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**PROPOSED RESIDENTIAL DEVELOPMENT
MAESTEG,
GWYNFRYN, WREXHAM
FOR
WALES & WEST HOUSING ASSOCIATION**

NOVEMBER 2013

**PHASE II GEO-ENVIRONMENTAL INVESTIGATION REPORT
13057**

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DOCUMENT STATUS

Site Reference	Maesteg, Gwynfryn, Wrexham.
Title	Phase II Geo-Environmental Investigation Report
Client	Wales & West Housing Association
Project No.	13076
Report Version	Final Issue
Date Issued	18th November 2013
Issue Notes	
Report Version	
Date Issued	
Issue Notes	
Report Version	
Date Issued	
Issue Notes	
Report Version	
Date Issued	
Issue Notes	
Report Version	
Date Issued	
Issue Notes	

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EXECUTIVE SUMMARY

Site	<i>Approximately 0.15ha in area and located at the junction of Ffodd Isaf and Allt Y Pentref in the village of Gwynfryn</i>
NGR	325731 352495
Site History	<i>The site has a full recorded history as being in agricultural usage.</i>
Investigations	<i>The investigations have extended to:-</i> <i>Intrusive investigations by window sampler boreholes</i> <i>Chemical analyses of soil samples</i> <i>Assessment of results</i>
Ground Conditions	<i>Uniform ground conditions comprising of topsoil 0.3 - 0.4m thick underlain by glaciofluvial sand and gravels deposits extending to at least 3.5m below ground level.</i>
Environmental	<i>Chemical testing has confirmed the topsoil to contain naturally occurring elevated concentrations of Lead. Remediation of topsoil is required. Underlying till deposits are not contaminated</i>
Trees	<i>The site contains a number of trees all of which are located at the main boundaries and are assumed to be retained as part of the development proposals. The ground conditions within the site are assessed to have a Low volume change potential as defined by NHBC</i>
Foundations	<i>Strip footings formed on natural clay strata with a safe bearing capacity of 150kN/m² at a minimum depth of 0.9m below finished ground level. Reinforcement is required in all foundations to protect against possible minor ground movements associated with nearby geological fault.</i>
Slabs	<i>Suspended ground floor slabs are recommended for all plots. All plots require FULL radon gas precautions within the ground floor construction.</i>
Remediation	<i>Topsoil should be removed from the site and replaced with imported topsoil from a certified source. Imported topsoil should be independently validated. FULL radon precautions required</i>

This brief summary should not be assumed to represent a complete account of all the potential geo-environmental issues that may exist at the site. As such it is strongly recommended that the report be read in its entirety.

PHASE II GEO-ENVIRONMENTAL INVESTIGATION WORKS

MAESTEG, GWYNFRYN, WREXHAM

1.0 INTRODUCTION

1.1 Instructions

1.1.1 We are instructed by Wales & West Housing Association of Flint Office, Unit 2 Acorn Business Park, Aber Road, Flint CH6 5YN to undertake a program of intrusive geo-environmental investigations at a site situated off Maesteg, Gwynfryn, Wrexham which they intend to redevelop. This site has been the subject of a previous Phase 1 Geo-Environmental desk study report prepared by this practice and dated July 2013. Reference should be made to the previous desk study report when considering this report.

1.2 Object

1.2.1 The object of these investigations were as follows:

- To enable sufficient information regarding ground conditions to be obtained from which risks to end users and the environment may be assessed;
- To utilise the information obtained from the investigations to provide recommendations for remediation measures where required;
- To determine the engineering properties of the soils present within the site to form a basis upon which foundation and general infrastructure recommendations and design may be based.

1.3 Scope

1.3.1 The investigations considered within this report have comprised of the following elements and are based upon the principles and recommendations presented in BS10175: 2011 "The Investigation of Potentially Contaminated Sites".

- Undertake intrusive ground investigation works utilising window sampling techniques;
- Determine the presence, nature and extent of any soil and groundwater contamination at the site;
- Determine the presence of any toxic or explosive gasses from areas of infilling within the site or the presence of biodegradable strata within the ground;
- Determination of the engineering properties of the soils present within the site to form a basis upon which recommendations for foundations and infrastructure construction may be based;
- Identify the potential requirements for any remedial actions where required.

1.4 Development Proposals

1.4.1 At the time of preparation of this report no formal development proposals have been completed. A proposed sketch site layout has however been provided to us to form the basis of the recommendations made within this report. This report is prepared on the basis that the site is to be considered for redevelopment on a residential basis and will propose the construction of properties in semi-detached and mews configurations as appropriate.

- 1.4.2 *It is also assumed that the site will contain areas of highways, hard standings and buildings with associated private residential gardens. It is acknowledged within this report that the proposed redevelopment will be subject to planning approval and it is possible that the development proposals shown upon the sketch site layout may be amended as a result of local planning and commercial requirements.*

1.5 Services

- 1.5.1 *Information regarding the possible presence of live public services within the site has been provided by our client. These records have confirmed that there are no recorded services present within the site area, though services are present within the adjoining highways. Whilst there is no evidence of any services present within the site, it is important to ensure that during the development process a watching brief is maintained to ensure that unrecorded services within the site area are not damaged.*

2.0 PHASE 1 DESK STUDY OVERVIEW

2.1 Previous Work

- 2.1.1 *This site has been the subject of a previous Phase 1 desk study report prepared by this practice. Report number 13057 "Phase 1 Geo-Environmental Desk Study Report" dated July 2013 was prepared for the benefit of our client in support of a planning application to redevelop the site in a private residential manner.*

2.2 Recommendations

- 2.2.1 *The initial works concluded that there was little documentary evidence to suggest that the site may have been affected by any significant chemical contamination or other environmental issues. The report did however recommend that a scheme of intrusive investigations should be undertaken to positively confirm the site conditions present. The original recommendations were that the works should be undertaken in accordance with the recommendations laid down in BS10175 : 2011 "Investigation of Potentially Contaminated Sites". The following elements were to be considered during this phase of work;*

- *Program of ground investigations to identify the strata sequence and assess engineering properties;*
- *Sampling of the existing strata for chemical and civil engineering laboratory test purposes;*
- *Program of chemical analyses upon representative samples of the strata to determine their suitability for reuse within a residential environment;*
- *Reinstatement;*
- *Commission an arboriculturist report on all trees within and adjacent to the site;*
- *Preparation of factual and interpretative report.*

2.3 Walkover Survey

- 2.3.1 *Prior to commencing any further intrusive ground investigations, a walkover survey of the site has been undertaken to ensure that the site conditions are similar to those reported upon within the initial phase I desk study. This walkover appraisal has confirmed that the site remains in a similar condition to that of July 2013 with no other significant features of note.*

2.4 Reference

- 2.4.1 *This phase II report should be read in conjunction with the initial desk study report for details of the site history and pre-existing environmental factors. The desk study report also includes details of all surrounding land uses and their potential impact upon the proposed development.*

3.0 SITE WORKS

3.1 Intrusive Works

- 3.1.1 *The ground conditions at this site have been investigated by the drilling of four (4 no.) window sampler boreholes. These boreholes have been drilled by Geo-Ventures (UK) Ltd., who are a ground investigation specialist contractor. These investigation techniques have been utilised over the whole area of the site to determine the shallow ground conditions present.*
- 3.1.2 *During the excavations representative samples of the soils encountered have been retained for laboratory analyses and testing where considered to be appropriate.*

3.2 Locations

- 3.2.1 *The locations of the boreholes were chosen by ourselves in conjunction with the desk study information and services locations in an effort to identify the representative ground conditions present across the whole site area. The ground conditions actually identified within the boreholes are considered to be representative of the majority of the shallow soils within the site area.*
- 3.2.2 *The locations of each of the boreholes are indicated upon the appended borehole location plan. These locations are shown in relation to site features present at the time of the investigations.*

3.3 Records

- 3.3.1 *During the investigations details of the strata types, water entries, ground conditions and levels have been maintained by Geo-Ventures (UK) Ltd. This information has been collated into a series of journals which are appended to this report for reference. During these investigations representative samples of the strata encountered have been retained for laboratory testing as required.*

3.4 Targeting

- 3.4.1 *The previous desk study has confirmed that this site has been in agricultural usage throughout the whole of its recorded history. There is no evidence of any specific previous development having taken place within the site area. The initial desk study has however identified the possible presence of marginally elevated lead concentrations within the upper soils.*
- 3.4.2 *The boreholes have been positioned so as to investigate the strata present over the whole of the proposed development area, though it is acknowledged that ground conditions may vary between individual borehole locations. The walkover survey has however identified no surface evidence to suggest variability within the ground conditions present.*

- 3.4.3 On the basis that this site is not considered to have been subject to likely contaminative usage the investigation locations have been spread over the whole area of the site in accordance with the recommendations laid down in BS10175 : 2011 "Investigation of Potentially Contaminated Sites". The initial ground investigation strategy is detailed within table 1 below.

