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PROPOSED DEVELOPMENT ON LAND TO THE REAR OF 22, BRYN ESTYN ROAD, WREXHAM

PHASE 1 & 2 SITE INVESTIGATION REPORT

Carried out for: Hart Hill Homes Ltd



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Date: 04/12/2017

Report No 3564/01 Issue 1

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DISCLAIMER

This report should be read with the Service Constraints Report Limitations & Planning Requirements set out in Appendix A.



PROPOSED DEVELOPMENT ON LAND TO THE REAR OF 22, BRYN ESTYN ROAD, WREXHAM

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PHASE 1 & 2 SITE INVESTIGATION REPORT

1. INTRODUCTION

1.1 Background Information

- 1.1.1 TerraConsult Limited was commissioned by Hart Hill Homes Ltd to carry out a preliminary site investigation for an area of land to the rear of no. 22, Bryn Estyn Road, Wrexham. The purpose of the report is to provide preliminary information on conditions at the site for a proposed residential development.
- 1.1.2 This report has been devised to generally comply with the relevant principles and requirements of a range of guidance including:
- Part IIA of the Environment Protection Act, 1990;
 - Contaminated Land (Wales) (Amendment) Regulations 2012 and Contaminated Land Statutory Guidance (Welsh Government, April 2012);
 - Planning Policy Wales (Ed 9, November 2016);
 - BS5930:2015: “Code of practice for site investigations”;
 - BS10175: 2011 +A1:2013 “Investigation of Potentially Contaminated Sites - Code of Practice”;
 - DEFRA/Environment Agency (2004) Report CLR11 “Model Procedures for the Management of Land Contamination”;
 - Environment Agency (2011) Report GPLC1 “Guiding Principles for Land Contamination”; and
 - Environment Agency (2017) Report GP3 “Groundwater protection: Principles and Practice” Version 1.1.
- 1.1.3 TerraConsult’s service constraints and report limitations are presented in Appendix A and a description of environmental risk assessment methodology and terminology is presented in Appendix B.

1.2. Development Proposals

- 1.2.1 The proposed development of the site is understood to comprise:
- Site clearance of vegetation across the site;
 - The construction of three residential houses including access roads, parking areas and service provision.
- 1.2.2 The findings and conclusions of the risk assessments have been set out and recommendations given for the proposed residential end use. If there is a subsequent

change in the proposed land the risk assessments and conclusions should be reviewed to determine whether they are still applicable for the revised end use.

1.2.3 The proposed development layout is shown in Figure 1, below.

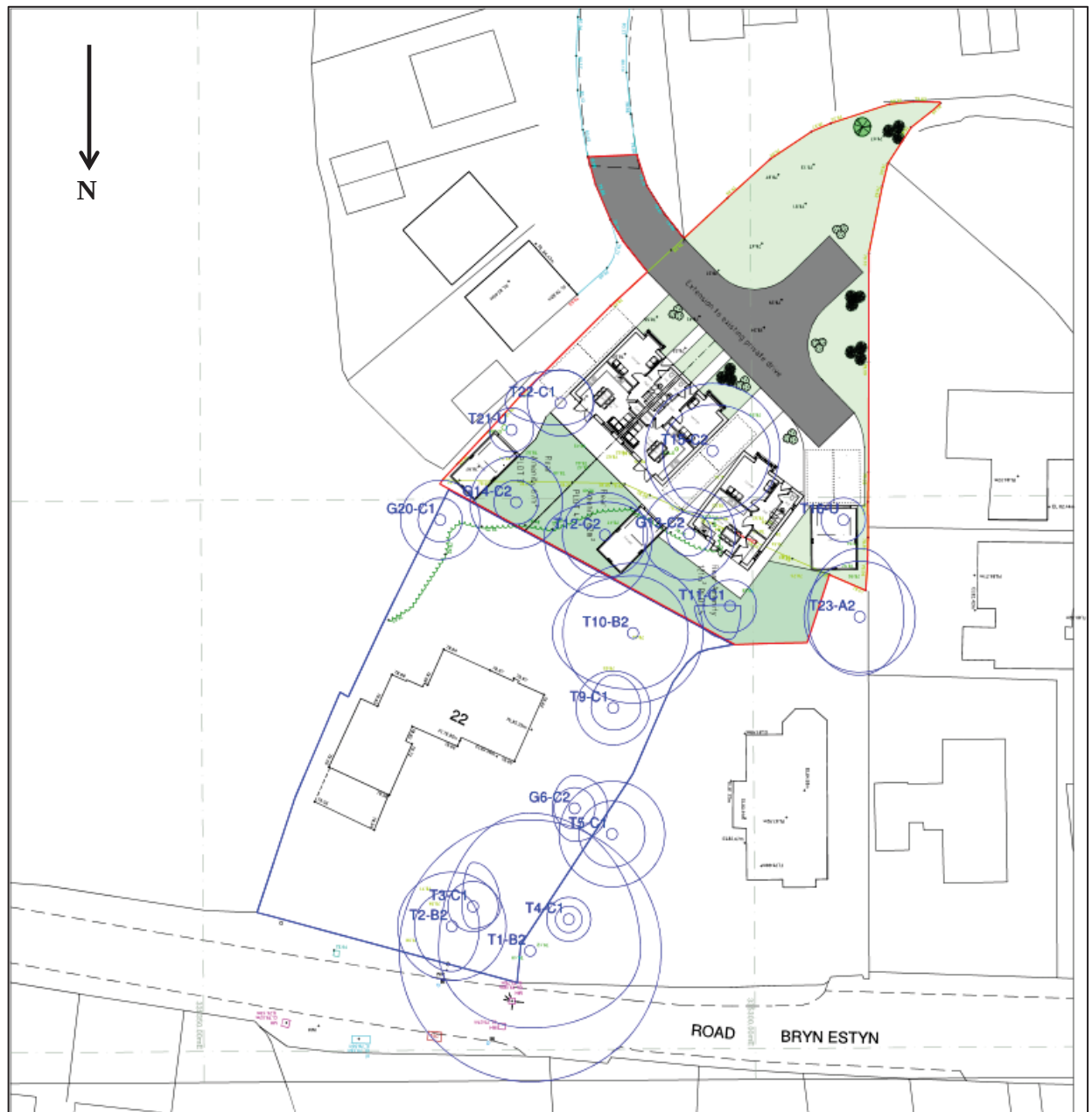


Figure 1: Proposed Development Layout Plan

1.3. Planning Status & Requirements

1.3.1 This report is designed to comply with the requirements of Chapter 13 of The Planning Policy Wales (2016) and is intended to be used by the developer as part of the submission to gain planning for the works.

1.4 Scope of the Investigation

1.4.1 The scope of the investigation was to meet the requirements to provide information for planning purposes and for design of the development. The specific activities carried out are as follows:

- undertake a desk study of available information based on internet searches only to provide a history of the site and geo-environmental data;
- carry out a site walk over;
- develop a preliminary conceptual site model and refine this according to the findings of the investigation;
- carry out an intrusive investigation comprising trial pitting with associated sampling and testing; and
- provide a geo-environmental risk assessment.

1.5. Previous Investigations

1.5.1 No previous reports are available for this site other than a Groundsure homebuyers Search Report Ref GS-2570-4184697 dated 16th August 2017.

2. SITE LOCATION AND DESCRIPTION

2.1 Site Location

2.1.1 The site is indicated in Figure 2 below and in Drawing No. 3564/1/001. The site location is summarised in Table 1.



Figure 2: Site Location

Table 1: Summary of Site Location	
Location	Approximately 2.3 km to the north east of Wrexham Central railway station, between no. 22 Bryn Estyn Road and the northern end of a cul-de-sac, Thornleigh.
Grid Reference	335332, 351222
Post Code	LL13 9NB
Site Area	0.30 ha (approx.)
Site Shape	The site has maximum plan dimensions of 90 m by 50 m and is roughly triangular in shape.
Topography	The elevation is at approximately 28 mOD. The site is approximately level varying between 27 mOD and 28mOD sloping down towards the northeast area of the site. The topographical survey gives further detail.

2.2 Site Description

2.2.1 A site visit was undertaken on 14th November 2017. Photographs of the site are presented in Appendix C.

Table 2: Summary of Description of the Site and its Environs	
Current Use:	The site currently comprises the rear garden of no 22 Bryn Estyn Road, and is undeveloped.
Access	Via asphalt roadway direct from Bryn Estyn Road and via asphalt roadway direct from Thornleigh road.
Existing Buildings & Structures	An “L” shaped two storey residential building, no. 22 Bryn Estyn Road, is located to the north of the site. There are no other buildings or structures on the site.
Site Surface	Overgrown grass and shrub cover. Tree stumps and roots present from recently felled trees. Localised depressions from previous excavations.
Vegetation	Generally overgrown grass with mature & semi-mature trees noted on site boundaries, with some scrub-like vegetation and brambles.
Storage Tanks	Below Ground Tanks: No evidence/none suspected. Above Ground Tanks: None present.
Services	No foul services were noted on site, as the property is part of a residential area care will need to be taken with respect to drainage.
Asbestos	No potential Asbestos Containing Materials (ACMs) noted on the ground surface.
Surrounding Area	Residential to the north, west and south and agricultural fields to the east.
Ecology	There is no evidence of protected burrowing animals (e.g. badgers) or habitats suitable for protected amphibians (e.g. Great Crested Newts). Trees are present on the site and these should not be cut down during the nesting season. No evidence of invasive plant species were noted. <i>These comments on the ecology are for initial preliminary assessment. They are based on the assessment of personnel who are not trained ecologists and does not constitute a Phase I Habitat Survey or similar.</i>
Local / Background Knowledge	The site was formerly farm land, before development into a residential property.

2.3 Site Ownership

2.3.1 The site is owned by Hart Hill homes Ltd.

2.4 History

2.4.1 Historic maps and records at 1:10,560, 1:2,500 and 1:1,250 scale were reviewed with records dating back to the 1879-1881 County Series maps, up to maps of 1993. From these maps it can be seen that the site was formerly occupied by a pond, until sometime between 1974 and 1984, when No. 22 Bryn Estyn Road was also constructed.

2.4.2 In the surrounding area, the site is bordered by farmland until the residential developments, which are currently present around the site, were constructed sometime

between 1968 and 1974. The client has advised that No 22 Bryn Estyn was constructed in 1968. Thornleigh, the cul-de-sac to the south of the site, and its associated housing development, was constructed sometime between 1993 and the present day.

2.5 Services Search

2.5.1 The Client has carried out a services search and is not aware of any services present on site.

3. ENVIRONMENTAL SETTING

3.1 Data Summary

3.1.1 A summary of the environmental background information (geology, hydrology, hydrogeology, database information etc.) and regulator consultation information has been tabulated and presented below. The source information for this table is presented in Appendix D or is referred to in Table 3 below. The table below represents the base data used to formulate the conceptual ground model.

Table 3: Data Summary: Environmental Setting & Regulator Contact		
	Data Source	Data Summary
Regional Geology	1:25,000 BGS Sheet SJ35 SE 1990. BGS Technical Report WA/91/4 BGS Maps 29/11/2017 http://mapapps2.bgs.ac.uk/geoindex/home.html	The site was shown to be underlain by drift deposits comprising of glacial sand and gravel. Bedrock was shown to be rocks of the Salop Formation, comprising interbedded mudrocks and moderately strong sandstones.
Mining	BGS Maps & Coal Authority Website 29/11/2017	The site is located in an area which may be affected by coal mining. However, the site is not within a Development High Risk area, as defined by the Coal Authority. 1 proposed oil, shale gas or coalbed methane well is located within 5km. The site is not in an area affected by historic brine or salt extraction.
Quarrying	Historic OS Plans	From the historic maps, there is no evidence of mineral extraction or quarrying at the site (e.g. brick pits, sand and gravel extraction etc.)
Hydrogeology	National Resources Wales Web Site, 29/11/2017 http://lle.gov.wales	Source Protection Zone – none underlying the site but SPZ III located 1.2 km east of the site. Aquifer (drift) – Secondary A Aquifer (solid) – Secondary A

Hydrology	Googlemaps.	Nearest watercourse – River Gwenfro lies approximately 1.3km to the south west of the site, and the Redwither Brook is approximately 1.5 km to the south west of the site.
	National Resources Wales Web Site, 29/11/2017 http://lle.gov.wales	The site is in not in a Flood zone. It is noted to be in an area classified by National Resources Wales (NRW) as very low under Risk of Flooding from Rivers and the Sea (RoFRaS). A “low” surface water flood risk is identified by the NRW.
	Drainage Plans	None currently available
	Buried Culverts	None currently identified
Radon Potential	Building Research Establishment, 2015, ‘Radon: Guidance on protective measures for new buildings’	The site is in a radon affected area as between 1 and 3 % of properties are above the action level. However this site is situated in an area where radon protective measures are not necessary in the construction of new buildings.
Other Radiation	Historic land use (from Groundsure report appended to this report).	No reasonable grounds for believing land to be radioactively contaminated (in accordance with 2005 extension of Part IIA of The Environment Protection Act 1990).
Ordnance	Zetica Bomb Risk Map	Low risk for unexploded ordnance. There are no WWII targets identified in the vicinity.
Environmental Database Information	Historical Maps	Full reference should be made to the report, however a brief summary follows. The site was previously agricultural land with a residential dwelling first being visible on site in 1984. The site is bordered by residential buildings to the north, west and south with agricultural land to the east. A pond was present below the site area and was infilled at around the time of construction of the surrounding residential developments.
	Groundsure Report	A pond was present below the site which has been infilled. There are no historical tanks, fuel sites or energy features within 100m. There are 6 existing and 6 proposed solar farms within 5km. Pollution Incidents: none noted within 250m
	Industrial Processes (from Groundsure Report)	There are no registered Integrated Pollution Control (IPC) Sites, Registered Radioactive Substances sites, Control of Major Accident sites (COMAH), Explosives Sites or Notification of Installations Handling Hazardous Substances (NIHHS) within 250m of the site.
Landfill Search	Ordnance Survey Historical Mapping Groundsure Report National Resources Wales Web Site, 29/11/2016 http://lle.gov.wales	There are no landfills or waste sites noted within 500m.
Fuel Stations	Fuel Stations recorded in 250m radius (from Groundsure Report appended to this report)	There are no recorded fuel stations within 250 m of site

Ecology	Groundsure Report	There are no sites of Special Scientific Interest (SSSI), Special Protection Areas, Conservation Areas, National Nature Reserves, or RAMSAR (wetlands) within 1km of the site.
	MAGIC website 29/11/2017 http://magic.defra.gov.uk/website/magic/	The site is not within areas of outstanding natural beauty, Green Belt, or a national park.
	National Resources Wales Web Site, 29/11/2017 http://lle.gov.wales	There are some areas of ancient woodland 820m to the east.
		There are no scheduled ancient monuments buildings in historic parks and gardens on site or buildings within the curtilage of scheduled ancient monuments.
Regulator Contact		There are no sites of archaeological interest on site.
	Wrexham County Borough Council	Contact with the Council was not made at this stage but they require a Phase 2 contaminated land investigation as part of the planning process.
	Natural Resources Wales	Contact with the NRW was not made at this stage.

3.2 Geology

- 3.2.1 The 1:50,000 scale BGS Drift map (1991) and Solid map (1991) show the site to be underlain by Devensian glacial sands and gravels which in turn overlie rock of the Salop Formation. The depth to bedrock is likely to be more than 10 m below ground level. The Salop Formation, which is part of the Permian-Carboniferous Warwickshire Group, is described as “red and red-brown mudstone, and red-brown (mostly sublitharenite) sandstone containing beds of pebbly sandstone and conglomerate itself containing Carboniferous limestone and chert clasts, and thin 'Spirobis' limestone beds and caliche in the lower part of the unit”.

3.3 Mining and Quarrying

- 3.3.2 There is no evidence of mining and quarrying based on geological maps, existing borehole logs and the historic maps of the area. We have not been commissioned to carry out a Coal Mining Risk Assessment but note that the site is not within a Development High Risk Area due to coal mining.

4. HAZARD ASSESSMENT & PRELIMINARY CONCEPTUAL SITE MODEL

4.1 Hazards Identified with the Proposed Development

- 4.1.1 The hazard identification is based on the assumptions presented below:

- the site will be a residential development;
- the residential development will include some domestic gardens, and residents may choose to grow their own vegetables. Landscaped communal areas will be present;
- drinking water will be from mains supply.

4.2 Potential Sources of Contamination

4.2.1 For the purpose of this assessment the potential contaminants of concern have been considered according to whether they are likely to have originated from on-site or off-site sources.

Potential On-site Sources of Contamination

- Made Ground: this will be present due to the infilled pond being present. The infill is most likely to be arising from the construction of the adjacent houses. It is likely to just be clean natural soils but could have metals, metalloids, PAH and petroleum hydrocarbons, from material used to infill the former pond.
- Ground gases (carbon dioxide and methane): from Made Ground and organic matter in natural soils,

Potential Off-site Sources of Contamination

- Made Ground, from redevelopment of the surrounding area,
- Ground gases (carbon dioxide and methane): from Made Ground and organic matter in natural soils;

4.3 Potential Receptors of Contamination

4.3.1 Based on the data previously discussed, the following potential receptors to contamination have been identified:

Table 4: Identified Potential Sensitive Receptors	
A	Humans – Pre development completion, i.e. working on site during demolition and construction.
B	Humans living on the site post construction.
C	Offsite Human Health receptors : adjacent residential properties
D	Controlled waters – Surface Waters (rivers and streams).
E	Groundwater – Perched groundwater in Made Ground and groundwater within drift deposits (Secondary A Aquifer) and bedrock (Secondary A Aquifer)
F	Local flora and fauna during and post demolition and construction.
G	Building structure and services.

4.3.2 The possible contaminant linkages are discussed below. It should be noted not all may be formed between all sources and receptors.

4.3.3 The preliminary assessment of risks undertaken for the development considers potential risks to receptors A to G in Table 5 above. The receptors A to F incorporate each of the receptors normally required by the Local Authority to be considered in their planning conditions relating to land contamination;

- Human health of current and future site users (A & B)
- Human health of current and future off site visitors and residents on adjacent site areas (C)
- Groundwater and surface water (C & D)
- Adjoining land (C, F & G)
- Property, current and future (including buildings, crops, livestock, pets, woodland, service lines) (F & G)
- Ecological systems (F)
- Buildings and structures (G)

4.3.4 It should be noted that there are no archaeological sites or ancient monuments considered to be within the zone of influence of the site. They are therefore not considered in the risk assessment.

4.3.5 The closest of each of the above receptor categories to the site are considered to be;

On-site

- Site users
- Buildings
- Flora and fauna
- Secondary A bedrock aquifer

Off-site

- Residential areas surrounding the site
- Agricultural land to the east

4.3.6 The possible contaminant linkages are discussed below. It should be noted not all may be formed between all sources and receptors.

4.4 Identification of Pathways

Pathways to Human Health

4.4.1 There are various routes by which a potential contaminant may reach a receptor. For example, in areas where contaminated material is exposed, dermal contact with the material, inhalation or ingestion of dust may occur.

4.4.2 Inhalation or ingestion of dust and water could occur during the construction and development phase at the site. Pathways from dermal contact with soil and groundwater may also arise. It is considered that the risk of short term exposure for ground workers and other construction workers is low unless there are asbestos fibres in the Made Ground.

4.4.3 Post construction, the surface of the development area will be occupied with buildings and hard standing; however garden areas will still be present. This is significant in that a number of potential pathways are possible such as long term direct contact and dust inhalation/ingestion is also applicable.

4.4.4 Gas and vapour entry into buildings is also possible.

Pathways to Controlled Waters

- 4.4.5 Groundwater levels at the site are anticipated to be high. Lateral migration of potentially contaminated groundwater offsite (either via permeable made ground or the underlying aquifer) must be considered.
- 4.4.6 The vertical leaching of contaminants from the Made Ground into the groundwater is a potential pathway for contaminants to impact upon groundwater. Made Ground contaminated materials may be in contact with the Secondary A Aquifer. However, any unsaturated drift deposits or bedrock will act as an attenuator to potential contaminants leaching into the groundwater at depth.
- 4.4.7 Surface run off from contaminated areas into surface watercourses must also be considered, however surface water courses are over 1km from the site, hence there is no viable overland pathway to surface water bodies.

Other Pathways

- 4.4.8 Other potential pathways that are possibly less significant to the site but still require consideration are; potential phytotoxic effects on sensitive landscaping plants; chemical attack on foundations and services and permeation of contaminants through domestic water pipes.

