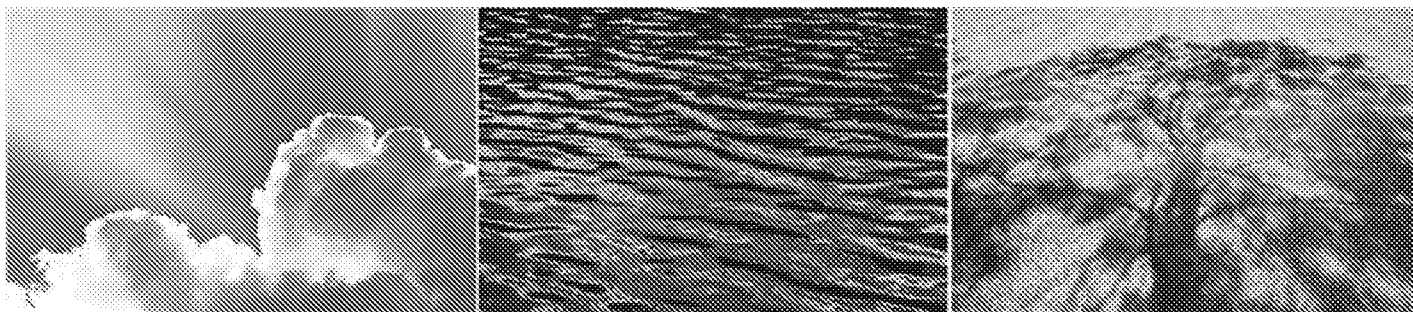


Desk Study, Site Investigation & Risk Assessment Report



Desk Studies | Risk Assessments | Site Investigations | Geotechnical | Contamination Investigations | Remediation Design and Validation

Site: Land South of Mayflower Way, Angmering

Client: Angmering Community Land Trust

Report Date: 25 August 2017

Project Reference: J13227

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SUMMARY

The site, which extends to about 0.43 ha, comprises an open plot of agricultural land, which at the time of our investigation was not in use. It is proposed to redevelop the site with two to three storey residential properties with associated private gardens and areas of parking

Geological records indicate the site to be underlain by Brickearth over Terrace Gravel over New Pit Chalk Formation.

A historical Ordnance Survey map search and desk study was carried out and indicates that the site has a history of agricultural use and is situated in a predominantly rural/residential area.

A single phase of intrusive investigation was carried out.

The soils encountered comprised a shallow covering of topsoil/made ground, over orange brown silty sandy Clay (Brickearth) over gravelly Clay trending to sandy Gravel with depth (River Terrace) over a chalky sandy gravel.

At the locations of TP101, TP104, TP105 and TP106, made ground soils were encountered to depths of between 0.45m to 1.3m bgl. The made ground soils were variable and in general comprised brown sandy clay with abundant fine to coarse brick, tile, felt, barbed wire, timber, roofing felt, glass, rubber, plastics, metal fragments and whole reinforced concrete fence posts. Fragments of asbestos containing materials in the form of asbestos cement were also identified.

Groundwater was not encountered during the course of this investigation.

The sulphate content of the fill and natural soil was found to fall within Class DS-1. The ACEC classification for the site is AC-1.

An allowable bearing capacity of 125kPa is recommended. NHBC LOW Volume Change Potential precautions will apply.

Suspended floor slabs are advised due to the presence of made ground soils across the site.

There is evidence of soil contamination in the form of asbestos containing materials and loose fibres of asbestos. Preliminary recommendations are given for remediation of the site, however further work is required to define the extent of the contamination and enable design of the remediation. The contamination screening values used are valid at the time of writing but may be subject to change and any such changes will have implications for the assessments based on them. Their validity should be confirmed at the time of site development.

A formal remediation strategy and verification plan should be agreed with the regulatory authorities prior to commencement of any remedial works.

The site investigation was conducted and this report has been prepared for the sole internal use and reliance of Angmering Community Land Trust and their appointed Engineers. This report shall not be relied upon or transferred to any other parties without the express written authorization of Southern Testing Laboratories Ltd. If an unauthorised third party comes into possession of this report they rely on it at their peril and the authors owe them no duty of care and skill.

The findings and opinions conveyed via this Site Investigation Report are based on information obtained from a variety of sources as detailed within this report, and which Southern Testing Laboratories Ltd believes are reliable. Nevertheless, Southern Testing Laboratories Ltd cannot and does not guarantee the authenticity or reliability of the information it has obtained from others.



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For and on behalf of Southern Testing Laboratories Limited

STL: J13227
25 August 2017

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A INTRODUCTION

1 Authority

Our authority for carrying out this work is contained in a signed order form from Bruce Howse of The Howse Wallis Partnership on behalf of their client, the Angmering Community Land Trust.

2 Location

The site, which comprises an existing field, is located to the south of Mayflower Way, approximately 500m north east of Angmering Railway Station, Littlehampton, BN16 4AY. The approximate National Grid Reference of the site is TQ 07262 03274.

3 Proposed Construction

It is proposed to develop a 0.43 ha site with housing. Ground loadings have not been given at this stage

For the purposes of the contamination risk assessment, the proposed development land use is classified as Residential with plant uptake. The gas sensitivity of the site is rated as High (CIRIA C665¹).

4 Object

This is a Phase 1 Desk Study and Walkover and Phase II geotechnical and contamination (risk estimation and evaluation) investigation (Tier 1).

The object of the investigation was to assess foundation bearing conditions and other soil parameters relevant to the proposed development, and to assess the likely nature and extent of any potential soil, groundwater and soil gas contamination on the site.

5 Scope

This report presents our desk study findings, exploratory hole logs and test results and our interpretation of these data.

As with any site there may be differences in soil conditions between exploratory hole positions.

This report is not an engineering design and the figures and calculations contained in the report should be used by the Engineer, taking note that variations will apply, according to variations in design loading, in techniques used, and in site conditions. Our figures therefore should not supersede the Engineer's design.

The findings and opinions conveyed via this Site Investigation Report are based on information obtained from a variety of sources as detailed within this report, and which Southern Testing Laboratories Ltd believes are reliable. Nevertheless, Southern Testing Laboratories Ltd cannot and does not guarantee the authenticity or reliability of the information it has obtained from others.

¹ CIRIA C665 (2006) Assessing risks posed by hazardous ground gases to buildings.

The site investigation was conducted and this report has been prepared for the sole internal use and reliance of Angmering Community Land Trust and their appointed Engineers. This report shall not be relied upon or transferred to any other parties without the express written authorization of Southern Testing Laboratories Ltd. If an unauthorised third party comes into possession of this report they rely on it at their peril and the authors owe them no duty of care and skill.

The recommendations contained in this report may not be appropriate to alternative development schemes. The contamination screening values used are valid at the time of writing but may be subject to change and any such changes will have implications for the assessments based on them. Their validity should be confirmed at the time of site development.

B DESK STUDY & WALKOVER SURVEY

6 Desk Study

A desk study has been carried out. Reference has been made to the following information sources.

- Geological Maps
- Hydrogeological/Groundwater Vulnerability maps
- Aerial Photographs
- Historical Ordnance Survey Maps
- Environmental Databases
- Previous Reports (reports by Southern Testing in the immediate area)
- Environment Agency website
- BRE Radon Atlas²

The environmental databases search report compiled for this desk study contains site-specific environmental data drawn from data sets that comprise publicly available information together with data from third parties, some of which is under review. Accordingly, Southern Testing Laboratories Limited does not warrant its accuracy, reliability or completeness.

The full report is included in Appendix F, a summary of the salient features is included in the following sections of this report.

6.1 Geology

The British Geological Survey Map indicates that the site geology consists of Brickearth over River Terrace deposits over New Pit Chalk Formation.

Brickearth

Brickearth (loess deposit) is a recent deposit which is so called as it is suited to brick manufacture. It is predominantly an Aeolian deposit; formed during cold, dry climatic conditions. There is evidence that Brickearth has been reworked as part of 'sheet flooding' which helped incorporate flint gravels into the deposit. Brickearth consists mainly of ferruginous silty clay, which is often sandy and may contain some finely divided chalk, scattered flints and gravelly seams, or other locally derived material.

² BR 211 (2015) 'Radon: guidance on protective measures for new buildings'

Terrace Gravels

Terrace gravels are sheets of irregular and sub-rounded gravel and sand, laid down as terraces alongside rivers. There is usually a covering of sandy silty clay, termed brickearth, and old backfilled gravel workings are sometimes found.

Middle Chalk

Chalk is a well-known soft white friable limestone consisting of over 95% of calcium carbonate. It is of organic origin and is composed of shell debris embedded in a fine matrix of microscopic calcareous bodies produced by planktonic algae (coccoliths).

Flints are largely absent in the Middle Chalk, except in the upper beds, and there is a hard band of chalk, the Melbourn Rock, at the base of the division.

While Upper Chalk frequently has excellent soakage properties, this is not the case in the Middle Chalk, where soakage may be poor.

6.2 Hydrology and Hydrogeology

Data from the Environment Agency and other information relating to controlled waters is summarised below.

Data		Remarks	Possible Hazard to/from Site Y/N
Aquifer Designation	Superficial Deposits	The site is mapped within a Secondary A Aquifer (River Terrace Deposits)	Y
	Bedrock	The site is mapped within a Principal Bedrock Aquifer (New Pit Chalk).	Y
Groundwater Vulnerability		The site is mapped within a Major Aquifer of high leaching potential.	Y
Abstractions		There are two groundwater abstraction licenses listed within 500m of the site (326m northeast and 327m east). Both relate to abstraction for spray irrigation at local nursery sites.	N
Source Protection Zones		The site is not mapped within a source protection zone. Furthermore no groundwater source protection zones are listed within 500m of the site.	N N
Surface Water Features		The nearest surface water feature is listed 195m west of the site. Which is related to the storm overflow ponds to the west.	N
Marine/Fluvial Flood Risk		The site is not shown within or adjacent an area mapped as being at risk.	N

Data	Remarks	Possible Hazard to/from Site Y/N
Surface Water Flood Risk	The site is not shown within or adjacent to an area mapped as being at risk.	N
Reservoir Flood Risk	The site is not shown within or adjacent to an area mapped as being at risk.	N
Discharge Consents	The nearest discharge consent is listed 56m north of the site and is listed as final/treated effluent. A further 3 discharge consents for final/treated effluent are listed within 250m of the site.	N N

The site is located on both a Secondary A superficial aquifer and a Principal Bedrock aquifer and as such any potential sources of on site contamination could have an impact on the underlying groundwater table. However, there are no groundwater source protection zones or potable abstraction wells in close proximity to the site and as such the overall risk to groundwater is therefore considered to be low.

6.3 Historical Map Search

Copy extracts of historical Ordnance Survey plans dating from 1876 to 2014 were obtained and are presented in Appendix F together with a summary of the salient features.

In brief, the site was first shown on the 1876 map as an open plot of land and appears to have remained undeveloped land up to the most recent map (2014). Anecdotal evidence from a council employee suggest that the site was used as allotment gardens for a period of time which was not shown on the historical maps or aerial photography.

The surrounding area is shown on the 1876 map as predominantly open land, the only feature being a road to the south and Ivy Cottage to the south east. The surrounding area remained essentially unaltered up to the 1932 map, when a collection of greenhouses were constructed approximately 250m east of the site along with two small houses. By the 1942-1943 map the local area has been significantly developed with numerous large scale horticultural nurseries and associated greenhouses and tanks to the north, south and east of the site. The 1970 map shows the large nursery (Half Moon Nursery) to the south of the site has been demolished and redeveloped into residential properties. The land to the north of the site has further developed with new greenhouses and nurseries being constructed, with areas of ponds mapped along with tanks and chimneys. The land to the east and west of the site has been developed with residential properties and just off site to the south east a pet food packing station has been developed. The surrounding area appears to have remained essentially unaltered up to the 1994 map when it appears that several of the nursery sites to the north have been demolished. The 2002 map shows an area of land to the northwest of the site has been developed into some sort of earthworks feature. By the 2014 map the remaining nursery site to north appears to have been demolished and replaced by a residential development. Whilst this is the last map available, during the walkover survey it was apparent that the final nursery site to the east has also been demolished and is currently being developed into residential properties.

6.31 Environmental Databases

	Distance (m)	Direction	Details	Possible Hazard to site
Historical Industrial Land Uses	0	Onsite	Nurseries	Y
			A further 12 entries for nursery sites were listed within 250m of the site.	Y
	81	NW	Unspecified Tanks	
	81	NW	A further 10 entries for unspecified tanks were listed within 250m of the site.	Y
Current Industrial Land Uses	32	SE	Furniture – Wood Design	N
	78	NE	Second-hand Vehicles	N
	80	NW	Tanks (Generic)	N
	81	NE	Scrap Metal Merchants	N
	81	NE	Vehicle Repair, Testing and Servicing	N
	89	NE	Vehicle Repair and Testing	N
	163	NE	Electrical substation	N
Current and Historical Landfills	-	-	No landfills listed within 1km of the site.	N
Fuel Sites	336	SE	John Cooper Garages – Obsolete	N
Pollution Incidents	31	S	Smoke- Category 3 Air/Land	N
	177	SE	Construction and Demolition Materials and Wastes- Category 3 Air/Land	N
IPC Part B Authorisations	-	-	None listed within 500m of the site	N
Hazardous Substances Consents	195	NE	Application under the Hazardous Substances Act 1992 for the storage of liquefied petroleum gas	N
	241	E	Historical NIHHS Site	N
Sensitive Land Use Designations	176	W	Nitrate Vulnerable Zone	N

The site has been mapped as open rural land since the first historical map up to the present day and as such the risk of on site contamination is expected to be low. The Groundsure report lists the site as being developed as nurseries, however the maps do not suggest the site was ever under nursery use and these entries may be related to the close proximity of the adjacent nurseries to the site boundary.

In addition, anecdotal evidence from a local council worker suggests that the site was developed into allotments for a period of time, and as such there is a risk of on site contamination associated with this land use.

The surrounding area has historically been developed into large scale horticultural plant nurseries and associated tanks, ponds and greenhouses. There is a low risk that residual contamination associated with the land use could impact the subject site. However, the recent redevelopment of these sites into residential estates suggests that any residual contamination encountered should have been remediated.

6.4 Geological Hazards and Mining Activities

Data from various sources relating to potential geological hazards at the site are summarized below. The Hazard Potentials listed for the BGS data are as presented in the Groundsure report, derived from various generic BGS sources, which are not considered as site-specific. It is important that this information is considered in context of the actual site topography, ground conditions encountered during future investigation, and development proposals.

Data Source	Hazard	Hazard Potential to Site	Remarks
BGS	Potential for Collapsible Ground Stability Hazard	Low	
	Potential for Compressible Ground Stability Hazard	Negligible	Brickearth potentially present on site and may have moderate to high compressibility.
	Potential for Ground Dissolution Stability Hazard	Very Low/ Negligible	
	Potential for Landslide Ground Stability Hazard	Very Low	
	Potential for Running Sand Ground Stability Hazard	Low	The underlying Terrace Gravel deposits are likely to be unstable below the water table.
	Potential for Swelling or Shrinking Clay Ground Stability Hazard	Low	Should be considered moderate to high given the likely presence of Brickearth materials at shallow depths on site.
	Non Coal Mining Hazard	Negligible	
ARUP	Mining Instability	Negligible	Nothing shown within 4km of site, chalk mining within Northeast of quadrant.
CSS/KURG*	Underground openings	Negligible	Nothing shown within 2km of site location.

**Chelsea Spelaeological Society/ Kent Underground Research Group*

6.5 Radon Risk

The property is in a Radon affected area, as between 1% and 3% of properties are above the action level.

With reference to BRE guidance, no radon protection is required on this site.

7 Walkover Survey

A walkover survey was carried out on 24th July 2017.

7.1 General Description and Boundaries

The site comprises a broadly rectangular plot of land, which at the time of our investigation was predominantly overgrown grass.

The northern boundary of the site contains a soil bund approximately 1.2m in height, beyond which Mayflower Way is situated and to the north of this is an area of land, which is disused and is covered in piles of scrap metal, soil and demolition rubble. The western and eastern site boundaries comprise residential properties with associated garden areas while the southern site boundary comprises an overgrown section of woodland, with an old dirt BMX bike track.

7.2 Topography and Drainage

The site and immediate surrounding area is generally flat and level with no major changes in elevation observed. To the north west of the site is an area of land which appears to be used for storm water storage during periods of heavy rainfall.

7.3 Vegetation

The site at the time of our walkover was generally covered in long grass with occasional weeds and shrubs throughout. The southern site boundary comprised mixed deciduous trees and shrubs including Laurel, Hawthorn and other mixed deciduous species. To the north of Mayflower Way a row of mature Silver Birch and conifers are situated.

7.4 Buildings and Land Use on Site and Nearby

The site comprises an open plot of land with no existing structures. To the east and to the west of the site are existing brick built residential properties and associated garden areas. To the north east of the site is a collection of second hand car and van sales and to the southeast of the site is an existing furniture warehouse.

7.5 Photographs

A series of photographs showing the site at the time of our walkover survey is included in Appendix E.

C PRELIMINARY CONCEPTUAL MODEL

8 Introduction

In the context of this report, the conceptual model summarises the potential pollutant linkages identified for the site and forms the basis of the risk assessment for the site. The preliminary model comprises the potential sources of contamination, receptors that could be harmed and exposure pathways identified from the desk study and walkover survey. These potential linkages form the basis upon which the investigation is designed and reported.

9 Potential Sources of Contamination

The site has a history of use as rural/agricultural land and based on anecdotal evidence may have also been allotments for a short period of time. In addition, whilst we do not believe the site was ever developed as part of the adjacent horticultural nurseries, there is a risk that residual contaminants associated with this land use may be encountered on site.

