Subsidence Investigation Report

[redacted]
Waterlooville
PO8 8PT

Survey Date: 27.10.2023

Client: Trinity
[redacted]

Registered address
Catalyst Services UK Ltd,
Gatehead Business Park,
Delph New Road, Oldham. OL3 5DE

Registered in England and Wales No: 09166356

Catalyst Services UK Ltd is authorised and regulated by the Financial Conduct Authority. (942818)

Description of Risk Address
Semi-Detached Property.

Area of Concern
Rear Elevation.

Circumstances
We were asked to perform investigations in relation to reported subsidence.

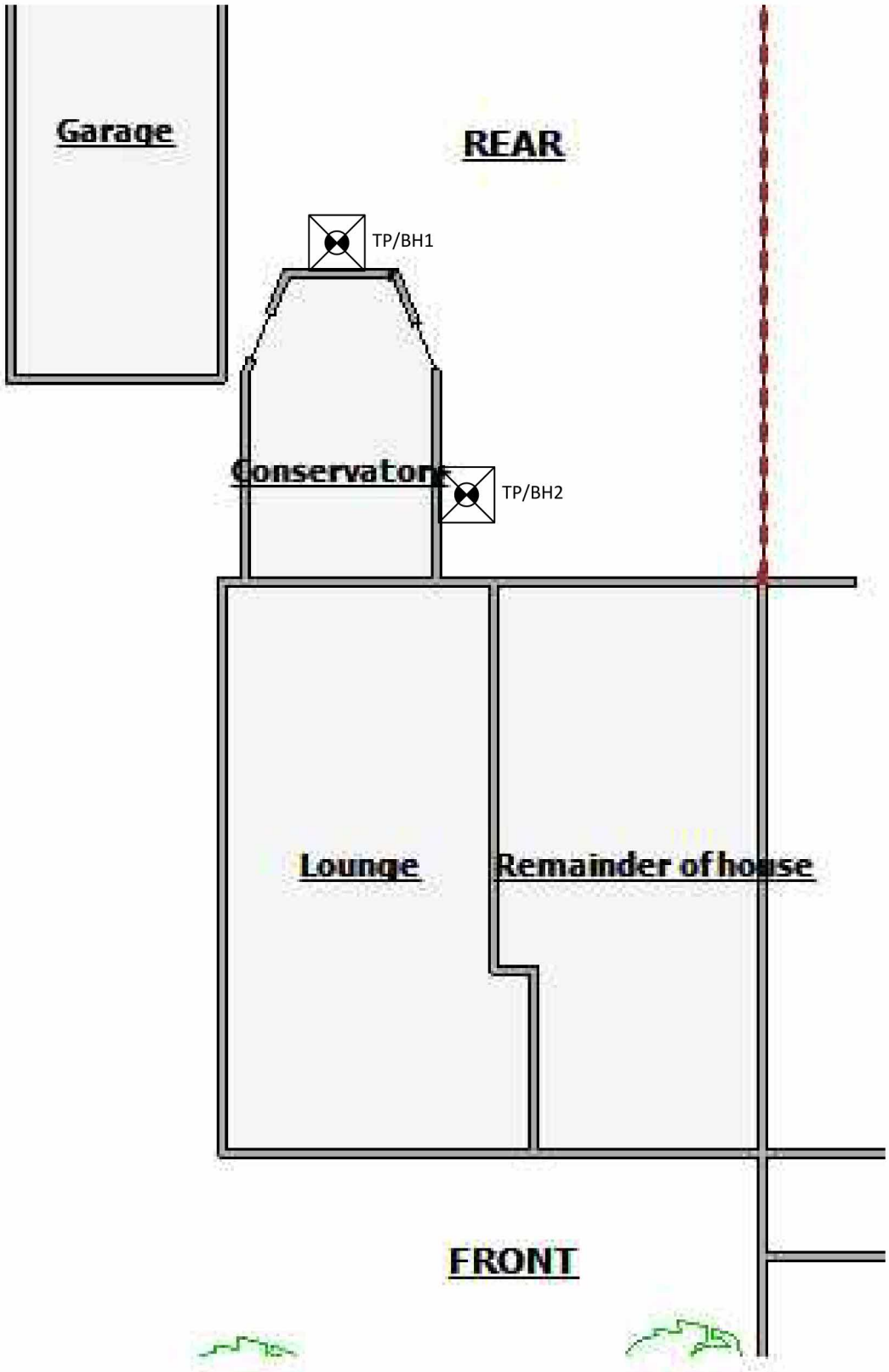
Works Completed

- Excavated 2 trial pits and 2 boreholes.
- Completed Shear Vane Testing.
- Completed Moisture Content and Atterberg Testing.
- Soil Suction Testing.
- Tested root samples.
- Heave Assessment

Reserves
Total Investigation Cost: [redacted]

Catalyst Services UK Ltd is authorised and regulated by the Financial Conduct Authority. (942818)

Catalyst	Site:		Client:			Identification:
	[redacted] Waterlooville PO8 8PT		Catalyst Services UK			SP
	Contract Number:	Date:	Logged By:	Checked by:	Drawn by:	
Sketch Site Plan	[redacted]	31.10.23	PJE	MCE	DJE	Sheet 1 of 1
	Easting:	Northing:	Ground Level:	Plan:	Weather:	Scale:
	ND	ND	ND	ND	Clear	NTS

