



Geological Report and Geotechnical Review of Proposed Minerals Development at White Cross Farm, Nr WALLINGFORD, Oxfordshire

August 2021





#### **Quality Assurance Review**

- Project Name: Geological Report and Geotechnical Review of Proposed Minerals Development at White Cross Farm, Wallingford, Oxfordshire
- Project Ref: Wal Geology & Geotech Final.doc
- Project No.: LRS/WAL/101
- Client: London Rock Supplies Ltd Unit 5, Delta Court Manor Way Borehamwood Hertfordshire WD6 1FJ

Version: Final 1.0

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#### **1. INTRODUCTION**

#### 1.1 Background

1.1.1 Greenfield Associates have been commissioned by London Rock Supplies Ltd to produce a geological and geotechnical assessment of land at White Cross Farm, near Wallingford, Oxfordshire. This document is intended to supplement the planning application for the proposed development.

#### 1.2 Proposed Scheme

- 1.2.1 The proposed development comprises the extraction of River Terrace Sand & Gravel on land at White Cross Farm, near Wallingford, in phased working scheme with the sand and gravel processed and sold into the local construction market. Following extraction, the void will be backfilled with imported inert materials that will allow the site to be restored back to original ground levels.
- 1.2.2 It is proposed that the in-situ deposits of sand and gravel will be excavated and processed with the near surface clays and soils used to restore the site as part of a phased working and restoration scheme. It is also proposed that the overburden clays will be used as a basal attenuation liner as required by the EA prior to the importation of inert material.

#### 2. SITE DESCRIPTION

#### 2.1 Location

- 2.1.1 The land at White Cross Farm covers an area of some 19 hectares and is located approximately 1km south of the Village centre of Wallingford, 18km to the north of Reading and some 20km south of Oxford. The site is centred at Grid Reference [SU 605 877], as shown in Figure 1.
- 2.1.2 The site is accessed via a farm access off the A329 that forms the western site boundary. The A329 links with the A4130 at the north western corner of the site. The A4130 is the Wallingford bypass and also forms the northern site boundary.

#### 2.2 Topography

- 2.2.1 The site comprises generally flat, low lying, agricultural land used for a mix of arable farming and grazing for livestock that covers an area of some 19 hectares.
- 2.2.2 The site is formed of three areas, a northern area used for livestock grazing and two southern areas. The western of the two southern areas is currently used for arable farming and the eastern is fallow. A drainage ditch runs from north to south down the centre of the site,

splitting the lower lying eastern part of the site from a slightly raised western half of the site. Site levels range from some 44m AOD to 46m AOD in the west of the site and approximately 43.5m AOD in the east of the site (see Figure 2).

2.2.3 The River Thames lies adjacent to the eastern site boundary, flowing from north to south. The river bank levels lie at approximately 43.5m AOD, with river water levels at approximately 42.4m AOD. The highest levels on the site are in the north western corner, where the land rises towards the roundabout. The A4130 has been constructed on an embankment that is raised by up to some 5m above the site levels.

#### 2.3 Geology

- 2.3.1 The BGS Geology of Britain viewer indicates that the bedrock of the site comprises the West Melbury Marly Chalk Formation that forms part of the Grey Chalk Subgroup of Upper Cretaceous age. The West Melbury Marly Chalk Formation is described by the BGS as *"Buff, grey and off-white, soft, marly chalk and hard grey limestone arranged in couplets."* That is generally between 15m and 25m thick. The Glauconitic Marl Member of the West Melbury Marly Chalk Formation is mapped across the majority of the site (see Figure 3). The Glauconitic marl member is generally described by the BGS as *"Calcareous glauconitic sand and glauconitic sandy silty chalk with phosphatic nodules."* and is general 2m to 4m thick.
- 2.3.2 There is a mineral assessment report published by the British Geological Survey (MAR 64 Wallingford and Goring) and BGS map sheet 254 for Henley-on-Thames that indicate that the dip of the strata is gently to the south east.
- 2.3.3 Extensive drift deposits are also mapped in this area, comprising continuous deposits of River Terrace Deposits and alluvium in the river valleys. The terrace deposits comprise the Northmoor Sand and Gravel Member that is generally described as "Sandy limestone gravel" by the BGS. The general stratigraphy of the area is shown in Table 1.

Table 1 General Stratigraphy of the Wallingford and Oxfordshire area

*Drift* Recent and Pleistocene Alluvium

River Terrace Deposits - Northmoor Sand and Gravel Member

Solid Upper Cretaceous Grey Chalk Subgroup

**Lower Cretaceous** Upper Greensand Group The Glauconitic Marl Member West Melbury Marly Chalk Formation

- 2.3.4 The Mineral Assessment Report published by the British Geological Survey confirms that the river terrace deposits are First Terrace Deposits that generally occur as a narrow outcrop flanking the River Thames, locally overlain by alluvium. The River Terrace Sand and Gravel mapped within the Wallingford area usually comprises mainly fine to coarse gravels with medium and coarse sands present. These deposits have a maximum proven thickness of 9m, but where proved generally range in thickness from 1.6m to 8m in thickness.
- 2.3.5 The gravel fraction is usually described as flint, quartz and limestone with minor amounts of chalk and ironstone in a matrix of quartzitic fine to medium sand which has a pinky brown to yellowish brown colour. Alluvium is mapped across the eastern half of the site overlying the sands and gravels comprising soft dark grey shelly clay and seams of peat.
- 2.3.6 A series of geological site investigations have been carried out on the site that proved the presence of a sand and gravel deposit with a thickness ranging from 0.50m to 5.20m. This deposit comprises brown to orange-brown quartzitic sand and gravel, with sub-angular flint and minor amounts of sandstone and limestone gravels and occasional angular cobbles. All of the boreholes drilled were terminated in the stiff grey/cream clays and soft marls of the Lower Chalk formation, of Cretaceous age.
- 2.3.7 The overburden materials comprise topsoil, subsoil and recent alluvium, ranging in thickness from 0.6m to up to 3.2m, generally thickening to the east. These materials consist of clayey soil with occasional flint and quartzite pebbles with occasional beds of peat. Within the area investigated an extraction area of 15.5ha has been identified. The potential extraction area has been designed using suitable margins to the boundaries of the site, as shown in the construction design plans in Appendix D.

#### 2.5 Footpaths & Rights of Way

2.5.1 There is a public footpath (The Thames Way) that runs along the crest of the embankment that forms the western edge of the River Thames. It is proposed that this footpath will not be impacted in any way as part of the development.

#### 2.6 Services & Utilities

2.6.1 There are no known overhead or buried cables within the site. There are no gas mains or water mains which lie within or border the site. Information supplied by the landowner suggests that a BT Openreach cable is present along the A329 Reading Road. This will not be affected by the proposed development.

#### **3. SURFACE WATER AND GROUNDWATER**

#### 3.1 Surface Water

- 3.1.1 The River Thames lies adjacent to the eastern site boundary, flowing from north to south. The riverbank levels lie at approximately 43.5m AOD, with river water levels at approximately 42.4m AOD. The highest levels on the site are in the north-western corner, where the land rises towards the roundabout. The A4130 has been constructed on an embankment that is raised by up to some 5m above the site levels.
- 3.1.2 Two drains are present onsite. One runs from north to south and one is present flowing from a culvert under the A4130, flowing towards the south-east across the site into the Thames.
- 3.1.3 The flood map for the site published by the Environment Agency indicates that the majority of the site lies within Flood Zones 2 and 3. The western part of the site does not lie within any flood zone and is where all of the proposed infrastructure, processing plant and marina welfare buildings will be located.
- 3.1.4 The proposed minerals development includes a soakaway pond which will be restored into a reedbed has been included as part of the proposed site design in order to manage surface water runoff from the site and may provide additional floodplain water storage. It is proposed that the ditches and watercourses through the site will continue to be linked to the river at the northern end of the site.

#### 3.2 Groundwater

- 3.2.1 A total of 12 borehole monitoring points have been installed on site. Water monitoring standpipes have been installed in 4 boreholes WSA 14/1, WSA 14/2, WSA 14/3 and WSA 14/4. Water and gas monitoring standpipes have been installed in 8 boreholes (GM 16/1 GM 16/8).
- 3.2.2 Continued monitoring of these boreholes indicates that the groundwater on the site generally lies at around ~43.5mAOD (see Figure 4).

#### 4. MINERAL QUALITY AND MINERAL RESOURCES

#### 4.1 Site Investigation

4.1.1 Three phases of drilling have been carried out at the site, the first phase was carried out during 2014 with additional boreholes drilled during 2015 and 2016. A summary of the drilling carried out and mineral thickness proved is given in Table 2 below. The borehole locations are presented on Figure 2 and the borehole logs included as Appendix A.

Table 2 Summary of borehole results

Borebole ID	Fasting	Northing		Overburden	Base of Overburden Level	Mineral Thickness (m)	Base of Mineral Level (mAOD)
WSA 14/1	460539	187981	44 49	1.9	42.6	3.0	39.6
WSA 14/2	460400	187827	45.74	0.9	44.8	4 4	40.4
WSA 14/3	460552	187637	43.63	0.9	42.7	3.3	39.4
WSA 14/4	460629	187488	43.60	3.2	40.4	0.5	39.9
WSA 14/5	460554	187803	43.63	0.8	42.8	2.9	39.9
WSA 14/6	460659	187778	43.47	2.1	41.4	1.9	39.5
WSA 14/7	460418	187698	45.12	0.8	44.3	3.4	40.9
WSA 14/8	460482	187897	45.23	0.8	44.4	3.8	40.6
WSA 14/9	460635	187637	43.45	2.5	41.0	1.2	39.8
WSA 14/10	460554	187548	43.37	0.9	42.5	2.1	40.4
WCF-15/1	460 420	187 521	44.75	0.8	44.0	2.0	42.0
WCF-15/2	460 513	187 586	44.29	1.0	43.3	1.2	42.1
WCF-15/3	460 398	187 627	44.97	1.0	44.0	1.8	42.2
WCF-15/4	460 486	187 688	44.73	0.7	44.0	2.6	41.4
WCF-15/5	460 495	187 845	44.83	0.7	44.1	3.5	40.6
WCF-15/6	460 433	187 916	45.72	1.0	44.7	3.9	40.8
WCF-15/7	460 581	187 701	43.49	0.9	42.6	2.1	40.5
WCF-15/8	460 603	187 595	43.27	1.7	41.6	1.2	40.4
	1		1		1		
WCF 16/1	460627	187949	43.65	1.6	42.0	2.1	39.9
WCF 16/2	460701	187961	43.59	2.3	41.3	1.3	40.0
WCF 16/3	460603	187875	43.57	1.4	42.2	2.3	39.9
WCF 16/4	460680	187873	43.52	2.3	41.2	1.3	39.9
	1	Γ	1				
GM 16/1	460670	188032	43.70	2.0	41.7	2.3	39.4
GM 16/2	460381	187909	46.49	1.7	44.8	4.6	40.2
GM 16/3	460353	187766	46.50	1.5	45.0	5.2	39.8
GM 16/4	460344	187623	45.61	1.7	43.9	1.8	42.1
GM 16/5	460344	187485	45.70	1.5	44.2	1.6	42.6
GM 16/6	460411	187445	44.53	0.6	43.9	1.8	42.1
GM 16/7	460538	187493	44.18	1.8	42.4	Barren	Barren
GM 16/8	460733	187975	43.24	2.1	41.1	0.8	40.3

4.1.2 The majority of the boreholes drilled on the site have been in order to prove the thickness of overburden and mineral present on the site. The GM16 series of boreholes were drilled primarily for groundwater and gas monitoring purposes for an environmental permit application. Standpipes have also been installed in boreholes WAL14/1, WAL14/2, WAL14/3 and WAL14/4.

#### 4.2 Mineral Quality

4.2.1 A significant sand and gravel deposit has been identified as part of the site investigation for the marina development. In order to assess the viability of this deposit a number of laboratory test have been carried out on the material. These tests include particle size distribution (PSD), Ten Percent Fines Value, Aggregate Crushing Value, Particle Density, Water Absorption and Magnesium Sulphate test. The results of the testing are presented in Appendix B and summaries in Tables 3 and 4 below. The results indicate that the material will be suitable for a range of single size sand and gravel products and for use in concrete.

Table	3:	Summary	of	aggregate	test	results
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Test	Result
10% Fines Value	140kN
Aggregate Crushing Value	22%
Water Absorption	1.9%
Particle Density (Saturated)	2.65 Mg/m <sup>3</sup>
Particle Density (Dried)	2.60 Mg/m <sup>3</sup>
Apparent Density	2.74 Mg/m <sup>3</sup>
Magnesium Sulphate Value	6%

#### Table 4: Particle Size Distribution

Fines	Sand	Gravel
(-63um)	(-63um-4mm)	( + 4mm)
4%	50%	46%

#### 4.3 Proven Mineral Resources

4.3.1 An assessment has been carried out for the site, which includes an appraisal of the overburden and mineral quantity, together with the mineral quality, and mineral distribution across the site.

- 4.3.2 This assessment indicates that there is an average of 1.4m of overburden present across the site, ranging from 0.6m to 3.2m and an average of 2.4m of mineral present that ranges in thickness from 0.5m to 5.2m. One borehole (GM16/7), located on the southern site boundary did not prove any mineral.
- 4.3.3 In order to calculate the potential reserves geological models have been created of the base of overburden and the base of mineral. Volumes of overburden and mineral have been calculated and the reserves are presented in Table 5 below.