4.5 Contaminant Linkages

- 4.5.1 For each contamination source there are potential contaminant linkages with all receptors. However, in the context of this site, not all of the contaminant linkages are plausible. The likelihood of the various pathways linking the contaminants to the receptors is presented in Table 5 below:

Table 5: Matrix of Contaminant Linkages

Source/ Contaminated Medium	Pathway	Receptor						
		A - Humans using the site pre-development completion	B - Humans living on the site post the construction	C – Offsite Residents	D – Surface Water	E - Groundwater	F - Flora & fauna	G - Building & Services
Soil/Made Ground	Ingestion	P	P	U	-	-	P	-
	Dermal Contact/Direct Contact	P	P	U	-	-	P	P
	Inhalation	P	P	U	-	-	U	-
	Infrastructure/Drainage	P	P	P	U	P	P	P
	Groundwater	P	P	P	P	P	P	P
	Surface water	P	P	P	U	P	U	P
Groundwater	Ingestion	P	P	P	-	-	P	-
	Inhalation	U	U	U	-	-	U	-
	Dermal Contact	P	P	P	-	-	P	-
	Groundwater	P	P	P	U	P	U	P
	Surface Water	U	U	U	U	P	P	P
Gas (Radon)	Migration	U	U	U	-	-	U	-
Gas (CH ₄ CO ₂)	Migration	P	P	P	-	-	P	P
Key to significance of contaminant linkages S = Significant Pathway P = Possible Pathway U = Unlikely Pathway - =Not Applicable Only Significant and Possible contaminant linkages are taken forwards to the next part of the risk assessment.								

4.6 Conceptual Site Model

4.6.1 In accordance with BS 10175, a schematic section has been developed for the site based on the previously presented data and contaminant linkage assessment:

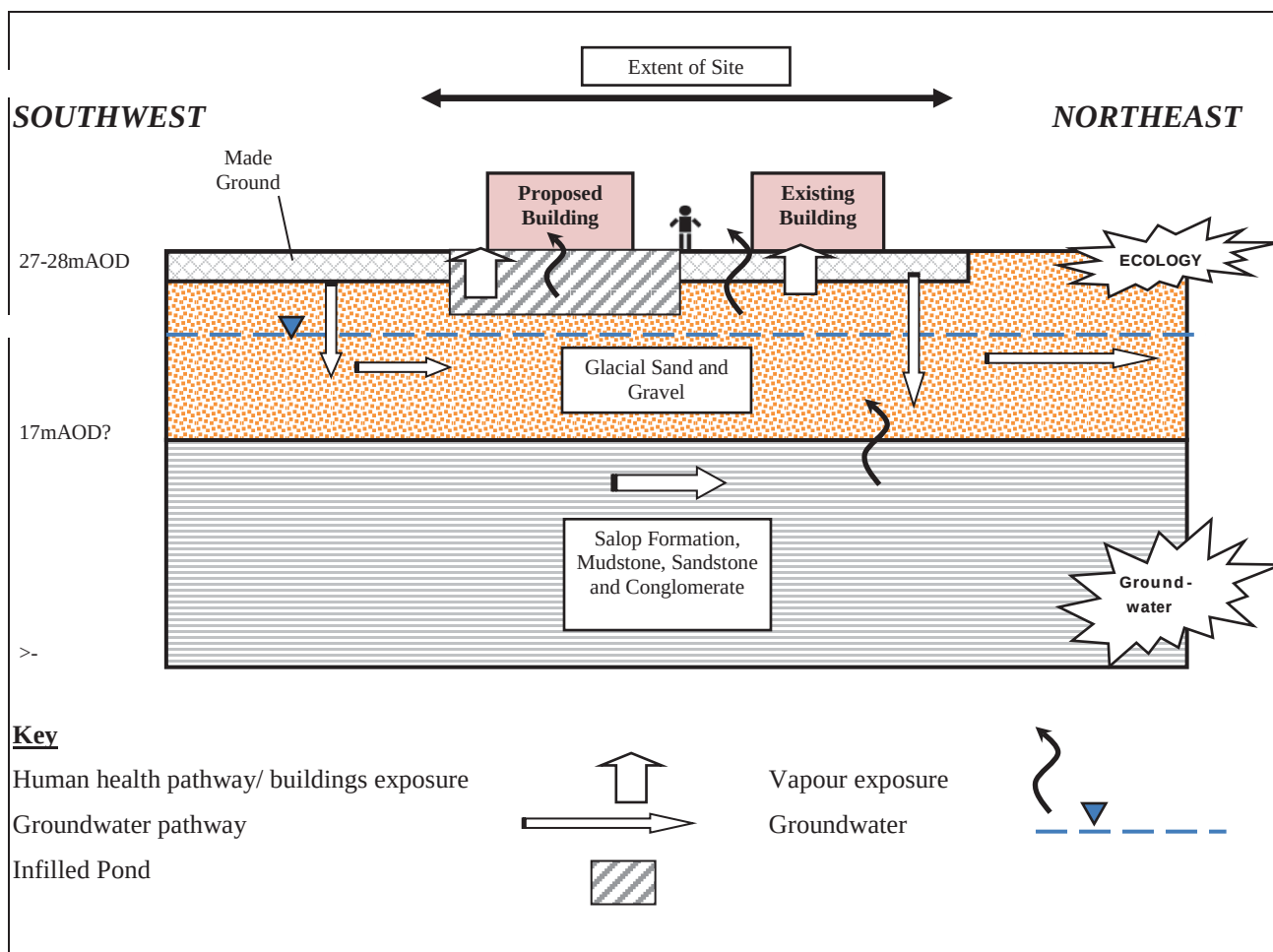


Figure 3: Preliminary Conceptual Ground Model - Schematic Section (not to scale)

- 4.6.2 The model shows the predicted geology and topography, the major on site potential contamination sources and vulnerable receptors. Levels shown are relative to Ordnance Datum and are based on published data previously presented in the report, although the drawing may not be considered to scale.
- 4.6.3 The information presented above represents the preliminary conceptual ground model that may need to be revised based on information obtained as part of any future intrusive investigation. A number of sensitive receptors and potential pathways and sources (in association with a list of likely contaminants) have been identified.
- 4.6.4 The ground model and proposed end use described above should be considered broadly representative of the standard housing (with vegetable uptake) as defined in SR3 “Updated Technical Model to the CLEA Model” (SC050021/SR3, 2011) for the purpose of this report.

4.7 Preliminary Contamination Hazard Assessment

- 4.7.1 The preliminary hazard assessment is based on current available guidance published by a number of sources and is summarised in Appendix B. A preliminary conceptual site model for this site has been established using the desk study information and has been used as a basis for the preliminary hazard assessment. The significant and possible potential pathways are only considered for the hazard assessment.
- 4.7.2 The preliminary hazard assessment is a qualitative assessment of the risks posed by each viable pollution link identified. The hazard assessment leads to a recommended subsequent activity that could be:
- Action Required (AR) in the short term to break existing contaminant-pathway-receptor (CPR) link;
 - Site Investigation Required (SIR) with objectives for risk estimation, or
 - No Action Required (NAR) at this stage.
- 4.7.3 The hazard assessment is summarised in Table 6, overleaf.

Table 6: Preliminary Hazard Assessment							
Hazard Identification				Hazard Assessment			
Link	Contaminant	Pathway	Receptor	Probability	Consequence	Risk	Hazard Assessment
1	Contaminated soil/groundwater	Ingestion (via soil dust) and inhalation (via soil dust and vapours), ingestion through dirty hands, dermal contact with soil/water.	A- Humans using the site during construction.	High Likelihood	Mild	Medium	SIR - Total soil concentration of relevant contaminants for contractors and designer's risk assessments.
2		Ingestion (via soil dust) and inhalation (via soil dust and vapours), ingestion through dirty hands, dermal contact with soil/water.	B- Humans using the site after development completion.	Medium/ Reasonably Foreseeable	Medium	Medium	SIR- Total soil concentration of relevant contaminants for contractor's risk assessments.
4		Ingestion (via soil dust) and inhalation (via soil dust and vapours), ingestion through dirty hands, dermal contact with soil/water.	C- Humans/ residents offsite during development	Medium/ Reasonably Foreseeable	Medium	Medium	SIR- Total soil concentration of relevant contaminants for contractor's risk assessments.
3		Via service pipes	B- Humans using the site after construction. F- Building structures	Medium/ Reasonably Foreseeable	Medium	Medium	SIR - Total soil concentration of relevant contaminants for designer's risk assessments.
4		Downward migration	D- Perched groundwater	Medium/ Reasonably Foreseeable	Medium	Medium	SIR- Total soil concentration of relevant contaminants for contractor's risk assessments.
5		Downward migration	D - Secondary aquifer/water supply	Medium/ Reasonably Foreseeable	Medium	Medium/ Low	SIR- Total soil concentration of relevant contaminants for contractor's risk assessments.
6	Contaminated soil/waste/ groundwater	Ingestion, inhalation, dermal/direct contact	E- Ecology (Flora/Fauna)	Medium/ Reasonably Foreseeable	Negligible	Near Zero	NAR- Risks to wildlife are negligible and no protected ecological species have been identified.
7	Contaminated groundwater	Secondary A Aquifer	E- Ecology (Flora/Fauna)	Low/Unlikely	Negligible	Near Zero	NAR- Risks to wildlife are negligible and no protected ecological species have been identified.
8	Contaminated soil/groundwater	Direct contact.	F- Building structures.	Medium/ Reasonably Foreseeable	Mild	Low	SIR- Total soil concentration of relevant contaminants to access interaction with foundations and services.
9	Gas – methane, carbon dioxide& Vapours Main gas source is likely to be carbon dioxide.	Inhalation, explosion	B & C- Humans using the site post construction and offsite site visitors/ workers G- Building structures and services	Medium/ Reasonably Foreseeable	Severe	High	SIR – there is potential for organic material to be present on site in the infilled pond. Assess using CL:AIRE RB 17 approach.

- 4.7.4 From Table 6, a range of risk ranking from low to high was established. Potentially medium and high risks require quantification and consideration prior to development. The site investigation objectives described above should represent part of a detailed main stage investigation that should include overall characterisation of the ground in association with obtaining and analysing the information described above.

5. INVESTIGATION METHODOLOGY

5.1 Investigation Strategy

- 5.1.1 The purpose of the trial pits are as follows:

- To assess shallow ground conditions both laterally and vertically below proposed new buildings and the ground conditions in the area of open space in the southwest of the site.
- To determine the depth of infill of the former pond and the nature of the infill
- To allow collection of samples for contamination and geotechnical testing.

6. FIELDWORK

6.1 General Observations

- 6.1.1 The fieldwork was carried out on 14th November 2017. TerraConsult personnel were present to supervise all work, describe the ground encountered and carry out in situ testing. A services search was carried out prior to the site work and a CAT scan performed at the location of each exploratory hole location. Fieldwork procedures were undertaken in accordance with the relevant sections of:

- British Drilling Association “Guidance for Safe Intrusive Activities on contaminated or Potentially Contaminated Land” (2008);
- BS5930:2015 "Code of Practice for Site Investigations;"
- BS10175:2011 + A1 (2013) “Investigation of potentially contaminated sites – Code of practice.”

- 6.1.2 The investigation comprised the following fieldwork scope:

- 5 No. trial pits using a tracked hydraulic excavator;
- Sampling and testing of soils;
- Description of the ground encountered in accordance with BS5930:2015 "Code of Practice for Site Investigations;"

- 6.1.3 The site investigation locations are shown on the appended Drawing No. 3564/002, and extract from which is shown below in Figure 4.

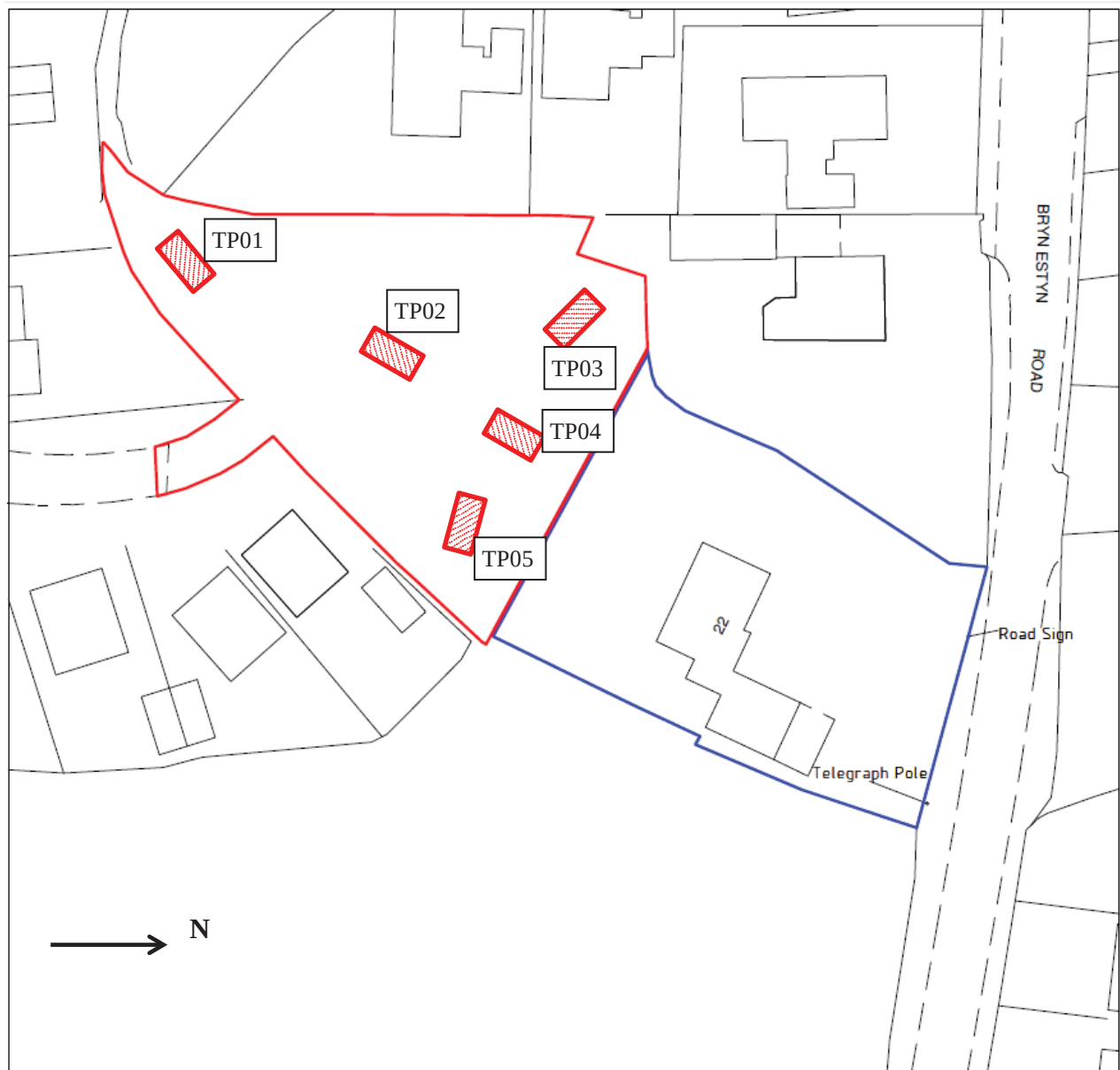


Figure 4: Extract from Drawing No. 3564/002

6.2 Trial Pits

6.2.1 Five trial pits were excavated using a 1.5 tonne tracked excavator, where access permitted, across the site to depths of between 1.8 mbgl (TP02) and 2.1mbgl (TP01).

6.2.2 The trial pit logs and photographs are presented in Appendix E.

6.3 Samples and Sample Containers

- 6.3.1 Soil samples for chemical analysis each comprised a pair of samples: a plastic tub for metals and inorganics, and an amber glass jar for organics.
- 6.3.2 Soil samples for organic analysis were stored in a cool box, with plastic tubs stored in a plastic crate directly to the testing laboratory.

7. LABORATORY TESTING

7.1 Chemical Laboratory Testing

- 7.1.1 The samples were submitted to QTS Environmental of Lenham in Kent who are UKAS accredited in accordance with ISO17025 and are also MCERTS accredited for soil analysis in accordance with the Environment Agency's scheme. The laboratory carries out Quality Assurance and Quality Control in accordance with BS ISO 17025 and participates in external laboratory comparison and quality control schemes. Details of the accreditation and the methods of analysis are provided on the relevant test reports.
- 7.1.2 The selection of samples for laboratory testing and analyses to be determined were made based on the Phase 1 assessment, the excavation records and other observations during the investigations. The sample selection rational was as follows:
- to gain a good coverage across the site and of the various material types and strata encountered;
 - to characterise samples which had visual or olfactory evidence of contamination;
 - to characterise samples from the interface of permeable and less permeable horizons within the ground;
 - to characterise soils samples located at groundwater level;
- 7.1.3 The selected soil and groundwater samples were tested for a range of typical contamination indicators including specific tests for contaminants suspected as being present from the desk study and from observations made on site.
- 7.1.4 The results of the laboratory analysis are presented in Appendix F. The various suites of analysis for the soil, leachate and water were as follows:

Table 7: Suites of Analysis for Soil Samples		
Determinand	Soil Suite 1	Soil Suite 2
Number of Samples	2	2
Index Tests		
pH	✓	✓
As, Be, Cd, Cr, Cu, Pb, Hg, Ni, Se, V, Zn (all totals)	✓	✓
Ca, Fe, K, Mg, Mn, Na		-
Inorganics		
Cyanide - Total	✓	✓
Chloride (2:1 extract on soil samples)	✓	✓
Fluoride (2:1 extract on soil samples)	-	✓
Nitrate (2:1 extract on soil samples)	-	✓
Sulfate (2:1 extract on soil samples)	✓	✓
Organics		
Phenols - Total (monohydric)	✓	✓
Total Organic Carbon (TOC)	✓	✓
PAH (Speciated USEPA 16)	✓	✓
TPH (C ₈ to C ₃₆) TPH CWG (RBCA) Speciation	-	✓
Mineral Oil (C ₁₀ to C ₄₀)	-	✓
Benzene, Toluene, Ethyl Benzene, Xylenes (BTEX);	-	✓
Volatile Organic Compounds (VOCs) and Chlorinated Solvents	-	✓
NOTE		
✓ = Test carried out on all samples **= Test required on selected samples only		
2. All soil samples to be tested and reported in accordance with EA MCERTS for Soils Scheme		

8. GROUND CONDITIONS

8.1 General

- 8.1.1 The site investigations have allowed the site specific ground conditions to be described and this information was used to provide an improved conceptual ground model. The geology encountered during the site investigations was generally consistent with that anticipated from the desk study and is summarised below;

8.2 Ground Surface

- 8.2.1 The ground surface was covered by low vegetation and some minor household rubbish e.g. crisp packets, disposable cups, etc. Tree stumps were present over the entire site. In the north east corner of the site there are some wooden sheets and plastic plant pots.

8.3 Anthropogenic Materials

- 8.3.1 Made Ground was present across the site to depths of between 0.9 m (TP05) and 1.5 m (TP01). The Made Ground comprised three layers, which are interpreted as:

- Demolition Rubble

- Sand
- Buried pond sediment layer

- 8.3.2 The upper layer of demolition rubble type materials was present across the site to between 0.4 m (TP02) and 0.9 m (TP05) depth. It comprised various brick rubble, concrete and plastic, with lesser quantities of glass, charcoal, wood and plasterboard fragments.
- 8.3.3 Below the demolition rubble type materials in TP01, TP02 and TP03 was a layer of brown sand with gravel of sandstone and igneous rocks. This layer was between 0.20 m and 0.50 m thick.
- 8.3.4 A 0.30 m to 0.40 m thick layer of dark brown or dark grey soft clay and clayey sand was present from between 0.80 m and 1.20 m depth in all of the trial holes with the exception of TP05, which is outside the location of the former pond, according to historical mapping. This dark layer, which may represent the sediment at the bottom of the former pond, includes some natural gravel and rootlets.
- 8.3.5 No visual or olfactory evidence of contamination was noted during the fieldwork other than the presence of charcoal (which can be a source of heavy metals, sulphates, PAHs etc.).

8.4 Drift Deposits

- 8.4.1 The glacial sands and gravels were encountered at depths of 0.90 to 1.50 m and is mainly comprised of brown sands with natural gravel of sandstone and igneous rocks. This was encountered to the bases of all the trial holes, except TP03 where a thin clay layer was noted at the base of the pit.

8.5 Solid Geology

- 8.5.1 Bedrock was encountered during the fieldwork.

8.6 Groundwater

- 8.6.1 There was a high water table at the site near the ground surface but the main water strike was encountered in the trial holes between 0.9m and 1.2m bgl in the natural sands and gravels. The water flow was high as the trial pits filled as quickly as the material was excavated.

8.7 Live Root Depth

- 8.7.1 Roots were encountered throughout all trial pits to the bases of the holes at 2.1m bgl.

9. GENERIC QUANTITATIVE RISK ASSESSMENT

9.1 Introduction

9.1.1 The assessment of contamination has been carried out in accordance with the overall guidance presented in CLR11 Model Procedures for the Management of Land Contamination using the procedures as indicated in Appendix B.

9.1.2 Generic risk assessment is a two stage process. Firstly, in the Risk Estimation stage, the measured contaminant concentrations are compared to the relevant GACs or C4SLs/S4ULs where they have been published. Where there is a suitable dataset, this is done after carrying out statistical analysis to determine the upper confidence limit on the true mean. Otherwise, maximum or specific data points are compared directly. The second stage, Risk Evaluation, comprises an authoritative review of the findings with other pertinent information, in cases where the C4SLs or GACs are exceeded, in order to consider if exceedance may be acceptable in the particular circumstances.