Table 1 - Initial Ground Investigation Strategy

Exploratory Hole No.	Target	Purpose
WS 1 – WS 4	Generally over the site area.	To determine the general nature of underlying soils and geology including: 1. Nature, distribution and thickness of made ground 2. Nature, degree and extent of potential contamination 3. Content of unacceptable material eg biodegradable matter etc. 4. Suitability of the ground for the founding of structures 5. Engineering properties of the ground

4.0 GROUND CONDITIONS

4.1 Surface Strata

- 4.1.1 These investigation works have confirmed that over the developable area of the site the upper ground conditions comprise predominately of clayey topsoil extending thicknesses between 0.3 – 0.4m. Typically the topsoil thickness is in the order of 0.3m. This upper topsoil material is considered to represent a potentially important natural resource which may be suitable for reuse within the final residential development.
- 4.1.2 These investigations have located no evidence of any made ground or anthropogenic materials. It is not anticipated that any significant areas of made ground will be present within the site.
- 4.1.3 Underlying the surface topsoil strata, the investigations have proved the presence of a thin layer of glacial till material comprising of soft becoming firm sandy boulder clay with bands of sands and gravel. The original desk study data suggests that superficial deposits are unlikely to be present within the site, though these investigations have proved that they extend to depth of some 2.7m to beyond 3.5m below ground level where bedrock is present.
- 4.1.4 Insitu standard penetration testing carried out within the drilling process has confirmed values of $N=15 - 19$ blows/300mm at a depth of 1.0m below existing ground level. These results suggest that the natural strata within this site is capable of offering a safe bearing capacity in excess of 150kN/m^2 at a minimum depth of 0.9m below ground level. It is therefore recommended that foundations for proposed structures within this site should be designed to generate a maximum bearing stress of 150kN/m^2 at a minimum depth of 0.9m below finished ground level. It may of course be necessary for foundations to extend to slightly greater depths in areas where the ground conditions are proved to be locally soft.

- 4.1.5 *The investigations have proved the presence of bedrock within WS 3 and WS 4 lying at a depth of some 2.7m below ground level. The strata comprises of initially black weathered siltstone which is underlain by weathered clayey siltstone. This bedrock strata is typical of that anticipated from the original desk study information which suggested that the site would be underlain by the Bowland Shales Formation rather than the limestone noted to the south and west.*

4.2 Groundwater

- 4.2.1 *These investigations have been carried out in effectively dry conditions with no significant water entries being identified in any boreholes. Minor seepages have been noted within WS 1, WS 2 and WS 3 at varying depths below ground level. These water entries are anticipated to be the result of minor volumes of water which have become perched within the glacial till material. Groundwater is not anticipated to represent any particular hazard to the development of this site, though it is important to note that the presence of low permeability layers will give rise to the presence of small quantities of perched groundwater which may ingress into deeper excavations.*
- 4.2.2 *It is likely that significant volumes of water will become perched within excavations made upon this site during inclement weather conditions due to the predominately low permeability of the subsoil. Where localised temporary flooding does occur, standing water may be removed by simple sump pumping operations.*

4.3 Excavations

- 4.3.1 *The shallow strata present within this site comprises principally of cohesive soft to firm sandy boulder clays. It is anticipated that the majority of excavations made within this site will be capable of remaining open for a significant period without side support. It is however important to recognise that the sudden catastrophic collapse of any excavation made within this site represents a significant hazard.*
- 4.3.2 *It is essential that personnel should not be allowed to approach or enter any excavation made upon this site unless appropriate precautions have been adopted to ensure that hazardous side instability has been prevented. This is particularly important in relation to foundation and drainage construction where personnel may be specifically required to enter deeper excavations for essential construction purposes.*

4.4 Contamination

- 4.4.1 *The intrusive investigations have generally proved that the strata present over the site area is considered to be of a natural origin with no visible evidence of any potential pollution or contamination. The desk study has not drawn attention to any historical influences either within the site or its immediate vicinity.*

4.5 Sampling

- 4.5.1 *Based upon the initial site appraisal in conjunction with the findings of the intrusive investigations a series of representative samples of the strata encountered have been retained for laboratory analyses. These analyses have been intended to determine the potential presence of any contamination which may represent a hazard to site operatives or end users of the site. This section of the work is considered in more detail in sections 5 and 6 of this report.*

4.6 Index Testing

- 4.6.1 *The materials encountered during these investigations comprise of cohesive clay deposits which are considered to be potentially subject to volumetric change as a result of variation in moisture content. Accordingly a series of five (5 no.) samples of the clay strata have been submitted to a civil engineering laboratory to determine the index properties of the clays present.*

4.7 Landfill Gases

- 4.7.1 *The initial environmental desk study has confirmed that there are no recorded landfill sites lying within a 250m buffer zone of the study site area. The site is therefore not considered to be at risk from potentially hazardous ground gas migration from outside the study site area.*
- 4.7.2 *These investigations have identified the presence of natural glacial till material which does not give rise to hazardous ground gases. The site contains no evidence of any made ground or other features which may be indicative of biodegradable deposits which could potentially give rise to possible hazardous ground gas generation. There is therefore no requirement for any ground gas monitoring to be undertaken at this site.*

4.8 SUDS

- 4.8.1 *Assessment of the ground conditions present within this site in terms of sustainable urban drainage confirms the presence of effectively impermeable cohesive glacial till material over the whole site area. It is our opinion based upon the results of these investigations that the superficial deposits within this site should be considered to be impermeable and are not suitable for the use of a soakaway system of surface water disposal. It will be necessary for surface water to be disposed of utilising an adjacent existing drainage systems.*

5.0 CONTAMINATION ANALYSIS & ASSESSMENT CRITERIA

5.1 Sampling

- 5.1.1 *A total of six (6 no.) samples of strata encountered during these investigations have been retained for chemical analyses. Generally these samples relate to the shallow ground conditions located within the site. These samples are considered to be representative of the ground conditions within the site and form a basis for assessment of their potential for reuse within a residential environment.*

5.2 Range

These investigations have identified the presence of three distinct strata types within this site.

- 5.2.1 *This site is generally covered by a thin veneer of topsoil material which may be suitable for reuse within the proposed residential development. However, it is considered important that the topsoil be specifically assessed to determine its suitability for reuse and four (4 no.) samples of this strata have been returned to the laboratory for analyses.*

5.2.2 The natural strata present over the site area has been confirmed to comprise of natural glacial till deposits. These materials are normally considered to be uncontaminated in their natural condition but the original desk study has drawn attention to potential slightly elevated concentrations of lead. Accordingly two (2 no.) samples of shallow glacial till strata have also been retained for chemical analyses.

5.3 Laboratory

5.3.1 All samples selected for chemical analyses have been returned to Exova who are an MCERTS and UKAS accredited laboratory facility. Each sample has been subject to a range of chemical analyses to determine the concentrations of a wide range of common contaminants applicable to the former use of this site and the materials present. Details of the analysis program are shown in table 3 below. Confirmation of the UKAS and MCERTS accreditations for each test is indicated within the results which are appended to this report.

