b Bicester Gateway	
Contract No.	15860	

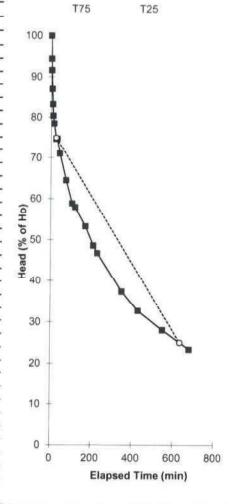
# Field Test

Trial Pit Log (include details of groundwater): See trial Pit record

Depth of Pit	1.50 m		
Width of Pit	0.60 m		
Length of Pit	2.30 m		
Depth of Pit Soaked	1.07 m		
ap50	4.483 m2		
Vp75-25	0.7383 m3		
t75-25	610.1 min		
water used	1.4766 m3		
f	4.499E-06 m/sec.		

### Field Data

Depth to	Elapsed	Head of	Head of
Water	Time	Water	Water
(m)	(min)	(% of Ho)	(m)
0.43	0	100	1.07
0.49	1.0	94	1.01
0.52	2.0	92	0.98
0.57	5.0	87	0.93
0.61	8.0	83	0.89
0.64	10.0	80	0.86
0.66	15.0	79	0.84
0.70	25.0	75	0.80
0.7	30.0	75	0.80
0.74	43.0	71	0.76
0.81	75.0	64	0.69
0.87	105.0	59	0.63
0.88	120.0	58	0.62
0.93	171.0	53	0.57
0.98	210.0	49	0.52
1.00	230.0	47	0.50
1.10	350.0	37	0.40
1.15	430.0	33	0.35
1.20	550.0	28	0.30
1.25	680.0	23	0.25



#### Comments

T75-25

Extrapolated from 230 mins in order to calculate an indicative infiltration rate

# SOILS LIMITED

Newton House, Cross Road, Tadworth Surrey, KT20 5SR

24.375

610.125 Derived from Best Fit

634.500

Telephone: Facsimile: 01737 814 221 01737 812 557 Soils Limited



# **APPENDIX C**

**Indicative Layout Drawing** 