Only limited contaminative sources have been identified in the general locality and on the site.

Potential contaminants associated with these uses have been compiled from DoE industry profiles and our experience of such sites.

9.1 On Site Sources

Source	Potential Contaminants
Allotment Gardens	Metals, PAH's, asbestos containing materials, Pesticides/Herbicides
Rural Land	Made Ground – May contain variable materials such as Metals, PAH's, asbestos containing materials

The site has had as history open rural/agricultural land and as such there is a risk of residual contamination associated with the use of pesticides/herbicides on the site.

In addition, anecdotal evidence suggests that the site was used as an allotment gardens at some point in its history and as such there is also a low risk of on site contamination associated with the potential for made ground soils to be encountered on site.

The close proximity of the site to the large scale horticultural nurseries in the area may have also led to residual contamination associated with heavy metals from paintwork used on the greenhouses and the use of pesticides/herbicides.

9.2 Off Site Sources

The site may be impacted by contamination migrating from beyond the site boundary. The following potential off-site sources have been identified.

Source	Distance from Site Boundary	Direction	Potential Contaminants	Likely Hazard to Site
Potentially Infilled Land	7m	N	Land Gas	Low
Unspecified Tanks	58m	NW	Petroleum Hydrocarbons, BTEX	Low
Nurseries	79m	S	Metals (principally lead), Asbestos, Pesticides/Herbicides	Low

The land to the north east of the site, where the Car and Van sales business are currently situated, contained a pond up to the 1994 map. Aerial imagery from 2000 shows that the pond has been backfilled and the site has been developed into a Car Sales Yard. Since 2000 the site has been redeveloped with new buildings and areas of hardstanding over the location of the former pond. Given the age of the backfilling and the fact that the site has been redeveloped since, we do not consider this feature to pose a significant risk of land gas generation and therefore do not consider there to be a need for land gas monitoring.

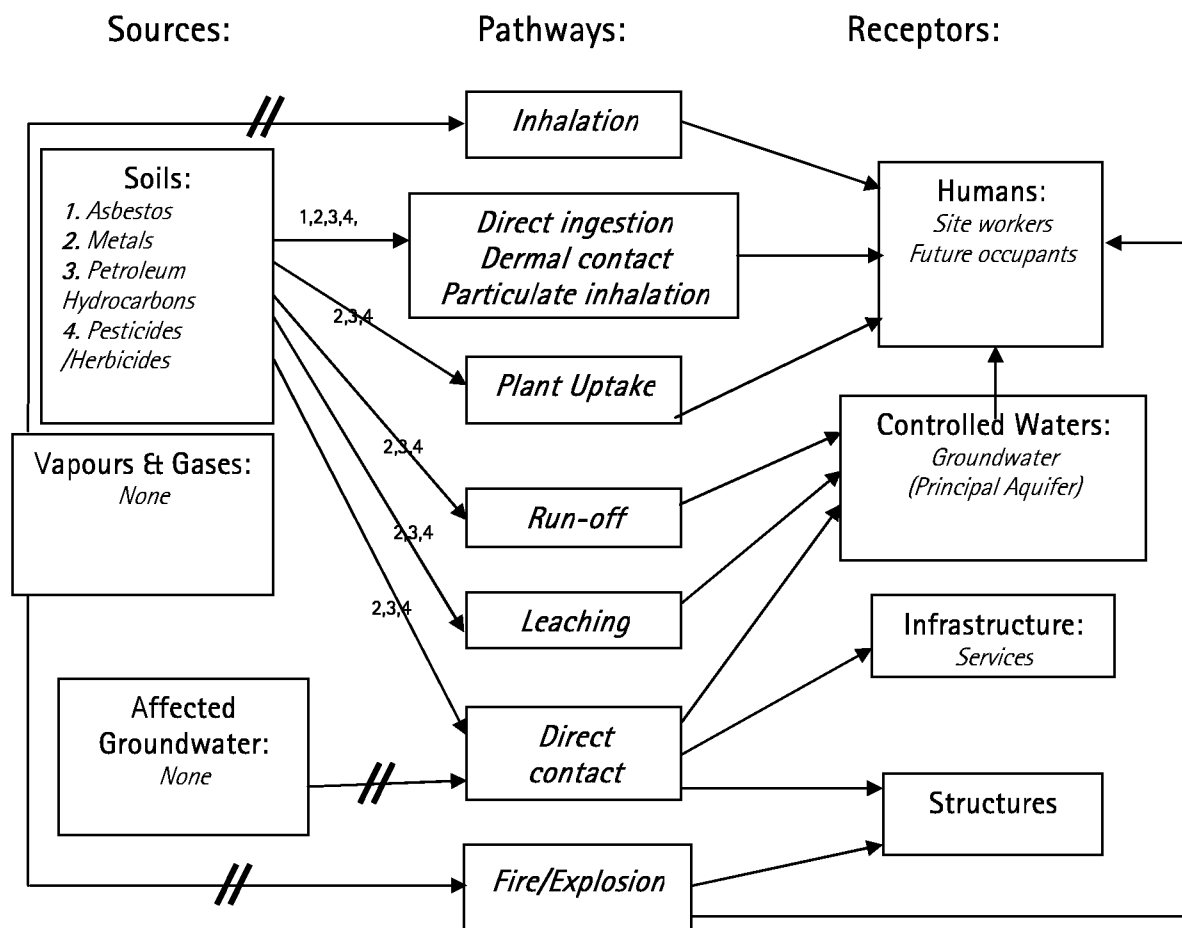
The unspecified tanks listed in the Groundsure Report are likely to be associated with the adjacent horticultural plant nurseries and could either be water tanks or potentially fuel tanks used for heating the greenhouses. The overall risk of these features is considered to be low given the distance from the site and small scale of the features. In addition, any potential spillages are likely to have been relatively small and given the fact that the shallow soils comprise Brickearth material, this would mitigate the spread of contaminants. Furthermore, all of the former nursery sites have now been or are in the process of being redeveloped into residential properties and as such the redevelop works would have led to the remediation of any potential pockets of contamination.

The Commercial Car Sales to the north east of the site are relatively small scale in operation and as such the risk of contamination associated with any spillages/leakages is considered to be low. In addition, the vehicles are mostly situated on hardstanding, reducing the possibility of any contaminants permeating the ground.

The surrounding area has historically been used as large scale horticultural plant nurseries there is a potential risk of heavy metals, namely the use of Lead paint on the Greenhouses which may have to residual contamination in shallow soils. In addition, there is also a risk of residual contamination associated with the use of pesticides/herbicides on the site.

10 Pollutant Linkages and Model Summary

The following diagram shows the potential pollutant linkages identified for the site and summarises the preliminary conceptual model:



// Denotes potential pollutant linkage not complete

D SITE INVESTIGATION

11 Method

The strategy adopted for the intrusive investigation comprised the following:

- A series of six trial pits were excavated using a hydraulic backhoe excavator.
- 6 No. in situ DCP CBR tests were carried out along proposed roads/parking areas.
- 2 No. Gravel filled BRE365 soakage tests were carried out.

Exploratory hole locations are shown in Figure 1 in Appendix A.

12 Weather Conditions

The fieldwork was carried out on 24th July 2017 at which time the weather was generally warm, with scattered clouds and sporadic rain showers.

13 Soils as Found

The soils encountered are described in detail in the attached exploratory hole logs (Appendix A), but in general comprised a covering of Made Ground/Topsoil over gravelly Clay over sandy Gravels. A summary is given below.

Depth	Thickness	Soil Type	Description
GL to 0.25m/0.3m	0.25m to 0.3m	Topsoil	Grass over brown sandy clayey TOPSOIL with occasional roots and flint gravel.
0.25m/0.3m to 1.4m/3.0m	1.1m to 2.75m	Silty/Sandy Clay	Stiff, high strength pale orange brown gravelly sandy CLAY. Gravels comprise fine to coarse subrounded to subangular flint
1.4m/2.9m to 3.0m	1.6m	Gravelly Clay	Firm to stiff high strength orange brown, silty gravelly CLAY. Gravels comprise fine to coarse sub-rounded to sub-angular flint.
2.9m to 3.5m/3.9m+	0.6m to 1.0m+	Sandy Gravel	Medium dense, pale orange brown mottled white chalk fine to coarse sandy GRAVEL. Gravels comprise fine to coarse subrounded to subangular flint and fine to medium chalk.

At the locations of TP101, TP104, TP105 and TP106, made ground soils were encountered to depths of between 0.45m to 1.3m bgl. The made ground soils were variable and in general comprised brown sandy clay with abundant fine to coarse brick, tile, felt, barbed wire, timber, roofing felt, glass, rubber, plastics, metal fragments and whole reinforced concrete fence posts. Fragments of asbestos containing materials in the form of asbestos cement were also identified.

13.1 Visual and Old factory Evidence of Contamination

Evidence of possible contamination in the form of made ground soils including suspected asbestos containing materials was recorded at the location of TP101, TP104, TP105 and TP106.

These occurrences are discussed in Section H.

14 Groundwater Strikes

Groundwater was not encountered in any of the trial pits excavated on site to date. However we would anticipate groundwater levels to rise in this area during the wetter winter months.

E FIELD TESTING AND SAMPLING

The following in-situ tests and sampling methods were employed. Descriptions are given in Appendix B together with the test results.

- BRE365 Soakage tests
- Hand Penetrometer
- Perth Penetrometer
- Dynamic Cone Penetrometer CBR's
- Disturbed sampling

F GEOTECHNICAL LABORATORY TESTS

The following tests were carried out on selected samples. Test method references and results are given in Appendix C.

- Moisture Content
- Atterberg Limit Tests
- Sulphate and pH

G DISCUSSION OF GEOTECHNICAL TEST RESULTS AND RECOMMENDATIONS

15 Soil Classification and Properties

Soil Type	Depth	Compressibility	VCP	Permeability	Frost Susceptibility	CBR	Remarks
Made Ground	GL to 0.45m/1.3m	High and variable	N/A	N/A	N/A	N/A	Not suitable for foundations
Brickearth	0.25m/0.3m to 1.4m/3.0m	Moderate to high	Low	Low	Yes	Poor	
Gravelly Clay	1.4m/2.9m to 3.0m	Moderate to high	Medium	Fair (subject to insitu testing).	N/A	N/A	
Sandy Gravel	2.9m to 3.5m/3.9m +	Moderate	Negligible	Fair (subject to insitu testing).	N/A	N/A	

16 Swelling and Shrinkage

Six out of the seven modified plasticity tests classified the clays as of NHBC LOW Volume Change Potential (VCP), with one result in the NHBC MEDIUM class. On balance it is considered that NHBC LOW would be appropriate as a general site classification. Full details of protective measures are given in NHBC Chapter 4.2, but for convenience the depth requirements are summarised below.

Certain trees have a very high water demand (Oak, Poplar, Willow, Elm, Hawthorn, Eucalyptus) and if these are planted then a greater increase will be required.

NHBC Chapter 4.2 Foundation Depth Chart for LOW Volume Change Potential Soils										
Water Demand	Tree Type (common examples)	Distance over Height Ratio (D/H)								
		0.0	0.1	0.2	0.3	0.4	0.5	0.6	1.0	1.25
		Foundation Depth (m)								
High	Broad Leaf (Elm, Eucalyptus, Hawthorn, Oak, Poplar, Willow or unknown species)	2.5	2.4	2.2	2.1	1.95	1.8	1.65	1.1	0.75
	Coniferous (Cypress)	2.5	2.2	1.9	1.65	1.35	1.05	0.75	0.75	0.75
Moderate	Broad Leaf (Ash, Beech, Fruit, Chestnut, Lime, Maple, Sycamore, Plane)	1.6	1.5	1.4	1.35	1.15	1.0	0.95	0.75	0.75
	Coniferous (Cedar, Pine, Spruce, Douglas Fir, Wellingtonia, & Yew)	1.6	1.35	1.1	0.85	0.75	0.75	0.75	0.75	0.75
Low	Broad Leaf (Birch, Hazel, Holly, Magnolia, Elder)	1.2	1.1	1.0	0.95	0.85	0.75	0.75	0.75	0.75

Minimum foundation depths of 0.75m bgl apply outside the zone of influence of new planting. Where new planting is proposed foundation depths should be calculated in accordance with NHBC Chapter 4.2, section D6.

17 Groundwater Levels

Groundwater levels vary considerably from season to season and year to year, often rising close to the ground surface in wet or winter weather, and falling in periods of drought. Long-term monitoring from boreholes or standpipes is required to assess the ground water regime and this was not possible during the course of this site investigation.

Despite groundwater not being encountered during our investigation to a maximum depth of 3.9m bgl, our works were carried out in the drier summer months. Based on historical data from previous reports carried out in this area we would anticipate groundwater levels to rise within the wetter winter months which may have implications on the use of soakaways on the subject site.

18 Soakaways

A total of two gravel filled BRE365 soakage tests were carried out across the site, at the locations shown on the attached site plan (Figure 1). The full results of the soakage tests are appended, however, the soakage rate from each trial hole is summarised in the table below.

Results of BRE 365 Soakage tests				
Pit	Depth (m)	f l/m ² /min	BRE Units (m/sec)	Comments
TP101 (test1)	3.4	4.14	6.9E-5	
TP101 (test2)	3.4	2.85	4.74E-5	
TP101 (test3)	3.4	1.62	2.69E-5	
TP106 (test1)	3.0	5.21	8.68E-5	
TP106 (test2)	3.0	3.31	5.57E-5	
TP106 (test3)	3.0	3.01	5.02E-5	

Based on the results of the soakage testing carried out on site to date we would consider an overall design value of 2l/m²/min to be appropriate. Due to the variability in the soils encountered on site consideration should be given to undertaking soakage tests at the proposed depth and location of any soakaways to confirm the design rate.

Any soakaway scheme will require the approval of the Environment Agency, Building Control and, where applicable, the adopting Highways Authority.

Groundwater levels can vary considerably from season to season and year to year, often rising in wet or winter weather, and falling in periods of drought. As such, a high groundwater table may affect the storage capacity of soakaways (where applicable). In addition, it should be noted that an unsaturated zone may be required between the base of soakaways and the groundwater table, by the Environment Agency.

19 Sulphates and Acidity

The recorded pH values are in the range of 7.9 to 8.1

The Design Sulphate Class is DS-1. Groundwater should be assumed to be mobile. The ACEC site classification is AC-1.

20 Bearing Capacity

Based on the soils encountered on site and results of the insitu testing an allowable bearing pressure of up to 125kPa is available for strip/trench fill foundation deepened through all made ground soils and set into underlying firm to stiff orange brown gravelly clay soils.

21 Floor Slabs

Due to the presence of pockets of made ground soils across the site suspended floor slabs should be used.

22 Settlement

Settlement is expected to be within standard construction tolerance based on the loadings given above.

23 Excavations and Trenching

Statutory support will be required in all excavations where personnel must work.

Excavations within the drier summer months are likely to be dry and stable, however if groundworks are to take place during the wetter winter months it is likely that either perched water or groundwater may be encountered in excavations and some form of dewatering may be required.

Contamination in the form of asbestos containing materials within made ground soils has been identified on the site. This may have implications for earthworks.

24 Road Construction

Measured Values and Construction Options

The measured CBR values at the anticipated formation depth ranged from 16% to 20% and on the basis of these in situ test results and of the results of laboratory tests a design CBR value of 4% is recommended. The subsoil often contains more than 10% fines and is considered potentially frost susceptible. It is recommended that a minimum construction thickness of 450mm be adopted to give frost protection.

General

The most important element of any road construction is drainage and attention must be given not only to the drainage of the subsoil, but to the various layers of construction. To this end the formation should be shaped to a camber or crossfall to allow water movement out of the sub-base. Silty soils soften extremely quickly if allowed to become wet or if they are excavated below the water table and this softening can give rise to a very substantial increase in costs.

Sub-base and coarse capping materials tend to segregate during placing operations, particularly when end tipped. On soft clay subgrades this can lead to punching and softening of the formation. The use of a layer of sand or geofabric will minimise the problem.

Construction traffic should be kept off formations and it is often advisable to leave a protective layer of soil above formation level until the last moment before placing the sub-base.

H LAND QUALITY

25 Analytical Framework

There is no single methodology that covers all the various aspects of the assessment of potentially contaminated land and groundwater. Therefore, the analytical framework adopted for this investigation is made up of a number of procedures, which are outlined below. All of these are based on a Risk Assessment methodology centred on the identification and analysis of Source – Pathway – Receptor linkages.

The CLEA model³ provides a methodology for quantitative assessment of the long term risks posed to human health by exposure to contaminated soils. Toxicological data is used to calculate a Soil Guideline Value (SGV) for an individual contaminant, based on the proposed site use; these represent minimal risk concentrations and may be used as screening values.

In the absence of any published SGVs for certain substances, Southern Testing have derived or adopted Tier 1 screening values for initial assessment of the soil, based on available current UK guidance including the LQM/CIEH⁴ S4UL's and CL:AIRE⁵ generic assessment criteria. In addition, in March 2014, DEFRA⁶ published the results of a research programme to develop screening values to assist decision making under Part 2A of the Environmental Protection Act. Category 4 screening levels were published for 6 substances, with reference to human health risk only. This guidance includes revisions of the CLEA exposure parameters, presenting parameters for public open space land use scenarios, and also of the toxicological approach. The screening levels represent a low risk scenario, based on a 'Low Level of Toxicological Concern' rather than the 'Minimal Risk' of CLEA, and the analytical results of this investigation may be considered relative to these levels.

The values used are valid at the time of writing but may be subject to change and any such changes will have implications for the assessments based upon them. Their validity should be confirmed at the time of site development.

