

CONWY COUNTY BOROUGH COUNCIL

**WATERLOO COTTAGE RETAINING WALL, PENTRE ISAF, LLANGERNYW, CONWY
GEOTECHNICAL GROUND INVESTIGATION REPORT**

REPORT No. E1155.GGI.R1

NOVEMBER 2019



Client : CONWY COUNTY BOROUGH COUNCIL

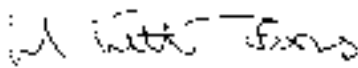
Project Title : WATERLOO COTTAGE RETAINING WALL, PENTRE ISAF,
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1. INTRODUCTION.

1.1 Background and Terms of Reference

- 1.1.1 In October 2019 e-geo Solutions Ltd were commissioned by Conwy County Borough Council to undertake a geotechnical ground investigation within the road carriageway adjacent to a retaining wall at Waterloo Cottage, Pentre Isaf, Llangernyw, Conwy. The objective of the investigation was to determine the nature of ground strata and soil properties behind the retaining wall.
- 1.1.2 This report presents the findings of the ground investigation comprising 5 Nr Dynamic Probes and window sample boreholes with in-situ ground strength tests along the length of the retaining wall. The report provides details of the ground conditions encountered, the geotechnical properties and ground bearing capacity of the near surface ground strata.
- 1.1.3 The report has been prepared by e-geo Solutions Ltd for the sole use of the Client, for the purposes described and no extended duty of care applies to other parties. Any other party using this report for any purpose whatsoever do so at their own risk and any duty of care to that party is specifically excluded.
- 1.1.4 The comments given, and opinions expressed, in this report are based on the information available at the time the report was compiled, however there may be additional information and data which becomes available at a later date which has an impact on the report content. Where data supplied by others has been used it has been assumed that the information is correct. No responsibility can be accepted by e-geo Solutions Ltd for inaccuracies within the data supplied by others.
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1.2 Report Contents

- 1.2.1 The report includes sections on:-
- Present site description, profile and setting
 - The scope of the investigation and testing and its justification
 - The geological, geotechnical and hydro-geological conditions encountered
 - The geotechnical properties and of the ground strata

2. SITE LOCATION, DESCRIPTION AND SETTING.

2.1 Site Location

- 2.1.1 The area of investigation is situated in the verge of a minor road at Waterloo Cottage, Pentre Isaf, Llangernyw. The area of investigation is shown on Figure 1 and is centred at Grid Reference SH87299 69191.

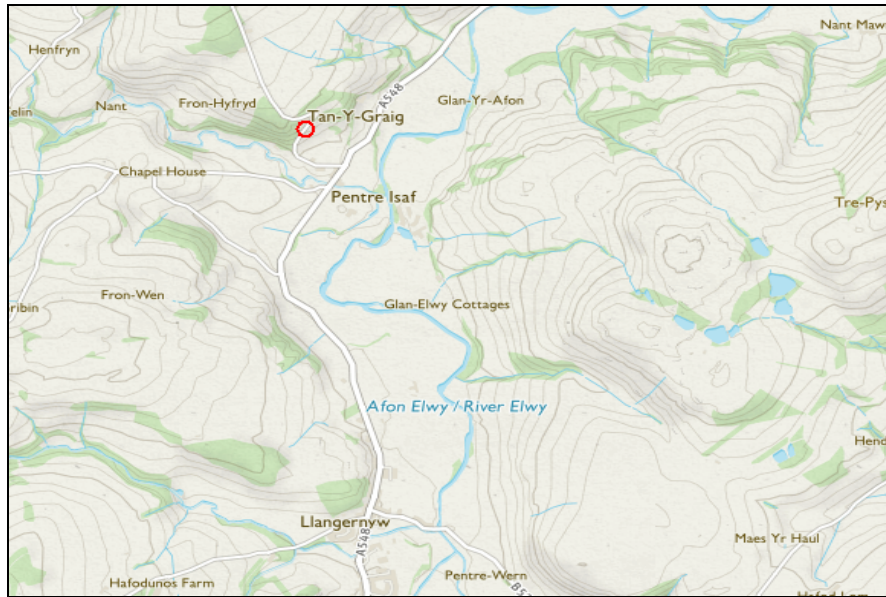


Figure 1 – Site Location

2.2 Site Description and Topography

- 2.2.1 The area of investigation comprises a road verge and the ground behind a retaining wall on the east side of the road. The retaining wall is approximately 3m in height and is between the road and the adjacent fields which slope steeply to the east. The area and extent is shown on Plate 1 below:



2.3.1 The British Geological Survey map for the area shows that drift deposits are absent at the site and over the surrounding area for at least 100m in all directions. To the south and 100m down gradient there is glacial till. The glacial till is likely to be of relatively shallow depth and probably less than 5m thick. The bedrock below the site comprises mudstone of the Elwy Formation.

