PROPOSED SPECIALIST CARE UNIT, BROAD GREEN ROAD, LIVERPOOL

SEDDON CONSTRUCTION LTD

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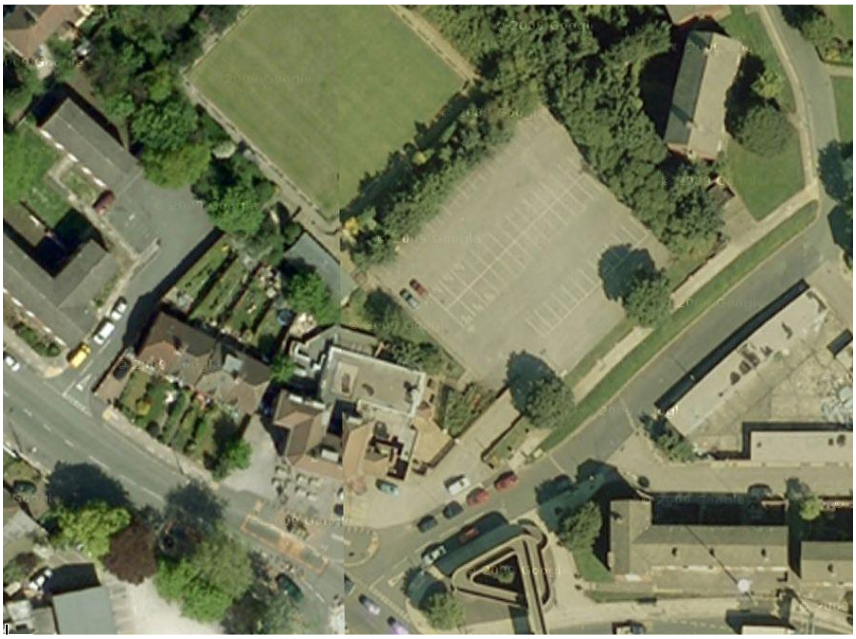

GROUND ENGINEERING INTERPRETATIVE REPORT

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EXECUTIVE SUMMARY

Seddon Construction Ltd (Seddon) proposes to develop a site at the former Gardeners Arms Pub, Broad Green Road, Liverpool, L13 5SF.

The development involves the construction of a specialist care unit with associated access roads, car parking and landscaped areas.

The ground investigation was designed based on information and recommendations of the Phase I Desk Study report and in liaison with BKP. All ground investigations were carried out with reference to and in line with current British Standards. The main ground investigation comprised the formation of nine mini-percussive boreholes and four hand excavated trial pits.

The general geology underlying the site is best described by discussing the upper and lower plateaus of the site independently.

The geology of the upper plateau is characterised by the presence of tarmac over subgrade at the surface which is in turn underlain by granular made ground. The made ground extends the deepest in WS5 (2.1m) where cohesive made ground was encountered. Directly underlying the made ground are natural cohesive deposits interspersed with small bands of granular material and pockets of sand. Weathered bedrock is inferred to underlie the natural cohesive deposits.

The geology of the lower plateau (approximately 2.5m below upper plateau) is similar to that of the upper plateau with the exception of natural granular deposits directly underlying the made ground which are in turn underlain by natural cohesive deposits followed by bedrock.

In terms of contamination the risk is considered to be low and does not pose a constraint to the proposed development. Ground gas is considered to be a low risk to the end users of the site and has been preliminarily classified as 'Characteristic Situation 2' for which special ground gas protection measures are required. Once the ground gas monitoring period has been fully completed, an addendum report will be issued with the final ground gas assessment and recommendations.

The proposed new building will be constructed mainly over the upper plateau. This area is covered by around 1.0m thickness of made ground which is underlain by firm natural cohesive deposits. These firm natural clays can offer a safe bearing capacity of around 90KPa which is adequate for supporting the proposed one storey buildings over traditional spread footings.

However, nearer to the lower plateau (as seen in WS5) the made ground attains a thickness of around 2.1m with the top of more competent firm natural clays laying at depth of around 2.4m below existing ground level. It is understood that the building spans into the lower plateau where it is proposed to comprise two storey building. At this stage it appears that the southern section of the proposed building may require deep trench filling or the use of stone columns to support the two storey building. Also, due to lack of access the present investigation could not provide any information on the soil quality at the northern part of the lower plateau.

A supplementary investigation has been recommended once the pub is demolished, to further investigate the quality of near surface soils and depth to the firm natural clays within the northern part of the lower plateau.

1 INTRODUCTION

Seddon Construction Ltd (Seddon) proposes to develop a site at the former Gardeners Arms Pub, Broad Green Road, Liverpool, L13 5SF.

The development involves the construction of a specialist care unit with associated access roads, car parking and landscaped areas.

Geoenvironmental Risk Solutions Ltd (GRS) has been appointed as geotechnical and geoenvironmental consultants for the project by Booth King Partnership (BKP) on behalf of the client.

This report forms the Phase II Ground Engineering Interpretative Report and has been carried out with reference to and in line with current relevant British and European Standards (see list of references in this report).

Although every effort has been made to provide a comprehensive review of the site, GRS cannot accept any liability for any difference in ground conditions beneath the site between exploratory holes, or the accuracy and reliability of any third party information.

2 THE SITE

2.1 SITE LOCATION AND DESCRIPTION

The site is located at the former Gardeners Arms Pub, Broad Green Road, Liverpool, L13 5SF at approximate national grid reference NGR: 340010, 390590. A site location plan is presented as Figure 1 in Appendix A.

The site is an irregularly shaped parcel of land measuring approximately 0.4 Hectares in area. It is split topographically with the now disused pub located on the lower plateau to the south and west of the site and a car park servicing both the pub and a bowling club on the upper plateau to the north and east of the site. The difference in height between the two plateaus is approximately 2.5m. The lower plateau currently contains the former Gardeners Arms pub which at the time of writing of this report was disused and boarded up. To the south and east of the pub are areas of hardstanding including a ramped access road to the upper plateau. To the immediate rear of the pub are retaining structures between the upper and lower plateaus. The car park on the upper plateau is of tarmac formation surrounded by grass and vegetation including several mature trees. It was noted that some minor fly tipping and rubbish was present in vegetated areas.

Immediately surrounding the site is a bowling green and club to the northwest which is accessed through the site, residential houses to the northeast, a road named The Green followed by residential housing to the southeast, Broad Green Road to the south and to the west are further residential houses. To the east, the site is approximately 2.0m above The Green.

The main access to the site is via Broad Green Road. Access to the upper plateau car park is prevented by a locked bollard. There is also limited access to the areas to the rear of the existing pub.

2.2 SITE HISTORY

A comprehensive review of the history of the site can be found in the Phase I Desk Study Report (GRS, March 2012) and is summarised below:

The site has changed very little since the earliest record in 1851 with Oak Vale Cottage in same place as the present pub. This pub is then marked from 1894 and is likely to have undergone modernisation over time. It is not known when the current car park was developed. Recent anecdotal evidence suggests that there was a bowling green at the site of the current car park.

2.3 PUBLISHED SITE GEOLOGY

The published geology studied in the Phase I Desk Study Report shows the site to be underlain directly by bedrock comprising the Chester Pebble Beds Formation described as pebbly (gravelly) Sandstone. However the data may not include made ground deposits which are likely to be present directly below the surface as the result of previous site developments. The nearest drift deposits are shown adjacent to the northwestern boundary of the site and are described as Devensian Till which comprises Diamicton and sandy gravelly cobbly clay. Given the scale of mapping of the published data it is possible that thin deposits of this drift material may be present underlying the site.

3 GROUND INVESTIGATION

3.1 GENERAL

The ground investigation was designed based on information and recommendations of the Phase I Desk Study report and in liaison with BKP. All ground investigations were carried out with reference to and in line with current British Standards. The main ground investigation comprised the formation of nine mini-percussive boreholes and four hand excavated trial pits. An approximate exploratory hole location plan is presented as Figure 2 in Appendix A and all exploratory hole log sheets are presented in Appendix B.

3.2 PREVIOUS INVESTIGATION

No details of any previous investigations were available to GRS at the time of writing of this report.

3.3 CURRENT INVESTIGATION

3.3.1 HAND EXCAVATED TRIAL PITS

Four hand excavated trial pits were formed across the proposed paved car parking areas using a hydraulic breaker and traditional hand digging tools to a maximum depth of 1.2mbgl. For each location, the relevant service drawings were checked and the ground CAT scanned prior to excavation. The trial pits were logged by the GRS Engineer on site. Representative samples were taken from each trial pit and scheduled for appropriate laboratory testing. The trial pits were then backfilled and compacted in layers.

3.3.2 MINI-PERCUSSIVE BOREHOLES

A total of nine mini-percussive boreholes were formed across the site to a maximum depth of 4.25m. For each borehole position service drawings were checked and the ground CAT scanned to ensure no underground services were present. As a further precaution a hand dug inspection pit was formed to a depth of 1.2m at each position and the base of the pit scanned and cleared before boring commenced. Standard Penetration Tests were carried out at various depths in each borehole and representative samples were taken and scheduled for appropriate laboratory testing. WS 2, 3, 4 & 5 were continued by Dynamic Probe to a maximum depth of 6.6m. WS 8 was terminated within the inspection pit due to a flat solid obstruction at 0.67m bgl.

3.3.3 GROUNDWATER/GROUND GAS MONITORING INSTALLATIONS

A 50mm diameter standpipe was installed in three of the mini-percussive boreholes to allow the future monitoring of groundwater and ground gas in the subsurface. The installations were formed using arisings from the base of the hole to the required depth. A bentonite seal was then formed above the arisings. The response zone was formed using slotted pipe with a surrounding gravel filter. A further bentonite seal was then formed at the top of the response zone with solid pipe continuing to the surface and sealed with a gas tap bung. Further details of these installations can be found on the relevant borehole log sheets in Appendix B.

4 GROUND CONDITIONS

4.1 GENERAL

The general geology underlying the site is best described by discussing the upper and lower plateaus of the site independently.

The geology of the upper plateau is characterised by the presence of tarmac over subgrade at the surface which is in turn underlain by granular made ground. The made ground extends the deepest in WS5 (2.1m) where cohesive made ground was encountered. Directly underlying the made ground are natural cohesive deposits interspersed with small bands of granular material and pockets of sand. Weathered bedrock is inferred to underlie the natural cohesive deposits.

The geology of the lower plateau (approximately 2.5m below upper plateau) is similar to that of the upper plateau with the exception of natural granular deposits directly underlying the made ground which are in turn underlain by natural cohesive deposits followed by bedrock.

The geology suggests that at some point in the past, the site comprised sloping ground and that a cut and fill exercise has been carried out in order to form the flat upper and lower plateaus. Further evidence for this is the small retaining wall between the upper and lower plateaus and deeper made ground in WS5. This is further evidenced by similar cohesive deposits found on both plateaus and the level of presumed rockhead found at approximately the same level. A generalised schematic cross section is presented as Figure 5 Appendix A further illustrating the geology underlying the site.

4.2 STRATIGRAPHY

Detailed descriptions of the ground conditions encountered can be found on the exploratory hole log sheets in Appendix B. Below is a table summarising the prevailing stratigraphy of the ground below the site and the depths at which differing strata were encountered .

Table 4.2a Summary of Stratigraphy of Upper Plateau (WS1 – 5)

Strata	**Depths to start of strata (mbgl)**	**Depths to base of strata (mbgl)**	**Thickness (m)**	
			Maximum	**Mean**
Made Ground	0	0.8 – 2.1	2.1	1.16
Natural Cohesive Deposits*	0.8 – 2.1	6 – 6.3	5.4	4.9
Presumed Weathered Bedrock	6 – 6.3	N/E	N/A	N/A

*The base of these deposits has been inferred from dynamic probe results.
N/E – not encountered N/A- not applicable

Table 4.2b Summary of Stratigraphy of Lower Plateau (WS6 – 9 & HP 1 – 4)

Strata	**Depths to start of strata (mbgl)**	**Depths to base of strata (mbgl)**	**Thickness (m)**	
			Maximum	**Mean**
Made Ground	0	0.2 – 0.6	0.6	0.38
Natural Granular Deposits	0.2 – 0.6	0.8 – 1.6	1	0.8
Natural Cohesive Deposits	0.8 – 1.6	2.8 – 3.9	2	1.7
Presumed Weathered Bedrock	2.8 – 3.9	N/E	N/A	N/A

N/E – not encountered N/A- not applicable

4.3 MADE GROUND

Underlying the surface material of either tarmac or concrete, made ground is encountered to a relatively shallow depth with the exception of WS 5. The made ground is predominantly granular and can generally be described as slightly clayey sand and gravel with medium to high cobble content. The gravel and cobbles comprise various lithologies, notably brick, hardcore, concrete, tarmac and occasional clinker. Underlying the granular made ground in WS5 the made ground is described firm light brown sandy slightly gravelly clay becoming soft dark brown very sandy slightly gravelly clay with ash and clinker present.

4.4 NATURAL GRANULAR DEPOSITS (LOWER PLATEAU ONLY)

The natural granular deposits were encountered directly underlying the made ground on the lower plateau of the site only. These deposits can be generally described as loose slightly clayey to clayey slightly gravelly SAND.

4.5 NATURAL COHESIVE DEPOSITS

Natural cohesive deposits were encountered in all of the mini-percussive boreholes directly underlying the made ground on the upper plateau and the natural granular deposits on the lower plateau. These deposits are described as Firm sandy slightly gravelly CLAY on the upper plateau and soft to firm on the lower plateau. Gravel comprises subangular sandstone. The reduced strength/cohesion on the lower plateau could be attributable a higher moisture content and/or disturbance from activities such as trenches for utilities to the previous pub as well as the original construction of the pub.

4.6 WEATHERED BEDROCK

Very dense gravelly SAND and sandy GRAVEL were encountered at the base of WS6, 7 & 9 on the lower plateau underlying the natural CLAYs yielding very high 'N' values and refusal. This layer has been inferred to represent the weathered rockhead although no rotary coring has been carried out to positively identify these deposits as the bedrock. Others holes were continued by dynamic probe which indicate refusals (possible rockhead) at around 6mbgl corresponding to the same horizon on the upper plateau.

4.7 GROUNDWATER

All exploratory holes were reported dry to base during the intrusive investigation with the exception of WS1 at 0.5m where perched water trapped within the made ground was noted trickling into the inspection pit. During the post siteworks monitoring visit small quantities of groundwater were recorded. This is considered to be perched water contained within the made ground and pockets of granular material and not in hydraulic connectivity with the deeper bedrock aquifer given the thickness of cohesive deposits underlying the site.

5 TESTING

5.1 INSITU TESTING

Standard Penetration Tests in the mini-percussive boreholes were undertaken to give an approximate indication of the strength/cohesion of the cohesive soil deposits and the relative density of granular deposits. In addition to this, the results from the Dynamic Probes were converted to give equivalent N values. The SPT 'N' values are shown alongside the relevant depth on the borehole log sheets presented in Appendix B. The results have also been plotted on a SPT 'N' value vs Depth (m) graph which is presented as Figure 4 in Appendix A. The graph shows the SPT 'N' values generally increase with depth prior to refusal at c.3.0m on the lower plateau and c.6.0m on the upper plateau which highlights top of the presumed weathered bedrock.

5.2 LABORATORY TESTING

5.2.1 GENERAL

Representative samples were selected and scheduled for laboratory testing based on recommendations of the Phase I Desk Study Report (March, 2012) and field observations. All testing was carried out in accordance with current British Standards at suitably accredited laboratories.

5.2.2 GEOENVIRONMENTAL TESTING

The chemical analysis of the selected samples was carried out by Chemtech Environmental Ltd and comprised of the following suite of analysis on soils:

- Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Zinc, water soluble boron, total cyanide, free cyanide, free sulphur, sulphide, sulphate aqueous extract as SO4, pH, phenol (total), Extractable Petrol Hydrocarbons (EPH), Speciated PAH.

Following initial review of the results of the above testing, three samples exhibited raised concentrations of some potential contaminants. Further leachate testing was therefore carried out on these samples comprising the following:

- Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Zinc and Speciated PAH.

5.2.3 GEOTECHNICAL TESTING

Geotechnical testing was carried out by Professional Soils Laboratory and comprised the following:

- Moisture Content (MC).
- Atterberg Limits (Liquid and Plastic Limits, LL & PL, and Plasticity Index, PI).
- pH.
- Water Soluble Sulphate.
- California Bearing Ration Test (CBR).

The results of the Geotechnical testing are presented in Appendix C.

A total of six moisture content and Atterberg Limit tests were carried out, five within the natural cohesive soils and one in the cohesive made ground (WS5). With the exception of WS4 at 1.2m which indicates clay of intermediate plasticity, all the samples tested are clay of low plasticity. The moisture contents of these samples are all slightly wet of their respective plastic limit which confirms the visual description of firm. The exception to this is the made ground samples from WS5 at 1.5m which is closer to its liquid limit than plastic limit which confirms the visual description of soft.

CBR tests were carried out on samples from shallow depths in the area of the proposed car park, two from the made ground and one from the natural granular strata. The results are variable ranging from 2.9% in the natural granular deposits to 44.5% in the made ground.

The pH and water soluble sulphate results show the pH to be in the range of 7.4 to 10.1 with a mean of 8.3 and the water soluble sulphate to be in the range of 10 to 184 mg/l with a mean of 46 mg/l.

6 CONTAMINATION

6.1 GENERAL

6.1.1 BACKGROUND ON GUIDANCE

The current UK framework (Contaminated Land Exposure Assessment (CLEA)) for the assessment of potentially contaminated land as set out by the Department of the Environment, Farming and Rural Affairs (DEFRA) is based on the pollutant linkage or Source-Pathways-Receptor scenario.

In order for land to be legally classified as contaminated under Part IIa of the Environmental Protection Act (EPA) 1990 all three of the elements pollutant linkage must be present.

Generic land uses have been published under the CLEA guidance and are divided into the following categories.

- Residential
- Allotments
- Commercial / Industrial

Each of these generic land uses has a prescribed set of pathways and assumptions associated with them which effectively characterise the land in terms of the way it is used. Further to this a set of Soil Guideline Values (SGV's) for a limited number of contaminants have been developed and published by DEFRA. It should be noted that CLEA is concerned with *human health only.*

A preliminary qualitative risk assessment including preliminary conceptual ground model in the Desk Study Report (GRS 05/03/12) classed the proposed development to fall under the generic land use of **Residential without Plant Uptake** in the absence of generic land use criteria specific to the proposed development of a specialist care unit.

6.1.2 ASSESSMENT CRITERIA AND SOIL GUIDANCE VALUES

Initial screening of the results was undertaken by comparison with the assessment criteria. For the purpose of this report, the assessment criteria pertaining to the land use of **Residential without Plant Uptake** (Atkins AtRisk derived SSV).