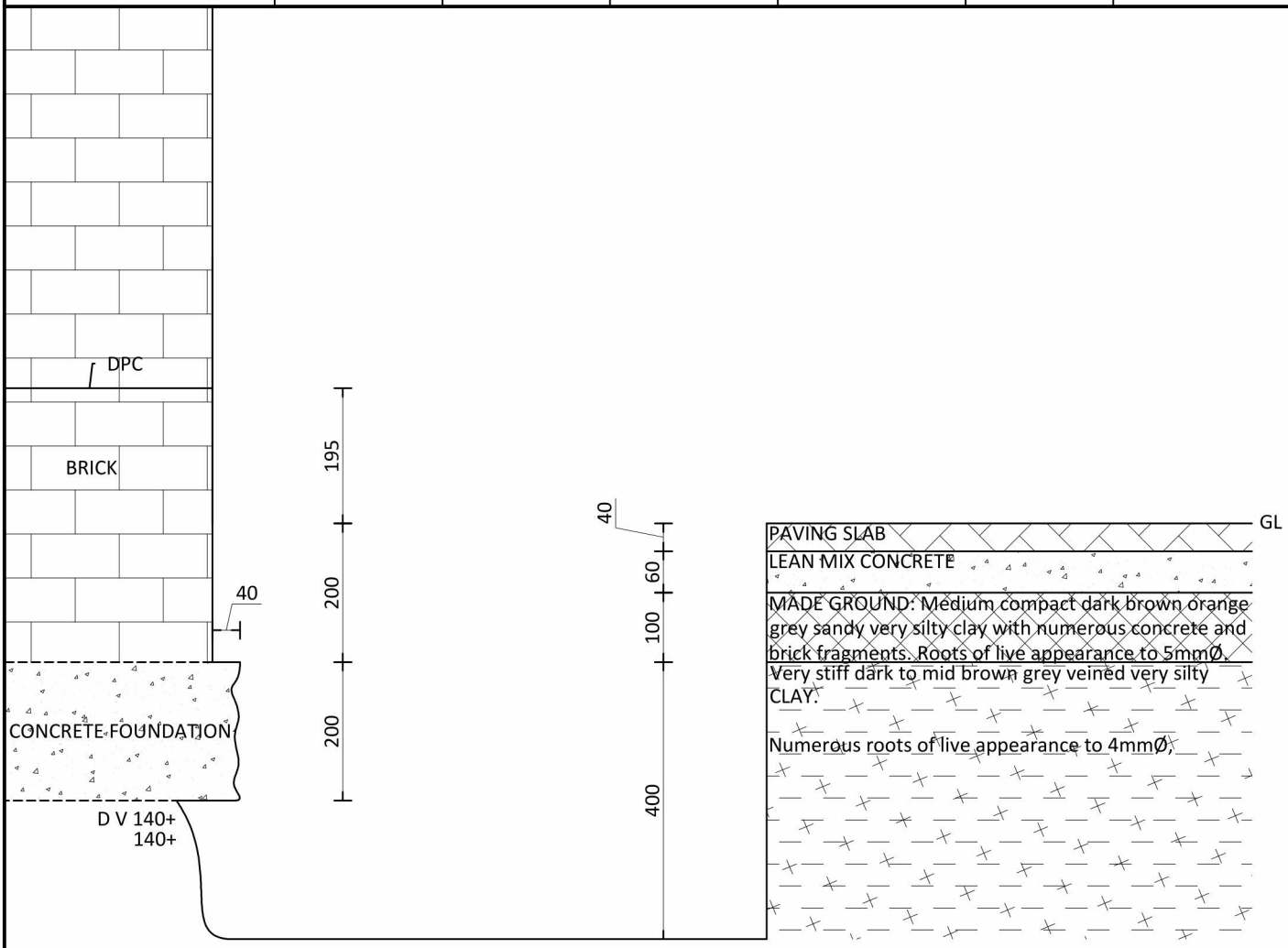


Remarks: On site tree identification for guidance only. Not authenticated.
All dimension in metres unless stated otherwise.

Key:

ND	NTS	TP/BH
No Data	Not to Scale	Trial Pit & Borehole

Catalyst	Site:			Client:		Identification
	[redacted] Waterlooville PO8 8PT			Catalyst Services UK		TP1
	Contract Number:	Date:	Logged By:	Checked by:	Drawn by:	
Trial Pit/Borehole Log	[redacted]	31.10.23	PJE	MCE	DJE	Sheet 1 of 1
	Easting:	Northing:	Ground Level:	Excavation Method:	Weather:	Scale:
	ND	ND	ND	Hand Tools	Clear	NTS



TRIAL PIT ENDS AT 600mm
FOR STRATA BELOW 600mm SEE BOREHOLE 1 LOG

Remarks:	Key:	
No water encountered. All dimensions in millimetres.	ND	No Data
	NTS	Not to Scale
	GL	Ground Level
	D	Small Disturbed Sample
	V	Pilcon Vane (kPa)

Borehole Log

Site:	Client:	Identification
[redacted], Waterlooville PO8 8PT	Catalyst Services UK	BH1

Contract Number:	Date:	Logged By:	Checked by:	Drawn by:	
[redacted]	31.10.23	PJE	MCE	DJE	Sheet 1 of 1
Easting:	**Northing:**	**Ground Level:**	**Plant Used:**	**Weather:**	**Scale:**
ND	ND	ND	Hand Auger	Clear	NTS

Samples & In Situ Testing			Strata Details				Roots and Groundwater	
Depth (m)	Sample	Test Result	Depth (m)	Thickness (m)	Legend	Strata Description	Roots Information	Groundwater (m)
GL			GL	0.60		AS TP1		
			0.60	2.40		Very stiff mid brown olive grey veined very silty CLAY.	Roots of live appearance to 2mmØ to 2.00m.	
1.00	D	V 140+ 140+						
1.50	D	V 140+ 140+						
2.00	D	V 140+ 140+					Hair-like and fibrous roots to 3.00m.	
2.50	D	V 140+ 140+						
3.00	D	V 140+ 140+	3.00			BOREHOLE ENDS AT 3.00m		