9.1.3 The aspects of risk from substances in the ground considered below are as follows:

- human health;
- plant life;
- pollution of Controlled Waters;
- water supply pipes
- below ground concrete; and
- ground gases.

9.2 Assessment for the Protection of Human Health

9.2.1 The Generic Qualitative Risk Assessment (GQRA) is based on a soil with a Soil Organic Matter of 1% was carried in accordance with the methodology for assessing soil samples set out in Appendix B based on a residential end use. A full summary of the chemical test results is presented in Appendix G.

9.2.2 The concentrations of all contaminants were low and all were less than the residential screening criteria indicating a negligible risk to human health.

9.3 Risk to Plant Life

9.3.1 The concentrations of the phytotoxic metals copper, chromium, nickel and zinc have the potential to be harmful to plants. However, all the measured concentrations of these metals are lower than the guideline values for the protection of plants as presented in the MAFF document “Code of Good agricultural practice for the protection of soil”. Therefore there is no risk to plants at the site due to phytotoxicity should any be planted in the ground as part of the proposed development.

9.4 Assessment for the Protection of Controlled Waters

- 9.4.1 The risks to controlled waters (groundwater and surface waters) from contaminants on-site have been assessed in accordance with the EA documents “The Environment Agency’s Approach to Groundwater Protection” (2017) and Remedial Targets Methodology (RTM, 2006). Pollutant inputs from contaminated land sites are considered as passive inputs under the European Water Framework Directive (2000/60/EC) (WFD) and its daughter Directives, and as such are regulated under the Agency’s ‘limit’ pollution objective. Acceptable water quality targets (WQT) are defined for protection of human health (based on Drinking Water Standards (DWS)) and for protection of aquatic ecosystems (Environmental Quality Standards (EQS)).
- 9.4.2 The data indicates that total concentrations detected within soil samples are low in human health terms and do not indicate concentrations which would be indicative of a significant source of groundwater contamination. There are no elevated concentrations of Chemicals of Potential Concern, and subject to agreement with NRW, TerraConsult does not believe the site poses a significant risk to groundwater because:
- the shallow groundwater at and in the vicinity of the site are not abstracted for human consumption;
 - the nearest surface water is over 1km from the site;
 - the site is not in an industrial area or near a petrol station or similar potential pollution off-site source;
 - the concentrations of potential contaminants within the Made Ground are all low and the Made Ground does not represent a potential source and are unlikely to present a significant risk.

9.5 Water Supply Pipe Material Assessment

- 9.5.1 Plastic pipe materials are potentially vulnerable to attack from elevated levels of hydrocarbons, which can potentially lead to contamination of potable water supplies and water supply companies also require the risk to their workers from other contaminants in the ground to be assessed. The assessment has been completed in accordance with the current UK Guidance for the Specification of Water Supply Pipes to be used in Brownfield Sites (UK Water Industry Research Ltd. UKWIR, 2014) together with guidance from United Utilities. This guidance provides threshold concentrations for different pipe material for various chemical groups.
- 9.5.2 The pipeline materials considered by the guidance are PE, PVC, wrapped steel, wrapped ductile iron or copper pipe and barrier pipe. PE are assessed using threshold concentrations for various chemical groups including volatile organic compounds (VOC) with tentatively identified compounds (TICs), semi-volatile organic compounds (SVOC) with TICs, mineral oils, aldehydes, ketones etc. Wrapped steel, wrapped ductile iron and copper pipe are assessed using corrosive properties. The default recommendation for water supply pipes is to use PE with other types of pipework only used if the limits for PE pipes are exceeded. When assessing the ground for water supply pipes the suite of

potential contaminants to be tested only needs to be those contaminants that are potentially present on site based on the desk study. At this site the desk study did not identify there to be a risk from SVOCs (including chlorinated phenols, cresols), aldehydes, ketones, ethers, nitrobenzene and amines so no analysis was carried out for these compounds.

9.5.3 The available data indicates no exceedances for the PE water supply pipe are present and as such the use of PE pipe is deemed permissible with the following caveats:

- should areas of unexpected contamination be found during construction and any water supply pipes are routed through those areas, additional sampling and testing will be required.
- Following confirmation of the water supply pipe route, the water supplier for the area should be contacted and written approval sought. They may require additional chemical data along any proposed potable water supply pipe routes.

9.6 Permanent Ground Gases

9.6.1 There are no off-site sources of ground gas on the site but on-site there is an infilled pond which has the potential to be a source of ground gas. The Made Ground infilling the site has been present for 30 to 40 years and it does not have a visible organic content. The Total Organic Content (TOC) of the Made Ground was 1.0 and 2.3 %.

9.6.2 There is a 0.3 to 0.4 m thick clay bed present which is organic. Two TOC tests were carried out of 2.5 and 5.0 %. It should be noted that the sample which had a 5% TOC had coal/charcoal fragments present and it is likely that the coal fragments give the elevated TOC concentration in this sample relative to the other clay sample. The higher TOC in the sample with 5 % TOC does not represent an elevated ground gas risk because coal/charcoal does not present a risk to ground gas generation.

9.6.3 Based on the above and using the assessment methodology in CL:AIRE report RB17 (2012) no mitigation measures are required for ground gas based on the conceptual ground model, age and the nature of the infilling, and the assessment of TOC results.

9.7 Chemical Attack on Below Ground Concrete

9.7.1 Below ground concrete structures are potentially at risk in areas of elevated sulphates and where there is low pH. An assessment of the soil and groundwater data (following the protocol established in BRE Special Digest 1, 2005) indicates that design class DS-1 and ACEC Class AC-1s conditions prevail. Therefore no special precautions are required at the site for the design of concrete in terms of the durability and structural performance.

9.8 Updated Conceptual Site Model

9.8.1 The conceptual site model initially developed from the desk study and walk-over survey (Section 5.6) has been updated using the findings of the Phase 2 ground investigation. The site investigation revealed the following general downward succession:

Site surface: grass, asphalt, concrete and demolition rubble.

Made Ground: (0.90 m to 1.50 m thick) sandy gravelly clay with concrete, brick, plastic, charcoal, glass and wood, natural sands, and pond sediments.

Glacial Sand & Gravel: (a minimum of 0.6 m thick) comprised of brown gravelly sands with sandstone and granite gravel with a soft clay layer at the base of one pit.

Bedrock: Unknown depth

Groundwater: Encountered inflow at a depth of 0.9 m-1.2 m in all pits but ground surface waterlogged.

9.8.2 The result of the site investigation and laboratory analysis indicates that there are low concentrations of potential contaminants at the site and there are no potential off-site sources that will affect the development. Therefore there is a negligible risk to:

- (i) *human health,*
- (ii) *controlled waters,*
- (iii) *property (existing or proposed) including buildings, crops, livestock, pets, woodland and service lines and pipes,*
- (iv) *adjoining land,*
- (v) *ecological systems, and*
- (vi) *archaeological sites and ancient monuments.*

9.8.3 No specific precautions are required with respect to landfill type ground gases, hydrocarbons or the potential risk from radon for the development. Protection measures will also not be required due to the potential risk from radon.

9.8.4 All below ground concrete should be designed to meet the requirements of DS-1 and ACEC Class AC-1s.

9.8.5 The risk assessments have concluded that no remediation measures are required to address risks to any potential receptors. However, as with any project on a Brownfield site there is the possibility of encountering unexpected contamination. If this occurs then the procedures set out in Appendix I should be implemented.

9.8.6 With soft landscaped areas proposed and limited topsoil present on site, then topsoil will need to be imported and it should be ensured these materials meet the following criteria:

- The requirements of BS 3882:2015 with the concentration of contaminants being lower than the screening criteria for residential land use in Appendix H.
- Site specific sampling and analysis will be required, and analytical results provided by topsoil suppliers will be insufficient on their own.
- Topsoil should be sampled at a rate of one sample per garden area with a minimum of three samples from a source/batch of imported topsoil.

10. WASTE ASSESSMENT

10.1 Waste Hierarchy

- 10.1.1 TerraConsult ere not commissioned to carry out a waste assessment. However som brief comments follow.

10.2 Waste Characterisation and Classification

- 10.2.1 If there is a portion of excess soil this will then have to be sent to a suitable landfill site. A summary of current relatively complex guidance on categorising waste from earthworks is presented in Appendix H. A two phase approach is required comprising comprises:

- Waste Characterisation; and
- Waste Classification (Waste Acceptance Criteria).

Waste Characterisation

- 10.2.2 The results of the total concentrations form the chemical testing on soil samples have been assessed to determine whether or not they are hazardous in terms of waste classification. The results of this assessment indicate that none of the materials encountered during the investigation can be classified as hazardous.

Waste Classification

- 10.2.3 In order to determine whether soils can be sent to a licensed landfill for disposal further testing is required comprising landfill Waste Acceptance Criteria (WAC) analysis for both total concentrations for certain chemicals and for leachate analysis. No WAC testing was carried out as part of this investigation. Should it be proposed to dispose any excess soil at a landfill site then WAC testing will have to be carried out to confirm the landfill waste classification and if any pre-treatment is required. In general the materials encountered during the investigation are all likely to be classified as being inert with the exception of the organic clay (pond bottoms) which has a TOC in excess of the WAC criteria for inert waste.

10.3 Materials Management and Reuse of Arisings On-site

- 10.3.1 The reuse of excavated arisings on site should be maximised. Any material excavated on site may be classified as waste and it is the responsibility of the holder of a material to form their own view on whether or not it is waste. This includes determining when waste that has been treated in some way can cease to be classed as waste for a particular purpose.
- 10.3.2 As soil is technically a waste when it has been excavated, it cannot be re-used on site unless one of the following four procedures are implemented:
- the procedures are followed in the CL:AIRE Code of Practice ‘The Definition of Waste: Development Industry Code of Practice’ Version 2 (2011).’ If these procedures are followed, excavated arisings can be re-used without them being defined as waste “where it is certain that the material will be used for the

purposes of construction in its natural state on the site from which it was excavated.” or:

- the site applies for an Environmental Permit exemption from the Waste Management Regulations so the material can be placed without a permit (note that the rules for permit exemptions have been changed and the maximum quantity covered by a permit exemption for re-using soil is 1,000 T), or;
- the site applies for a full Environmental Permit (either a standard rules permit or a bespoke permit) from the Environment Agency under the Environmental Permitting Regulations 2007; or
- WRAP ‘Quality Protocol: Aggregates from inert waste.’ Only granular aggregates (e.g. Class 1 or Class 6 materials etc. apply, Class 2 materials are not covered by the WRAP Protocol).

10.3.3 Given the size of the development TerraConsult recommends that the development applies for an Environmental Permit exemption. There is no cost associated with this, there are just forms on the NRW website to download, complete and return.

11. CONCLUSION

11.1 Environmental Risk Assessment

11.1.1 A preliminary risk assessment has been carried out based on the contaminant-pathway-receptor model as defined in Statutory Guidance to Part IIA of the Environment Protection Act, 1990, and in accordance with BS 10175: 2011 +A1 2013 “Investigation of Potentially Contaminated Sites – Code of Practice”. In order to make a more detailed assessment of the potential hazards, a Phase 2 intrusive investigation was carried out to develop a more comprehensive conceptual ground model of the site. This detailed the characteristic ground conditions and elements of the surrounding environment and has assisted with identifying the potential contaminants of contamination, the potential receptors of the contamination and the potential pathways between them.

11.1.2 The results of the risk assessments indicate that there is no significant source of contaminants present at the site so there is a negligible risk to all receptors including humans, controlled waters and ecological receptors. No specific precautions are required with respect to landfill type ground gases, radon and hydrocarbons for the development.

11.1.3 The risk assessments have concluded that no remediation measures are required to address risks to any potential receptors. However, as with any project on a Brownfield site there is the possibility of encountering unexpected contamination. If this occurs then the procedures set out in Appendix I should be implemented.

11.2 Recommendations for Further Works

Waste assessment

11.2.1 As most developments require a portion of excess soil to be sent to a landfill sites, we would make an assessment of the Made Ground and natural strata to classify them in

accordance with Landfill Waste Acceptance Criteria which is being required in the immediate future.

Re-use of Soil on Site

- 11.2.2 In order to legally re-use excavated soils as part of the development it is recommended that the development applies for an Environmental Permit exemption. There is no cost associated with this, there are just forms on the NRW website to download, complete and return.

Topsoil

- 11.2.3 With soft landscaped areas proposed and limited topsoil present on site, then topsoil will need to be imported and it should be ensured these materials meet the following criteria:

- The requirements of BS 3882:2015 with the concentration of contaminants being lower than the screening criteria for residential land use in Appendix H.
- Site specific sampling and analysis will be required, and analytical results provided by topsoil suppliers will be insufficient on their own.
- Topsoil should be sampled at a rate of one sample per garden area with a minimum of three samples from a source/batch of imported topsoil.

Regulatory Liaison

- 11.2.4 Any proposals to remediate or develop the site should be agreed with the relevant authorities (e.g. local authority environmental health officer, Environment Agency etc.) to obtain Planning Permission prior to commencement of the works and should be agreed with the NHBC or similar, or with the local authority building control officer prior to commencement of the works.

11.3 Health and Safety

- 11.3.1 As outlined within the HSE publication “Successful Health and Safety Management – HSG65” this report should inform your development of safe systems of work and information as an input into the safety management system. The contents of this report may be used to supplement the contents of the Health and Safety File as required under the Construction Design and Management (CDM) Regulations 2015. All risk control measures should be in accordance with the guidelines laid down within the Management of Health and Safety at Work Regulations 1999.
- 11.3.2 In accordance with the Construction Design and Management (CDM) Regulations 2015, TerraConsult has acted in the role of Principal Contractor and as Principal Designer for the works as described in this report. With issue of this report TerraConsult has discharged and completed all contractual and legal requirements for these positions and we have no further involvement with the project.

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UK Water Industry Research Limited

DRAWINGS



Existing boundaries to remain as existing. Where areas of existing boundaries have deteriorated and new boundaries between plots, contractor to install timber post and vertical timber board fencing to local authority approval.

Project:
Proposed development on
land to the rear of
22, Bryn Estyn Road,
Wrexham.

Title: Planning: Site & Location Plan	Scale: (A2) 1:250
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Drawn By: D.J.Edwards	Date: April 2017
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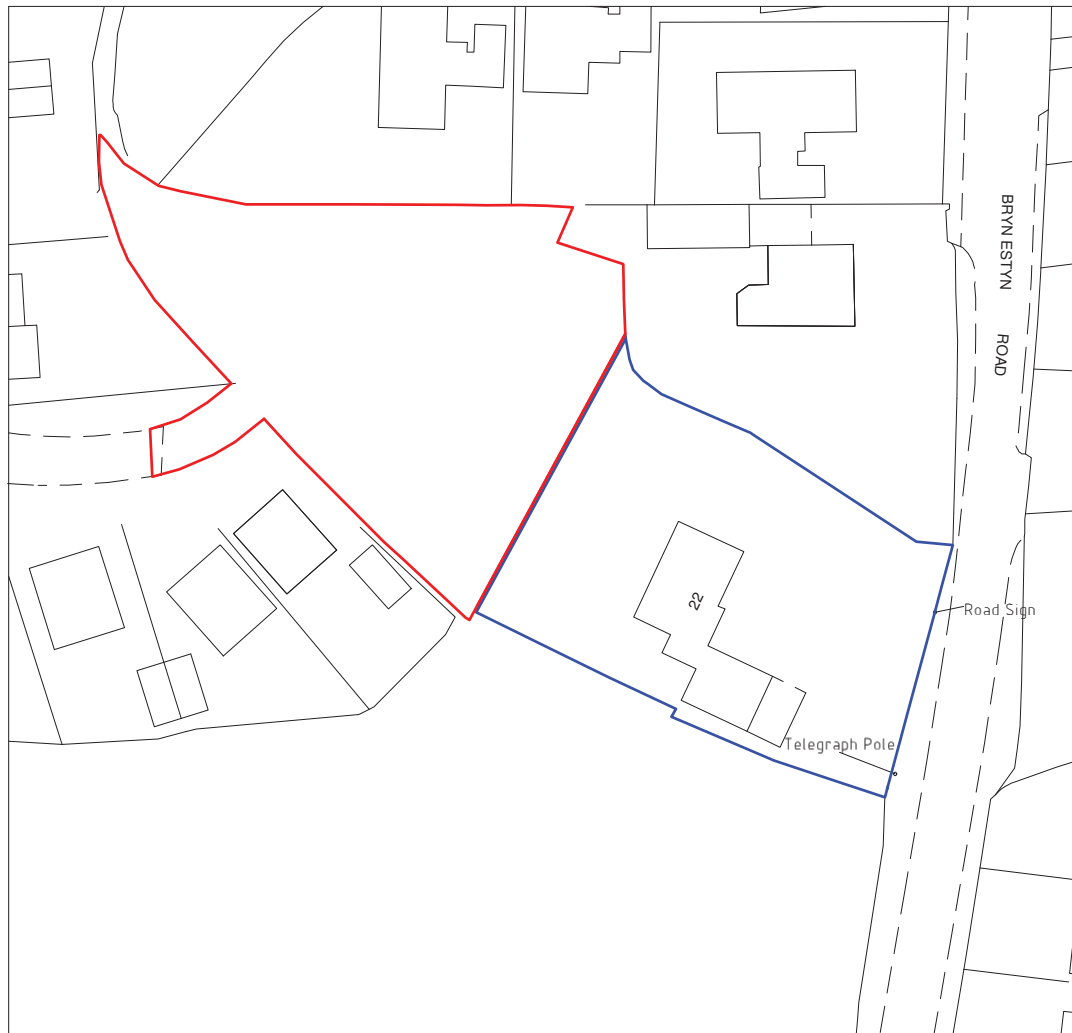
Drawing No: C077/013	Sheet: 1 of 1
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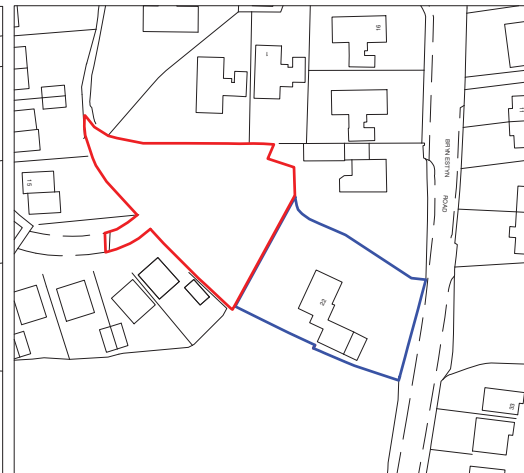


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Site Plan 1:500



Location Plan 1:1250

Rev	Date	Detail	Initial
B	05/17	Design Amends	D.J.E.
A	01/17	Design Amends	D.J.E.

Project:

Proposed development on land to the rear of 22, Bryn Estyn Road, Wrexham.

Title:

Existing: Site &
Location Plan

Scale: (A3)

1:500 &
1:1250

Drawn By:

D.J. Edwards

Date:

Dec 2016

Drawing No:

C077/001

Sheet:

1 of 1

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APPENDICES

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APPENDIX A

Service Constraints, Report Limitations & Planning

Service Constraints, Report Limitations & Planning Requirements

This consultancy contract, report and the site investigation (together comprise the "Services") were compiled and carried out by TerraConsult Limited (TCL) for Hart Hill homes Ltd (the "client") on the basis of a defined programme and scope of works and the terms of a contract between TCL and the "client." The Services were performed by TCL with all reasonable skill and care ordinarily exercised by a reasonable environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by TCL taking into account the limits of the scope of works required by the client, the prevailing site conditions, the time scale involved and the resources, including financial and manpower resources, agreed between TCL and the client. TerraConsult Ltd cannot accept responsibility to any parties whatsoever, following the issue of this report, for any matters arising which may be considered outwith the agreed scope of works.

Other than that expressly contained in the above paragraph, TCL provides no other representation or warranty whether express or implied, is made in relation to the Services. Unless otherwise agreed this report has been prepared exclusively for the use and reliance of the client in accordance with generally accepted consulting practices and for the intended purposes as stated in the agreement under which this work was completed. This report may not be relied upon, or transferred to, by any other party without the written agreement of a Director of TCL. If a third party relies on this report, it does so wholly at its own and sole risk and TCL disclaims any liability to such parties.

It is TCL's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of, or reliance upon the report in those circumstances by the client without TCL's review and advice shall be at the client's sole and own risk.

The information contained in this report is protected by disclosure under Part 3 of the Environmental Information Regulations 2004 pursuant to the provisions of Regulation 12(5) without the consent in writing of a Director of TerraConsult Limited.

