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Project	STATION ROAD, NANTGAREDIG – SITE INVESTIGATION REPORT
Client	Life Property Ltd

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Client		Life Property Ltd	
Current Site Status		The existing site is approximately rectangular, being an agricultural field.	
Development Proposals		The development proposals are understood to comprise residential housing.	
Site Conditions	Location		The site is at Nantgaredig, Carmarthenshire.
	History	Site	<ul style="list-style-type: none"> The site has been classified as an agricultural field, since the first available historic map of 1889 to 1972. A garage was built in the south east around 1971.
		Adjacent land	<ul style="list-style-type: none"> Mostly agricultural with residential developments.
	Geology	<ul style="list-style-type: none"> The published geology indicates fluvial deposits overlying Ordovician shales. 	
Mining	<ul style="list-style-type: none"> Not shown at the site. 		
Controlled Waters	Surface Water	<ul style="list-style-type: none"> No terrestrial waters. 	
	Ground Waters	<ul style="list-style-type: none"> No records of controlled waters. 	
Flood Risk	<ul style="list-style-type: none"> 1 in 30 year surface water risk. 		
Radon	<ul style="list-style-type: none"> The site is not in an area at risk from Radon. 		
Landfill	<ul style="list-style-type: none"> There are no landfills within the site area. 		

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Principle contamination issues	<p>The following contamination issues were identified during the Phase 1;</p> <ul style="list-style-type: none"> No specific historic on site uses have been identified which would suggest contamination.
Environmental Risk	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> In advance of site investigation: Made ground has not yet been identified. Natural arisings likely to be 100% inert.
Geotechnical Constraints	<p>Based on the available information, the following issues may be anticipated, and should be investigated by site investigation prior to development;</p> <ul style="list-style-type: none"> Near surface soft clay. Below ground services. Potential instability of excavations. Potential elevated background chemical values.
Services	<ul style="list-style-type: none"> Below ground services may be anticipated on site including existing site drainage.
Future Works	<p>The following future works/surveys may be required;</p> <ul style="list-style-type: none"> Topographical survey. Ground Investigation to prove the ground conditions and to collect samples for soil contamination testing and assessment.

1.0 INTRODUCTION

1.1 Introduction

Spectrum Geo Services (SGS) were requested by Life Property Ltd, to undertake a Site Investigation Study, of a site at Station Road, Nantgaredig.

This report includes a review of the available geological and historical information and Phase 2 Ground Investigation operations.

1.2 Scope of Works

The objectives of this assessment are:

- Purchase historic maps, envirocheck report and radon report.
- Review desktop data and advise on any issues raised.
- 1 day window sampling including installation of 3 monitoring wells.
- 1 day trial pitting
- 1 day of infiltration testing.
- 3 No. return visits to monitor water and gas levels.
- CBR Testing.
- Geotechnical and contamination testing.
- Preparing a combined desktop and interpretative report.

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 the regulatory authority requirements.

2.0 EXISTING SITE INFORMATION

2.1 Site Location

The development site is situated to the east of Station Road, Nantgaredig. The site location plan is included in as Drawing 2031/01, **Appendix A**.

The existing site is roughly rectangular and has previously been agricultural fields.

2.2 Published Geology

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

Superficial deposits:

- 1:50000 scale superficial deposits description: River Terrace Deposits (undifferentiated) - Sand and Gravel. Superficial Deposits formed up to 3 million years ago in the Quaternary Period. Local environment previously dominated by rivers (U).
- Setting: rivers (U). These sedimentary deposits 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).

Solid Geology:

- 1:50000 scale bedrock geology description: Hendre Shales Formation - Mudstone. Sedimentary Bedrock formed approximately 449 to 466 million years ago in the Ordovician Period. Local environment previously dominated by deep seas.
- Setting: deep seas. These sedimentary rocks are marine in origin. They are detrital and comprise coarse- to fine-grained slurries of debris from the continental shelf flowing into a deep-sea environment, forming distinctively graded beds.

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, 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

- Between 1888 and 1972, the area is shown as comprising agricultural fields. Well to the south is Nantgaredig Railway Station.
- Sometime after 1971, a garage was built in the south western corner of the site. It is noted that this area has now been/is being redeveloped for housing purposes.

3.3 Radon Report

The radon report indicates that no radon protection measures are required.