Site-specific assessments are undertaken wherever possible and/or applicable.

CLEA requires a statistical treatment of the test results to take into account the normal variations in concentration of potential contaminants in the soil and allow comparisons to be made with published guidance.

26 Site Investigation – Soil

26.1 Sampling Regime

The number of sample locations was designed to provide general coverage.

26.2 Testing

The potential for contamination by heavy metals, PAH's, asbestos containing materials and pesticides/herbicides were identified in the preliminary conceptual model and observations made on site and, therefore, the following tests were selected.

³ Environment Agency Publication SC050021/SR3 'Updated technical background to the CLEA Model' (2009).

⁴ The LQM/CIEH S4ULs for Human Health Risk Assessment. (2014).

⁵ The EIC/AGS/CL:AIRE Soil Generic Assessment Criteria for Human Health Risk Assessment (2009).

⁶ SP1010 Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination. DEFRA, 2014.

Test Suite	Number of Samples	Soil Tested
STL Key Contaminant Suite	5	Made Ground
	1	Topsoil
	1	Natural Soil
Asbestos Identification	5	Made Ground
	1	Topsoil
	1	Natural Soil
Pesticides/Herbicides	2	Topsoil
	1	Made Ground

The test results are presented in full in Appendix D. A summary and discussion of the significance of the results and identified contamination sources is given below.

26.3 Test Results and Identified Contamination Sources

26.3.1 General Contaminants

The results of the key contaminant tests have been analysed in accordance with the CLEA methodology. The samples have been grouped into three populations comprising made ground, natural soil and topsoil. For each parameter in each population the sample mean is calculated and compared to a Tier 1 screening value. If the sample mean exceeds the screening value, the soil may be regarded as contaminated and further assessment may be required. If neither the sample mean nor any single value exceeds the screening value, the soil may be regarded as not contaminated, though further confirmatory assessment may be required. Where any single parameter value exceeds the screening value but the sample mean does not, further statistical analysis may be applied to that parameter if the available data is suitable. Such analysis would include an assessment of the Normality of the distribution of the data, consideration of the presence of outliers, and the calculation of a UCL estimate of the mean.

Summary data is presented in the tables below and the laboratory analysis is included in Appendix D. The screening values and source notes are presented in Table 1 "Tier 1 Screening Values" at the front of Appendix D.

Soil Type: Made Ground

Contaminants	Units	No of Samples Tested	Range	Sample Mean	Residential with Homegrown Produce Consumption Tier 1 Screening Value
Arsenic (As)	mg/kg	5	9.3 – 17	11	37
Cadmium (Cd)	mg/kg	5	0.4-0.6	0.48	11
Total Chromium (Cr)	mg/kg	5	<4	4	910
Hexavalent Chromium (CrVI)	mg/kg	-	-	-	-
Lead (Pb)	mg/kg	5	67 – 130	95	200
Mercury (Hg)	mg/kg	5	<0.3	0.3	7.6-11
Selenium (Se)	mg/kg	5	<1 – 1.1	1.0	250
Nickel (Ni)	mg/kg	5	14 – 17	15	130
Copper (Cu)	mg/kg	5	18 – 28	23	2400
Zinc (Zn)	mg/kg	5	87 – 180	141	3700
Phenol	mg/kg	5	<1	<1	120-380
Benzo[a]pyrene	mg/kg	5	0.18 – 2.1	1.1	1.7-2.4
Naphthalene	mg/kg	5	<0.05	0.05	2.3-13
Total Cyanide (CN)	mg/kg	5	<1	1	-
Acidity (pH value)	Units	5	6.6 – 8.6	7.6	-
Soil Organic Matter	%	5	3.3 – 4.2	4.2	-

Five samples of made ground soils from various depths were taken and sent for analysis. The results are attached in full and summarised in the table above. In general the made ground soils were found to be free from significant contamination.

Soil Type: Topsoil

One sample of the existing Topsoil was taken from TP102 at 0.15m. The sample was found to be free from significant contamination.

Soil Type: Natural Soil

One sample of the natural soil was taken from TP103 at 0.3m. The sample was found to be free from significant contamination.

26.3.2 Asbestos

Asbestos containing materials in the form of suspected asbestos cement fragments were observed in the made ground soils at the location of TP101 and TP105.

In addition, loose fibres of chrysotile asbestos were detected in the samples of made ground from TP101 @ 1.0m bgl and from TP103 @ 0.3m bgl, which was in natural soil beneath the existing topsoil layer.

The samples were subsequently quantified and the results show that the volume of loose asbestos fibres in the samples tested were below the laboratory detection limit of <0.001%.

26.3.3 Pesticides and Herbicides

Two samples of Topsoil (TP102 @ 0.15m and TP103 @ 1.0m) and one sample of made ground (TP104 @ 0.15m bgl) were screened for the presence of pesticides/herbicides. The two samples of topsoil were screened and the presence of pesticides/herbicides recorded as absent. The sample of made ground from TP104 @ 0.15m was found to contain pesticides/herbicides compounds.

The sample was subsequently screened for speciated compounds and the results are attached. In general the concentrations recorded are well below any screening criteria for pesticides and as such are not considered to pose a risk to the end users of the development.

27 Summary of Identified Contamination

Based on the limited testing carried out to date the soils from across the site have been found to be free from significant contamination with respect to heavy metals and PAH's.

The made ground soils from across the site were found to contain fragments of asbestos containing materials and loose fibres of chrysotile asbestos. Whilst the laboratory analysis indicates that the concentrations of loose fibres are below the laboratory detection limit of 0.001%, there is still a potential risk to the end users of the site.

28 Risk Evaluation

The object of the risk evaluation is to assess the pollution linkages for specific contaminant groups considered in the conceptual model, identify any unacceptable risks and, therefore establish whether there is a need for further investigation and/or remedial action.

The risks are considered in the context of the specific development proposals for the site and, therefore, the conclusions may not be appropriate for alternative schemes.

28.1 Asbestos

Both fragments of asbestos containing materials and loose fibres of chrysotile asbestos were detected in the made ground samples tested to date. These material are not considered suitable to remain on site and will require further delineation and removal from site.

28.2 Revised Conceptual Model

The preliminary site model has been refined in light of the findings of this investigation and is summarised below.

<i>Metals</i>	<i>Petroleum Hydrocarbons</i>	<i>PAH's</i>	<i>Landfill Gas</i>	<i>Asbestos</i>	PATHWAYS	RECEPTORS
N	N	n	n/a	Y	Ingestion and inhalation of contaminated soil and dust	Human Health
N	N	N	N	n/a	Dermal contact with contaminated soil and dust	
N	N	N	N	n/a	Inhalation of vapours or gases	
N	N	N	n/a	n/a	Uptake into edible fruit and vegetables	
N	N	N	n/a	n/a	Surface water run-off into surface water features	Water Environment
N	N	N	n/a	n/a	Migration through ground into surface water or groundwater	
N	N	N	N	n/a	Off-site migration of contaminated groundwater	
N	N	N	N	n/a	Vegetation on site growing in contaminated soil	Flora and Fauna
N	N	N	n/a	n/a	Aquatic life in affected waters	
N	n	N	n/a	n/a	Contact with contaminated soil	Building materials/ buried services
N	N	N	n	n/a	Fire or explosion	

Key:

Y	Pollutant linkage likely
N	Pollutant linkage not likely
P	Pollutant linkage possible
n/a	Pathway not applicable to contaminant

28.3 Relevant Pollutant Linkages

A number of Relevant Pollutant Linkages for which remedial action will be required have been identified in the revised conceptual model, as follows.

Contaminant/Source	Pathways	Receptors
Asbestos in Made Ground	Soil/dust Dermal exposure	Site/ Construction workers
	Soil/dust Ingestion/inhalation	Future residents

Further investigation is required to determine the extent of the made ground soils across the site and additional testing to determine whether remediation, with regards to the asbestos containing materials will be required, see below.

29 Discussion and Conclusions

Further investigation is required to is further assess the extent and composition of the made ground soils encountered across the site in order to provide an accurate risk assessment and remediation proposal for the redevelopment of the site.

At this stage, without any further works, we would recommend that the shallow soils from across the subject site be stripped down onto natural soils and removed from site. In areas where made ground soils are in excess of 600mm thick, these soils, in areas of private gardens, should be stripped down to 600mm below finished levels and a detor to dig layer installed, with levels made up with site won clean soils and imported clean, certified topsoil.

As with any site, areas of contamination not identified during site investigation works may come to light in the course of redevelopment. Accordingly, a discovery strategy must be in place during the redevelopment to ensure that any hitherto unknown contamination is identified and dealt with in an appropriate manner. Depending on the nature of any such contamination, it may prove necessary to reassess the remedial strategy for the site.

A formal remediation strategy and verification plan should be agreed with the regulatory authorities prior to commencement of any remedial works.

30 General Guidance

Allowance should be made for experienced verification of any remedial works.

It may be that specific local requirements apply to this site, of which we are not aware at this time.

In general terms, the workforce and general public should be protected from contact with contaminated material. There is a range of relevant documents published by the Health and Safety Executive, and organisations such as CIRIA, and the BRE.

Some soils will require removal from site and disposal to suitably licensed landfills. Different guidelines and charges will apply to different waste classification. As waste producers, the Developer holds responsibilities under the various governing regulations. The chemical analyses appended to this report should be forwarded to tip operators for their own assessment, to confirm classification of the soils for offsite disposal, and whether they can accept the material. Waste Acceptance Criteria (WAC) testing may be requested for confirmation of the material's classification.

All hazardous and non-hazardous soils leaving site will need to be pre-treated. Waste minimisation by selective excavation is a recognised form of pre-treatment.

Many water supply companies now require higher specification pipe on contaminated sites, even following remediation.

APPENDIX A

Site Plans and Exploratory Hole Logs

Key to Exploratory Hole Logs

General

All soil & rock descriptions in general accordance with BS5930, BS EN ISO 14688 and BS EN ISO 14689
The Geology Code is only provided where positive identification of the sampled strata has been made.

Sampling

ES	Environmental Sample (taken in appropriate sampling container)
D	Disturbed Sample
B	Bulk Sample
LB	Large Bulk for Earthworks testing
C	Core Sample
U	Undisturbed Sample (number of blows indicated in results column)
SPTLS	SPT Liner Sampler
P	Piston Sample
W	Water Sample

Insitu Tests

SPT	Standard Penetration Test in accordance with BS EN ISO 22476-3
SPT (C)	Cone Penetration Test in accordance with BS EN ISO 22476-3
PT	Penetration Test - STL documented equivalent SPT N Value
PPT	Perth Penetration Test - STL in house documented method (N Value)
UCS (┐┌)	Unconfined Compressive Strength measure by hand penetrometer (kN/m ²)
IVN	Hand Vane (kPa)
PID	Photo Ionisation Detector Results (ppm)
MEXE	Mexecone CBR Result

Drilling Records

Depth to standing water level	
Depth to water strike	
TCR	Total Core Recovery (%)
SCR	Solid Core Recovery (%)
RQD	Rock Quality Index (%)
FI	Fracture Index

Backfill Symbols

Arisings	
Concrete	
Blacktop	
Bentonite Seal	
Gravel Filter	
Sand Filter	

Pipe Symbols

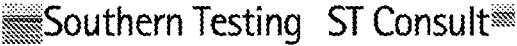
Plain Pipe	
Slotted Pipe	
Filter Tip	

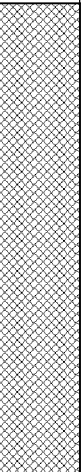
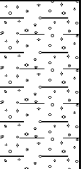
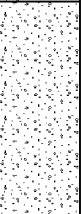
Principal Soil Types

Topsoil	
Made Ground	
Clay	
Silt	
Sand	
Gravel	
Peat	

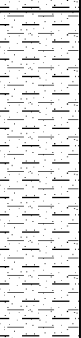
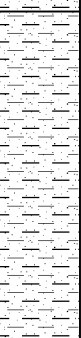
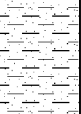
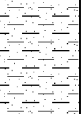
Principal Rock Types

Mudstone/Claystone	
Siltstone	
Sandstone	
Limestone	
Chalk	

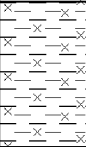
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Project Name: Land Off Mayflower Way				Remarks:		Co-ordinates:		Level (m AOD):		Logger: DK	
Location: Angmering											
Client: Angmering Community Land Trust											

Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description	
Depth (m)	Type	Results						
0.15	ES	UCS(kPa)=270.00		(1.30)		1.30	Grass over MADE GROUND comprising brown sandy gravelly CLAY with abundant fine to coarse brick, tile, felt, concrete, barbed wire, timber, plastic fragments and whole re-inforced concrete fence posts.	1
0.15	ES						Fragments of asbestos containing materials in the form of cement sheeting were observed.	
1.00	ES							
1.00	ES							
1.50	D							
1.50	HP							
1.50	D	N=12(450)		(1.10)		2.40	Firm to stiff, high strength orange brown gravelly sandy CLAY. Gravels comprise fine to coarse subrounded to subangular flint.	2
1.50	HP							
2.00	D							
2.00	PPT							
2.00	PPT	N=13(450)		(0.50)		2.90	Medium dense orange brown clayey sandy GRAVEL. Gravels comprise fine to coarse subrounded to subangular flint.	3
2.50	PPT							
3.00	D			(0.60)		3.50	Medium dense, pale orange brown mottled white chalky fine to coarse sandy GRAVEL. Gravels comprise fine to coarse subrounded to subangular flint and fine to medium subrounded chalk.	4
3.50	D							
						Pit terminated at 3.50m.		

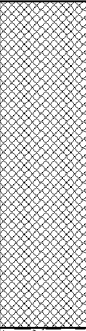
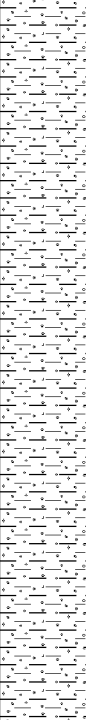
Pit Dimension (m)		Pit Stability:		Water Strikes:	
Width:	0.45	Unstable to 1.3m bgl due to the presence of made ground soils		Dry	
Length:	2.20				
Depth:	3.50				

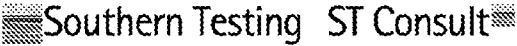
 Southern Testing ST Consult www.southerntesting.co.uk tel:01342 333100 www.stconsult.co.uk tel:01604 500020				Start - End Date: 24/07/2017		Project ID: J13227		Machine Type: JCB 3CX		TP102 Sheet 1 of 1	
Project Name: Land Off Mayflower Way				Remarks:		Co-ordinates:		Level (m AOD):		Logger: DK	
Location: Angmering											
Client: Angmering Community Land Trust											
Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description				
Depth (m)	Type	Results									
0.15	ES			(0.30)		0.30	Grass over dry brown sandy clayey TOPSOIL with frequent fine roots and occasional fine to medium flint gravel.				
0.15	ES										
0.40	ES			(0.40)		0.70	Dry, pale orange brown sandy CLAY with abundant fine to medium chalk gravel and fine to coarse flint gravel.				
0.40	ES										
1.00	D			(2.10)		2.80	Stiff, high strength orange brown sandy CLAY with rare fine to medium flint gravel.		1		
1.00	HP	UCS(kPa)=310.00									
1.50	D			(2.10)		3.00	Pockets of firm to stiff grey clay.				
1.50	HP	UCS(kPa)=250.00									
2.00	D			(0.20)		3.00	Firm high strength orange brown gravelly CLAY. Gravels comprise fine to coarse subangular to subrounded flint.		2		
2.00	HP	UCS(kPa)=180.00									
2.50	D			(0.20)		3.00	Pit terminated at 3.00m.		3		
2.50	HP	UCS(kPa)=160.00									
3.00	D								4		
3.00	HP	UCS(kPa)=140.00									
Pit Dimension (m)			Pit Stability:				Water Strikes:				
Width:	0.45		Pit sides stable in the short term				Dry				
Length:	2.10										
Depth:	3.00										

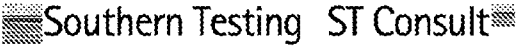
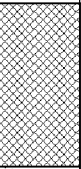
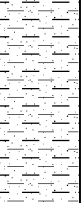
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Project Name: Land Off Mayflower Way				Remarks:		Co-ordinates:		Level (m AOD):		Logger: DK	
Location: Angmering											
Client: Angmering Community Land Trust											

Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description	
Depth (m)	Type	Results						
0.10	ES			(0.25)		0.25	Grass over brown sandy clayey TOPSOIL with occasional roots and flint gravel.	
0.10	ES							
0.30	ES			(0.15)		0.40	Dry, pale brown silty CLAY with occasional flint gravel, weak chalk gravel and fine roots.	
0.30	ES							
				(0.40)			Stiff, pale orange brown silty CLAY with rare roots.	
						0.80	Stiff, high strength orange brown silty sandy CLAY with occasional flint gravel and rare fine roots.	1
1.00	D							
1.00	HP	UCS(kPa)=410.00						
1.50	HP	UCS(kPa)=250.00						
				(2.10)				
2.00	D							2
2.00	HP	UCS(kPa)=170.00						
2.50	HP	UCS(kPa)=150.00						
3.00	D					2.90	Firm to stiff, pale grey mottled orange brown silty gravelly SAND. Gravels comprise fine to medium subrounded chalk and fine to coarse subrounded flint.	3
				(0.80)				
						3.70	Pit terminated at 3.70m.	4

Pit Dimension (m)		Pit Stability:		Water Strikes:	
Width:	0.45	Pit sides stable in the short term		Dry	
Length:	2.00				
Depth:	3.70				