5.4 Development Proposals

5.4.1 We understand that the site is to be re-developed on a private residential basis and that it is most likely that the proposals will include for the preparation of sensitive private garden areas. It is assumed that the majority of the site will be covered by buildings, hard standing and access road ways. However it is essential to ensure that the materials present within the sensitive garden areas are suitable for retention within a residential environment. At this time no firm development proposals have been prepared and recommendations are presented on a residential basis only.

5.5 Analysis Range

5.5.1 The initial desk study and preliminary conceptual model confirm that this site is unlikely to have been affected by contamination, though the possible presence of unacceptable material within the topsoil strata has been considered.

5.5.2 Table 2 below confirms the range of analyses undertaken upon the samples of soil obtained from this site.

Table 2 – Table of Chemical Testing

Analysis Suite	Determinands	No. of Samples	Sample References	
			Topsoil	Natural Ground
Metals	Arsenic, Cadmium, Chromium (total), Chromium VI, Copper, Lead, Mercury, Nickel, Selenium, Zinc	6	WS1-0.1m, WS2-0.1m, WS3-0.2m, WS4-0.1m	WS1-0.5m, WS4-0.5m
Organics	PAH – USEPA 16 suite, Phenol	6	WS1-0.1m, WS2-0.1m, WS3-0.2m, WS4-0.1m	WS1-0.5m, WS4-0.5m
Inorganics	Cyanide, Soluble sulphates, Sulphide, pH, Organic matter	6	WS1-0.1m, WS2-0.1m, WS3-0.2m, WS4-0.1m	WS1-0.5m, WS4-0.5m

5.6 Results

5.6.1 Full details of the chemical analyses results are appended to this report for reference and should be read in conjunction with the comments and recommendations regarding risk assessments. Summaries of the test results are presented in conjunction with the current assessment criteria in section 6 of this report.

5.7 Approach

- 5.7.1 *The current UK approach to the consideration of contaminated land is based upon the principles of risk assessment. This in turn is founded upon the use of a source-pathway-target principle in order to establish the presence of a potential pollutant linkage. Our approach to the risk assessment is consistent with UK guidance and best practice. As advocated in the EA Policy Statement: Guidelines for Environmental Risk Assessment and Management a tiered approach has been adopted. This tiered approach is central to Part IIA of the Environmental Protection Act 1990 and the Town and Country Planning Act 1990.*

5.8 Site Classification

- 5.8.1 *The current development proposals for this site confirm that the site will be developed on a private residential basis utilising large areas of private gardens. Accordingly the site usage has been considered on the basis of an end land use of residential as defined by EA Science Report SC050021/SR3 2009 in relation to the most recent soil guideline values.*

5.9 Criteria

- 5.9.1 *The concentrations of contaminants within the ground have been compared to a range of generic soil guideline values that have been prepared by DEFRA and the Environment Agency. Where published, soil guideline values (sgv) have been utilised as intervention values for the purpose of an initial tier 1 assessment*
- 5.9.2 *At the time of the preparation of this report soil guideline values were available only for a limited number of contaminants and the development of both the CLEA model and additional soil guideline values is on-going. Where published soil guideline values are available they have been utilised as intervention values for the purposes of an initial tier 1 assessment. A number of sgv's have recently been updated to reflect a modern approach to the protection of human health.*
- 5.9.3 *Where soil guideline values were not published at the time of preparing this report, generic assessment criteria (GAC) published by Land Quality Management Ltd., in conjunction with the Chartered Institute Of Environmental Health have been adopted. The values published in the LQM/CIEH "Generic Assessment Criteria for Human Health Risk Assessment": 2nd Edition have been adopted.*
- 5.9.4 *Reference has also been made to published soil screening values presented by Atkins Ltd., under their Atrisk Subscription Service. The SSVs have been adopted where SGVs or GACs are not available. The remaining contaminants have been considered based upon information that was the best available at the time of the study.*

6.0 RESULTS OF ANALYSIS & QUALITATIVE RISK ASSESSMENT

6.1. Model

- 6.1.1 *As discussed above, assessment of contaminated land is based upon a simple assessment of pollutant linkages referred to as the source-pathway-target model. This assessment considers the current or proposed usage of the site in terms of suitability for use. This implies the use of risk assessment in principle in order to evaluate the potential effects and concerns of contamination on a site-specific basis.*

6.1.2 Initial assessment of the chemical analyses results has been undertaken to assess the concentrations of determinands in relation to tier 1 assessment criteria. The summary of these test results is detailed below.

6.2 Results Summary

6.2.1 The following tables 3 - 6 have been prepared as a summary of the laboratory analyses depending upon the class of analyses undertaken and the strata type present. The test results have been compared to the adopted assessment criteria, relating to a proposed residential land usage.

6.2.2 The samples obtained have been separated into topsoil and natural ground on the basis that these strata represent two significantly differing materials.

Table 3: Summary of Contamination Analysis: Metals & Inorganics (Topsoil)

	No. of Samples	Range of Values (mg/kg)	Assessment Criteria (mg/kg)	No. of Samples Failing	Locations
Arsenic	4	12 – 16	32 ¹	0	
Cadmium	4	1.0 – 2.8	10 ¹	0	
Chromium (total)	4	15 – 19	3000 ³	0	
Copper	4	18 – 37	2330 ³	0	
Lead	4	418 – 868	342 ²	4	All
Mercury	4	<0.5	170 ¹	0	
Nickel	4	7 – 20	130 ¹	0	
Selenium	4	<2	350 ¹	0	
Zinc	4	120 – 486	3750 ³	0	
Total Cyanide	4	<10	34 ²	0	
Phenol	4	<1	420 ³	0	
pH	4	4.3 – 6.1	-	-	
SOM	4	3.4% – 10.9%	-	-	
SO ₄ (2:1)	4	<0.01 – 0.02	0.5 ⁴	0	

¹ Revised SGV – SC050021 (values based upon “Residential” land use).

² Atkins Atrisk SSV residential with consumption of home grown produce (6% SOM)

³ LQM and CHIC Generic Assessment Criteria 2nd Edition.

⁴ BRE Special Digest 1:2005 DS-1.

N.D. – None detected.

6.3 Metals and Inorganics (Topsoil)

6.3.1 Reference to table 3 above confirms the range of contaminants considered within this series. The results show that for the metals and inorganics significant exceedences have been identified within the topsoil material in relation to the lead content. All samples tested have confirmed concentrations of lead which are above the current assessment criteria for a residential with gardens land usage. The maximum concentration of lead identified exceeds the gac by approximately 2½ times. The presence of lead at such concentrations represents a potential hazard to end users of the site and this is considered in more detail later within this report.

Table 4: Summary of Contamination Analysis: Organics: PAH USEPA 16 Suite (Topsoil)

	No. of Samples	Range of Values (mg/kg)	Assessment Criteria ¹ (mg/kg)	No. of Samples Failing	Locations
Acenaphthene	2	<0.1	100	0	
Acenaphthylene	2	<0.1	850	0	
Anthracene	2	<0.1	9200	0	
Benzo[a]anthracene	2	<0.1	5.9	0	
Benzo[a]pyrene	2	<0.1	1.0	0	
Benzo[b]fluoranthene	2	<0.1	7.0	0	
Benzo[ghi]perylene	2	<0.1	47	0	
Benzo[k]fluoranthene	2	<0.1	10	0	
Chrysene	2	<0.1	9.3	0	
Dibenz[ah]anthracene	2	<0.1	0.9	0	
Fluoranthene	2	<0.1	670	0	
Fluorene	2	<0.1	780	0	
Indeno[123-cd]pyrene	2	<0.1	4.2	0	
Naphthalene	2	<0.1	8.7	0	
Phenanthrene	2	<0.1	380	0	
Pyrene	2	<0.1	1600	0	

¹ LQM & CHIC Generic Assessment Criteria 2nd Edition - Residential (6% SOM)

6.4 Speciated PAH (Topsoil)

6.4.1 The soil samples retained from these investigations have been subject to a programme of analyses which have assessed the concentrations of the individual constituents of the polycyclic aromatic hydrocarbon series. A summary of these results is shown in table 4 above. The assessment criteria utilised are based upon the presence of 6% soil organic matter within the samples generally. Reference to the tests results does however show more variable soil organic matter content.