The CLEA model has been used by DEFRA and the Environment Agency (EA) to derive SGV's for the land use varieties detailed in section 6.1.1. The SGV's are indicators to an assessor that soil contamination above this level may represent an unacceptable risk to the health of site users and that further investigation/remediation may be required. To date, SGV's have only been issued for a limited range of contaminants. In the absence of a DEFRA/EA published SGV, the Atkins AtRisk Soil guidance values (SSV) have been used.

6.1.3 ANALYSIS OF CONTAMINATION DATA

A two tier semi-quantitative risk assessment of the contaminants posing a risk to human health is generally carried out. The first tier involves the screening of contaminants that exhibit concentrations above the SGV's. If concentrations exceeding the SGV's are encountered then the second more detailed tier is carried out using the following statistical analyses:

- **Mean Value Test:** a sample mean for a small number of samples may be significantly less than the true (population) mean. Therefore a no remedial action decision based on a small number of samples may not be sufficiently health protective. The approach used is to identify the 95% confidence limits of the measure mean and to compare the upper 95th percentile with the SGV's. Where non-detects i.e. the laboratory results is less than the detectable limit the conservative figure of the laboratory detection limit will be used.
- **Maximum Value Test:** is used to determine whether the maximum value for a set of results is considered to be an 'outlier' or part of the anticipated range for the site as a whole.

6.2 COMPARISON WITH GUIDANCE LEVELS

6.2.1 SOILS

The initial screening of the results shows that the guidance limits have been exceeded for the two heavy metals and several PAH compounds. The following table shows the contaminant, guidance limit, no of samples exceeding guidance limit, maximum concentration and location.

Table 6.2.1 – Summary of contaminants exceeding guidance limits

Contaminant	SSV (mg/kg)	No. Samples exceeding SSV/No. Samples tested	Maximum Concentration(mg/kg)	Location of Sample
Arsenic	35	1/10	37	WS5 1.3m
Lead	383	2/10	3307	HP2 0.2m WS5 1.3m
Fluorene	3.8	2/10	9.2	WS5 1.3m WS9 0.3m
Benzo(a)anthracene	5.42	3/10	30.4	WS5 1.3m WS9 0.3m HP2 0.2m
Benzo(b)fluoranthene	9.68	3/10	32.3	WS5 1.3m WS9 0.3m HP2 0.2m
Benzo(a)pyrene	0.989	5/10	32.3	WS5 1.3m WS9 0.3m HP2 0.2m HP1 0.3m WS1 0.2m
Indeno(123cd)pyrene	9.53	3/10	16.7	WS5 1.3m WS9 0.3m HP2 0.2m
Dibenzo(ah)anthracene	0.949	3/10	3.7	WS5 1.3m WS9 0.3m HP2 0.2m

The samples impacted by raised PAHs which also exhibited slightly raised total EPH. However no visual or olfactory evidence of hydrocarbon free product was encountered during the intrusive investigation. The gravel in these samples included tarmac, clinker and ash, all of which can be attributable to PAH compounds and hydrocarbons being present in the soil.

6.2.2 GROUNDWATER

No ground water strikes were encountered during the intrusive investigation and subsequent monitoring visits showed only a limited amount of water in the monitoring wells inferred to be perched water percolating through the made ground. However given that the bedrock below the site is designated as a major aquifer, leachate testing was carried out on those samples showing elevated concentrations of contaminants. In the absence of specific leachate generic screening criteria, UK Drinking Water Standards have been used as Tier 1 Screening criteria. It should be noted that these are considered to be overly conservative.

The results show that there are leachable concentrations of arsenic and lead in samples from WS5 at 1.30m and HP2 at 0.2m exceeding the initial screening criteria.

6.3 GROUND GAS

6.3.1 GENERAL

A total of three ground gas monitoring visits have been carried out to date with a further three visits remaining. The results obtained so far are summarised in the table below and an initial assessment of the ground gas risk will be made using this data. A supplementary letter report will be submitted once all the ground gas monitoring is complete with a final ground gas risk assessment.

6.3.2 GROUND GAS MONITORING RESULTS

Table 6.3.2 – Summary of Ground Gas Monitoring Data

Exploratory Hole No.	No. of Monitoring Visits	Range of Peak Methane (%)	Range of Peak Carbon Dioxide (%)	Range of Min. Oxygen (%)	Range of Peak Flow (l/hr)	Range of Carbon Monoxide (ppm)	Range of Atmospheric Pressure (mb)
WS3	5	0-0.1	0 – 1.4	13.8 – 20.9	0.1	0	987 - 1009
WS1	5	0	0 – 2.5	16.5 – 21.5	0 – 5.6	0	987 – 1009
WS7	5	0	0.6 -0.8	18.7 – 21.1	0 – 0.1	0	987-1009

7 RISK ASSESSMENT

7.1 GENERAL

As discussed in section 6 of this report the soils underlying the site are impacted by several potential contaminants that are above the threshold levels for the nearest generic land use (residential without plant uptake) for the proposed development of a specialist care unit.

7.2 SOILS

7.2.1 END USERS AS A TARGET

The encountered potential contaminants present a risk to end users of the site only through direct exposure pathways i.e. ingestion or dermal contact. The proposed development will comprise of a main building, hardstanding for car parking and access and managed landscaped areas, the soils underlying the site will be effectively covered thus removing any direct contact pathways. The source-pathway-receptor pollutant linkage is therefore broken and the risk to end users is removed.

7.2.2 GROUNDWATER AS A TARGET

The results from the leachate tests show that there are leachable concentrations of both arsenic and lead in HP2 at 0.2m and WS5 at 1.3m. The concentration of arsenic has been recorded as 16µg in both samples compared with a guidance limit of 10µg. As the concentrations of arsenic are only slightly raised and the guidance standards used are drinking water standards which are conservative, the risk to groundwater from arsenic is considered to be low.

The leachate results from lead are 358µg in HP2 at 0.3m and 55µg in WS5 at 1.30m which have been compared in an initial screen against the guidance limit of 25µg. Again the screening criteria used are UK drinking water standards and as such are conservative.

The presence of leachable contaminants does not preclude a risk to groundwater and other factors have to be taken into account such as the infiltration rate of water and underlying geology. It is anticipated that the two areas of concern will be covered by the proposed building and car park. This will greatly inhibit infiltration rates and hence leachability of the soil. Further to this low permeability cohesive deposits have been encountered across the site which will attenuate the downward migration of contaminants.

Information from the post siteworks monitoring visits show that whilst there is a small quantity of water contained within the wells, this appears not to be in hydraulic conductivity with the bedrock aquifer and is likely to be attributable to recent periods of heavy rainfall.

It is therefore reasonable to assume that given the above discussion that the risk to groundwater is considered to be low and in turn the risk to the underlying bedrock aquifer to be negligible.

7.2.3 CONSTRUCTION AND WORKERS AS A TARGET

There is the potential that during construction, site personnel and maintenance staff may be exposed to potential contaminants. It is advised that appropriate precautions are taken to reduce the risk through good working practices on site i.e. the appropriate PPE is worn at all times and adherence to a good, common sense hygiene practices (no smoking, eating , drinking etc.).

7.2.4 FUTURE MAINTENANCE WORKERS AS A TARGET

It is likely that the proposed development will require future maintenance of both the building and landscaped areas. The risk to these future maintenance workers is considered to be low as the soils underlying the site will have been covered by buildings, hardstanding and managed landscaping thus removing the direct pathways from identified contaminants.

7.3 GROUND GAS

Guidance from CIRIA Report C665 'Assessing Risks Posed by Hazardous Ground Gases to Buildings' uses gas concentration and flow rates to calculate the Gas Screening Value (GSV). The GSV for the worst case scenario is then used to categorise the site as defined in CIRIA Report C665. For the land use of commercial/industrial which most closely fits the proposed end use for ground gas risk, the Wilson and Card (1999) methodology is used to class the site as a 'Characteristic Situation'.

At the time of writing of this report only three of the scheduled six ground gas monitoring visits had been completed and this therefore forms a preliminary assessment. Once the ground gas monitoring has been fully completed then an addendum report will be issued with a final ground gas assessment.

The gas monitoring results so far show that only a trace of methane gas has been detected in WS3 only. Concentrations of oxygen were shown to be generally in the range of normal with the exception of WS3 during the third visit where depleted oxygen levels were recorded. Slightly raised levels of carbon dioxide also detected throughout the monitoring completed so far. No hydrogen sulphate or carbon monoxide was detected in any of the installations. The maximum flow rate recorded was 5.6 l/h.

The GSV has been calculated using the highest value recorded for carbon dioxide and methane and the highest flow reading which gives a figure of 0.14l/h for carbon dioxide and 0.0056l/h for methane. The site therefore just falls into the category of Characteristic Situation 2 (Low Risk) for which special ground gas protection measures are required.

8 PROPOSED DEVELOPMENT

8.1 INTRODUCTION

It is proposed to build a specialist care unit with associated access roads and car parking. A preliminary architects drawing provided by BKP shows that the building will be predominantly situated to the north (upper plateau) of the site comprising one storey. The very southern part of the building will comprise two storeys as it will bridge across the lower plateau. The proposed car park will be located at the south of the site where presently the existing pub stands. A private secure garden will be located to the northeast of the site with small areas of landscaping throughout. The preliminary architects' drawing is presented as Figure 3 in Appendix A.

8.2 CONSTRAINTS

8.2.1 BURIED OBSTRUCTIONS

No buried obstructions were encountered during the intrusive investigation. It is not anticipated that any buried obstructions will be present underlying the proposed building over the upper site. However, if any obstructions are encountered during the earthworks phase of the development then further advice should be sought.

8.2.2 CONTAMINATION

As discussed in sections 6 and 7 of this report the risk of contamination at this site is considered to be low and does not pose a constraint to the proposed development.

8.2.3 GROUND GAS

Ground gas is considered to be a low risk to the end users of the site. As discussed in section 7.3 the site has been preliminarily classified as 'Characteristic Situation 2'. Once the ground gas monitoring period has been fully completed, an addendum letter report will be issued with the final ground gas assessment and recommendations.

8.2.4 EXISTING SERVICES

A full survey of existing services has not been within the scope of this investigation. Services that are known to exist on this site may require removal or redirection prior to development commencing. These services should be traced by a suitably qualified contractor and advice sought from the persons responsible for these services.

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9 DISCUSSION AND RECOMMENDATIONS

9.1 GENERAL

The general geology underlying the site is best described by discussing the upper and lower plateaus of the site independently.

The geology of the upper plateau is characterised by the presence of tarmac over subgrade at the surface which is in turn underlain by granular made ground. The made ground extends the deepest in WS5 (2.1m) where cohesive made ground was encountered. Directly underlying the made ground are natural cohesive deposits interspersed with small bands of granular material and pockets of sand. Weathered bedrock is inferred to underlie the natural cohesive deposits.

The geology of the lower plateau (approximately 2.5m below upper plateau) is similar to that of the upper plateau with the exception of natural granular deposits directly underlying the made ground which are in turn underlain by natural cohesive deposits followed by bedrock.

9.2 FOUNDATIONS

The proposed new building will be constructed mainly over the upper plateau. This area is covered by around 1.0m thickness of made ground which is underlain by firm natural cohesive deposits. These firm natural clays can offer a safe bearing capacity of around 90KPa which is adequate for supporting the proposed one storey buildings over traditional spread footings.

However, nearer to the lower plateau (as seen in WS5) the made ground attains a thickness of around 2.1m with the top of more competent firm natural clays laying at depth of around 2.4m below existing ground level. It is understood that the building spans into the lower plateau where it is proposed to comprise two storey building. Combination of poorer ground and expected higher loading requirements means that the use of traditional shallow spread foundations for the southern end of the building is not practical. Besides, due to lack of access the present investigation could not provide any information on the soil quality at the northern part of the lower plateau. At this stage it appears that the southern section of the proposed building may require deep trench filling or the use of stone columns to support the two storey building. It is recommended to commission a supplementary investigation once the pub is demolished, comprising three to four shallow mini-percussive holes to further investigate the quality of near surface soils and depth to the firm natural clays within the northern part of the lower plateau. Although the primary purpose of the supplementary investigation will be to explore and confirm the geology underlying the pub and close to the base of the slope, some chemical samples could be taken during the investigation to confirm the findings of this report.

9.3 FLOOR SLABS

Ground bearing slabs at this site should be constructed over a minimum of 300mm of well compacted granular engineering fill. Recommendations given in Section 9.9 should also be considered for the design of the floor slabs.

9.4 BURIED CONCRETE

The site has been given a Design Sulphate Classification of DS-1 and an Aggressive Chemical Environment for Concrete (ACEC) of AC-1 in accordance with BRE Special Digest 1:2005 Concrete in Aggressive Ground.

9.5 PAVEMENT DESIGN

The near surface soils mainly comprise granular made ground. From the site observations and laboratory derived CBR values the near surface materials vary significantly in terms of their CBR values which can range between 3 and 50%. Therefore a conservative design CBR value of around 5% must be considered for the design of paved areas with the proviso that any localised wet/soft pockets must be removed and replaced by adequately compacted granular engineering fill.

9.6 EXCAVATION AND EARTHWORKS

Based on the observations made during the intrusive investigation and the general assessment of the near surface soil profile it is considered that shallow temporary excavations for foundations and services not requiring man entry will stand vertical for the short term stability. Localised shallow perched water entries may be encountered which may require appropriate water exclusion measures.

Any surplus excavated material destined for offsite disposal will require Waste Acceptance Criteria (WAC) testing in order to categorise the waste for disposal. It should be noted that WAC testing can take up to ten days to complete.

9.7 CONTAMINATION

As discussed in sections 6 and 7 of this report, the risk to site in terms of contaminated soils is low for which no remedial measures are required. However, it should be noted that at the time of the intrusive investigation the Red Lion building remained onsite. If during the demolition/construction phase of the development any signs of contamination are encountered below the footprint of the Red Lion building then further advice should be sought.

9.8 GROUND GAS PROTECTION

As discussed in the previous ground gas sections of this report (section 7.3 & 8.2.3) the full ground gas monitoring period is yet to be completed at the time of writing of this report. However as a preliminary assessment the site has been classified as 'Characteristic Situation 2' (Low Risk) for which ground gas protection measures are required. The typical scope of protective measures relating to 'Characteristic Situation 2' is as follows (as recommended in CIRIA C665):

a) Reinforced concrete in situ floor slab (suspended, non-suspended or raft) with at least 1200gDPM$_2$.
b) Beam and block or pre cast concrete slab minimum 2000gDPM/reinforced gas membrane.
c) All joints and penetrations sealed.
d) Possibly underfloor venting or pressurisation in combination with a) or b) depending on use.

It should be noted that these protective measures relate to generic commercial buildings. Therefore as the proposed development is a specialist care unit it may be more appropriate to use the points system given in BS8485:2007 'Code of Practice for characterisation and remediation from ground gas in affected developments' as it defines public buildings (eg. Managed apartments, schools, hospitals) as a separate category. Although this development may not be considered a public building the end use of the site could be considered similar in use to a public building. This system still uses the Characteristic Situation scenario but for required protection measures a certain number of points have to be achieved through the construction method. Therefore for 'Characteristic Situation 2' a total of 3 points have to be scored. However the recorded concentrations of carbon dioxide and methane are only slightly raised and the Gas Screening Value is only slightly above the boundary between 'Characteristic Situation 2' and 'Characteristic Situation 1'. It may therefore be more appropriate to relax the number of points required to that of a commercial building for which 2 points are required.

As the exact design structure is not available at the time of writing of this report GRS cannot score the ground gas protection measures. Reference should therefore be made to the below table 3 extract from BS8485 during the construction design phase.

Table 3 Solutions scores

PROTECTION ELEMENT/SYSTEM		SCORE	COMMENTS
a) Venting/dilution (see Annex A)			
Passive sub floor ventilation (venting layer can be a clear void or formed using gravel, geocomposites, polystyrene void formers, etc.) [A]	Very good performance	2.5	*Ventilation performance in accordance with Annex A.*
	Good performance	1	*If passive ventilation is poor this is generally unacceptable and some form of active system will be required.*
Subfloor ventilation with active abstraction/pressurization (venting layer can be a clear void or formed using gravel, geocomposites, polystyrene void formers, etc.) [A]		2.5	*There have to be robust management systems in place to ensure the continued maintenance of any ventilation system. Active ventilation can always be designed to meet good performance. Mechanically assisted systems come in two main forms: extraction and positive pressurization.*
Ventilated car park (basement or undercroft)		4	*Assumes car park is vented to deal with car exhaust fumes, designed to Building Regulations Document F [5] and IStructE guidance [6].*
b) Barriers			
Floor slabs			
Block and beam floor slab		0	*It is good practice to install ventilation in all foundation systems to effect pressure relief as a minimum. Breaches in floor slabs such as joints have to be effectively sealed against gas ingress in order to maintain these performances.*
Reinforced concrete ground bearing floor slab		0.5	
Reinforced concrete ground bearing foundation raft with limited service penetrations that are cast into slab		1.5	
Reinforced concrete cast in situ suspended slab with minimal service penetrations and water bars around all slab penetrations and at joints		1.5	
Fully tanked basement		2	
c) Membranes			
Taped and sealed membrane to reasonable levels of workmanship/in line with current good practice with validation [B], [C]		0.5	*The performance of membranes is heavily dependent on the quality and design of the installation, resistance to damage after installation, and the integrity of joints.*
Proprietary gas resistant membrane to reasonable levels of workmanship/in line with current good practice under independent inspection (CQA) [B], [C]		1	
Proprietary gas resistant membrane installed to reasonable levels of workmanship/in line with current good practice under CQA with integrity testing and independent validation		2	
d) Monitoring and detection (not applicable to non-managed property, or in isolation)			
Intermittent monitoring using hand held equipment		0.5	
Permanent monitoring and alarm system [A]	Installed in the underfloor venting/ dilution system	2	*Where fitted, permanent monitoring systems ought to be installed in the underfloor venting/dilution system in the first instance but can also be provided within the occupied space as a fail safe.*
	Installed in the building	1	
e) Pathway intervention			
Pathway intervention		—	*This can consist of site protection measures for off-site or on-site sources (see Annex A).*

NOTE In practice the choice of materials might well rely on factors such as construction method and the risk of damage after installation. It is important to ensure that the chosen combination gives an appropriate level of protection

[A] It is possible to test ventilation systems by installing monitoring probes for post installation validation.

[B] If a 1 200 g DPM material is to function as a gas barrier it should be installed according to BRE 212 [8]/BRE 414 [9], being taped and sealed to all penetrations.

[C] Polymeric Materials >1 200 g can be used to improve confidence in the barrier. Remember that their gas resistance is little more than the standard 1 200 g (proportional to thickness) but their physical properties mean that they are more robust and resistant to site damage.