				Start - End Date: 24/07/2017		Project ID: J13227		Machine Type: JCB 3CX		TP104 Sheet 1 of 1		
Project Name: Land Off Mayflower Way				Remarks:		Co-ordinates:		Level (m AOD):		Logger: DK		
Location: Angmering												
Client: Angmering Community Land Trust												
Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description					
Depth (m)	Type	Results										
0.15 0.15	ES ES			(0.90)		0.90	Grass over MADE GROUND comprising brown sandy clayey TOPSOIL with abundant fine to coarse flint gravel, brick, metal and occasional timber fragments.					
0.60 0.60	ES ES											
1.00 1.00	D HP	UCS(kPa)=410.00		(2.00)		2.90	Firm to stiff, high to very high strength orange brown silty CLAY with occasional fine to medium subrounded flint gravel.		1			
1.50	HP	UCS(kPa)=210.00										
2.00 2.00	D HP	UCS(kPa)=160.00										2
2.50	PPT	N=12(450)										
3.00 3.00	D PPT	N=26(450)		(1.00)		3.90	Medium dense, pale grey gravelly fine to coarse SAND. Gravels comprise fine to coarse subrounded flint and fine to medium subrounded chalk.		3			
							Pit terminated at 3.90m.		4			
Pit Dimension (m)			Pit Stability:				Water Strikes:					
Width:	0.45		Pit sides stable in the short term				Dry					
Length:	2.10											
Depth:	3.90											

				Start - End Date: 24/07/2017		Project ID: J13227		Machine Type: JCB 3CX		TP105 Sheet 1 of 1		
Project Name: Land Off Mayflower Way				Remarks:		Co-ordinates:		Level (m AOD):		Logger: DK		
Location: Angmering												
Client: Angmering Community Land Trust												
Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description					
Depth (m)	Type	Results										
0.40	ES			(0.75)		0.75	Grass over MADE GROUND comprising grey-brown mottled black silty sandy CLAY with abundant re-inforced concrete posts, metal fragments, rubber tyres, glass, timber and plastic. Fragments of asbestos containing materials in the form of cement sheeting were observed.					
0.40	ES											
1.00	HP	UCS(kPa)=250.00		(2.25)		3.00	Firm high strength orange brown gravelly CLAY. Gravels comprise fine to coarse subangular to subrounded flint.		1			
1.20	D											
1.50	HP	UCS(kPa)=220.00										
2.00	D											
2.00	HP	UCS(kPa)=160.00									2	
2.30	D											
2.50	HP	UCS(kPa)=120.00										
3.00	HP	UCS(kPa)=110.00					Pit terminated at 3.00m.		3			
									4			
Pit Dimension (m)			Pit Stability:				Water Strikes:					
Width:		0.45	Pit sides stable in the short term				Dry					
Length:		2.00										
Depth:		3.00										

				Start - End Date: 24/07/2017		Project ID: J13227		Machine Type: JCB 3CX		TP106 Sheet 1 of 1	
Project Name: Land Off Mayflower Way				Remarks:		Co-ordinates:		Level (m AOD):		Logger: DK	
Location: Angmering											
Client: Angmering Community Land Trust											
Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description				
Depth (m)	Type	Results									
0.15 0.15	ES ES			(0.45)		0.45	Grass over MADE GROUND comprising brown sandy gravelly CLAY with abundant fine to coarse brick, tile, felt, concrete, timber, plastic fragments.				
0.60 0.60	D HP	UCS(kPa)=360.00		(0.35)		0.80	Stiff, high strength, pale orange brown silty fine sandy CLAY.				
1.00 1.00	D HP	UCS(kPa)=350.00		(0.60)		1.40	Stiff, high to very high strength orange brown sandy silty CLAY.		1		
1.50 1.50	D PPT	N=17(450)		(1.60)			Stiff/Medium dense, orange brown silty CLAY/GRAVEL. Gravels comprise fine to coarse subrounded to subangular flint.				
2.00 2.00	D PPT	N=14(450)					Becoming increasingly gravelly				
2.50 2.50	D PPT	N=9(450)					Lenses of orange brown sandy CLAY				
							Pit terminated at 3.00m.				
Pit Dimension (m)			Pit Stability:				Water Strikes:				
Width:	0.45		Pit sides stable in the short term				Dry				
Length:	2.10										
Depth:	3.00										

APPENDIX B

Field Sampling and in-situ Test Methods & Results

Field Sampling and in-situ Test Methods

Disturbed Samples

Disturbed samples were taken from the trial holes at intervals and stored in sealed glass jars and polythene bags, as appropriate.

Hand Penetrometer Test

The hand penetrometer consists of a spring loaded and calibrated plunger which is forced into the soil. A reading of unconfined compression strength (equal-twice cohesion) is given on a calibrated scale. In common with other hand methods of strength assessment (eg. the shear vane) it does not give an accurate indication of bearing capacity in stiff or fissured soils, because of the small test area. The figures are used for strength classification according to the table below.

Hand Penetrometer Value (kPa)	Undrained Shear Strength c_u (kPa)	Undrained Shear Strength of Clays
<20	<10	Extremely Low
20-40	10-20	Very Low
40-80	20-40	Low
80-150	40-75	Medium
150-300	75-150	High
300-600	150-300	Very High
600>	300>	Extremely High

Dynamic Cone Penetrometer (DCP) CBR Test (Modified)

The CBR value is the result of an empirical test on soil that can be used for road design purposes. In the field the definitive test requires the use of a reaction load, usually a four-wheel drive vehicle, excavating plant, a CBR jack, and load measuring equipment. The dynamic cone CBR test uses light portable equipment and is used to provide a continuous record of the penetration resistance of each layer in the ground for a depth of a metre from the surface. The penetration resistance provides a measure from which CBR values may be calculated using formulae published by the Transport Research Laboratory.

In the test a 22 mm diameter 60° cone is driven into the ground to a depth of up to one metre by a 9 kg weight, freely falling over 600 mm. The number of blows is recorded for each successive 50mm penetration increment.

A plot of the cumulative number of blows versus depth penetrated is drawn. This plot usually takes the form of a series of straight lines, the slopes of which are measured and expressed as penetration in mm per blow. Several authors have prepared relationships between the DCP readings and the CBR and it is the practice of this laboratory to adopt the lower of two values derived from formulae established by Kleyn & Van Heerden, and by the TRL.

$$CBR = 10^{(2.632 - 1.281 \log_{10}(mm/blow))} \quad (\text{K\&VH})^1$$

$$CBR = 10^{(2.48 - 1.057 \log_{10}(mm/blow))} \quad (\text{TRL})^2$$

¹ Kleyn & Van Heerden

The test is an adaptation of the Perth Penetrometer Test developed for the granular soils in Perth West Australia in the 1960s, and in the UK by this laboratory since 1973. It is similar to the Victoria Country Roads Board Penetrometer, the Transvaal Road Department Penetrometer, and the TRL dynamic cone penetrometer. It has been used for the determination of CBR values, after calibration for the local soil, and for compaction comparisons. In UK conditions it has been found to give consistent results for granular soils. It has the advantage that, as it can be driven through bituminous surfacings, granular road base, sub base and hardcore, the strength and thickness of each layer can be estimated.

Soakage Tests after BRE 365 (1991)

The BRE 365 paper on soakaway design allows for the design of trench soakaways as well as traditional square and circular soakaways.

The test to measure the soil infiltration rate is carried out in pits which are excavated to the full depth of the proposed soakaway. The trial pits are filled and allowed to drain to empty or near empty, three times, on the same day or on consecutive days.

The pit is considered full when the water level is the same as the proposed inlet invert. The time for the water level to fall from $\frac{3}{4}$ full to $\frac{1}{4}$ full is obtained and the soil infiltration rate is obtained from the following formula:

$$f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$$

- Where:
- f = soil infiltration rate (in this case expressed in l/m²/minute)
 - V_{p75-25} = the effective storage volume of water in the trial pit between 75% and 25% effective depth;
 - a_{p50} = the internal surface area of the trial pit up to 50% effective depth and including the base area;
 - t_{p75-25} = the time for the water level to fall from 75% to 25% effective depth.

The soakage rate in this report is expressed as l/m²/minute, which is a convenient rate to use. The BRE use a unit of m/sec, which is the value in l/m²/minute divided by 60,000.

BRE 365 stipulates that the pit should be refilled three times in all, on the same day, or on successive days. Where the sides are unstable the pit should be filled with granular material to provide stability. Where trench soakaways are to be constructed, and the design length is between 10 and 25m a repeat test should be carried out at the end of the proposed soakaway. Where the length is more than 25m the test should be carried out at 25m c/c.

Because of time and cost constraints testing was restricted to 1 day.

As it is a full scale test the BRE 365 test may be expected to give more reliable results than the superseded BRE 151 test, but it is more expensive, takes longer, requires large volumes of water, together with pumps and a specially equipped bowser, and requires a computer program for analysis. It is impractical in areas of restricted access, particularly in the back gardens of existing properties.

Perth Penetrometer Test

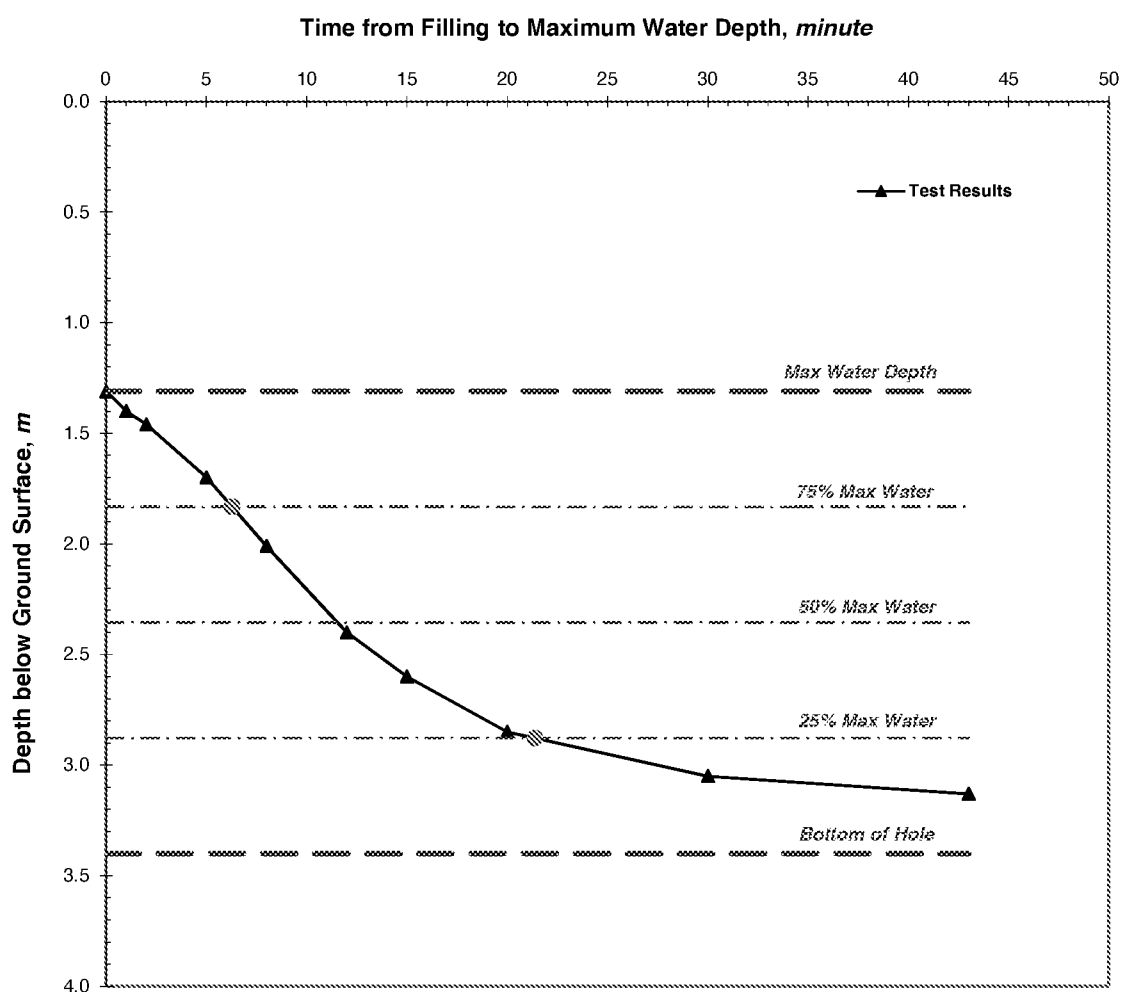
Perth Penetrometer tests were carried out. The Perth Penetrometer is a device used for measuring the relative density of sands. It consists of a 16 mm diameter hardened steel probe, which is driven into the soil by successive blows of a 9 kg weight, which freely falls over a distance of 600 mm. The number of blows required for each 50 mm of penetration is recorded, and the test is continued for a depth of 450 mm, according to soil type. Useful information can be obtained by carrying the test past the standard depth, and 2,000 mm and 3,000 mm extensions are used to probe the depth of loose fill or other soil, or to make an estimate of the strength of soils or rock in an auger hole or in the base of an unsupported test pit.

The energy input per square metre is roughly the same as the energy input from the Standard Penetration Test (SPT), and the blow counts recorded in sand are roughly the same as SPT blow counts (but this relationship does not hold for coarse soils). The SPT test is a similar type of test except that much heavier driving weights (63.5 kg) are used. The relative density relationship given for the SPT test is:

Number of Blows (N)	Density
0 - 4	Very Loose
4 - 10	Loose
10 - 30	Medium Dense
30 - 50	Dense
Over 50	Very Dense

BRE Digest 365 Soakage Test

Test Hole No: TP101
Test No: Test No 1 (Initial)



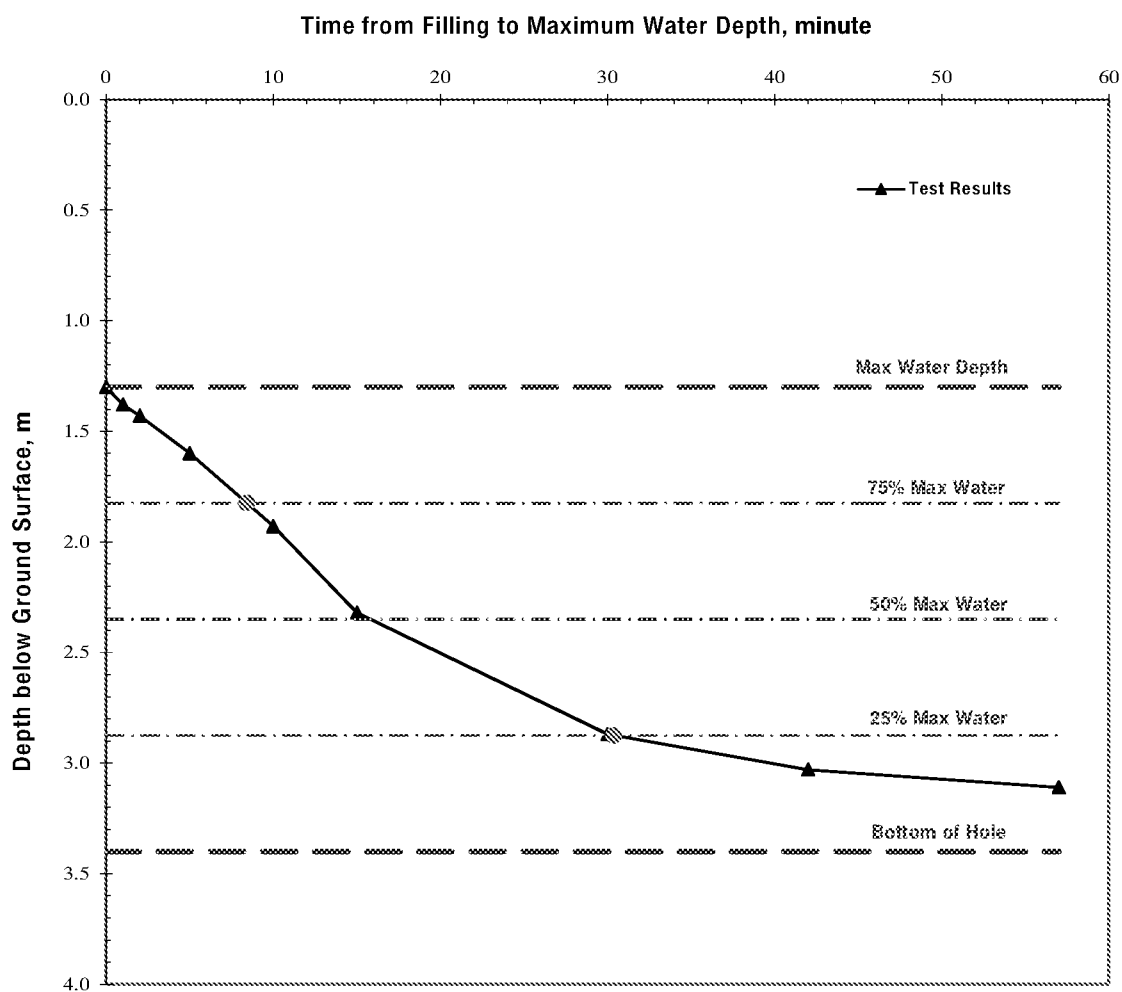
Pit Length, m	2.000	Depth to Water at Start of Test, m	1.310
Pit Width, m	0.450	Max Water Dropdown during Test, m	1.820
Depth to Pit Base, m	3.400	Total Soakage Test Time, min	43.0
Depth to Top of Permeable Soils, m	1.400	Mean Internal Discharge Area, m ²	6.021
Depth to Groundwater Surface, m		Discharge Rate, litre/min	24.926
Depth to Top of Granular Fill, m	1.500	Soakage Rate, litre/m ² /min	4.14
Voids Assumed for Granular Fill, %	40%	BRE Soil Infiltration Rate, m/sec	6.90E-05

Comments: 1550l used
Pit was nearly emptied at finish of test.