The report was written in November 2017 and should be read in light of any subsequent changes in legislation, statutory requirements and industry practices. Ground conditions can also change over time and further investigations or assessment should be made if there is any significant delay in acting on the findings of this report. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of TCL. In the absence of such written advice of TCL, reliance on the report in the future shall be at the client's own and sole risk. Should TCL be requested to review the report in the future, TCL shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between TCL and the client.

The observations and conclusions described in this report are based solely upon the Services that were provided pursuant to the agreement between the client and TCL. TCL has not performed any observations, investigations, studies or testing not specifically set out or mentioned within this report. TCL is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, TCL did not seek to evaluate the presence on or off the site of asbestos, electromagnetic fields, lead paint, radon gas or other radioactive or hazardous materials.

The Services are based upon TCL's observations of existing physical conditions at the site gained from a walkover survey of the site together with TCL's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The findings and recommendations contained in this report are based in part upon information provided by third parties, and whilst TerraConsult Ltd have no reason to doubt the accuracy and that it has been provided in full from those it was requested from, the items relied on have not been verified. No responsibility can be accepted for errors within third party items presented in this report. Further TCL was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. TCL is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to TCL and including the doing of any independent investigation of the information provided to TCL save as otherwise provided in the terms of the contract between the client and TCL.

Where field investigations have been carried out these have been restricted to a level of detail required to achieve the stated objectives of the work. Ground conditions can also be variable and as investigation excavations only allow examination of the ground at discrete locations. The potential exists for ground conditions to be encountered which are different to those considered in this report. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition, chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and TCL] based on an understanding of the available operational and historical information, and it should not be inferred that other chemical species are not present.

The groundwater conditions entered on the exploratory hole records are those observed at the time of investigation. The normal speed of investigation usually does not permit the recording of an equilibrium water level for any one water strike. Moreover, groundwater levels are subject to seasonal variation or changes in local drainage conditions and higher groundwater levels may occur at other times of the year than were recorded during this investigation.

Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site.

Throughout the report the term 'geotechnical' is used to describe aspects relating to the physical nature of the site (such as foundation requirements) and the term 'geoenvironmental' is used to describe aspects relating to ground-related environmental issues (such as potential contamination). However, it should be appreciated that this is an integrated investigation and these two main aspects are inter-related. The geoenvironmental sections are written in broad agreement with BS 10175:2011+A1 2013. For the geotechnical aspects of the report, the general requirements of Eurocode 7 (BS EN 1997-2:2007) are to produce a Ground Investigation Report (GIR) which shall form part of the Geotechnical Design Report (GDR). The geotechnical section of this report is intended to fulfil the general requirements of the GIR as outlined in BS EN 1997-2, Section 6. The GIR contains the factual information including geological features and relevant data, and a geotechnical evaluation of the information stating the assumptions made in the interpretation of the test results. This report shall not be considered as being a GDR.

Planning Requirements

The National Planning Policy Framework (NPPF, 2012) has twelve core land-use planning principles, two of which directly relate to the potential for pollution and contaminated land:

- Requirement to “*contribute to conserving and enhancing the natural environment and reducing pollution*” and setting out of a preference for developments to be on land of “*lesser environmental value*”; and
- “*encourage the effective use of land by re-using land that has been previously developed (brownfield land), providing that it is not of high environmental value.*”.

In accordance with the core principles of NPPF, Paragraph 109 clarifies that enhancing the natural environment includes:

- “*preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability; and*
- *remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate.*”.

Paragraph 121 of NPPF states that planning policies and decisions for developments should also ensure that:

- “*the site is suitable for its new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining, pollution arising from previous uses and any proposals for mitigation including land remediation or impacts on the natural environment arising from that remediation;*
- *after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and*
- *adequate site investigation information, prepared by a competent person, is presented.*”.

This report has been prepared and authorised by staff that are competent as defined in the NPPF.

Unexploded Ordnance

Clients have a legal duty under the CDM 2015 Regulations to provide designers and contractors with project-specific health and safety information needed to identify hazards and risks. This includes the possibility of unexploded ordnance (UXO) being encountered on the site. Further details are given in CIRIA Report C681 (Stone et al 2009). A non-UXO specialist screening exercise has been carried out for the site by considering any evidence of UK defence activities on or near the site evident from the gathered desk study information and the unexploded aerial delivered bomb (UXB) regional risk maps produced by Zetica. Other data sources are available, but as a first stage screening exercise the freely available Zetica maps have been used. The level of risk stated is that determined by Zetica, a company experience in the desk study, field investigation and clearance of UXO/UXB.

APPENDIX B

Environmental Risk Assessment Methodology & Terminology

ENVIRONMENTAL RISK ASSESSMENT METHODOLOGY & TERMINOLOGY

LEGISLATION OVERVIEW

This report includes hazard identification and environmental risk assessment in line with the risk-based methods referred to in relevant UK legislation and guidance. Government environmental policy is based upon a “suitable for use approach,” who is relevant to both the current use of land and also to any proposed future use. The contaminated land regime is the statutory regime for remediation of contaminated land that causes an unacceptable level of risk and is set out in Part 2A of the Environmental Protection Act 1990 (“EPA 1990”). The main objective of introducing the Part IIA regime is to provide an improved system for the identification and remediation of land where contamination is causing unacceptable risks to human health or the wider environment given the current use and circumstances of the land. Part IIA provides a statutory definition of contaminated land under Section 78A (2) 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 a significant possibility of such harm being caused;*
- or*
- (b) Pollution of controlled waters is being, or is likely to be, caused.”*

In order to assist in establishing if there is a “significant possibility of significant harm” there must be a “contaminant linkage” for potential harm to exist. That means there must be a source(s) of contamination, sensitive receptors present and a connection or pathway between the two. This combination of contaminant-pathway-receptor is termed a “contaminant linkage or CPR linkage.”

Part IIA of The Environmental Protection Act 1990 is supported by a substantial quantity of guidance and other Regulations. Key implementing legislation of the Part 2A regime includes the Contaminated Land (England) Regulations 2006 (SI 2006/1380) as amended by the overarching legislation for the contaminated land regime, which implements the provisions of Part IIA of the Environmental Protection Act 1990 (as inserted by section 57 of the Environment Act 1995), came into force on 14th July 2000 together with recent amended regulations: Contaminated Land (Wales) (Amendment) Regulations 2012 (SI 2012/264). Revised Contaminated Land Statutory Guidance was published by DEFRA in April 2012. Part IIA defines the duties of Local Authorities in dealing with it. Part IIA places contaminated land responsibility as a part of planning and redevelopment process rather than Local Authority direct action except in situations of very high pollution risk.

In the planning process guidance is provided by Planning Policy Wales (Edition 9, November 2016) which requires that a site which has been developed shall not be capable of being determined “contaminated land” under Part IIA. In practice, Planning Authorities require sites being developed to have a lower level of risk post development than the higher level of risk that is required in order to determine a site as being contaminated in accordance with Part IIA. This is to ensure that there is a suitable zone of safety below the level for Part IIA determination and prevent recently developed sites becoming reclassified as contaminated land if there are future legislative or technical changes (e.g. a substance is subsequently found to be more toxic than previously assessed this increases its hazard).

The criteria for assessing concentrations of contaminants and hence determining whether a site represents a hazard are based on a range of techniques, models and guidance. Within this context it is relevant to note that Government objectives are:

- (a) to identify and remove unacceptable risks to human health and the environment;
- (b) to seek to bring damaged land back into beneficial use;
- (c) to seek to ensure that the cost burdens faced by individuals, companies and society as a whole are proportionate, manageable and economically sustainable.

These three objectives underlie the “suitable for use” approach to risk management and remediation of contaminated land. The “suitable for use” approach focuses on the risks caused by land contamination. The approach recognises that

the risks presented by any given level of contamination will vary greatly according to the use of the land and a wide range of other factors, such as the underlying geology of the site. Risks therefore should be assessed on a site-by-site basis.

The "suitable for use" approach then consists of three elements:

- (a) *ensuring that land is suitable for its current use* - in other words, identifying any land where contamination is causing unacceptable risks to human health and the environment, assessed on the basis of the current use and circumstances of the land, and returning such land to a condition where such risks no longer arise ("remediating" the land); the contaminated land regime provides the regulatory mechanisms to achieve this;
- (b) *ensuring that land is made suitable for any new use, as planning permission is given for that new use* - in other words, assessing the potential risks from contamination, on the basis of the proposed future use and circumstances, before official permission is given for the development and, where necessary to avoid unacceptable risks to human health and the environment, remediating the land before the new use commences; this is the role of the town and country planning and building control regimes; and
- (c) *limiting requirements for remediation to the work necessary to prevent unacceptable risks to human health or the environment in relation to the current use or future use of the land for which planning permission is being sought* - in other words, recognising that the risks from contaminated land can be satisfactory assessed only in the context of specific uses of the land (whether current or proposed), and that any attempt to guess what might be needed at some time in the future for other uses is likely to result either in premature work (thereby running the risk of distorting social, economic and environmental priorities) or in unnecessary work (thereby wasting resources).

The mere presence of contaminants does not therefore necessarily warrant action, and consideration must be given to the scale of risk involved for the use that the site has, and will have in the future.

OVERALL METHODOLOGY

The work presented in this report has been carried out in general accordance with recognised best practice as detailed in guidance documents such as in the CLR 11 Model Procedures for the Management of Land Contamination (Environment Agency, 2004), and BS10175:2011+A1 2013. Important aspects of the risk assessment process are transparency and justification. The particular rationale behind the risk assessments presented is given in this appendix.

The first stage of a two-staged investigation and assessment of a site is the Preliminary Investigation (BS 10175:2011), often referred to as the Phase 1 Study, comprising desk study and walk-over survey, which culminates in the Preliminary Risk Assessment. A preliminary conceptual site model (CSM) is developed which identifies potential geotechnical and geo-environmental hazards and the qualitative degree of risk associated with them. From the geo-environmental perspective, the Hazard Identification process uses professional judgement to evaluate all the hazards in terms of potential contaminant linkages (of contaminant source-pathway-receptor). Potential contaminant linkages are potentially unacceptable risks in terms of the current contaminated land regime legal framework and require either remediation or further assessment. These are normally addressed via intrusive ground investigation and generic risk assessment.

The second stage is the Ground Investigation, Generic Risk Assessment and Geotechnical Interpretation. This represents the further assessment mentioned above. The scope of the Ground Investigation is based on the findings of the Preliminary Risk Assessment and is designed to reduce uncertainty in the geotechnical and geoenvironmental hazard identification. The Ground Investigation comprises fieldwork, laboratory testing and usually also on-site monitoring. The Ground Investigation may include the Exploratory, Main and Supplementary Investigations described in BS 10175:2011+A1 2013. The results of the Ground Investigation reduces uncertainty in the geotechnical and geoenvironmental risks. Depending on the findings more detailed investigations or assessments may be required.

PRELIMINARY RISK ASSESSMENT

Current practice recommends that the determination of potential liabilities that could arise from land contamination be carried out using the process of risk assessment, whereby “risk” is defined as:

- “(a) The probability, or frequency, or occurrence of a defined hazard; and*
- (b) The magnitude (including the seriousness) of the consequences.”*

The UK’s approach to the assessment of environmental risk is set out in by the Department of the Environment Transport and the Regions (2000) publication “A Guide to Risk Assessment and Risk Management for Environmental Protection” (also called Greenleaves II). This established an iterative, systematic staged process which comprises:

- (a) Hazard identification;
- (b) Hazard assessment;
- (c) Risk estimation;
- (d) Risk evaluation;
- (e) Risk assessment;

At each stage during the development process, the above steps are repeated as more detailed information becomes available for the site.

For an environmental risk to be present, all three of the following elements must be present:

- Source/Contaminant: hazardous substance that has the potential to cause adverse impacts;
- Receptor: target that may be affected by contamination: examples include human occupants/users of site, water resources (rivers or groundwater), or structures;
- Pathway: a viable route whereby a hazardous substance may come into contact with the receptor.

The absence of one or more of each component (contaminant, pathway, receptor) would prevent a contaminant linkage being established and there would be no significant environmental risk.

The identification of potential contaminant linkages is based on a Conceptual Model of the site, which is subject to continual refinement as additional data becomes available. As part of a Preliminary Risk Assessment (Desk Study and site walk over) a Preliminary Conceptual Site Model (PCSM) is formed. Based on the PCSM, potential contaminant linkages can be assessed. If the PCSM and hazard assessment indicate that a contaminant linkage is not of significance then no further assessment or action is required for this linkage. For each significant and potential linkage a risk assessment is carried out. The linkages which potentially pose significant risks may require a variety of responses ranging from immediate remedial action or risk management or, more commonly, further investigation and risk assessment. This next stage is termed a Phase II Main Site Investigation and should provide additional data to allow refinement of the Conceptual Site Model and assess the level of risk from each contaminant linkage.

Definition of Risk Assessment Terminology

The criteria used for risk assessment are broadly based on those presented in DETR’s “A Guide to Risk Assessment and Risk Management for Environmental Protection” (2000). The Severity of the risk is classified according to the criteria in Table B.1 below:

Table B.1 Severity/Consequence of Risk	
Severe	Acute risks to human health. Catastrophic damage to buildings/property (e.g. by explosion). Direct pollution of sensitive water receptors or serious pollution of other controlled water(watercourses or groundwater) bodies.
Medium	Harm to human health from long-term exposure. Slight pollution of sensitive controlled waters (surface waters or aquifers) or pollution of other water bodies. Significant effects on sensitive ecosystems or species.
Mild	No significant harm to human health in either short or long term. No pollution of sensitive controlled waters, no more than slight pollution of non-sensitive waters. Significant damage to buildings or structures. Requirement for protective equipment during site works to mitigate health effects.
Negligible	Damage to non-sensitive ecosystems or species. Minor damage to buildings or structures. No harm or pollution of water.

The probability of the risk occurring is classified according to criteria given in Table B.2 below:

Table B.2: Probability of Risk Occurring	
High likelihood	Contaminant linkage may be present, and risk is almost certain to occur in the long term, or there is evidence of harm to the receptor.
Medium/Reasonably Foreseeable	Contaminant linkage may be present, and it is probable that the risk will occur over the long term.
Low/Unlikely	Contaminant linkage may be present and there is a possibility of the risk occurring, although there is no certainty that it will do so.
Negligible/Not credible	Contaminant linkage may be present but the circumstances under which harm would occur are improbable.

An overall evaluation of the level of risk is gained from a comparison of the severity and probability, as shown in Table B.3 below:

Table B.3: Comparison of Severity and Probability					
		Severity			
		Severe	Medium	Mild	Negligible
Probability	High likelihood	Very High Risk	High Risk	Medium/Low Risk	Low Risk
	Medium/Reasonably Foreseeable	High Risk	Medium Risk	Low Risk	Near Zero
	Low/Unlikely	High/Medium Risk	Medium/Low Risk	Low Risk	Near Zero
	Negligible/Not credible	Medium/Low Risk	Low Risk	Low Risk	Near Zero

The various risk rankings provide guidance for recommended actions, whether this is:

- AR - Action Required, Remediation or mitigation or site investigation works required
- SIR - Site Investigation Required, further assessment is required.
- NAR - No Action Required.

A description of the evaluated risk is as follows:

Table B.4 – Description of the Classified Risks and Likely Action Required	
Evaluated Risk	Recommended Actions
Very High Risk	AR: There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.
High Risk	AR: Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the long term.
Moderate Risk	SI: It is possible that harm could arise to a designated receptor from an identified hazard. However, it is relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer term.
Low Risk	NAR: It is possible that harm could arise to a designated receptor from an identified hazard, but there is a low likelihood of this hazard occurring and if realised, harm would at worst normally be mild.
Near Zero	NAR: There is a negligible possibility that harm could arise to a receptor. In the event of such harm being realised, it is not likely to be severe.

GENERIC QUANTITATIVE RISK ASSESSMENT

In the following sections the current UK guidance on risks to the following receptors are discussed: human health, plant life and controlled waters

• Human Health

The overall methodology for assessing the risk to human health from potential contaminants in soil is set out in the Environment Agency's guidance "Using Soil Guideline Values" SC050021/SGV Introduction, 3289 2009 and using the CLEA 1.06 model software (and CLEA 1.071 for nickel). The generic assessment criteria are in accordance with the following:

- Science Report SC050021/SR2: Human health toxicological assessment of contaminants in soil;
- Science Report SC050021/SR3: Updated technical background to the CLEA model;
- Science Report SC050021/SR4: CLEA Software (Version) Handbook;
- Toxicological reports and SGV technical notes;
- Toxicological data published by LQM/CIEH (2009) and CL:AIRE/EIC/AGS (2009)
- DEFRA Development of Category 4 Screening Levels for assessment of land affected by contamination - SP1010 (December 2013).
- LQM/CIEH Suitable 4 Use Levels (S4ULs) for Human Health Risk Assessment
- Toxicology review published by the European Food Safety Authority for nickel (2015)

In 3289 2014 six 'proposed' Category 4 Screening Levels (pC4SL) were issued by Defra. These screening values are considered to be within Category 4 as defined in the Contaminated Land Statutory Guidance and indicate safe levels for new developments passing through the planning system. The SGV for lead has been withdrawn, and the pC4SL for lead has been derived using current best practice. In January 2015 LQM/CIEH published S4ULs for 89 contaminants in accordance with the C4SL methodology.

Note that groundwater contamination may pose a risk to human health but that there are no relevant generic assessment criteria available for comparison. TerraConsult has derived our own assessment criteria for this.

• Phytotoxic Risks

Generic assessment of phytotoxicity is by comparison with guideline values presented in the British Standard for Topsoil and the MAFF document "Code of Good agricultural practice for the protection of soil", October 1998. This is in accordance with CLR's reference to DEFRA notice CLAN 4/04.

- **Controlled Waters**

Risks to controlled waters (groundwater and surface waters) from contaminants are assessed in accordance with the EA documents Groundwater Protection: Policy and Practice GP3 (2012) and Remedial Targets Methodology (RTM, 2006). Pollutant inputs from contaminated land sites are considered as passive inputs under the European Water Framework Directive (2000/60/EC) (WFD) and its daughter Directives, and as such are regulated under the Environment Agency's 'limit' pollution objective. Acceptable water quality targets (WQT) are defined for protection of human health (based on Drinking Water Standards (DWS)) and for protection of aquatic ecosystems (Environmental Quality Standards (EQS)). The risk posed to controlled waters from total soil concentrations cannot be directly assessed. The risk is assessed either by comparison of results of leachate tests carried out on soil samples, or from the direct testing of samples of groundwater to screening criteria. Leachate testing generally forms a conservative assessment and is not appropriate for organic contaminants.

CURRENT GUIDANCE ON INTERPRETATION OF CHEMICAL ANALYSIS OF SOILS

Contaminated land is defined under law through Part IIA of the Environmental Protection Act 1990, implemented through Section 57 of the Environment Act 1995. This supports a 'suitable for use' based approach to the risk assessment of potentially contaminated land. The site specific risk assessment is based upon assessment of plausible contaminant linkages, referred to as the contaminant-pathway- receptor model, based upon the current or proposed use of the site.

Before undertaking a risk assessment a conceptual site model is devised in order to identify the potential contaminants, pathways and receptors. The individual contaminants, pathways and receptors then need to be further investigated in order to refine the initial assessment and risk assessment undertaken.

In 3289 2002, the Department for Environment, Food and Rural Affairs (DEFRA) and the Environment Agency published the Contaminated Land Exposure Assessment (CLEA) Model and a series of related reports. These were designed to provide a scientifically based framework for the assessment of chronic risks to human health from contaminated land. These reports (CLR7-10) together with associated "SGV" documents were withdrawn and the following documents have been published as revised guidance to the CLEA assessment:

- Environment Agency : 2008: Using Soil Guideline Values SC050021/SGV Introduction, 3289 2008.
- Environment Agency : 2008: Science Report SC050021/SR2: Human health toxicological assessment of contaminants in soil.
- Environment Agency : 2008: Science Report SC050021/SR3: Updated technical background to the CLEA model.
- Environment Agency : 2008 :Compilation of Data for Priority Organic Contaminants for Derivation of Soil Guideline Values Science report SC050021/SR7
- Environment Agency :Science Report SC050021/SR4: CLEA Software (Version 1.05) Handbook.
- Environment Agency :CLEA Software Version 1.071, September 2015
- DEFRA Development of Category 4 Screening Levels for assessment of land affected by contamination - SP1010 (December 2013).
- LQM/CIEH Suitable 4 Use Levels for Human Health Risk Assessment

Additional guidance on statistical assessment replacing CLR 7 is partly provided in:

- CL:AIRE:2009: Guidance on Comparing Data With a Critical Concentration

A different approach to the statistical appraisal of data is required depending on whether the assessment of risk is to assess whether land is Contaminated Land in accordance with regulations, or whether the assessment is to assess whether the site is suitable for new development in according with Planning guidance. This is discussed further in CL:AIRE:2009 "Guidance on Comparing Data With a Critical Concentration".