Source: Table 3 BS8485:2007 'Code of Practice for characterisation and remediation from ground gas in affected developments'

10 DESIGN ASSUMPTIONS - RISK MATRIX

	Information From Desk Study			Information From Intrusive Investigation		
Item Description	**Comments**	**Risk**	**Recommendations**	**Comments**	**Risk**	**Recommendations**
Foundations	Ground conditions are expected to comprise made ground over bedrock.	4	**An investigation specific to the development is required.**	The subsurface ground conditions comprise made ground over mainly firm natural clay deposits at depth of around 1.0mbgl.	2 (4)	The majority of the proposed one storey building can be supported on traditional spread footings formed over natural firm clays. However, the southern two storey section spans over deeper incompetent ground. Alternative foundation solutions and further supplementary investigation has been recommended.
Ground Slab Build Up	Ground bearing slabs may be feasible on this site.	4	**Investigation to assess near surface soil properties is required.**	The near surface material comprises predominantly granular made ground.	2 (4)	Ground bearing slab is feasible at this site constructed over 300mm of well compacted granular engineering fill. The design of the floor slab should also consider ground gas protection recommendations given in section 9.9.
Mining	The site is not within an area affected by coal mining.	1	None.			
Contamination	There is the potential albeit low that contamination from historical uses is present on site.	3	**Further investigation required.**	The site is considered to be at low risk for which no remedial measures are required.	1	None.
Ground Gas	Ground gas risk is considered to be low given infilled ground on and surrounding the site.	3	**Further investigation/monitoring required.**	The ground gas monitoring results so far show the site to fall into 'Characteristic Situation 2' for which ground gas protection measures will be required.	4	Although the ground gas monitoring period has yet to be completed this preliminary assessment suggest that ground gas protection measures are required and appropriate recommendations have been given in section 9. 9 of this report. An addendum report will be submitted once all monitoring is complete with the final ground gas assessment and recommendations.
Pavement Build Up	Paved areas will be required for access routes and car parking.	3	**Investigation required to determine pavement design parameters.**	The near surface granular made ground exhibits variable CBR values.	2	A conservative CBR design value of 5% must be considered with the proviso that any localised soft/wet pockets must be replaced with suitably compacted granular engineering fill. .
Slopes	There is potential for slopes to be present on site. However exact details are not known.	2	Further advice should be sought if slopes are to feature in the development.			
Cut and Fill	There are no details of any cut and fill requirements at this stage. However initial architect's drawings show the proposed building over a split level.	2	If cut and fill is required then further advice should be sought.			
Retaining Walls	Retaining structures already exist on site between the upper and lower plateaus. The fate of these is at present unknown. Details of any retaining walls required to accommodate the proposed development are currently unavailable.	2	Further advice should be sought if retaining walls are required as part of this development.			
Flooding	There is less than 0.1% chance of flooding from rivers or seas.	1	None.			
Drainage	Provision of SUDS may be feasible	3	**Further investigation of feasibility required.**	Although shallow granular deposits are present across parts of the site, these are directly underlain by cohesive soils.	2	It is not likely that SUDS such as soakaways are feasible on this site. If required further insitu testing can be carried out to further assess the potential for SUDS.
Radon	Less than 1 % of homes are below the action level.	1	None.			

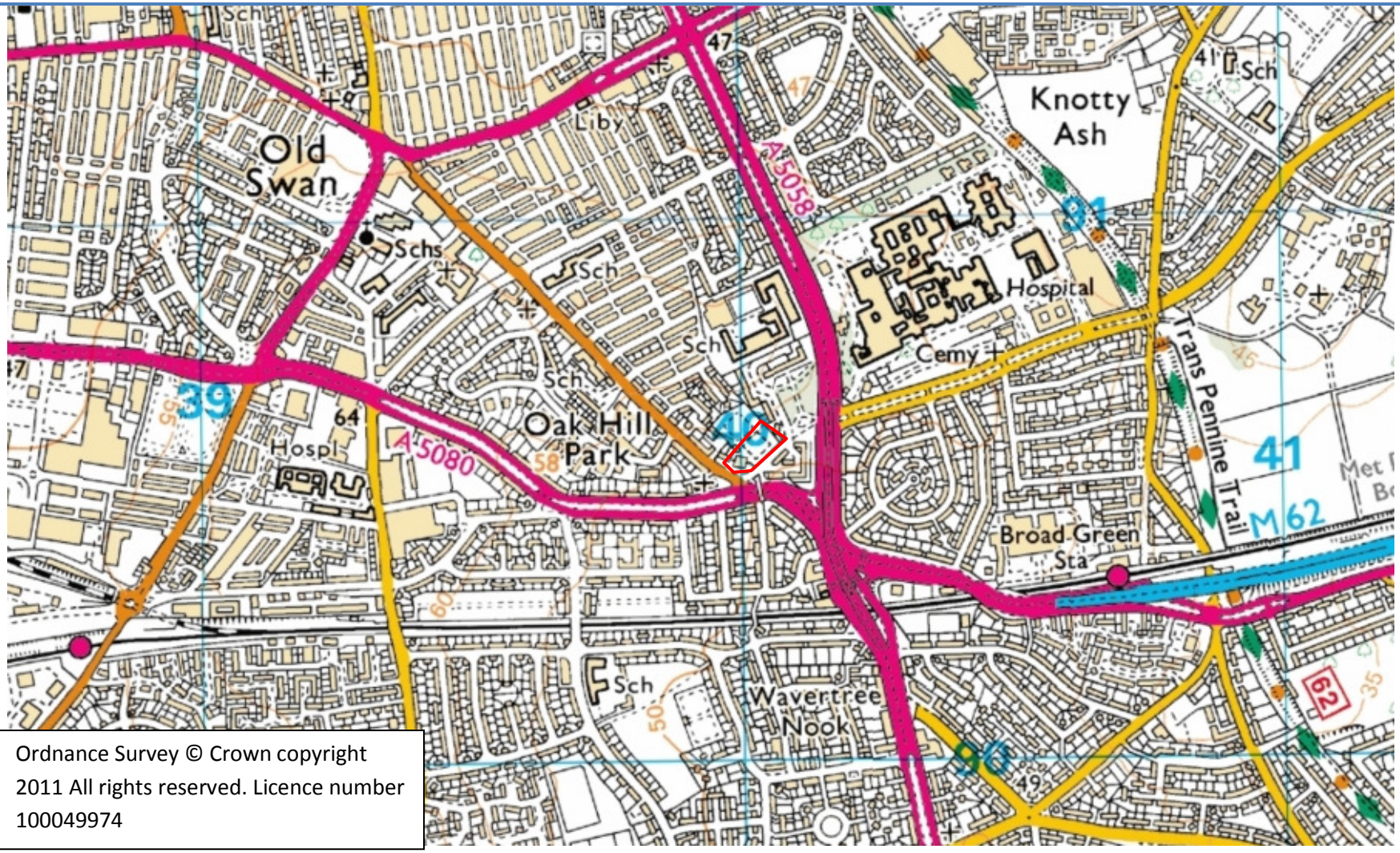
1. The recommendations are based on available information on 11/05/12.
2. A full site investigation has to be carried out before design scheme.
3. The risks are on a scale of 1 to 5.
4. Risks rated 1 & 2 no action. Risks rated 3 & 4 can be downgraded with further information which is due to become available. Those rated 5 need costs allocating.

REFERENCES

The following is a list of the relevant current British and European Standards that have been used in compiling this report. Where ambiguity between different documents exists, the relevant European Standard will take precedence.

- BS EN 1997-2:2007 Geotechnical Design. Ground Investigation and Testing.
- BS EN ISO 14688-1:2002 Geotechnical Investigation and Testing – Identification and Classification of Soil – Part 1: Identification and description.
- BS EN ISO 14688-2:2004 Geotechnical Investigation and Testing – Identification and Classification of Soil – Part 2: Principals for a classification.
- BS EN ISO 14689-1:2003 Geotechnical Investigation and Testing – Identification and Classification of Rock- Identification and description.
- BS EN ISO 22476-3:2005 Geotechnical Investigation and Testing – Field Testing. Standard penetration test.
- BS EN ISO 22476-2:2005 Geotechnical Investigation and Testing – Field Testing. Dynamic probing.
- BS EN ISO 22475-1:2006 Geotechnical Investigation and Testing – Sampling Methods and Groundwater Measurements. Technical principals for execution.
- BS 10175:2011 Investigation of Potentially Contaminated Sites – Code of Practice.
- BS 5930:1999 Code of Practice for Site Investigations.
- BS 1377:1990 Methods of Test for Soils for Civil Engineering Purposes.
- BRE Special Digest 1:2005 Concrete in Aggressive Ground.
- CIRIA Report C665 'Assessing Risks Posed by Hazardous Ground Gases to Buildings'
- BS8485:2007 'Code of Practice for characterisation and remediation from ground gas in affected developments'

APPENDIX A - FIGURES



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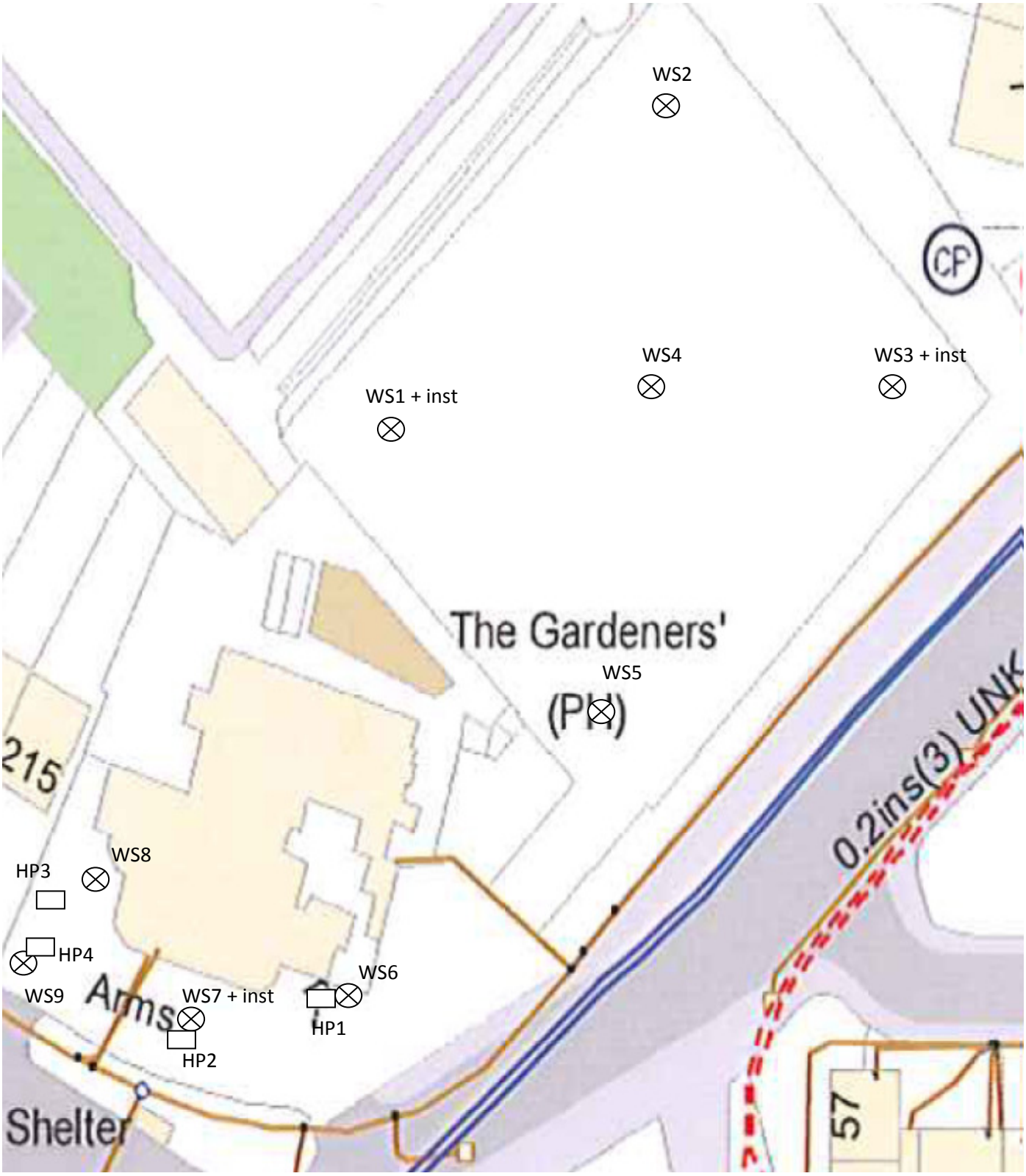
Title	Figure 1 Appendix A – Site Location Plan
Client	Seddons represented by Booth King Partnership Ltd
Site	Proposed Specialist Care Unit, Broad Green Road, Liverpool
Job Number	GRS0112-1458

Geoenvironmental Risk Solutions



Title	Figure 2 Appendix A – Approximate Exploratory Hole Location Plan	GEOENVIRONMENTAL RISK SOLUTIONS
Client	Seddons represented by BKP	
Site	Proposed Specialist Care Unit	
Job Number	GRS0112-1458	

NOTE:
SUBJECT TO STATUTORY APPROVALS

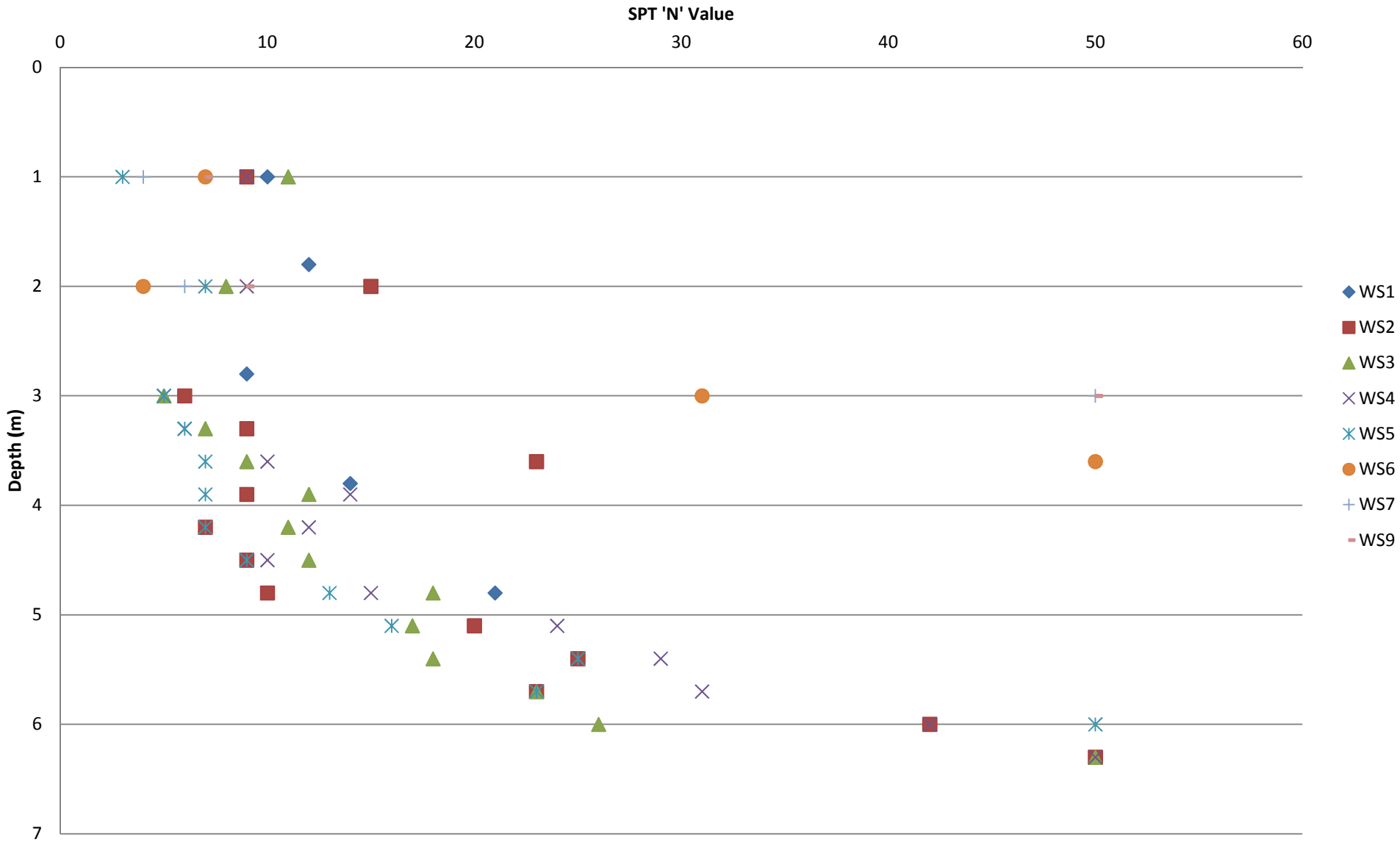
SCALE 1:500@A3

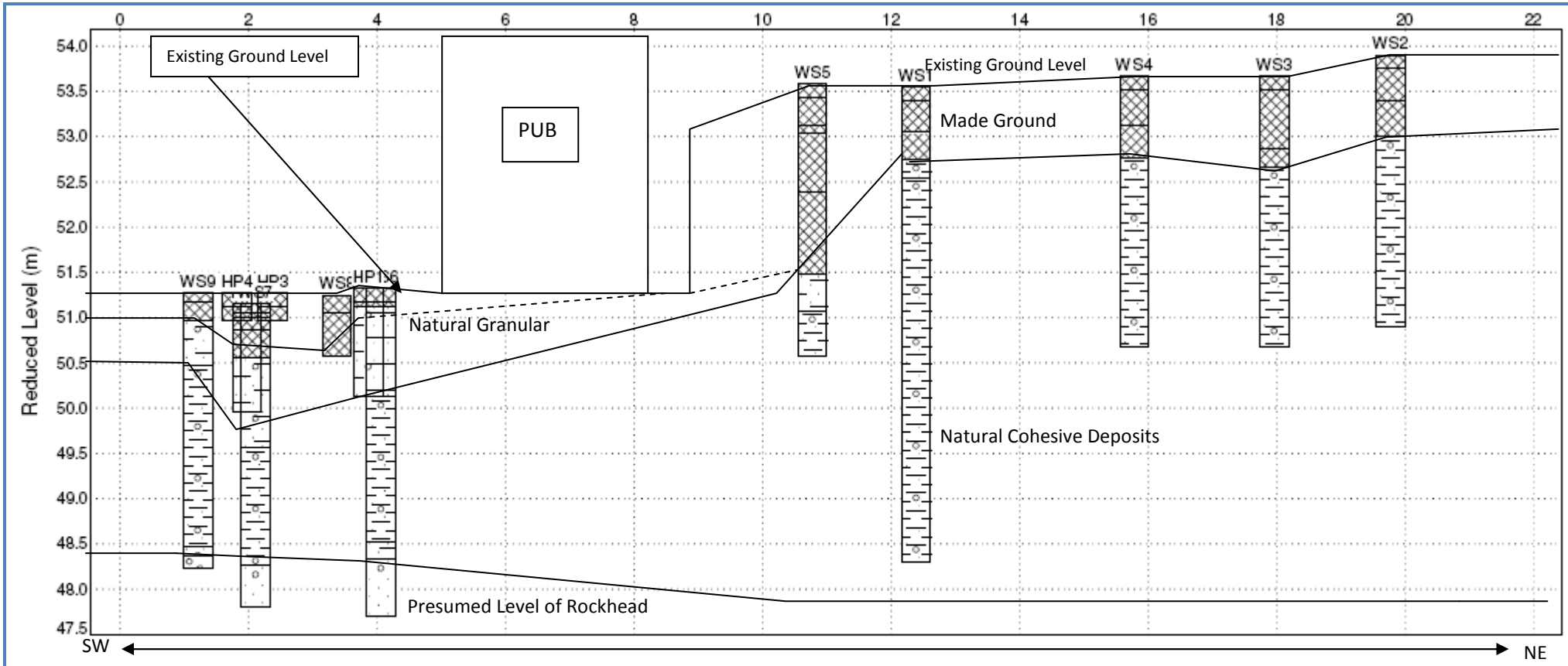
0 10 20 30 40 50

PRELIMINARY
PROPOSED SPECIALIST BRAIN INJURY CARE UNIT
THE GARDENER'S ARMS PUBLIC HOUSE
BROAD GREEN RD. LIVERPOOL
KOH 24.02.2012
12.001-SK 07

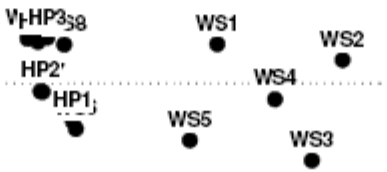
CLA
Condy Lofthouse Architects
T: 0151 207 4371 • F: 0151 207 7087

Figure 4 Appendix A - SPT 'N' Value vs Depth





Reduced Level figures are approximated from spot heights shown on Utility Survey and are for illustrative purposes only.