Client: The Angmering Community Land Trust	Job No: J13227	Test Date: 24/Jul/2017
Site: Mayflower Way, Angmering	Tested By: AA	Engineer: DK Fig. S1

BRE Digest 365 Soakage Test

Test Hole No: TP101
Test No: Test No 2 (Repeated)



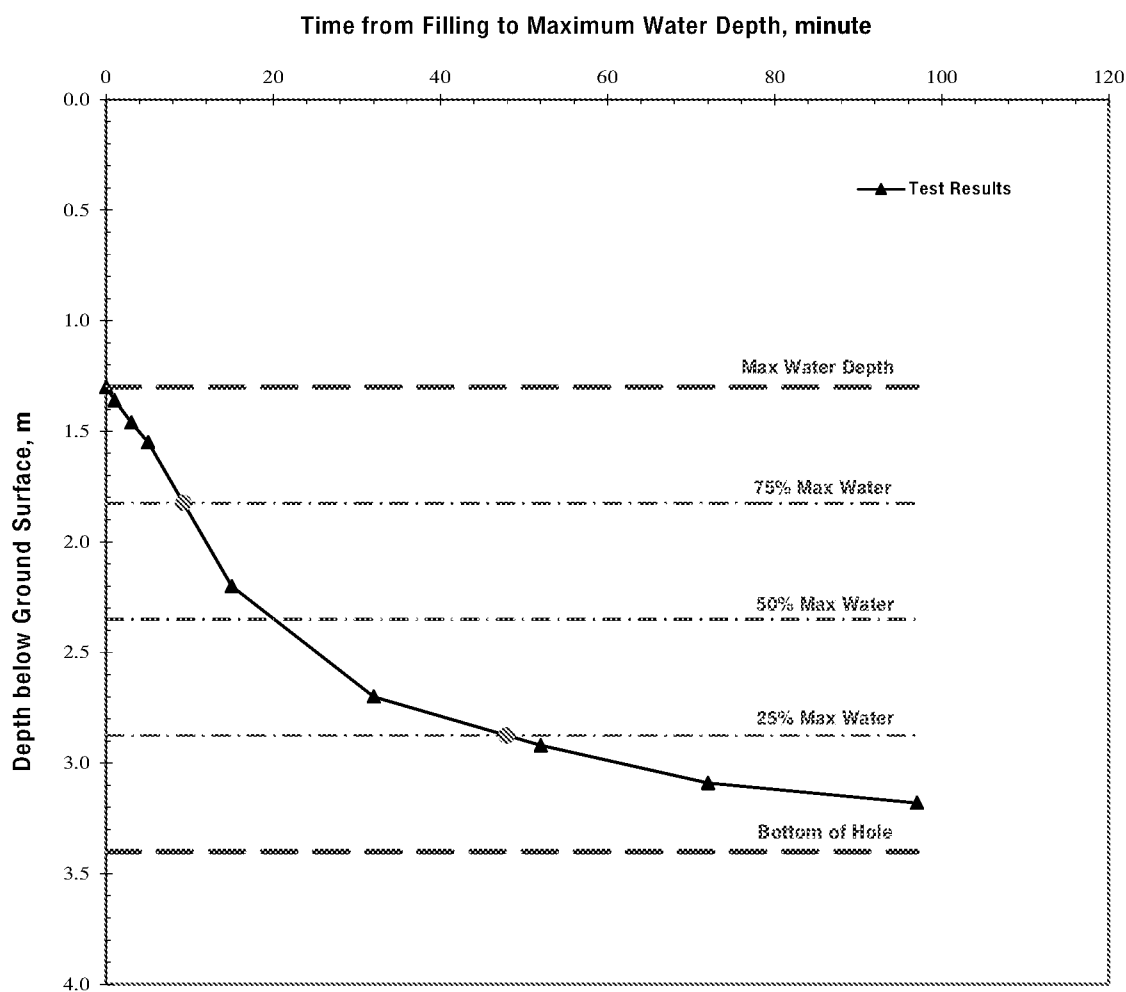
Pit Length, m	2.000	Depth to Water at Start of Test, m	1.300
Pit Width, m	0.450	Max Water Dropdown during Test, m	1.810
Depth to Pit Base, m	3.400	Total Soakage Test Time, min	57.0
Depth to Top of Permeable Soils, m	1.400	Mean Internal Discharge Area, m ²	6.045
Depth to Groundwater Surface, m		Discharge Rate, litre/min	17.208
Depth to Top of Granular Fill, m	1.500	Soakage Rate, litre/m ² /min	2.85
Voids Assumed for Granular Fill, %	40%	BRE Soil Infiltration Rate, m/sec	4.74E-05

Comments: 1400l used
Pit was nearly emptied at finish of test.

Client: The Angmering Community Land Trust	Job No: J13227	Test Date: 24/Jul/2017
Site: Mayflower Way, Angmering	Tested By: AA	Engineer: DK Fig. S2

BRE Digest 365 Soakage Test

Test Hole No: TP101
Test No: Test No 3 (Repeated)



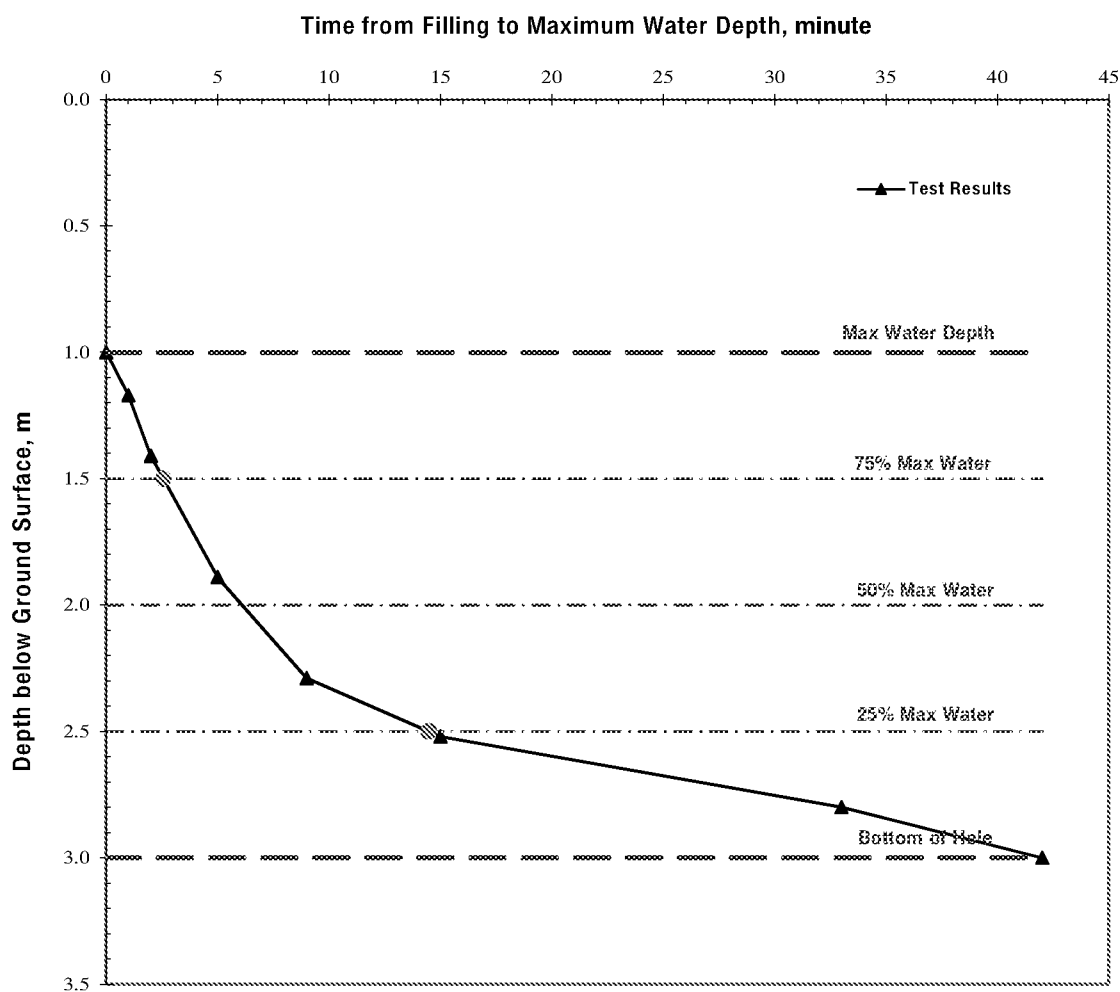
Pit Length, m	2.000	Depth to Water at Start of Test, m	1.300
Pit Width, m	0.450	Max Water Dropdown during Test, m	1.880
Depth to Pit Base, m	3.400	Total Soakage Test Time, min	97.0
Depth to Top of Permeable Soils, m	1.400	Mean Internal Discharge Area, m ²	6.045
Depth to Groundwater Surface, m		Discharge Rate, litre/min	9.773
Depth to Top of Granular Fill, m	1.500	Soakage Rate, litre/m ² /min	1.62
Voids Assumed for Granular Fill, %	40%	BRE Soil Infiltration Rate, m/sec	2.69E-05

Comments: 1400l used
Pit was nearly emptied at finish of test.

Client: The Angmering Community Land Trust	Job No: J13227	Test Date: 24/Jul/2017
Site: Mayflower Way, Angmering	Tested By: AA	Engineer: DK Fig. S3

BRE Digest 365 Soakage Test

Test Hole No: TP106
Test No: Test No 1 (Initial)



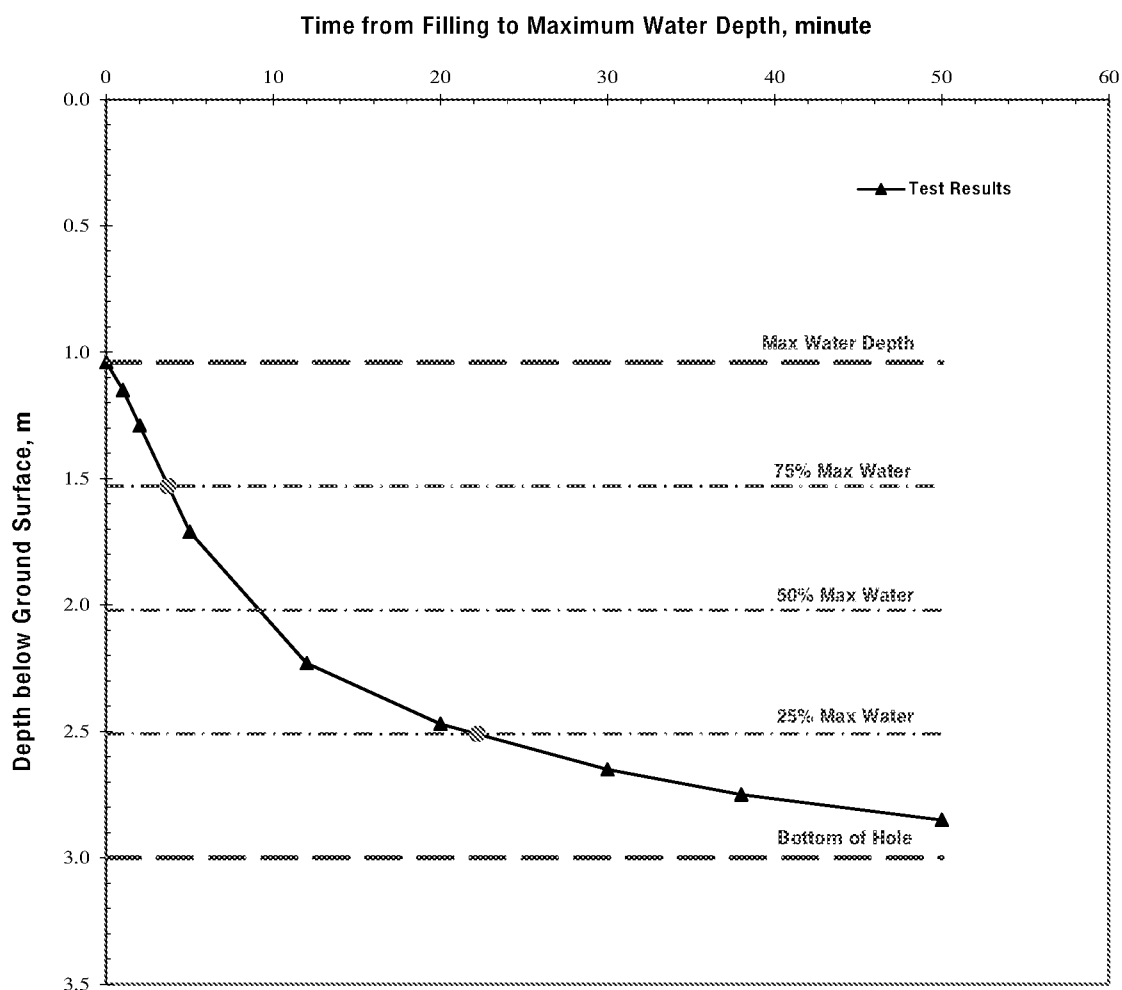
Pit Length, m	2.000	Depth to Water at Start of Test, m	1.000
Pit Width, m	0.450	Max Water Dropdown during Test, m	2.000
Depth to Pit Base, m	3.000	Total Soakage Test Time, min	42.0
Depth to Top of Permeable Soils, m		Mean Internal Discharge Area, m ²	5.800
Depth to Groundwater Surface, m		Discharge Rate, litre/min	30.212
Depth to Top of Granular Fill, m	1.100	Soakage Rate, litre/m ² /min	5.21
Voids Assumed for Granular Fill, %	40%	BRE Soil Infiltration Rate, m/sec	8.68E-05

Comments: 1200l used
Pit was emptied at finish of test.

Client: The Angmering Community Land Trust	Job No: J13227	Test Date: 24/Jul/2017
Site: Mayflower Way, Angmering	Tested By: AA	Engineer: DK Fig. S4

BRE Digest 365 Soakage Test

Test Hole No: TP106
Test No: Test No 2 (Repeated)



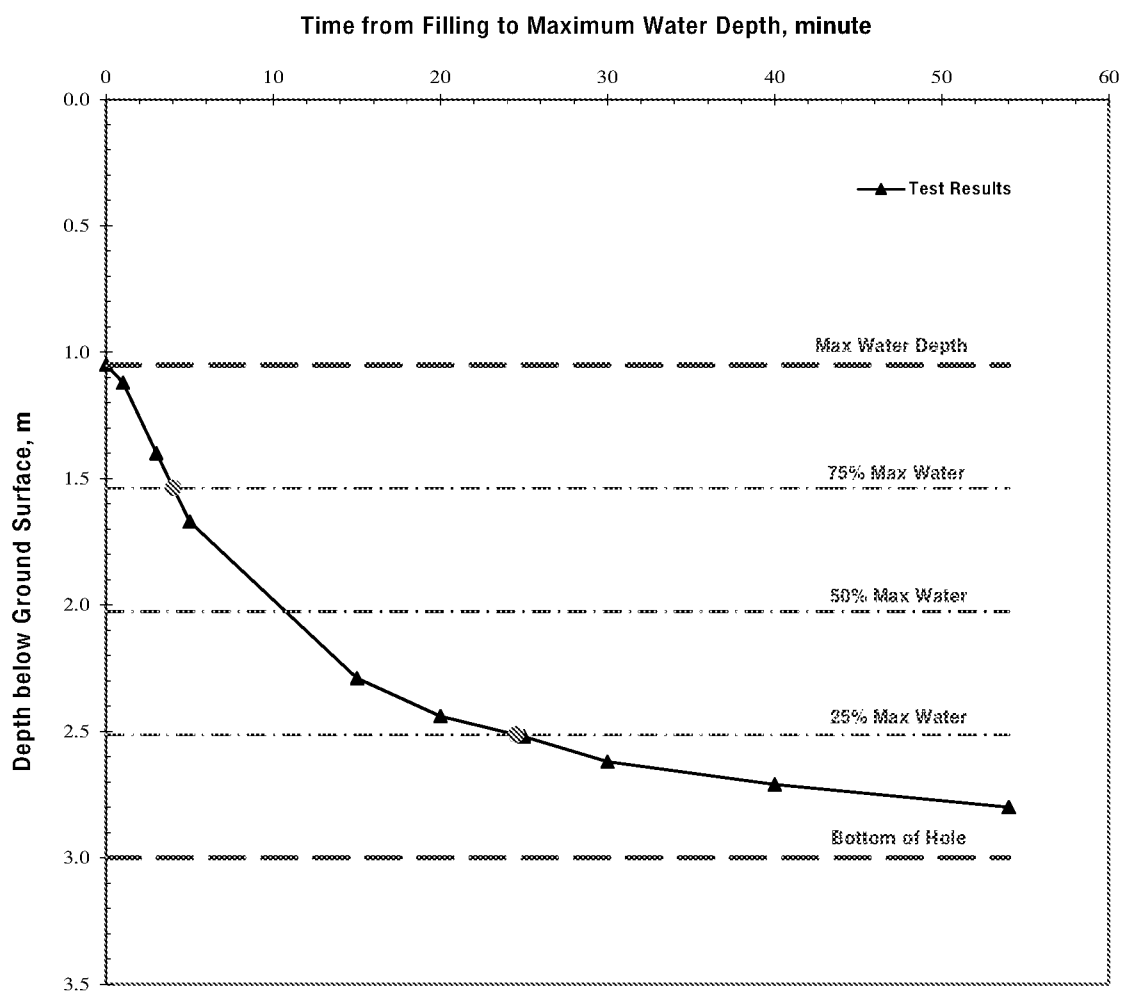
Pit Length, m	2.000	Depth to Water at Start of Test, m	1.040
Pit Width, m	0.450	Max Water Dropdown during Test, m	1.810
Depth to Pit Base, m	3.000	Total Soakage Test Time, min	50.0
Depth to Top of Permeable Soils, m		Mean Internal Discharge Area, m ²	5.702
Depth to Groundwater Surface, m		Discharge Rate, litre/min	19.062
Depth to Top of Granular Fill, m	1.100	Soakage Rate, litre/m ² /min	3.34
Voids Assumed for Granular Fill, %	40%	BRE Soil Infiltration Rate, m/sec	5.57E-05

Comments: 1200l used
Pit was nearly emptied at finish of test.