3.4 Enviro Insight Report

The Enviro Insight report assesses the recorded likelihood of occurrence of various environmental risks at the site.

- a) Historic Landfill – none,
- b) Environmental Permits – none,
- c) Landfill – none,
- d) Current land use – none,
- e) Abstraction Licences – none,
- f) Surface Water abstraction Licences – none,
- g) Flooding Groundwater – low,
- h) Flooding Surface Water – 1 in 30 year
- i) Environmental Sensitivity – none,
- j) Natural Hazards – Very low/negligible,

4.0 SITE OPERATIONS

4.1 Site Works

Site works were undertaken on 23 March 2020 and comprised 5 Trial Pits, 4 Soakaway tests and 6 Window Sample holes. Conditions during the fieldwork were predominantly sunny and dry. The positions are shown on Drawing SGS/2031/02.

The work was undertaken in accordance with BS5930.

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

Soakaway tests were undertaken in four of the trial pits.

5.0 LABORATORY TESTING

5.1 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.

- Atterberg Limits,
- Moisture Content,
- Particle Size distribution,
- pH,
- Sulphate by aqueous extract,
- Metals soil suite,
- PAH,
- Organic Matter,
- Asbestos ID.

The results are presented within Appendix C.

6.0 SITE CONDITIONS ENCOUNTERED

6.1 Ground Conditions

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

Stratum	Depth to base (m)	Remarks
Topsoil	0.10	Deepest at TP03
Soft and soft to firm CLAY	0.40 – (0.60)	Alluvial CLAY
SAND and GRAVEL	0.60 – 0.80	WS03, 04 and 06 only
GRAVEL	(0.90 – 1.30)	River GRAVEL
Weathered MUDSTONE	(1.50)	Bedrock?

Table 6.1. Generalised Strata

In general, the site was mantled in Topsoil.

The natural deposits comprised soft to firm CLAY overlying relatively competent GRAVEL.

6.2 Groundwater Conditions

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

Subsequent water monitoring visits noted dry standpipes, as shown in GW1.

It should be noted that groundwater levels vary due to changes in climatic and other operations.

7.0 GEOTECHNICAL PARAMETERS

7.1 Introduction

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

7.1.1 Clay

Soft to firm CLAY was encountered across the site.

Field descriptions suggest the following parameters:

Undrained Cohesive Strength (cu)	=	40 to 50kN/m ²
Coefficient of Volume Compressibility (mv)	=	0.30–1.50m ² /MN

....which equates to a soft to firm clay of high compressibility.

Atterberg limits analyses indicated the materials to be CL, MI or non-plastic, suggesting that the materials are close to the 'A' Line.

7.1.2 SAND and Gravel

GRAVEL or SAND was noted at all locations, extending to 1.40m in WS01.

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. Suffice to say, progress was slow and hard.

7.1.3 Bedrock

What is likely to have been weathered mudstone was noted beneath the GRAVEL at WS01. However, this may have been a boulder within the river deposits.

8.0 GEOTECHNICAL ASSESSMENT

8.1 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.

8.2 Foundation Options

Should pad or strip foundations be taken into the gravels, then an allowable bearing capacity in the order of 125kN/m² is considered appropriate.

Excavations will degrade in wet conditions, and thus close support should be considered.

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.

8.3 Attack to Buried Concrete

Laboratory testing during, noted slightly acid pH values, and a maximum soluble sulphate value of 520mg/kg, indicating Sulphate Class DS-2, in accordance with BRE Special Digest 1.

8.4 Groundwater

Groundwater was not noted during the site works or monitoring period. However, it is prudent to assume that there may be perched tables or standing water during periods of rainfall. Thus, pumping from open sumps should be accommodated for.

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 CONTAMINATION TESTING

Contamination testing was undertaken on three 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 9.1 shows the recorded values, related to current Soil Guideline Values (SGVs), or other published values.

Thus, it is evident that no test values exceed SGVs for residential development.

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.

Red values indicate exceedance of guideline values.