Title	Figure 5 Appendix A - Schematic Generalised Cross-Section	Geoenvironmental Risk Solutions
Client	Seddons represented by BKP	
Site	Specialist Care Unit, Former Gardeners Arms, Liverpool	
Job Number	GRS0112-1458	

APPENDIX B - EXPLORATORY HOLE LOG SHEETS

Key To Exploratory Hole Logs

GEOENVIRONMENTAL RISK SOLUTIONS

Soils

- Made ground
- Boulders and cobbles
- Gravel
- Sand
- Silt
- Clay
- Peat (Organic)

NOTE: Composite soil types will be signified by combined symbols, e.g.,

- Silty sand

Rocks

Sedimentary

Rudaceous

- Chalk
- Limestone
- Conglomerate
- Breccia

Arenaceous

- Sandstone
- Siltstone

Argillaceous

- Mudstone
- Shale
- Coal
- Pyroclastic (volcanic ash)
- Gypsum, Rocksalt etc.

Well Details

- Slotted Pipe with Gravel Filter
- Solid Pipe with Bentonite Seal
- Bentonite
- Cement/Bentonite Grout
- Arisings

Water Column Details

- Water Strike
- Standing Water Level following water strike

Sampling

B	Bulk sample
D	Small disturbed sample
CH	Chemical sample
CBR	CBR Mould sample
C	Core sample
J	Jar sample
U	Undisturbed sample
W	Water sample
WAC	Waste Acceptance Criteria sample
V	Vial sample

In-situ Testing

SPT	Standard Penetration Test
HSV	Hand Shear Vane
PID	Photo Ionisation Detector
U100	Undisturbed sample run
CPT	Cone Penetration Test

GEOENVIRONMENTAL RISK SOLUTIONS

Geoenvironmental Risk Solutions Ltd
Evans Business Centre, Durham Way South
Newton Aycliffe, County Durham
Telephone: 08702240643

BOREHOLE LOG

Project				BOREHOLE No
Gardeners Arms, Broad Green Road, Liverpool				**WS1**
Job No: GRS0112-1458	Date: 26-03-12 / 26-03-12	Ground Level (m)	Co-Ordinates ()	
Contractor				Sheet: 1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
						0.15	MADE GROUND: Tarmac over subgrade.		
0.20	CH1					0.50	MADE GROUND: Light brown slightly clayey sand and gravel with high cobble content. Gravel and cobbles comprise brick and clinker.		
0.50	CH2					0.80	MADE GROUND: Black clayey sandy gravel.		
						1.00	Soft to firm dark brown sandy slightly gravelly CLAY.		
1.00-1.45 1.00	SPT D3	N10					Firm light brown red sandy slightly gravelly CLAY. Gravel is subangular of sandstone. Occasional sand lenses noted.		
1.80-2.25 1.80	SPT D4	N12							
2.70 2.80-3.25	D5 SPT	N9				(4.25)			
3.80-4.25 3.80	SPT D6	N14							
4.80-5.25	SPT	N21				5.25			
							Hole completed and monitoring point installed.		

Boring Progress and Water Observations						Chiselling			Water Added	
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To

GENERAL REMARKS

1. Water in pit at 0.5m bgl.

All dimensions in metres Scale 1:50	Client: Seddons	Method/ Plant Used	Logged By: DD

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BOREHOLE LOG

Project				BOREHOLE No
Gardeners Arms, Broad Green Road, Liverpool				**WS2**
Job No: GRS0112-1458	Date: 26-03-12 / 26-03-12	Ground Level (m)	Co-Ordinates ()	
Contractor				Sheet: 1 of 1

SAMPLES & TESTS				STRATA					
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Geology	Instrument/ Backfill
						0.15	MADE GROUND: Tarmac over subgrade.		
0.30	CH1					0.50	MADE GROUND: Multicoloured slightly clayey sand and gravel with high cobble content. Gravel and cobbles comprise various lithologies including brick and tarmac.		
						(0.40) 0.90	MADE GROUND: Soft dark brown black sandy slightly gravelly clay. (Possible relic topsoil). Thin layer of black gravel.		
1.00-1.45	SPT	N9					Firm light brown/red sandy slightly gravelly CLAY. Gravel comprises subangular sandstone. c1.1m bgl Thin saturated sand band.		
1.50	D2								
2.00-2.45	SPT	N15				(2.10)			
2.00	D3								
						3.00	Hole continued by dynamic probe.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	1. Dry to base.

All dimensions in metres Scale 1:50	Client: Seddons	Method/ Plant Used	Logged By: DD

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DYNAMIC PROBE LOG

Project				PROBE No
Gardeners Arms, Broad Green Road, Liverpool				**WS2**
Job No: GRS0112-1458	Date: 26-03-12 26-03-12	Ground Level (m)	Co-Ordinates ()	
Contractor				Sheet: 1 of 1

Depth (m)	Readings (blows/100mm)	Remarks
3	2 1 3 3 3	N6
	3 7 9 7 3	N9
		N23
4	3 3 2 3 2	N9
		N7
	3 3 3 2 4	N9
		N10
5	4 6 8 6 8	N20
		N25
	9 8 8 7 8	N23
6	8 11 23 50	N42
		N>50
7		

Diagram (N100 Values): 5, 10, 15, 20, 25, 30

Torque (Nm)

Hammer Wt (kg)	
Hammer Drop (mm)	
Cone Dia (mm)	
Cone Type	
Damper	

GENERAL REMARKS

1. Dry to base.

All dimensions in metres Scale 1:50	Client: Seddons	Method/ Plant Used	Logged By: DD

AGS3 DYNAMIC PROBE GRS0112-1458 GRADENERS ARMS.GPJ GINT STD AGS 3_1.GDT 25/4/12

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Newton Aycliffe, County Durham
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BOREHOLE LOG

Project				BOREHOLE No
Gardeners Arms, Broad Green Road, Liverpool				**WS3**
Job No: GRS0112-1458	Date: 26-03-12 / 26-03-12	Ground Level (m)	Co-Ordinates ()	
Contractor				Sheet: 1 of 1

SAMPLES & TESTS				STRATA					
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Geology	Instrument/ Backfill
						0.15	MADE GROUND: Tarmac over subgrade.		
0.15	CH1					(0.65) 0.80	MADE GROUND: Multicoloured slightly clayey sand and gravel with medium cobble content. Gravel and cobbles comprise brick, hardcore, tarmac and sandstone.		
						1.00	MADE GROUND: Soft dark brown black sandy slightly gravelly clay. (Possible relic topsoil).		
1.00-1.45	SPT	N11					Firm light brown/red sandy slightly gravelly CLAY. Gravel comprises subangular sandstone.		
1.20	D2								
2.00-2.45	SPT	N8				(2.00)			
2.50	D3					3.00			
							Hole continued by Dynamic Probe.		

Boring Progress and Water Observations						Chiselling			Water Added	
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To

GENERAL REMARKS

1. Dry to base.

All dimensions in metres Scale 1:50	Client: Seddons	Method/ Plant Used	Logged By: DD

AGS3 UK BH GRS0112-1458 GRADENERS ARMS.GPJ GINT STD AGS 3_1.GDT 25/4/12

GEOENVIRONMENTAL RISK SOLUTIONS

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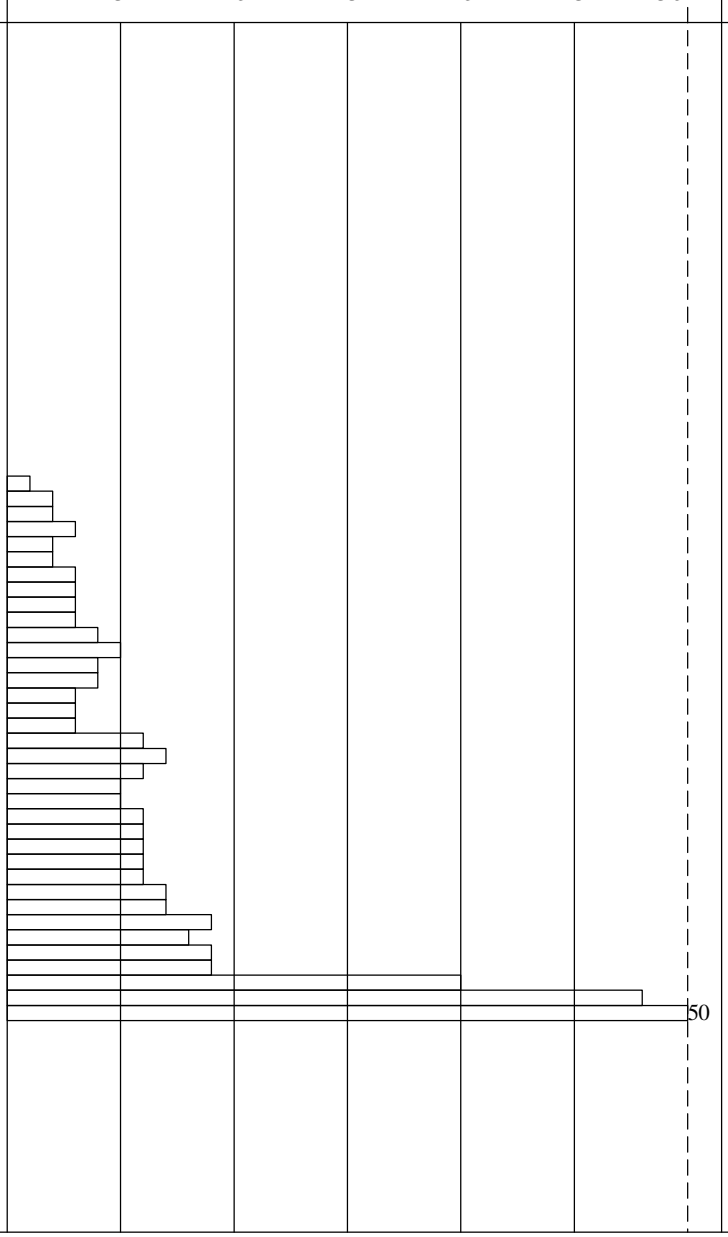
Newton Aycliffe, County Durham
Telephone: 08702240643

DYNAMIC PROBE LOG

Project				PROBE No
Gardeners Arms, Broad Green Road, Liverpool				**WS3**
Job No: GRS0112-1458	Date: 26-03-12 26-03-12	Ground Level (m)	Co-Ordinates ()	
Contractor				Sheet: 1 of 1

Depth (m)	Readings (blows/100mm)	Remarks
3	1 2 2 3 2	N5
	2 3 3 3 3	N7
		N9
4	4 5 4 4 3	N12
		N11
	3 3 6 7 6	N12
5		N18
	5 5 6 6 6	N17
		N18
	6 6 7 7 9	N23
6	8 9 9 20 28	N26
	50	N>50



Hammer Wt (kg)			GENERAL REMARKS
Hammer Drop (mm)			1. Dry to base.
Cone Dia (mm)			
Cone Type			
Damper			

All dimensions in metres Scale 1:50	Client: Seddons	Method/ Plant Used	Logged By: DD

AGS3 DYNAMIC PROBE GRS0112-1458 GRADENERS ARMS.GPJ GINT STD AGS 3_1.GDT 25/4/12

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Newton Aycliffe, County Durham
Telephone: 08702240643

BOREHOLE LOG

Project				BOREHOLE No
Gardeners Arms, Broad Green Road, Liverpool				**WS4**
Job No: GRS0112-1458	Date: 26-03-12 / 26-03-12	Ground Level (m)	Co-Ordinates ()	
Contractor				Sheet: 1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
						0.15	MADE GROUND: Tarmac over subgrade.		
						(0.40) 0.55	MADE GROUND: Multicoloured slightly clayey sand and gravel with medium cobble content. Gravel and cobbles comprise brick, hardcore, tarmac and sandstone.		
0.55	CH1					0.90	MADE GROUND: Soft dark brown black sandy slightly gravelly clay. (Possible relic topsoil).		
1.00-1.45	SPT	N9					Firm light brown/red sandy slightly gravelly CLAY. Gravel comprises subangular sandstone.		
1.20	CH2								
						(2.10)			
2.00-2.45	SPT	N9							
2.20	D3					3.00			
							Hole continued by Dynamic Probe.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	1. Dry to base.

All dimensions in metres Scale 1:50	Client: Seddons	Method/ Plant Used	Logged By: DD

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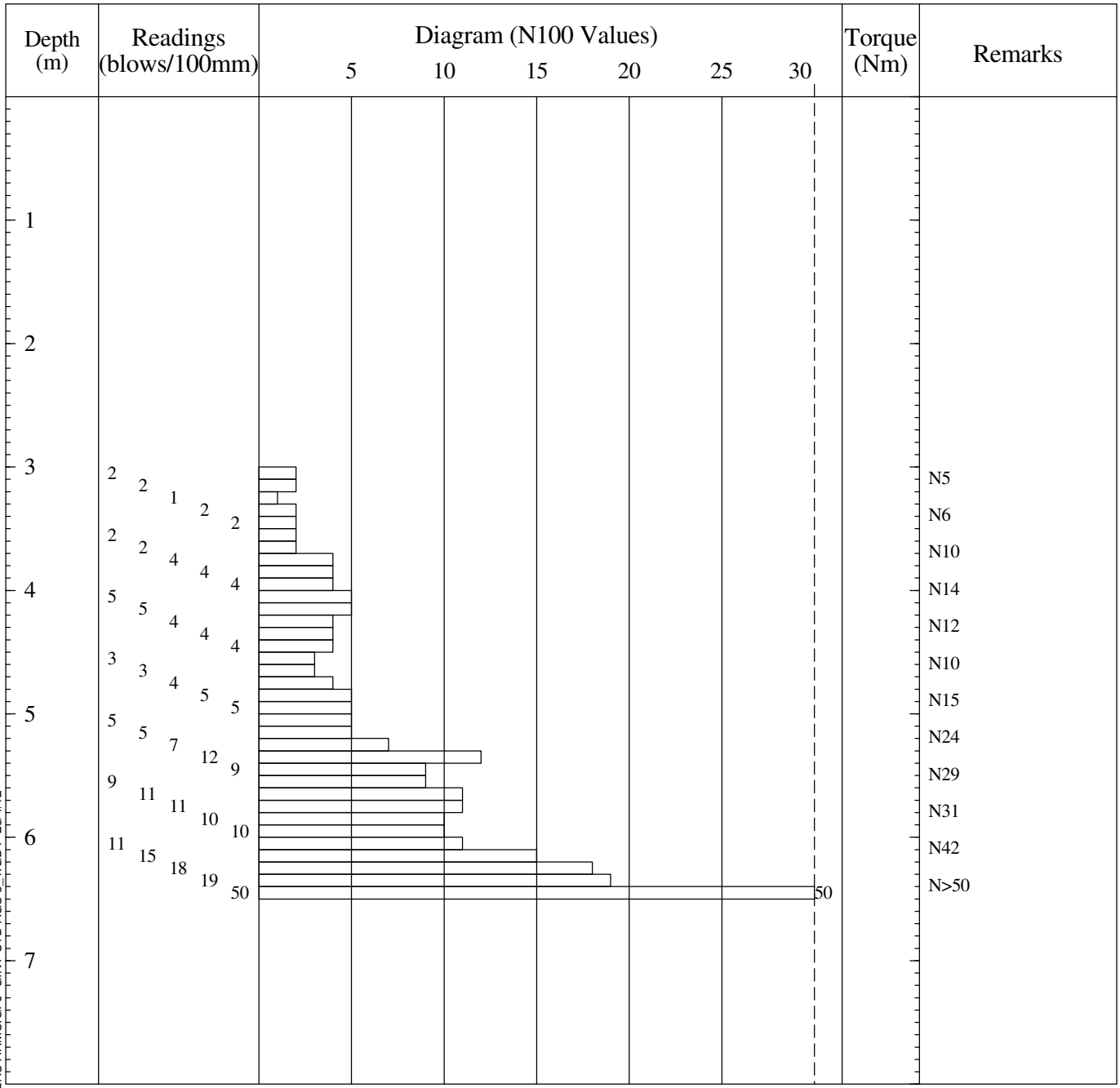
DYNAMIC PROBE LOG

Project				PROBE No
Gardeners Arms, Broad Green Road, Liverpool				**WS4**
Job No: GRS0112-1458	Date: 26-03-12 26-03-12	Ground Level (m)	Co-Ordinates ()	
Contractor				Sheet: 1 of 1



Hammer Wt (kg)	
Hammer Drop (mm)	
Cone Dia (mm)	
Cone Type	
Damper	

GENERAL REMARKS

1. Dry to base.

All dimensions in metres Scale 1:50	Client: Seddons	Method/ Plant Used	Logged By: DD

AGS3 DYNAMIC PROBE GRS0112-1458 GRADENERS ARMS.GPJ GINT STD AGS 3_1.GDT 25/4/12

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Newton Aycliffe, County Durham
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BOREHOLE LOG

Project				BOREHOLE No
Gardeners Arms, Broad Green Road, Liverpool				**WS5**
Job No: GRS0112-1458	Date: 27-03-12 27-03-12	Ground Level (m)	Co-Ordinates ()	
Contractor				Sheet: 1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
						0.15	MADE GROUND: Tarmac over subgrade.		
						0.45	MADE GROUND: Multicoloured slightly clayey sand and gravel with medium cobble content. Gravel and cobbles comprise brick, hardcore, tarmac and sandstone.		
0.45	CH1					0.55	MADE GROUND: Black gravel.		
						(0.65)			
1.00-1.45	SPT	N3				1.20	MADE GROUND: Firm light brown/red sandy slightly gravelly CLAY. Gravel comprises subangular sandstone.		
1.30	CH2						MADE GROUND: Soft dark brown very sandy CLAY. Ash noted in sample.		
1.50	D3					(0.90)			
2.00-2.45	SPT	N7				2.10			
2.20	D4					(0.40) 2.50	Brown very clayey SAND. (Strata noted as damp).		
2.80	D5					(0.50) 3.00	Firm light brown/red sandy slightly gravelly CLAY. Gravel comprises subangular sandstone.		
							Hole continued by Dynamic Probe.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	1. Dry to base.