6.4.2 Assessment of Table 4 above confirms that the samples obtained from this site do not contain any significant concentrations of PAH compounds. Indeed all results are below the limit of detection. Accordingly these hydrocarbon compounds do not present a potential hazard to site operatives or end users of the site.

Table 5: Summary of Contamination Analysis: Metals & Inorganics (Natural Strata)

	No. of Samples	Range of Values (mg/kg)	Assessment Criteria (mg/kg)	No. of Samples Failing	Locations
Arsenic	4	8 – 12	32 ¹	0	
Cadmium	4	<0.5 – 0.5	10 ¹	0	
Chromium (total)	4	19 – 23	3000 ³	0	
Copper	4	14 – 11	2330 ³	0	
Lead	4	71 – 167	342 ²	0	
Mercury	4	<0.5	170 ¹	0	
Nickel	4	12 – 19	130 ¹	0	
Selenium	4	<2	350 ¹	0	
Zinc	4	46 – 51	3750 ³	0	
Total Cyanide	4	<10	34 ²	0	
Phenol	4	<1	420 ³	0	
pH	4	5.8 – 6.4	-	-	
SOM	4	0.6%	-	-	
SO ₄ (2:1)	4	<0.01	0.5 ⁴	0	

- ¹ Revised SGV – SC050021 (values based upon “Residential” land use).
² Atkins Atrisk SSV residential with consumption of home grown produce (6% SOM)
³ LQM and CHIC Generic Assessment Criteria 2nd Edition.
⁴ BRE Special Digest 1:2005 DS-1.
N.D. – None detected.

6.5 Metals and Inorganics (Natural Strata)

6.5.1 Reference to table 5 above confirms that the natural strata present within this site does not contain any elevated concentrations of contaminants within this series. These results suggest that elevated lead concentrations are confined only to the surface topsoil material.

Table 6: Summary of Contamination Analysis: Organics: PAH USEPA 16 Suite (Natural Strata)

	No. of Samples	Range of Values (mg/kg)	Assessment Criteria ¹ (mg/kg)	No. of Samples Failing	Locations
Acenaphthene	2	<0.1	100	0	
Acenaphthylene	2	<0.1	850	0	
Anthracene	2	<0.1	9200	0	
Benzo{a}anthracene	2	<0.1	5.9	0	
Benzo{a}pyrene	2	<0.1	1.0	0	
Benzo{b}fluoranthene	2	<0.1	7.0	0	
Benzo{ghi}perylene	2	<0.1	47	0	
Benzo{k}fluoranthene	2	<0.1	10	0	
Chrysene	2	<0.1	9.3	0	
Dibenz{ah}anthracene	2	<0.1	0.9	0	
Fluoranthene	2	<0.1	670	0	
Fluorene	2	<0.1	780	0	
Indeno{123-cd}pyrene	2	<0.1	4.2	0	
Naphthalene	2	<0.1	8.7	0	
Phenanthrene	2	<0.1	380	0	
Pyrene	2	<0.1	1600	0	

¹ LQM & CHIC Generic Assessment Criteria 2nd Edition - Residential (6% SOM)

6.6 Speciated PAH (Natural Soil)

6.6.1 Assessment of table 6 above again confirms that the natural strata samples obtained from this site do not contain any significant concentrations of PAH compounds. Indeed all results are below the limit of detection. These hydrocarbon compounds do not present a potential hazard to site operatives or end users of the site.

6.7 Sulphates

6.7.1 Within the program of laboratory testing each sample has also been analysed to determine the concentration of water soluble sulphates within the ground. Reference to the laboratory results presented by Exova confirms that soluble sulphates are present at concentrations of <0.02g/l. Reference to BRE Special Publication 1 : 2005 “Concrete in Aggressive Ground” confirms that at <0.5g/l, the design sulphate class for this site is DS-1. Accordingly the ACEC class for the site is assessed to be AC-1S on the basis that the site does not have mobile groundwater and the pH value is >5.5.

6.8 Index Properties

6.8.1 A total of five (5 no.) samples of the clay strata encountered during these investigations have been returned to a civil engineering laboratory to determine their index properties. Copies of the laboratory test results are appended to this report for reference. Consideration of these results confirms that the clay soils within the site have a plasticity index in the range of 10% – 14%. Accordingly the clay strata within this site is considered to have a low volume change potential as defined by NHBC Handbook Chapter 4.2.2.

7.0 DISCUSSIONS

7.1 General

7.1.1 The initial desk study of this site has confirmed a history which includes apparent agricultural usage over the whole period. The initial walkover survey of the site has identified no visible evidence of any potentially hazardous contamination but nevertheless consideration of possible non-visible contamination has been considered within this report.

7.1.2 The results of the chemical analyses undertaken upon representative samples of strata obtained from this site have been assessed in section 6 above and subject to further discussion below.

7.2 Metals & Inorganics

7.2.1 The analysis undertaken for this suite of determinants has identified significantly elevated concentrations of lead within the topsoil material. In fact the presence of elevated lead concentrations is a well-recognised phenomenon within this area of North Wales and is associated with potential lead bearing deposits particularly associated with limestone bedrock which lies within the general vicinity. Whilst the elevated concentrations are recognised to represent a natural phenomenon, and it is almost certainly the case that surrounding residential areas contain topsoil within equally elevated lead content, it is nevertheless recognised that the topsoil within this site does present a potential long term hazard to the end users of the site in relation to rear garden areas where food may be grown for consumption.

7.2.2 Accordingly the topsoil within this site is considered to be unsuitable for reuse within a residential environment where plants may be grown for consumption and where close contact of the soils may occur. Remediation by the removal of the topsoil materials and immediately underlying strata will be required at this site.

7.2.3 Representative samples of the natural strata from increased depths have confirmed no evidence of widespread elevated concentrations of lead and it is confirmed that the contamination is contained only within the immediate surface material.

7.3 PAH Suite

7.3.1 The analysis has confirmed no elevated concentrations of any PAH compounds. Indeed all factions of the PAH grouping have been found to be present at concentrations of less than the limits of detection. PAH compounds do not therefore represent any potential long term hazard to the site.

7.4 Ground Gases

7.4.1 The site is not affected by the presence of any surrounding landfill sites and the investigations have not located any evidence of potentially biodegradable materials within the site area. On this basis therefore there is no requirement for any program of long term ground gas monitoring to be undertaken at this site.

7.5 Mining

7.5.1 Within the initial desk study report the possible presence of mining within the vicinity has been identified. Reference to the geological section of the report confirms that coal mining has not taken place within the immediate vicinity of this site, but draws attention to the possible presence of mineral mining within the vicinity. The results of these investigations have demonstrated that the bedrock material represents the Bowland Shales Formation and is separated from the lead bearing limestone strata by geological faulting. On the basis that the Bowland Shales are present within this site, we are of the opinion that the site is not affected by mineral mining activity.

7.6 Conceptual Site Model

7.6.1 As a result of these intrusive ground investigations and subsequent program of chemical analyses, it has been possible to revise the preliminary conceptual site model presented in the desk study report. The revised conceptual site model is now shown in table 7 below.