Client Sample ID	Units	TP01	SA03	SA04	SGV or other
Depth to Top		0.40	0.40	0.30	
Sample Type		Soil - ES	Soil - ES	Soil - ES	
% Stones >10mm	% w/w	<0.1	<0.1	10.1	
pH	pH	5.66	5.71	5.69	
Sulphate (acid soluble)	mg/kg	490	520	440	
Organic matter	% w/w	2.5	7.5	3	
Arsenic	mg/kg	6	6	8	35
Copper	mg/kg	9	9	9	2330
Chromium	mg/kg	35	35	30	3000
Lead	mg/kg	20	21	21	450
Mercury	mg/kg	<0.17	<0.17	<0.17	14
Nickel	mg/kg	32	29	27	130
Asbestos in Soil (inc. matrix)					
Asbestos in soil		NAD	NAD	NAD	
Asbestos ACM - Suitable for Water Absorption Test?		N/A	N/A	N/A	Non detected

PAH-16MS					SGV
Acenaphthene	mg/kg	<0.01	<0.01	<0.01	1000
Acenaphthylene	mg/kg	<0.01	<0.01	<0.01	850
Anthracene	mg/kg	<0.02	<0.02	<0.02	9200
Benzo(a)anthracene	mg/kg	0.06	<0.04	<0.04	5.9
Benzo(a)pyrene	mg/kg	<0.04	<0.04	<0.04	1
Benzo(b)fluoranthene	mg/kg	<0.05	<0.05	<0.05	7
Benzo(ghi)perylene	mg/kg	<0.05	<0.05	<0.05	47
Benzo(k)fluoranthene	mg/kg	<0.07	<0.07	<0.07	10
Chrysene	mg/kg	<0.06	<0.06	<0.06	9.3
Dibenzo(ah)anthracene	mg/kg	<0.04	<0.04	<0.04	0.9
Fluoranthene	mg/kg	<0.08	<0.08	<0.08	670
Fluorene	mg/kg	<0.01	<0.01	<0.01	780
Indeno(123-cd)pyrene	mg/kg	<0.03	<0.03	<0.03	4.2
Naphthalene	mg/kg	<0.03	<0.03	<0.03	8.7
Phenanthrene	mg/kg	<0.03	<0.03	<0.03	380
Pyrene	mg/kg	<0.07	<0.07	<0.07	1600
Total PAH-16MS	mg/kg	<0.08	<0.08	<0.08	14574

6% SOM

Residential No Plant Uptake.

Table 9.1: Contamination Results

10.0 IN-SITU TESTING

In-situ Soakaway Testing was undertaken. Calculation sheets are appended to this report.

Infiltration Values (I_f) of between 1.5×10^{-4} m/s, and 2.4×10^{-5} m/s were recorded at the southern end of the site. Two tests undertaken in the north did not achieve full tests due to slow infiltration. Thus, locations of soakaways will need to be carefully considered.

CBR values were determined from DTP Penetrometer tests. Within the alluvial clays a value of <2.5% is considered appropriate. Care should be taken during construction to note and remove/replace any soft spots. Inclement weather will result in softening of the clays during site operations. Thus, temporary capping may be required.

Gas Monitoring was undertaken to determine the concentrations of deleterious gases. There were no significant concentrations

All in-situ testing is Appended.

11.0 CONCLUSIONS

Foundations loads will need to be extended to the underlying gravels at depths of at approximately 1.00m. Formations, will need to be inspected for soft/loose spots and where those are found, treated accordingly.

Groundwater was not noted within these depths, however pumping from sumps should be allowed for.

Soakaway values were variable, and care will need to be taken in choosing a value of If in the design process.

No ground gas protection measures are considered necessary.

Soakaway locations will need to be confined to the southern site areas.

Contamination testing has shown there to be no elevated common determinands. Nevertheless, the LPO may require further testing, depending upon their views.

Acidic soil results were noted, and thus Sulphate Class DS-2, in accordance with BRE Special Digest 1 is recommended for buried concrete.

Radon protection measures are not considered necessary.

APPENDIX A

Phase 1 Data

Enviro Insight

Small Scale Historical Maps

Large Scale Historical Maps

Radon Report

APPENDIX B

Exploratory Hole Logs

TP01, SA01 to SA04

WS01 to WS06

APPENDIX C

Laboratory Testing

APPENDIX D

In-Situ Testing

Soakaways

SA1 and SA2

DTP Penetrometers

CBR1 to 5

APPENDIX E

Water and Gas Monitoring

Groundwater	GW1
Ground Gas	GM1

APPENDIX F

Photographic Plates

APPENDIX G

Drawings

Site Location	SGS/2031/01
Exploratory Hole Locations	SGS/2031/02