All dimensions in metres Scale 1:50	Client: Seddons	Method/ Plant Used	Logged By: DD

GEOENVIRONMENTAL RISK SOLUTIONS

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Newton Aycliffe, County Durham
Telephone: 08702240643

DYNAMIC PROBE LOG

Project				PROBE No
Gardeners Arms, Broad Green Road, Liverpool				**WS5**
Job No: GRS0112-1458	Date: 27-03-12 27-03-12	Ground Level (m)	Co-Ordinates ()	
Contractor				Sheet: 1 of 1

Depth (m)	Readings (blows/100mm)	Remarks
3	1 2 2 3 1	N5
	2 2 3 2 2	N6
	3 2 2 3 2	N7
4	2 3 4 4 4	N7
	5 4 5 7 7	N7
5	10 8 6 7 10	N9
	50	N13
		N16
		N25
		N23
6		N>50

Diagram (N100 Values): 5, 10, 15, 20, 25, 30; 50

Torque (Nm)

Hammer Wt (kg)	
Hammer Drop (mm)	
Cone Dia (mm)	
Cone Type	
Damper	

GENERAL REMARKS

1. Dry to base.

All dimensions in metres Scale 1:50	Client: Seddons	Method/ Plant Used	Logged By: DD

AGS3 DYNAMIC PROBE GRS0112-1458 GRADENERS ARMS.GPJ GINT STD AGS 3_1.GDT 25/4/12

GEOENVIRONMENTAL RISK SOLUTIONS

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Newton Aycliffe, County Durham
Telephone: 08702240643

BOREHOLE LOG

Project				BOREHOLE No
Gardeners Arms, Broad Green Road, Liverpool				**WS6**
Job No: GRS0112-1458	Date: 27-03-12 / 27-03-12	Ground Level (m)	Co-Ordinates ()	
Contractor				Sheet: 1 of 1

SAMPLES & TESTS				STRATA					
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Geology	Instrument/ Backfill
						0.15	MADE GROUND: Tarmac over subgrade.		
						0.20	MADE GROUND: Dark brown slightly clayey sand and gravel. Gravel comprise hardcore.		
						(1.00)	Loose red slightly clayey to clayey slightly gravelly SAND.		
1.00-1.45	SPT	N7				1.20			
1.00	D1						Soft light brown red very sandy slightly gravelly CLAY. Gravel is subangular of sandstone.		
1.50	D2								
2.00-2.45	SPT	N4				(1.60)			
2.50	D3					2.80			
2.80	D4					3.00	Light brown very clayey SAND. Samples noted as damp.		
3.00-3.45	SPT	N31				(0.63)	Very dense light brown orange gravelly SAND with low cobble content. (Weathered bedrock).		
3.40	D5					3.63			
3.60-3.63	SPT	N>50					Hole completed due to refusal.		
3.60	D6								

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	1. Dry to base.

All dimensions in metres Scale 1:50	Client: Seddons	Method/ Plant Used	Logged By: DD

AGS3 UK BH GRS0112-1458 GRADENERS ARMS.GPJ GINT STD AGS 3_1.GDT 25/4/12

GEOENVIRONMENTAL RISK SOLUTIONS

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Newton Aycliffe, County Durham
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BOREHOLE LOG

Project				BOREHOLE No
Gardeners Arms, Broad Green Road, Liverpool				**WS7**
Job No: GRS0112-1458	Date: 27-03-12 / 27-03-12	Ground Level (m)	Co-Ordinates ()	
Contractor				Sheet: 1 of 1

SAMPLES & TESTS				STRATA					
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Geology	Instrument/ Backfill
						0.10	MADE GROUND: Tarmac over subgrade.		
						0.15	MADE GROUND: Black sand and gravel.		
						0.30	MADE GROUND: Multicoloured slightly clayey sand and gravel with high cobbles. Gravel and cobbles comprise brick, tarmac, hardcore and sandstone.		
						0.60	MADE GROUND: Multicoloured slightly clayey gravelly sand. Gravel comprises brick, tarmac, hardcore and sandstone.		
1.00-1.45	SPT	N4				(1.00)	Loose red slightly clayey to clayey slightly gravelly SAND.		
1.20	D1					1.60			
1.80	D2						Firm light brown red very sandy slightly gravelly CLAY. Gravel is subangular of sandstone.		
2.00-2.45	SPT	N6				(1.30)			
						2.90			
2.90	D3						Very dense light brown orange gravelly SAND with low cobble content. (Weathered bedrock).		
3.00-3.35	SPT	N>50				(0.45)			
3.00	D4					3.35			
							Hole completed due to refusal.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	1. Dry to base.

All dimensions in metres Scale 1:50	Client: Seddons	Method/ Plant Used	Logged By: DD

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BOREHOLE LOG

Project				BOREHOLE No
Gardeners Arms, Broad Green Road, Liverpool				**WS8**
Job No: GRS0112-1458	Date: 27-03-12 / 27-03-12	Ground Level (m)	Co-Ordinates ()	
Contractor				Sheet: 1 of 1

SAMPLES & TESTS				STRATA					
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Geology	Instrument/ Backfill
						0.20	MADE GROUND: Concrete.		
0.20-0.40	B2					(0.47)	MADE GROUND: Multicoloured clayey sand and gravel with medium cobble content. Gravel and cobble comprise brick, concrete and hardcore. Steel reinforcement bars noted within fill.		
0.50	CH1					0.67	Hole terminated due to flat solid obstruction at base of hole.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	1. Dry to base.

All dimensions in metres Scale 1:50	Client: Seddons	Method/ Plant Used	Logged By: DD

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Newton Aycliffe, County Durham
Telephone: 08702240643

BOREHOLE LOG

Project				BOREHOLE No
Gardeners Arms, Broad Green Road, Liverpool				**WS9**
Job No: GRS0112-1458	Date: 27-03-12 / 27-03-12	Ground Level (m)	Co-Ordinates ()	
Contractor				Sheet: 1 of 1

SAMPLES & TESTS			STRATA						
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Geology	Instrument/ Backfill
						0.10	MADE GROUND: Tarmac over subgrade.		
0.30	CH1					0.30	MADE GROUND: Multicoloured clayey sand and gravel with medium cobble content. Gravel and cobble comprise brick, concrete and hardcore. Steel reinforcement bars noted within fill.		
0.50	D2					(0.50)			
						0.80	Red slightly clayey to clayey slightly gravelly SAND.		
1.00-1.45	SPT	N7					Firm light brown red very sandy slightly gravelly CLAY. Gravel is subangular of sandstone.		
1.50	D3					(2.00)			
2.00-2.45	SPT	N9							
2.00	D4								
						2.80			
						2.90	Very dense red orange gravelly SAND with low cobble content. (Weathered bedrock).		
2.90	D5					3.04			
3.00-3.04	SPT	N>50					Very dense light brown sandy GRAVEL with low cobble content. (Weathered bedrock).		
3.00	D6						Hole completed due to refusal.		

Boring Progress and Water Observations						Chiselling			Water Added	
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To

GENERAL REMARKS

1. Dry to base.

All dimensions in metres Scale 1:50	Client: Seddons	Method/ Plant Used	Logged By: DD

GEOENVIRONMENTAL RISK SOLUTIONS

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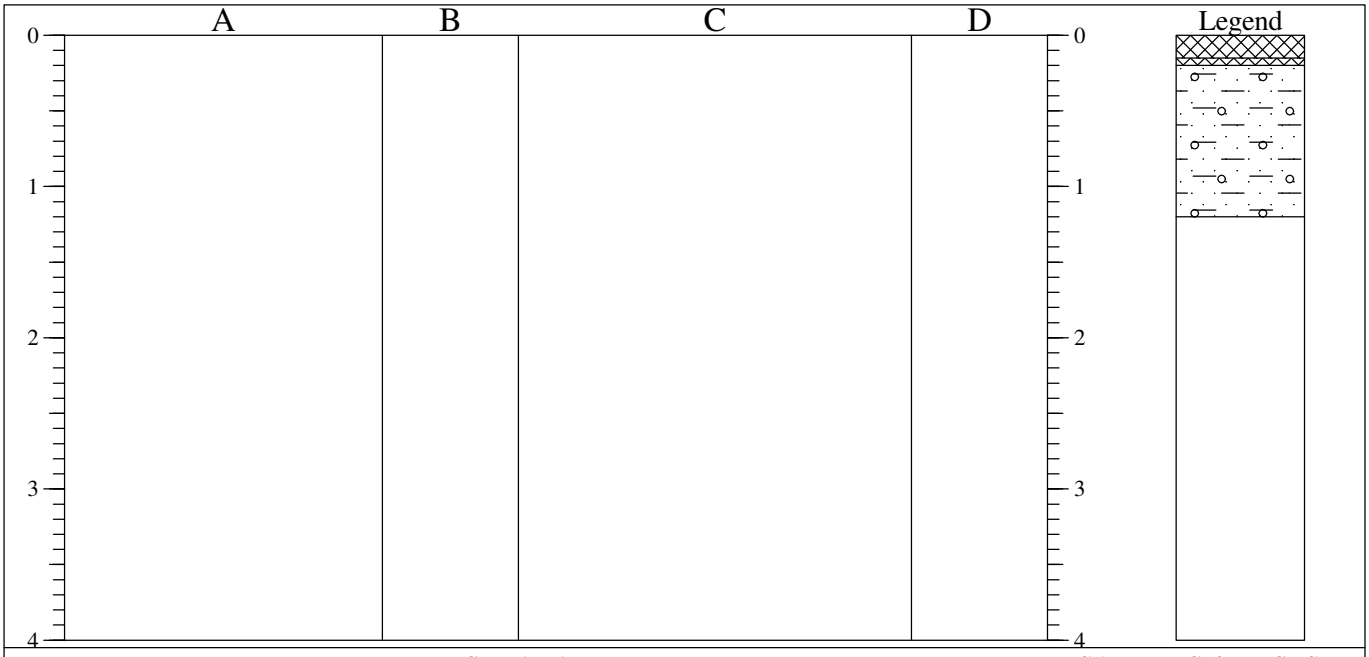
Newton Aycliffe, County Durham
Telephone: 08702240643

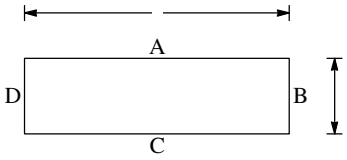
TRIAL PIT LOG

Project				TRIAL PIT No
Gardeners Arms, Broad Green Road, Liverpool				**HP1**
Job No: GRS0112-1458	Date: 26-03-12 26-03-12	Ground Level (m)	Co-Ordinates ()	
Contractor				Sheet: 1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.15		MADE GROUND: Tarmac over subgrade.			
0.15-0.20		MADE GROUND: Dark brown slightly clayey sand and gravel. Gravel comprise hardcore.	0.20-0.40	B2	
0.20-1.20		Loose red slightly clayey to clayey slightly gravelly SAND.	0.30	CH1	
1.20		Inspection Pit Complete.			

Shoring/Support:
Stability:



GENERAL REMARKS

1. Dry to base.

All dimensions in metres Scale 1:50	Client: Seddons	Method/ Plant Used	Logged By: DD

AGS3 UK TP GRS0112-1458 GRADENERS ARMS.GPJ GINT STD AGS 3_1.GDT 25/4/12

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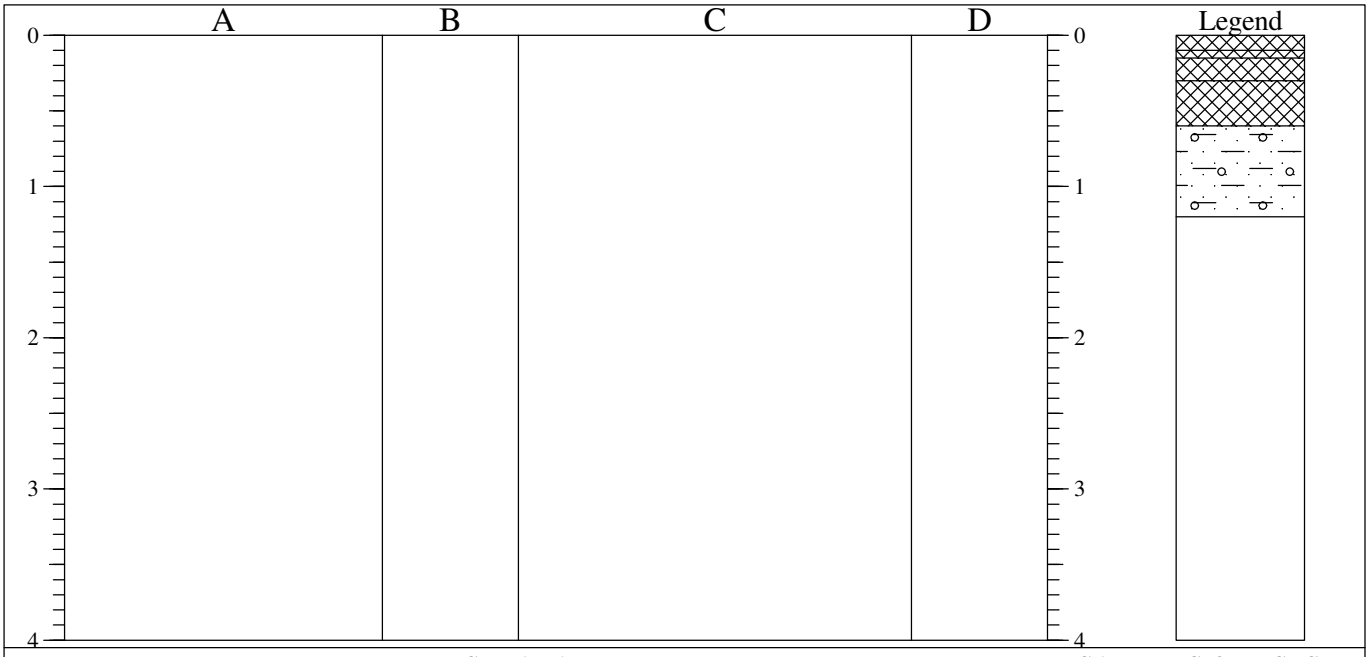
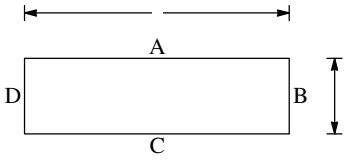
TRIAL PIT LOG

Project				TRIAL PIT No
Gardeners Arms, Broad Green Road, Liverpool				**HP2**
Job No: GRS0112-1458	Date: 26-03-12 26-03-12	Ground Level (m)	Co-Ordinates ()	
Contractor				Sheet: 1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.10		MADE GROUND: Tarmac over subgrade.			
0.10-0.15		MADE GROUND: Black sand and gravel.	0.20	CH	
0.15-0.30		MADE GROUND: Multicoloured slightly clayey sand and gravel with high cobbles. Gravel and cobbles comprise brick, tarmac, clinker, hardcore and sandstone.	0.30-0.50	B	
0.30-0.60					
0.60-1.20		MADE GROUND: Multicoloured slightly clayey gravelly sand. Gravel comprises brick, tarmac, hardcore and sandstone.	0.60-0.80	B	
		Loose red slightly clayey to clayey slightly gravelly SAND.			
1.20		Inspection Pit Complete.			

Shoring/Support:
Stability:



GENERAL REMARKS

1. Dry to base.

All dimensions in metres Scale 1:50	Client: Seddons	Method/ Plant Used	Logged By: DD

AGS3 UK TP GRS0112-1458 GRADENERS ARMS.GPJ GINT STD AGS 3_1.GDT 25/4/12

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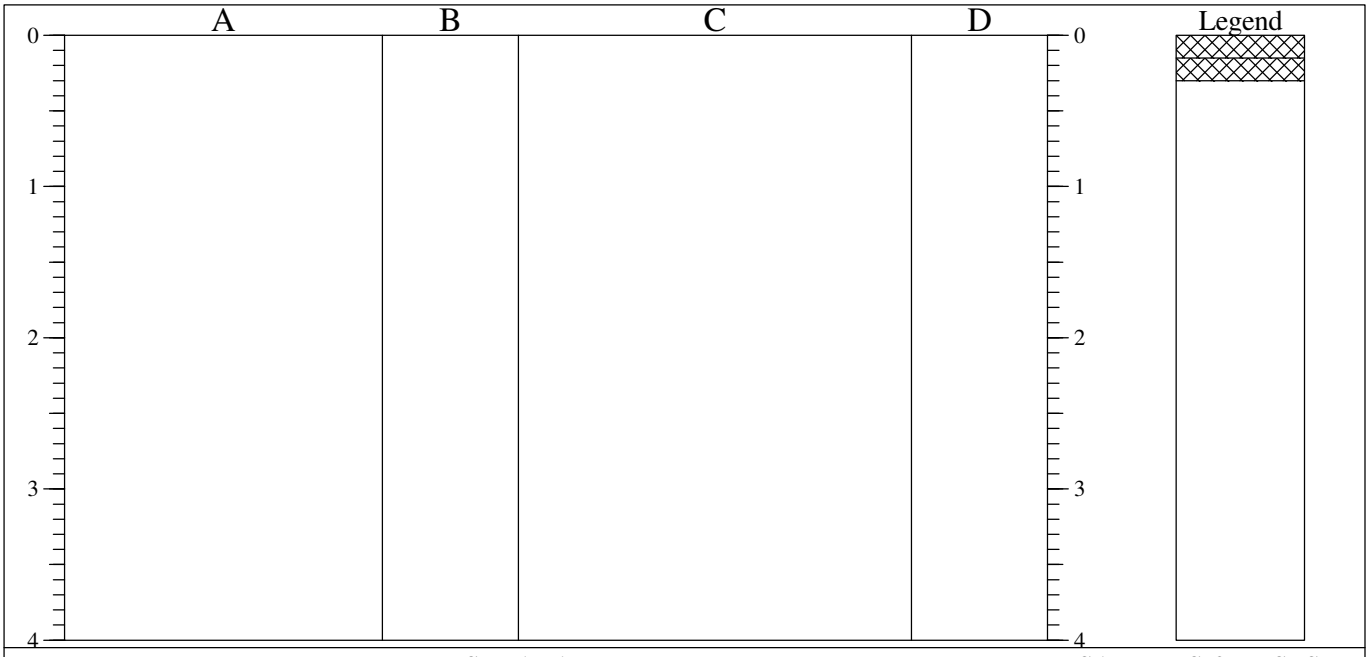
Newton Aycliffe, County Durham
Telephone: 08702240643

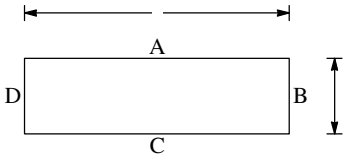
TRIAL PIT LOG

Project				TRIAL PIT No
Gardeners Arms, Broad Green Road, Liverpool				**HP3**
Job No: GRS0112-1458	Date: 26-03-12 26-03-12	Ground Level (m)	Co-Ordinates ()	
Contractor				Sheet: 1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.15		MADE GROUND: Tarmac over subgrade.			
0.15-0.30		MADE GROUND: Fill with steel reinforcement bars.			
0.30		Hole terminated due to steel bar obstruction.			