**Table 5: Potential Mineral Reserves** 

Extraction Area	Soils & Overburden	Volume of in- situ Mineral	Potential Processing Losses	Estimated Saleable Reserves
(ha)	(m³)	(m³)	(%)	tonnes
15.5	180,000	339,600	10	550,152

#### 5. GEOTECHNICAL REVIEW OF PROPOSALS

#### 5.1 Mineral Excavation

- 5.1.1 The geotechnical aspects of the proposals have been divided into two groups based on the materials that are being assessed. The initial extraction phasing requires the assessment of the in-situ materials (sand, gravel and clay) with the restoration phases requiring the consideration of imported inert materials that are to be used as backfill material and is required to be stable in the long term.
- 5.1.2 In order to design the site so it is stable, especially adjacent to the River Thames and other site boundaries, geotechnical testing of the available material has been carried out. Particle size distribution testing on 15 bulk samples that are considered to be representative of the sand and gravel has been carried out. The clay materials have been tested for Moisture Content, 4 point liquid and plastic limit, Permeability and Dry Density/Moisture Content relationship with hand shear vane tests at each compaction point. The results of testing are presented in Appendix B at the rear of this report.
- 5.1.3 The friction angle and unit weight of the sand and gravel have been estimated using the methodology set out in BS8002:2015. This indicates that the friction angle of the material may be approximately 37° as the sand and gravel is has a uniformity coefficient in excess of 2 and is generally sub angular. The guidance also indicates that a unit weight of 20kN/m<sup>3</sup> is likely to be appropriate for the material.
- 5.1.4 The same guidance has been used to estimate the friction angle and unit weight of the clay and peat on site. The friction angle of the clay has been estimated using the plasticity index/friction angle relationship. The plasticity index of the clay samples indicates a conservative friction angle range of 23° to 25°, therefore an average angle of 24° has been adopted. The guidance also indicates that a unit weight of 18kN/m<sup>3</sup> is likely to be appropriate for the material. The undrained cohesion of the clay material is estimated to be 35kPa. Testing was not carried out on the peat, conservative values have been selected based on the field descriptions which generally described the material as soft silty organic rich clay. The parameters selected are a unit weight of 12.5kN/m<sup>3</sup>, an undrained cohesion of 20kPa, drained cohesion of OkPa and friction angle of 24°. The basal chalk marl has been assigned geotechnical parameters of a unit weight of 20kN/m<sup>3</sup>, friction angle of 26° based on descriptions of material obtained during the drilling investigations.
- 5.1.5 The proposed extraction design indicates that side slopes will be excavated at a gradient of approximately 1v:2h (27°) and it is proposed that the excavation will be dewatered so the

sand and gravel can be excavated more easily and the geological barrier required for the backfill can be compacted in place.

- 5.1.6 Geotechnical analysis of the initial cut slope at 1v:2h has been carried out to determine the stability of the slope during the extraction phase of the work (see Appendix C). Three sets of analysis have been carried out, these are the undrained short term stability, the drained long term stability and an intermediate scenario that is partially drained. In the undrained (short term) scenario the minimum FoS for full face failure is 1.425, which is considered to be acceptable. There is however the potential for shallow, small scale failures within the sand and gravel deposit at the base of the excavation. The exposed sand and gravel face that will need to be monitored and maintained where necessary.
- 5.1.7 In the medium term the minimum FoS is 1.157, this is considered to be acceptable due to the temporary nature of the excavation. The long term drained analysis of the excavation indicates that there may be some instability in the upper part of the face, where the predominantly clay strata are present. The instability is likely to be small scale shallow failures. The minimum FoS for full face failures is marginally in excess of 1.
- 5.1.8 As there will be no delay in the backfilling operations following mineral extraction the slope remains stable in the long term, with the FoS with this gradient is 1.196 during restoration works. It is recommended that the working faces can be developed at 1v:2h.
- 5.1.9 As the extraction progresses the site will need to be dewatered from a sump in the extraction area. It is proposed that the fines could be mixed with the imported inert materials waste or overburden material for liner works in the long term.
- 5.1.10 Lagoon construction will be carried out under the quarries regulations 1999, thus there is a requirement for all of the lagoons and excavation faces to be designed, constructed and maintained to ensure they are stable throughout the life span of the development.
- 5.1.11 During the works there will be two site accesses, one for HGV's into the site and one for HGV's out of the site. The site entrance will utilise the existing farm access on the western site boundary and the site exit will be on to the A4130 Nosworthy Way on the northern site boundary. At the location of the access onto Nosworthy Way the road lies approximately 3m higher than the site levels. It is proposed that the levels will be raised within the site to allow access onto the road. The ramp up to the road will be constructed in accordance with

the specification for highways works using appropriate overburden materials from within the site and capped off with recycled aggregate to form a firm, clean surface.

#### 5.2 Landscaping and Restoration

- 5.2.1 It is not considered that there is not sufficient overburden clay resource available to suitably landscape and restore the site following mineral extraction, thus it is proposed that imported inert material shall be used to raise the level to ensure restoration to original site contours. It is standard practice for the Environment Agency to require inert fill material to be placed within a "lined void" to prevent any possible contaminants leaching from the material.
- 5.2.2 Testing of the available clay on site indicates that it would be suitable for use as a geological barrier. In some cases the clay was found to be wet of the optimum moisture content and would need to be dried to ensure it can be compacted sufficiently. The clay will be placed along the edges of the area to be filled to ensure the imported material is not in contact with any groundwater. The geological barrier will be built up the sides of the compacted imported fill at a gradient of approximately 1v:3.5h to ensure it remains stable in the long term.
- 5.2.3 It is considered that some degree of erosion control will be required in some sensitive/high traffic areas of the site.
- 5.2.4 A stability assessment has been carried out of the excavated site margins that will be constructed in imported fill. The profile stability has been analysed in the short term (undrained) and long term (drained) scenarios. The geotechnical properties adopted for the natural strata are as stated previously and fill material has been assigned properties of a unit weight of 20kN/m<sup>3</sup>, undrained cohesion of 45kPa, drained cohesion of 0kPa and friction angle of 26°. The clay comprising the "geological barrier" has been assigned properties of unit weight of 21kN/m<sup>3</sup>, undrained cohesion of 50kPa, a drained cohesion of 0kPa and friction angle of 24°.
- 5.2.5 Stability analysis of the final cut slope indicates that in the short term (prior to backfilling and restoration) the minimum FoS for the slope is 1.748, rising to 2.054 fur full face failures. The long term stability for the slope, once the backfilling has been completed confirms no long-term impacts in relation to stability.

#### 6. CONCLUSIONS AND RECOMMENDATIONS

- 6.1 A series of geological site investigations have been carried out on the site that proved the strata on the site comprise clay, peat and sand and gravel overlying chalk bedrock. The soils will be stored during the works and used in the restoration, with the overburden used as a basal "attenuation material" prior to the importation of inert backfill materials.
- 6.2 The sand and gravel deposit has a thickness ranging from 0.50m to 5.20m. A number of aggregate tests have also been carried out that indicate the material will be suitable for a range of single size sand and gravel products and for use in concrete.
- 6.3 Across the proposed extraction area of 15.5ha it is estimated that approximately 550,000 tonnes of sand and gravel will need to be extracted. The overlying clays (180,000 m<sup>3</sup>) will be used as part of the restoration.
- 6.4 A stability assessment has been carried out on the proposed excavation slopes and the proposed slopes for the backfill operations. The analysis indicates that during the excavation slopes cut at 1v:2h will be stable in the short to medium term. Analysis of the backfill slopes indicates that the slopes will also be stable in both the short and long term with a slope to ensure long-term restoration stability of the site.

### **FIGURES**



Figure 1	Title Site Location   Project Geological &		cation Area		Greenfield
Based upon the 2006 Ordnance Survey 1:25,000 map with the permission of The Controller of	Geotechnical Review			LONDON ROCK	associates
Her Majesty's Stationary Office Crown Copyright Greenfield Associates, 1 Commercial Rd, Keyworth, Nottingham Licence No. 100020505	<sup>Site</sup> White Cross Farm, Wallingford	Project No. LRS/WAL100	Scale nts	SUPPLIES LTD	1 commerciai roâda, Keyworth, Notîlîghâm, NG12 5JS Email: admin@greenfield-associates.co.uk Tel: (0115) 9372002









#### Figure 4 Groundwater Levels, Wallingford, White Cross Farm

**Date Measured** 

Water Level (mAOD)

Greenfield Environmental

Appendix A Borehole Logs

		Depth (m)	Lithological Description		Thickness (m)	Level (m AOD)	Water Depth/ Level (m/ mAOD)	Instal	lation diagram
	0.0	0.4	<b>Soil and Subsoll</b> Clayey dark soil		0.4	44.09		0.2m above	Plain pipe
		0.4	<b>Clay</b> Yellowish, stiff clay						Bentonite
_	1.0					W	<b>ater strike at 0.88 m/ 43.61m AOD</b>	<u></u>	U.ƏM-1M
		19			1.5	42.59			
	2.0	2.1	<b>Sand</b> Brown, very silty, fine sand.		0.2	42.39			
	3.0		Sand and gravel Yellowish-brown sand and gravel. 60% gravel, 40% sand. G: fine-medium, angular-rounded flint gravel. S: fine-medium, slightly silty. Occasional small cobbles.					_2.8m	Perforated pipe with filter wrapping
	4.0				2.0	00.50			
	5.0	4.9	Clay		2.8	39.59			
		50	Grey clay, stiff, silty, turning to weak shale.		1.0	38.59			
_	6.0	0.0	End of Borehole - 5.90m					5.8m Spoil sa used	nd and gravel as backfill
	7.0								
	8.0								
	9.0								
- 1	10.0								
BOI	reho	ole No.	Contractor	Client					

Borehole No.	Contractor	Client	
WSA 14/1	Metcalfe Bros	London Rock	Greentield
Date 17/12/14	BH Dlameter 150 mm	Project Geological Investigation	associates
Grid Ref: SU 460539 187981	Surface Level 44.49 mAOD	Site White Cross Farm, Wallingford	E-mail: admin@greenfield-associates.co.uk Tel: 0115 9372002

45.74 mAOD

Surface Level

Grid Ref:

SU 460400 187827

Shell & Auger Borehole Log: Borehole No. WSA 14/2

	Depth (m)	Litholog	ical Description			Thickness (m)	Level (m AOD)	Water Depth/ Level (m/ mAOD) Grading (F: S: G)	Insta	Illation diagram
_ 0.0	03	Soil and S	Subsoil Sandy dark soil			0.3	45.44		0.2m	Plain
	0.0	<i>Clay</i> Brown to	yellow clay, firm, pebbly			0.6	44.84		G.L	pipe
- 1.0	0.9	<b>Sand and</b> Light orar (50-50 mi	G <b>ravel</b> ngey brown sand & grave ix). Gravel, fine to mediu	əl				8: 50: 42		0.5m-1m
		sand: fine Gravel, a	e-coarse. Ingular to rounded.	.0 d	0 0 0		W	ater strike at 1.78 m/		
1		Slightly si	ilty. Some clay lumps.					43.96m AOD		
- 2.0								10: 53: 37	2.8m	
- 30				10 - 0 1 - 0		2.1	42.74			Perforated
4.0		Sand and Brown san with sand. fine to coa rounded.	<b>Gravel</b> nd and gravel. 60-70% grave Fine to medium gravel, arse sand. G: Angular-sub			10	41 54	5: 66: 29		pipe with filter wrapping
- 4.0	4.2	Dabbly Sa	d		A	1.2	41.04			
- 50		Brown, pel slightly silt	bbly sand. Fine to coarse, ly.			11	40.44			-
0.0	5.3	Clay		1997.98 1		1.1	40.44			
- 6.0		Grey clay, weak grey	stiff. Silty clay, turning to shale with depth.		V (* 1997) 1997 1997 1997 1997 1997 1997 199				5.8m Spoil s use	aand and gravel
						1.7	38.74			
- 7.0		End of Bo	orehole - 7.00m							
- 8.0										
9.0										
- 10.0										
Boreho	ole No. /SA 14	4/2	Contractor Metcalfe Bros		Client	London R	ock	Gre	en	field
Date	17/12/	14	BH Diameter 150 mm		Projec Ge	eological li	nvestigatior	n ass	o c i	ates

Site White Cross Farm,

Wallingford

*a s s o c i a t e s* 1 Commercial Rd, Keyworth, Nottingham NG12 5JS E-mail: admin@greenfield-associates.co.uk Tel: 0115 9372002

	Depth (m)	Lithological Description		Thickness (m)	Level (m AOD)	Water Depth/ Level (m/ mAOD) Grading (F: S: G)	Installation diagram
_ 0.0	)	Soll and Subsoll					0.2m
	0.5	Firm peaty soil		0.5	43.01	Water strike at	G.L pipe
	0.9	Clay Soft yellow clay		0.4	42.61	43.32m AOD	Bentonite
- 1.0	)	Sand and Gravel	0 0 0 0				🚟 0.5m-1m
		Orange-brown sand and gravel. Sand fine-coarse, Gravel fine to	9 a 0 9 a 0				1.2m
		coarse. Angular-rounded. Mix of	0.0.0.0.0				
		70% gravel, 30% sand. Slightly	9 a. 019 a. 0				
- 2.0	)	gravels very angular and sharp.	0 0 0 0 0 0				
			9 a 0 19 a				
			9 a 9 a 9 6 a 10 a 10				
- 3.0	)						Perforated
			0 0 0 0				pipe with
			10 0 0 0 1 0 0			0. 74. 07	
40	)		9 a 0 9 a 0		00.04	2: / 1: 2/	
	4.2		10 - 6 - 10 - 6 10 - 10 - 10 - 1	3.3	39.31		
		Clay					4.2m
		Grey day, sun, turning to shale.					Spoil sand and gravel
6			- 10,				
0.0	, , 17		2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 -	0.5	38.81		
	4./	End of Borehole - 4.70m					
- 6.0	)						
- 7.0	)						
- 8.0	)						
- 9.0	)						
- 10.0	0						
	-						

Borehole No.	Contractor	Client	Greenfield
WSA 14/3	Metcalfe Bros	London Rock	
Date 17/12/14	BH Dlameter 150 mm	Project Geological Investigation	associates
Grid Ref:	Surface Level	Ste White Cross Farm,	E-mail: admin@greenfield-associates.co.uk
SU 460552 187637	43.51 mAOD	Wallingford	Tel: 0115 9372002

	Depth (m)	Lithological Description		Thickness (m)	Level (m AOD)	Water Depth/ Level (m/ mAOD) Grading (F: S: G)	Installation diagram
0.0		Soll and Subsoll Firm peaty soil					0.2m above G.L
- 1.0	0.8	<b>Clay</b> Yellowish clay, soft, silty.		0.8	42.79	Water strike at 0.7m 42.89m AOD	Bentonite 0.5m-1m Plain pipe
- 2.0					44.40		1.8m
	2.4	Peat		1.6	41.19		
- 3.0	3.2	Sand and Gravel		0.8	40.39		Perforated pipe with filter wrapping
	3.7	Brown sand and gravel. Fine to coarse sand, fine to medium gravel.	e	0.5	39.89		
- 4.0		Grey clay, firm, silty, stiff.			00.50		
- 5.0		End of Borehole - 5.00m		1.3	38.59		5.0m Spoil sand and gravel
- 6.0							used as backfill
- 7.0							
- 8.0							
9.0							
- 10.0							