Client: The Angmering Community Land Trust	Job No: J13227	Test Date: 24/Jul/2017
Site: Mayflower Way, Angmering	Tested By: AA	Engineer: DK Fig. S5

BRE Digest 365 Soakage Test

Test Hole No: TP106
Test No: Test No 3 (Repeated)



Pit Length, m	2.000	Depth to Water at Start of Test, m	1.050
Pit Width, m	0.450	Max Water Dropdown during Test, m	1.750
Depth to Pit Base, m	3.000	Total Soakage Test Time, min	54.0
Depth to Top of Permeable Soils, m		Mean Internal Discharge Area, m ²	5.678
Depth to Groundwater Surface, m		Discharge Rate, litre/min	17.111
Depth to Top of Granular Fill, m	1.100	Soakage Rate, litre/m ² /min	3.01
Voids Assumed for Granular Fill, %	40%	BRE Soil Infiltration Rate, m/sec	5.02E-05

Comments: 1200l used
Pit was nearly emptied at finish of test.

Client: The Angmering Community Land Trust	Job No: J13227	Test Date: 24/Jul/2017
Site: Mayflower Way, Angmering	Tested By: AA	Engineer: DK Fig. S6

Summary Sheet							
Results of BRE Digest 365 Soakage Tests							
Site : Mayflower Way, Angmering					Job No : J13227		
Client : The Angmering Community Land Trust					O S Reference : TQ 07262 03274		
Tested By : AA				Engineer: DK		Test Date : 24/07/2017	
Hole No	Test No	Hole Depth <i>m</i>	Soakage Rate for Each Test <i>litre/m² /min</i>	Soakage Rate for Each Hole <i>litre/m² /min m/sec</i>		Water Level at Finish of Test	Remarks
TP101	No 1	3.40	4.14	1.62	2.69E-5	Nearly empty pit.	1550l used Depth to top of permeable soils was 1.4m.
TP101	No 2	3.40	2.85			Nearly empty pit.	1400l used
TP101	No 3	3.40	1.62			Nearly empty pit.	1400l used
TP106	No 1	3.00	5.21	3.01	5.02E-5	Empty pit.	1200l used
TP106	No 2	3.00	3.34			Nearly empty pit.	1200l used
TP106	No 3	3.00	3.01			Nearly empty pit.	1200l used
Mean Value of All Calculated Soakage Rates :				2.32 <i>litre/m² /min</i>	3.86E-5 <i>m/sec</i>		

Dynamic Cone Penetrometer (DCP) Test Results

Test No: DCP1

Chainage:

Tested By: N H

Start Layer: GL

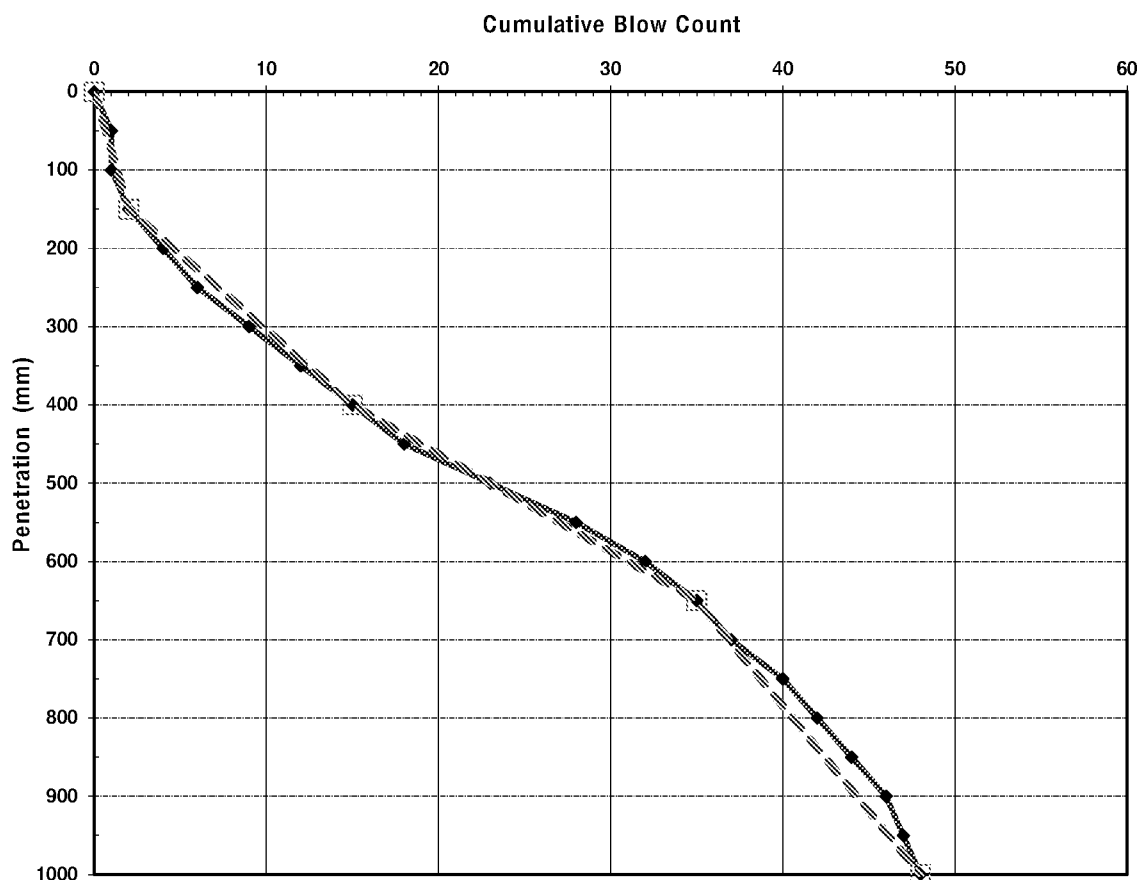
Checked By: DK

Soil Condition:

Test Date: 24-Jul-17

Notes:

Perth Cone CBR Penetration vs Cumulative Blow Count



Evaluated CBR Values from DCP Test Results

Layer No	From (mm)	To (mm)	Depth (mm)	Blow Count	No. of Blows	DCP mm/blow	CBR %	Soil Type	Remarks
1	0	150	150	2	2	75.0	1.7		
2	150	400	250	15	13	19.2	9.7		
3	400	650	250	35	20	12.5	17		
4	650	1000	350	48	13	26.9	6.3		

Client: The Howse Wallis Partnership

Job No: J13227

Site: Mayflower Way, Angmering

Date: 09/08/2017

Fig.

Dynamic Cone Penetrometer (DCP) Test Results

Test No: DCP2

Chainage:

Tested By: N H

Start Layer: GL

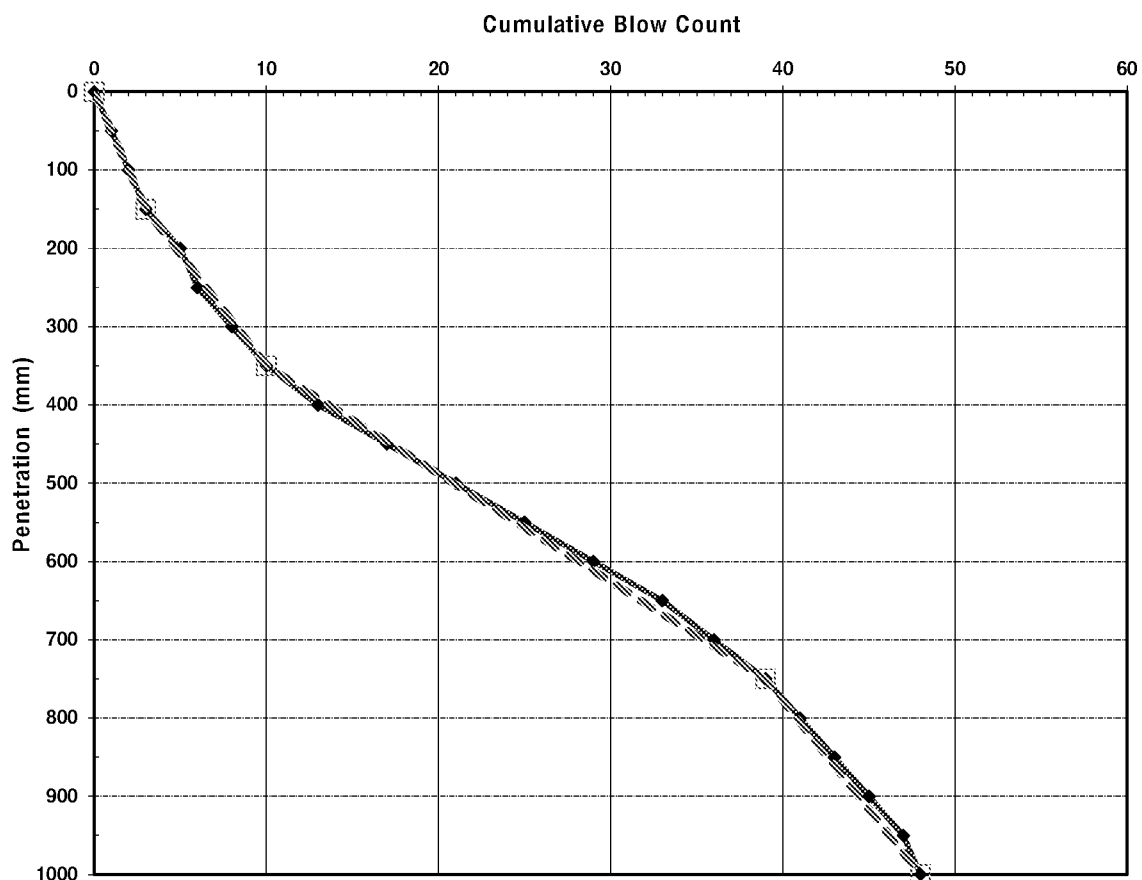
Checked By: DK

Soil Condition:

Test Date: 24-Jul-17

Notes:

Perth Cone CBR Penetration vs Cumulative Blow Count



Evaluated CBR Values from DCP Test Results

Layer No	From (mm)	To (mm)	Depth (mm)	Blow Count	No. of Blows	DCP mm/blow	CBR %	Soil Type	Remarks
1	0	150	150	3	3	50.0	2.9		
2	150	350	200	10	7	28.6	5.9		
3	350	750	400	39	29	13.8	15		
4	750	1000	250	48	9	27.8	6.1		

Client: The Howse Wallis Partnership

Job No: J13227

Site: Mayflower Way, Angmering

Date: 09/08/2017

Fig.

Dynamic Cone Penetrometer (DCP) Test Results

Test No: DCP3

Chainage:

Tested By: N H

Start Layer: GL

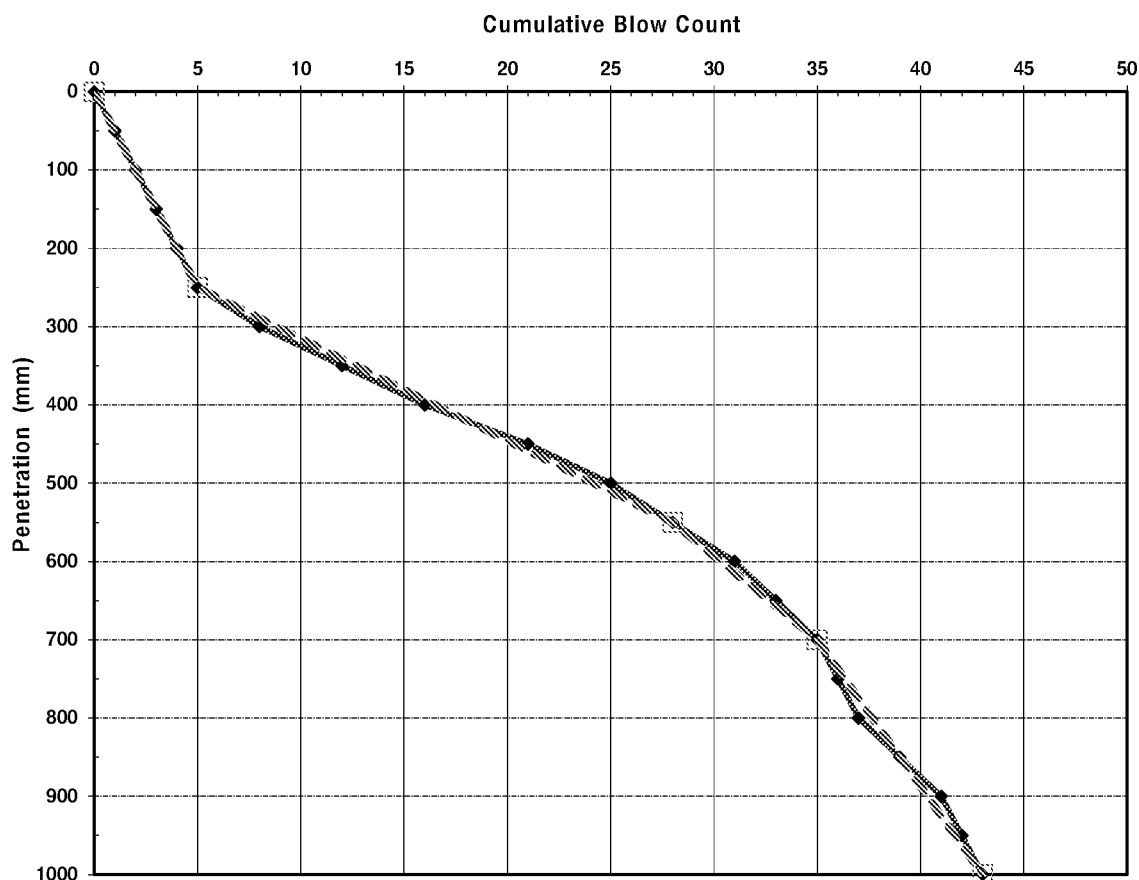
Checked By: DK

Soil Condition:

Test Date: 24-Jul-17

Notes:

Perth Cone CBR Penetration vs Cumulative Blow Count



Evaluated CBR Values from DCP Test Results

Layer No	From (mm)	To (mm)	Depth (mm)	Blow Count	No. of Blows	DCP mm/blow	CBR %	Soil Type	Remarks
1	0	250	250	5	5	50.0	2.9		
2	250	550	300	28	23	13.0	16		
3	550	700	150	35	7	21.4	8.5		
4	700	1000	300	43	8	37.5	4.1		

Client: The Howse Wallis Partnership

Job No: J13227

Site: Mayflower Way, Angmering

Date: 09/08/2017

Fig.

Dynamic Cone Penetrometer (DCP) Test Results

Test No: DCP4

Chainage:

Tested By: N H

Start Layer: GL

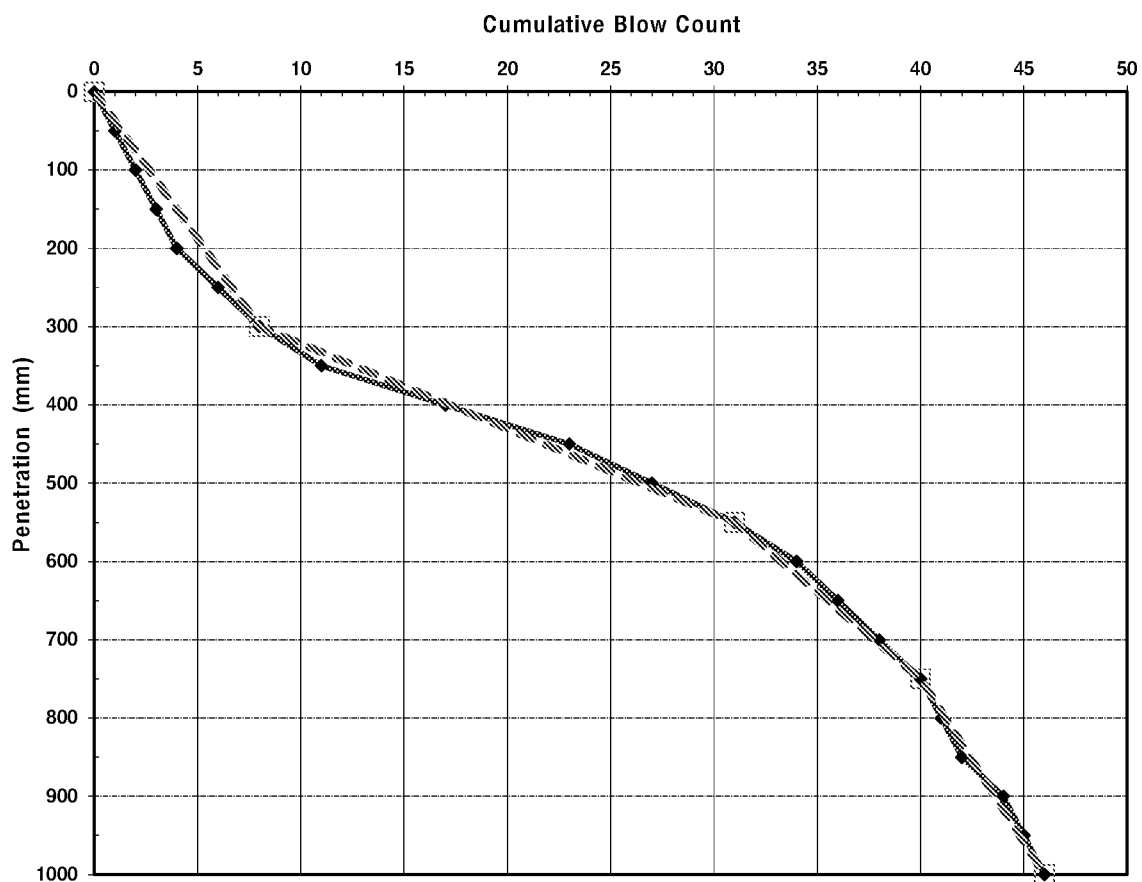
Checked By: DK

Soil Condition:

Test Date: 24-Jul-17

Notes:

Perth Cone CBR Penetration vs Cumulative Blow Count



Evaluated CBR Values from DCP Test Results

Layer No	From (mm)	To (mm)	Depth (mm)	Blow Count	No. of Blows	DCP mm/blow	CBR %	Soil Type	Remarks
1	0	300	300	8	8	37.5	4.1		
2	300	550	250	31	23	10.9	20		
3	550	750	200	40	9	22.2	8.1		
4	750	1000	250	46	6	41.7	3.6		

Client: The Howse Wallis Partnership

Job No: J13227

Site: Mayflower Way, Angmering

Date: 09/08/2017

Fig.