Remarks:

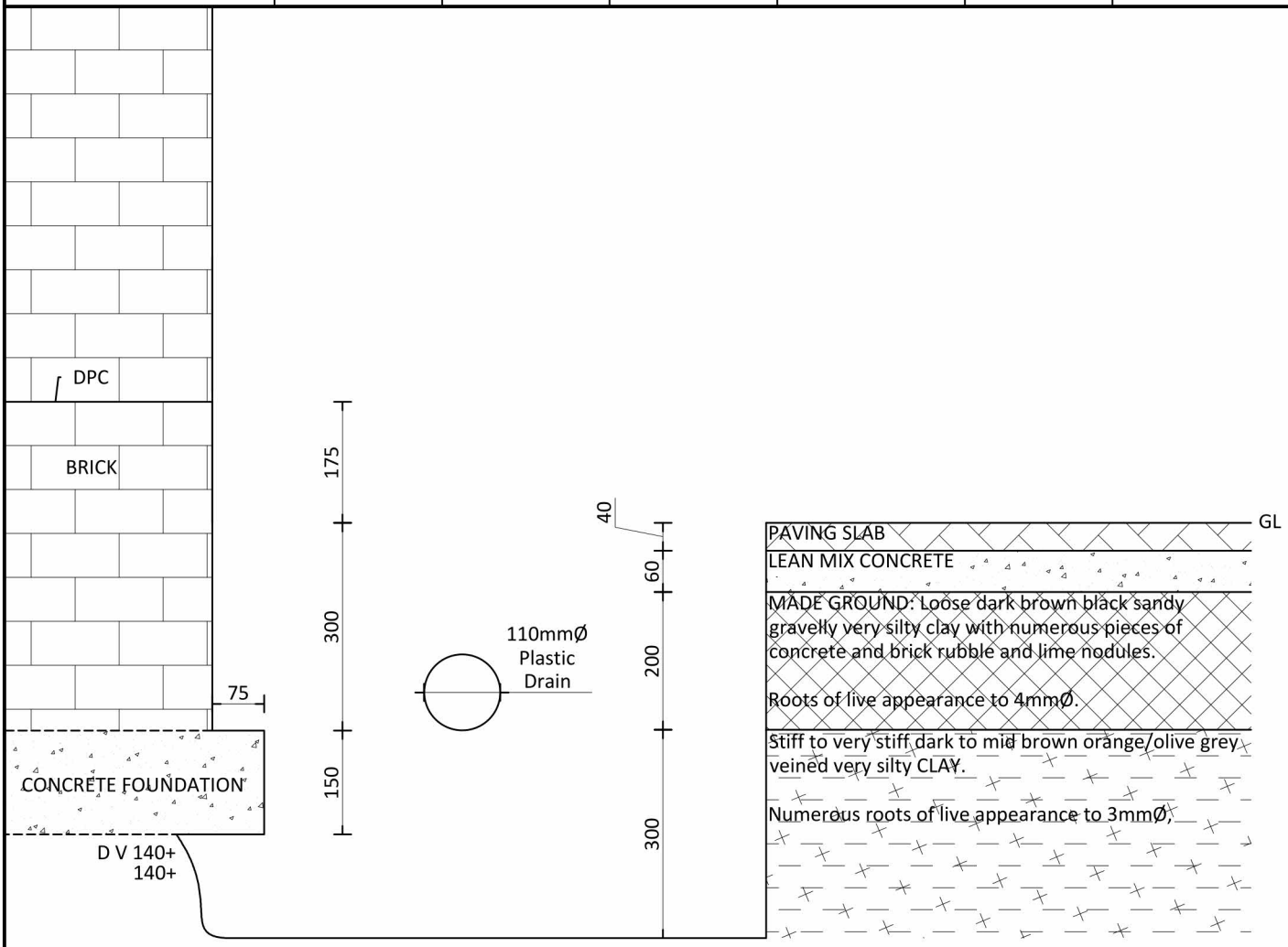
Borehole 'dry' on completion.
Borehole 'open' on completion.

All dimensions in metres.

Key:

ND	No Data	V	Pilcon Vane (KPa)
CFA	Continuous Flight Auger		
NTS	Not to Scale		
GL	Ground Level		
D	Small Disturbed Sample		

Catalyst	Site:			Client:		Identification
	[redacted], Waterlooville PO8 8PT			Catalyst Services UK		TP2
	Contract Number:	Date:	Logged By:	Checked by:	Drawn by:	
Trial Pit/Borehole Log	[redacted]	31.10.23	PJE	MCE	DJE	Sheet 1 of 1
	Easting:	Northing:	Ground Level:	Excavation Method:	Weather:	Scale:
	ND	ND	ND	Hand Tools	Clear	NTS



TRIAL PIT ENDS AT 600mm
FOR STRATA BELOW 600mm SEE BOREHOLE 2 LOG

Remarks:	Key:	
No water encountered. All dimensions in millimetres.	ND	No Data
	NTS	Not to Scale
	GL	Ground Level
	D	Small Disturbed Sample
	V	Pilcon Vane (kPa)

Catalyst

Borehole Log

Site:		Client:		Identification
[redacted] Waterlooville PO8 8PT		Catalyst Services UK		BH2
Contract Number:	**Date:**	**Logged By:**	**Checked by:**	**Drawn by:**
[redacted]	31.10.23	PJE	MCE	DJE
Easting:	**Northing:**	**Ground Level:**	**Plant Used:**	**Weather:**
ND	ND	ND	Hand Auger	Clear

