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Project

CAE NANT TERRACE, SKEWEN – SITE INVESTIGATION REPORT

Client

Castell Group

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Client			Castell Group
Current Site Status			The existing site is approximately rectangular, being an existing Snooker Club, with associated parking.
Development Proposals			The development proposals are understood to comprise residential housing.
Site Conditions	Location		The site is in Skewen, SA106UP.
	History	Site	The site has been classified as an agricultural field, then developed as a Hall and Snooker Club.
		Adjacent land	Residential properties built along the eastern and southern boundary. The northern side is bounded by a rail line.
	Geology	The geology of the area comprises Glacial Till overlying bedrock of Carboniferous Coal Measure..	
Mining	Coal Authority Report suggests no coals have been extracted above 110m		
Controlled Waters	Surface Water	No terrestrial waters.	
	Ground Waters	No records of controlled waters	
Flood Risk	1 in 30years		
Radon	The site is not considered to be in an area at risk from Radon		
Landfill	There are no landfills within the site area		

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Phase 1 Summary Page 2 of 2

Principle contamination issues	The following contamination issues were identified during the Phase 1; No specific historic on site uses have been identified which would suggest contamination, however the site is in a predominantly industrial area.
Environmental Risk	- Significant and widespread contamination is considered unlikely, unless some processes as yet unidentified have occurred. - Initial consideration, in advance of site investigation is that: - The risk to end users is considered to be Low - The risk to construction/maintenance workers is considered Moderate. However, with appropriate PPE the risk is considered to be Low - The risk to the off site surface water and groundwater receptors is Low to Very Low - The risk to end users from marginally elevated soil gas is considered to be Low
Waste Management	Made ground has been identified
Geotechnical Constraints	Based on the available information, the following issues may be anticipated, and should be investigated by site investigation prior to development; - Near surface soft clay - Below ground services - Potential instability of excavations - Potential subsidence due to loose ground - Potential elevated background chemical values
Services	Below ground services may be anticipated on site including existing site drainage
Future Works	The following future works/surveys may be required; - Topographical survey - Trial Pitting Ground Investigation to prove the ground conditions and to collect samples for soil contamination testing and assessment. (undertaken as part of this report. - Additional intrusive investigation to determine the thickness of the soft clays, to include window sampling/boreholes and plate testing.

1.0 INTRODUCTION

1.1 Introduction

Spectrum Geo Services (SGS) were requested by Castell Group, to undertake a Site Investigation Study, of a site at Cae Nant Terrace, Skewen, Swansea,

This report includes a review of the available geological and historical information and trial pitting Ground Investigation operations.

1.2 Scope of Works

The objectives of this assessment are to report on:

- Envirocheck Historical Data
- Coal Authority Report
- Foundation options
- Drainage soakaway parameters
- Contamination levels.

1.3 Development Proposals

It is understood that the intention is to develop the site for the purposes of Residential Development.

1.4 Limitations

Subsoils are inherently variable and by their very nature are hidden from view such that no investigation can be exhaustive to the extent that all soil conditions are revealed. Conditions may therefore be present beneath the site that were not apparent from the data available for review.

Unless specifically noted to the contrary, it should be assumed that this report has not been submitted to any regulatory authorities for approval. Redevelopment sites may have planning conditions attached in respect of contaminated land assessment. Where we are made aware of such conditions in advance of scoping the works, we can tailor the report to the regulatory authority requirements. Where we are not made aware of any such requirements there can be no certainty that our investigation will meet any or all of the regulatory authority requirements.

2.0 EXISTING SITE INFORMATION

2.1 Site Location

The development site is situated on Cae Nant Terrace, Skewen, Swansea, SA10 6UP. The site location plan is included in as Drawing 2004/01, **Appendix A.**

The existing site is roughly rectangular and has previously been developed, with former buildings and rough unmetalled areas.