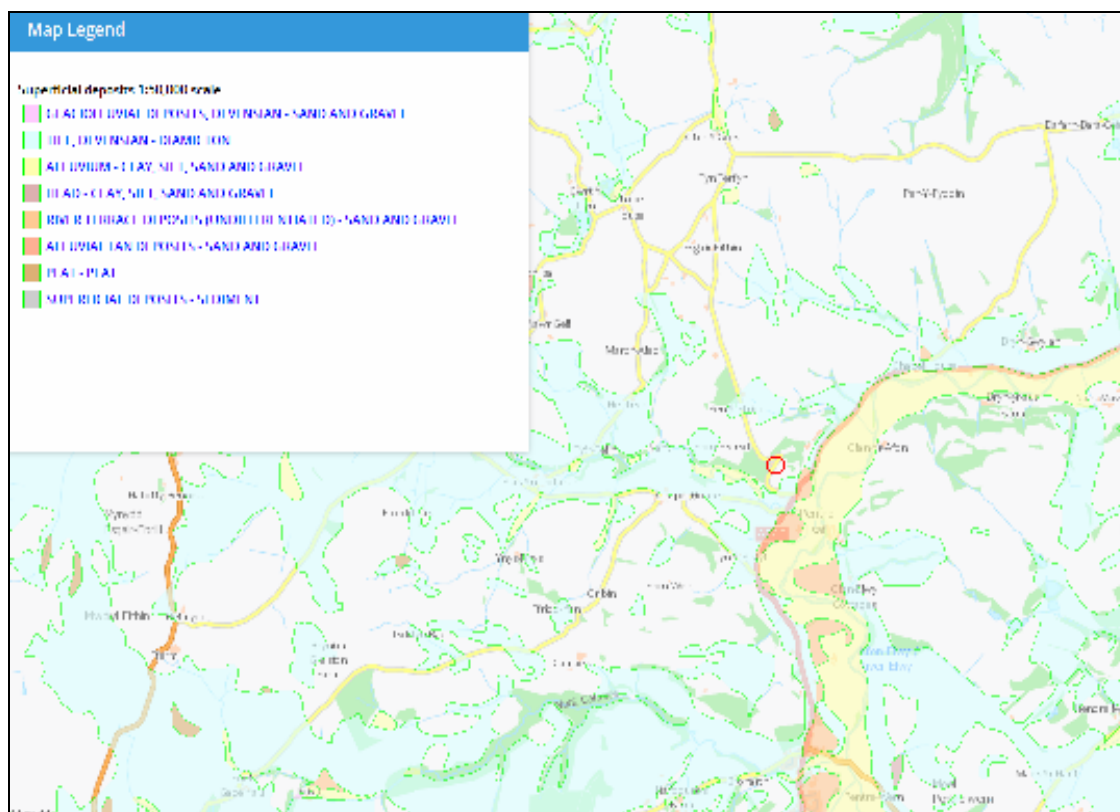


Figure 2 – Superficial Geology Map Extract

3. GROUND INVESTIGATION WORKS.

3.1 Previous Investigations

- 3.1.1 No known previous ground investigations have been undertaken at the site.

3.2 Scope of Work – Exploratory Holes

- 3.2.1 A geotechnical ground investigation was undertaken to provide information on the ground conditions and geology behind the retaining wall. The works were carried out by e-geo Solutions Ltd with the field work element undertaken on 15th October 2019. The investigation was designed, supervised and administered by e-geo Solutions Ltd and undertaken in accordance with BS5930 (2015) – code of Practice for Site Investigations (Amendment 1).

- 3.2.2 The main scope of work involved:

- The construction of 5 Nr. dynamic probes with continuous in-situ standard penetration tests (SPT) to a maximum depth of 5.30m. Dynamic probe records are presented in Appendix 1
- The construction of a window sample borehole to 3.00m.
- The examination of ground strata by a geo-environmental engineer with the description of soil types. Detailed descriptions of the ground strata are presented in the borehole records in Appendix 2.

3.3 Scope of Work – Testing and Analysis

- 3.3.1 No laboratory geotechnical was undertaken but samples are retained.