Borehole No.	Contractor	Client	Graanfield
VVSA 14/4	Metcalte Bros		
Date 17/12/14	BH Dlameter	Project	associates
	150 mm	Geological Investigation	1 Composite Del Kourothe Nettinghom NC12 EIS
Grid Ref:	Surface Level	Site White Cross Farm,	E-mail: admin@greenfield-associates.co.uk
SU 460629 187488	43.59 mAOD	Wallingford	Tel: 0115 9372002

	Depth (m)	Lithological Description		Thickness (m)	Level (m AOD)	Water Depth/ Level (m/ mAOD)	Grading F: S: G
0.0		Soil and Subsoil			40.00		
	0.4	Clay		0.4	43.23	Water strike at 0.4m/	
- 1.0	0.8	Yellowish clay, soft, silty, turns grey	.e.dd	0.4	42.83	43.23m AOD	
- 2.0	I	Orange-brown sand and gravel. Coarse mix (80% G, 20% S). Gravel, fine to coarse, angular to sub-angular. Sand, fine-coarse. Gravel, hard flint and sandstone.				2: 38: 60	
- 3.0				2.9	39.93		
	3.7	Clay	n tek gatek	2.0			
- 4.0	10	Grey clay, firm, silty, stiff.		0.5	39.43		
	4.2	End of Borehole - 4.20m					
5.0							
- 6.0	l						
- 7.0	l						
- 8.0	I						
- 9.0							
- 10.0	)						

Borehole No.	Contractor	Client	Greenfield
WSA 14/5	Metcalfe Bros	London Rock	
Date 17/12/14	BH Dlameter	Project	a $s$ $s$ $o$ $c$ $i$ $a$ $t$ $e$ $s$
	150 mm	Geological Investigation	1 Compared Ed Kourath Netterham NC(2515)
Grid Ref:	Surface Level	Site White Cross Farm,	E-mail: admin@greenfield-associates.co.uk
SU 460554 187803	43.63 mAOD	Wallingford	Tel: 0115 9372002

	Depth (m)	Lithological Description		Thickness (m)	Level (m AOD)	Water Depth/ Level (m/ mAOD)	<b>Grading</b> F: S: G
		Soil and Subsoil Peaty soil					
	0.5			0.5	42.97	Water strike at 0.3m/	
- 1.0		<i>Clay</i> Yellowish clay, soft.				43.17m AOD	
	1.4			0.9	42.07		
- 2.0	2.1	<i>Clay</i> Dark grey clay, soft, turning to silty peat.		0.7	41.37		
- 3.0		Sand and Gravel Brown-dark brown sand and gravel. 60-70% gravel, 30-40% sand. Sand, coarse. Gravel, fine to medium. Angular-rounded. Occasional small clay bound lumps Gravel is flint and sanstone.					
40			.0. d. 0. d	1.9	39.47		
	45	<b>Clay</b> Light grey clay, stiff.		0.5	38.97		
	<b>U</b> .	End of Borehole - 4.50m					
- 5.0							
6.0							
- 7.0							
- 8.0							
- 9.0							
- 10.0	)						

Borehole No.	Contractor	Client	Greenfield
WSA 14/6	Metcalfe Bros	London Rock	
Date 17/12/14	BH Dlameter	Project	associates
	150 mm	Geological Investigation	Commercial Ed Keyworth Nettinsham NC(2515
Grid Ref:	Surface Level	Site White Cross Farm,	E-mail: admin@greenfield-associates.co.uk
SU 460659 187778	43.47 mAOD	Wallingford	Tel: 0115 9372002

	Depth (m)	Lithological Description		Thickness (m)	Level (m AOD)	Water Depth/ Level (m/ mAOD)	Grading F: S: G
0.0		Soil and Subsoil		0.4	44 72		
	0.4	<i>Clay</i> Brown clay, stiff, pebbly		0.4	44.32		
- 1.0	0.0	<b>Sand and gravel</b> Brown to orange-brown sand and gravel. 60% sand, 40% gravel.				3: 44: 53	
- 2.0		Sand: Fine-medium, G: Fine-med. Sub-rounded to rounded.			40.00	Water strike at 1.60r 43.52m AOD	n/
- 3.0	2.3	<b>Sand and gravel</b> Orange-brown sand and gravel. 80% gravel, 20% sand. Gravel, fine-coarse, angular- sub-angular.		1.5	42.82		
		Occasional cobbles. Sand: Fine to medium.					
- 4.0	4.2	Shale	0 0 0 0 1 0 0	1.9	40.92		
		Light grey shale, stiff.		0.0	40.42		
- 5.0		End of Borehole - 5.00m		0.8	40.12		
- 6.0							
- 7.0							
- 8.0							
- 9.0							
- 10.0							

Borehole No.	Contractor	Client	Greenfield
WSA 14/7	Metcalfe Bros	London Rock	
Date 17/12/14	BH Dlameter	Project	associates
	150 mm	Geological Investigation	Commercial Ed Kouvette Nottingham NC(2515
Grid Ref:	Surface Level	Site White Cross Farm,	E-mail: admin@greenfield-associates.co.uk
SU 460418 187698	45.12 mAOD	Wallingford	Tel: 0115 9372002

	Depth (m)	Lithological Description	Thickness (m)	Level (m AOD)	Water Depth/ Level (m/ mAOD)	Grading F: S: G
0.0		Soil and Subsoil	0.4	44.8		
	0.4	<i>Clay</i> Yellow clay, pebbley, firm.	0.4	44.6		
- 1.0	0.0	<b>Sand and Gravel</b> Orange to brown sand and gravel. 80% gravel, 20% sand mix.				
- 2.0	)	Sand, fine to coarse. Gravel, fine to coarse, angular to sub-angular.			Water strike at 1.4m/ 43.8m AOD	
- 3.0	)				4: 46: 50	
	07		2.9	41.5		
- 4.0	3.7	Sand and Gravel Brown sand and gravel, 50-50 mix. Sand, fine to medium. Gravel, fine to medium, angular to rounded. Slightly silty. Occasional clay bound lumps. Few rounded cobbles.	0.0	40.6		
- 50	4.6	Clay	0.9	1010		
	5.1	End of Borehole - 5.10m	0.5	40.1		
- 6.0	)					
- 7.0	)					
- 8.0	)					
- 9.0						
- 10.0	)					

Borehole No.	Contractor	Client	Greenfield
WSA 14/8	Metcalfe Bros	London Rock	
Date 17/12/14	BH Dlameter 150 mm	Project Geological Investigation	associates
Grid Ref:	Surface Level	Site White Cross Farm,	E-mail: admin@greenfield-associates.co.uk
SU 460482 1878	45.2mAOD	Wallingford	Tel: 0115 9372002

	Depth (m)	Lithological Description		Thickness (m)	Level (m AOD)	Water Depth/ Level (m/ mAOD)	<b>Grading</b> F: S: G
0.0		<i>Soll and Subsoil</i> Firm, peaty soil mix.					
- 1.0	0.9	Clay		0.9	42.55		
		Yellow clay, silty, soft.		0.9	41.65	Water strike at 0.5m/	
- 2.0	1.8	<b>Clay and peat</b> Dark grey clay peat, soft mix.		0.0	1100	42.95m AOD	
	2.5	Sand and Gravel		0.7	40.95		
- 3.0		medium flint and sandstone gravel, fine to coarse sand. Slightly silty.					
40	3.7	Clay	10 - 6 - 6 	1.2	39.75		
- 4.0	4.2	Light grey, suit clay.		0.5	39.25		
5.0							
- 6.0							
- 8.0							
9.0							
10.0	)						

Borehole No.	Contractor	Client	Greenfield
WSA 14/9	Metcalfe Bros	London Rock	
Date 17/12/14	BH Dlameter	Project	associates
	150 mm	Geological Investigation	Commercial Ed Keyworth Nettinsham NC(2515
Grid Ref:	Surface Level	Ste White Cross Farm,	E-mail: admin@greenfield-associates.co.uk
SU 460635 187637	43.45 mAOD	Wallingford	Tel: 0115 9372002

	Depth (m)	Lithological Description		Thickness (m)	Level (m AOD)	Water Depth/ Level (m/ mAOD)	<b>Grading</b> F: S: G
		Soil and Subsoil					
	0.6	Peat soil mix		0.4	42.97		
	0.0	Clay			10.07	Water strike at 0.7m/	
10	0.9	Sand Yellow silty, firm sand		0.3	42.67	<b>42.67m AOD</b>	
- 1.0		Sand and gravel	0 0 0 0				
- 2.0		Orange-brown sand and gravel. 50-50 mix of sand and gravel. Sand, fine to medium. Gravel, fine to medium, angular to rounded. Slightly silty. Occasional clay bound lumps.				5: 56: 39	
		Occasional larger rounded pebbles.					
			e e e	2.0	40.57		
- 3.0		<b>Clay</b> Light grey clay, turning to weak shale.					
1				1.0	39.57		
- 4.0		End of Borehole - 4.00m					
- 5.0							
- 6.0							
- 7.0							
- 8.0							
- 9.0							
- 10.0	)						

Borehole No.	Contractor	Client	Croonfield
WSA 14/10	Metcalfe Bros	London Rock	Greeniieid
Date 17/12/14	BH Diameter	Project	associates
	150 mm	Geological Investigation	1 Commonciel Ed. Konworth Notflingham NG12 515
Grid Ref:	Surface Level	Site White Cross Farm,	E-mail: admin@greenfield-associates.co.uk
SU 460554 187548	43.37 mAOD	Wallingford	Tel: 0115 9372002

	Depth (m)	Lithological Description	Thickness (m)	Level (m AOD) 44.8	Water Depth/ Level (m/ mAOD)	Grading F: S: G
	0.4	Soil and Subsoil Stoney soil	0.4	44.4		
	0.8	<b>Clay</b> Yellow-brown firm clay, occasional pebbles.	0.4	44.0		
– 1.0		Sand and gravel Brown slightly silty sand & gravel, fine-medium sand, fine-medium, angular-rounded fiint gravel. Occasional clay bound lumps.			Vater strike at 1.7 m/	
- 2.0		Sand and gravel	1.2	42.8	43.1m AOD	
		Brown sand & gravel, fine-coarse sand fine-medium, angular to rounded flint gravel. Occasional cobbles.	0.8	42 0		2: 27: 72
- 3.0	2.8	<i>Clay</i> Light grey chalky clay.				
- 4.0		End of Borehole - 4.00m	1.2	40.8		
- 5.0						
- 6.0						
- 7.0						
- 8.0						
9.0						
- 10.0	)					

Borehole No.	Contractor	Client	Greenfield
WCF 15/1	Metcalfe Bros	London Rock	
Date 29/09/2015	BH Dlameter	Project	associates
	150 mm	Geological Investigation	1 Compareid Ed Kourath Notificham NC42515
Grid Ref:	Surface Level	Site White Cross Farm,	E-mail: admin@greenfield-associates.co.uk
SU 460420 187521	44.75 mAOD	Wallingford	Tel: 0115 9372002

	Depth (m)	Lithological Description		Thickness (m)	Level (m AOD) 44,3	Water Depth/ Level (m/ mAOD)	
[ 0.0	0.25	Soil Stoney dark clayey soil		0.25	44.1		
	0.20	<i>Clay</i> Brown stiff clay with occasional cobbles.		0.75	43.4		
- 1.0		Sand and Gravel	9				
		Orange-brown sand & gravel, sand	10 0 10 0				
		fine-coarse, fine-medium			<u>v</u>	Vater strike at 1.4 m/	0. 57. 40
		sub angular to sub rounded flint	10 0 10 0			<b>42.9m AOD</b>	3: 57: 40
1 20		giavei.	9 . 0 . 0 . 0 9 . 0 . 0 . 0				
2.0			.0 0 0 0	1.2	42.2		
	2.2	Clay					
		Light grey, firm chalky clay.					
- 3.0	)						
	3.2			1.0	41.2		
	•	End of Borehole - 3.20m					
- 4.0							
50							
0.0							
- 6.0							
- 1.0							
80							
0.0	,						
- 9.0							
- 10.0	)						

Borehole No.	Contractor	Client	Greenfield
WCF 15/2	Metcalfe Bros	London Rock	
Date 29/09/2015	BH Dlameter 150 mm	Project Geological Investigation	associates
Grid Ref:	Surface Level	Site White Cross Farm,	E-mail: admin@greenfield-associates.co.uk
SU 460513 187586	44.29 mAOD	Wallingford	Tel: 0115 9372002

0.0	Depth (m)	Lithological Description		Thickness (m)	Level (m AOD) 45.0	Water Depth/ Level (m/ mAOD)	
0.0	• •	Soil and Subsoil Stoney soil		03	44.7		
	0.3	Clay		0.0			
	0.9	Brown firm clay.	- <u>-</u>	0.6	44.1		
- 1.0	0.0	Clayey Sand		0.1	44.0		
	1.7	Sand and Gravel Brown slightly silty sand & gravel, fine-medium sand, fine-coarse angular to sub angular flint gravels. Occasional clay lumps.		0.7	43.3	Water strike at	
- 2.0		Sand and Gravel Brown- grey brown sand & gravel, fine-coarse sand, fine-medium, sub angular to rounded flint gravels		11	12 2	1.8 m/ 43.2m AOD	3: 39: 58
- 3.0	2.8	Clay	<u>. (67. g</u> . (68.	1.1	42.2		
		Light grey firm chalky clay.					
1	3.8	End of Porchala 2 90m		1.0	41.2		
4.0		End of Borenole - 3.80m					
- 5.0							
- 6.0							
- 7.0							
- 8.0							
- 9.0							
- 10.0	)						