2.2 Published Geology

Based on data available from the BGS webviewer, the following geological setting is anticipated;

- **Superficial deposits:**
- 1:50,000 scale superficial deposits description: Till, Devensian - Diamicton. Superficial Deposits formed up to 2 million years ago in the Quaternary Period. Local environment previously dominated by ice age conditions (U).
- Setting: ice age conditions (U). These sedimentary deposits are glacial in origin. They are detrital, created by the action of ice and meltwater, they can form a wide range of deposits and geomorphologies associated with glacial and inter-glacial periods during the Quaternary.
- **Solid Geology:**
- 1:50,000 scale bedrock geology description: Hughes Member - Sandstone. Sedimentary Bedrock formed approximately 308 to 310 million years ago in the Carboniferous Period. Local environment previously dominated by rivers.
- Setting: rivers. These sedimentary rocks are fluvial in origin. They are detrital, ranging from coarse- to fine-grained and form beds and lenses of deposits reflecting the channels, floodplains and levees of a river or estuary (if in a coastal setting).

2.3 Hydrology

The site has no surface waters in proximity.

3.0 DESK STUDY

3.1 Introduction

To facilitate a Desk Study, Enviro Insight, Geo Insight and historical map information was procured, and is Appended.

3.2 Site History

Information about the historical development of the site and the adjacent land has been obtained from a review of the available Ordnance Survey maps. The historical land use is summarised in below:

On site historical Land use

- 1876: The site appeared to be fields, with an east west stream in the north east. A rail cutting is evident running west to east along the sites northern boundary.
- The 1889 map that a pair of small buildings had been constructed in the north of the site.
- By 1918 The Main Colliery is shown to the north west of the site, several hundred metres distant. Cae Nant Terrace has been built to the south east and a Picture Theatre to the southern boundary,
- By 1940 other buildings including a large "Hall" had been built at the site. More housing stock is evident around the area. The site remained similar until 1970, when the British Legion/Snooker Club was built.
- The site has remained similar until current date.

3.3 Former Land Use and Potential Contaminative Processes/Landfill

- a) The EnviroInsight report indicates not potential risks of such within a reasonable distance. Indeed, the closest areas of industrial process lie across the rail cutting to the north and thus there is little risk of impact to the site.

3.4 Coal Authority Report

The Coal Authority indicates that the shallowest recorded coal workings were at 110m depth at the site and that there are no known mine entries within 20m of the site. No Mine Gas has been recorded.

4.0 CONCEPTUAL MODEL

4.1 Rationale

The site characterisation attempts to identify potential previous and existing site sources of contamination. The Conceptual Model links the identified sources likely to cause significant possibility of significant harm via pathways to identified critical receptors. The Conceptual Model is therefore based on a number of identified source-pathway-receptor scenarios. For land to be classified as contaminated a significant pollutant linkage will need to be identified which will include each component of the Conceptual Model. The absence or removal of a source or interception of a pathway will 'break' the pollutant linkage.

The Conceptual Model is characterised by identification of the following:

- On-site sources, which may impact on-site receptors via plausible pathways.
- On-site sources, which may impact off-site receptors via plausible pathways.
- Off-site sources, which may impact on-site receptors via plausible pathways.

The change of land use will require assessment of the new site development layout within the context of introducing new exposure pathways. The planning regime will require assessment of the site to ensure the new development will not be classed as contaminated land under the definition provided by the Part 2A of the Environmental Protection Act 1990 as defined in the Environment Act 1995.

From the information available a Conceptual Model for the site has been produced. These include metals, asbestos and PAH.

5.0 PRELIMINARY CONCEPTUAL MODEL AND QUALITATIVE RISK ASSESSMENT

The principles of environmental risk assessment are presented in ***Appendix B***

Source Characterisation

All potential **on-site** and **off-site** sources of contamination identified by this desk study are detailed in Table 5.2.1 below. The table also details any potential sources which have been discounted.