Table 7 – Revised Conceptual Site Model

Potential Source	Potential Receptor	Possible Pathway	Probability	Consequence	Risk	Mitigation / Investigation
Contaminated Soils	Site personnel during construction	Direct contact of soils Inhalation or ingestion of soil / dust	Ul	Md	Low	No evidence of contamination in any analysis results
	Future site users	Direct contact of soils Inhalation or ingestion of soil / dust	Ul	Md	Low	
	Surface water in the vicinity of the site	Leaching of contaminants through drainage system	Lw	Mi	Low	
	Ground water in aquifer	Leaching of contaminants to ground water	Ul	Md	Low	
	Future site users	Vapour migration from soils	Ul	Md	Low	
	Proposed buildings and services	Direct contact with contaminated soils	Lw	Mi	Low	
	Plants in gardens and soft landscaping	Direct contact	Lw	Mr	Very Low	
Contaminated ground water	Site personnel during construction	Water entering excavations	Lw	Mr	Very Low	No ground water issues
	Future site Users	Retained surface water	Lw	Mi	Very Low	
Toxic and explosive gasses	Proposed buildings and occupiers	Ground gas migration into buildings	Ul	Md	Low	No potential ground gas influences
Radon gas	Proposed buildings and occupiers	Ground gas migration into buildings	Li	Sv	High	FULL radon precautions required

Key: Sv = Severe, Md = Medium, Mi = Mild, Mr = Minor Hi = High, Li = Likely, Lw = Low Likelihood, Ul = Unlikely

7.7 Preliminary Remediation Proposals

- 7.7.1 *These investigations have proved the presence of significantly elevated concentrations of lead within the surface topsoil strata. The presence of naturally occurring elevated lead concentrations within surface topsoil is a common phenomenon generally within this area of North Wales, but nevertheless it is considered that the concentrations of lead which are present significantly exceed the current assessment criteria and as such a program of remediation will be required.*
- 7.7.2 *It will therefore be necessary for the topsoil materials to be stripped from the site and disposed of at an appropriate tipping location. Prior to the removal of the topsoil it will be prudent to undertake a program of further sampling and WAC testing to determine the leachable concentrations of lead present as this will form a basis upon which waste soil may be classified. The concentrations of lead which are present preclude the topsoil from use in any residential environment, though it is possible that the materials could be utilised within a commercial/industrial location.*
- 7.7.3 *The removal of topsoil from the site will require the importation of replacement topsoil to be placed within gardens and soft landscaped areas. It is necessary that materials imported to this site should be obtained from a suitably certified source and be confirmed by a program of rigorous sampling and testing to be suitable for use within a residential with plant growth environment. These importation works should be independently verified and validated to ensure the long term safety of end users of the site.*
- 7.7.4 *The initial desk study undertaken within this report has identified that the site lies within an area which may be affected by radon gas omissions. Accordingly it will be necessary for full radon gas precautions to be adopted within all properties constructed upon this site.*

7.8 Foundations

- 7.8.1 *The ground conditions within this site are relatively uniform and comprise of a relatively thin layer of topsoil overlying natural glacial tills comprising of soft to firm sandy boulder clays. The natural strata is considered to offer a safe bearing capacity of at least 150kN/m² at a depth of some 0.9m below ground level. As such the strata within this site is suitable for the adoption of a shallow spread type foundation. The majority of the structures within this site may be founded at a minimum depth of 0.9m below existing ground level. All foundations should be provided with nominal reinforcement to protect against any potential minor ground movements associated with the adjacent geological faulting.*
- 7.8.2 *A program of laboratory testing has confirmed that the clays present within this site have been assessed to have a low volume change potential as defined by NHBC Handbook Chapter 4.2. It will however be necessary for specific foundation designs to be undertaken to all properties which are to be located in proximity to existing trees regardless as to whether these trees are to be retained or removed. Foundation depths may potentially extend up to 2.5m below existing ground level, however foundation depths should be determined in conjunction with the final site layout details, NHBC recommendations and a detailed arboriculturist report.*

7.9 Ground Floor Construction

7.9.1 *It is recommended that all properties within this site should be provided with a suspended ground floor construction. This may be of a specialist manufactured precast concrete beam and block type, or of a designed cast insitu construction. It is recommended within the areas of tree root influences that a beam and block floor utilising an appropriate air void be adopted in accordance with the recommendations made by the NHBC. In all other areas it will be possible to utilise a cast insitu ground floor construction if required. Full radon gas precautions are required in all ground floor constructions.*

7.10 Precautions

7.10.1 *Whilst these investigations have not located any evidence of suspicious or unusual ground conditions, it is important to recognise that should such features become evident during the development process, they should be drawn to the attention of the appropriate authorities before proceeding. It is important that inspection, sampling and testing of any unusual materials encountered within the site is undertaken so as to ensure that these do not represent a hazard to site operatives or final end users.*

8.0 CONCLUSIONS & RECOMMENDATIONS

8.1 Remediation

8.1.1 *Sampling and laboratory testing of representative samples of topsoil from this site has confirmed the presence of elevated concentrations of lead. Accordingly at this time we propose that a program of remediation should be carried out at the site which includes the removal of all surface topsoil and disposal away from the site. It would be prudent to undertake a program of further sampling and WAC testing to determine the leachable proportion of lead present within the topsoil to determine the classification of the topsoil in terms of disposal.*

8.1.2 *The site lies within an area which may be affected by radon gas omissions. Accordingly it will be necessary for all properties and extensions to properties on this site to be provided with full radon gas precautions in accordance with the recommendations and procedures laid down in BRE 211 2007 Radon : "Guidance on Protective Measures for New Buildings".*

8.2 Foundations

8.2.1 *The superficial natural ground conditions within this site are conducive to the use of a shallow spread foundation formed at a minimum depth of 0.9m below ground level. It is likely within the area where trees are in close proximity that foundations will need to extend to increased depths depending upon the conditions present. In those areas where trees are present, it will be necessary for the foundations to be design in accordance with the requirements of the NHBC Handbook Chapter 4.2 in conjunction with the arboriculturist report. The clay soils within this site are considered to have a low volume change potential for design purposes. All foundations should be provided with nominal reinforcement to protect against any potential minor ground movements associated with the adjacent geological faulting.*

8.3 Ground Floor Construction

8.3.1 *It is recommended that a suspended ground floor construction be adopted to all properties located within this site. These constructions may be of a precast concrete beam and block arrangement or of a suitably designed cast insitu reinforced concrete. In those areas where tree root influences are important, it is recommended that a pre-cast concrete beam and block floor construction be utilised with an appropriate air void in accordance with the requirements of the NHBC. Full radon gas precautions are required to all structures located upon this site.*

8.4 SUDS

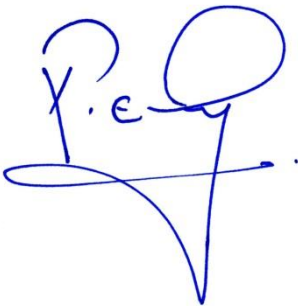
8.4.1 *The superficial deposits present within this site have been confirmed to comprise of glacial till material consisting of soft to firm sandy clays. This type of strata is considered to be effectively impermeable and is not conducive to the adoption of a soakaway system of surface water disposal. It will therefore be necessary for surface water at this site to be disposed of to an appropriate drainage point outside the site area.*

9.0 NOTES

- 9.1 *All reports are for advisory purposes only and all design decisions are the ultimate responsibility of others.*
- 9.2 *Unless stated otherwise the investigation has been undertaken in general accordance with the recommendations given in BS 5930 : 1999 "A Code of Practice for site Investigations" and the laboratory testing has been carried out in accordance with BS 1377 : 1990 "Methods of Test for Civil Engineering Purposes".*
- 9.3 *Soil and rock descriptions are generally based on the scales of strength and relative density within BS 5930 although it should be noted that in certain circumstances descriptions are based on site records or a qualitative assessment without the benefit of in-situ or laboratory test results.*
- 9.4 *The assessment of ground conditions given in this report is based on the results of the fieldwork and laboratory testing carried out and there may be other conditions at the site not encountered by these works, which have not been taken into account.*
- 9.5 *The scope of the investigation and information provided may not necessarily reflect all the geotechnical and environmental aspects related to the site, and the omission of certain items does not mean that the site is unaffected by such problems.*
- 9.6 *It should be noted that groundwater levels can vary and may at times be significantly different to those recorded during the investigation and attention is drawn to BS 5930 which indicates that measurements may be necessary over an extended period of time to investigate changes in groundwater pressures due to seasonal, tidal and other causes.*
- 9.7 *Any recommendations on construction methods within this report are for initial guidance only and all design proposals remain the responsibility of the appropriate contractor/consultant.*
- 9.8 *Further assessment, investigation, construction activities or time may reveal conditions that were not found during the period of investigation and, therefore, could not have been taken into account in the preparation of the report and where such information might impact upon the stated opinion R. E. Fry & Associates Ltd request the opportunity to review such information and modify the report if necessary.*

- 9.9** *Where information has been obtained from sources other than the direct findings of the investigation, R. E. Fry & Associates Ltd cannot and does not guarantee the authenticity or reliability of this information.*
- 9.10** *Where opinions expressed in this report are based on current available guidelines and legislation, no liability can be accepted by R. E. Fry & Associates Ltd for the effects of any future changes to such guidelines and legislation.*
- 9.11** *This report has been prepared on the instructions and to the requirements of the named client and any unauthorised party using this information for any purpose does so at his own risk and any duty of care to that party is excluded.*

Signed for and on behalf of
R E FRY & ASSOCIATES LIMITED

A handwritten signature in blue ink, appearing to read 'R. E. Fry', with a large loop at the end of the name.