Sheet 1 of 1
Scale:
NTS

Samples & In Situ Testing			Strata Details				Roots and Groundwater	
Depth (m)	Sample	Test Result	Depth (m)	Thickness (m)	Legend	Strata Description	Roots Information	Groundwater (m)
GL			GL	0.60		AS TP2		
			0.60	2.40		Very stiff mid brown olive/orange grey veined very silty CLAY.	Roots of live appearance to 2mmØ to 2.00m.	
1.00	D	V 140+ 140+						
1.50	D	V 140+ 140+						
2.00	D	V 140+ 140+					Hair-like and fibrous roots to 3.00m.	
2.50	D	V 140+ 140+						
3.00	D	V 140+ 140+	3.00			BOREHOLE ENDS AT 3.00m		

Remarks:

Borehole 'dry' on completion.
Borehole 'open' on completion.

All dimensions in metres.

Key:

ND	No Data	V	Pilcon Vane (KPa)
CFA	Continuous Flight Auger		
NTS	Not to Scale		
GL	Ground Level		
D	Small Disturbed Sample		

Photograph 1 - Trial Pit 1

Photograph 2 - Trial Pit 2

Tree Root Identification Report

at: [redacted]Sutton Road, Waterlooville, Hampshire, PO8 8PT.

29th November 2023

1. Microscopic Analysis

Trial Pit/ Borehole	Sample Depth (mm)	Family	Genus	Diameter (mm)	Starch Test
TP1	U/S Foundation 400	*Fagaceae* (x3)	*Quercus* (x3)	1, 2 and 4	Positive
BH1	600 – 2000	*Fagaceae* (x3)	*Quercus* (x3)	<1	Positive
TP2	U/S Foundation 450	*Fagaceae* (x4)	*Quercus* (x4)	<1 to 1	Positive
BH2	600 – 2000	*Fagaceae* (x2)	*Quercus* (x2)	<1	Positive

Quercus is Oak.

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Laboratory Testing Results

BS 1377 : 1990

Job Number : [redacted]
Client : [redacted]
Client Reference : [redacted]
Site Name : [redacted]

Date Received : 08/11/2023
Date Testing Started : 08/11/2023
Date Testing Completed : 15/11/2023

Sample Ref			Sample Type	*Moisture Content (%) [1]	*Soil Faction > 0.425mm (%) [2]	*Liquid Limit (%) [3]	*Plastic Limit (%) [4]	*Plasticity Index (%) [5]	*Liquidity Index (%) [5]	*Modified Plasticity Index (%) [6]	*Soil Class [7]	Filter Paper Contact Time (h) [8]	*Soil Sample Suction (kPa)	Insitu Shear Vane Strength (kPa) [9]	Organic Content (%) [10]	*pH Value [11]	*Sulphate Content (g/l)		
BH/TP/WS	Depth (m)	UID															SO_3 [12]	SO_4 [13]	Class [14]
TPBH1	0.4		D	24	<5	48	24	24	0.02	23	CI	168	120	140					
TPBH1	1.0		D	22	<5	50	23	27	-0.02	26	CH	168	128	140					
TPBH1	1.5		D	24	<5									140					
TPBH1	2.0		D	24	<5	51	23	28	0.02	27	CH	168	118	140					
TPBH1	2.5		D	24	<5									140					
TPBH1	3.0		D	24	<5	51	24	27	0.01	26	CH	168	117	140					

Notes :-

[1] BS 1377 : Part 2 : 1990, Test No 3.2

[2] Estimated if <5%, otherwise measured

[3] BS 1377 : Part 2 : 1990, Test No 4.4

[4] BS 1377 : Part 2 : 1990, Test No 5.3

[5] BS 1377 : Part 2 : 1990, Test No 5.4

[6] BRE Digest 240 : 1993

[7] BS 5930 : 1981 : Figure 31 - Plasticity Chart for the classification of fine soils

[8] In-house method S9a adapted from BRE IP 4/93

[9] Values of shear strength were determined in situ using a Pilcon hand vane or Geonor vane (GV).

[10] BS 1377 : Part 3 : 1990, Test No 4

[11] BS 1377 : Part 2 : 1990, Test No 9

[12] BS 1377 : Part 3 : 1990, Test No 5.6

[13] $SO_4 = 1.2 \times SO_3$

[14] BRE Special Digest One (Concrete in Aggressive Ground) 2005

Note that if the SO_4 content falls into the DS-4 or DS-5 class, it would be prudent to consider the sample as falling into the DS-4m or DS-5m class respectively unless water soluble magnesium testing is undertaken to prove otherwise

Key

D - Disturbed sample

B - Bulk sample

U - U100 (undisturbed sample)

W - Water sample

ENP - Essentially Non-Plastic

U/S - Underside Foundation

Comments :-

Technician :- MB

Checked & Authorised By:-

Date Checked :- 05/12/2023

Laboratory Testing Results

BS 1377 : 1990

Catalyst

Job Number : [redacted]
Client : [redacted]
Client Reference : [redacted]
Site Name : [redacted]

Date Received : 08/11/2023
Date Testing Started : 08/11/2023
Date Testing Completed : 15/11/2023