Soil Guideline Values

- heavy metals and other inorganic compounds: arsenic, cadmium, chromium, cyanide, lead (now withdrawn), mercury nickel (now withdrawn), and selenium;
- benzene, ethylbenzene, toluene and xylenes;
- phenol;
- dioxins and dioxin-like polychlorinated biphenyls (PCBs);
- polycyclic aromatic hydrocarbons (PAHs) – 11 substances.

In addition CIEH through LQM and the EIC have published generic assessment criteria (GACs) for a wide variety of other parameters including metals, hydrocarbons, chlorinated aliphatic compounds, PAHs and explosive substances for three standard land uses. These have been produced to supplement the Environment Agency guidance. These GACs will be replaced by SGVs when or if the Environment Agency publishes any more SGVs.

The diagram illustrates various exposure pathways for dust and soil in a domestic environment. It shows a cross-section of a house with a person sitting at a table, a person standing, and a dog. Key exposure pathways include:

- Ingesting dust:** A person sitting at a table.
- Inhalating indoor dusts and vapours:** A person standing inside the house.
- Ingesting soil:** A dog lying on the floor.
- Inhalating outdoor dusts and vapours:** A person standing outside.
- Exposure Pathways (indicated by red arrows):**
 - Rising vapours:** From the ground into the house.
 - Tracking back of soil/dust from garden into house:** From the garden into the house.
 - Wind-blown dust:** From the garden into the house.
- Other labels:**
 - Eating contaminated vegetables and soil adhering to vegetables:** A person sitting at a table.
 - Skin contact with dust:** A person standing inside the house.
 - Skin contact with soil:** A dog lying on the floor.
 - Plant uptake:** From the ground into the house.

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- ingestion of indoor dust;
- ingestion of home grown vegetables;
- ingestion of soil attached to home grown vegetables.
- **Dermal Contact**
 - dermal contact with outdoor soil;
 - dermal contact with indoor dust.
- **Inhalation**
 - inhalation of outdoor dust;
 - inhalation of indoor dust;
 - inhalation of outdoor soil vapour;
 - inhalation of indoor soil vapour.

It should be noted that there are other potential exposure pathways on some sites not included in the CLEA model e.g. certain organic compounds can pass through plastic water pipes into drinking water supply.

The presence and/or significance of each of the above exposure pathways are dependent on the type of land use being considered and the nature of the contaminant under scrutiny. Accordingly, the CLEA model considers for principle 'default' land use types and makes a series of 'default' assumptions with regard to human exposure frequency, duration and critical human target groups for each land use considered:

- residential land use;
- allotments;
- commercial and industrial land use.

The land use categories defined in the CLEA are detailed below.

Residential: This land use category assumes that people live in a variety of dwellings including terraced, detached and semi-detached houses up to two storeys high. The structure of buildings varies. Default parameters for building materials and building design are included in CLEA documents to calculate the relevant multi-layer diffusion coefficients for vapour intrusion and to model indoor vapour intrusion. The CLEA model assumes that regardless of the style of housing the residents will have access to either a private garden or community open space nearby, and that soil tracked into the home will form indoor dust. It allows for the ingestion pathways from home grown vegetables.

Allotments: The CLEA model incorporates an assessment of land provided by local authorities specifically for people to grow fruit and vegetables for their own consumption. Consumption of such fruit and vegetables present several exposure pathways; plants absorb contaminants mainly via water uptake through roots, the contaminants move to edible portions of plants via translocation and contaminated soil particles become trapped in the skin and between leaves. At present the model fails to account for exposure through the consumption of animals, and their products (e.g. eggs), which have been reared on contaminated land.

Commercial/Industrial: Although there are a wide variety of workplaces and work-related activities, the CLEA assessment of this land-use assumes that work occurs in a permanent, three-storey structure, where employees spend most time indoors, conducting office-based or light physical work. The model assumes employees sit outside during breaks for most of the year. Limitations in applying this land-use to different industries is detailed in EA publication "Updated technical background to the CLEA model" (2011). The generic model assumes that the site would not be covered by hard standing. Risk of exposure to contaminants would be clearly less where commercial land is essentially all buildings and hard standing.

Based on the assumptions of each land use and the associated applicable exposure pathways, a 'Soil Guideline Value' (SGV) may be calculated for each contaminant under consideration for a particular land use in order to determine whether certain contaminant soil concentrations pose a significant risk to human health. The primary purpose of the CLEA SGVs are as 'trigger values' – indicators to a risk assessor that soil concentrations below this level require no further assessment as it can be assumed that the soil is suitable for the proposed use. Where soil concentrations occur above the SGV then further assessment of the results is required. The Contaminated Land (England) (Amendment) Regulations 2012 and Contaminated Land Statutory Guidance (DEFRA, 2012) which came into force in early April

2012 provides new clarity on the assessment of risk where soil concentrations exceed the SGV. The guidance introduces a four stage classification system relating to concentration of contaminants and the assessed risk which indicates appropriate actions. Category 1 and 2 sites are classified as “Contaminated Land” as defined in Part IIA of The Environmental Protection Act (1990). Category 3 and 4 sites are not considered as “Contaminated Land” in accordance with the Act. This can be explained using the figure on the following page.

There are also difficulties in establishing soil concentrations of contaminants beyond which risks from exposure to these contaminants would be ‘unacceptable’ and that they would lead to “significant possibility of significant harm” as defined in Part IIA of The Environmental Protection Act (1990) and determine that the land is “contaminated.” This ultimately requires detailed ‘toxicological’ information of the health effects of individual contaminants and also a scientific judgement on what constitutes an ‘unacceptable’ risk. It is for local authorities or the Environment Agency to determine whether a particular site is contaminated land and it is for local Planning Authorities to determine whether land affected by contamination can be redeveloped.

Given the SGVs have been derived only for a limited number of contaminants and there was little prospect of further SGVs being published, two professional groupings have produced Generic Assessment Criteria (GACs) in accordance with the CLEA model for a large number of additional contaminants. These GACs were recognised in the new Contaminated Land Statutory Guidance (DEFRA, 2012) and have been produced as follows:

LQM/CIEH : 2009 Nathaniel CP, McCaffrey C, Ashmore MH, Cheng NPS GROUP, Gillett A, Ogden R & Scott D : 2009 . The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment (2nd edition). Land Quality Press, Nottingham.

CL:AIRE/EIC/AGS: 2009 : Soil Generic Assessment Criteria (GAC) for Human Health Risk Assessment. Contaminated Land: Applications in Real Environments, Environment Industries Commission & Association of Geotechnical and Environmental Specialists. December 2009.

Category 4 Screening Levels and LQM/CIEH Suitable 4 Use Levels

For new developments progressing through the planning regime, it is desirable that the soil concentrations are within Category 4 where there is a valid contaminant linkage. The upper boundary between Category 4 and 3 is not defined in the guidance. This boundary can also be better defined by carrying out a Detailed Quantified Risk Assessment (DQRA) and this is discussed later in this appendix.

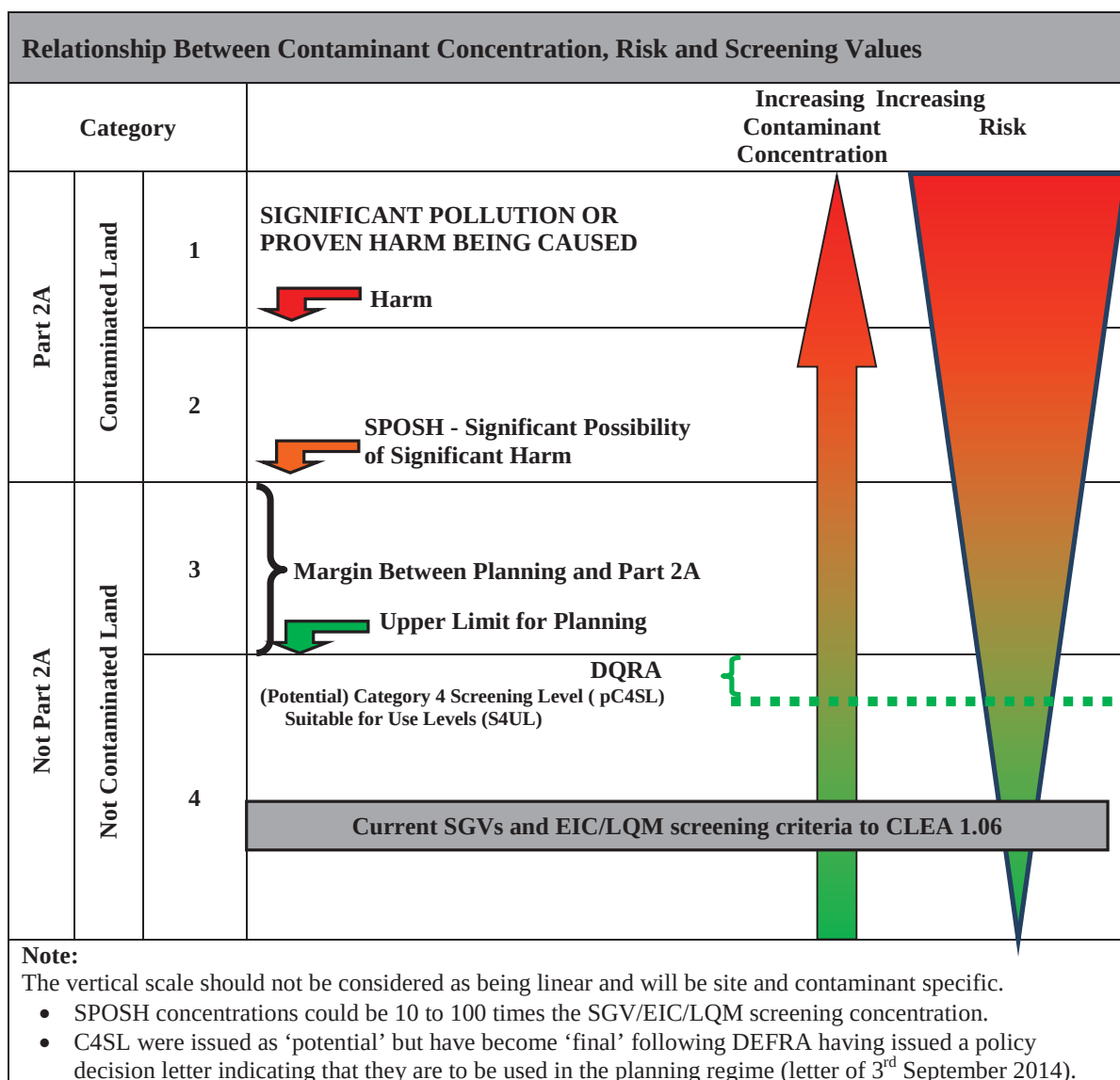
In December 2013 Defra issued the findings of a research project undertaken by CL:AIRE to set out the framework by which potential Category 4 Screening Levels (pC4SL) may be derived. The report was not designed to produce ‘final’ C4SL as the steering group producing the report believes that final C4SL should be set by a ‘relevant authority’ (e.g. Defra), the toxicological framework proposed has not been reviewed by the Committee on Toxicity and the document has yet to be subject to peer review.

In 2014, appendices to the main Defra report were published detailing the derivation of pC4SL for 6 contaminants and other appendices regarding a review of the CIEH/CL:AIRE statistics guidance and sensitivity analysis. For each contaminant, a range of pC4SL have been produced relating to modifying toxicological parameters only, modifying exposure parameters only or by modifying both. It should be noted that the pC4SL produced for lead (the SGV was withdrawn in 2011) has undertaken a relatively large toxicological review in relation to modelling blood lead concentrations. pC4SL have been produced for:

- Arsenic;
- Benzene;
- Benzo(a)pyrene (as a surrogate marker for PAHs);
- Cadmium;
- Chromium (VI); and
- Lead

As previously discussed the values were initially published as ‘potential’ C4SL but have become ‘final’ following DEFRA having issued a policy decision letter indicating that they are to be used in the planning regime (letter of 3rd September 2014). It is considered that the pC4SL provide a simple test for deciding whether land is suitable for use without any remediation. The pC4SL represent a new set of screening levels that are more pragmatic (but strongly

precautionary) compared to the existing soil guideline values (SGVs and the other GACs calculate in accordance with the existing CLEA methodology). The pC4SL provide cautious estimates of contaminant concentrations in soil that are still considered to present an acceptable level of risk, within the context of Part 2A, by combining information on toxicology, exposure assessment and normal levels of exposure to these contaminants. pC4SL values should not be seen as 'SPOH values.' Exceeding a pC4SL means that further investigation is required, not that the land is necessarily contaminated. In January 2015, LQM published Suitable 4 Use Levels (S4ULs) for a further 89 contaminants using the Defra C4SL methodology. In a similar manner to the pC4SLs, no authoritative review has been undertaken although the approach and quality of the work undertaken is widely accepted as being of high quality.



Lead

The SGV for lead was withdrawn in 2011 and is not used in this report. The pC4SL for lead provides a technically robust and conservative assessment tool using significantly updated toxicological modelling in line with current scientific understanding of lead toxicology.

Nickel

The SGV for nickel was withdrawn in 2015 and is not used in this report. In-house GACs for nickel have been produced using the updated toxicological review by the EFSA and the CLEA 1.071 software.

Public Open Space

The Defra report (December 2013) has also introduced exposure scenarios for two other commonly occurring land uses which require assessment (under the planning and Part 2A regimes) on a relatively frequent basis. These exposure scenarios are:

- Public Open Space – Space Near Residential Housing (POS_{resi}); and
- Public Open Space – Public Park (POS_{park}).

Potential use of pC4SL relating to Public Open Space (POS) require care due to the significant variability in exposure characteristics. For example, POS may include:

- Children's play areas, public parks where children practise sport several times a week and teenagers only once a week;
- Grassed areas adjacent to residential properties which are rarely used;
- Dedicated sports grounds where exposure is only to players and groundworkers; and
- Nature reserves or open ground with low level activity (for example, dog walking).

Within the Defra report (December 2013) the following exposure scenarios have been modelled as these are considered the most important for potential exposure for the critical receptor i.e. young children:

- Green open space close to housing, including tracking back of soil (POS_{resi}); and
- Park-type scenario where distance is considered sufficient to discount tracking back of soil (POS_{park}).

Detailed Quantified Risk Assessment (DQRA)

SGVs, GACs, pC4SL and S4ULs are based on a number of basic assumptions. There are two main options for developing Site Specific Assessment Criteria (SSAC) by adjusting the CLEA model so that they have greater relevance to the site:

- **Simple adjustment of the generic SGV / C4SL model.** Such adjustment is restricted to the choice of exposure routes selected for the generic land use, building type, soil type and soil organic matter content within the CLEA software.
- **Detailed adjustment.** It may be relevant to make greater modifications to the model due to the specific use of the land in question. This can include modification to any parameter value, including exposure assumptions, building parameters, and the choice and application of fate and transport models. This is equally relevant to site-specific modifications of existing generic land uses, the development of new land uses, and the inclusion of additional exposure pathways. Much of this can be undertaken using the CLEA software. Depending on the complexity of the detailed adjustments required, it may be necessary to use other tools either alone or in conjunction with the CLEA software. Both options should follow established protocols for DQRA and require sufficient justification and supporting information for the adjustments made. Detailed adjustments are likely to require substantially greater technical justification and supporting documentation, especially if modifications are based on information not contained within the SGV framework documents.

The two choices present the risk assessor with three options/decisions:

- (1) Use a published SGV/GAC/pC4SL/S4UL if it can be demonstrated that the assumptions inherent in the value are appropriate to the site in question. If they are not, proceed to either option 2 or 3 below.

- (2) Make simple site-specific adjustments to the generic exposure model used to derive the SSAC. Three examples of when this could be appropriate are:
 - a. High density residential development with no exposed contaminated soil at surface. It is appropriate in this case to consider the relevance of direct contact pathways and consumption of homegrown produce.
 - b. Soil type is significantly different (specifically when soil type is likely to be less protective e.g. made ground) to that assumed in the SGV/GAC/pC4SL/S4UL.
 - c. Soil organic matter content is significantly different to that assumed in the derivation of the SGV/GAC/pC4SL/S4UL.
- (3) If simple adjustments are not sufficient to reflect site conditions, undertake a DQRA. This may be undertaken using the CLEA software or by using an alternative risk assessment methodology that is relevant, appropriate, authoritative and scientifically based. Changes to toxicological end points may also be considered, although this should only be undertaken by a toxicology expert. In the context of this guidance, simple adjustments of a generic land use scenario for soil type or SOM content for example are not considered sufficient to be classed as a DQRA.

DQRAs should be conducted with the agreement of the local authority (or the Environment Agency) since it is the authority that determines whether land is Contaminated Land or whether Planning Permission for a new development may be granted.

Representative Data

The type, quantity and quality of the available soil data influence the method chosen to obtain a site representative soil concentration that is compared with a SGV/GAC/pC4SL/S4UL in the screening process. The soil data should be representative of the exposure scenario being considered. This can include factors such as:

- averaging area over which exposure occurs;
- sample depth;
- heterogeneity of soil

where the 'averaging area' is defined as:

That area (together with a consideration of depth) of soil to which a receptor is exposed or which otherwise contributes to the creation of hazardous conditions'.

Site investigations take discrete samples from a given area (and to a certain depth). It has to be assumed that these samples are to some degree representative of the contaminant concentration throughout that volume of soil. The critical soil volume (taking into account area and depth) which might be usefully compared with a SGV/GAC/pC4SL/S4UL is a site-specific decision, but a starting point is the generic land use scenarios used in the derivation of the SGV/GAC/pC4SL/S4UL. The critical soil volume depends on two factors:

- Contaminant distribution and vertical profile (bands of highly contaminated material or lateral hot spots should not necessarily be averaged out with more extensive cleaner areas of soil without justification)
- Contribution to average exposure underpinning the SGV. Direct contact exposure pathways depend on the adult or child coming into contact with near-surface soils and the area over which that exposure occurs is usually important (i.e. the averaging area). Vapour pathways are less dependent on surface area, for example vapour intrusion may result from a highly concentrated hot spot beneath a building leading to elevated average indoor air concentrations. For the three standard land uses for which SGVs are derived, relevant considerations are:
 - For the standard **residential or allotment land use**, the critical soil volume is the area of an individual garden, communal play area or working plot from the surface to a depth of between 0.5m and 1.0m. This is the ground over which children are most likely to come into contact with soil or from which vegetable and

fruit produce will be harvested. In the case of volatile contaminants, it may also be appropriate to consider the volume of soil underneath the footprint of the building although vapour intrusion may be driven by a soil volume much smaller than this if the contaminant source is highly concentrated.

- For the standard **commercial land use**, the critical soil volume has to be decided on a case-by- case basis due to the wide range of possible site layouts. However, for non-volatile contaminants, landscaped and recreational areas around the perimeter of office buildings are likely to be most important. For volatile contaminants, the footprint occupied by the building itself should also be considered.
- For **most exposure pathways**, the contamination is assumed to be at or within one metre of the surface.

The use of averaging areas must be justified on the basis of relevance to the exposure scenario. SGVs are relevant only when the exposure assumptions inherent in them are appropriate for the identified exposure averaging area. Further guidance on critical soil volumes and the consideration of averaging exposure areas can be found in:

- *Secondary model procedure for the development of appropriate soil sampling strategies for land contamination (Environment Agency, 2000);*
- *Guidance on comparing soil contamination data with a critical concentration (CIEH/CL:AIRE, 2009); and*
- *Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Appendix I (Defra December 2013, 3289 2014)*

It is the mean soil concentration for the individual contaminant within an individual averaging area, which is compared to the SGV. However, as contaminant concentrations vary across a site, and sampling and analysis will introduce measurement errors, the comparison between measured mean concentration and the SGV must take this uncertainty into account.

There are two principal options available to obtain site representative soil concentrations from a site investigation dataset; statistical and non-statistical methods. Data objectives, quality and quantity are likely to determine which approach is most appropriate. If statistical methods such as those presented in CIEH/CL:AIRE (2011) are to be used, sufficient data need to be available or obtained. No one single statistical approach is applicable to all sites and circumstances. The wider range of robust statistical techniques developed by organisations including the US Environmental Protection Agency (USEPA) are also important tools. Risk assessors should choose an appropriate statistical approach on the basis of the specific site and the decision that is being made. For further guidance on the appropriate use of statistical approaches, refer to USEPA 2006 or good environmental monitoring statistics textbooks.

When statistical approaches are inappropriate (this will depend on the objectives of the site investigation), individual or composite samples should be compared directly to the SGV. Guidance on use of alternative data handling approaches such as the use of composite sampling can be found in documents such as:

- *Verification of remediation of land contamination (Environment Agency, 2010);*
- *Sampling and testing of wastes to meet landfill Waste Acceptance Criteria (Environment Agency, 2005);*
- *Guidance on choosing a sampling design for environmental data collection (USEPA, 2002);*
- *Soil Quality – Sampling, ISO 10381 series (ISO, 2002–2007).*

The statistical tests should not be used as arbiters for decisions under Part 2A. They are an additional, useful line of evidence to assist in decision-making. The implications of the basis for the derivation of the site representative soil concentration must be taken into account in any decision-making process and clearly documented.