Shoring/Support:
Stability:



GENERAL REMARKS

1. Dry to base.

All dimensions in metres Scale 1:50	Client: Seddons	Method/ Plant Used	Logged By: DD

AGS3 UK TP GRS0112-1458 GRADENERS ARMS.GPJ GINT STD AGS 3_1.GDT 25/4/12

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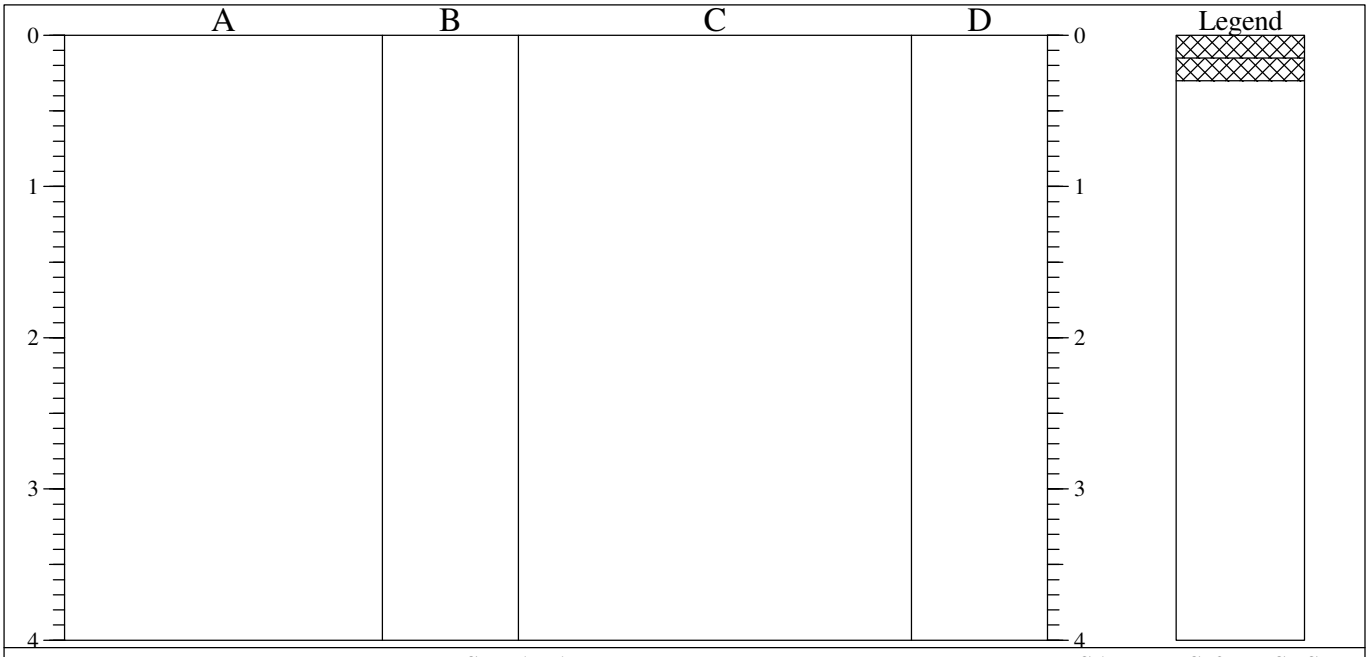
Newton Aycliffe, County Durham
Telephone: 08702240643

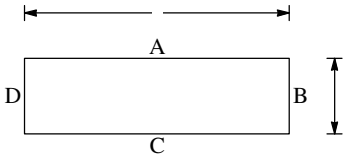
TRIAL PIT LOG

Project				TRIAL PIT No
Gardeners Arms, Broad Green Road, Liverpool				**HP4**
Job No: GRS0112-1458	Date: 26-03-12 26-03-12	Ground Level (m)	Co-Ordinates ()	
Contractor				Sheet: 1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.15		MADE GROUND: Tarmac over subgrade.			
0.15-0.30		MADE GROUND: Fill with steel reinforcement bars.			
0.30		Hole terminated due to steel bar obstruction.			

Shoring/Support:
Stability:



GENERAL REMARKS

1. Dry to base.

All dimensions in metres Scale 1:50	Client: Seddons	Method/ Plant Used	Logged By: DD

AGS3 UK TP GRS0112-1458 GRADENERS ARMS.GPJ GINT STD AGS 3_1.GDT 25/4/12

APPENDIX C - LABORATORY RESULTS

PSL
Professional Soils Laboratory

LABORATORY REPORT

UKAS TESTING
4043

Contract Number: PSL12/1354

Client's Reference: Report Date: 17 April 2012

Client Name: GRS
Evans Business Centre
Durham Way South
Newton Aycliffe

DL5 6XP

For the attention of: D David

Contract Title: Gardeners Arms

Date Received: 30-Mar-12
Date Commenced: 30-Mar-12
Date Completed: 17-Apr-12

Notes: Observations and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

R Gunson	A Watkins	M Beastall
(Director)	(Director)	(Laboratory Manager)

5 – 7 Hexthorpe Road, Hexthorpe,
Doncaster DN4 0AR
tel: +44 (0)844 815 6641
fax: +44 (0)844 815 6642
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awatkins@prosoils.co.uk

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Depth m	Description of Sample
WS1	4	D	1.80	Brown slightly gravelly very sandy CLAY.
WS2	2	D	1.50	Brown slightly gravelly very sandy CLAY.
WS3	3	D	2.50	Brown slightly gravelly very sandy CLAY.
WS4		D	1.20	Brown slightly gravelly sandy CLAY.
WS5	3	D	1.50	MADE GROUND dark grey slightly gravelly very sandy clay with ash.
WS5	5	D	2.80	Brown slightly gravelly very sandy CLAY.
HP1		B	0.20-0.40	MADE GROUND brown gravelly sand.
HP2		B	0.30-0.50	Brown very gravelly SAND.
HP2		B	0.60-0.80	MADE GROUND brown very gravelly sand.

PSL
Professional Soils Laboratory

Compiled by	Date	Checked by	Date	Approved by	Date
	17/04/12		17/04/12		17/04/12

GARDENERS ARMS.

Contract No: PSL12/1354

Client Ref: GRS0112-1458

SUMMARY OF SOIL CLASSIFICATION TESTS

(B.S. 1377 : PART 2 : 1990)

Hole Number	Sample Number	Sample Type	Depth m	Moisture Content % Clause 3.2	Bulk Density Mg/m^3 Clause 7.2	Dry Density Mg/m^3 Clause 7.2	Particle Density Mg/m^3 Clause 8.	Liquid Limit % Clause 4.3/4.4	Plastic Limit % Clause 5.	Plasticity Index % Clause 6.	% Passing .425mm	Remarks
WS1	4	D	1.80	16				29	13	16	98	Low plasticity CL.
WS2	2	D	1.50	16				33	15	18	98	Low plasticity CL.
WS3	3	D	2.50	17				28	12	16	97	Low plasticity CL.
WS4		D	1.20	19				36	16	20	96	Intermediate plasticity CI.
WS5	3	D	1.50	25				30	16	14	95	Low plasticity CL.
WS5	5	D	2.80	18				30	14	16	97	Low plasticity CL.

SYMBOLS : NP : Non Plastic *** : Liquid Limit and Plastic Limit Wet Sieved.**

PSL
Professional Soils Laboratory

Compiled by	Date	Checked by	Date	Approved by	Date
	17/04/12		17/04/12		17/04/12

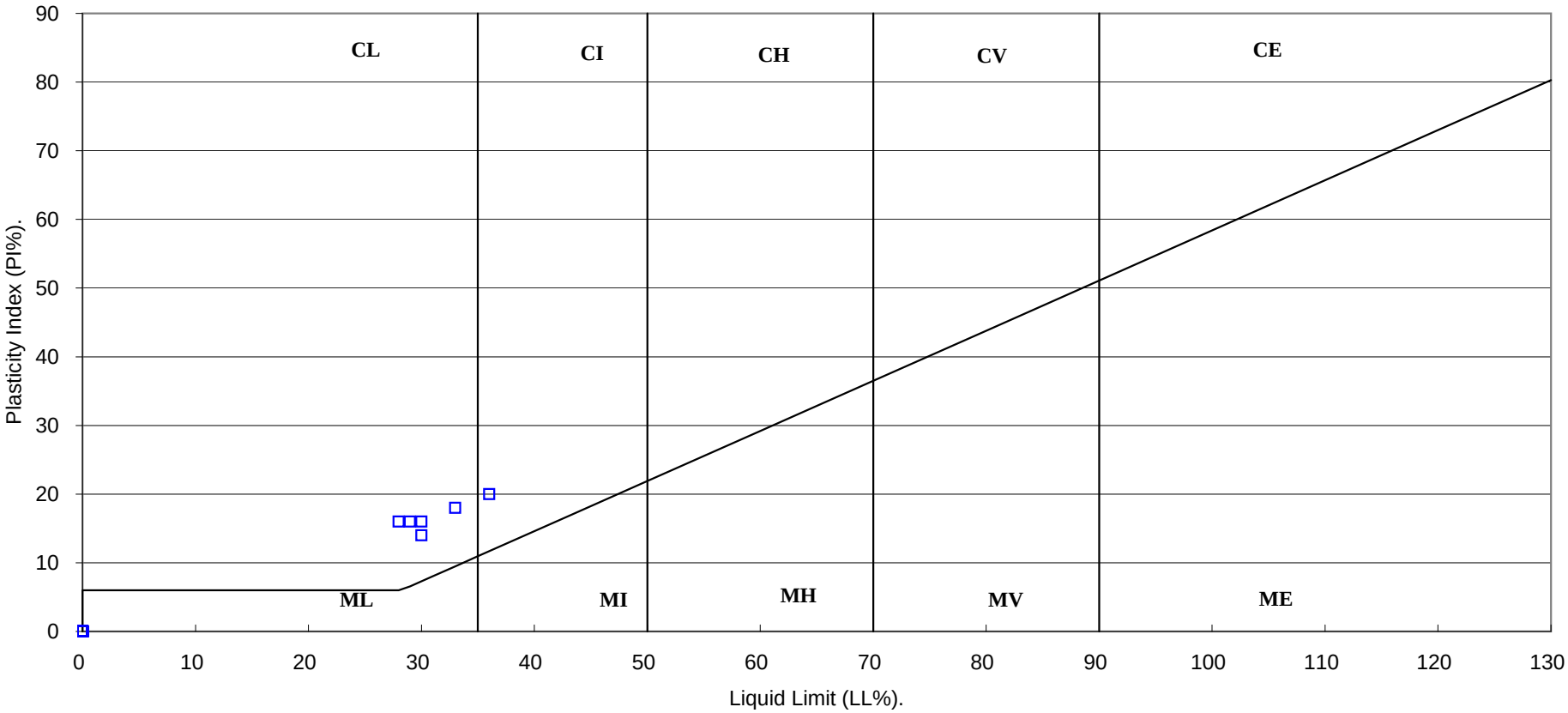
GARDENERS ARMS.

Contract No: **PSL12/1354**

Client Ref: **GRS0112-1458**

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

(B.S.5930 : 1999)



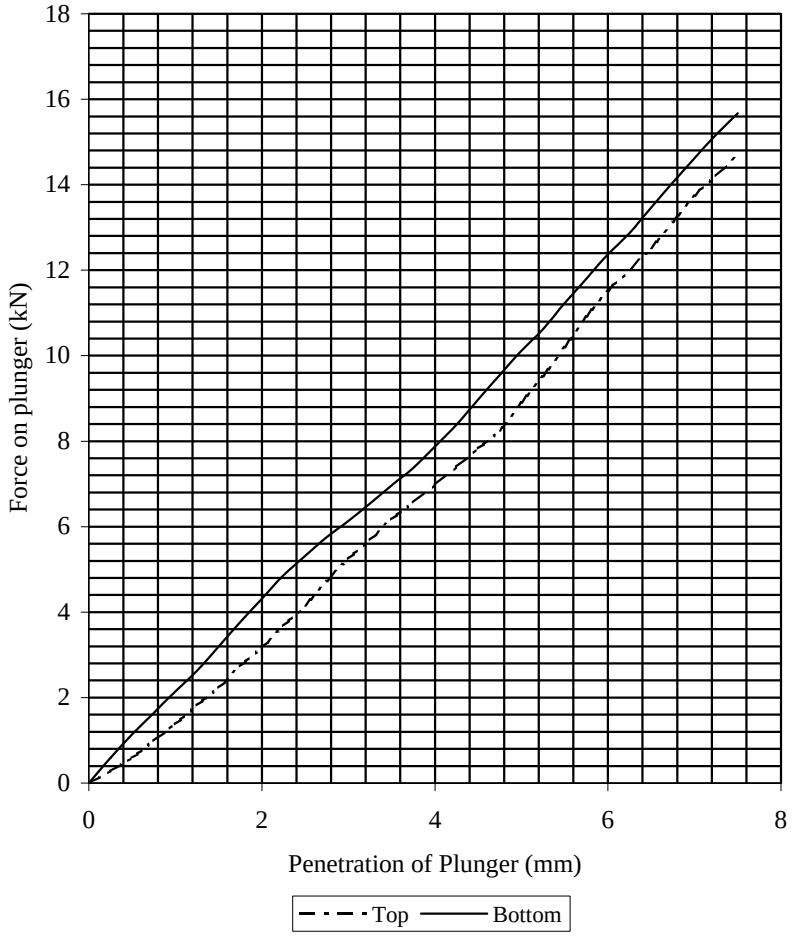
PSL Professional Soils Laboratory	Compiled by	Date	Checked by	Date	Approved by	Date
		17/04/12		17/04/12		17/04/12
	GARDENERS ARMS.				Contract No:	PSL12/1354
					Client Ref:	GRS0112-1458

California Bearing Ratio Test.

BS 1377 : Part 4 : 1990

Hole Number: **HP1** **Depth (m):** **0.20-0.40**

Sample Number: **Sample Type:** **B**



Initial Sample Conditions		Test Conditions		Method of compaction	2.5Kg Rammer		
Moisture Content:	11	Surcharge Kg:	4.20	Final Moisture Content %		C.B.R. Value %	
Bulk Density Mg/m3:	2.09	Soaking Time hrs	0	Sample Top	11	Sample Top	44.5
Dry Density Mg/m3:	1.88	Swelling mm:	0	Sample Bottom	12	Sample Bottom	50.6
Percentage retained on 20mm BS test sieve:	8	Remarks:	See Summary of Soil Description.				

Checked by	Date	Approved By	Date
	17/04/12		17/04/12

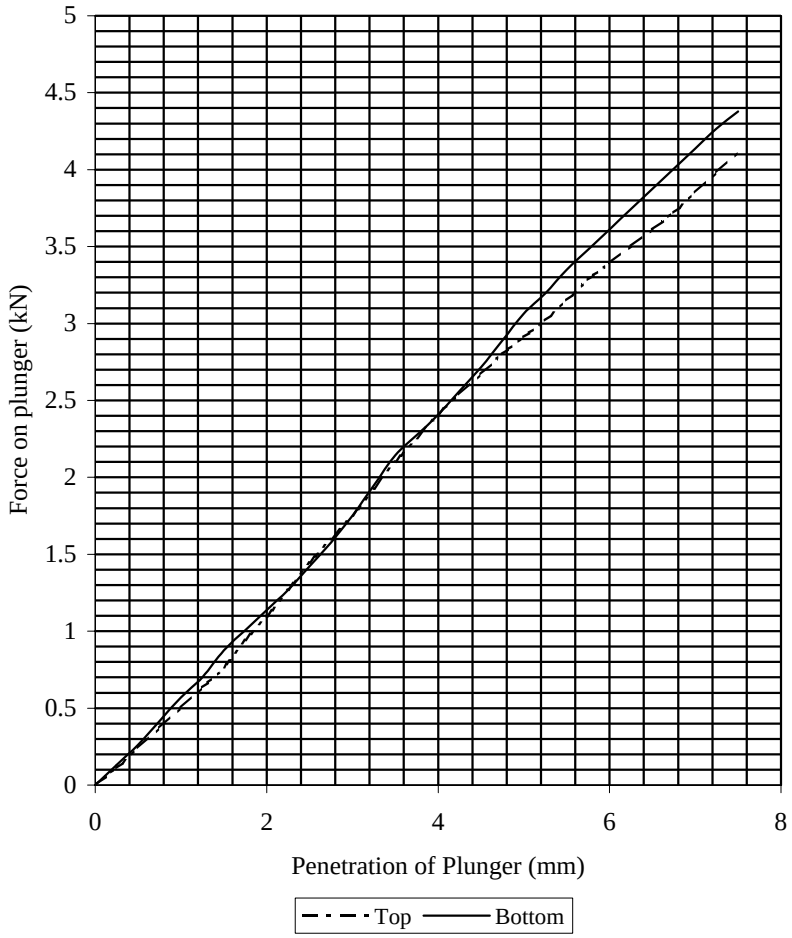
PSL Professional Soils Laboratory	**GARDENERS ARMS.**	**Contract No. PSL12/1354**

California Bearing Ratio Test.