Borehole No.	Contractor	Client	Greenfield
WCF 15/3	Metcalfe Bros	London Rock	
Date 29/09/15	BH Dlameter	Project	associates
	150 mm	Geological Investigation	1 Composed Ed Koursth Nottingham NC42515
Grid Ref:	Surface Level	Site White Cross Farm,	E-mail: admin@greenfield-associates.co.uk
SU 460398 187627	44.97 mAOD	Wallingford	Tel: 0115 9372002

0.0	Depth (m)	Lithological Description		Thickness (m)	Level (m AOD) 44.7	Water Depth/ Level (m/ mAOD) Grading (F: S: G)	
0.0	0.05	Soil and Subsoil Clayey dark soil		0.25	44.5		
	0.25	Clav					
		Brown stiff clay with odd pebbles		0.05	44.0		
	0.6		· · · · · · · · · · · · · · · · · · ·	0.35	44.2		
10	0.7	Sandy Clay		0.1	44.1		
- 1.0		Sand and Gravel					
		Orange-brown sand & gravel, fine	9 m 49 m				
		rounded to sub-angular flint gravely	0.000000000000000000000000000000000000				
		Occasional silt bound lumps.	9.00.00			Water strike at 1.7m/	
			0.00.0	1.3	42.8	43.0m AOD	
- 2.0		Sand and Gravel			1210		
		Orange-brown sand & gravel, fine	9 a 9 a 9				
		to coarse sand with fine-medium,	10 ( 0 ( 0 ( 0 ( 0 ( 0 ( 0 ( 0 ( 0 ( 0 (				
		angular to sub-rounded flint and	9 8 0 49 8 0				
		quartzite gravels. Occasional	a d'a d'a d				
3.0		coarse gravei.	9 0 9				
	0.0		0 0 0 0	12	415		
	3.3	Clav		1.0	-11.0		
		Light arey firm chalky clay	······································				
				07	10 0		
4.0		End of Developing 4,00m		0.7	40.0		
		End of Borenole - 4.00m					
- 5.0							
- 6.0							
- 7.0							
8.0							
1							
- 90							
0.0							
1							
400							
10.0							

Borehole No.	Contractor	Client	Greenfield
WCF 15/4	Metcalfe Bros	London Rock	
Date 29/09/2015	BH Diameter	Project	associates
	150 mm	Geological Investigation	1 Commercial Del Kourathe Nettinghom NC(2) 516
Grid Ref:	Surface Level	Sthe White Cross Farm,	E-mail: admin@greenfield-associates.co.uk
SU 460486 187688	44.73 mAOD	Wallingford	Tel: 0115 9372002

	Depth (m)	Lithological Description		Thickness (m)	Level (m AOD) 44 8	Water Depth/ Level (m/ mAOD)	<b>Grading</b> F: S: G
	0.25	Soil and Subsoil		0.25	44.6		
	0.20	Clay Brown firm-stiff clay		0.25	44.0		*
	0.6	Clavev Sand		0.35	<u>44.2</u> 44.1		
- 1.0	0.7	Sand and Gravel Orange-brown sand & gravel, fine to medium sand, slightly silty with fine to medium, sub angular to rounded, flint gravels. Occasional clay lumps.				Water strike at 1.7m/	
- 2.0		Sand and Gravel		1.3	42.8	43.1M AOD	
- 3.0		Orange-brown sand & gravel, fine to coarse sand, fine to coarse angular to sub angular flint and quartzite gravels.					2: 56: 42
- 4.0					10.0		
	4.2	Clav	ne se o provise di National de la company	2.2	40.6		
		Light grey firm clay.					
50				0.8	39.8		
60		End of Borehole - 5.00m					
- 0.0							
- 8.0							
- 9.0							
- 10.0	)						

Borehole No. WCF 15/5	Contractor Metcalfe Bros	Client London Rock	<b>Greenfield</b>		
Date 17/12/14	BH Dlameter 150 mm	Project Geological Investigation			
Grid Ref: SU 460495 187845	Surface Level 44.83 mAOD	Site White Cross Farm, Wallingford	E-mail: admin@greenfield-associates.co.uk Tel: 0115 9372002		

	Depth (m)	Lithological Description	Thickness (m)	Level (m AOD) 45.7	Water Depth/ Level (m/ mAOD)	<b>Grading</b> F: S: G
0.0	0.2	Soil and Subsoil	0.2	45.5		
	0.2	Gravel Soil with brick rubble.	0.3	45.2		
	0.8	<i>Clay</i> Orange-brown stiff clay.	0.5	44.7		
- 1.0   - 20		Sand and Gravel Brown sand & gravel, fine-medium, silty sand with fine-coarse, angular to sub angular flint and quartzite gravels.			Water strike at 2.0m/	7: 37: 56
- 3.0					43./m AOD	
- 4.0	47		3.9	40.8		
- 5.0	4.7 5.1	<i>Clay and Gravel</i> Light grey chalky clay and sandy gravel.	0.4	40.4		
	5.2	Light grey-yellow weak rock. End of Borehole - 5.20m	0.1	40.3		
- 6.0						
- 7.0						
- 8.0						
9.0						
- 10.0	)					

Borehole No. WCF 15/6	Contractor Metcalfe Bros	Client London Rock	<b>Greenfield</b>		
Date 30/09/2015	BH Dlameter 150 mm	Project Geological Investigation			
Grid Ref: SU 460433 187916	Surface Level 45.72 mAOD	Site White Cross Farm, Wallingford	E-mail: admin@greenfield-associates.co.uk Tel: 0115 9372002		
Shell & Auger Borehole Log: Borehole No. WCF 15/7

	Depth (m)	Lithological Description		Thickness (m)	Level (m AOD) 43.5	Water Depth/ Level (m/ mAOD)	Grading F: S: G
[ 0.0	02	Soil and Subsoil		0.2	43.3		
	0.9	<b>Clay</b> Soft yellow clay turning to soft grey clay.		0.7	42.6	Water strike at 0.9m/	
- 1.0		Sand and gravel Brown sand & gravel, fine-coarse sand, fine-medium, sub angular to rounded gravels.				42.6m AOD	2: 60: 38
			0 0 40 0 0 0 0	0.4	40.5		1: 49: 50
- 3.0		<b>Clay</b> Light grey firm chalky clay.		2.1	40.5		
1	3.8	End of Borehole - 3.80m		0.8	39.7		
- 4.0							
- 6.0							
- 7.0							
8.0							
9.0							
- 10.0	)						

Borehole No.	Contractor	Client	Greenfield
WCF 15/7	Metcalfe Bros	London Rock	
Date 30/09/2015	BH Dlameter	Project	associates
	150 mm	Geological Investigation	1 Commercial Rd Keyworth, Nottingham NG125JS
Grid Ref:	Surface Level	Site White Cross Farm,	E-mail: admin@greenfield-associates.co.uk
SU 460581 187701	43.49 mAOD	Wallingford	Tel: 0115 9372002

Shell & Auger Borehole Log: Borehole No. WCF 15/8

	Depth (m)	Lithological Description		Thickness (m)	Level (m AOD) 43.3	Water Depth/ Level (m/ mAOD)	Grading F: S: G
[ 0.0	02	Soil and Subsoil		0.2	43.1		
	0.2	<b>Clay</b> Brown firm clay.		0.6	40 5		
- 1.0	0.8	<i>Clay</i> Soft grey blue clay.		0.0	42.5		
	47			0.9	41.6	Water strike at 1.7m/	
- 2.0	1. <i>1</i> )	Sand & Gravel Brown sand & gravel, fine to coarse sand, fine-coarse angular to sub angular flint gravels with occasional cobbles.				41.6m AOD	
	• •		0 0 0 0	12	40.4		
- 3.0	) 2.9	<b>Clay</b> Light grey firm chalky clay.		0.6	20.9		
	3.5	End of Borehole - 3 50m	<u>• 10, → • 10, → • 10</u>	0.0	39.0		
- 4.0	)						
- 5.0	5.1						
- 6.0	)						
- 7.0	)						
- 8.0	)						
- 9.0	)						
- 10.(	D						

Borehole No.	Contractor	Client	Greenfield		
WCF 15/8	Metcalfe Bros	London Rock			
Date 30/09/2015	BH Dlameter	Project	a $s$ $s$ $o$ $c$ $i$ $a$ $t$ $e$ $s$		
	150 mm	Geological Investigation	1 Compared Ed Koureth Nettenham NC(2515)		
Grid Ref: SU 460603 187595	Surface Level 43.27 mAOD	Site White Cross Farm, Wallingford	1 Commercial Kd, Keyworm, Notingnam NG12 5JS E-mail: admin@greenfield-associates.co.uk Tel: 0115 9372002		

0.0	Depth (m)	Lithological Description	Thickness (m)	Level (m AOD) 43.7	Water Depth/ Level (m/ mAOD)	Grading F: S: G
	0.4	<b>Soil and Subsoil</b> Stoney soil	0.4	43.3		
- 1.0	0.4	<i>Clay</i> Yellow to grey soft silty CLAY	1.2	42.1	Water strike at	
- 2.0	1.0	Sand and gravel Brown silty fine to medium sandy GRAVEL, sub-angular to sub-rounded Occasional small ironstone pieces and large flint fragments.	21		1.6 m/ 42.0m AOD	
- 3.0	37			40.0		
- 4.0	0.7	Clay Grey stiff CLAY with rocky bands	0.4	39.6		
- 5.0		End of Borehole - 4.10m				
- 6.0	)					
- 7.0	)					
- 8.0	)					
9.0						
- 10.0	)					

Borehole No.	Contractor	Client	Greenfield		
WCF 16/1	Metcalfe Bros Ltd	London Rock			
Date 31/05/2016	BH Dlameter	Project	a $s$ $s$ $o$ $c$ $i$ $a$ $t$ $e$ $s$		
	150 mm	Geological Investigation	1 Compareial Pd Kowenth Nettingham NG12 515		
Grid Ref: SU 46062 18794	Surface Level 43.65 mAOD	Site White Cross Farm, Wallingford	1 Commercial Rd, Keyworth, Nottingham NG12 5JS E-mail: admin@greenfield-associates.co.uk Tel: 0115 9372002		

	Depth (m)	Lithological Description	Thickness (m)	Level (m AOD)	Water Depth/ Level (m/ mAOD)
□ 0.0	0.2	Soll Peaty clayey soil	0 20	43.6 43.4	
- 1.0 - 2.0		<i>Clay</i> Yellow to grey soft silty CLAY	2.1	79.7	
	2.3			41.3	Water strike at
- 3.0	2.6	Sand and Gravel Brown sandy fine to coarse GRAVEL with some small pieces of dark ironstone	1.3	40.0	2.3m/ 41.3m AOD
4.0	0.0	<i>Clay</i> Grey stiff flaky CLAY	0.6		
	4.2	End of Borehole - 4 20m	0.0	39.4	
- 5.0					
- 7.0					
8.0					
9.0					
- 10.0	)				

Borehole No.	Contractor	Client	Greenfield
WCF 16/2	Metcalfe Bros Ltd	London Rock	
Date	BH Dlameter	Project	associates
31/05/2016	150 mm	Geological Investigation	
Grid Ref:	Surface Level	Ste White Cross Farm,	E-mail: admin@greenfield-associates.co.uk
SU 46070 18796	43.59 mAOD	Wallingford	Tel: 0115 9372002

				1				
	0.0	Depth (m)	Lithological Description		Thickness (m)	Level (m AOD) 43.6	Water Depth/ Level (m/ mAOD)	
	- 0.0	0.2	Soil and Subsoil Peaty soil		0.3	43.3		
-	- 1.0	1.4	<i>Clay</i> Yellow to grey soft silty CLAY		1.1	42.2	Water strike at	
-	- 2.0	1.4	Sand and Gravel Brown silty fine to medium sandy GRAVEL, sub-angular to sub-rounded. With occasional large flint pieces and small ironstone pieces		2.3		1.4m/ 42.2m AOD	
	- 3.0	27				39.9		
	- 4.0	J.I	Clay Grey stiff CLAY with thin rock		0.5	30 /		
			End of Borehole - 4.20m	<u>- 1:;,⇒- 1:;,⇒- 1:</u>	1	00.7		
-	- 5.0	3.8						
-	- 6.0							
-	- 7.0							
-	- 8.0							
-	- 9.0							
-	- 10.0							

Borehole No.	Contractor	Client	Greenfield	
WCF 16/3	Metcalfe Bros Ltd	London Rock		
Date 01/06/2016	BH Diameter 150 mm	Project Geological Investigation	associates	
Grid Ref:	Surface Level	Site White Cross Farm,	E-mail: admin@greenfield-associates.co.uk	
SU 46060 18787	43.57 mAOD	Wallingford	Tel: 0115 9372002	

_			· · ·				
	- 00	Depth (m)	Lithological Description		Thickness (m)	Level (m AOD) 43.5	Water Depth/ Level (m/ mAOD) Grading (F: S: G)
	0.0	0.2	Soil and Subsoil Peaty soil		0.3	43.2	
		0.3	<i>Clay</i> Yellow soft CLAY		0.5	42.7	
	- 1.0	0.0	Grey soft CLAY		0.8		
		16				41.9	
	- 2.0	1.0	Soft Peat		0.7	44.0	Water strike at
		2.3	Sand and Gravel			41.2	2.3m/ 41.2m AOD
	- 3.0	26	Brown silty fine to medium sandy GRAVEL, sub-angular to sub-rounded. Small amount of coarse sand. With occasional large flint pieces and small ironstone pieces		1.3	30 0	
		3.0	Clay			00.0	
	- 4.0		Grey stiff flaky CLAY		0.7	39.2	
			End of Borehole - 4.30m				
	- 5.0						
	- 6.0						
	- 7.0						
	- 8.0						
	9.0						
	40.0						
	10.0						
- 1	1			1		1	1

Borehole No.	Contractor	Client	Greenfield
WCF 16/4	Metcalfe Bros Ltd	London Rock	
Date	BH Dlameter	Project	associates
31/05/2016	150 mm	Geological Investigation	
Grid Ref:	Surface Level	Site White Cross Farm,	E-mail: admin@greenfield-associates.co.uk
SU 46068 18787	43.52 mAOD	Wallingford	Tel: 0115 9372002