Where the statistical tests are conducted in accordance with the method described in CL:AIRE 2009:

- For the Planning situation, it has to be demonstrated that the concentration of contaminants is low compared to the pC4SL/S4UL or SSAC. All of the test data should be below the screening criteria and no statistical analysis is required or if there are exceedances of the criteria then a statistical assessment is required. For the statistical assessment this decision is based on whether there is at least a 95% confidence level that the true mean of the dataset is lower than the screening criteria.

- For the Part 2A scenario the regulator needs to determine whether the concentration of contaminants is greater than the SGV/GAC/pC4SL/S4UL or SSAC. This decision is based on whether there is at least a 95% confidence level that the true mean of the dataset is higher than the SSAC. However, the regulator may proceed with determination if there is just a 51% probability, “on the balance of probabilities.”

If the screening levels are exceeded then more sophisticated quantitative risk assessment can be undertaken or remedial action may be taken to break the contaminant linkages. The benefits of undertaking a quantitative risk assessment must be weighed against the likelihood that it will bring about cost savings in the proposed remediation. Further information about the use of soil guideline values is provided in Environment Agency : 2008: Using Soil Guideline Values SC050021/SGV Introduction, 3289 2008.

GENERIC RISK ASSESSMENT CRITERIA FOR RISK TO PLANTS

Soil contaminants, if present at sufficient concentrations, can have an adverse effect on the plant population. Phytotoxic effects can be manifested by a variety of responses, such as growth inhibition, interference with plant processes, contaminant-induced nutrient deficiencies and chlorosis (yellowing of leaves). All chemicals are probably capable of causing phytotoxic effects. Thus the phytotoxic potential of substances is dependent on the concentrations capable of having adverse effects on plants and the concentrations likely to be found at contaminated sites. Phytotoxicity is a difficult parameter to quantify given that experimental techniques vary widely and variations exist in plant tolerances, soil effects and synergistic/antagonistic reactions between chemicals. Contaminants may be taken up and accumulated by plants through a range of mechanisms. The principal pathways are active and/or passive uptake through the plant root, adsorption to root surfaces and volatilisation from the soil surface followed by foliar uptake. After plant uptake, contaminants may be metabolised or excreted, or they may be bio accumulated and this is highly species dependant. Many of the substances capable of adversely affecting vegetation exert this effect because of their water solubility, a characteristic that could result in their transport from contaminated sites into adjacent locations where the chemical may generate a phytotoxic response. This could be important if, for example, the adjacent site has important conservation status.

The concentration in soil at which substances become phytotoxic depend on a range of factors including plant type, soil type, pH, the form and availability of the contaminant and other vegetation stress factors that may be present (such as drought). Some plants (including some rare plants will only grow in soils where there are relatively high concentrations which would be phytotoxic to other species. Whilst many contaminants may be phytotoxic, data are limited. Some heavy metals are essential as trace elements for plant growth but may become toxic at higher concentrations.

TerraConsult has carried out a review of a number of current and former guidance documents and other texts on phytotoxicity. It is not possible to produce a definitive list of phytotoxic substances on account of the variables mentioned above. However, a number of metals are repeatedly cited as commonly occurring priority pollutants. As a result, the following list is adopted by TerraConsult as indicators of the potential for phytotoxicity: As, Cr, Cu, Ni and Zn (note that Boron has been excluded from this list because the more modern studies do not assess this).

As the CLEA framework is a risk based approach, applied to humans, an alternative strategy is required to assess the risk to plants from substances that are phytotoxic. Reference to published criteria and background concentrations can help put site data into context. Published assessment criteria for the protection of plant life from a number of countries are given in the following Table. The most authoritative source is the British Standard for topsoil, but this only lists three elements. CLR 11 states that the ICRCL Guidance Note 70/90 can be used for initial screening criteria. This approach has been adopted by TerraConsult where BS3882 is lacking, but where an ICRCL 70/90 criterion is lacking, the lowest criterion in Table below from, firstly UK, and, secondly, European and then other worldwide criteria. The adopted criteria are highlighted in the table 3.8. The MAFF value of 250 mg/kg has been chosen for As over the ICRCL value of 50 mg/kg as MAFF explains the 50 is applicable to vegetables and human health, whereas 250 is applicable to the plants themselves.

Table B.5: Published Assessment Criteria for Phytotoxic Elements (mg/kg)							
Reference	As	CR (Total)	Cr (III)	Cr (VI)	Cu	Ni	Zn
British Standard for topsoil (BS3882:2007)	-	-	-	-	200 (pH >7) 135 (pH 6-7) 100 (pH 5.5-6.0)	110 (pH >7) 75 (pH 6-7) 60 (pH 5.5-6.0)	300 (pH >7) 200 (pH 6-7) 200 (pH 5.5-6.0)
MAFF Code of Good Agricultural Practice for the Protection of Soil (1998)	250	-	400 for sites containing sewage and sludge	-	500 (grass) but may fall to 250 for clover and sensitive species (at pH>6)	110 (pH>7) 75 (pH 6-7) 60 (pH 5.5-6.0)	1000 (clover & grass at pH 6), may fall to 300 for sensitive species (at pH 6-7)
ICRCL 59/83 (1987) now withdrawn for human health assessment	-	-	-	-	130	70	300
ICRCL 70/90 (1990) threshold trigger value	50	-	-	25*	250	-	1000
Dutch ecotoxicological intervention value (Swartjes 1993 & 1994)	40	230	-	7	190	-	-
Australian Guideline B(1) (1999), Interim Urban Ecological Investigation Level (EIL). Soils not generally considered phytotoxic below these EILs.	20	-	400	1	100	60	200
New Zealand guidelines for timber treatment sites (1977), estimated based on Cu bioavailability *	-	-	-	-	500 - 1000 clay soils	-	-
New Zealand guidelines for timber treatment sites (1977), soil criteria for protection of plant life (residential/agricultural setting)	10-20	-	600	25	130	-	-
Note: * Cr (VI) is only likely to be present in as a significant proportion of total Cr where pH >12 so this does not routinely need to be tested for regarding plant health.							

CURRENT GUIDANCE FOR CONTROLLED WATERS RISK ASSESSMENT

Summary of Regulatory Context

Government policy is based upon a “suitable for use approach,” which is relevant to both the current use of land and also to any proposed future use. When considering the current use of land, Part IIA of the Environment Protection Act 1990^[4] (EPA 1990) provides the regulatory regime, which was introduced by Section 57 of the Environment Act 1995^[5], which came into force in England on 1 April 2000. The main objective of introducing the Part IIA regime is to provide an improved system for the identification and remediation of land where contamination is causing unacceptable risks to human health, controlled waters or the wider environment given the current use and circumstances of the land. Part IIA provides a statutory definition of contaminated land under Section 78A(2) 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 a significant possibility of such harm being caused; or*
- (b) Pollution of controlled waters is being, or is likely to be, caused.”*

Part IIA provides a statutory definition of the pollution of controlled waters under Section 78A(9) as:

*“the entry into controlled waters of **any** poisonous, noxious or polluting matter or **any** solid waste matter”*

Part IIA is supported by a substantial quantity of guidance and other Regulations, especially for England, The Contaminated Land (Wales) (Amendment) Regulations 2012 and Contaminated Land Statutory Guidance (Welsh Office, 2012) which came into force in early April 2012. The document re-confirms the duties of Enforcing Authorities in dealing with contamination including the role of the Environment Agency which has powers under Part 7 of The Water Resources Act (1991) to take action to prevent or remedy the pollution of controlled waters, including circumstances where the pollution arises from contamination in the land.

Part IIA introduces the concept of a contaminant linkage; where for potential harm to exist there must be a connection between the source of the hazard and the receptor via a pathway. Risk assessment in contaminated land is therefore directed towards identifying the contaminants, pathways and receptors that can provide contaminant linkages. This is known as the contaminant-pathway-receptor link (CPR or contaminant linkage).

Part IIA places contaminated land responsibility as a part of the planning and redevelopment process rather than Local Authority or Environment Agency taking direct action except in situations of very high pollution risk or where harm is occurring. In the planning process guidance 2. This requires that a site which has been developed shall not be capable of being determined “contaminated land” under Part IIA. Therefore, appropriate risk-based investigation is required to identify the contaminant linkages that can then be assessed, and then mitigated using methods that can be readily agreed with the planners.

Environment Agency Guidance

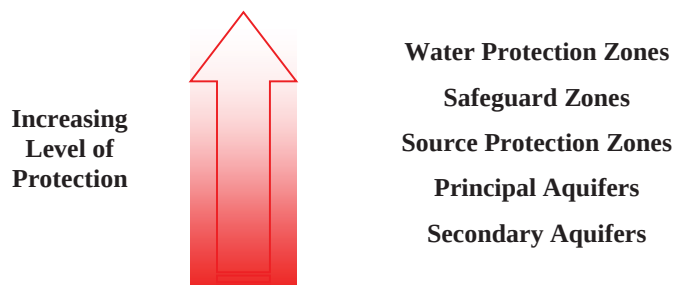
Legislation and guidance surrounding the protection of controlled waters in the UK is numerous and can be complex. The NRW’s overall position on groundwater is “*To protect and manage groundwater resources for present and future generation in ways that are appropriate for the risks that we identify.*” In brief, the core objectives of the existing legislation serve to enforce this position.

In 1992, the National Rivers Authority published their Policy and Practice for the Protection of Groundwater (PPPG), this document was influential as it provided a focus for key developments such as Source Protection Zones (SPZs) and Groundwater Vulnerability Maps. The Policy was then revised in 1998, since which there have been substantial changes in legislation, driven by Europe. Key European Directives relating to groundwater include the Groundwater Directive (80/68/EEC) and the Water Framework Directive (2000/60/EC). Aspects of these directives are controlled

by primary UK legislation such as the Water Resources Act 1991 as amended by the Water Act 2003. Further to legislative changes, gaps identified in the 1998 PPPG required addressing. These changes are reflected in the Environment Agency Policy document *Groundwater Protection: Policy and Practice (GP3)*, Version 1 of November 2012. The following diagram indicates the three main parts of GP3:



The Environment Agency follows a tiered, risk based approach to drinking water protection and this should be taken into account when carrying out controlled waters risk assessment:



Tools available for Risk Assessment of Controlled Waters

In order for a developer of a potentially contaminated site to fulfil their obligations under the legislation, a site assessment would be required to be undertaken in order to identify any potential risks to controlled waters and to derive suitable clean-up criteria if necessary to ensure the protection of controlled waters. A number of tools are available for this purpose and the general approach is detailed further in Part 3 of GP3.

Three main stages apply to any risk assessment of controlled waters, these are:

- i) Risk Screening (devise Conceptual Site Model, making reference to groundwater vulnerability maps, site setting etc)
- ii) Generic Risk Assessment (using the EA Remedial Targets Methodology –Tier 1 - Comparison of groundwater data with relevant standards)
- iii) Detailed Quantitative Risk Assessment (Consideration of aquifer properties and site specific parameters, using the EA Remedial Targets Methodology - Tiers 2 & 3)

The process is summarised below (Taken from the Environment Agency GP3 draft consultation document, 2006):

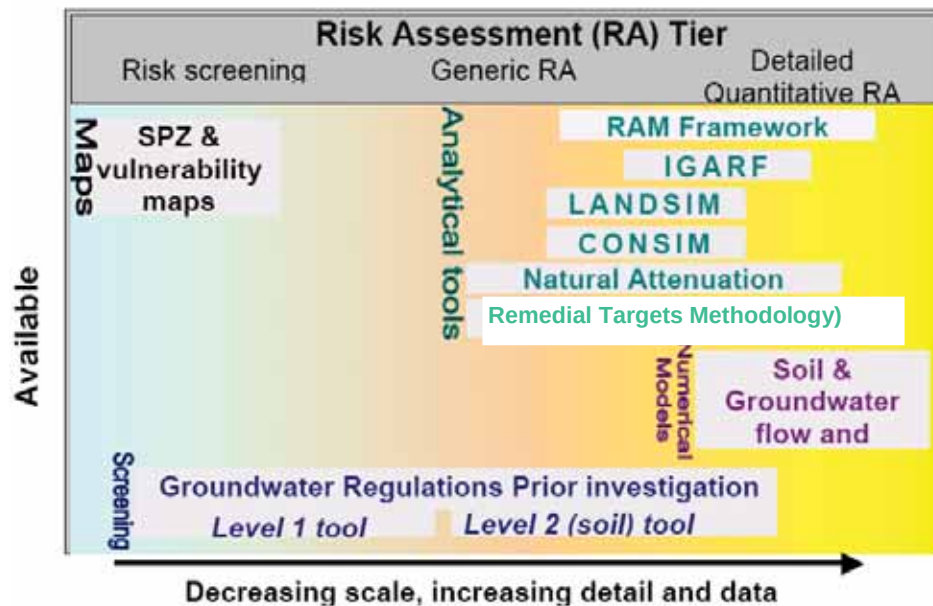


Figure 1-1 Environment Agency groundwater assessment tools, mapped against the different levels of risk assessment.

When assessing groundwater impact the Environment Agency advocate the application of their framework methodology “Remedial Targets Methodology – Hydrogeological Risk Assessment for Land Contamination” Environment Agency (2006). The methodology has four tiers of assessment:

Tier 1 utilises either a soil concentration (calculation of pore water concentrations based on partitioning calculations), leaching test or pore-water concentration of perched water as a source concentration input and these are contrasted directly to water quality standards. No dilution or attenuation is considered at Level 1.

Tier 2 (groundwater) considers dilution of the contaminant within the underlying receiving groundwater or surface water body. To determine a dilution factor the infiltration rate of pore water and the discharge of groundwater beneath the source must be determined. Level 2 Assessment is comprises a comparison between measured groundwater concentrations with to water quality standards.

Tier 3 considers natural attenuation in the form of dispersion, retardation and degradation of the contaminant. As the levels are progressed, the assessment becomes increasingly more detailed and less conservative as the data requirements are increased with each successive tier. The Environment Agency has released Excel Worksheets to carry out basic calculations using a conservative approach up to Tier 3. However, in this case the conceptual model is a simple one and assumes there is a simple migration of contaminants from the source zone into the aquifer receptor. Using these worksheets requires a sensitivity analysis showing how by varying each parameter, what effect it might have on the outcome of the assessment. Groundwater conceptual models are not always this simple.

Tier 4 is for more complex conceptual models where multiple sources, multiple pathways, multiple receptors and complex water balances can be assessed.

The Environment Agency developed a spreadsheet based code to support the Remedial Target Methodology, and the code is capable of undertaking assessments for Tiers 1 to 3. Tier 4 assessment is not supported by the spreadsheet based code.

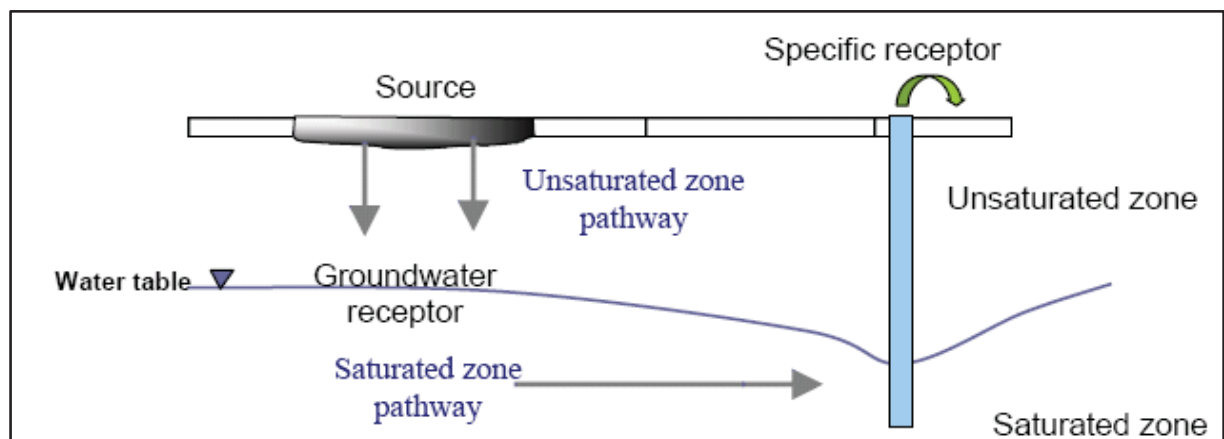
A more advanced code, ConSim 2, developed on behalf of the Environment Agency to support the Remedial Targets Methodology, allows for the introduction of additional geological horizons and is used mainly to determine the concentrations reaching a receptor and the timescales over which this may happen.

The codes assess only the dissolved phase contaminants. There are many further codes commercially available for use in controlled waters risk assessment, particularly for more complex situations, however, these should be used with caution and only once agreement has been obtained from the Environment Agency. All have the overall aim of the estimation of risk from contaminant linkages and the protection of controlled waters.

General notes on each stage of the controlled waters risk assessment process

Risk Screening

The understanding of the Conceptual Site Model (CSM) is the key to assessing any site. Using a robust CSM, potential pathways or receptors may be screened out from any further assessment at an early stage. For example if the pathway through the unsaturated zone is blocked by the presence of a significant thickness of low permeability clay. A greater understanding of the CSM is achieved with each tier of risk assessment. An example of a basic Source-Pathway-Receptor concept is given below (taken from the Environment Agency GP3, 2012):



Generic Risk Assessment

When undertaking the Generic Hydrogeological Risk Assessment (EA Remedial Targets Methodology Tier 1), comparison of chemical analytical results is made with screening criteria. Published values of screening criteria with which chemical test results can be compared are published in the following guidance:

There is a hierarchy of screening criteria which is as follows:

- Updated Recommendations on Environmental Technical Standards, River Basin Management (2015-21), April 2012 by the UK Technical Advisory Group on the Water Framework Directive;
- Environmental Quality Standards (EQS) for freshwaters based on The EC Dangerous Substances Directive (76/464/EEC and Daughter Directives);
- Surface Waters (Abstraction for Drinking Water) (Classification) Regulations (1996)
- Surface Waters (Fishlife) (Classification) Regulations (1997)
- UK Drinking Water Standards (DWS) (Water Supply (Water Quality) Regulations 2000);
- Dutch Ministry of Housing, Spatial Planning and Environment (2001) Intervention Values and Target Values – soil quality standards;
- World Health Organisation Guidelines for Drinking Water (2004)

Should the Level 1 or 2 assessments indicate threshold levels to be exceeded, then there are three alternative ways in which to proceed:

- To devise suitable remedial solutions;
- To carry out more investigation, sampling and analysis;
- To conduct a site-specific Detailed Quantitative Risk Assessment (DQRA) to whether or not the soil materials are suitable for their site-specific intended use or to devise a site-specific clean-up level.

Detailed Quantitative Risk Assessment (DQRA)

The decision to carry out a DQRA will be dependent on the extent and implications of the initial qualitative and generic assessment. The scope of any such assessment will be accurately defined by the outcomes of the former two stages. The CSM will be sufficiently refined by this stage that only certain contaminants of concern, certain pathways and certain receptors will require further assessment, the remainder having been screened out.

Additional site specific data is normally required for this stage of assessment, as explained above, more processes that are capable of affecting contaminant concentrations are considered (such as dilution and attenuation).

Remediation criteria derived will therefore be specific to each site and will be based on a detailed assessment of the potential impact at the identified receptor or *compliance point*. A greater level of confidence can be placed on the predicted impact on the compliance point following a DQRA.

Definition of Controlled Waters

The term ‘controlled waters’ is defined in Section 104 of the Water Resources Act 1991 as:

“Territorial Waters...which extend seawards for three miles..., coastal waters..., inland freshwaters, waters in any relevant lake or pond or of so much of any relevant river or watercourse as is above the freshwater limit, and ground waters, that is to say, any waters contained in underground strata.”

Note that the definition of groundwater under the Water Resources Act 1991 includes all water within underground strata (including soil / pore water in the unsaturated zone). The definition of groundwater under the Groundwater Directive however is limited to water in the saturated zone. For the purposes of Part IIA of the Environmental Protection Act 1990, the NRW recommends that the groundwater within the saturated zone only is considered as the receptor (rather than soil / pore water).

Environment Agency’s Aquifer Designations

The Environment Agency have classified different types of aquifer from which groundwater can be extracted. The aquifer designations reflect the importance of aquifers in terms of groundwater as a resource (drinking water supply) but also their role in supporting surface water flows and wetland ecosystems. The aquifer designation data is based on geological mapping provided by the British Geological Survey.

The maps are split into two different types of aquifer designation:

- **Superficial (Drift)** – permeable unconsolidated (loose) deposits.
- **Bedrock (Solid)**– solid permeable formations e.g. sandstone, chalk, limestone.