Sample Ref			Sample Type	*Moisture Content (%) [1]	*Soil Faction > 0.425mm (%) [2]	*Liquid Limit (%) [3]	*Plastic Limit (%) [4]	*Plasticity Index (%) [5]	*Liquidity Index (%) [5]	*Modified Plasticity Index (%) [6]	*Soil Class [7]	Filter Paper Contact Time (h) [8]	*Soil Sample Suction (kPa)	Insitu Shear Vane Strength (kPa) [9]	Organic Content (%) [10]	*pH Value [11]	*Sulphate Content (g/l)		
BH/TP/WS	Depth (m)	UID															SO_3 [12]	SO_4 [13]	Class [14]
TPBH2	0.45		D	25	<5	50	24	26	0.04	25	CH	168	112	140					
TPBH2	1.0		D	25	<5	52	22	30	0.11	29	CH	168	114	140					
TPBH2	1.5		D	23	<5									140					
TPBH2	2.0		D	24	<5	51	22	29	0.08	28	CH	168	119	140					
TPBH2	2.5		D	24	<5									140					
TPHB2	3.0		D	24	<5	51	23	28	0.05	26	CH	168	121	140					

Notes :-

[1] BS 1377 : Part 2 : 1990, Test No 3.2

[2] Estimated if <5%, otherwise measured

[3] BS 1377 : Part 2 : 1990, Test No 4.4

[4] BS 1377 : Part 2 : 1990, Test No 5.3

[5] BS 1377 : Part 2 : 1990, Test No 5.4

[6] BRE Digest 240 : 1993

[7] BS 5930 : 1981 : Figure 31 - Plasticity Chart for the classification of fine soils

[8] In-house method S9a adapted from BRE IP 4/93

[9] Values of shear strength were determined in situ using a Pilcon hand vane or Geonor vane (GV).

[10] BS 1377 : Part 3 : 1990, Test No 4

[11] BS 1377 : Part 2 : 1990, Test No 9

[12] BS 1377 : Part 3 : 1990, Test No 5.6

[13] $SO_4 = 1.2 \times SO_3$

[14] BRE Special Digest One (Concrete in Aggressive Ground) 2005

Note that if the SO_4 content falls into the DS-4 or DS-5 class, it would be prudent to consider the sample as falling into the DS-4m or DS-5m class respectively unless water soluble magnesium testing is undertaken to prove otherwise

Key

D - Disturbed sample

B - Bulk sample

U - U100 (undisturbed sample)