Dynamic Cone Penetrometer (DCP) Test Results

Test No: DCP5

Chainage:

Tested By: N H

Start Layer: GL

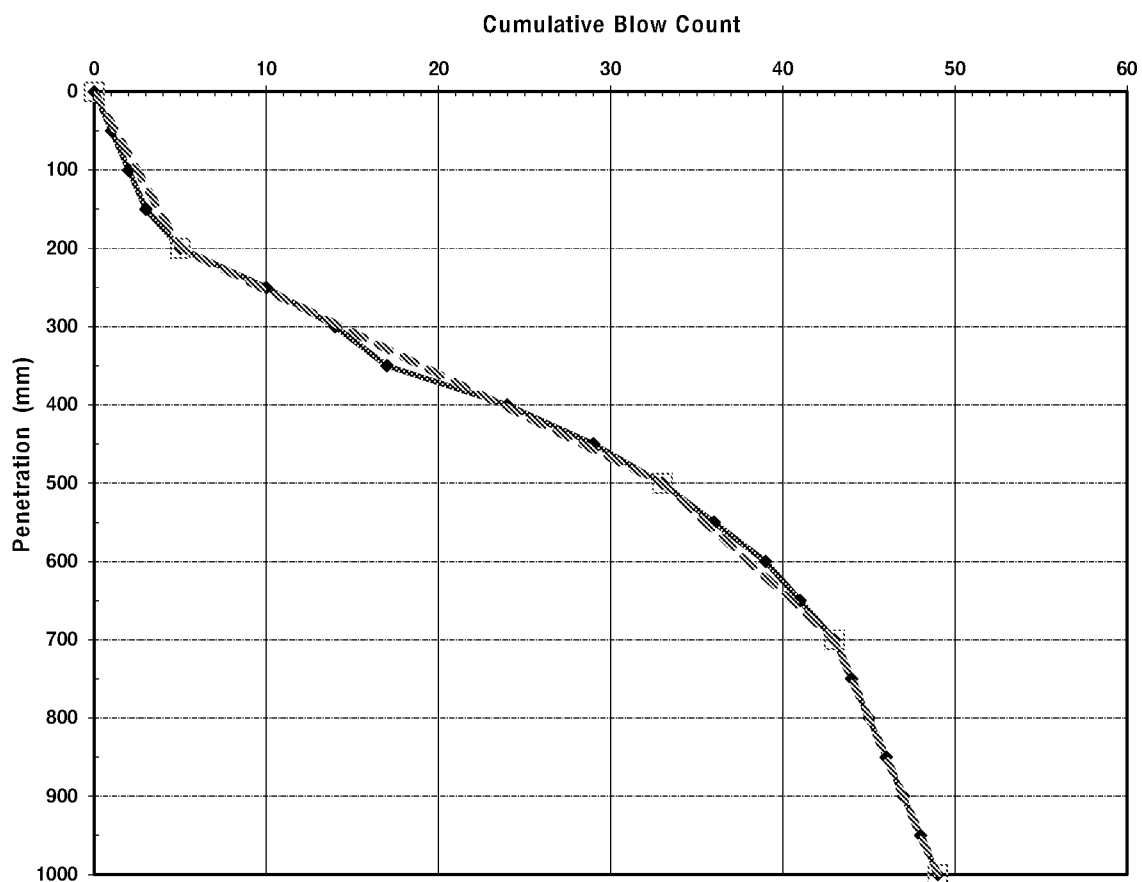
Checked By: DK

Soil Condition:

Test Date: 24-Jul-17

Notes:

Perth Cone CBR Penetration vs Cumulative Blow Count



Evaluated CBR Values from DCP Test Results

Layer No	From (mm)	To (mm)	Depth (mm)	Blow Count	No. of Blows	DCP mm/blow	CBR %	Soil Type	Remarks
1	0	200	200	5	5	40.0	3.8		
2	200	500	300	33	28	10.7	21		
3	500	700	200	43	10	20.0	9.3		
4	700	1000	300	49	6	50.0	2.9		

Client: The Howse Wallis Partnership

Job No: J13227

Site: Mayflower Way, Angmering

Date: 09/08/2017

Fig.

Dynamic Cone Penetrometer (DCP) Test Results

Test No: DCP6

Chainage:

Tested By: N H

Start Layer: GL

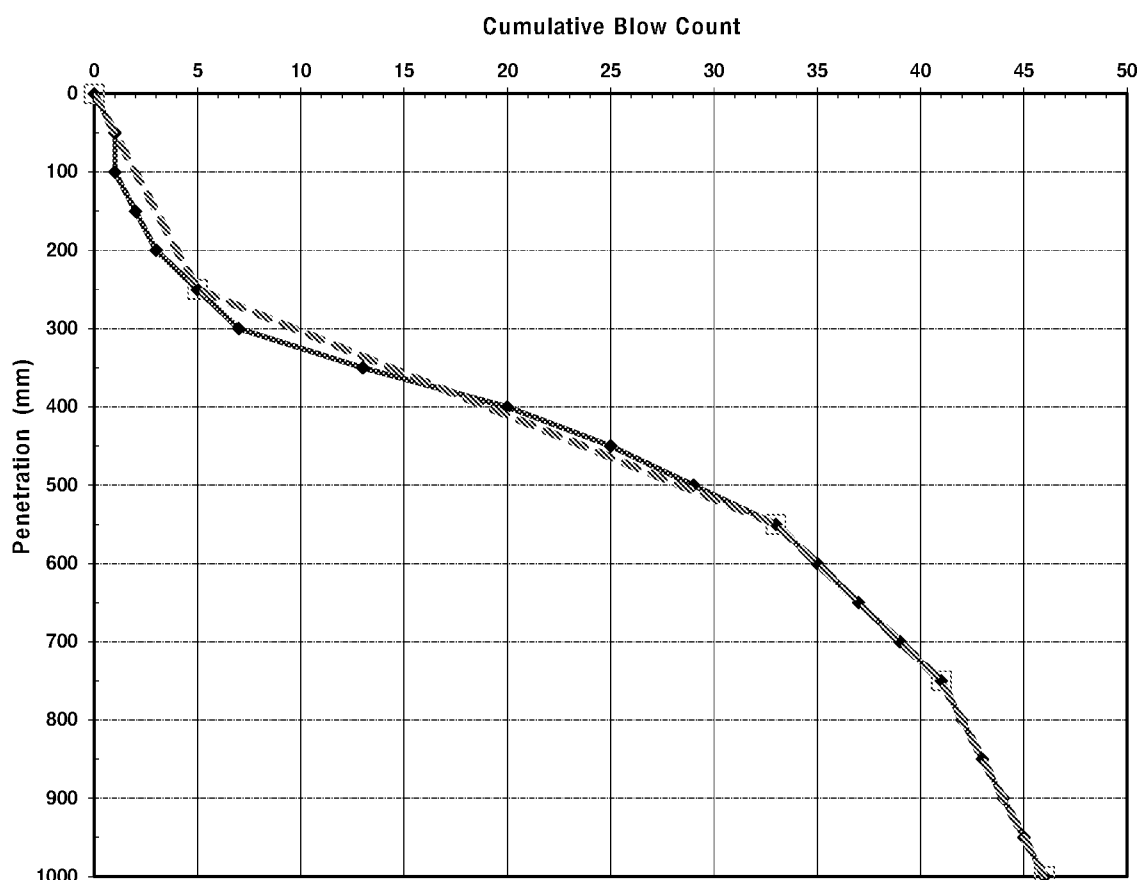
Checked By: DK

Soil Condition:

Test Date: 24-Jul-17

Notes:

Perth Cone CBR Penetration vs Cumulative Blow Count



Evaluated CBR Values from DCP Test Results

Layer No	From (mm)	To (mm)	Depth (mm)	Blow Count	No. of Blows	DCP mm/blow	CBR %	Soil Type	Remarks
1	0	250	250	5	5	50.0	2.9		
2	250	550	300	33	28	10.7	21		
3	550	750	200	41	8	25.0	7.0		
4	750	1000	250	46	5	50.0	2.9		

Client: The Howse Wallis Partnership

Job No: J13227

Site: Mayflower Way, Angmering

Date: 09/08/2017

Fig.

APPENDIX C

Geotechnical Laboratory Test References & Results

Project Name		Land south of Mayflower Way, Angmering					Project Number			J13227		
Client		Angmering Community Land Trust			PE	DK	Date Issued		07-Aug-17			
Location	Depth m	Sample Type	Visual Description	Comments	Natural MC %	Liquid Limit %	Plastic Limit %	Plasticity Index	Classi- fication	Passing 425 micron %		
TP101	2.00	D	Stiff light brown sandy CLAY.		22	38	21	17	CI	100		
TP102	1.00	D	Stiff dark brown sandy CLAY.		20	39	21	18	CI	100		
TP103	2.00	D	Stiff brown slightly sandy gravelly CLAY. Gravel consists of fine and medium angular flint.	Sample passed through 425µm sieve	19	39	17	22	CI	76		
TP104	1.00	D	Very stiff brown slightly sandy gravelly CLAY. Gravel consists of fine and medium angular flint.		20	40	19	21	CI	99		
TP105	2.00	D	Firm brown sandy slightly gravelly CLAY. Gravel consists of fine subangular flint.		21	39	22	17	CI	99		
TP106	1.00	D	Stiff light brown sandy CLAY.		22	41	22	19	CI	100		
TP106	1.50	D	Firm brown slightly sandy gravelly CLAY. Gravel consists of fine to coarse angular flint.	Sample passed through 425µm sieve	15	41	17	24	CI	43		

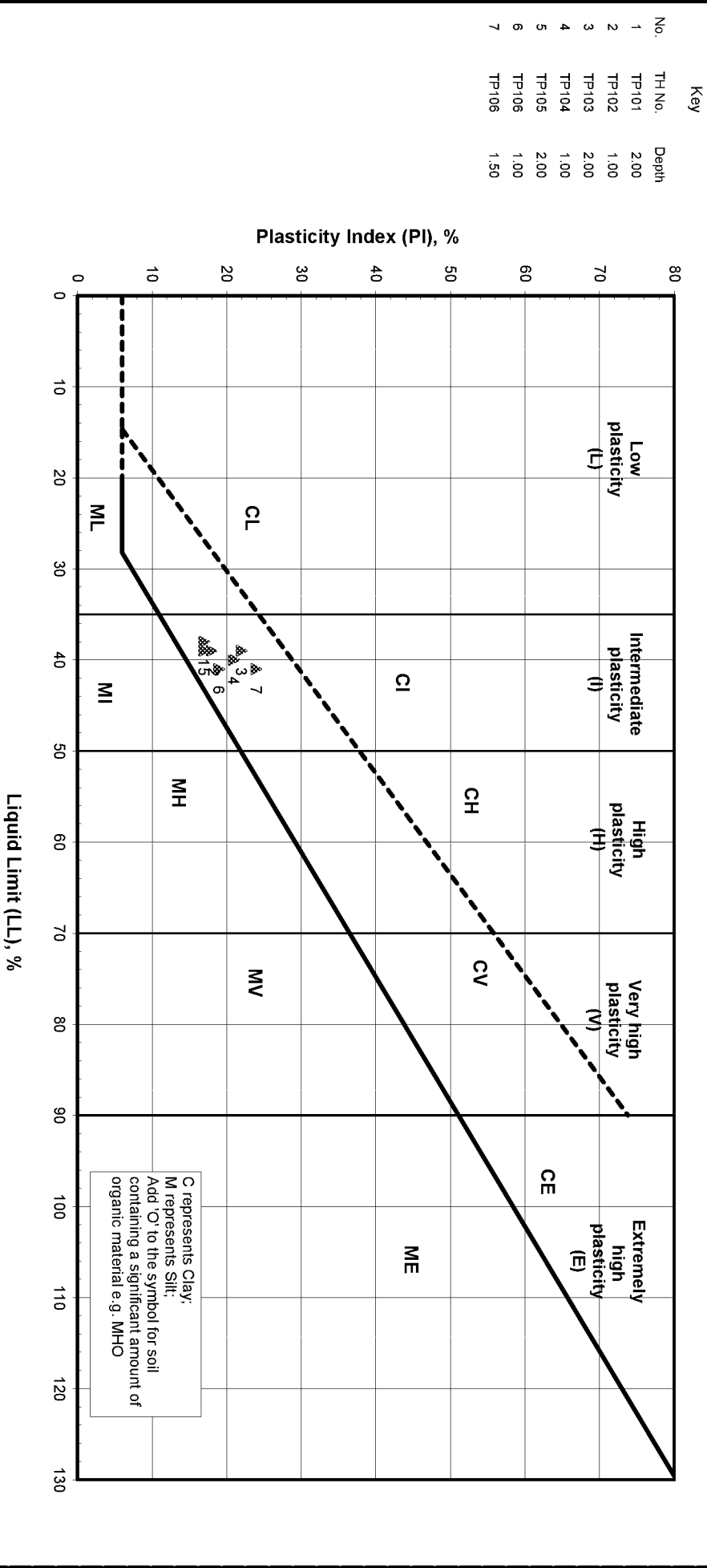
Southern Testing Laboratories Limited, East Grinstead is registered under BS EN ISO 9001:2008 BSI ref: FS29280

Jun '13



Plasticity Chart for Atterberg Limit Tests

Project Name		Land south of Mayflower Way, Angmering		Project Number		J13227
Client Name		Angmering Community Land Trust		PE	DK	Date Issued
				07-Aug-17		

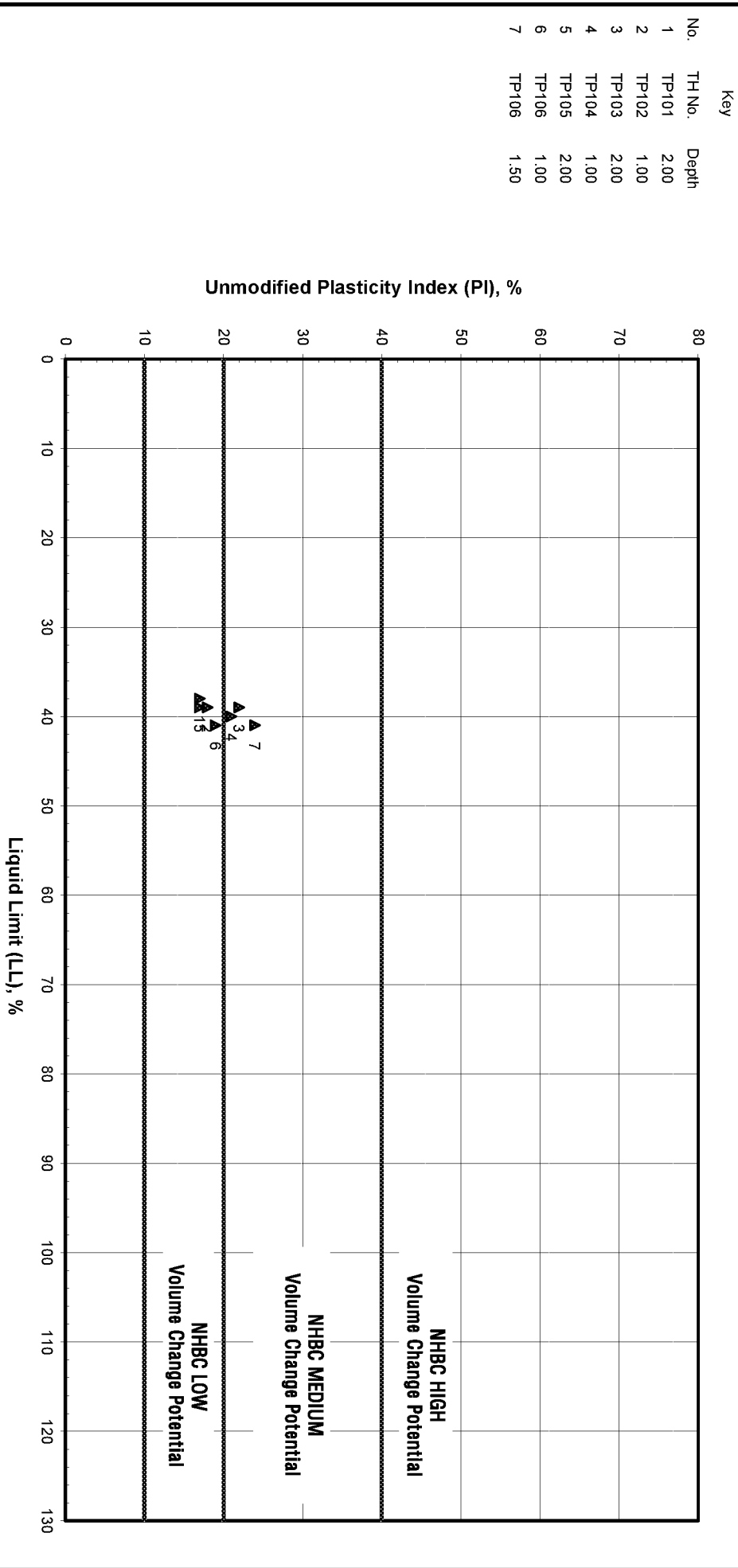


Liquid Limit		Plastic Limit		Plasticity Index	
Maximum Value	41	Maximum Value	22	Maximum Value	24
Minimum Value	38	Minimum Value	17	Minimum Value	17
Average Value	40	Average Value	20	Average Value	20