The aquifer designations displayed on the Environment Agency maps are as follows:

- **Principal Aquifers (formerly termed Major Aquifers)** – These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as a major aquifer.
- **Secondary Aquifers (formerly termed Minor Aquifers)** – These include a wide range of rock layers or drift deposits with an equally wide range of water permeability and storage. Secondary aquifers are subdivided into two types:
 - **Secondary A** - permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers;
 - **Secondary B** - predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.
 - **Secondary Undifferentiated** - has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.
- **Unproductive Strata (formerly termed Non-Aquifer)** – These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

Hazardous and Non Hazardous Substances

The Groundwater (England and Wales) Regulations 2009 control the disposal to the hydrogeological environment of potentially polluting substances which are divided into Hazardous Substances and Non-hazardous Contaminants (this roughly approximates to the former List 1 and List 2 substances).

Hazardous Substances are the most damaging and toxic and must be prevented from directly or indirectly entering the groundwater environment. Hazardous Substances include mineral oils and hydrocarbons, pesticides, biocides, herbicides, solvents and some metals. Discharge of Hazardous Substances to Controlled Waters must be prevented.

Non-hazardous Pollutants are any contaminants other than Hazardous Substances. Non-hazardous Pollutants are potentially toxic but are less harmful than Hazardous Substances, but their direct discharge to groundwater is generally not permitted and any indirect discharge to groundwater must be limited and be controlled by technical precautions in order to prevent pollution. Non-hazardous Pollutants include ammonia and nitrites, many metals and fluorides.

MANAGEMENT OF CONTAMINATED LAND

When risk assessment of the site has been completed and this indicates that remedial works are required, the main guidance in managing this process is set out in the DEFRA/EA publication CLR11 (2004) “Model Procedures for the Management of Land Contamination.” The stages of managing remediation are as follows:

- (a) Options Appraisal and develop Remediation Strategy;
- (b) Develop Implementation Plan and Verification Plan;
- (c) Remediation, Verification and Monitoring.

The Remediation Strategy sets out the remediation targets, identifies technically feasible remedial solutions and presents an evaluation of the options so that these can be assessed enabling that the most suitable solution is

adopted. An outline of the proposed remedial method should be presented. Agreement should be sought of the appropriate statutory bodies for the Remediation Strategy before proceeding to the next stage.

The Implementation Plan is a detailed method statement setting out how the remediation is to be carried out including stating how the site will be managed, welfare procedures, health and safety considerations together with practical measures such as details of temporary works, programme of works, waste management licences and regulatory consents required. Agreement should again be sought of the appropriate statutory bodies for this Plan.

The Verification Plan sets out the requirements for gathering data to demonstrate that the remediation has met the required remediation objectives and criteria. The Verification Plan presents the requirements for a wide range of issues including the level of supervision, sampling and testing regimes for treated materials, waste and imported materials, required monitoring works during and post remediation, how compliance with all licenses and consents will be checked etc. Agreement should again be sought of the appropriate statutory bodies for the Verification Plan. On completion of the remediation a Verification Report should be produced to provide a complete record of all remediation activities on site and the data collected as required in the Verification Plan. The Verification Report should demonstrate that the remediation has met the remedial targets to show that the site is suitable for the proposed use.

GLOSSARY

TERMS		UNITS	
AST	Above Ground Storage Tank	m	Metres
BGS	British Geological Survey	km	Kilometres
BSI	British Standards Institute	%	Percent
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes	%v/v	Percent volume in air
CIEH	Chartered Institute of Environmental Health	mb	Milli Bars
CIRIA	Construction Industry Research Association		(atmospheric pressure)
CLEA	Contaminated Land Exposure Assessment	l/hr	Litres per hour
CSM	Conceptual Site Model	ha	Hectare (10,000 m ²)
DNAPL	Dense Non-Aqueous Phase Liquid (chlorinated solvents, PCB)	µg/l	Micrograms per Litre
DWS	Drinking Water Standard		(parts per billion)
EA	Environment Agency	ppb	Parts Per Billion
EQS	Environmental Quality Standard	mg/kg	Milligrams per kilogram
GAC	General Assessment Criteria		(parts per million)
GL	Ground Level	ppm	Parts Per Million
GSV	Gas Screening Value	mg/m ³	Milligram per metre cubed
HCV	Health Criteria Value	Mg/m ³	Megagram per metre cubed
LNAPL	Light Non-Aqueous Phase Liquid (petrol, diesel)	µg/m ³	Microgram per metre cubed
ND	Not Detected	m bgl	Metres Below Ground Level
LMRL	Lower Method Reporting Limit	m bcl	Metre Below Cover Level
NR	Not Recorded	mOD	Metres Above Ordnance
OD	Ordnance Datum		Datum (sea level)
PAH	Poly Aromatic Hydrocarbon	kN/m ²	Kilo Newtons per metre
PCB	Poly-Chlorinated Biphenyl		squared
PID	Photo Ionisation Detector	kPa	Kilo Pascal – same as kN/m ²
PCSM	Preliminary Conceptual Site Model	µm	Micro metre
SGV	Soil Guideline Value		
TPH (CWG)	Total Petroleum Hydrocarbon (Criteria Working Group)		
SPT	Standard Penetration Test		
SVOC	Semi Volatile Organic Compound		
UST	Underground Storage Tank		
VCCs	Vibro Concrete Columns		
VOC	Volatile Organic Compound		
VSCs	Vibro Stone Columns		

APPENDIX C

Site Photographs



Photograph 1: Southwest corner of the site showing the vegetation and fencing



Photograph 2: Taken facing northeast from southwest corner of the site. Shows the shrub covering the site. Fencing along the southern boundary of the site which can be removed for access.



Photograph 3: Taken facing north from southwest corner of the site. Shows the shrub covering the site. Fencing along the west boundary of the site.



Photograph 4: Taken facing southwest from northeast corner of the site. Shows the shrub covering the site. Fencing along the west and south boundary of the site. Access through the southern boundary fencing which can be removed.



Photograph 5: Taken facing west from north corner of the site. Shows the trees and fencing along the northern boundary of the site.



Photograph 6: Taken facing east from north corner of the site. Shows the trees and fencing along the northern boundary of the site.



Photograph 7: Shows the northeast corner of the site bounded by fences and trees. Some discarded fence boards and plant pots.



Photograph 8: Taken facing south from northeast corner of the site. Shows the fencing along the southern boundary of the site; as well as the shrubs and tree stumps around site area.



Photograph 9: Taken facing north from outside southern edge of the site. Shows the removable fencing to allow access for small vehicles and people.



Photograph 10: Taken facing north from outside southern edge of the site. Shows the removable fencing to allow access for small vehicles and people and the asphalt road leading to the access point.



Photograph 11: Taken facing west from southern edge of the site. Shows the western boundary fencing and the shrubbery covering the site.



Photograph 12: Shows the material removed from TP01.



Photograph 13: Shows the material removed from TP01.



Photograph 14: Shows the material removed from TP01.



Photograph 15: Shows TP01 to depth of 2.1m



Photograph 16: Shows TP01 and sides of trial pit.



Photograph 17: Shows the material removed from TP02.



Photograph 18: Shows the material removed from TP02.



Photograph 19: Shows TP02 to depth of 1.8m.



Photograph 20: Shows TP02 to depth of 1.8m.



Photograph 21: Shows TP02 to depth of 1.8m and sides of trial pit.



Photograph 22: Shows the material removed from TP03.



Photograph 23: Shows TP03 to a depth of 2m.



Photograph 24: Shows TP03 to a depth of 2m and sides of the trial pit.



Photograph 25: Shows TP04 to a depth of 2m.



Photograph 26: Shows the material removed from TP04.



Photograph 27: Shows the material removed from TP04.



Photograph 28: Shows TP04 to a depth of 2m and the sides of the trial pit.



Photograph 29: Shows the material removed from TP04.



Photograph 30: Shows TP05 to a depth of 2 m.



Photograph 31: Shows the material removed from TP05.

APPENDIX D

Groundsure Report

RESIDENTIAL

HOMEBUYERS

Search Report

Date

16-08-2017

Groundsure Reference

GS-2570-4184697

Address

22, BRYN ESTYN ROAD, WREXHAM,
LL13 9NB

Grid Reference

335332 351222

Your Reference

ATD-4087856-JP2B

PROFESSIONAL OPINION

Contaminated Land



PASSED

Groundsure considers there is not a **High Potential Risk*** that the site will be identified as **Contaminated Land****. No further action is required in relation to Contaminated Land.

*"High Potential Risk" is the level of risk which results in 1% of reports being In Need of Further Assessment.
** within the meaning set out in Part 2A of the Environmental Protection Act 1990

River, coastal and surface water flooding



LOW

The property or an area within 25m has been assessed to be at Low risk of flooding. The JBA Insurability Index is **Green** for this property.
Please see the Overview and Guidance section for further information.

Natural Ground Subsidence



PASSED

The property or an area within 25m has been assessed to have a **Negligible-Very Low** potential for natural ground subsidence.
Please see Section 5.9 for further information.

Energy



IDENTIFIED

The property has been identified to lie within 5km of one or more energy features.
Please see section 7 for further information.



No significant issues identified



Issues have been identified. Further investigation is recommended.



Some issues have been identified which a prudent purchaser may wish to investigate further.

Other Considerations

Potential Infilled Land

Groundsure has identified past activities that can cause structural problems on or in proximity to the property. Please refer to the Detailed Findings and Section 1.2 and/or 6.5 for further guidance.

Coal Mining

The study site lies in an area which may be affected by coal mining. Please refer to the Detailed Findings and Section 6.1 for further guidance.

BGS Non-Coal Mining

The British Geological Survey (BGS) have not identified a risk of non-coal mining at the property.

Development Constraints

The property has not been identified to lie within or in close proximity to any designated areas which may restrict development at the site. Please note this relates solely to the environmental and cultural designations listed in Section 4 of this report.

Groundwater flooding

The site or an area in close proximity is considered to have the potential for groundwater flooding of property situated below ground level. Please refer to the Detailed Findings and Section 5.8 for further guidance.

Radon

The study site is located in an area where some properties are Radon Affected. Please refer to the Detailed Findings and Section 5.10 and 5.11 for further guidance.

HS2 and Crossrail 1

The property does not lie within 5km of the proposed High Speed 2 (HS2) train route or within 500m of the proposed Crossrail 1 train route. No further recommendations are necessary. Please note that this assessment takes account of both the original Phase 2b proposed route and the amended route proposed in 2016. As the Phase 2b route is still under consultation, Groundsure are providing information on both options until the final route is formally confirmed. Practitioners should take account of this uncertainty when advising clients.

Please note that no physical inspection of the property has been carried out in the preparation of this report. If you need any further assistance, please do not hesitate to contact our helpline on 08444 159000 quoting reference: GS-2570-4184697

Environmental Overview and Guidance

Recommendations - Flood

Groundsure consider that the area within 25m of the centre of the property has a **Low** risk of flooding. Please note this rating is calculated using a weighted assessment of fluvial, coastal and pluvial risk and historic flood events only.

Recommendations

A **Very Low** risk of tidal/fluvial flooding and a **Low to Moderate** risk of surface water (pluvial) flooding have been identified within 25m of the centre of the property. Please refer to the individual flood assessment sections below for further specific guidance. Alternatively flood resistance measures may assist in reducing the flood risk to the property.

Please be aware that this is an automated assessment based upon the highest flood risk found within 25m of the centre of the property. Therefore a purchaser may wish to check the maps provided within this report to confirm whether the flood risk area lies on or in close proximity to the property. If you would like Groundsure to manually assess the property a £35 + VAT fee may be applicable. Please note this manual assessment does not include a site visit.

JBA Overall Insurability Index

Guidance

The property has been rated as **Green** within JBA's Insurability Index. **Green** indicates a level of flood hazard such that (subject to terms, applicant's status and individual insurers' approach to risk, exclusions to the Flood Re scheme and any other factors which may be relevant), insurance covering flood risk may be obtainable relatively easily as part of a standard household insurance contract. This rating is calculated by JBA and is based entirely on JBA's modelled river, coastal and pluvial flood risk data. This data is used by a large number of top insurance companies in order to assess flood risk, though individual insurers may also have recourse to further information not used in this assessment such as claim history, and is indicative rather than definitive.

On the 4th April 2016 the Flood Re scheme was implemented. The scheme is designed to provide affordable household insurance for residential properties within the UK, which are perceived to have a high flood risk. Insurance companies are able to cede residential properties they consider to have a flood risk into the Flood Re scheme. Annual premiums and excesses are then capped depending on the council tax band for individual properties.

There are some exclusions to the Flood Re scheme and these include; commercial properties (including buy to let), new homes built after 1st January 2009 and blocks of flats with three or more units. Flood Re is designed to run for 25 years, to allow time for the Government, local authorities, insurers and communities to become better prepared for flooding. After this period, the market is expected to return to risk reflective pricing, and properties with flood risks that have not been mitigated may face significantly increased premiums and/or difficulty in obtaining cover.

The JBA Insurability Index is categorised on a fivefold scale and also includes a statement of the possibility of insurance companies ceding the property into the Flood Re scheme (subject to terms, applicant's status and individual insurers' approach to risk, historical flooding events at the property, exclusions to the Flood Re scheme and any other factors which may be relevant),-

- **Green** indicates a level of flood hazard such that insurance covering flood risk may be obtainable relatively easily as part of a standard household insurance contract. Very low possibility of insurance companies ceding the property into the Flood Re scheme unless the property has flooded in the past.
- **Amber** indicates a level of flood hazard such that insurance covering flood risk may be available but may be subject to increased premiums and non-standard and/or additional terms. Low possibility of insurance companies ceding the property into the Flood Re scheme unless the property has flooded in the past.
- **Red** indicates a level of flood hazard such that standard priced insurance covering flood risk may be more difficult to obtain. Low to moderate possibility of insurance companies ceding the property into the Flood Re scheme unless the property has flooded in the past.
- **Black 1** indicates a level of flood hazard such that standard priced insurance covering flood risk may be significantly more difficult to obtain. Moderate to high possibility of insurance companies ceding the property into the Flood Re scheme, especially if the property has flooded in the past.
- **Black 2** indicates a level of flood hazard such that standard priced insurance covering flood risk may be extremely difficult to obtain. High possibility of insurance companies ceding the property into the Flood Re scheme, especially if the property has flooded in the past.

Please note that due to the methodology employed to produce the dataset, JBA insurability ratings are only suitable for individual residential properties and as such any rating given for commercial property should be considered invalid. As this index is indicative we recommend a number of insurers are contacted in order to obtain a comparative quote.

Risk of Flooding from Rivers and the Sea (RoFRaS)

As the site lies within or in close proximity to an area with a **Very Low** risk rating in the RoFRaS database no further recommendations are required.

Guidance

The Environment Agency/Natural Resources Wales RoFRaS database provides an indication of river and coastal flood risk at a national level on a 50m grid with the flood rating at the centre of the grid calculated and given above. The data considers the likelihood of flood defences overtopping or breaching by considering their location type condition and standard of protection.

A number of major insurance companies refer to this information within their risk model although they may also utilise additional information such as claims histories which may further influence their decision. Where a High risk of flooding is identified there is a much higher likelihood of increased insurance premiums or the flood risk part of the insurance premium being ceded to Flood Re. Property owners of sites within Low and Medium risk areas are still considered to be at risk of flooding and insurance premiums may be increased as a result. Owners of properties within Low, Medium and High risk areas are advised to sign up to the Environment Agency/Natural Resources Wales's Flood Warning scheme on 0345 988 1188 or at www.environment-agency.gov.uk. Please see Section 5.1 for further details. Additionally a prudent purchaser may wish to consider reducing the impact of flooding at the property by installing flood protection measures at the site if risks have been identified. Such measures may help reduce the effects of flooding at the property if flood defences are absent or are breached and may assist in obtaining insurance for the site. Further information on flood protection measures can be obtained by contacting Groundsure.

Surface Water Flooding

The study site or an area within 25m of the centre of the study site has been assessed to be at a **Low to Moderate** risk of surface water (pluvial) flooding. This indicates that this area would be expected to be affected by surface water flooding in a 1 in 200 year rainfall event to a depth of between 0.1m and 0.3m.

Guidance

Surface Water (pluvial) flooding is defined as flooding caused by rainfall-generated overland flow before the runoff enters a watercourse or sewer. In such events, sewerage and drainage systems and surface watercourses may be entirely overwhelmed.

Surface Water (pluvial) flooding will usually be a result of extreme rainfall events though may also occur when lesser amounts of rain falls on land which has low permeability and/or is already saturated, frozen or developed. In such cases overland flow and 'ponding' in topographical depressions may occur. This data is provided by JBA Risk Management. Please see Section 5.7 for further details.

Historic Flood Events

The site is not recorded to have been subject to historic flooding. However the absence of data does not provide a definitive conclusion that the site has never flooded, only that the Environment Agency/Natural Resources Wales hold no record of any flooding at the site.

Guidance

Over 23,500 separate events are recorded within the Environment Agency/Natural Resources Wales's national database on historic flood events. This data is used to understand where flooding has occurred in the past and provides details as available. Absence of a historic flood event for an area does not mean that the area has never flooded but only that the national Environment Agency/Natural Resources Wales do not currently have records of flooding within the area. Local Environment Agency/Natural Resources Wales offices and Local Authorities may have records of smaller-scale flooding and homeowners are also advised to check their TA6 Property Information form for any records of flooding. A record of a flood footprint in previous years does not mean that an area will flood again and this information does not take account of flood management schemes and improved flood defences. Please see Section 5.6 for further details.

Areas Benefiting from Flood Defences

The property does not lie in or within 25m of an area the Environment Agency/Natural Resources Wales consider to benefit from flood defences. Property-level defences and some older schemes may not be included in the Environment Agency/Natural Resources Wales database of areas considered to benefit from flood defences.

Guidance

These are areas that may benefit from the presence of major defences during a 1% fluvial (river) or 0.5% tidal flood event. These areas would flood if the defence were not present but may not flood because the defence is present.

Proposed Flood Defences

The property does not lie in or within 25m of an area the Environment Agency/Natural Resources Wales consider to benefit from proposed flood defences.

Guidance

Flood defences seek to reduce the risk of flooding and to safeguard life, protect property, sustain economic activity and the natural environment. Flood defences are designed to protect against flood events of a particular magnitude expressed as risk in any one year.

Flooding from Groundwater

There is **potential** for groundwater flooding to occur below the surface of the study site. Where potential for groundwater flooding of property situated below ground level is indicated this means that given the geological conditions there may be a groundwater flooding hazard to basements and other below surface infrastructure. Unless other relevant information e.g. records of previous flooding suggests groundwater flooding has occurred before in this area you need take no further action in relation to groundwater flooding hazard. If there are records of previous incidences of groundwater flooding then is recommended that other information e.g. rainfall history property type and land drainage information in addition to previous records of flooding be investigated in order to establish relative but not absolute risk of groundwater flooding.

Guidance

The BGS Susceptibility to Groundwater Flooding hazard dataset identifies areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the ground surface. The BGS Susceptibility to Groundwater Flooding hazard dataset identifies areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the ground surface.

The susceptibility data is suitable for use for regional or national planning purposes where the groundwater flooding information will be used along with a range of other relevant information to inform land-use planning decisions. It might also be used in conjunction with a large number of other factors e.g. records of previous incidence of groundwater flooding rainfall property type and land drainage information to establish relative but not absolute risk of groundwater flooding at a resolution of greater than a few hundred metres. The susceptibility data should not be used on its own to make planning decisions at any scale and in particular should not be used to inform planning decisions at the site scale. The susceptibility data cannot be used on its own to indicate risk of groundwater flooding.

Flood Storage Areas

The property does not lie in or within 25m of a Flood Storage Area.

Guidance

Flood Storage Areas are considered part of the functional flood plain and are areas where water has to flow or be stored in times of flood.

Flood Risk Framework

The Flood Risk Assessment section is based on datasets covering a variety of different flooding types. No inspection of the property or of the surrounding area has been undertaken by Groundsure or the data providers. The modelling of flood hazards is extremely complex and in creating a national dataset certain assumptions have been made and all such datasets will have limitations. These datasets should be used to give an indication of relative flood risk rather than a definitive answer. Local actions and minor variations such as blocked drains or streams etc. can greatly alter the effect of flooding. A low or negligible modelled flood risk does not guarantee that flooding will not occur. Nor will a high risk mean that flooding definitely will occur. Groundsure's overall flood risk assessment takes account of the cumulative risk as assessed within the Environment Agency/Natural Resources Wales's RoFRaS database in addition to surface water (pluvial) flooding and historic flood events.