W - Water sample

ENP - Essentially Non-Plastic

U/S - Underside Foundation

Comments :-

Technician :- MB

Checked & Authorised By:-

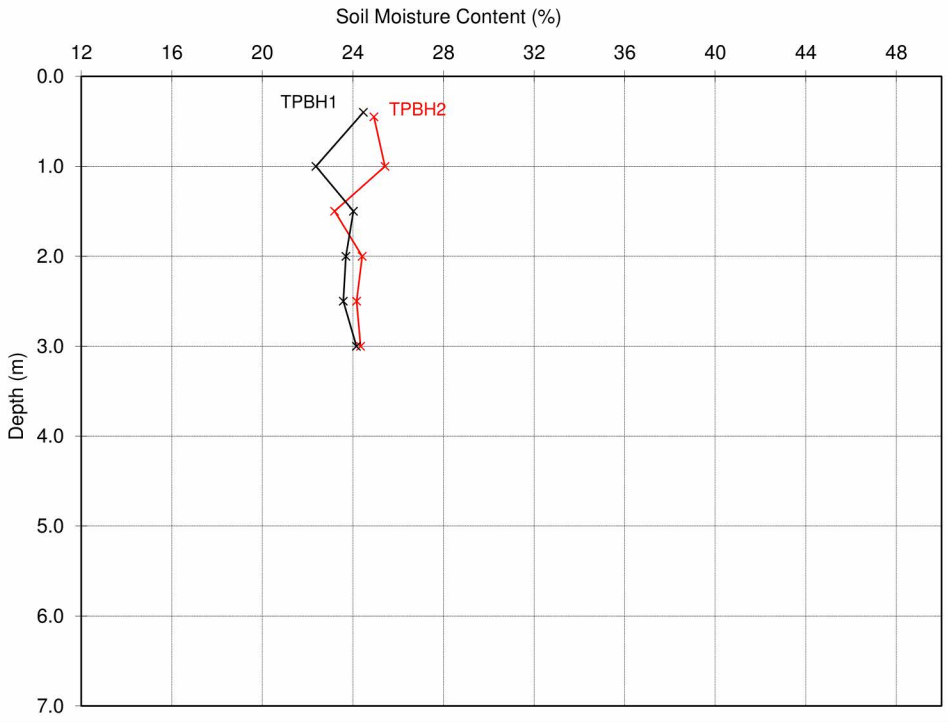
Date Checked :- 05/12/2023

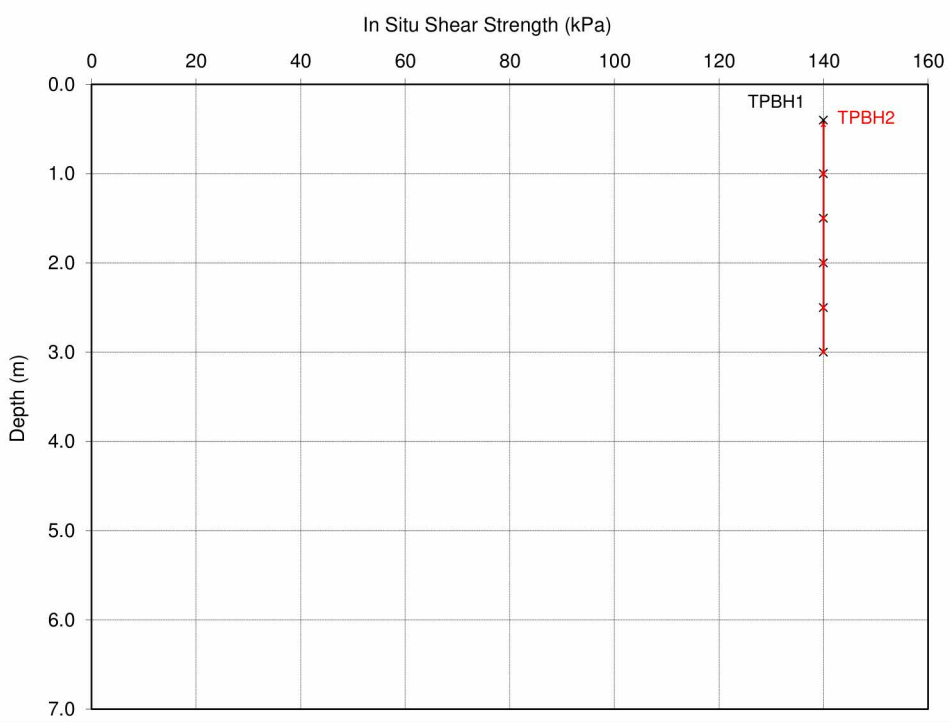
Laboratory Testing Results

Moisture Content/Shear Strength Profile

Job Number : [redacted]
Client : [redacted]
Client Reference : [redacted]
Site Name : [redacted]

Date Received : 08/11/2023
Date Testing Started : 08/11/2023
Date Testing Completed : 15/11/2023





Notes :-

1. If the Soil Fraction > 0.425mm exceeds 5% the Equivalent Moisture Content of the remainder (calculated in accordance with BS 1377: Part 2 : 1990, cl.3.2.4 note 1) is also plotted and the alternative profile additionally shown as an appropriately coloured broken line.
2. If plotted, 0.4 LL and PL+2 (after Driscoll, 1983) should only be applied to London Clay (and similarly over consolidated clays) at shallow depths.

Unless otherwise stated, values of Shear Strength were determined in situ using a Pilcon Hand Vane the calibration of which is limited to a maximum reading of 140 kPa. (Not UKAS accredited)

Comments :-

Checked & Authorised By:-

Date: 05/12/2023

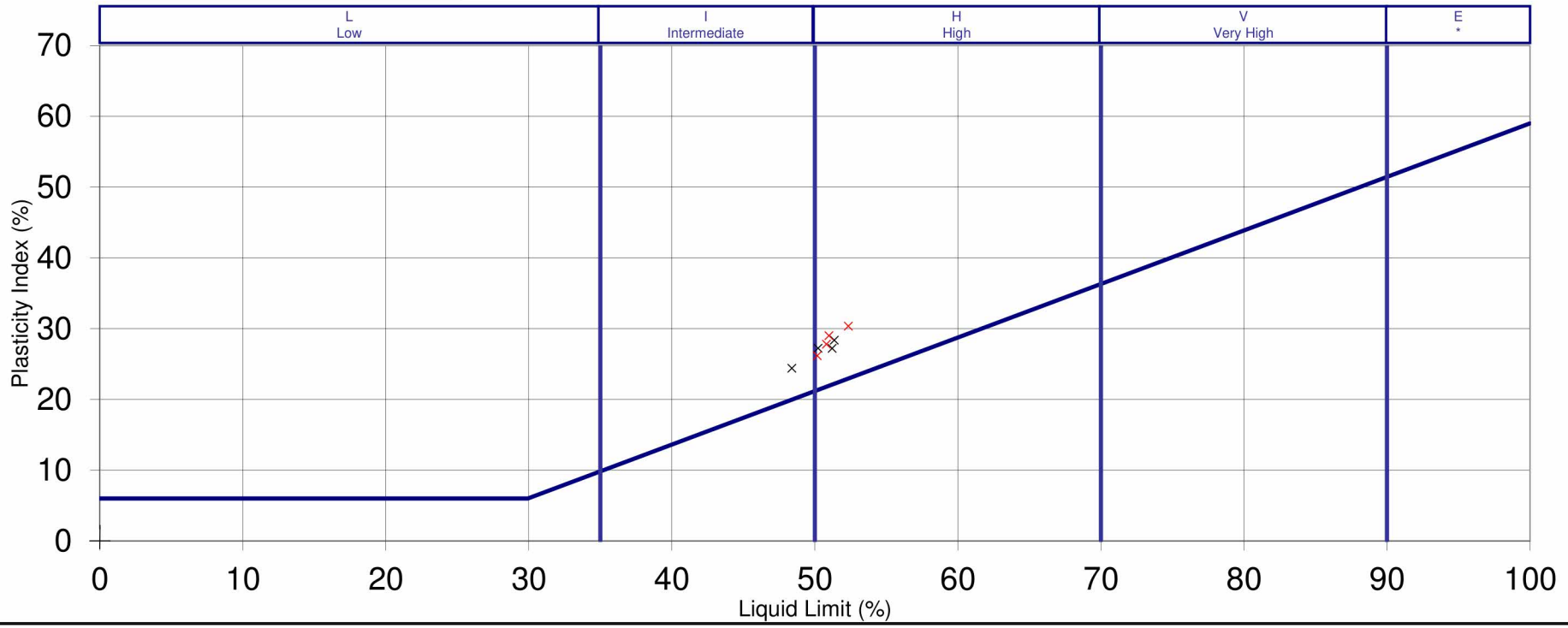
Laboratory Testing Results

Plasticity Chart for the classification of fine soils and the finer part of coarse soils
In Compliance with BS5930 : 1999

Catalyst

Job Number : [redacted]
Client :
Client Reference :
Site Name :

Date Received : 08/11/2023
Date Testing Started : 08/11/2023
Date Testing Completed : 15/11/2023



Notes :-
SILT (M-SOIL), M, plots below A-Line
CLAY, C, plots above A-Line }M and C may be combined as FINE SOIL, F.