R E FRY B Sc (Hons), C Eng., MI Struct.E., M.a.P.S.

APPENDIX A

* PLEASE NOTE: THIS DRAWING IS NOT TO SCALE *



SITE PLAN VIEW

KEY:



WS1

APPROXIMATE
LOCATION OF
WINDOW
SAMPLER
BOREHOLES

revision suffix	Revision Details		Date
Draft	Comments	Tender	
Issued	Information	Construction	
Preliminary	Approval	As Built	

This drawing is not authorised unless signed as checked & approved

Client

**Wales & West
Housing Association**

Job title

Maesteg, Gwynfryn

Drawing title

Borehole Location Plan



45 Bridgeman Terrace
Wigan, Lancs
WN1 1TT
Tel: (01942) 826020
Fax: (01942) 230816

CONSULTING ENGINEERS

CIVIL • STRUCTURAL

GEOTECHNICAL • ENVIRONMENTAL

Chkd	Appvd	date	scale	drawn
		14.11.13	N.T.S	P.T
DRAWING No		13057/01		rev

© This drawing is the property of REFA and should not be copied, used or its contents divulged without prior written consent.
Any discrepancies to this drawing discovered on site should be reported to REFA immediately. IF IN DOUBT ASK!

APPENDIX B



337.7m

+

Bryn Awel

16

ESTEG

5

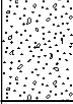
Private
garden
42m²

Bryn Foty

House types.

5 no. 2 bed / 4 person. --m²

APPENDIX C

Geo-Ventures (UK) Limited Geotechnical and Environmental Services						Site Maesteg, Gwynfryn		Number WS1	
Excavation Method Drive-in Window Sampler		Dimensions		Ground Level (mOD)		Client		Job Number 13-804	
		Location		Dates 29/10/2013		Engineer Robert E Fry & Associates Limited		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	
0.10	G		4,4/4,6,5,4		(0.40)	Black TOPSOIL		▽1	
0.40	G				0.40	Firm grey / orange / brown CLAY with occasional fine angular sandstone gravel (Made Ground?)			
0.50	G								
1.00-1.45	SPT(C) N=19 D				(2.20)				
1.00-1.45									
2.00-2.45	D SPT(C) N=19				Seepage(1) at 2.00m. 3,4/4,5,5,5				
2.00-2.45									
2.80	D SPT(C) N=16 D				4,5/4,4,4,4	2.60	Medium dense grey / brown claybound coarse SAND and fine to coarse angular GRAVEL		
3.00-3.45						(0.85)			
3.00-3.45						3.45	Complete at 3.45m		
Remarks Service pit excavated by hand to 1.00m							Scale (approx) 1:50	Logged By Dr J Crook	
							Figure No. 13-804.WS1		

Geo-Ventures (UK) Limited Geotechnical and Environmental Services						Site Maesteg, Gwynfryn		Number WS2	
Excavation Method Drive-in Window Sampler		Dimensions		Ground Level (mOD)		Client		Job Number 13-804	
		Location		Dates 29/10/2013		Engineer Robert E Fry & Associates Limited		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	
0.10	G				(0.30)	Black TOPSOIL			
0.35	G				0.30				
0.50	D				(0.40)	Grey /orange claybound sandy fine sub-rounded / sub-angular GRAVEL (Made Ground?)			
0.80	D				0.70				
1.00-1.45	SPT(C) N=15		2,2/3,4,4,4			Soft / firm and firm grey / orange / brown sandy very gravelly CLAY / loose / medium dense very clayey sandy fine / medium angular GRAVEL (Made Ground?)			
1.00-1.45	D								
2.00-2.45	D		Seepage(1) at 2.00m.		(2.75)			Σ1	
2.00-2.45	SPT(C) N=15		2,2/2,5,4,4						
3.00-3.45	SPT(C) N=5		1,1/1,1,1,2						
3.00-3.45	D				3.45				
						Complete at 3.45m			
Remarks Service pit excavated by hand to 1.00m							Scale (approx) 1:50	Logged By Dr J Crook	
							Figure No. 13-804.WS1		

Geo-Ventures (UK) Limited Geotechnical and Environmental Services						Site Maesteg, Gwynfryn		Number WS3	
Excavation Method Drive-in Window Sampler		Dimensions		Ground Level (mOD)		Client		Job Number 13-804	
		Location		Dates 29/10/2013		Engineer Robert E Fry & Associates Limited		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	
0.20 0.35	G G				(0.30) 0.30	Black TOPSOIL		V1	
						Soft / firm to firm grey / orange / yellow CLAY			
1.00-1.45 1.00-1.45	SPT(C) N=18 D		2,2/3,4,6,5 Seepage(1) at 1.10m.						
					(2.40)				
2.00-2.45 2.00-2.45	SPT(C) N=19 D		3,3/3,6,6,4						
2.80	D				2.70 (0.20)	Black laminated SHALE / COAL (Made Ground?)			
3.00-3.45 3.00-3.45	SPT(C) N=29 D		3,3/5,5,9,10		2.90 (0.55)	Firm / stiff grey / yellow CLAY			
					3.45				
						Complete at 3.45m			
Remarks Service pit excavated by hand to 1.00m							Scale (approx)	Logged By	
							1:50	Dr J Crook	
							Figure No. 13-804.WS1		

Geo-Ventures (UK) Limited Geotechnical and Environmental Services						Site Maesteg, Gwynfryn		Number WS4	
Excavation Method Drive-in Window Sampler		Dimensions		Ground Level (mOD)		Client		Job Number 13-804	
		Location		Dates 29/10/2013		Engineer Robert E Fry & Associates Limited		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	
0.10	G				(0.40)	Black TOPSOIL			
0.40	G				0.40	Firm brown and grey / brown CLAY (Made Ground ?)			
0.50	G								
1.00-1.45	SPT(C) N=19		2,4/4,5,5,5						
1.00-1.45	D				(2.30)				
2.00-2.45	SPT(C) N=26		3,3/3,6,7,10						
2.00-2.45	D								
2.80	D				2.70 (0.20)	Black laminated SHALE / COAL (Made Ground?)			
3.00-3.45	SPT(C) N=29		3,4/6,7,8,8		2.90 (0.55)	Firm / stiff grey / yellow CLAY			
3.00-3.45	D				3.45				
						Complete at 3.45m			
Remarks Service pit excavated by hand to 1.00m							Scale (approx) 1:50	Logged By Dr J Crook	
							Figure No. 13-804.WS1		

Geo-Ventures (UK) Limited
Geotechnical and Environmental Services

Standard Penetration Test Results

Site : Maesteg, Gwynfryn

Client :