3.4 Trial Hole Locations

- 3.4.1 Dynamic probe and window sample borehole locations are indicated on Figure 3 below.

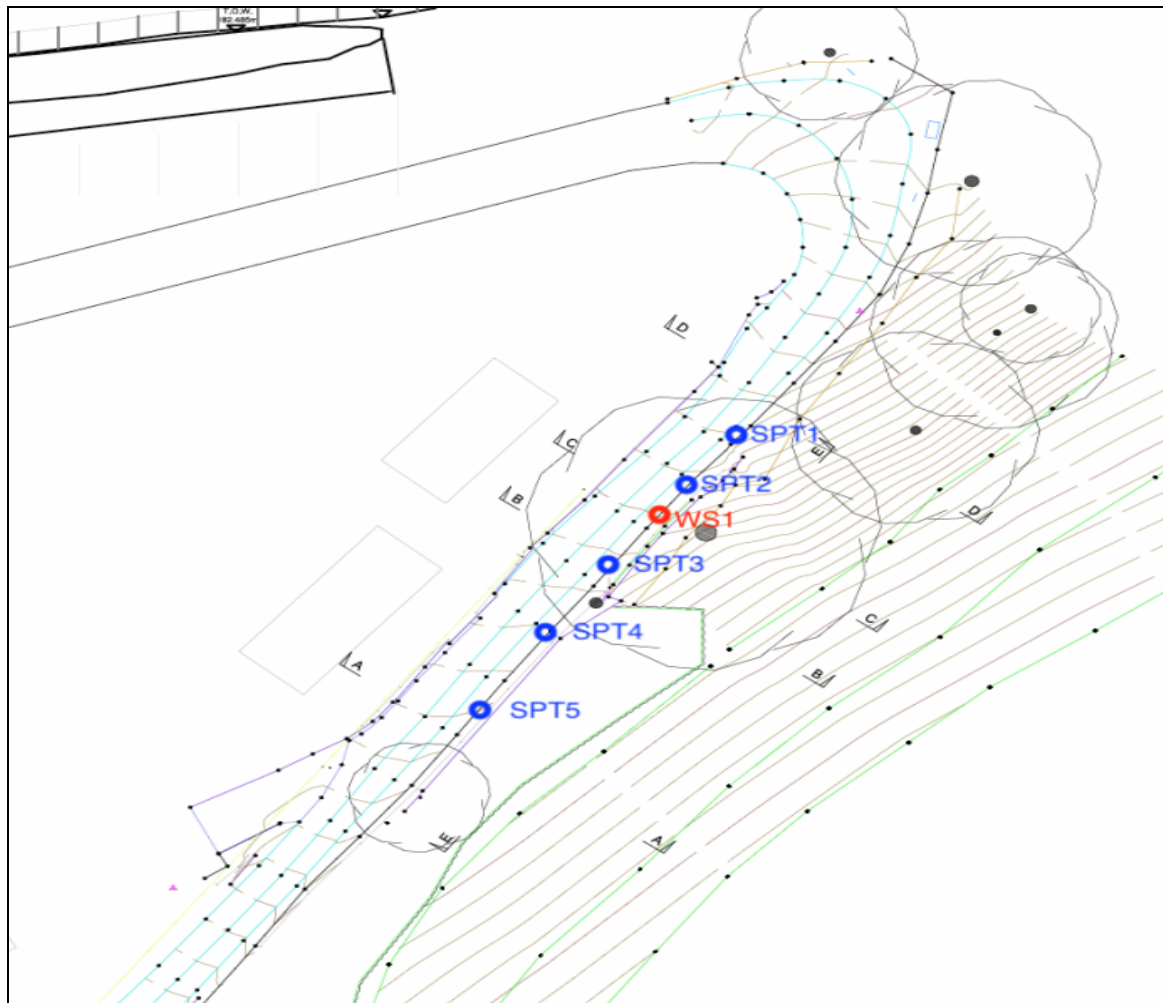


Figure 3 – Dynamic Probe and Window Sample Borehole Locations

4. GROUND CONDITIONS AND GEOLOGY.

4.1 General

- 4.1.1 Details of the ground strata and depths are presented on the borehole record in Appendix 1 and 2. A summary of the findings are presented below.