Key :- TPB H1
TPBH2

Comments :-

Checked & Authorised By:-

Date: 05/12/2023

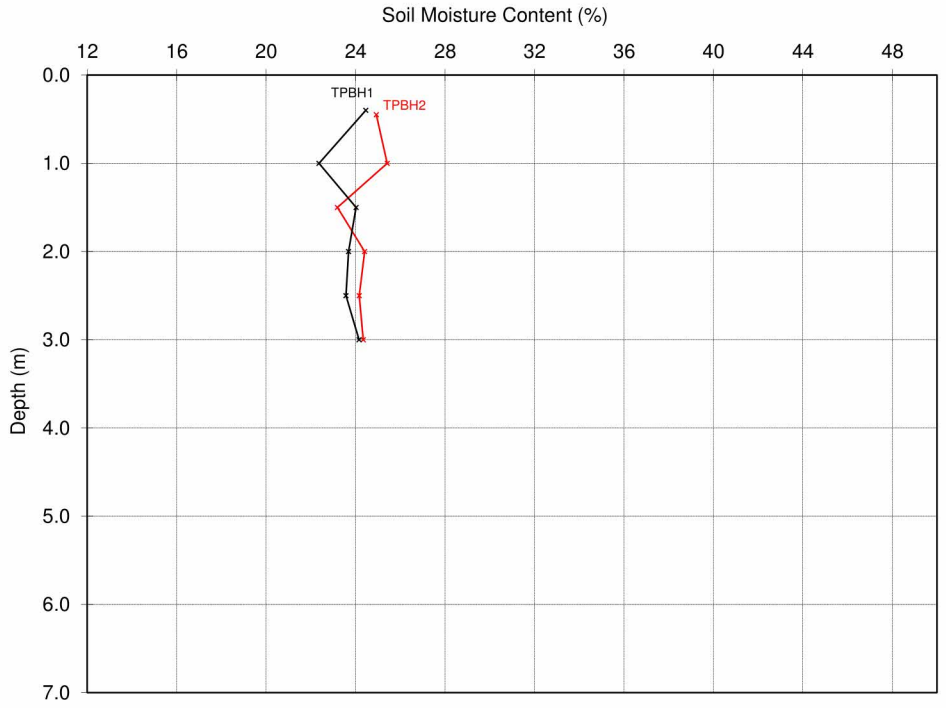
Laboratory Testing Results

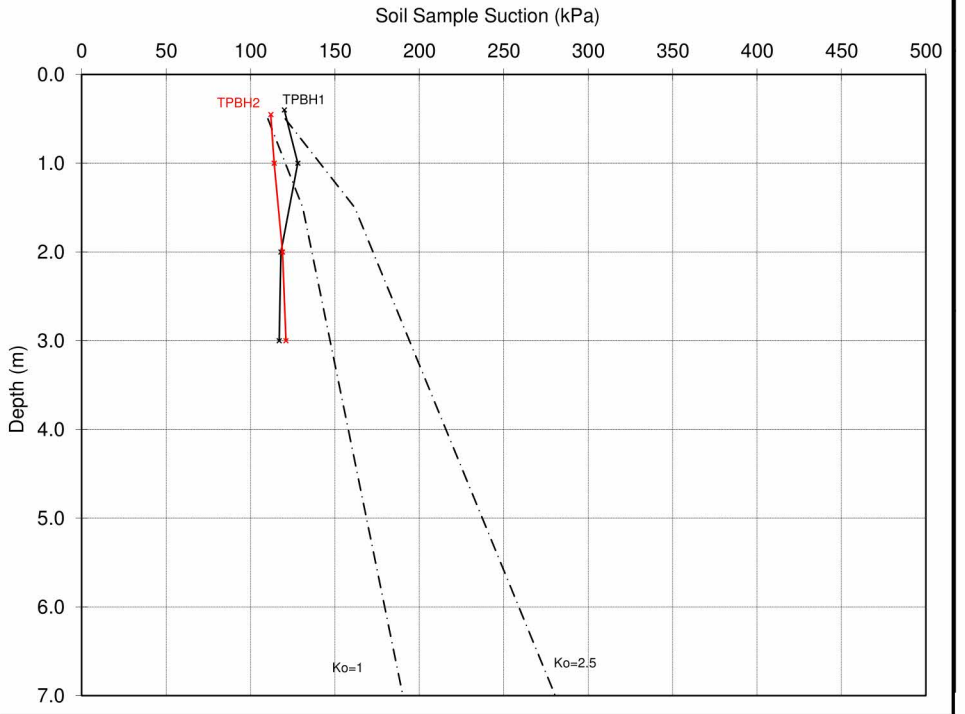
Moisture Content/Soil Suction Profile

Catalyst

Job Number : [redacted]
Client :
Client Reference :
Site Name :

Date Recieved : 08/11/2023
Date Testing Started : 08/11/2023
Date Testing Completed : 15/11/2023





Notes :-

1. If the Soil Fraction > 0.425mm exceeds 5% the Equivalent Moisture Content of the remainder (calculated in accordance with BS 1377: Part 2 : 1990, cl.3.2.4 note 1) is also plotted and the alternative profile additionally shown as an appropriately coloured broken line.
2. If plotted, 0.4 LL and PL+2 (after Driscoll, 1983) should only be applied to London Clay (and similarly overconsolidated clays) at shallow depths.

Unless otherwise stated, values of Shear Strength were determined in situ using a Pilcon Hand Vane the calibration of which is limited to a maximum reading of 140 kPa.