Engineer: Robert E Fry & Associates Limited

Borehole Number	Base of Borehole (m)	End of Seating Drive (m)	End of Test Drive (m)	Test Type	Seating Blows per 75mm		Blows for each 75mm penetration				Result	Comments
					1	2	1	2	3	4		
1	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
2	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
3	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
4	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
5	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
6	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
7	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
8	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
9	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
10	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
11	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
12	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
13	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
14	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
15	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
16	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
17	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
18	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
19	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
20	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
21	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
22	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
23	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
24	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
25	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
26	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
27	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
28	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
29	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
30	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
31	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
32	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
33	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
34	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
35	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
36	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
37	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	
38	1.0	1.0	1.0	1	1	2	1	2	3	4	Pass	

Sheet

1 / 1

Borehole Number	Base of Borehole (m)	End of Seating Drive (m)	End of Test Drive (m)	Test Type	Seating Blows per 75mm		Blows for each 75mm penetration				Result	Comments
					1	2	1	2	3	4		
WS1	1.00	1.15	1.45	CPT	4	4	4	6	5	4	N=19	
WS1	2.00	2.15	2.45	CPT	3	4	4	5	5	5	N=19	
WS1	3.00	3.15	3.45	CPT	4	5	4	4	4	4	N=16	
WS2	1.00	1.15	1.45	CPT	2	2	3	4	4	4	N=15	
WS2	2.00	2.15	2.45	CPT	2	2	2	5	4	4	N=15	
WS2	3.00	3.15	3.45	CPT	1	1	1	1	1	2	N=5	
WS3	1.00	1.15	1.45	CPT	2	2	3	4	6	5	N=18	
WS3	2.00	2.15	2.45	CPT	3	3	3	6	6	4	N=19	
WS3	3.00	3.15	3.45	CPT	3	3	5	5	9	10	N=29	
WS4	1.00	1.15	1.45	CPT	2	4	4	5	5	5	N=19	
WS4	2.00	2.15	2.45	CPT	3	3	3	6	7	10	N=26	
WS4	3.00	3.15	3.45	CPT	3	4	6	7	8	8	N=29	

APPENDIX D



Test Certificate

Client: Robert E Fry & Associates Ltd
45 Bridgeman Terrace, Wigan, Lancashire, WN1 1TT
Site: 13057 - Maesteg, Gwynfryn

Date Tested: 01/11/13, 04/11/13, 07/11/13, 08/11/13, 11/11/13, 12/11/13
Date Reported: 12 November, 2013
Date Received: 31 October, 2013
Sample Type: Solid

Certificate No: 13/2866/R/SS/C1
File No: 13/2866/R/SS
Client Ref: None Supplied

		Lab sample ref: B455405		B455406		B455407		B455408		B455409	
		Client sample ref: WS1		WS1		WS2		WS3		WS4	
		0.1m		0.5m		0.1m		0.2m		0.1m	
		Date sampled: Not Stated		Not Stated		Not Stated		Not Stated		Not Stated	
		Sample matrix (see notes page): S		S		S		S		S	
Determinand	Method	Units	ISO17025	MCERTS	LOD						
Deviation Assessment											
Deviation(s)	C. Review	N/A	N/A	N/A	N/A	5	5	5	5	5	5
MCERTS Sample Prep											
% Stones	Stones	%	N/A	N/A	0	0.0	16.2	0.0	0.0	0.0	0.0
Moisture Content @ 35°	CTP01	% w/w	N/A	N/A	0.1	18.8	10.3	25.8	29.5	26.4	26.4
Sample Description^	SGP5		N/A	N/A		4	5A	4	4	4	4
Misc											
pH*	AN5a		Y	Y		5.6	5.8	4.3	4.9	6.1	6.1
Sulphate (water soluble)	CTP29	g/l	Y	Y	0.01	0.01	<0.01	0.01	0.02	<0.01	<0.01
Sulphide _M	CTP16	mg/kg	N	N	2	<2	<2	<2	<2	<2	<2
Cyanide (total) _M	CTP18c	mg/kg	Y	Y	10	<10	<10	<10	<10	<10	<10
Phenols (screen) _M	CTP20	mg/kg	Y	N	1	<1	<1	<1	<1	<1	<1
Organic Matter*	AN48b	%	N	N	0.1	9.4	0.6	10.3	10.9	3.4	3.4
Arsenic	CTP11A 2	mg/kg	Y	Y	2	12	12	15	13	16	16
Cadmium	CTP11A 0.5	mg/kg	Y	Y	0.5	1.0	0.5	1.0	2.8	1.3	1.3
Chromium (total)	CTP11A 3	mg/kg	Y	Y	3	17	19	18	15	19	19
Copper	CTP11A 3	mg/kg	Y	Y	3	18	14	19	21	37	37
Lead	CTP11A 1	mg/kg	Y	Y	1	418	71	652	439	868	868
Mercury	CTP11A 0.5	mg/kg	Y	Y	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nickel	CTP11A 2	mg/kg	Y	Y	2	7	12	11	12	20	20
Selenium	CTP11A 2	mg/kg	Y	Y	2	<2	<2	<2	<2	<2	<2
Zinc	CTP11A 2	mg/kg	Y	Y	2	151	46	120	486	206	206
Moisture Content @ 105°	CTP01	% w/w	N	N/A	0.1	24.2	33.8	32.8	41.3	36.1	36.1
PAH (USEPA16)											
Acenaphthene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b)fluoranthene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(ghi)perylene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(k)fluoranthene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenz(a,h)anthracene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene _M	GCM 501	mg/kg	Y	Y	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-cd)pyrene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Naphthalene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene _M	GCM 501	mg/kg	Y	Y	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1



Test Certificate

Client: Robert E Fry & Associates Ltd
45 Bridgeman Terrace, Wigan, Lancashire, WN1 1TT
Site: 13057 - Maesteg, Gwynfryn
Date Tested: 01/11/13, 04/11/13, 07/11/13, 08/11/13, 11/11/13, 12/11/13
Date Reported: 12 November, 2013
Date Received: 31 October, 2013
Sample Type: Solid

Certificate No: 13/2866/R/SS/C1
File No: 13/2866/R/SS
Client Ref:

Lab sample ref: B455410
Client sample ref: WS4
Date sampled: 0.5m
Sample matrix (see notes page): Not Stated
S

Determinand	Method	Units	ISO17025	MCERTS	LOD	
Deviation Assessment						
Deviation(s)	C. Review	N/A	N/A	N/A	N/A	5
MCERTS Sample Prep						
% Stones	Stones	%	N/A	N/A	0	0.0
Moisture Content @ 35°	CTP01	% w/w	N/A	N/A	0.1	11.9
Sample Description*	SGP5		N/A	N/A		5
Misc						
pH*	AN5a		Y	Y		6.4
Sulphate (water soluble)	CTP29	g/l	Y	Y	0.01	<0.01
Sulphide _M	CTP16	mg/kg	N	N	2	<2
Cyanide (total) _M	CTP18c	mg/kg	Y	Y	10	<10
Phenols (screen) _M	CTP20	mg/kg	Y	N	1	<1
Organic Matter*	AN48b	%	N	N	0.1	0.6
Arsenic	CTP11A 2	mg/kg	Y	Y	2	8
Cadmium	CTP11A 0.5	mg/kg	Y	Y	0.5	<0.5
Chromium (total)	CTP11A 3	mg/kg	Y	Y	3	23
Copper	CTP11A 3	mg/kg	Y	Y	3	11
Lead	CTP11A 1	mg/kg	Y	Y	1	167
Mercury	CTP11A 0.5	mg/kg	Y	Y	0.5	<0.5
Nickel	CTP11A 2	mg/kg	Y	Y	2	19
Selenium	CTP11A 2	mg/kg	Y	Y	2	<2
Zinc	CTP11A 2	mg/kg	Y	Y	2	51
Moisture Content @ 105°	CTP01	% w/w	N	N/A	0.1	10.8
PAH (USEPA16)						
Acenaphthene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1
Acenaphthylene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1
Anthracene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1
Benz(a)anthracene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1
Benzo(a)pyrene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1
Benzo(b)fluoranthene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1
Benzo(ghi)perylene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1
Benzo(k)fluoranthene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1
Chrysene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1
Dibenz(a,h)anthracene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1
Fluoranthene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1
Fluorene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1
Indeno(1,2,3-cd)pyrene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1
Naphthalene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1
Phenanthrene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1
Pyrene _M	GCM 501	mg/kg	Y	Y	0.1	<0.1