4.2 Stratigraphy

- 4.2.1 The general stratigraphic sequence was:

MADE GROUND - Firm dark grey to black slightly gravely sandy SILT
GLACIAL SILT – Soft medium greyish brown becoming medium brown very gravely SILT
BEDROCK - (Strong) medium and medium grey brown MUDSTONE

- 4.2.2 The strata and depths encountered during the investigation was:

Stratum	Description	Depth to base m range (average)
MADE GROUND	Grass topped firm dark grey to black slightly gravely sandy SILT with some tarmac gravel	0.30
GLACIAL SILT	Soft medium greyish brown very gravely sandy clayey SILT. Gravel is fine to coarse angular siltstone. Low cobble content	2.45m to 5.30m
BEDROCK	Strong medium grey brown fractured MUDSTONE	From 2.45m to 5.30m

4.3 Groundwater

- 4.3.1 No groundwater was encountered in the boreholes.

4.4 Contamination Observations

- 4.4.1 During the examination of the ground strata no obvious indications of contamination was noted however the upper 0.30m of ground contained tarmac gravel fragments.

4.5 Geotechnical Properties

- 4.5.1 From the Dynamic probe tests the following equivalent SPT 'N' values were obtained in the various strata.

Stratum	Description	Depth	SPT 'N' value
MADE GROUND	Grass topped firm dark grey to black slightly gravely sandy SILT with some tarmac gravel	0.0-0.2	2,2,3,3,2
GLACIAL SILT	Soft medium greyish brown very gravely sandy clayey SILT. Gravel is fine to coarse angular siltstone. Low cobble content	0.2-0.5 0.5-0.8 0.8-1.1 1.1-1.4 1.4-1.7 1.7-2.0 2.0-2.3 2.3-2.6 2.6-2.9 2.9-3.2 3.2-3.5	3,5,10,6,4 4,6,7,5,9 3,5,4,5,5 4,3,1,4,2 2,0,1,2,0 1,0,2,1,3 7,1,3,1,7 6,1,5,9 7,4,11,10 10,10,11 16,12

		3.5-3.8 3.8-4.1	15,23 17,21
BEDROCK	Strong medium grey brown fractured MUDSTONE	2.45 to 5.3	50+ Refused

- 4.5.2 From these SPT N value results, and using a correlation factor (Stroud, Sowers and Sivrikaya&E.Togrol) of 5 based on the soil type (clay) and its assumed plasticity (low to medium plasticity) the following shear strengths can be assumed for the ground at various depths.

Stratum	Description	Depth (m)	Assumed Shear Strength kN/m ² (f=5)
MADE GROUND	Grass topped firm dark grey to black slightly gravelly sandy SILT with some tarmac gravel	0.0-0.2	12
GLACIAL SILT	Soft medium greyish brown very gravelly sandy clayey SILT. Gravel is fine to coarse angular siltstone. Low cobble content	0.2-0.5 0.5-0.8 0.8-1.1 1.1-1.4 1.4-1.7 1.7-2.0 2.0-2.3 2.3-2.6 2.6-2.9 2.9-3.2 3.2-3.5 3.5-3.8 3.8-4.1	28 31 22 14 5 7 21 32 30 31 28 38 38
BEDROCK	Strong medium grey brown fractured MUDSTONE	2.5 to 5.3	300+

4.6 Retaining Wall Height and Depth to Bedrock

- 4.6.1 The height of the existing retaining wall measured from ground level at the dynamic probe and borehole location to the base of the wall compared to the depth to bedrock (refusal) is indicated below.

DCP Nr.	Depth to Bedrock (mbgl)	Retaining Wall Height (m)
DCP1	2.45	1.70
DCP2	3.10	2.00
DCP3	3.60	2.40
DCP4	5.30	2.70
DCP5	4.90	3.00

5. GEOTECHNICAL CONSIDERATIONS

5.1 Ground Conditions

- 5.1.1 From the findings of the borehole and dynamic probe investigation the ground behind the retaining wall comprises soft medium greyish brown very gravely sandy clayey SILT with a low cobble content to a depth that ranges from 2.30m bgl (DCP1) to 5.30m bgl (DCP4). Below the silt is siltstone bedrock.
- 5.1.2 Within the upper 2 to 3m there were sand lenses which could indicate that the ground immediately behind the wall is made ground of natural origin, which has been excavated and replaced as fill behind the wall.
- 5.1.3 In all dynamic probes the SPT N values obtained in the ground between 1.50m and 2.50m were very low (typically 0 to 2) indicating very loose or soft ground and may be due to the outward movement of the retaining wall.
- 5.1.4 No groundwater was encountered.