BS 1377 : Part 4 : 1990

Hole Number: **HP2** **Depth (m):** **0.30-0.50**

Sample Number: **Sample Type:** **B**



Initial Sample Conditions		Test Conditions		Method of compaction	2.5Kg Rammer		
Moisture Content:	17	Surcharge Kg:	4.20	Final Moisture Content %		C.B.R. Value %	
Bulk Density Mg/m3:	2.01	Soaking Time hrs	0	Sample Top	17	Sample Top	14.6
Dry Density Mg/m3:	1.72	Swelling mm:	0	Sample Bottom	17	Sample Bottom	15.3
Percentage retained on 20mm BS test sieve:	0	Remarks:	See Summary of Soil Description.				

Checked by	Date	Approved By	Date
	17/04/12		17/04/12

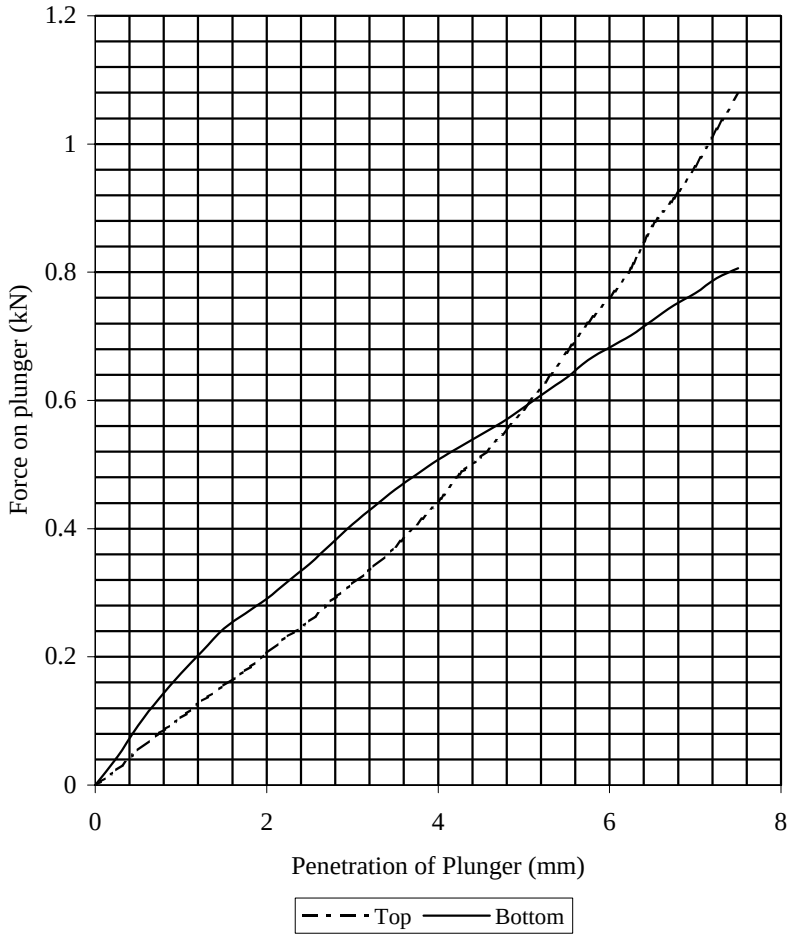
PSL Professional Soils Laboratory	**GARDENERS ARMS.**	**Contract No. PSL12/1354**

California Bearing Ratio Test.

BS 1377 : Part 4 : 1990

Hole Number: **HP2** **Depth (m):** **0.60-0.80**

Sample Number: **Sample Type:** **B**



Initial Sample Conditions		Test Conditions		Method of compaction	2.5Kg Rammer		
Moisture Content:	16	Surcharge Kg:	4.20	Final Moisture Content %		C.B.R. Value %	
Bulk Density Mg/m3:	2.08	Soaking Time hrs	0	Sample Top	15	Sample Top	2.9
Dry Density Mg/m3:	1.80	Swelling mm:	0	Sample Bottom	16	Sample Bottom	2.9
Percentage retained on 20mm BS test sieve:	4	Remarks:	See Summary of Soil Description.				

Checked by	Date	Approved By	Date
	17/04/12		17/04/12

PSL Professional Soils Laboratory	**GARDENERS ARMS.**	**Contract No. PSL12/1354**

2531

CHEMTECH environmental

ANALYTICAL TEST REPORT

Contract no: 44819

Contract name: Gardeners Arms

Client reference: PSL12/1354

Clients name: Professional Soils Laboratory

Clients address: 5-7 Hexthorpe Road
Doncaster
DN4 0AR

Samples received: 03 April 2012

Analysis started: 03 April 2012

Analysis completed: 11 April 2012

Report issued: 11 April 2012

Notes:
Opinions and interpretations expressed herein are outside the UKAS accreditation scope.
Unless otherwise stated, Chemtech Environmental Ltd were not responsible for sampling.
Methods, procedures and performance data are available on request.
Results reported herein relate only to the material supplied to the laboratory.
This report shall not be reproduced except in full, withour prior written approval.
Samples will be disposed of 6 weeks from initial receipt unless otherwise instructed.

Key:
U UKAS accredited test
M MCERTS & UKAS accredited test
$ Test carried out by an approved subcontractor
I/S Insufficient sample to carry out test
N/S Sample not suitable for testing

Approved by: K Campbell

Karan Campbell — Director
John Campbell — Director

Unit 25a-25b Number One Industrial Estate, Consett, County Durham, DH8 6TJ
Tel 01207 581260 Fax 01207 581582 Email info@chemtech-env.co.uk

Vat Reg No. 772 5703 18 Reg in England No. 4284013

Chemtech Environmental Limited

SOILS

Lab number			44819-1
Sample id			WS 4
Depth (m)			1.20
Test	**Method**	**Units**	
pH	CE004 [M]	units	7.8
Sulphate (2:1 water soluble)	CE049 [U]	g/l SO_4	0.02

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METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE004	pH	Based on BS 1377, pH Meter	Wet	M	-	units
CE049	Sulphate (2:1 water soluble)	Aqueous extraction, IC-COND	Dry	U	0.01	g/l SO_4

2531

ANALYTICAL TEST REPORT

Contract no: 44769(1)

Contract name: Gardeners Arms

Client reference: GRS0112-1458

Clients name: Geoenvironmental Risk Solutions

Clients address: Evans Business Centre
Durham Way South
Newton Aycliffe
DL5 6XP

Samples received: 28 March 2012

Analysis started: 28 March 2012

Analysis completed: 19 April 2012

Report issued: 20 April 2012

This is a supplementary report to report number 44769 issued 20 April 2012.

Notes:
Opinions and interpretations expressed herein are outside the UKAS accreditation scope.
Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.
Methods, procedures and performance data are available on request.
Results reported herein relate only to the material supplied to the laboratory.
This report shall not be reproduced except in full, withour prior written approval.
Samples will be disposed of 6 weeks from initial receipt unless otherwise instructed.

Key:
U UKAS accredited test
M MCERTS & UKAS accredited test
$ Test carried out by an approved subcontractor
I/S Insufficient sample to carry out test
N/S Sample not suitable for testing

Approved by:

K Campbell

Karan Campbell
Director

John Campbell
Director

Chemtech Environmental Limited

SAMPLE INFORMATION

MCERTS (Soils):

Soil descriptions are only intended to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions. MCERTS accreditation applies for sand, clay and loam/topsoil, or combinations of these whether these are derived from naturally occurring soils or from made ground, as long as these materials constitute the major part of the sample. Other materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

All results are reported on a dry basis. Samples dried at no more than 30°C in a drying cabinet.
Analytical results are exclusive of stones.

Lab ref	Sample id	Depth (m)	Soil description passing 2mm sieve	Description of material retained on 2mm sieve	% Retained on 2mm sieve	Moisture (%)
44769-1	HP 1	0.30	Sand	Stones & Gravel	15.8	9.1
44769-2	HP 2	0.20	Sand	Stones, Gravel, Clinker & Brick	69.0	11.4
44769-3	WS 1	0.20	Sand	Stones, Clinker, Brick & Gravel	66.8	12.9
44769-4	WS 2	0.30	Sand	Stones, Clinker, Brick & Gravel	72.1	10.1
44769-5	WS 3	0.15	Sand	Stones, Clinker, Brick & Gravel	74.4	9.1
44769-6	WS 3	1.20	Sandy Clay	Gravel	10.2	12.7
44769-7	WS 4	0.55	Ashy Sandy Clay	Stones, Gravel & Clinker	42.3	14.5
44769-8	WS 5	0.45	Ashy Sand	Clinker & Stones	73.7	17.7
44769-9	WS 5	1.30	Ashy Sand Clay	Clinker & Gravel	43.4	21.6
44769-10	WS 6	1.00	Clayey Sand	Stones & Gravel	31.5	10.9
44769-11	WS 8	0.50	Clayey Sand	Stones, Clinker, Gravel & Brick	63.9	12.7
44769-12	WS 9	0.30	Sand	Stones, Gravel & Clinker	61.1	10.0

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SOILS

Lab number			44769-1	44769-2	44769-3	44769-4	44769-5	44769-6
Sample id			HP 1	HP 2	WS 1	WS 2	WS 3	WS 3
Depth (m)			0.30	0.20	0.20	0.30	0.15	1.20
Test	**Method**	**Units**						
Arsenic (total)	CE054 M	mg/kg As	7.2	15	10	23	7.1	16
Boron (water soluble)	CE063 M	mg/kg B	0.4	<0.3	<0.3	0.4	0.4	<0.3
Cadmium (total)	CE054 M	mg/kg Cd	0.5	0.4	0.7	0.8	0.7	0.9
Chromium (total)	CE054 M	mg/kg Cr	24	14	19	21	40	25
Copper (total)	CE054 M	mg/kg Cu	13	59	46	43	18	34
Lead (total)	CE054 M	mg/kg Pb	6.2	3019	348	74	6.9	37
Mercury (total)	CE054	mg/kg Hg	0.6	18.1	<0.5	<0.5	<0.5	<0.5
Nickel (total)	CE054 M	mg/kg Ni	27	11	24	29	33	28
Selenium (total)	CE054 M	mg/kg Se	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Zinc (total)	CE054 M	mg/kg Zn	32	91	176	64	43	62
pH	CE004 M	units	7.9	8.6	8.3	8.5	8.7	8.0
Sulphate (2:1 water soluble)	CE049 U	mg/l SO_4	14	11	17	70	16	12
Sulphur (free)	CE034	mg/kg S	<10	<10	15	121	<10	<10
Sulphide	CE079	mg/kg S^{2-}	<10	<10	<10	<10	<10	<10
Cyanide (free)	CE077	mg/kg CN	<2	<2	<2	<2	<2	<2
Cyanide (total)	CE077	mg/kg CN	<2	<2	<2	<2	<2	<2
Thiocyanate	CE014 M	mg/kg SCN	6.5	<1	<1	<1	<1	<1
Phenols (total)	CE078	mg/kg PhOH	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
PAH								
Naphthalene	CE087	mg/kg	<0.1	<0.1	0.3	0.2	<0.1	<0.1
Acenaphthylene	CE087	mg/kg	<0.1	0.4	<0.1	<0.1	<0.1	<0.1
Acenaphthene	CE087	mg/kg	<0.1	4.0	0.3	0.2	<0.1	<0.1
Fluorene	CE087	mg/kg	<0.1	2.2	0.3	0.1	<0.1	<0.1
Phenanthrene	CE087	mg/kg	1.2	13.9	3.1	1.7	0.2	<0.1
Anthracene	CE087	mg/kg	0.4	7.7	0.4	0.2	<0.1	<0.1
Fluoranthene	CE087	mg/kg	3.8	47.5	3.1	1.6	0.2	<0.1
Pyrene	CE087	mg/kg	3.5	42.9	2.9	1.4	0.3	<0.1
Benzo(a)anthracene	CE087	mg/kg	2.0	24.9	1.2	0.6	0.2	<0.1
Chrysene	CE087	mg/kg	1.6	23.4	1.4	0.7	0.1	<0.1
Benzo(b)fluoranthene	CE087	mg/kg	2.1	32.3	1.3	0.5	0.2	<0.1
Benzo(k)fluoranthene	CE087	mg/kg	0.7	13.3	0.4	0.3	<0.1	<0.1
Benzo(a)pyrene	CE087	mg/kg	1.8	32.3	1.1	0.5	0.2	<0.1
Indeno(123cd)pyrene	CE087	mg/kg	1.0	16.7	0.6	0.2	<0.1	<0.1
Dibenz(ah)anthracene	CE087	mg/kg	0.2	3.7	0.1	<0.1	<0.1	<0.1
Benzo(ghi)perylene	CE087	mg/kg	1.1	17.8	0.7	0.3	0.1	<0.1
PAH (total)	CE087	mg/kg	19	283	17	8.5	<5	<5
TPH								
TPH (C10-C40)	CE033 U	mg/kg	32	1236	545	251	440	<10

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SOILS

Lab number			44769-7	44769-8	44769-9	44769-10	44769-11	44769-12
Sample id			WS 4	WS 5	WS 5	WS 6	WS 8	WS 9
Depth (m)			0.55	0.45	1.30	1.00	0.50	0.30
Test	**Method**	**Units**						
Arsenic (total)	CE054 M	mg/kg As	16	29	37	5.2	14	5.3
Boron (water soluble)	CE063 M	mg/kg B	0.6	0.4	1.4	<0.3	0.4	0.7
Cadmium (total)	CE054 M	mg/kg Cd	0.8	1.2	1.5	0.4	0.7	0.4
Chromium (total)	CE054 M	mg/kg Cr	24	22	25	19	26	16
Copper (total)	CE054 M	mg/kg Cu	30	76	122	14	35	17
Lead (total)	CE054 M	mg/kg Pb	37	72	3307	14	49	21
Mercury (total)	CE054	mg/kg Hg	<0.5	1.3	<0.5	0.6	0.9	<0.5
Nickel (total)	CE054 M	mg/kg Ni	27	40	33	22	33	14
Selenium (total)	CE054 M	mg/kg Se	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Zinc (total)	CE054 M	mg/kg Zn	59	118	368	28	54	32
pH	CE004 M	units	7.8	8.1	7.4	8.0	10.1	10.0
Sulphate (2:1 water soluble)	CE049 U	mg/l SO_4	48	84	<10	12	91	184
Sulphur (free)	CE034	mg/kg S	39	119	85	<10	26	<10
Sulphide	CE079	mg/kg S^{2-}	<10	<10	<10	<10	<10	<10
Cyanide (free)	CE077	mg/kg CN	<2	<2	<2	<2	<2	<2
Cyanide (total)	CE077	mg/kg CN	<2	<2	<2	<2	<2	<2
Thiocyanate	CE014 M	mg/kg SCN	1.5	<1	4.8	4.5	<1	<1
Phenols (total)	CE078	mg/kg PhOH	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
PAH								
Naphthalene	CE087	mg/kg	0.3	0.1	0.3	<0.1	<0.1	2.3
Acenaphthylene	CE087	mg/kg	<0.1	<0.1	0.2	<0.1	<0.1	0.7
Acenaphthene	CE087	mg/kg	<0.1	<0.1	7.2	<0.1	<0.1	9.1
Fluorene	CE087	mg/kg	<0.1	<0.1	4.4	<0.1	<0.1	9.2
Phenanthrene	CE087	mg/kg	0.4	0.6	39.7	0.3	0.4	89.3
Anthracene	CE087	mg/kg	<0.1	<0.1	8.8	0.2	<0.1	26.4
Fluoranthene	CE087	mg/kg	0.1	0.4	70.6	1.3	0.9	87.5
Pyrene	CE087	mg/kg	0.1	0.4	70.7	1.2	0.9	71.6
Benzo(a)anthracene	CE087	mg/kg	<0.1	0.2	29.1	0.7	0.5	30.4
Chrysene	CE087	mg/kg	<0.1	0.1	30.0	0.5	0.4	27.1
Benzo(b)fluoranthene	CE087	mg/kg	<0.1	0.2	22.6	0.6	0.5	28.7
Benzo(k)fluoranthene	CE087	mg/kg	<0.1	<0.1	11.6	0.4	0.3	12.6
Benzo(a)pyrene	CE087	mg/kg	<0.1	0.2	23.6	0.6	0.4	28.1
Indeno(123cd)pyrene	CE087	mg/kg	<0.1	<0.1	10.3	0.4	0.3	13.8
Dibenz(ah)anthracene	CE087	mg/kg	<0.1	<0.1	2.7	<0.1	<0.1	3.4
Benzo(ghi)perylene	CE087	mg/kg	<0.1	0.1	11.9	0.3	0.3	14.6
PAH (total)	CE087	mg/kg	<5	<5	344	6.5	<5	455
TPH								
TPH (C10-C40)	CE033 U	mg/kg	97	99	1369	42	74	2005

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LEACHATES

Lab number			44769-2L	44769-9L	44769-12L
Sample id			HP 2	WS 5	WS 9
Depth (m)			0.20	1.30	0.30
Test	**Method**	**Units**			
Arsenic (dissolved)	CE055	mg/l As	0.016	0.016	0.007
Cadmium (dissolved)	CE055 U	mg/l Cd	<0.001	<0.001	<0.001
Chromium (dissolved)	CE055 U	mg/l Cr	0.007	<0.003	<0.003
Copper (dissolved)	CE055 U	mg/l Cu	0.015	0.010	<0.004
Lead (dissolved)	CE055 U	mg/l Pb	0.358	0.055	<0.009
Mercury (dissolved)	CE055	mg/l Hg	<0.001	<0.001	<0.001
Nickel (dissolved)	CE055 U	mg/l Ni	0.016	0.016	<0.003
Selenium (dissolved)	CE055	mg/l Se	0.002	0.004	0.002
Zinc (dissolved)	CE055 U	mg/l Zn	<0.020	<0.020	0.034
PAHs					
Naphthalene	CE087	mg/l	0.0005	<0.0001	<0.0001
Acenaphthylene	CE087	mg/l	<0.0001	<0.0001	<0.0001
Acenaphthene	CE087	mg/l	0.0001	<0.0001	0.0005
Fluorene	CE087	mg/l	<0.0001	<0.0001	0.0006
Phenanthrene	CE087	mg/l	0.0008	0.0083	0.0034
Anthracene	CE087	mg/l	0.0001	0.0004	0.0005
Fluoranthene	CE087	mg/l	0.0013	0.0021	0.0012
Pyrene	CE087	mg/l	0.0014	0.0014	0.0008
Benzo(a)anthracene	CE087	mg/l	0.0004	0.0002	0.0003
Chrysene	CE087	mg/l	0.0007	0.0002	0.0002
Benzo(b)fluoranthene	CE087	mg/l	<0.0001	0.0001	<0.0001
Benzo(k)fluoranthene	CE087	mg/l	<0.0001	<0.0001	<0.0001
Benzo(a)pyrene	CE087	mg/l	<0.0001	<0.0001	<0.0001
Indeno(123cd)pyrene	CE087	mg/l	<0.0001	<0.0001	<0.0001
Dibenz(ah)anthracene	CE087	mg/l	<0.0001	<0.0001	<0.0001
Benzo(ghi)perylene	CE087	mg/l	<0.0001	<0.0001	<0.0001
PAH (total)	CE087	mg/l	0.0053	0.0127	0.0075