Table 5.2.1: Identified Potential Sources of Contamination

Source		Distance (m)	Compass Direction	Identified by:	Comments
Former Rail Sidings/Cutting	Off-Site	50	N	Historical maps	Discounted due to distance and because the site is above of the source
Potential Fly tipping and demolition waste	On site	On Site	NA	Historical Maps	General suites of chemical testing

It is not possible to discount all of potential sources of contamination. Potential sources of contamination which cannot be discounted are carried forward to a preliminary qualitative risk assessment. The Contaminants of Concern (CoC) for the remaining potential sources of contamination are listed in Table 5.2. 2.

Table 5.2. 2: Contaminants of Concern

CONTAMINANTS OF CONCERN									
Source	Metals	Pesti cides	PAH	Soil Organic Matter	SO ₄ , SO ₃	pH	Asbestos	SVOCs / VOCs	
ON-SITE									
Made Ground	X		X	X	X	X	X		

Pathway Characterisation

The potential pathways by which receptors might be exposed to contaminants (sources) at the site can vary depending on the proposed or current land use (e.g. residential properties, public open space, retail).

For humans, the three possible routes of exposure to contaminants are:

Inhalation of dusts or vapours

Ingestion of dusts or soil either by hand-to-mouth activity or by eating plants grown in contaminated soils

Dermal (skin) contact with contaminated soils and waters and transfer of contaminants through the skin into the body

Buildings and service conduits can also be affected by contaminants in the following ways:

Soil gas or vapour pooling in voids within or beneath structures

By direct contact of building fabric with contaminated soils

Service trenches acting as preferential migration pathways

Ingress of contaminants into conduits, contaminating drinking water supplies

Finally, for the local water environment the following pathways may be present:

Run-off from the site surface entering surface water courses near the site

Leaching of contaminants from the soil to on-site groundwater

Migration of contaminated on-site groundwater to off-site groundwater and/or surface water bodies

Receptor Characterisation

The receptors are the elements in the pollutant linkage that can potentially be harmed by the contaminants. These are as follows:

Humans: site workers and residential users

Buildings: building fabric and services; and

The local water environment (surface water and groundwater)

Pollutant Linkages

The significance of potential pollutant linkages at the site is now qualitatively assessed by considering the magnitude of the hazard and the possibility of the linkages occurring based on the observations made, in Table 4.2.3 below.

Preliminary Qualitative Risk Assessment

The preliminary conceptual model outlined above has been used to undertake an initial qualitative risk assessment for the site to determine the possibility of significant risks that may exist following development of the site. This is presented in Table 5.2.3. The qualitative risk assessment will

also investigate the risks to the wider environment as a result of contamination from on site sources. The principles of environmental risk assessment are presented in Appendix B.

Table 5.2.3: Preliminary Qualitative Environmental Risk Assessment for Identified sources of Contamination

Source	Potential contaminants	Potential Pathway(s)	Potential receptor(s)	Assessment	Potential Severity	Potential Probability	Risk Class	Investigation Required
Made Ground	Metals, PAHs, asbestos, SO ₄ , pH,	Ingestion, inhalation, dermal contact	Humans (residents & end users)	Dermal contact, inhalation and ingestion pathways will be broken in areas covered by hardstanding. However the risk of humans coming into contact with potential contaminants at the site will remain in areas of soft landscaping. Contaminants could compromise the integrity of any water supply pipe and subsequently lead to consumption of contaminated water supply.	High	Very Low	Low	Yes
			Humans (site workers)	Construction and maintenance workers could come into contact with contaminated made ground. Excessive exposure may occur during some manual activities including working in service trenches.	High	Low	Moderate	Yes
		Direct contact, aggressive ground conditions,	Building fabric and services	The presence of contamination in shallow soils may pose a risk to buried concrete structures. Direct contact with this contamination in both soil and superficial groundwater (if present) can result in damage to concrete fabric and services in a similar fashion to that described above for water supply pipe.	High	Low	Moderate	Yes
		Leaching, migration.	Surface water environment Groundwater environment – Superficial Groundwater	There is no surface water at the site. The majority of proposed development is to consist of tarmac and drained surfaces which will prevent surface water run-off from coming into contact with potentially contaminated made ground. Mobile contaminants that may be present on site, could migrate to surface water bodies by transportation via the bedrock aquifer, however the presence of hardcover to the site will reduce the infiltration of water through potentially contaminated soils therefore reducing the leaching potential. Given that superficial deposits are expected to be very limited beneath the site, it is unlikely that a superficial aquifer will be present.	High	Very Low	Low	No