5.2 Existing Retaining Wall Foundations

- 5.2.1 The existing retaining wall is likely to be founded on the soft medium greyish brown very gravely sandy clayey SILT and just above the bedrock level.

Appendix 1 - Dynamic Probe Records

Depth (m)	Sample/ Test	Field Record	Depth (m)	Strata Description	Casing Depth(m)	Water Depth(m)
0.00 - 0.20	SPT N = 2	1,1				
0.20 - 0.50	SPT N = 3	1,1,1				
0.50 - 0.80	SPT N = 4	2,1,1				
0.80 - 1.10	SPT N = 3	1,1,1				
1.10 - 1.40	SPT N = 4	1,1,2				
1.40 - 1.70	SPT N = 2	1,0,1				
1.70 - 2.00	SPT N = 1	0,0,1				
2.00 - 2.30	SPT N = 7	3,3,1				
2.30 - 2.50	SPT N = Refuse	16,50/50mm,				
				Base of DP at 2.45		

SITE: RETAINING WALL AT WATERLOO COTTAGE, LLANGERNYW	BOREHOLE No:
LOCN:WATERLOO COTTAGE, PENTRE ISAF, LLANGERNYW, CONWY	DCP 2
CLIENT: CONWY COUNTY COUNCIL	Sheet 1 of 1
Dates : 15/10/2019	Project Ref: E1155
Elev (maOD) :	
Casing dia : 100mm	Logged By: HLJ
Engineer : e-geo Solutions Ltd	

Depth (m)	Sample/ Test	Field Record	Depth (m)	Strata Description	Casing Depth(m)	Water Depth(m)
0.00 - 0.20	SPT N = 2	1,1				
0.20 - 0.50	SPT N = 5	1,2,2				
0.50 - 0.80	SPT N = 6	1,3,2				
0.80 - 1.10	SPT N = 5	2,2,1				
1.10 - 1.40	SPT N = 3	1,1,1				
1.40 - 1.70	SPT N = 0	0,0,0				
1.70 - 2.00	SPT N = 0	0,0,0				
2.00 - 2.30	SPT N = 1	0,0,1				
2.30 - 2.60	SPT N = 6	2,2,2				
2.60 - 2.90	SPT N = 7	1,3,3				
2.90 - 3.20	SPT N = Refuse	3,10,50/80mm				
				Base of DP at 3.10m		



WINDOW SAMPLE BOREHOLE AND DCP RECORD

SITE: RETAINING WALL AT WATERLOO COTTAGE, LLANGERNYW	BOREHOLE No: DCP 3 Sheet 1 of 1
LOCN: WATERLOO COTTAGE, PENTRE ISAF, LLANGERNYW, CONWY	
CLIENT: CONWY COUNTY COUNCIL	
Dates : 15/10/2019	Project Ref: E1155
Elev (maOD) :	
Casing dia : 100mm	Logged By: HLJ
Engineer : e-geo Solutions Ltd	

Depth (m)	Sample/ Test	Field Record	Depth (m)	Strata Description	Casing Depth(m)	Water Depth(m)	
0.00 - 0.20	SPT N = 3	1,2					
0.20 - 0.50	SPT N = 10	3,5,2					
0.50 - 0.80	SPT N = 7	2,2,3					
0.80 - 1.10	SPT N = 4	2,1,1					
1.10 - 1.40	SPT N = 1	1,0,0					
1.40 - 1.70	SPT N = 1	0,0,1					
1.70 - 2.00	SPT N = 2	0,1,1					
2.00 - 2.30	SPT N = 3	1,1,1					
2.30 - 2.60	SPT N = 1	1,0,0					
2.60 - 2.90	SPT N = 4	1,1,2					
2.90 - 3.20	SPT N = 10	3,3,4					
3.20 - 3.50	SPT N = 33	4,8,21					
3.50 - 3.60	SPT N = Refuse	50/60mm					
				Base of DP at 3.60m			



WINDOW SAMPLE BOREHOLE AND DCP RECORD

SITE: RETAINING WALL AT WATERLOO COTTAGE, LLANGERNYW	BOREHOLE No:
LOCN: WATERLOO COTTAGE, PENTRE ISAF, LLANGERNYW, CONWY	DCP 4
CLIENT: CONWY COUNTY COUNCIL	Sheet 1 of 1
Dates : 15/10/2019	Project Ref: E155
Elev (maOD) :	
Casing dia : 100mm	Logged By: HLJ
Engineer : e-geo Solutions Ltd	