Comments :-

Checked & Authorised By:-

Date: 05/12/2023

6th December 2023

Dear Sirs,

HEAVE ASSESSMENT AT – [redacted]Sutton Road, Waterlooville, PO8 8PT

The following has been based on the appended ground investigation undertaken on the 31th October 2023, ref [redacted]

The site under investigation was found to be occupied by an existing 2-storey, semi-detached residential property, together with associated front and rear garden. Numerous trees were noted on site, in particular towards the rear boundary.

At the location of TP/BH1, roots of 5mm diameter were noted to a depth of 200mm bgl, roots of 4mm diameter were also noted to a depth of 0.60m bgl. Roots of 2mm diameter were then also recorded to a depth of 2.00m bgl with Hair & Fibrous roots encountered to a depth in excess of 3.00m bgl.

At the location of TP/BH2, roots of 4mm diameter were noted to a depth of 300mm bgl, roots of 3mm diameter were also noted to a depth of 0.60m bgl. Roots of 2mm diameter were then also recorded to a depth of 2.00m bgl with Hair & Fibrous roots encountered to a depth in excess of 3.00m bgl.

The roots obtained from the locations of both TP/BH1 and TP/BH2 were all found to be 'live' and most likely associated with an Oak Tree.

No groundwater was recorded during the current ground investigation.

The superficial natural clay encountered beneath the site has been classified as having a 'medium' volume change potential as defined by the National House Building Councils (NHBC), indicating the soils have a potentially 'medium' sensitivity to moisture content changes therefore the possibility of heave occurring following tree removal is considered to be 'likely' at this stage.

For the samples tested from BH1 the suction was found to range between 117 kPa and 128 kPa. For the samples tested from BH2 the suction was found to range between 112 kPa and 121 kPa.

Driscoll's guidance suggests that that the natural clay encountered at the locations of BH1 and BH2 is 'not desiccated'.

The soil suction test data predicted a 'heave' of **7mm** at a depth of 0.40m bgl at the location of BH1.

The soil suction test data predicted a 'heave' of **7mm** at a depth of 0.45m bgl at the location of BH2.

If not already undertaken, it is recommended that a drainage survey of the existing system on site be undertaken in order to assess the condition of the existing system. In addition, it is also recommended, if not already commissioned, that an arboricultural report be carried out to determine the impact of tree removal.

The above results of the heave assessment are considered in the context of the methods and limitations stated within the caveats overleaf.

Yours sincerely,

Technical Director

This report provides an assessment of the likely potential for ground heave to occur should trees be removed from the basis of the guidance set out within BRE Digest 412 Desiccation in Clay Soils, 19961.

All fieldwork was generally executed in accordance with the recommendations given in British Standard BS 5930:2015 (2015) Code of practice for site investigations.

The current site investigation works were completed on the 27th October 2023 and included the excavation of two trial pits (TP1 & TP2) and the drilling of two associated boreholes, BH1 and BH2.

According to the BGS website the anticipated geology beneath the site is the Lambeth Bedrock Formation.

Full details of the investigative works and the ground conditions encountered at this site can be found on the accompanying record sheets.

Owing to the variable nature and unknown provenance of Made Ground it is possible that deeper or more extensive areas of Made Ground may exist at this site which have not been revealed by the current work.

The results of all geotechnical tests can be seen in the appended Laboratory report; all tests have been carried out on the samples recovered from the trial pit and boreholes undertaken at the site during this most recent investigation.

The Moisture Content and Atterberg Limit tests have been carried out in accordance with the recommendations given in British Standard 1377:1990, "Methods of Test for Soils for Civil Engineering Purposes".

Suction testing uses an in-house procedure derived from the guidance set out within BRE IP 4/93.

Atterberg Limits are undertaken to determine the plasticity index of cohesive clay soils and subsequently the modified plasticity index and shrinkage potential. Clays of high to extremely high plasticity (i.e. clays with a liquid limit of 50% and above) present problems associated with shrinkage and swelling.

Soil suction tests are undertaken on a natural Clay to determine the degree of moisture depletion (desiccation) within the soils (see commentary below).

Soil suction tests are undertaken on a natural Clay to
In accordance with published guidance (Driscoll, 1983)2 desiccation is considered to commence where the suction pressure is noticeable and by empirical correlation this approximately corresponds to a suction pressure of 10kN/m^2.

Significant desiccation is considered to have occurred where the suction is sufficiently large that on release it may lift a low rise building and this roughly corresponds to a suction pressure of around 100 kN/m^2. BRE412 also provides guidance as to the degree of desiccation.

Desiccation can also be estimated from the moisture related soil parameters in accordance with Driscoll's work; where the natural moisture content is less than 40% of the liquid limit the soil may be considered as desiccated. However, this guidance exclusively applies to purely fine-grained materials and should be used with caution.

The following caveats are provided, and the results of the heave assessment considered in the context of these limitations.

BRE guidance indicates that the effects of sampling disturbance are much less certain with disturbed samples than with undisturbed samples and the calculated equilibrium profile for disturbed samples should not be used for results obtained from such samples with any certainty.

In the absence of any 'control' borehole a comparison of potential 'heave' can be undertaken at this site, using the BRE Digest 412 methodology by comparing one moisture or suction content profile with another.

BRE Digest 412 states that 'Different techniques of heave prediction will inevitably give different results. As with movement calculations, the results are only estimates and should be used only to obtain an approximate magnitude of any potential heave'.

At both the locations of TP/BH1 and TP/BH2, heave is likely to exist below the currently drilled depth of 3.00m bgl. Therefore the heave value at foundation underside is likely to exceed the currently calculated estimates.