6.0 SITE OPERATIONS

6.1 Site Works

The site was mostly obscured by the existing Snooker Hall. Thus, site works were limited to 2 No Trial Pits in the car park, which were undertaken on 04 February 2020 and comprised those Trial Pits, and a Soakaway test. Conditions during the fieldwork were predominantly sunny and dry. The positions are shown on Drawing SGS/2004/02.

The positions of the Ground Investigation holes were limited to those areas, which were not affected by underground utilities.

The work was undertaken in accordance with BS5930.

Samples were recovered of strata encountered, to allow laboratory testing to be undertaken.

Soakaway testing was undertaken in one of the trial pits.

7.0 LABORATORY TESTING

7.1 Introduction

On completion of site operations, selected soil and rock samples were scheduled for laboratory testing. The following laboratory testing was undertaken and is Appended.

- pH,
- Sulphate by aqueous extract
- Metals soil suite
- PAH
- Organic Matter
- Asbestos ID

The results are presented within Appendix D.

8.0 SITE CONDITIONS ENCOUNTERED

8.1 Ground Conditions

The ground conditions encountered are summarised below. Conditions can vary in areas which are between trial pits and thus have not been investigated.

Stratum	Depth to base (m)	Remarks
Made Ground.	1.40 – 1.80	Comprising both cohesive and granular strata.
Very soft to soft CLAY	(2.40) – (2.80)	Glacial CLAY and alluvium.
PEAT	2.10	1.85m to 2.10m at TP02

Table 8.1. Generalised Strata

In general the site was mantled in Made Ground, which comprised of black and brown GRAVEL and CLAY of sandstone with various glass, wood, slate, ceramics and glass matter.

The natural deposits comprised relatively low strength and compressible Glacial Till of both GRAVEL and CLAY. The CLAY was noted as very soft to soft. PEAT was noted at TP02.

8.2 Groundwater Conditions

During the field operations, water was not noted as shown on the Engineering Logs, Appendix C.

It should be noted that groundwater levels vary due to changes in climatic and other conditions and may therefore at times vary from those recorded during these operations.

9.0 GEOTECHNICAL PARAMETERS

9.1 Introduction

This section presents geotechnical parameters, which will be taken forward into the foundation options appraisals, and assigns parameters to the strata encountered.

9.1.1 Made Ground

These deposits were found to extend to 1.80m depth at TP01.

The materials were loose and friable and extremely varied. Thus, it is not considered appropriate to assign them geotechnical parameters.

Plate Bearing testing should be undertaken to determine settlement parameters.

9.1.2 Clay

Very soft to soft CLAY was encountered within both trial pits.

Field descriptions suggest the following parameters:

Undrained Cohesive Strength (cu) = 20 to 40kN/m²

9.1.3 Peat

The peat was noted as fibrous.

It is not considered appropriate to assign geotechnical parameters in the absence of in-situ test results, which would only be obtained in borehole tests.

10.0 GEOTECHNICAL ASSESSMENT

10.1 Introduction

The following sections provide an assessment of the options relating to foundation options at site, making suggestions relating to potential options/assessment for bearing capacity and foundations and attack to buried concrete.

7.2 Foundation Options

The Made Ground will not prove suitable for founding on without treatment, due to lateral and vertical inhomogeneity. The Made Ground will also exhibit very low CBR values and thus would need to be treated for pavement design. It is recommended that intrusive boreholes/window samples and plate bearing testing is undertaken once the Snooker Hall is demolished.

The CLAY would provide an allowable bearing capacity as low as 25kN/m².