Depth (m)	Sample/ Test	Field Record	Depth (m)	Strata Description	Casing Depth(m)	Water Depth(m)	
0.00 - 0.20	SPT N = 3	1,2					
0.20 - 0.50	SPT N = 6	1,3,2					
0.50 - 0.80	SPT N = 5	2,1,2					
0.80 - 1.10	SPT N = 5	2,2,1					
1.10 - 1.40	SPT N = 4	2,1,1					
1.40 - 1.70	SPT N = 2	1,1,0					
1.70 - 2.00	SPT N = 1	0,0,1					
2.00 - 2.30	SPT N = 1	1,0,0					
2.30 - 2.60	SPT N = 5	1,2,2					
2.60 - 2.90	SPT N = 11	3,4,4					
2.90 - 3.20	SPT N = 10	3,2,5					
3.20 - 3.50	SPT N = 16	5,5,6					
3.50 - 3.80	SPT N = 15	5,5,5					
3.80 - 4.10	SPT N = 17	5,6,6					
4.10 - 4.40	SPT N = 41	10,14,17					
4.40 - 4.70	SPT N = 64	20,25,19					
4.70 - 5.00	SPT N = 51	17,17,17					
5.00 - 5.30	SPT N = Refuse	17,20,50/60mm					
				Base of DP at 5.30m			



WINDOW SAMPLE BOREHOLE AND DCP RECORD

SITE: RETAINING WALL AT WATERLOO COTTAGE, LLANGERNYW	BOREHOLE No: DCP 5 Sheet 1 of 1
LOCN: WATERLOO COTTAGE, PENTRE ISAF, LLANGERNYW, CONWY	
CLIENT: CONWY COUNTY COUNCIL	
Dates : 15/10/2019	Project Ref: E1155
Elev (maOD) :	
Casing dia : 100mm	Logged By: HLJ
Engineer : e-geo Solutions Ltd	

Depth (m)	Sample/ Test	Field Record	Depth (m)	Strata Description	Casing Depth(m)	Water Depth(m)	
0.00 - 0.20	SPT N = 2	1,1					
0.20 - 0.50	SPT N = 4	0,2,2					
0.50 - 0.80	SPT N = 9	2,3,4					
0.80 - 1.10	SPT N = 5	2,2,1					
1.10 - 1.40	SPT N = 2	2,0,0					
1.40 - 1.70	SPT N = 0	0,0,0					
1.70 - 2.00	SPT N = 3	0,1,2					
2.00 - 2.30	SPT N = 7	1,2,4					
2.30 - 2.60	SPT N = 9	3,3,3					
2.60 - 2.90	SPT N = 10	3,3,4					
2.90 - 3.20	SPT N = 11	4,3,4					
3.20 - 3.50	SPT N = 12	3,3,6					
3.50 - 3.80	SPT N = 23	7,7,9					
3.80 - 4.10	SPT N = 21	8,8,5					
4.10 - 4.40	SPT N = 30	10,8,12					
4.40 - 4.70	SPT N = 51	15,18,18					
4.70 - 5.00	SPT N = Refuse	24,50/40mm					
				Bse of DP at 4.90m			

Appendix 2 - Window Sampler Borehole Record



WINDOW SAMPLE BOREHOLE RECORD

SITE: RETAINING WALL AT WATERLOO COTTAGE, LLANGERNYW	BOREHOLE No: WS1 Sheet 1 of 1 Project Ref: e1155 Logged By: HLJ
LOCN: WATERLOO COTTAGE, PENTRE ISAF, LLANGERNYW, CONWY	
CLIENT: CONWY COUNTY COUNCIL	
Dates : 15/10/2019	Project Ref: e1155
Elev (maOD) :	
Casing dia : 100mm	
Engineer : e-geo Solutions Ltd	Logged By: HLJ

Depth (m)	Sample/ Test	Field Record	Depth (m)	Strata Description	Casing Depth(m)	Water Depth(m)	
0.00 - 1.00	Core		0.30	Grass topped firm dark grey to black slightly gravely sandy SILT with some tarmac gravel (MADE GROUND) Soft medium greyish brown very gravely sandy clayey SILT. Gravel is fine to coarse angular siltstone. Low cobble content.			
			1.00	Soft medium to light brown very gravely sandy clayey SILT. Gravel is fine to coarse angular siltstone. Low cobble content. Rare lenses of reddish brown sand			
1.00 - 2.00	Core						
2.00 - 3.00	Core						
			3.00	Strong medium grey brown fractured MUDSTONE			
				No penetration from 3.00m			