Project	ord							ВО	REHOLE No		
		ates	Ground Level (n	1 OD)				- (	GM 16/1		
LR/WF/101	1	start 18-11-16									
Client					Co-Ordinates ()			Shee	t		
London Ro	ock								1 of 1		
		STRATA			SAM				PLES & TESTS		
Depth Legend	Reduced Level		DESCRIPT	ION		ater	Depth	Туре	Test		
	(Thickness)	Topsoil				3		INO	Result		
	0.20)	Soft to firm browni	sh grey becoming	grey with occasio	nal brown	1	0.20-0.50	B1			
		patches slightly sa	ndy CLAY with occ	asional rootlets i	n the top 0.3m		-0.50-1.60	B2			
	1.40)						-				
	,										
							-				
	0 40)	Dark grey with gre	y patches slightly s	andy silty organi	c CLAY (peat)	1	1.60-2.00	В3			
$2.00 \times 10^{\frac{1}{12}} \times 10^{\frac{1}{12}} \times 10^{\frac{1}{12}}$	0.40)		AVEL fine to coa	rse sand and fine		-	-2.00-4 30	B4			
		medium rounded t	o sub-angular flint	gravel	. coulonally			<u> </u>			
· 0· 5· 0· · 0 5· 0							-				
							-				
0.5°0(2	2.30)						-				
							-				
.0.0.0.							-				
· 0							-				
4.30 0.00	0.20)					-	4 30-4 50	B5			
4.50	0.20)					1	-				
							-				
							-				
							-				
							-				
							-				
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	olline //	lator Addad ata					t				
	ennig/w	ALEI AUUEU ELC.									
	metres	Engineer		Method/				Loaaed I	3ν <u></u>		
Scale 1:50	)			Plant Used					T Shellard		

Project	Co vol							BORE	EHOLE No
walling	rora	) otoo	Cround Loval (r					G	M 16/2
		start 17-11-16	Ground Level (r	n OD)					
Client	51	finish 17-11-16			Co-Ordinates ()			Sheet	
	Rock							1	of 1
		STRATA					SAM		FSTS
	Reduced		•			5			Tost
Depth Legend	Level (Thickness)		DESCRIP	ΓΙΟΝ		Wat	Depth	No	Result
0.20	(0.20)	Topsoil					-		
	_(1.50)	sub-angular flint g	ravel and rootlets	flint gravel in the	bottom 0.3m			DT	
1.70 × ×	- - - -						1.40-1.70	B2	
	(2.00)	Brown SAND + Gi sub-angular flint g	RAVEL, fine to coa	rse sand and fine	e rounded to	-	1.70-3.70	Β3	
6 30 ° c · c	-(2.60)	Yellowish brown fi medium rounded t chalk sand	ne to coarse SANI o sub-angular flint	D with much fine gravel and occas	occasionally sional coarse se	•	3.70-6.30	Β4	
6.90 p	(0.60)	Creamy grey firm f	o stiff locally extre	mely weak weath	ered CHALK		6.30-6.90	В5	
Remarks/Ch	iselling//	Vater Added etc					<u>[</u>		
All dimensions i Scale 1:	in metres 50	Engineer		Method/ Plant Used				Logged By	T Shellard

Project	'n							BOR	REHOLE No	
Job No		Dates	Ground Level (r	n OD)				G	M 16/3	
LR/WF/101		start 16-11-16 finish 17-11-16		,						
Client	I		1		Co-Ordinates ()			Sheet		
London Roc	k								1 of 1	
		STRATA					SAM	LES & TESTS		
Depth Legend	Reduced Level		DESCRIPT	ΓΙΟΝ		ater	Depth	Туре	Test	
(Th	hickness)	Topsoil				3		NO	Result	
	30) 20)	Brown stiff to very	stiff slightly sandy	SILT with occasio	onal rootlets		-0.30-1.50	B1		
	50)	Light brown fine to fine to medium flint	coarse SAND with gravel and occas	h much rounded i	to sub-angular lk sand		-1.50-3.00	В2		
3.00 ° ° ° ° ° ° ° ° ° ° ° ° ° ° ° ° ° °	70)	Yellowish brown S	AND + GRAVEL, r	nedium to coarse	e occasionally flint gravel		4.50-6.70	B3 B4		
		Cream/grey weak t	o extremely weak	slightly weathere	ed silty CHALK		6.70-7.70	B5		
	00)	fractured with dri	Illing in range of c	oarse sand to coa	arse gravel					
Remarks/Chisel Hand dug pit to	lling/M 1.0m	Vater Added etc.								
All dimensions in m Scale 1:50	etres	Engineer		Method/ Plant Used				Logged By	<sup>y</sup> T Shellard	

Project Wallingford	BORE	EHOLE No					
Job No	Dates start 16-11-16	Ground Level (m OD)				GN	/1 16/4
LR/WF/101	finish 16-11-16						
Client			Co-Ordinates ()			Sheet	
London Rock						1	of 1
	STRATA	<b>N</b>			SAM	PLES & TI	ESTS
Depth Legend Level (Thickne	ss)	DESCRIPTION		Water	Depth	Type No	Test Result
0.25	Topsoil				-		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Brown stiff friable coarse chalk sand Light brown with c rootlets and mediu Brown slightly clay rounded flint grave Brown SAND + Gf sub-angular to rou	sandy CLAY/SILT with oc ream patches slightly sar um chalk sand rey sandy SILT with occas al and coarse chalk sand RAVEL, fine to coarse sar inded flint gravel	dy SILT with occasional		0.25-1.20	B1 B2 B3 B4	
3.50 4.50 4.50 4.50 4.50 4.50 4.50 4.50 4.50 4.50 4.50 4.50 4.50 5.0	Light creamy grey fine to medium any matrix	silty weathered CHALK n gular gravel and firm sligh	narl with weak to medium tly clayey silty sand	-	-3.50-4.50	в5	
Remarks/Chiselling	/Water Added etc.						
All dimensions in metres Scale 1:50	Engineer	Metho Plant	d/ Used			Logged By	T Shellard

Project								BORI	EHOLE No
Job No		ates	Ground Level (r	n OD)				– Gl	M 16/5
LR/WF/101		start 16-11-16 finish 16-11-16							
Client			1		Co-Ordinates ()			Sheet	
London Rock	ζ				1 of 1				
		STRATA	L .				SAM	PLES & T	ESTS
Depth Legend L (Thi	duced .evel ckness)		DESCRIPT	TION		Water	Depth	Type No	Test Result
0.30	D)	Topsoil							
(0.90 1.20 1.50 × (0.30	D) D)	Dark brown firm to sand Light brown silty fir soft silt to coarse s	stiff sandy CLAY	with occasional m D with some hea	nedium chalk		-0.30-1.20	B1 B2	
	0)	Light Brown slighti medium sub-round chalk sand	y silty fine to coars led to angular flint	e SAND with mu gravel and occas	ch fine to sional coarse		- 1.50-3.10 	B3	
	0)	Light grey/cream fi CHALK marl with c	rm to extremely w	eak heavily weath h brown iron stai	nered silty	-	-3.10-4.40	В4	
Remarks/Chisell	ing/W	/ater Added etc.							
All dimensions in me Scale 1:50	tres	Engineer		Method/ Plant Used				Logged By	T Shellard



Project									BOR	EHOLE No
Wa	llingf	ord							- GI	M 16/6
Job No		ا ا ۱	Start 15-11-16	Ground Level (r	n OD)					
Client	(/V/F/10	1	finish 15-11-16			Co-Ordinates	()		Sheet	
Lon	ndon Ro	ock					()			1 of 1
			STRATA					SAM		FSTS
		Reduced		<b>`</b>			2	57.11		Toot
Depth	Legend	Level (Thickness	)	DESCRIP	TION		Wat	Depth	No	Result
0.30		(0.30)								
0.60		(0.30)	Brown to dark bro medium chalk san	wn firm to stiff san Id	dy CLAY with occ	asional		-0.30-0.60	B1	
		(1.80)	Brown slightly silty occasionally medi occasional mediur	SAND + GRAVEI um sub-angular to n to coarse chalk :	, fine to medium rounded flint gra sand	sand and fine vel and		-0.60-2.40	B2	
2.40	. <i>ö</i> . <u>Ö</u> . <u>Ö</u> . <u>Ö</u> .		Light grey firm to s	stiff locally extreme	ly weak silty CHA			2.40-3.40	B3	
		(1.00)								
3.40	-									
								-		
	- - - -									
	-							-		
	- - - -							-		
	-									
	-							-		
2	-							E		
	- -							ł F		
Rema	rks/Chie	sellina/\	Vater Added etc					<u>+</u>		
5										
All dime	ensions in	metres	Engineer		Method/				Logged By	T Shellard
5	Scale 1:5	0			Plant Used					



Project	4					BORE	HOLE No
	Dates	Ground Lovel (m OD)				- GN	/ 16/7
LR/WF/101	start 15-11-16						
Client	inisn 15-11-16		Co-Ordinates ()	)		Sheet	
London Rock	ζ.					1	of 1
	STRAT	A	I		SAM	PLES & TI	ESTS
Depth Legend	duced			ater	Denth	Туре	Test
(Thi	ckness)	DESCRIPTION		Ň	Bopur	No	Result
	)) Iopsoil Light brown to bro sub-rounded to ro	own slightly sandy CLAY v bunded fine flint gravel and	vith occasional d occasional rootlets		0.20-1.30	B1	
	Soft grangish bro	wn/light grey mottled sligh	itly silty CLAY with			B2	
	)) occasional mediu	im chalk sand					
-°	) Soft grey very sar rounded chalk gr from rootlets	ndy CLAY with occasional avel and occasional orang	fine sub-rounded to jish brown iron staining		-1.90-3.00	ВЗ	
	Light brown/crear	n extremely weak to weak	weathered CHALK marl		-3.00-4.00	В4	
Remarks/Chiselli	ng/Water Added etc.						
All dimensions in me Scale 1:50	tres Engineer	Metho Plant	od/ Used			Logged By	T Shellard

Project	Project								BOR	EHOLE No
Wa	alling	rord	Datas						G	M 16/8
		-1	start 18-11-16	Ground Level (r	m OD)					
Client	√/VVF/1(	JI	finish 18-11-16			Co-Ordinates ()			Sheet	
	ndon R	lock								1 of 1
			STRATA					SAM		FSTS
		Reduced		<b>`</b>			-			Tost
Depth		Level (Thicknes	s)	DESCRIP	TION		Wat	Depth	No	Result
0.15		(0.25)	Grey with occasion	nal brown patches	slightly sandy CL			0.15-0.40	B1	
	$\langle 1 4 4 4 1 1 1 1 1 2 1 1 2 1 1 1 2 1 1 1 1 1 1 1 \mathbf{1$	(0.90)	Occasional mediu Dark brown slightl (peat)	n to coarse chalk s y sandy silty CLAY	sand with much organ			-0.40-1.30	B2	
1.30	× × × × × × × × × × × × × × × × × × ×	(0.80)	Dark brown very c	layey organic SILT				1.30-2.10	В3	
2.10		(0.80)	Brown SAND + GI rounded to sub-ar	RAVEL, fine to coa Igular flint gravel w	irse sand and fine <i>i</i> th occasional fin	e to medium e chalk gravel	-	2.10-2.90	B4	
2.30		(1.00)	Cream/grey slight	y clayey sandy silt	y heavily weather	ed CHALK marl		-2.90-3.90	B5	
			Notor Addad at a					<u>t</u>		
	arks/UN	iseiiing/	vvaler Added etc.							
All dim	ensions i Scale 1:	in metres 50	Engineer		Method/ Plant Used				Logged By	<sup>/</sup> T Shellard

# Appendix B Laboratory Test Results

## Table 1 Particle Size Distribution of Borehole Samples - Wallingford

#### Samples collected: 17/12/2014 & 2015

	Percentage Passing (mm)												Fines	Sand	Gravel			
	0.063	0.125	0.25	0.50	1.0	2.0	4.0	6.3	8.0	10.0	16.0	20.0	31.5	40.0	80.0	(-63u)		(+4mm)
WSA 14-3 (3.4-4.2m)	2.0	3	13	47	56	64	73	78	81	84	93	97	100	100	100	2	71	27
WSA 14-10 (1.0-3.0m)	5.0	6	10	38	47	53	61	68	73	78	90	94	99	100	100	5	56	39
WSA 14-8 (2.0-3.5m)	4.0	5	8	21	28	35	50	60	66	73	85	91	99	100	100	4	46	50
WSA 14-2 (2.0-3.0m)	10.0	12	17	39	46	53	63	71	76	81	92	97	100	100	100	10	53	37
WSA 14-2 ( 3.0-4.5m)	5.0	7	13	33	43	54	71	81	87	91	97	98	100	100	100	5	66	29
WSA 14-7 (0.8-2.3m)	3.0	4	7	25	29	34	47	57	63	70	87	92	99	100	100	3	44	53
WSA 14-2 (0.9-2.0)	8.0	9	12	30	35	42	58	68	73	79	91	94	99	100	100	8	50	42
WSA 14-5 (0.8-2.3)	2.0	2	4	16	23	29	40	50	56	63	77	84	98	98	100	2	38	60
WCF 15-1 (2-2.8m)	1.5	2	2	9	12	16	28	41	49	60	81	88	97	100	100	2	27	72
WCF 15-2 (1-2.2m)	3.4	4	4	9	15	29	60	80	87	93	97	97	100	100	100	3	57	40
WCF 15-3 (1.7-2.8m)	2.9	3	5	16	19	25	42	59	66	75	89	93	100	100	100	3	39	58
WCF 15-5 (1.7-4.1m)	2.4	3	7	33	42	47	58	64	67	70	77	85	94	96	100	2	56	42
WCF 15-6 (0.8-2m)	6.6	7	10	28	32	36	44	54	61	70	84	91	100	100	100	7	37	56
WCF 15-7 (0.9-2.4m)	2.3	3	6	25	36	47	62	74	80	85	93	95	100	100	100	2	60	38
WCF 15-7 (2.4-3m)	1.0	1	2	24	33	40	50	58	64	70	82	87	97	97	100	1	49	50
Mean	3.9	5	8	26	33	40	54	64	70	76	88	92	99	99	100	4	50	46