Excavations will degrade in wet conditions, and thus close support should be considered. The Made Ground will not stand open for any length of time.

All formations must be inspected by a professional Geotechnical Engineer to confirm that the materials will accommodate the allowable bearing capacity calculated, and so that soft spots are identified, and removed.

10.3 Attack to Buried Concrete

Laboratory testing during, noted a slightly acid to neutral pH value, and a maximum soluble sulphate value of 1600mg/kg, indicating Sulphate Class DS-2, in accordance with BRE Special Digest 1.

10.4 Groundwater

Groundwater was not noted. It is common to intercept perched water tables within glacial deposits, and thus suitable methods of dewatering should be made available at site.

It should be noted that groundwater levels vary due to changes in climatic and other conditions and may therefore at times vary from those recorded during these operations.

11.0 CONTAMINATION TESTING

Contamination testing was undertaken on two samples, as shown in the Appendices.

The results have been compared with current Environment Agency limits for Residential Uses, both with and without plant uptake.

Table 11.1 shows the exceedance, which were arsenic at TP01 and 02 (both with and without plants) and lead at TP02 (both with and without plants).

Thus, it is suggested that should soft landscaping be incorporated in the development, then a capping design will be required.

It may be also that the Local Authority may require further assessment of the elevated values in relation to a contamination Risk Assessment, both to on and off-site receptors.

Location	Units	Limit of Detection	TP01	TP02	TP04	CLEA/LQM/ GAC 6% SOM Resi Plant	CLEA/LQM/ GAC 6% SOM Resi No Plant
Depth to Top							
Depth to Bottom			0.50	0.30	1.50		
Date Sampled			30-Nov-19	30-Nov-19	30-Nov-19		
Sample Type			Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code			5A	4AE	5AE		
% Stones >10mm	% w/w	0.1	0.6	<0.1	21.2		
pH	pH	0.01	6.6	7.33	7.57		
Sulphate (acid soluble)	mg/kg	200	660	1600	<200		
Organic matter	% w/w	0.1	8.5	18.2	1.7		
Arsenic	mg/kg	1	56	51	6	32	35
Copper	mg/kg	1	84	231	13	2300	
Chromium	mg/kg	1	16	12	10	3000	
Lead	mg/kg	1	67	1520	30	450	450
Mercury	mg/kg	0.17	<0.17	<0.17	<0.17	11	14
Nickel	mg/kg	1	24	32	20	130	130

Asbestos in Soil (inc. matrix)					
Asbestos in soil			NAD	Chrysotile	NAD
			-	Loose Fibres	-
Asbestos ACM - Suitable for Water Absorption Test?			N/A	N/A	N/A

Red values indicate exceedance of guideline values.

PAH-16MS

Acenaphthene	mg/kg	0.01	<0.01	0.08	<0.01	1000
Acenaphthylene	mg/kg	0.01	<0.01	0.1	<0.01	850
Anthracene	mg/kg	0.02	<0.02	0.18	<0.02	9200
Benzo(a)anthracene	mg/kg	0.04	<0.04	1.12	<0.04	5.9
Benzo(a)pyrene	mg/kg	0.04	<0.04	0.8	<0.04	1
Benzo(b)fluoranthene	mg/kg	0.05	<0.05	1.22	<0.05	7
Benzo(ghi)perylene	mg/kg	0.05	<0.05	0.35	<0.05	47
Benzo(k)fluoranthene	mg/kg	0.07	<0.07	0.39	<0.07	10
Chrysene	mg/kg	0.06	<0.06	1.45	<0.06	9.3
Dibenzo(ah)anthracene	mg/kg	0.04	<0.04	0.11	<0.04	0.9
Fluoranthene	mg/kg	0.08	<0.08	2.88	<0.08	670
Fluorene	mg/kg	0.01	<0.01	0.14	<0.01	780
Indeno(123-cd)pyrene	mg/kg	0.03	<0.03	0.46	<0.03	4.2
Naphthalene	mg/kg	0.03	<0.03	0.13	<0.03	8.7
Phenanthrene	mg/kg	0.03	0.05	2.49	<0.03	380
Pyrene	mg/kg	0.07	<0.07	2.34	<0.07	1600
Total PAH-16MS	mg/kg	0.01	<0.08	14.2	<0.08	617000

Table 11.1: Contamination Results

12.0 IN-SITU TESTING

In-situ Soakaway Testing was undertaken. Calculation sheet is appended to this report.