Notes

- All analyses performed on the sample dried at 35°C, except analyses suffixed with 'M'.
- Analyses suffixed 'M' were performed on the sample as received and corrected for '% moisture at 35°C' where applicable.
- All results are expressed as dry weight.
- MCERTS accreditation applicable to Sample Matrix 'S' only.
- Natural stones (pebbles, gravels etc.) which do not pass a 2mm sieve are excluded from dried analyses.
- Tests marked * indicate subcontracted analyses.
- The laboratory has tested the material/items supplied by the client as sampled in accordance with the client's own requirements.
- *Sample Description key: 1. - Sand, 2. Loam, 3. Clay, 4. Sandy loam, 5. Sandy clay, 6. Clayey loam, 7. Other.
suffixed with: A - Stones, B - Construction rubble, C - Visible Hydrocarbons
- Dates of testing for all parameters are available on request.
- Where a deviation has been found in relation to the sample(s) submitted for testing, the test result may be compromised. Reasons for deviating samples are denoted by means of a number 1, 2, 3, 4, 5, 6 or 7 under the analyte 'Deviation(s)'. Explanation of this number coding as follows: 1. Sample was not cooled, 2. Sample not submitted in an appropriate container (organic testing), 3. Sample not submitted in an appropriate container (inorganic testing), 4. Sample not submitted in an appropriate container (all testing), 5. Sample lacks the date and time of sampling, 6. Sample has exceeded the maximum preservation time and, 7. Other, (e.g. inappropriate headspace).
- Please note subcontracted tests have been analysed at Exova (Hillington). This laboratory holds UKAS accreditation (UKAS No. 0568).

Signed for, and on behalf of Exova (UK) Ltd.

Prepared by:

S. Blemings

S Blemings
Account Manager

Approved by:

A. Young

A Young
Operations Manager



APPENDIX E



LABORATORY REPORT



4043

Contract Number: PSL13/4338

Client's Reference:

Report Date: 15 November 2013

Client Name: Robert E Fry & Associates Ltd
45 Bridgeman Terrace
Wigan

WN1 1TT

For the attention of: Elaine Johnson

Contract Title: Maesteg, Gwynfryn

Date Received: 06/11/2013

Date Commenced: 06/11/2013

Date Completed: 15/11/2013

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
(Director)

A Watkins
(Director)

M Beastall
(Laboratory Manager)

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

[illegible]

Professional Soils Laboratory

Compiled by	Date	Checked by	Date	Approved by	Date
	15/11/13		15/11/13		15/11/13
MAESTEG, GWYNFRYN.				Contract No: PSL13/4338	
				Client Ref: 13057	

SUMMARY OF SOIL CLASSIFICATION TESTS

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

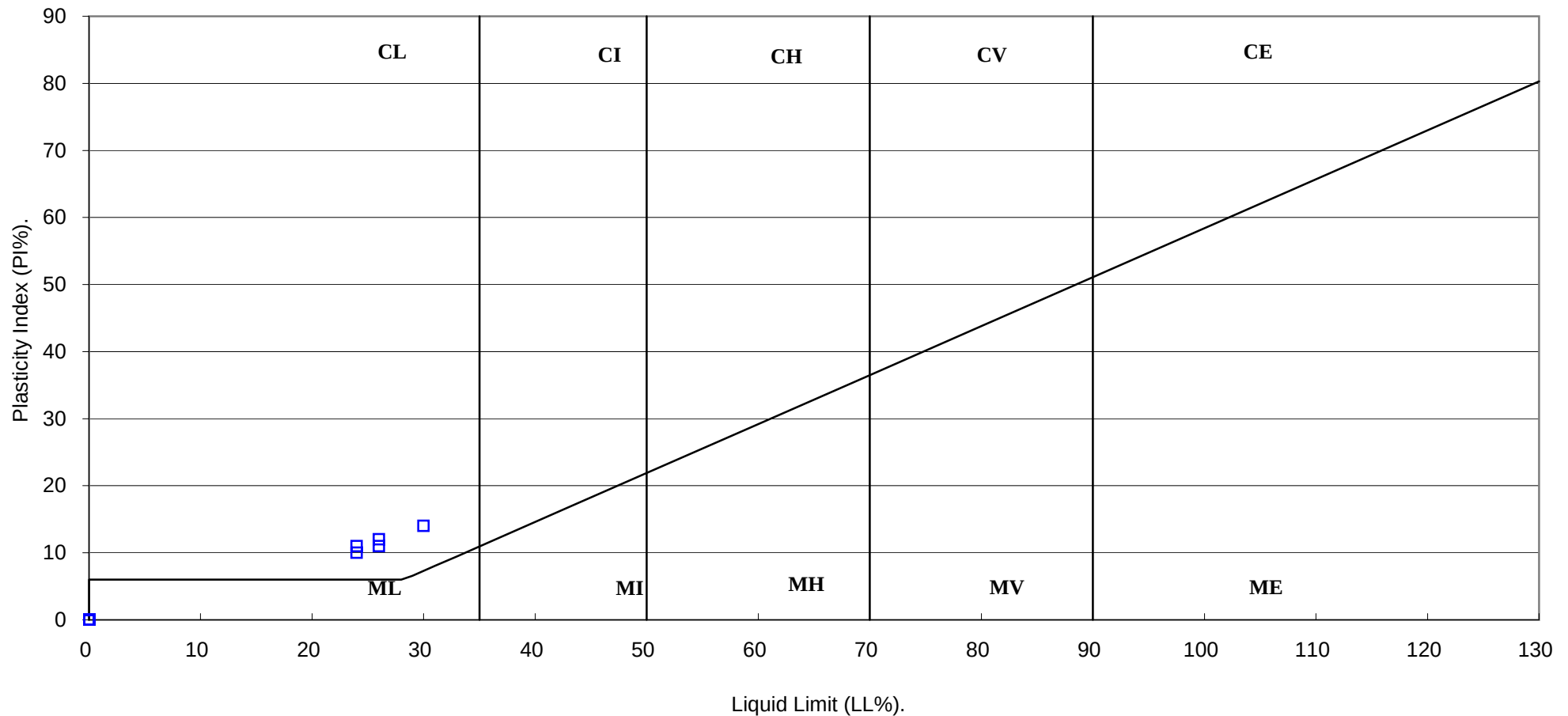
Hole Number	Sample Number	Sample Type	Depth m	Moisture Content % Clause 3.2	Bulk Density Mg/m ³ Clause 7.2	Dry Density Mg/m ³ Clause 7.2	Particle Density Mg/m ³ Clause 8.	Liquid Limit % Clause 4.3/4.4	Plastic Limit % Clause 5.	Plasticity Index % Clause 5.4	% Passing .425mm	Remarks
WS1			1.00-1.45	12				26	14	12	83	Low plasticity CL.
WS2			1.00-1.45	17				30	16	14	85	Low plasticity CL.
WS2			2.00-2.45	16				24	13	11	80	Low plasticity CL.
WS3			1.00-1.45	15				26	15	11	82	Low plasticity CL.
WS4			1.00-1.45	19				24	14	10	89	Low plasticity CL.

SYMBOLS : NP : Non Plastic

	Compiled by	Date	Checked by	Date	Approved by	Date
		15/11/13		15/11/13		15/11/13
	MAESTEG, GWYNFRYN.				Contract No: PSL13/4338	
					Client Ref: 13057	

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

(B.S.5930 : 1999)



PSL

Professional Soils Laboratory

Compiled by	Date	Checked by	Date	Approved by	Date
	15/11/13		15/11/13		15/11/13
MAESTEG, GWYNFRYN.				Contract No:	PSL13/4338
				Client Ref:	13057