Sand Fraction Only (-4mm)								
	0.063	0.125	0.250	0.50	1.0	2.0	4.0	
WSA 14-3 (3.4-4.2m)	3	4	18	64	77	88	100	
WSA 14-10 (1.0-3.0m)	8	10	16	62	77	87	100	
WSA 14-8 (2.0-3.5m)	8	10	16	42	56	70	100	
WSA 14-2 (2.0-3.0m)	16	19	27	62	73	84	100	
WSA 14-2 ( 3.0-4.5m)	7	10	18	46	61	76	100	
WSA 14-7 (0.8-2.3m)	6	9	15	53	62	72	100	
WSA 14-2 (0.9-2.0)	14	16	21	52	60	72	100	
WSA 14-5 (0.8-2.3)	5	5	10	40	58	73	100	
WCF 15-1 (2-2.8m)	5	7	7	32	43	57	100	
WCF 15-2 (1-2.2m)	6	7	7	15	25	48	100	
WCF 15-3 (1.7-2.8m)	7	7	12	38	45	60	100	
WCF 15-5 (1.7-4.1m)	4	5	12	57	72	81	100	
WCF 15-6 (0.8-2m)	15	16	23	64	73	82	100	
WCF 15-7 (0.9-2.4m)	4	5	10	40	58	76	100	
WCF 15-7 (2.4-3m)	2	2	4	48	66	80	100	
Mean	7	9	14	48	60	74	100	

Sand Gra	ades		
	Fine	Medium	Coarse
	Sand	Sand	Sand
Fines:	(-250u)	(+250u)	( + 1mm)
3	15	59	23
8	8	61	23
8	8	40	44
16	11	46	27
7	11	42	39
6	9	47	38
14	7	40	40
5	5	48	43
5	2	36	57
6	1	18	75
7	5	33	55
4	8	60	28
15	8	50	27
4	6	48	42
2	2	62	34
7	7	46	40





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# Contract Number: 33440

Client's Reference:

Report Date: 05-01-2017

**Client Greenfield Associates Bellots House Bellots Rd** Bath **BA2 3RT** 

Contract Title: Wallingford For the attention of: Tom Skailes

Laboratory Report

Date Received: 07-12-2016 Date Commenced: 07-12-2016 Date Completed: 05-01-2017

#### **Test Description**

#### **Moisture Content**

1377 : 1990 Part 2 : 3.2 - \* UKAS

## 4 Point Liquid & Plastic Limit (LL/PL)

1377 : 1990 Part 2 : 4.3 & 5.3 - \* UKAS

#### Dry Den/MC (4.5kg Rammer Method 1 Litre Mould) 1377 : 1990 Part 4 : 3.5 - \* UKAS

Hand Vane at each compaction point (5HV's)

Procedure for the Determination of the Permeability of Clayey Soils in a Triaxial Cell Using the Accelerated Permeability Test Environment Agency Method P1-398/TR/2 - \* UKAS

#### **Disposal of Samples on Project**

Notes: Observations and Interpretations are outside the UKAS Accreditation

- \* 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 Tel: 01554 784040 Fax: 01554 784041 info@gstl.co.uk gstl.co.uk

## Test Report: Method of the Determination of the plastic limit and plasticity index BS 1377 : Part 2 : 1990 Method 5

Client ref:	
Location:	Wallingford
Contract Number:	33440

Hole/			Moisture	Liquid	Plastic	Plasticity	%	
Sample	Sample	Depth	Content	Limit	Limit	Index	Passing	Remarks
Number	Туре	m	%	%	%	%	.425mm	
			Cl. 3.2	Cl. 4.3/4.4	Cl. 5.	Cl. 6.		
GM16/N	В	N/A	35	60	27	33	96	CH High Plasticity
GM16/C	В	N/A	11	38	16	22	98	CI Intermediate Plasticity
GM16/S	В	N/A	19	45	16	29	96	CI Intermediate Plasticity
Symbols:		NP : Non Plast	tic #:Lic	uid Limit an	d Plastic Lir	nit Wet Siev	ed	
	PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.							
				BS 5930:1	1999+A2:20	10		
90 🖵			1					
00		CL	CI	CH	I	CV		CE
80 -								
			1				1	





## For and behalf of GEO Site & Testing Services Ltd

Authorised By: Emma Sharp (Office Manager) Date: 4.1.17





**Client ref:** 

## Location:

### Wallingford **Contract Number:**

33440

Hole Number	Sample Number	Туре	Depth (m)	Description of Sample*
GM16/N		В	N/A	Greyish brown sl fine gravelly CLAY
GM16/C		В	N/A	Brown sl fine gravelly sl sandy sl silty CLAY
GM16/S		В	N/A	Brown sl fine gravelly sl sandy sl silty CLAY
ļ	<u> </u>			

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: 4.1.17





## SUMMARY OF SHEAR STRENGTH TESTS (TOTAL STRESS)

(BS 1377 : PART 7 : 3 : 1990)

**Client ref:** Location: **Contract Number:** 

Wallingford 33440

								U	ndrained Tr	iaxial Compe	ssion Tests	(Total Stress	5)		
Borhole	Sample	Sample	Sample	Sample	Moisture	Bulk	Dry	Size	Lateral	Cohesion	Average	Failure	Туре	Hand	Vane
Number	Number	Depth	Depth	Туре	Content	Density	Density		Pressure	1/2(s <sub>1</sub> -s <sub>3</sub> )	Cohesion	Strain	of	ki	Pa
		from	to						S <sub>3</sub>				Failure		
		m	m		%	Mg/m <sup>3</sup>	Mg/m <sup>3</sup>	mm	kPa	kPa	kPa	%		Peak	Residual
GM16/N		N/A	N/A	В	32.36			33						18	9
					6.21			33						232	
					10.36			33						232	
					14.08			33						232	
					22.27			33						126	44
GM16/C		N/A	N/A		10.57			33						232	
					3.23			33						232	
					6.06			33						232	
					8.41			33						232	
					12.26			33						232	
GM16/S		N/A	N/A		31.7			33						21	9
					2.5			33						232	
					5.08			33						232	
					10.12			33						232	
					14.33			33						232	

SYMBOLS: RM: Remoulded MS: Multistage B: Brittle P: Plastic C: Compound Vane Size : 19mm/33n



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Checked by:

DP Glans

04/01/17

GEO Site & Teeting Services Limited

Approved by:

Date of approval:

## Dry Density/Moisture Content Relationship BS 1377:Part 4:1990

Client ref:	
Location:	Wallingford
Contract Number:	33440
Hole Number:	GM16/N
Sample Number:	
Depth (m):	
Sample Type:	В

1.80 14 1.70 1.60 Dry Density Mg/m3 6.2 • 1.50 1.40 - GM16/N Air voids 5% 1.30 - Air voids 10% 35 --- Air voids 0% 1.20 5 10 0 15 20 25 30 35 40 Moisture Content % Compaction Point: 1 2 3 4 5 Moisture Content: 6.2 10 14 22 35 Bulk Density (Mg/m<sup>3</sup>): 1.62 1.83 1.93 1.89 1.72 Dry Density (Mg/m<sup>3</sup>): 1.55 1.53 1.66 1.69 1.27 Initial Moisture Content: Method of Compaction: 35 4.5KG Particle Density (Mg/m<sup>3</sup>): 2.4 Assumed Material Retained on 37.5 mm Test Sieve (%): 0 Maximum Dry Density  $(mg/m^3)$ : 1.69 Material Retained on 20.0 mm Test Sieve (%): 0 Optimum Moisture Content (%): 14 Sample Preparation Clause: 3.2.4.1

Remarks:







Checked By

Date Approved:

6.1.17

## Permeability in a Triaxial Cell

as per Accelerated test (Environment Agency Report P1-398/TR/2)

Borehole		GM16/N
Sample No.		
Depth	m	
Date		22/12/2016
Disturbed / Undisturbed		
		4.5kg Recompacted

#### **Description of Specimen**

Grey silty CLAY

#### **Initial Specimen Conditions**

Height	mm	117.60
Diameter	mm	101.50
Area	mm <sup>2</sup>	8091.37
Volume	cm <sup>3</sup>	951.54
Mass	g	1815.90
Dry Mass	g	1578.20
Density	Mg/m <sup>3</sup>	1.908
Dry Density	Mg/m <sup>3</sup>	1.659
Moisture Content	%	15.1
Voids Ratio		
Specific Gravity	kN/m <sup>3</sup>	2.65
(assume	assumed	

#### **Final Specimen Conditions**

Moisture Content	%	17.00
Density	Mg/m <sup>3</sup>	1.94
Dry Density	Mg/m³	1.66

#### **Test Setup**

Date started	16/12/2016
Date Finished	21/12/2016
Top Drain Used	у
Base Drain Used	ý
Pressure System Number	PCell 2
Cell Number	CCell 2

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**Checked and Approved By** 



Wallingford



**Client Ref** 

**Contract No** 

33440

## Permeability in a Triaxial Cell

as per Accelerated test (Environment Agency Report P1-398/TR/2)



## Dry Density/Moisture Content Relationship BS 1377:Part 4:1990

Client ref:	
Location:	Wallingford
Contract Number:	33440
Hole Number:	GM16/C
Sample Number:	
Depth (m):	
Sample Type:	В

2.00 - GM16/C - Air voids 5% 8.4 - Air voids 10% 1.90 Dry Density Mg/m3 ----- Air voids 0% 6.1 11 1.80 12 ≽ 3.2 4 1.70 -0 2 4 6 8 10 12 14 Moisture Content % Compaction Point: 1 2 3 4 5 Moisture Content: 3.2 6.1 8.4 11 12 Bulk Density (Mg/m<sup>3</sup>): 1.81 1.99 2.08 2.06 2.00 Dry Density  $(Mg/m^3)$ : 1.75 1.87 1.92 1.86 1.78 Initial Moisture Content: Method of Compaction: 11 4.5KG Particle Density (Mg/m<sup>3</sup>): 2.45 Assumed Material Retained on 37.5 mm Test Sieve (%): 0 Maximum Dry Density (mg/m<sup>3</sup>): 1.92 Material Retained on 20.0 mm Test Sieve (%): 0 Optimum Moisture Content (%): 8.4 Sample Preparation Clause: 3.2.4.1

Remarks:



× 1 ml





Checked By Date Approved:

6.1.17

## Permeability in a Triaxial Cell

as per Accelerated test (Environment Agency Report P1-398/TR/2)

Specimen D	etails
------------	--------

Develople		014170
Borenoie		GIVI 16C
Sample No.		
Depth m	ı	
Date		21/12/2016
Disturbed / Undisturbed		
		4.5kg Recompacted

#### **Description of Specimen**

Brown sl sandy silty CLAY

#### **Initial Specimen Conditions**

Height	mm	117.00
Diameter	mm	101.30
Area	mm <sup>2</sup>	8059.51
Volume	cm <sup>3</sup>	942.96
Mass	g	1964.50
Dry Mass	g	1788.50
Density	Mg/m <sup>3</sup>	2.083
Dry Density	Mg/m <sup>3</sup>	1.897
Moisture Content	%	9.8
Voids Ratio		
Specific Gravity	kN/m <sup>3</sup>	2.65
(assumed/	/measured)	assumed

#### **Final Specimen Conditions**

Moisture Content	%	12.53
Density	Mg/m <sup>3</sup>	2.13
Dry Density	Mg/m³	1.90

#### **Test Setup**

Date started	16/12/2016
Date Finished	20/12/2016
Top Drain Used	У
Base Drain Used	ý
Pressure System Number	PCell 4
Cell Number	CCell 4

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**Checked and Approved By** 







**Client Ref** 

**Contract No** 

33440

## Permeability in a Triaxial Cell

as per Accelerated test (Environment Agency Report P1-398/TR/2)



## Dry Density/Moisture Content Relationship BS 1377:Part 4:1990

Client ref:	
Location:	Wallingford
Contract Number:	33440
Hole Number:	GM16/S
Sample Number:	
Depth (m):	
Sample Type:	В



Remarks:



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Checked By

DP Glan<u>S</u> Approved By:



Date Approved:

6.1.17

## Permeability in a Triaxial Cell

as per Accelerated test (Environment Agency Report P1-398/TR/2)

-		
Borehole		GMC16/S
Sample No.		
Depth	m	
Date		21/12/2016
Disturbed / Undisturbed		
		4.5kg Recompacted

#### **Description of Specimen**

Greyish brown silty CLAY

#### **Initial Specimen Conditions**

Height	mm	115.80
Diameter	mm	104.60
Area	mm <sup>2</sup>	8593.17
Volume	cm <sup>3</sup>	995.09
Mass	g	2049.70
Dry Mass	g	1856.20
Density	Mg/m <sup>3</sup>	2.060
Dry Density	Mg/m <sup>3</sup>	1.865
Moisture Content	%	10.4
Voids Ratio		
Specific Gravity	kN/m <sup>3</sup>	2.65
(assumed	/measured)	assumed

#### **Final Specimen Conditions**

Moisture Content	%	12.58
Density	Mg/m <sup>3</sup>	2.10
Dry Density	Mg/m³	1.87

#### **Test Setup**

Date started	16/12/2016
Date Finished	20/12/2016
Top Drain Used	У
Base Drain Used	ý
Pressure System Number	PCell 1
Cell Number	CCell 1

DP Grang

**Checked and Approved By** 







**Client Ref** 

**Contract No** 

33440

## Permeability in a Triaxial Cell

as per Accelerated test (Environment Agency Report P1-398/TR/2)



Appendix C Slide Analysis

Safety Factor 0.500 0.700 6-0.900 Project Title: Wallingford 1in2 short term undrained Groundwater Method: Water Surfaces Bishop simplified Surface Type: Circular 1.100 1.300 ခြ 1.500 0.586 1.700 0.589 1.900 2 0.592 1.425 2.100+ W ▼ W ▼ <u>o</u>\_ 20 -10 10 30 40 50 60 0



# Slide Analysis Information

### Document Name

File Name: WAL cut1in2 ST.sli

## Project Settings

Project Title: Wallingford 1in2 short term undrained Failure Direction: Left to Right Units of Measurement: SI Units Pore Fluid Unit Weight: 9.81 kN/m3 Groundwater Method: Water Surfaces Data Output: Standard Calculate Excess Pore Pressure: Off Allow Ru with Water Surfaces or Grids: Off Random Numbers: Pseudo-random Seed Random Number Seed: 10116 Random Number Generation Method: Park and Miller v.3