An If value of $1.44 \times 10^{-4} \text{ms}^{-1}$ was recorded.

13 CONCLUSIONS

The Made Ground will not prove suitable as a foundation stratum, unless it is treated.

The underlying CLAY is considered to be of low quality, and thus not suitable for strips or pads.

Groundwater was not noted within these depths however, pumping from sumps may be necessary due to potential perched water tables.

Soakaway infiltration (If) values were considered reasonable to allow a design.

SGS consider that once the Snooker Club has been demolished, further ground investigation should be undertaken to determine the nature, depth and extent of the very soft and soft clays. This would likely be undertaken by window sampling or boreholes and in-situ plate tests.

Contamination testing has shown there to be elevated occurrence of both lead and arsenic. Depending upon the end development details, further assessment may be required to include a capping design, or risk assessment.

APPENDIX A

Phase 1 Data

Geo Insight	GS-5788441
Enviro Insight	GS-5788440
Small Scale Historical Maps	GS-5788439
Large Scale Historical Maps	GS-5788439

APPENDIX B

Principles of Environmental Risk Assessment

The Environmental Protection Act 1990, Part II A Contaminated Land (Section 57 of the Environment Act 1995), revised by Scottish Statutory Instrument No.658 (2005), and the Contaminated Land Regulations 1999 provide a basis on which to determine the risks and liabilities presented by a contaminated site. Contaminated Land is defined within Annex 3, Chapter A Part 1- Scope of Chapter and in all those Sections mentioned as:

“Any land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land that-

- (a) Significant harm is being caused or there is significant possibility of such harm being caused; or*
- (b) Significant pollution of the water environment is being caused or there is a significant possibility of such pollution being caused.”*

Section 57 of the Environment Act 1995 requires that any site identified as being “contaminated” by the Local Authority will be registered by them and remediation will be required to render the site fit for use.

The presence of contamination is not the sole factor for deciding whether a site is contaminated. Relevant parties should identify site-specific risks and provide objective, cost-effective methods to manage the contamination in a manner that satisfies the proposed end-use.

A risk-based approach, which takes both technical and non-technical aspects into consideration when making decisions on contamination resulting from past, present or future human activities, is advocated. The assessment of environmental risks generally relies on the identification of three principal elements forming a ‘pollutant linkage’:

- SOURCE:** the contaminant
- PATHWAY:** the route through which the contaminant can migrate, and
- RECEPTOR:** any human, animal, plant, water environment or property that may be adversely affected (harmed) by the contaminant

In the absence of any one of these elements, on any given site, there is no risk. Where all three elements are present, risk assessment is required to determine the significance of the harm that is being or may be caused. As outlined above, the terms of the Contaminated Land regime specify that remediation need only be implemented where a site is causing, or there is a significant possibility that it will cause, significant harm, or significant pollution to the water environment.

Development of contaminated land is usually addressed through the application of planning and development legislation and guidance (i.e. Planning Advice Note 33). The suitable for use approach is seen as the most appropriate to deal with contaminated land, taking account of environmental, social and economic objectives. The assessment is made in the context of the proposed land use (i.e. residential, retail, open-space and tourist developments).

APPENDIX C

Trial Pit Logs

TP01 to TP02

APPENDIX D

Laboratory Testing

Drawings

Site Location

Exploratory Hole Locations

APPENDIX E

In-Situ Testing

Soakaway

SA1

APPENDIX F

Photographic Plates

APPENDIX G

Drawings

Site Location Plan	SGS/2004/01
Exploratory Hole Location Plan	SGS/2004/02