NHBC Classification for Volume Change Potential

Project Name		Land south of Mayflower Way, Angmering		Project Number	J13227
Client Name	Angmering Community Land Trust	PE	DK	Date Issued	07-Aug-17



Liquid Limit		Plastic Limit		Unmodified Plasticity Index	
Maximum Value	41	Maximum Value	22	Maximum Value	24
Minimum Value	38	Minimum Value	17	Minimum Value	17
Average Value	40	Average Value	20	Average Value	20

Project Name		Land south of Mayflower Way, Angmering					Project Number		J13227	
Client		Angmering Community Land Trust			PE	DK	Date Issued		07-Aug-17	
TH No.	Depth m	Sample Type	Visual Description	Comments	Passing 2mm %	pH Value	Soil Sulphate 2:1 Water Extract		Groundwater Sulphate	
							g/l SO ₃	BRE mg/l SO ₄	g/l SO ₃	BRE mg/l SO ₄
TP101	1.50	D	Stiff light brown slightly sandy slightly gravelly CLAY. Gravel consists of fine to coarse angular and subangular flint.		66	7.9	0.02	29		
TP102	2.00	D	Firm light brown slightly sandy slightly gravelly CLAY. Gravel consists of fine and medium angular and subangular flint.		85	8.1	0.02	29		
TP104	2.00	D	Stiff light brown sandy slightly gravelly CLAY. Gravel consists of fine and medium angular flint.		88	7.9	0.02	19		
TP105	1.20	D	Stiff dark brown sandy CLAY.		100	7.9	0.02	19		

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The samples above may have been crushed to pass a 2mm sieve.

Jun 13

Page: 1

APPENDIX D

Contamination Laboratory Test Results

Table 1 – Tier 1 Screening Values

Contaminant	Units	Proposed Land Use					
		Residential with homegrown produce consumption	Residential without homegrown produce consumption	Open Space* (Residential)	Open Space* (Park)	Allotments	Commercial / Industrial
Arsenic (As) [2]	mg/kg	37	40	79	170	43	640
Cadmium (Cd) [2]	mg/kg	11	85	120	555	1.9	190
Trivalent Chromium (CrIII) [2]	mg/kg	910	910	1,500	33,000	18,000	8600
Hexavalent Chromium (CrVI) [2]	mg/kg	6	6	7.7	220	1.8	33
Lead (Pb) [3]	mg/kg	200	310	630	1300	80	2330
Mercury (Hg) [1,2,7]	mg/kg	7.6-11	9.2-15	40	68-71	6.0	29-320
Selenium (Se) [2]	mg/kg	250	430	1,100	1,800	88	12,000
Nickel (Ni) [2,4]	mg/kg	130	180	230	800	53	980
Copper (Cu) [2,4]	mg/kg	2,400	7,100	12,000	44,000	520	68,000
Zinc (Zn) [2,4]	mg/kg	3,700	40,000	81,000	170,000	620	730,000
Phenol [1,2]	mg/kg	120-380	440-1200	440-1300	440-1300	23-83	440-1300
Benzo[a]pyrene [1,5]	mg/kg	1.7-2.4	2.6	4.9	10	0.67-2.7	36
Naphthalene [1,2]	mg/kg	2.3-13	2.3-13	77-430 ⁺	77-430 ⁺	4.1-24	77-430 ⁺
Total Cyanide (CN) [6]	mg/kg	/	/	/	/	/	/
Free Cyanide [6]	mg/kg	/	/	/	/	/	/
Complex Cyanides [6]	mg/kg	/	/	/	/	/	/
Thiocyanate [6]	mg/kg	/	/	/	/	/	/

Notes:

* Open Space levels calculated on the basis of the exposure modelling developed in the C4SL research.

+ Screening values constrained to saturation limit. Higher values may be acceptable on a site specific basis.

[1] Where ranges of values are given for organic contaminants the screening value is dependant on the Soil Organic Matter.

[2] LQM/CIEH S4UL (2014). Copyright Land Quality Management Ltd reproduced with permission; Publication Number S4UL 3116. All rights reserved.

[3] C4SL (DEFRA 2014).

[4] Copper, Zinc and Nickel may have phototoxic effects at the given concentrations. Alternative criteria should be adopted for importation of Topsoil or other soils for cultivation. BS3882:2015 and BS8601:2013 suggest values of 200 to 300mg/kg for Zn, 100 to 200mg/kg for Cu, and 60 to 110mg/kg for Ni, for topsoil and subsoil, depending on pH.

[5] Based on the Surrogate Marker approach and modelled using the modified exposure parameters of C4SL but retaining 'minimal risk' HCV.

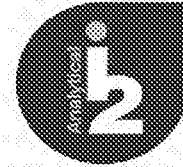
[6] Screening criteria derived on a site specific basis if test results indicate.

[7] S4UL for Methyl Mercury, higher concentrations may be tolerable if inorganic mercury is the only species present. Lower concentrations apply for elemental Mercury.

These screening values are valid at the time of writing but may be subject to change and any such changes will have implications for the assessments based on them. Their validity should be confirmed at the time of site development.



4841



Environmental Science

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Analytical Report Number : 17-55680

Replaces Analytical Report Number : 17-55680, issue no. 1

Project / Site name:	Land South of Mayflower Way, Angmering	Samples received on:	27/07/2017
Your job number:	J13227	Samples instructed on:	27/07/2017
Your order number:	J13227-1	Analysis completed by:	10/08/2017
Report Issue Number:	2	Report issued on:	10/08/2017
Samples Analysed:	9 soil samples		

Signed:

Dr Irma Doyle
Senior Account Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

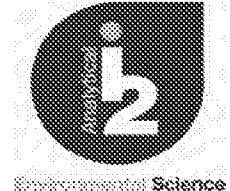
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Analytical Report Number: 17-55680

Project / Site name: Land South of Mayflower Way, Angmering

Your Order No: J13227-1

Lab Sample Number				790201	790202	790203	790204	790205
Sample Reference				TP101	TP101	TP102	TP103	TP103
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.15	1.00	0.15	0.10	0.30
Date Sampled				24/07/2017	24/07/2017	24/07/2017	24/07/2017	24/07/2017
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	18	14	17	16	7.7
Total mass of sample received	kg	0.001	NONE	0.49	0.48	0.45	0.43	0.41

Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	Chrysotile	-	-	Chrysotile
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Detected	Not-detected	-	Detected
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	-	< 0.001	-	-	< 0.001
Asbestos Quantification Total	%	0.001	ISO 17025	-	< 0.001	-	-	< 0.001

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.6	7.8	7.4	-	7.7
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	-	< 1
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.017	0.047	0.0076	-	0.0053
Sulphide	mg/kg	1	MCERTS	1.2	7.7	< 1.0	-	< 1.0
Organic Matter	%	0.1	MCERTS	4.6	3.3	4.5	-	2.4

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	< 1.0
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	-	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	0.18	0.21	< 0.05	-	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	-	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	-	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	0.79	0.67	0.54	-	< 0.05
Anthracene	mg/kg	0.05	MCERTS	0.28	0.37	0.17	-	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	2.3	2.9	1.6	-	< 0.05
Pyrene	mg/kg	0.05	MCERTS	2.2	2.8	1.6	-	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	1.2	1.9	0.87	-	< 0.05
Chrysene	mg/kg	0.05	MCERTS	1.2	1.6	0.78	-	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	1.2	1.9	0.97	-	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	1.2	1.8	0.55	-	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	1.2	2.1	0.79	-	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.90	1.4	0.59	-	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	0.25	0.41	0.13	-	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.96	1.5	0.63	-	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	13.7	19.5	9.18	-	< 0.80
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Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	9.9	9.3	6.7	-	11
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.4	0.4	0.3	-	0.4
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	-	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	23	24	24	-	20
Copper (aqua regia extractable)	mg/kg	1	MCERTS	18	22	16	-	16
Lead (aqua regia extractable)	mg/kg	1	MCERTS	120	130	53	-	43
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	-	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	14	15	14	-	15
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	1.1	< 1.0	1.4	-	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	87	140	63	-	57

Pesticide and Herbicide Screen

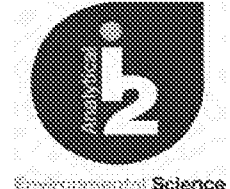
Pesticides/Herbicides Screen in Soil	P/A	N/A	NONE	-	-	Absent	Absent	-
Organochlorine Pesticides (OCP)								
DDD	mg/kg	0.01	NONE	-	-	-	-	-
DDE	mg/kg	0.01	NONE	-	-	-	-	-

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Analytical Report Number: 17-55680

Project / Site name: Land South of Mayflower Way, Angmering

Your Order No: J13227-1

Lab Sample Number				790206	790207	790208	790209	
Sample Reference				TP104	TP104	TP105	TP106	
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	
Depth (m)				0.15	0.60	0.40	0.15	
Date Sampled				24/07/2017	24/07/2017	24/07/2017	24/07/2017	
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	
Moisture Content	%	N/A	NONE	12	15	10	18	
Total mass of sample received	kg	0.001	NONE	0.45	0.46	0.42	0.43	

Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	-	-	-	
Asbestos in Soil	Type	N/A	ISO 17025	-	Not-detected	Not-detected	Not-detected	
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	-	-	-	-	
Asbestos Quantification Total	%	0.001	ISO 17025	-	-	-	-	

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	-	7.6	7.6	6.6	
Total Cyanide	mg/kg	1	MCERTS	-	< 1	< 1	< 1	
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	-	0.016	0.011	0.022	
Sulphide	mg/kg	1	MCERTS	-	< 1.0	< 1.0	< 1.0	
Organic Matter	%	0.1	MCERTS	-	4.4	4.3	4.5	

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	-	< 1.0	< 1.0	< 1.0	
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	-	< 0.05	< 0.05	< 0.05	
Acenaphthylene	mg/kg	0.05	MCERTS	-	< 0.05	0.22	< 0.05	
Acenaphthene	mg/kg	0.05	MCERTS	-	< 0.05	0.14	< 0.05	
Fluorene	mg/kg	0.05	MCERTS	-	< 0.05	< 0.05	< 0.05	
Phenanthrene	mg/kg	0.05	MCERTS	-	< 0.05	1.9	0.32	
Anthracene	mg/kg	0.05	MCERTS	-	< 0.05	0.61	0.09	
Fluoranthene	mg/kg	0.05	MCERTS	-	0.31	4.9	0.69	
Pyrene	mg/kg	0.05	MCERTS	-	0.28	4.4	0.63	
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	0.19	2.3	0.33	
Chrysene	mg/kg	0.05	MCERTS	-	0.20	2.1	0.33	
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	-	0.22	2.5	0.31	
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	-	0.11	1.1	0.30	
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	0.18	1.8	0.29	
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	0.16	1.3	0.23	
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	< 0.05	0.33	< 0.05	
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	0.20	1.2	0.25	

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	-	1.85	24.6	3.77	
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Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	-	17	9.3	11	
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	-	0.6	0.4	0.6	
Chromium (hexavalent)	mg/kg	4	MCERTS	-	< 4.0	< 4.0	< 4.0	
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	29	22	26	
Copper (aqua regia extractable)	mg/kg	1	MCERTS	-	28	25	21	
Lead (aqua regia extractable)	mg/kg	1	MCERTS	-	79	77	67	
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	-	< 0.3	< 0.3	< 0.3	
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	-	17	14	14	
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	-	< 1.0	< 1.0	< 1.0	
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	-	150	180	150	

Pesticide and Herbicide Screen

Pesticides/Herbicides Screen in Soil	P/A	N/A	NONE	Present	-	-	-	
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Organochlorine Pesticides (OCP)

DDD	mg/kg	0.01	NONE	0.04	-	-	-	
DDE	mg/kg	0.01	NONE	0.14	-	-	-	

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Analytical Report Number: **17-55680**
Project / Site name: **Land South of Mayflower Way, Angmering**
Your Order No: **J13227-1**

Certificate of Analysis - Asbestos Quantification

Methods:

Qualitative Analysis

The samples were analysed qualitatively for asbestos by polarising light and dispersion staining as described by the Health and Safety Executive in HSG 248.

Quantitative Analysis

The analysis was carried out using our documented in-house method A006 based on HSE Contract Research Report No: 83/1996: Development and Validation of an analytical method to determine the amount of asbestos in soils and loose aggregates (Davies et al, 1996) and HSG 248. Our method includes initial examination of the entire representative sample, then fractionation and detailed analysis of each fraction, with quantification by hand picking and weighing.

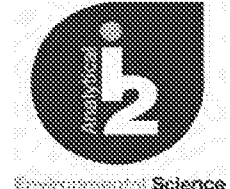
The limit of detection (reporting limit) of this method is 0.001 %.

The method has been validated using samples of at least 100 g, results for samples smaller than this should be interpreted with caution.

Both Qualitative and Quantitative Analyses are UKAS accredited.

Sample Number	Sample ID	Sample Depth (m)	Sample Weight (g)	Asbestos Containing Material Types Detected (ACM)	PLM Results	Asbestos by hand picking/weighing (%)	Total % Asbestos in Sample
790202	TP101	1.00	142	Loose Fibres	Chrysotile	< 0.001	< 0.001
790205	TP103	0.30	114	Loose Fibres	Chrysotile	< 0.001	< 0.001

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.



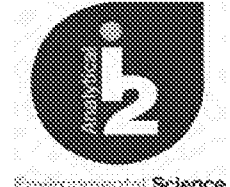
Analytical Report Number : 17-55680

Project / Site name: Land South of Mayflower Way, Angmering

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
790201	TP101	None Supplied	0.15	Light brown loam and clay with gravel and vegetation.
790202	TP101	None Supplied	1.00	Light brown clay and sand with gravel and vegetation.
790203	TP102	None Supplied	0.15	Light brown loam and clay with gravel and vegetation.
790204	TP103	None Supplied	0.10	Light brown loam and clay with gravel and vegetation.
790205	TP103	None Supplied	0.30	Light brown clay and sand with vegetation.
790206	TP104	None Supplied	0.15	Light brown loam and clay with gravel and vegetation.
790207	TP104	None Supplied	0.60	Brown loam and clay with gravel and vegetation.
790208	TP105	None Supplied	0.40	Brown loam and sand with gravel and vegetation.
790209	TP106	None Supplied	0.15	Brown loam and clay with gravel and vegetation.



Analytical Report Number : 17-55680

Project / Site name: Land South of Mayflower Way, Angmering

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Asbestos Quantification - Gravimetric	Asbestos quantification by gravimetric method - in ouse method based on references.	HSE Report No: 83/1996, HSG 248, HSG 264 & SCA Blue Book (draft).	A006-PL	D	ISO 17025
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazine followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	BS1377 Part 3, 1990, Chemical and Electrochemical Tests""	L009-PL	D	MCERTS
Organochlorine pesticides in soil	Determination of organochlorine pesticides in soil by GC-MS	In-house method		W	NONE
Pesticides and Herbicides in soil screening	In-house method	In-house method		W	NONE
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES.	L038-PL	D	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-PL	D	MCERTS
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

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APPENDIX E

Photographs

J13227 – Land off Mayflower Way, Angmering



Entrance into site from Mayflower Way



BRE365 test in progress



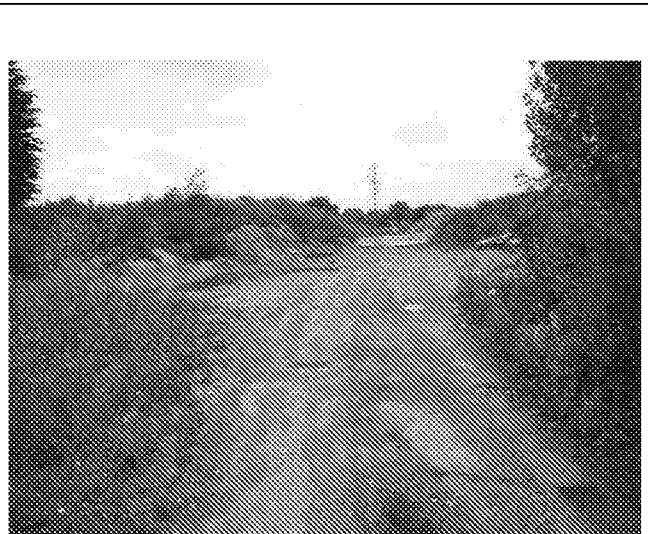
View looking south east across the site



View looking north east along Mayflower Way



View looking north west along Mayflower Way



Land to the north of the site



TP101



TP101



TP102



TP102



TP105



TP105