## Analysis Methods

Analysis Methods used: Bishop simplified

Number of slices: 25 Tolerance: 0.005 Maximum number of iterations: 50

## Surface Options

Surface Type: Circular Search Method: Grid Search Radius increment: 10 Composite Surfaces: Disabled Reverse Curvature: Create Tension Crack Minimum Elevation: Not Defined Minimum Depth: Not Defined

### Material Properties

<u>Material: Lower chalk clay</u> Strength Type: Mohr-Coulomb Unit Weight: 20 kN/m3 Cohesion: 0 kPa Friction Angle: 26 degrees Water Surface: Water Table Custom Hu value: 1

<u>Material: sand and gravel</u> Strength Type: Mohr-Coulomb Unit Weight: 20 kN/m3 Cohesion: 0 kPa Friction Angle: 37 degrees Water Surface: Water Table Custom Hu value: 1

Material: Peat Strength Type: Undrained Unit Weight: 12.5 kN/m3 Cohesion Type: Constant Cohesion: 20 kPa Water Surface: None

<u>Material: Clay</u> Strength Type: Undrained Unit Weight: 18 kN/m3 Cohesion Type: Constant Cohesion: 35 kPa Water Surface: None

#### Global Minimums

Method: bishop simplified FS: 0.585612 Center: 46.691, 28.187 Radius: 19.712 Left Slip Surface Endpoint: 37.449, 10.775 Right Slip Surface Endpoint: 38.307, 10.346 Resisting Moment=0.384606 kN-m Driving Moment=0.656758 kN-m

### Valid / Invalid Surfaces

Method: bishop simplified Number of Valid Surfaces: 20334 Number of Invalid Surfaces: 13887 Error Codes: Error Code -106 reported for 61 surfaces Error Code -108 reported for 10257 surfaces Error Code -112 reported for 214 surfaces Error Code -1000 reported for 3355 surfaces

## Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 \* (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

## List of All Coordinates

<u>Search Grid</u> 30.043 56.894 56.894 30.043	16.015 16.015 49.211 49.211
<u>Material Bour</u>	<u>ndary</u>
0.000	12.500
34.000	12.500
<u>Material Bour</u>	<u>ndary</u>
0.000	11.700
35.600	11.700
<u>Material Bour</u>	<u>ndary</u>
0.000	10.000
39.000	10.000
<u>Material Bour</u>	<u>ndary</u>
0.000	13.500
32.000	13.500
External Bour	ndary
0.000	-9.991
54.500	-9.991
54.500	10.000
39.000	10.000
35.600	11.700
34.000	12.500
32.000	13.500
0.000	14.500
0.000	14.500
0.000	14.000
0.000	13.500
0.000	12.500
0.000	11.700
0.000	10.000
Water Table 0.000 32.000 39.000	13.500 13.500 10.000

54.500

10.000




# Document Name

File Name: WAL cut1in2 MT.sli

# Project Settings

Project Title: Wallingford 1in2 intermediate term partially drained Failure Direction: Left to Right Units of Measurement: SI Units Pore Fluid Unit Weight: 9.81 kN/m3 Groundwater Method: Water Surfaces Data Output: Standard Calculate Excess Pore Pressure: Off Allow Ru with Water Surfaces or Grids: Off Random Numbers: Pseudo-random Seed Random Number Seed: 10116 Random Number Generation Method: Park and Miller v.3

# Analysis Methods

Analysis Methods used: Bishop simplified

Number of slices: 25 Tolerance: 0.005 Maximum number of iterations: 50

# Surface Options

Surface Type: Circular Search Method: Grid Search Radius increment: 10 Composite Surfaces: Disabled Reverse Curvature: Create Tension Crack Minimum Elevation: Not Defined Minimum Depth: Not Defined

# Material Properties

<u>Material: Lower chalk clay</u> Strength Type: Mohr-Coulomb Unit Weight: 20 kN/m3 Cohesion: 0 kPa Friction Angle: 26 degrees Water Surface: Water Table Custom Hu value: 1

Material: Peat Strength Type: Mohr-Coulomb Unit Weight: 12.5 kN/m3 Cohesion: 10 kPa Friction Angle: 12 degrees Water Surface: Water Table Custom Hu value: 1

Material: Clay Strength Type: Mohr-Coulomb Unit Weight: 18 kN/m3 Cohesion: 15 kPa Friction Angle: 12 degrees Water Surface: Water Table Custom Hu value: 1

# List of All Coordinates

### Material Boundary

0.000	12.500
34.000	12.500

## Material Boundary

0.000	11.700
35.600	11.700

### Material Boundary

0.000	10.000
39.000	10.000

## External Boundary

0.000	-9.991
54.500	-9.991
54.500	10.000
39.000	10.000
35.600	11.700
34.000	12.500
30.000	14.500
0.000	14.500
0.000	14.000
0.000	12.500
0.000	11.700
0.000	10.000

## Water Table

0.000	13.500
29.342	13.500
30.743	13.308
31.860	13.008
34.886	11.870
23.334	11.700
30.608	11.344
35.961	10.657
39.000	10.000
54.500	10.000

Search Grid	
30.043	16.015
56.894	16.015
56.894	49.211
30.043	49.211



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# Document Name

File Name: WAL cut1in2 IT dewatered.sli

# Project Settings

Project Title: Wallingford 1in2 intermediate term drained Failure Direction: Left to Right Units of Measurement: SI Units Pore Fluid Unit Weight: 9.81 kN/m3 Groundwater Method: Water Surfaces Data Output: Standard Calculate Excess Pore Pressure: Off Allow Ru with Water Surfaces or Grids: Off Random Numbers: Pseudo-random Seed Random Number Seed: 10116 Random Number Generation Method: Park and Miller v.3

# Analysis Methods

Analysis Methods used: Bishop simplified

Number of slices: 25 Tolerance: 0.005 Maximum number of iterations: 50

# Surface Options

Surface Type: Circular Search Method: Grid Search Radius increment: 10 Composite Surfaces: Disabled Reverse Curvature: Create Tension Crack Minimum Elevation: Not Defined Minimum Depth: Not Defined

# Material Properties

<u>Material: Lower chalk clay</u> Strength Type: Mohr-Coulomb Unit Weight: 20 kN/m3 Cohesion: 0 kPa Friction Angle: 26 degrees Water Surface: Water Table Custom Hu value: 1

Material: Peat Strength Type: Mohr-Coulomb Unit Weight: 12.5 kN/m3 Cohesion: 0 kPa Friction Angle: 24 degrees Water Surface: Water Table Custom Hu value: 1

Material: Clay Strength Type: Mohr-Coulomb Unit Weight: 18 kN/m3 Cohesion: 0 kPa Friction Angle: 24 degrees Water Surface: Water Table Custom Hu value: 1

# List of All Coordinates

### Material Boundary

0.000	12.500
34.000	12.500

## Material Boundary

0.000	11.700
35.600	11.700

### Material Boundary

0.000	10.000
39.000	10.000

## External Boundary

0.000	-9.991
54.500	-9.991
54.500	10.000
39.000	10.000
35.600	11.700
34.000	12.500
30.000	14.500
0.000	14.500
0.000	14.000
0.000	12.500
0.000	11.700
0.000	10.000

## Water Table

0.000	13.500
17.858	13.500
19.970	13.290
20.785	13.008
23.334	11.700
30.608	11.344
35.961	10.657
39.000	10.000
54.500	10.000

Search Grid	
30.043	16.015
56.894	16.015
56.894	49.211
30.043	49.211

Safety Factor 0.500 0.700 6-0.900 Project Title: Wallingford 1in2 short term undrained Groundwater Method: Water Surfaces Bishop simplified Surface Type: Circular 1.100 1.300 ခြ 1.500 0.586 1.700 0.589 1.900 2 0.592 1.425 2.100+ W ▼ W ▼ <u>o</u>\_ 20 -10 10 30 40 50 60 0



# Document Name

File Name: WAL cut1in2 ST.sli

# Project Settings

Project Title: Wallingford 1in2 short term undrained Failure Direction: Left to Right Units of Measurement: SI Units Pore Fluid Unit Weight: 9.81 kN/m3 Groundwater Method: Water Surfaces Data Output: Standard Calculate Excess Pore Pressure: Off Allow Ru with Water Surfaces or Grids: Off Random Numbers: Pseudo-random Seed Random Number Seed: 10116 Random Number Generation Method: Park and Miller v.3

# Analysis Methods

Analysis Methods used: Bishop simplified

Number of slices: 25 Tolerance: 0.005 Maximum number of iterations: 50

# Surface Options

Surface Type: Circular Search Method: Grid Search Radius increment: 10 Composite Surfaces: Disabled Reverse Curvature: Create Tension Crack Minimum Elevation: Not Defined Minimum Depth: Not Defined

## Material Properties

<u>Material: Lower chalk clay</u> Strength Type: Mohr-Coulomb Unit Weight: 20 kN/m3 Cohesion: 0 kPa Friction Angle: 26 degrees Water Surface: Water Table Custom Hu value: 1

Material: Peat Strength Type: Undrained Unit Weight: 12.5 kN/m3 Cohesion Type: Constant Cohesion: 20 kPa Water Surface: None

<u>Material: Clay</u> Strength Type: Undrained Unit Weight: 18 kN/m3 Cohesion Type: Constant Cohesion: 35 kPa Water Surface: None

## Global Minimums

Method: bishop simplified FS: 0.585612 Center: 46.691, 28.187 Radius: 19.712 Left Slip Surface Endpoint: 37.449, 10.775 Right Slip Surface Endpoint: 38.307, 10.346 Resisting Moment=0.384606 kN-m Driving Moment=0.656758 kN-m

# Valid / Invalid Surfaces

Method: bishop simplified Number of Valid Surfaces: 20334 Number of Invalid Surfaces: 13887 Error Codes: Error Code -106 reported for 61 surfaces Error Code -108 reported for 10257 surfaces Error Code -112 reported for 214 surfaces Error Code -1000 reported for 3355 surfaces

# Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 \* (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

# List of All Coordinates

Search Grid 30.043 56.894 56.894 30.043	16.015 16.015 49.211 49.211
<u>Material Bou</u>	<u>ndary</u>
0.000	12.500
34.000	12.500
<u>Material Bou</u>	<u>ndary</u>
0.000	11.700
35.600	11.700
<u>Material Bou</u>	<u>ndary</u>
0.000	10.000
39.000	10.000
<u>Material Bou</u>	<u>ndary</u>
0.000	13.500
32.000	13.500
External Bou 0.000 54.500 54.500 39.000 35.600 34.000 32.000 30.000 0.000 0.000 0.000 0.000 0.000 0.000	-9.991 -9.991 10.000 10.000 11.700 12.500 13.500 14.500 14.500 14.000 13.500 12.500 11.700 10.000
<u>Water Table</u> 0.000 32.000 39.000	13.500 13.500 10.000

54.500

10.000





# Document Name

File Name: WAL cut 1in3.5 upper ST.sli

# Project Settings

Project Title: Wallingford 1in2 lower 1in3.5 upper short term undrained Failure Direction: Left to Right Units of Measurement: SI Units Pore Fluid Unit Weight: 9.81 kN/m3 Groundwater Method: Water Surfaces Data Output: Standard Calculate Excess Pore Pressure: Off Allow Ru with Water Surfaces or Grids: Off Random Numbers: Pseudo-random Seed Random Number Seed: 10116 Random Number Generation Method: Park and Miller v.3

# Analysis Methods

Analysis Methods used: Bishop simplified

Number of slices: 25 Tolerance: 0.005 Maximum number of iterations: 50

# Surface Options

Surface Type: Circular Search Method: Grid Search Radius increment: 10 Composite Surfaces: Disabled Reverse Curvature: Create Tension Crack Minimum Elevation: Not Defined Minimum Depth: Not Defined

# Material Properties

<u>Material: Lower chalk clay</u> Strength Type: Mohr-Coulomb Unit Weight: 20 kN/m3 Cohesion: 0 kPa Friction Angle: 26 degrees Water Surface: Water Table Custom Hu value: 1

Material: Peat Strength Type: Undrained Unit Weight: 12.5 kN/m3 Cohesion Type: Constant Cohesion: 20 kPa Water Surface: None

<u>Material: Clay</u> Strength Type: Undrained Unit Weight: 18 kN/m3 Cohesion Type: Constant Cohesion: 35 kPa Water Surface: None

## Global Minimums

Method: bishop simplified FS: 0.585616 Center: 45.058, 25.316 Radius: 16.413 Left Slip Surface Endpoint: 37.361, 10.820 Right Slip Surface Endpoint: 38.080, 10.460 Resisting Moment=0.226806 kN-m Driving Moment=0.387294 kN-m

# Valid / Invalid Surfaces

Method: bishop simplified Number of Valid Surfaces: 25045 Number of Invalid Surfaces: 9176 Error Codes: Error Code -103 reported for 3 surfaces Error Code -106 reported for 11 surfaces Error Code -108 reported for 9032 surfaces Error Code -112 reported for 130 surfaces

# Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

-106 = Average slice width is less than 0.0001 \* (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

# List of All Coordinates

Search Grid 26.263 53.114 53.114 26.263	17.017 17.017 50.212 50.212
<u>Material Bou</u>	<u>indary</u>
-3.900	12.500
32.886	12.500
<u>Material Bou</u>	<u>ndary</u>
-3.900	11.700
35.600	11.700
<u>Material Bou</u>	<u>indary</u>
-3.900	10.000
39.000	10.000
External Bou -3.900 54.500 54.500 39.000 35.600 32.886 26.100 0.000 -3.900 -3.900 -3.900 -3.900	<u>-9.991</u> -9.991 10.000 10.000 11.700 12.500 14.500 14.500 14.500 12.500 11.700 10.000
Water Table -3.900 29.493 35.600 39.000 54.500	13.500 13.500 11.700 10.000 10.000





# Document Name

File Name: WAL cut1in3.5 MT.sli

# Project Settings

Project Title: Wallingford 1in2 lower 1in3.5 upper intermediate term partially drained Failure Direction: Left to Right Units of Measurement: SI Units Pore Fluid Unit Weight: 9.81 kN/m3 Groundwater Method: Water Surfaces Data Output: Standard Calculate Excess Pore Pressure: Off Allow Ru with Water Surfaces or Grids: Off Random Numbers: Pseudo-random Seed Random Number Seed: 10116 Random Number Generation Method: Park and Miller v.3