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METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE054	Arsenic (total)	Aqua regia digest, ICP-OES	Dry	M	1	mg/kg As
CE063	Boron (water soluble)	Hot water extract, ICP-OES	Dry	M	0.3	mg/kg B
CE054	Cadmium (total)	Aqua regia digest, ICP-OES	Dry	M	0.2	mg/kg Cd
CE054	Chromium (total)	Aqua regia digest, ICP-OES	Dry	M	1	mg/kg Cr
CE054	Copper (total)	Aqua regia digest, ICP-OES	Dry	M	1	mg/kg Cu
CE054	Lead (total)	Aqua regia digest, ICP-OES	Dry	M	1	mg/kg Pb
CE054	Mercury (total)	Aqua regia digest, ICP-OES	Dry		0.5	mg/kg Hg
CE054	Nickel (total)	Aqua regia digest, ICP-OES	Dry	M	1	mg/kg Ni
CE054	Selenium (total)	Aqua regia digest, ICP-OES	Dry	M	0.3	mg/kg Se
CE054	Zinc (total)	Aqua regia digest, ICP-OES	Dry	M	3	mg/kg Zn
CE004	pH	Based on BS 1377, pH Meter	Wet	M	-	units
CE049	Sulphate (2:1 water soluble)	Aqueous extraction, IC-COND	Dry	U	10	mg/l SO_4
CE034	Sulphur (free)	Solvent extraction, HPLC	Dry		10	mg/kg S
CE079	Sulphide	Extraction, Continuous Flow Colorimetry	Wet		10	mg/kg S^{2-}
CE077	Cyanide (free)	Extraction, Continuous Flow Colorimetry	Wet		2	mg/kg CN
CE077	Cyanide (total)	Extraction, Continuous Flow Colorimetry	Wet		2	mg/kg CN
CE014	Thiocyanate	Weak acid extraction, Colorimetry	Dry	M	1	mg/kg SCN
CE078	Phenols (total)	Extraction, Continuous Flow Colorimetry	Wet		0.5	mg/kg PhOH
CE087	PAH (speciated)	Solvent extraction, GC-MS	Wet		0.1	mg/kg
CE087	PAH (total)	Solvent extraction, GC-MS	Wet		5	mg/kg
CE033	TPH (C10-C40)	Solvent extraction, GC-FID	Wet	U	10	mg/kg

Chemtech Environmental Limited

METHOD DETAILS

METHOD	LEACHATES	METHOD SUMMARY	STATUS	LOD	UNITS
CE055	Arsenic (dissolved)	ICP-OES		0.001	mg/l As
CE055	Cadmium (dissolved)	ICP-OES	U	0.001	mg/l Cd
CE055	Chromium (dissolved)	ICP-OES	U	0.003	mg/l Cr
CE055	Copper (dissolved)	ICP-OES	U	0.004	mg/l Cu
CE055	Lead (dissolved)	ICP-OES	U	0.009	mg/l Pb
CE055	Mercury (dissolved)	ICP-OES		0.001	mg/l Hg
CE055	Nickel (dissolved)	ICP-OES	U	0.003	mg/l Ni
CE055	Selenium (dissolved)	ICP-OES		0.001	mg/l Se
CE055	Zinc (dissolved)	ICP-OES	U	0.020	mg/l Zn
CE087	PAH (speciated)	Solvent extraction, GC-MS		0.0001	mg/l
CE087	PAH (total)	Solvent extraction, GC-MS		0.0001	mg/l

APPENDIX D - GROUNDWATER AND GROUND GAS MONITORING

Ground Gas and Groundwater Monitoring Results

Site No:	GRS0112-1458	Weather Conditions:	Rain	Pressure Trend	Falling
Site Name:	Former Gardeners Arms				
Date:	03/04/2012				

GEOENVIRONMENTAL RISK SOLUTIONS

			CH_4 (%)	CO_2 (%)	O_2 (%)	BAL (%)	LEL (%)	H_2 (Low/Med /High)	H_2S ppm	CO ppm	Peak CH_4 (%)	Peak CO_2 (%)	Min O_2 (%)	Relative Pressure (mB)	Atmospheric Pressure (mB)	Depth to Groundwater (mbgl)	Depth to Base (mbgl)	Remarks
WS3	Ambient		0	0	21	79	0	L	0	0	0	1.5	13.6	0.31	998	-	1	
	Installation	30 Sec	0	1	16	83	0	L	0	0								
		1 Min	0	0.8	16.8	86.4	0	L	0	0								
		5 Min	0	1.4	13.8	84.8	0	L	0	0								
Time		10 sec	30 sec	1 min	2 min	3 min	4 min	5 min	10 min	15 min								
Flow (l/h)		-0.1	0	-0.1	-0.1	-0.1	0	-0.1	-0.1	-0.1								

			CH_4 (%)	CO_2 (%)	O_2 (%)	BAL (%)	LEL (%)	H_2 (Low/Med /High)	H_2S ppm	CO ppm	Peak CH_4 (%)	Peak CO_2 (%)	Min O_2 (%)	Relative Pressure (mB)	Atmospheric Pressure (mB)	Depth to Groundwater (mbgl)	Depth to Base (mbgl)	Remarks
WS1	Ambient		0	0	21.3	78.7	0	L	0	0	0	0	21.5	-0.03	998	0.96	2.91	
	Installation	30 Sec	0	0	21.5	78.5	0	L	0	0								
		1 Min	0	0	21.5	78.5	0	L	0	0								
		5 Min	0	0	21.5	78.5	0	L	0	0								
Time		10 sec	30 sec	1 min	2 min	3 min	4 min	5 min	10 min	15 min								
Flow (l/h)		5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6								

			CH_4 (%)	CO_2 (%)	O_2 (%)	BAL (%)	LEL (%)	H_2 (Low/Med /High)	H_2S ppm	CO ppm	Peak CH_4 (%)	Peak CO_2 (%)	Min O_2 (%)	Relative Pressure (mB)	Atmospheric Pressure (mB)	Depth to Groundwater (mbgl)	Depth to Base (mbgl)	Remarks
WS7	Ambient		0	0	21.6	78.4	0	L	0	0	0	0.7	21.1	-0.06	998	-	2.95	
	Installation	30 Sec	0	0.7	21.1	78.2	0	L	0	0								
		1 Min	0	0.7	21.1	78.2	0	L	0	0								
		5 Min	0	0.7	21.1	78.2	0	L	0	0								
Time		10 sec	30 sec	1 min	2 min	3 min	4 min	5 min	10 min	15 min								
Flow (l/h)		0	0	0	0	0	0	0	0	0								

Ground Gas and Groundwater Monitoring Results

Site No:	GRS0112-1458	Weather Conditions:	Sunny	Pressure Trend	Steady
Site Name:	Former Gardeners Arms				
Date:	12/04/2012				

			CH_4 (%)	CO_2 (%)	O_2 (%)	BAL (%)	LEL (%)	H_2 (Low/Med /High)	H_2S ppm	CO ppm	Peak CH_4 (%)	Peak CO_2 (%)	Min O_2 (%)	Relative Pressure (mB)	Atmospheric Pressure (mB)	Depth to Groundwater (mbgl)	Depth to Base (mbgl)	Remarks
WS3	Ambient		0	0	20.9	79.1	0	L	0	0	0.1	0	20.8	0	998	0.7	1	
	Installation	30 Sec	0.1	0	20.8	79.2	0	L	0	0								
		1 Min	0	0	20.8	79.2	0	L	0	0								
		5 Min	0	0	20.8	79.2	0	L	0	0								
Time		10 sec	30 sec	1 min	2 min	3 min	4 min	5 min	10 min	15 min								
Flow (l/h)		0	0	0	0	0	0	0	0	0								

			CH_4 (%)	CO_2 (%)	O_2 (%)	BAL (%)	LEL (%)	H_2 (Low/Med /High)	H_2S ppm	CO ppm	Peak CH_4 (%)	Peak CO_2 (%)	Min O_2 (%)	Relative Pressure (mB)	Atmospheric Pressure (mB)	Depth to Groundwater (mbgl)	Depth to Base (mbgl)	Remarks
WS1	Ambient		0	0	21	79	0	L	0	0	0	0.1	20.7	-0.04	998	1.08	2.9	
	Installation	30 Sec	0	0.1	20.7	79.2	0	L	0	0								
		1 Min	0	0	20.8	79.2	0	L	0	0								
		5 Min	0	0	20.8	79.2	0	L	0	0								
Time		10 sec	30 sec	1 min	2 min	3 min	4 min	5 min	10 min	15 min								
Flow (l/h)		0	0	0	0	0	0	0	0	0								

			CH_4 (%)	CO_2 (%)	O_2 (%)	BAL (%)	LEL (%)	H_2 (Low/Med /High)	H_2S ppm	CO ppm	Peak CH_4 (%)	Peak CO_2 (%)	Min O_2 (%)	Relative Pressure (mB)	Atmospheric Pressure (mB)	Depth to Groundwater (mbgl)	Depth to Base (mbgl)	Remarks
WS7	Ambient		0	0	20.9	79.1	0	L	0	0	0	0.6	19.9	-0.04	998	2.88	2.95	
	Installation	30 Sec	0	0.6	19.9	79.5	0	L	0	0								
		1 Min	0	0.6	19.9	79.6	0	L	0	0								
		5 Min	0	0.6	19.9	79.5	0	L	0	0								
Time		10 sec	30 sec	1 min	2 min	3 min	4 min	5 min	10 min	15 min								
Flow (l/h)		0	0	0	0	0	0	0	0	0								

Ground Gas and Groundwater Monitoring Results

Site No:	GRS0112-1458	Weather Conditions:	Cloudy	Pressure Trend	Rising
Site Name:	Former Gardeners Arms				
Date:	20/04/2012				

GEOENVIRONMENTAL RISK SOLUTIONS

			CH_4 (%)	CO_2 (%)	O_2 (%)	BAL (%)	LEL (%)	H_2 (Low/Med /High)	H_2S ppm	CO ppm	Peak CH_4 (%)	Peak CO_2 (%)	Min O_2 (%)	Relative Pressure (mB)	Atmospheric Pressure (mB)	Depth to Groundwater (mbgl)	Depth to Base (mbgl)	Remarks
WS3	Ambient		0	0	20.8	79.2	0	L	0	0	0	0.1	20.1	-0.07	987	0.6	1	
	Installation	30 Sec	0	0.1	20.1	79.8	0	L	0	0								
		1 Min	0	0.1	20.2	79.7	0	L	0	0								
		5 Min	0	0.1	20.2	79.7	0	L	0	0								
Time		10 sec	30 sec	1 min	2 min	3 min	4 min	5 min	10 min	15 min								
Flow (l/h)		0	0	0	0	0	0	0	0	0								

			CH_4 (%)	CO_2 (%)	O_2 (%)	BAL (%)	LEL (%)	H_2 (Low/Med /High)	H_2S ppm	CO ppm	Peak CH_4 (%)	Peak CO_2 (%)	Min O_2 (%)	Relative Pressure (mB)	Atmospheric Pressure (mB)	Depth to Groundwater (mbgl)	Depth to Base (mbgl)	Remarks
WS1	Ambient		0	0	20.9	79.1	0	L	0	0	0	0.3	20.5	-0.08	987	1.1	2.9	
	Installation	30 Sec	0	0.3	20.5	79.2	0	L	0	0								
		1 Min	0	0.3	20.6	79.1	0	L	0	0								
		5 Min	0	0.1	20.7	79.2	0	L	0	0								
Time		10 sec	30 sec	1 min	2 min	3 min	4 min	5 min	10 min	15 min								
Flow (l/h)		-4.8	3.5	4.8	4.8	4.8	4.7	4.8	4.8	4.8								

			CH_4 (%)	CO_2 (%)	O_2 (%)	BAL (%)	LEL (%)	H_2 (Low/Med /High)	H_2S ppm	CO ppm	Peak CH_4 (%)	Peak CO_2 (%)	Min O_2 (%)	Relative Pressure (mB)	Atmospheric Pressure (mB)	Depth to Groundwater (mbgl)	Depth to Base (mbgl)	Remarks
WS7	Ambient		0	0	21.1	78.9	0	L	0	0	0	0.8	21.1	0	987	2.9	2.95	
	Installation	30 Sec	0	0.8	20	79.2	0	L	0	0								
		1 Min	0	0.8	20	79.2	0	L	0	0								
		5 Min	0	0.8	20	79.2	0	L	0	0								
Time		10 sec	30 sec	1 min	2 min	3 min	4 min	5 min	10 min	15 min								
Flow (l/h)		0	0	0	0	0	0	0	0	0								

Ground Gas and Groundwater Monitoring Results

Site No:	GRS0112-1458	Weather Conditions:	Sunny	Pressure Trend	Rising
Site Name:	Former Gardeners Arms				
Date:	30/04/2012				

GEOENVIRONMENTAL RISK SOLUTIONS

			CH_4 (%)	CO_2 (%)	O_2 (%)	BAL (%)	LEL (%)	H_2 (Low/Med /High)	H_2S ppm	CO ppm	Peak CH_4 (%)	Peak CO_2 (%)	Min O_2 (%)	Relative Pressure (mB)	Atmospheric Pressure (mB)	Depth to Groundwater (mbgl)	Depth to Base (mbgl)	Remarks
WS3	Ambient		0	0	20.7	79.3	0	L	0	0	0	0.2	19.6	-0.31	1009	0.5	1	
	Installation	30 Sec	0	0.2	19.6	80.1	0	L	0	0								
		1 Min	0	0.1	20.2	79.7	0	L	0	0								
		5 Min	0	0.1	20.2	79.7	0	L	0	0								
Time		10 sec	30 sec	1 min	2 min	3 min	4 min	5 min	10 min	15 min								
Flow (l/h)		0	0.1	0	0	0	0	0	0	0								

			CH_4 (%)	CO_2 (%)	O_2 (%)	BAL (%)	LEL (%)	H_2 (Low/Med /High)	H_2S ppm	CO ppm	Peak CH_4 (%)	Peak CO_2 (%)	Min O_2 (%)	Relative Pressure (mB)	Atmospheric Pressure (mB)	Depth to Groundwater (mbgl)	Depth to Base (mbgl)	Remarks
WS1	Ambient		0	0	20.8	79.2	0	L	0	0	0	2.5	16.5	-0.28	1009			Installation damaged, bung could not be removed
	Installation	30 Sec	0	2.5	16.5	81	0	L	0	0								
		1 Min	0	2.4	16.7	81	0	L	0	0								
		5 Min	0	2.3	16.8	80.9	0	L	0	0								
Time		10 sec	30 sec	1 min	2 min	3 min	4 min	5 min	10 min	15 min								
Flow (l/h)		-4.1	-1.3	0	0	0	0	0	0	0								

			CH_4 (%)	CO_2 (%)	O_2 (%)	BAL (%)	LEL (%)	H_2 (Low/Med /High)	H_2S ppm	CO ppm	Peak CH_4 (%)	Peak CO_2 (%)	Min O_2 (%)	Relative Pressure (mB)	Atmospheric Pressure (mB)	Depth to Groundwater (mbgl)	Depth to Base (mbgl)	Remarks
WS7	Ambient		0	0	20.8	79.2	0	L	0	0	0	0.7	18.7	-0.34	1009	2.68	2.95	
	Installation	30 Sec	0	0.7	18.7	80.6	0	L	0	0								
		1 Min	0	0.7	18.7	80.6	0	L	0	0								
		5 Min	0	0.7	18.7	80.6	0	L	0	0								
Time		10 sec	30 sec	1 min	2 min	3 min	4 min	5 min	10 min	15 min								
Flow (l/h)		0	0	0	0	0	0	0	0	0								

Ground Gas and Groundwater Monitoring Results

Site No:	GRS0112-1458	Weather Conditions:	Rain	Pressure Trend	Falling
Site Name:	Former Gardeners Arms				
Date:	09/05/2012				

GEOENVIRONMENTAL RISK SOLUTIONS

			CH_4 (%)	CO_2 (%)	O_2 (%)	BAL (%)	LEL (%)	H_2 (Low/Med /High)	H_2S ppm	CO ppm	Peak CH_4 (%)	Peak CO_2 (%)	Min O_2 (%)	Relative Pressure (mB)	Atmospheric Pressure (mB)	Depth to Groundwater (mbgl)	Depth to Base (mbgl)	Remarks
WS3	Ambient		0	0	21	79	0	L	0	0	0	0	20.9	-0.15	1002	0.7	1	
	Installation	30 Sec	0	0	20.9	79.1	0	L	0	0								
		1 Min	0	0	20.9	79.1	0	L	0	0								
		5 Min	0	0	20.9	79.1	0	L	0	0								
Time		10 sec	30 sec	1 min	2 min	3 min	4 min	5 min	10 min	15 min								
Flow (l/h)		0	0	0	0	0	0	0	0	0								

			CH_4 (%)	CO_2 (%)	O_2 (%)	BAL (%)	LEL (%)	H_2 (Low/Med /High)	H_2S ppm	CO ppm	Peak CH_4 (%)	Peak CO_2 (%)	Min O_2 (%)	Relative Pressure (mB)	Atmospheric Pressure (mB)	Depth to Groundwater (mbgl)	Depth to Base (mbgl)	Remarks
WS1	Ambient		Installation damaged, no readings could be taken.															
	Installation	30 Sec																
		1 Min																
		5 Min																
Time		10 sec																
Flow (l/h)																		

			CH_4 (%)	CO_2 (%)	O_2 (%)	BAL (%)	LEL (%)	H_2 (Low/Med /High)	H_2S ppm	CO ppm	Peak CH_4 (%)	Peak CO_2 (%)	Min O_2 (%)	Relative Pressure (mB)	Atmospheric Pressure (mB)	Depth to Groundwater (mbgl)	Depth to Base (mbgl)	Remarks
WS7	Ambient		0	0	20.9	79.1	0	L	0	0	0	1	19.3	0.32	1002	2.8	2.95	
	Installation	30 Sec	0	1	19.3	79.7	0	L	0	0								
		1 Min	0	1	19.3	79.7	0	L	0	0								
		5 Min	0	1	19.3	79.7	0	L	0	0								
Time		10 sec	30 sec	1 min	2 min	3 min	4 min	5 min	10 min	15 min								
Flow (l/h)																		