# Analysis Methods

Analysis Methods used: Bishop simplified

Number of slices: 25 Tolerance: 0.005 Maximum number of iterations: 50

# Surface Options

Surface Type: Circular Search Method: Grid Search Radius increment: 10 Composite Surfaces: Disabled Reverse Curvature: Create Tension Crack Minimum Elevation: Not Defined Minimum Depth: Not Defined

## Material Properties

<u>Material: Lower chalk clay</u> Strength Type: Mohr-Coulomb Unit Weight: 20 kN/m3 Cohesion: 0 kPa Friction Angle: 26 degrees Water Surface: Water Table Custom Hu value: 1

<u>Material: Peat</u> Strength Type: Mohr-Coulomb Unit Weight: 12.5 kN/m3 Cohesion: 10 kPa Friction Angle: 12 degrees Water Surface: Water Table Custom Hu value: 1

<u>Material: Clay</u> Strength Type: Mohr-Coulomb Unit Weight: 18 kN/m3 Cohesion: 15 kPa Friction Angle: 12 degrees Water Surface: Water Table Custom Hu value: 1

## Global Minimums

Method: bishop simplified FS: 1.438410 Center: 35.951, 22.101 Radius: 13.953 Left Slip Surface Endpoint: 24.249, 14.500 Right Slip Surface Endpoint: 42.898, 10.000 Resisting Moment=4097.21 kN-m Driving Moment=2848.43 kN-m

## Valid / Invalid Surfaces

Method: bishop simplified Number of Valid Surfaces: 20289 Number of Invalid Surfaces: 13932 Error Codes: Error Code -105 reported for 1 surface Error Code -106 reported for 70 surfaces Error Code -108 reported for 10463 surfaces Error Code -112 reported for 43 surfaces Error Code -1000 reported for 3355 surfaces

# Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

-106 = Average slice width is less than 0.0001 \* (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

## List of All Coordinates

<u>Search Grid</u> 30.043 56.894 56.894 30.043	16.015 16.015 49.211 49.211
<u>Material Bou</u>	<u>ndary</u>
-4.184	12.500
32.800	12.500
<u>Material Bou</u>	<u>ndary</u>
-4.184	11.669
35.600	11.700
<u>Material Bou</u>	<u>ndary</u>
-4.200	10.000
39.000	10.000
External Bou	<u>indary</u>
-4.200	-9.991
54.500	-9.991
54.500	10.000
39.000	10.000
35.600	11.700
32.800	12.500
25.800	14.500
0.000	14.500
-4.184	14.500
-4.184	12.500
-4.184	11.669
-4.200	10.000
Water Table -4.184 26.476 28.829 30.237 33.766 23.334 30.608 35.961 39.000	13.500 13.500 13.249 12.823 12.018 11.700 11.344 10.657 10.000

54.500 10.000





# Document Name

File Name: WAL cut1in3.5 upper LT dewatered.sli

# Project Settings

Project Title: Wallingford 1in2 lower 1in3.5 upper intermediate term drained Failure Direction: Left to Right Units of Measurement: SI Units Pore Fluid Unit Weight: 9.81 kN/m3 Groundwater Method: Water Surfaces Data Output: Standard Calculate Excess Pore Pressure: Off Allow Ru with Water Surfaces or Grids: Off Random Numbers: Pseudo-random Seed Random Number Seed: 10116 Random Number Generation Method: Park and Miller v.3

# Analysis Methods

Analysis Methods used: Bishop simplified

Number of slices: 25 Tolerance: 0.005 Maximum number of iterations: 50

# Surface Options

Surface Type: Circular Search Method: Grid Search Radius increment: 10 Composite Surfaces: Disabled Reverse Curvature: Create Tension Crack Minimum Elevation: Not Defined Minimum Depth: Not Defined

# Material Properties

<u>Material: Lower chalk clay</u> Strength Type: Mohr-Coulomb Unit Weight: 20 kN/m3 Cohesion: 0 kPa Friction Angle: 26 degrees Water Surface: Water Table Custom Hu value: 1

Material: Peat Strength Type: Mohr-Coulomb Unit Weight: 12.5 kN/m3 Cohesion: 0 kPa Friction Angle: 24 degrees Water Surface: Water Table Custom Hu value: 1

Material: Clay Strength Type: Mohr-Coulomb Unit Weight: 18 kN/m3 Cohesion: 0 kPa Friction Angle: 24 degrees Water Surface: Water Table Custom Hu value: 1

# List of All Coordinates

### Material Boundary

-3.900	12.500
32.886	12.500

## Material Boundary

-3.900	11.700
35.600	11.700

### Material Boundary

-3.900	10.000
39.000	10.000

# External Boundary

-3.900	-9.991
54.500	-9.991
54.500	10.000
39.000	10.000
35.600	11.700
32.886	12.500
26.100	14.500
0.000	14.500
-3.900	14.500
-3.900	12.500
-3.900	11.700
-3.900	10.000

## Water Table

-3.900	13.500
17.858	13.500
19.970	13.290
20.785	13.008
23.334	11.700
30.608	11.344
35.961	10.657
39.000	10.000
54.500	10.000

Search Grid	
30.043	16.015
56.894	16.015
56.894	49.211
30.043	49.211





# Document Name

File Name: WAL cut 1in3.5 upper.sli

# Project Settings

Project Title: Wallingford 1in2 lower 1in3.5 upper long term drained Failure Direction: Left to Right Units of Measurement: SI Units Pore Fluid Unit Weight: 9.81 kN/m3 Groundwater Method: Water Surfaces Data Output: Standard Calculate Excess Pore Pressure: Off Allow Ru with Water Surfaces or Grids: Off Random Numbers: Pseudo-random Seed Random Number Seed: 10116 Random Number Generation Method: Park and Miller v.3

# Analysis Methods

Analysis Methods used: Bishop simplified

Number of slices: 25 Tolerance: 0.005 Maximum number of iterations: 50

# Surface Options

Surface Type: Circular Search Method: Grid Search Radius increment: 10 Composite Surfaces: Disabled Reverse Curvature: Create Tension Crack Minimum Elevation: Not Defined Minimum Depth: Not Defined

# Material Properties

<u>Material: Lower chalk clay</u> Strength Type: Mohr-Coulomb Unit Weight: 20 kN/m3 Cohesion: 0 kPa Friction Angle: 26 degrees Water Surface: Water Table Custom Hu value: 1

<u>Material: Peat</u> Strength Type: Mohr-Coulomb Unit Weight: 12.5 kN/m3 Cohesion: 0 kPa Friction Angle: 24 degrees Water Surface: Water Table Custom Hu value: 1

Material: Clay Strength Type: Mohr-Coulomb Unit Weight: 18 kN/m3 Cohesion: 0 kPa Friction Angle: 24 degrees Water Surface: Water Table Custom Hu value: 1

# List of All Coordinates

### Material Boundary

-3.900	12.500
32.886	12.500

## Material Boundary

-3.900	11.700
35.600	11.700

### Material Boundary

-3.900	10.000
39.000	10.000

# External Boundary

-3.900	-9.991
54.500	-9.991
54.500	10.000
39.000	10.000
35.600	11.700
32.886	12.500
26.100	14.500
0.000	14.500
-3.900	14.500
-3.900	12.500
-3.900	11.700
-3.900	10.000

## Water Table

-3.900	13.500
54.500	13.500

## Search Grid

27.092	16.236
53.943	16.236
53.943	49.431
27.092	49.431




# Slide Analysis Information

### Document Name

File Name: Fill ST.sli

## Project Settings

Project Title: Wallingford backfill face ST Failure Direction: Left to Right Units of Measurement: SI Units Pore Fluid Unit Weight: 9.81 kN/m3 Groundwater Method: Water Surfaces Data Output: Standard Calculate Excess Pore Pressure: Off Allow Ru with Water Surfaces or Grids: Off Random Numbers: Pseudo-random Seed Random Number Seed: 10116 Random Number Generation Method: Park and Miller v.3

## Analysis Methods

Analysis Methods used: Bishop simplified

Number of slices: 25 Tolerance: 0.005 Maximum number of iterations: 50

## Surface Options

Surface Type: Circular Search Method: Grid Search Radius increment: 10 Composite Surfaces: Disabled Reverse Curvature: Create Tension Crack Minimum Elevation: Not Defined Minimum Depth: Not Defined

## Material Properties

<u>Material: Lower chalk clay</u> Strength Type: Mohr-Coulomb Unit Weight: 20 kN/m3 Cohesion: 0 kPa Friction Angle: 26 degrees Water Surface: Water Table Custom Hu value: 1

<u>Material: sand and gravel</u> Strength Type: Mohr-Coulomb Unit Weight: 20 kN/m3 Cohesion: 0 kPa Friction Angle: 37 degrees Water Surface: Water Table

### Custom Hu value: 1

<u>Material: peat</u> Strength Type: Undrained Unit Weight: 12.5 kN/m3 Cohesion Type: Constant Cohesion: 20 kPa Water Surface: Water Table Custom Hu value: 1

<u>Material: clay</u> Strength Type: Undrained Unit Weight: 18 kN/m3 Cohesion Type: Constant Cohesion: 35 kPa Water Surface: Water Table Custom Hu value: 1

<u>Material: geo barrier</u> Strength Type: Undrained Unit Weight: 21 kN/m3 Cohesion Type: Constant Cohesion: 50 kPa Water Surface: None

Material: general fill Strength Type: Undrained Unit Weight: 20 kN/m3 Cohesion Type: Constant Cohesion: 45 kPa Water Surface: None

### List of All Coordinates

### Material Boundary

0.000	12.500
32.800	12.500

#### Material Boundary

0.000	11.700
35.600	11.700

### Material Boundary

0.000	10.000
39.000	10.000
42.550	10.000
42.550	9.500
43.550	9.500
43.550	10.000

### Material Boundary

25.800	14.500
29.300	13.500
31.050	13.000
32.800	12.500
35.600	11.700
39.000	10.000

Material Boun	dary
0.000	13.500
29.300	13.500
Material Boundary	
30.300	13.500
32.050	13.000
42.550	10.000
Material Boun	darv
0.000	13.000
31.050	13.000
32.050	13.000
33.050	13.000
External Bour	ndarv
0.000	0.000
54.500	0.000
54.500	10.000
46.000	10.000
43.550	10.000
33.050	13.000
31.300	13.500
30.300	13.500
26.800	14.500
25.800	14.500
0.000	14.500
0.000	13.000
0.000	12 500
0.000	12.300
0.000	10.000
Water Table	40 500
0.000	13.500
31.300	10.000
54.500	10.000
Search Grid	16 970
21.031 51.001	16.870
51 991	45 851
27.031	45.851





# Slide Analysis Information

### Document Name

File Name: Slide1.sli

## Project Settings

Project Title: Wallingford backfill face LT Failure Direction: Left to Right Units of Measurement: SI Units Pore Fluid Unit Weight: 9.81 kN/m3 Groundwater Method: Water Surfaces Data Output: Standard Calculate Excess Pore Pressure: Off Allow Ru with Water Surfaces or Grids: Off Random Numbers: Pseudo-random Seed Random Number Seed: 10116 Random Number Generation Method: Park and Miller v.3

## Analysis Methods

Analysis Methods used: Bishop simplified

Number of slices: 25 Tolerance: 0.005 Maximum number of iterations: 50

## Surface Options

Surface Type: Circular Search Method: Grid Search Radius increment: 10 Composite Surfaces: Disabled Reverse Curvature: Create Tension Crack Minimum Elevation: Not Defined Minimum Depth: Not Defined

## Material Properties

<u>Material: Lower chalk clay</u> Strength Type: Mohr-Coulomb Unit Weight: 20 kN/m3 Cohesion: 0 kPa Friction Angle: 26 degrees Water Surface: Water Table Custom Hu value: 1

<u>Material: sand and gravel</u> Strength Type: Mohr-Coulomb Unit Weight: 20 kN/m3 Cohesion: 0 kPa Friction Angle: 37 degrees Water Surface: Water Table

### Custom Hu value: 1

<u>Material: peat</u> Strength Type: Mohr-Coulomb Unit Weight: 12.5 kN/m3 Cohesion: 0 kPa Friction Angle: 24 degrees Water Surface: Water Table Custom Hu value: 1

<u>Material: clay</u> Strength Type: Mohr-Coulomb Unit Weight: 18 kN/m3 Cohesion: 0 kPa Friction Angle: 24 degrees Water Surface: Water Table Custom Hu value: 1

<u>Material: geo barrier</u> Strength Type: Mohr-Coulomb Unit Weight: 21 kN/m3 Cohesion: 0 kPa Friction Angle: 24 degrees Water Surface: Water Table Custom Hu value: 1

Material: general fill Strength Type: Mohr-Coulomb Unit Weight: 20 kN/m3 Cohesion: 0 kPa Friction Angle: 26 degrees Water Surface: Water Table Custom Hu value: 1

### List of All Coordinates

Material Boundary	
12.500	
12.500	

Material Boundary

0.000	11.700
35.600	11.700

### Material Boundary

0.000	10.000
39.000	10.000
42.550	10.000
42.550	9.500
43.550	9.500
43.550	10.000

### Material Boundary

25.800	14.500
29.300	13.500
31.050	13.000
32.800	12.500

35.600	11.700
39.000	10.000
<u>Material Bou</u>	<u>ndary</u>
0.000	13.500
29.300	13.500
<u>Material Bou</u>	<u>ndary</u>
30.300	13.500
32.050	13.000
42.550	10.000
<u>Material Bou</u>	ndary
0.000	13.000
31.050	13.000
32.050	13.000
33.050	13.000
External Bou	ndary
0.000	0.000
54.500	10.000
54.500	10.000
46.000	10.000
43.550	13.000
33.050	13.500
31.300	13.500
26.800	14.500
25.800	14.500
0.000	14.500
0.000	13.500
0.000	13.500
0.000	13.000
0.000	12.500
0.000	11.700
0.000	10.000
Water Table 0.000 29.900 45.468 54.500	13.500 13.500 13.500 13.500
Search Grid 27.031 66.205 66.205 27.031	17.180 17.180 75.015 75.015