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Overview of Findings

Factor	Assessment	Subsection
Potentially Contaminative Historical Land Uses		
1:10,000 & 1:10,560 scale Historical Data	Passed	1.1
Potentially Infilled Land (1:10,000 & 1:10,560 scale survey)	Identified	1.2
Additional Information 1:2,500 scale Historical Data		
Historical Tanks	Passed	1.3
Historical Energy Features	Passed	1.4
Historical Petrol Stations	Passed	1.5
Historical Garage / Vehicle Repair	Passed	1.6
Historical Military / Ordnance Sites	Passed	1.7
Landfill and Waste Sites		
Landfill Sites	Passed	2.1
Landfills from Local Authority and Historical Mapping Records	Passed	2.2
Waste Treatment, Transfer or Disposal Sites	Passed	2.3
Environment Agency/Natural Resources Wales Licensed Waste Sites	Passed	2.4
Industrial Sites and Processes		
Potentially Contaminative Industrial Sites	Passed	3.1
Petrol & Fuel Sites	Passed	3.2
Historic IPC Authorisations	Passed	3.3
Part A(1) Authorised Processes	Passed	3.4
Part A(2) and Part B Authorised Processes and Enforcements	Passed	3.5
Red List Discharge Consents	Passed	3.6
Water Industry Referrals	Passed	3.7
List 1 Dangerous Substances	Passed	3.8
List 2 Dangerous Substances	Passed	3.9
Dangerous or Hazardous Sites	Passed	3.10
Sites Determined as Contaminated Land under Part 2A EPA 1990	Passed	3.11
Environment Agency/Natural Resources Wales Recorded Pollution Incidents	Passed	3.12
Hazardous Substance Consents and Enforcements	Passed	3.13
Environmental Setting		
Sites of Special Scientific Interest (SSSI)	No	4.1
Ramsar Sites	No	4.2
National Nature Reserves (NNR)	No	4.3
Special Areas of Conservation (SAC)	No	4.4
Special Protection Areas (SPA)	No	4.5
Local Nature Reserves (LNR)	No	4.6
World Heritage Sites	No	4.7
Areas of Outstanding Natural Beauty (AONB)	No	4.8
National Parks (NP)	No	4.9
Green Belt	No	4.10
Designated Ancient Woodland	Yes	4.11

Factor	Assessment	Subsection
Natural Hazards & Additional Factors		
What is the maximum Risk of Flooding from Rivers and the Sea (RoFRaS) Flood Rating within 25m of the centre of the property?	Very Low	5.1
Are there any Areas Benefiting from Flood Defences within 250m?	No	5.2
Are there any flood defences within 250m of the study site?	No	5.3
Are there any Proposed Flood Defences within 250m of the study site?	No	5.4
Are there any Areas Used for Flood Storage within 250m?	No	5.5
Has the site or an area within 25m been subject to past flooding as recorded by the Environment Agency/Natural Resources Wales?	No	5.6
What is the maximum Surface Water flood risk identified within 25m of the centre of the property?	Low to Moderate	5.7
What is the maximum susceptibility to Groundwater Flooding in proximity to the study site?	Potential below ground level	5.8
Natural Ground Subsidence	Negligible - Very Low	5.9
Radon	The property is in a Radon Affected Area, as between 1 and 3% of properties are above the Action Level	5.10
Radon Protective Measures	No radon protective measures are necessary	5.11
Mining		
Coal Mining	Yes	6.1
BGS Non-Coal Mining	Unclassified	6.2
Mining Cavities	No	6.3
Natural Cavities	No	6.4
Historical Mining	No	6.5
Historical Underground Workings	No	6.6
Energy		
Existing oil, gas, shale gas or coalbed methane wells	No	7.1
Proposed oil, gas, shale gas or coalbed methane wells	Yes	7.2
Existing wind farms	No	7.3
Proposed wind power projects	No	7.4
Existing solar farms	Yes	7.5
Proposed solar farms	Yes	7.6
Existing power stations	No	7.7
Existing Nuclear Establishments	No	7.8
Proposed Energy and other large Infrastructure Projects	Yes	7.9
Additional Information		
Ofcom Sitefinder Mobile Phone Mast Records	No	8.1
Mobile Phone Mast Planning Records	No	8.2
Overhead Electricity Transmission Lines and Pylons	No	8.3

Aerial Photograph



Site Address: 22, BRYN ESTYN ROAD, WREXHAM, LL13 9NB
Grid Reference: 335332 351222
Date of aerial image capture: 09-06-2013

Aerial photography supplied by Getmapping PLC.
©Copyright Getmapping PLC 2017. All Rights Reserved.

Notes on Professional Assessments

Professional Assessment of Contaminated Land

Please note that this assessment takes account of the following data: historical land use, landfill and waste transfer/treatment or disposal sites, scrap yards, current industrial uses (as defined by PointX data), Part A(1), A(2) and B Processes, COMAH and NIHHS sites, Dangerous Substances releases, RAS consents, Discharge and Red List Discharge consents, EPA 1990 sites, Pollution Incidents and Hazardous Substance Consents and Enforcements. This information is listed in this report. The Professional Assessment of Contaminated Land does not include assessment of the risk presented by natural hazards such as radon, subsidence or flooding or for past or present coal mining activity. No physical inspection of the property has been carried out.

Our risk assessments assume that the Site will be used for residential accommodation. The report is not suitable for non-domestic properties or for identifying risks for developments at the planning stage in accordance with National Planning Policy Framework (NPPF).

Professional Assessment of Flood Risk

Please note this assessment is based entirely on information provided by the Environment Agency/Natural Resources Wales (river/coastal flooding) and JBA Risk Management (pluvial/surface water flooding).

JBA Insurability

Please note that this assessment is produced by JBA Risk Management and is based entirely on their own modelled data for river flooding, coastal flooding and surface water flooding. As JBA have modelled this data in-house, there may be times when JBA's assessment of river and coastal flood risk will differ from that modelled by the Environment Agency/Natural Resources Wales. If you require further explanation of the insurability data, please contact Groundsure.

Introduction to Detailed Findings

All mapped features within this report are given an identification number. This number identifies the feature on the maps which precede the following data sections. All distances provided are in metres and directions are given as compass headings.

Section 1.1 - Historical maps are a widely recognised source of information for investigating site history. Nevertheless, analysis of mapping at 1:10,560 and 1:10,000 scale will not always provide a complete site history. If you are concerned about the former uses of a site, we would advise additional analysis of planning records and/or more detailed historical mapping.

Please note that the number of records identified relates to areas subject to potentially contaminative former activities and these do not necessarily correspond to the number of sites found within these areas.

Section 1.2 - Systematic analysis of historical maps can highlight areas which, over time, have the potential to have been infilled with various materials. Such areas can relate to such features as ditches, ponds, clay pits, brickfields and quarries. Areas of infill do not always refer to landfill sites, although they may sometimes indicate the presence of such sites. Such areas are normally infilled with inert materials, although in some cases contaminative materials may have been used.

Sections 1.3 to 1.6 – Selected highly contaminative land uses have been extracted from 1:2,500 and 1:1,250 scale historical mapping. This database covers the majority of the UK from the first available map, but where areas of the UK are not covered it is indicated in the report as “No Data Available”. This indicates that no assessment of the risk from these features is included in the report. In this instance if you are still concerned about the former uses of a site, we would advise additional analysis of planning records and/or more detailed historical mapping.

Section 1.7 – Certain military installations were not noted on historic mapping for security reasons. Whilst not all military land is necessarily of concern, Groundsure has researched and digitised a number of Ordnance Factories and other military industrial features (e.g. Ordnance Depots, Munitions Testing Grounds) which may be of contaminative concern. This research was drawn from a number of different sources, and should not be regarded as a definitive or exhaustive database of potentially contaminative military installations. The boundaries of sites within this database have been estimated from the best evidence available to Groundsure at the time of compilation.

Section 2 - This information is gathered from a wide range of sources including the Environment Agency/Natural Resources Wales (Agency) and the British Geological Survey (BGS). Data supplied by Environment Agency/Natural Resources Wales refers to waste management licences required by anyone involved in waste disposal under the Environmental Protection Act 1990. A survey by the BGS undertaken in 1972/3 provides data on some older landfill sites, which were not subject to this legislation.

Section 3.1 – The answer to this question is based on searches of current industrial data provided by PointX

Section 3.2 – The answer to this question is based on searches of current and recent petrol stations provided by Catalist.

Sections 3.3, 3.4, 3.6-3.11 and 3.14 – This information is supplied by the Environment Agency/Natural Resources Wales.

Section 3.5, 3.13 and 3.15 – This information is supplied by Local Authorities.

Section 3.12 – This information is supplied by the Health and Safety Executive.

Section 5.1 – The answer to this question is based upon a 50m search radius from the centre of the search location. This information is supplied by the Environment Agency/Natural Resources Wales.

Sections 5.2 to 5.6 – The answers to these questions are based upon a 250m search radius from the centre of the search location. This information is supplied by the Environment Agency/Natural Resources Wales.

Sections 5.8-5.9 – The answer to this question is based upon a 50m search radius from the centre of the search location.

Section 6.1 – The answer to this question is based upon information found within 50m of the search centre.

Sections 6.2 and 6.4 – These databases provide an indication of “non-coal” mining and natural ground cavities. They are used to provide an indication that activities that have the potential to cause ground instability issues are present in the general vicinity of the property. However the accuracy of the data is not sufficient to confirm if the property will be directly affected.

Sections 6.5 and 6.6 - Systematic analysis of historical maps can highlight areas where either mining or underground workings have occurred in the past. The information is taken from features presented on historical maps which do not indicate the distance or direction which underground or mining workings extend beneath the surface. e.g features such as mine shafts only indicate the entrance to a mine, and by inference indicate the potential for underground features to extend outward from this point. Some features within this database may also relate to non-mining underground activities e.g. air shafts for underground railways.

Section 8.1 and Section 8.2 - Provides information on records of Ofcom-registered mobile phone masts and mobile mast planning records up to 250m.

Section 8.3 – Please be aware that the findings contained within the overhead power transmission lines section is based upon information found within Ordnance Survey OpenData.

1. Past Land Use

1.1 Potentially Contaminative Uses

The systematic analysis of data extracted from standard 1:10,560 and 1:10,000 scale historical maps provides the following information.

Are there any potentially contaminative past land uses within 250m of the search centre?	No
Risk Assessment	Passed

Guidance: Database searched and no data found. No further action is recommended.

1.2 Potentially Infilled Land

The systematic analysis of data extracted from standard 1:10,560 and 1:10,000 scale historical maps provides the following information.

Are there areas of potentially infilled land within 250m of the search centre?	Yes
--	-----

Guidance: The study site appears to be located on or in close proximity to a past land use or area of potentially infilled land that can cause structural problems. You may wish to check that any structural surveys performed on the property have taken this into consideration. If such factors have not been considered, you may wish to contact the local Building Regulations Officer, Planning Department and if recently constructed, the site developers. Newer developments may benefit from an NHBC guarantee or other environmental warranty which often covers structural issues.

The following Historical Surface Ground Working Features derived from the Historical Mapping information is provided by Groundsure:

Distance (m)	Direction	Use	Date
8	SW	Pond	1914
11	SW	Pond	1949
14	SW	Pond	1982
19	SW	Pond	1968
19	SW	Pond	1960
227	S	Pond	1949
227	S	Pond	1914

1.3 Additional Information – Historical Tank Database

The systematic analysis of data extracted from High Detailed 1:1,250 and 1:2,500 scale historical maps provides the following information.

Are there any historical tanks within 100m of the search centre?	No
Risk Assessment	Passed

Guidance: Database searched and no data found. No further action is recommended.

1.4 Additional Information – Historical Energy Features Database

The systematic analysis of data extracted from High Detailed 1:1,250 and 1:2,500 scale historical maps provides the following information.

Are there any historical energy features within 100m of the search centre?	No
Risk Assessment	Passed

Guidance: Database searched and no data found. No further action is recommended.

1.5 Additional Information – Historical Petrol Station Database

The systematic analysis of data extracted from High Detailed 1:1,250 and 1:2,500 scale historical maps provides the following information.

Are there any historical petrol stations within 100m of the search centre?	No
Risk Assessment	Passed

Guidance: Database searched and no data found. No further action is recommended.

1.6 Additional Information – Historical Garage and Motor Vehicle Repair Database

The systematic analysis of data extracted from High Detailed 1:1,250 and 1:2,500 scale historical maps provides the following information.

Are there any historical garage and motor vehicle repair sites within 100m of the search centre?	No
Risk Assessment	Passed

Guidance: Database searched and no data found. No further action is recommended.

1.7 Historical Military/Ordnance Sites

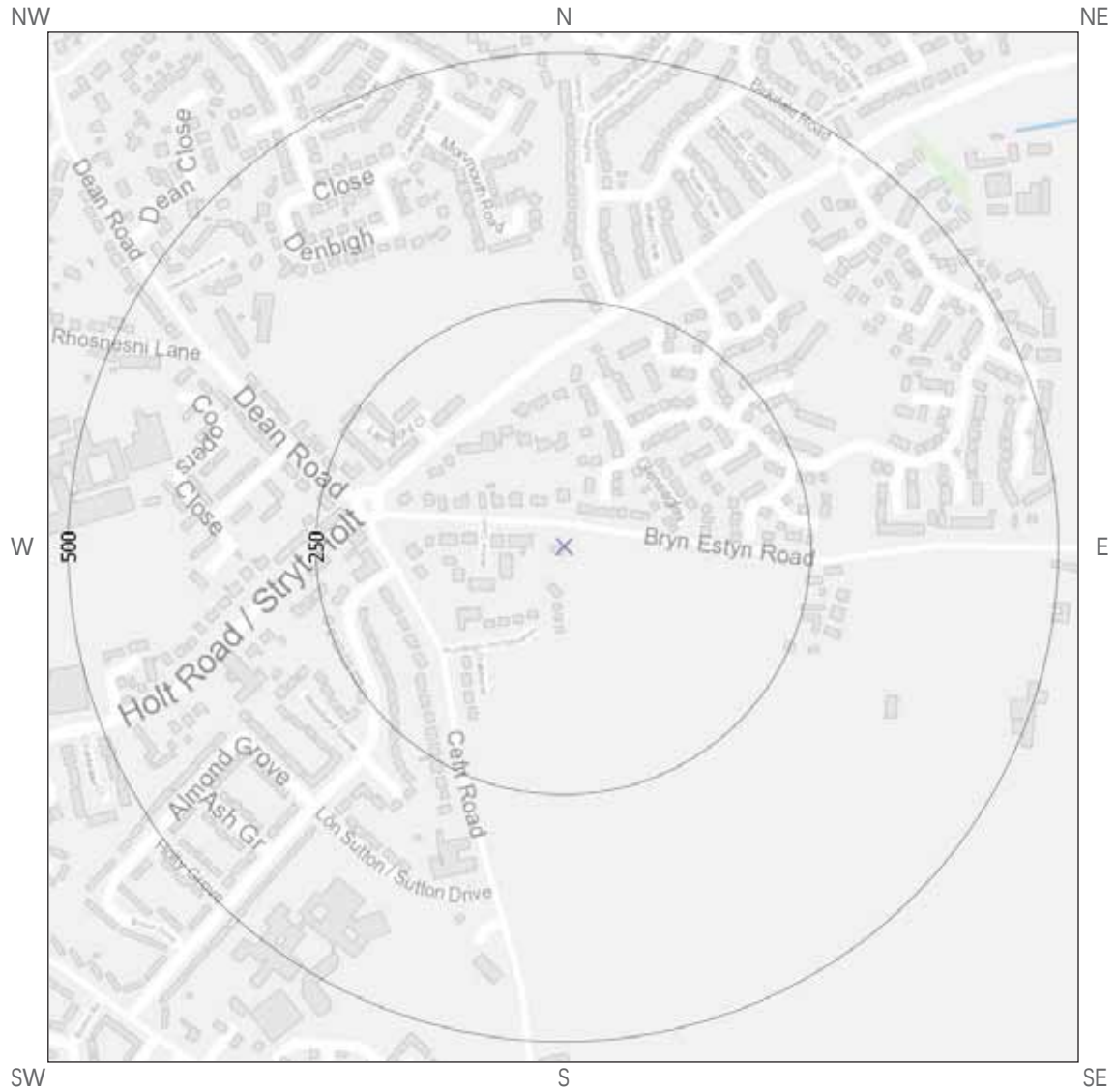
Analysis of historic military records has identified the following information.

Are there any historical military industrial sites known to Groundsure within 100m of the search centre?	No
Risk Assessment	Passed

Guidance: Database searched and no data found. No further action is recommended.

2. Landfill and Waste Sites

Landfill and Waste Sites Map



Landfill and Waste Sites Map

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2.1 Landfill Sites

Are there any operational or non-operational landfill sites within 500m of the search centre?	No
Risk Assessment	Passed

Guidance: Groundsure has searched this database and no data was found. No further action is recommended

2.1.1 Environment Agency/Natural Resources Wales Active Landfill Sites

Database searched and no data found.

2.1.2 Environment Agency/Natural Resources Wales Historic Landfill Sites

Database searched and no data found.

2.1.3 British Geological Survey / DoE Landfill Site Survey

Database searched and no data found.

2.2 Records of Landfills in Local Authority and Historical Mapping Records

Are there any additional Landfills in Local Authority and Historical Mapping records within 500m of the search centre?	No
Risk Assessment	Passed

Guidance: Groundsure has searched this database and no data was found. No further action is recommended.

2.3 Waste Sites

Are there any operational or non-operational waste treatment, transfer or disposal sites within 500m of the search centre?	No
Risk Assessment	Passed

Guidance: Groundsure has searched this database and no data was found. No further action is recommended.

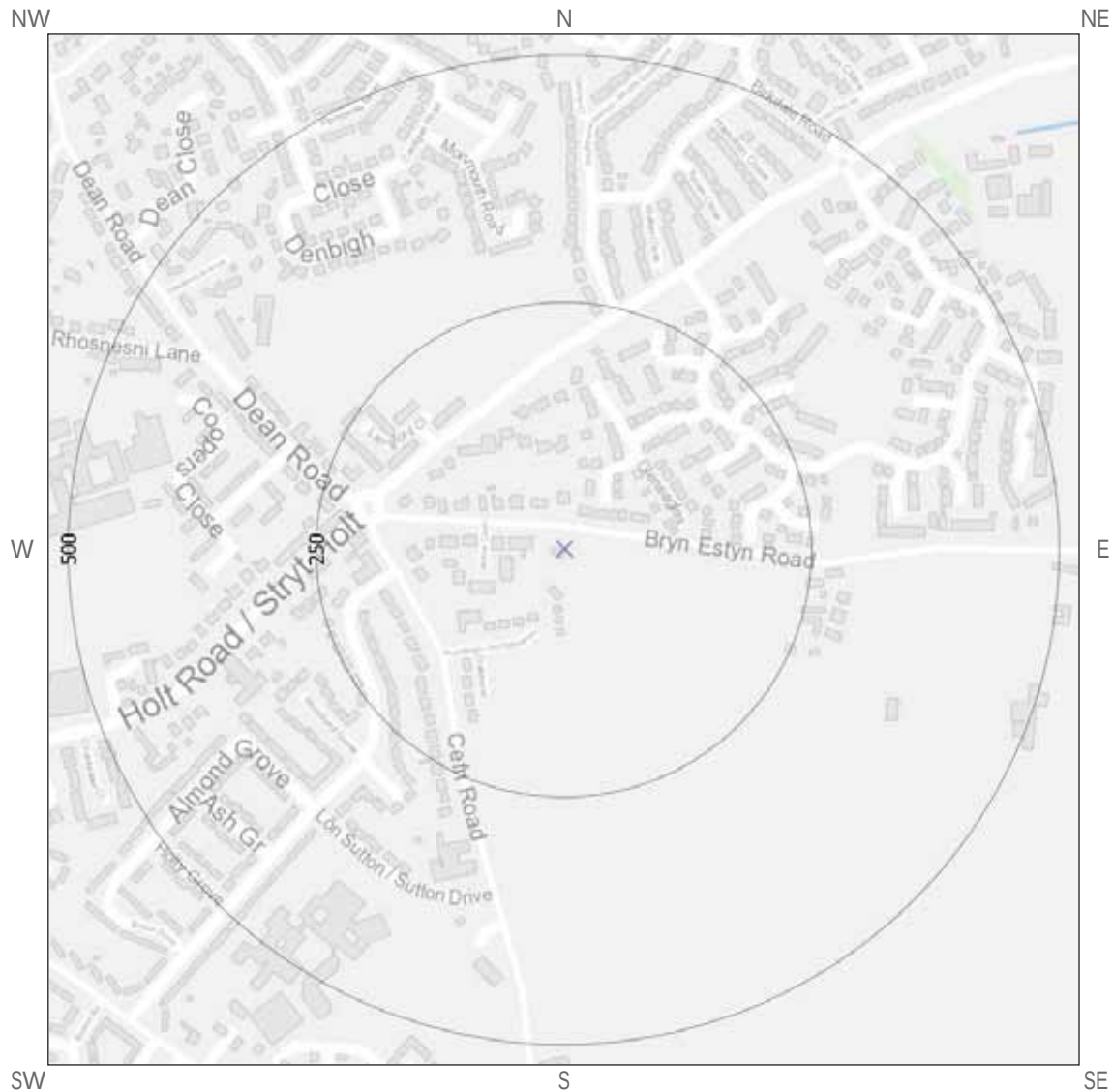
2.4 Environment Agency/Natural Resources Wales Licensed Waste Sites

Are there any Environment Agency/Natural Resources Wales Licensed Waste Sites within 500m of the search centre?	No
Risk Assessment	Passed

Guidance: Groundsure has searched this database and no data was found. No further action is recommended.

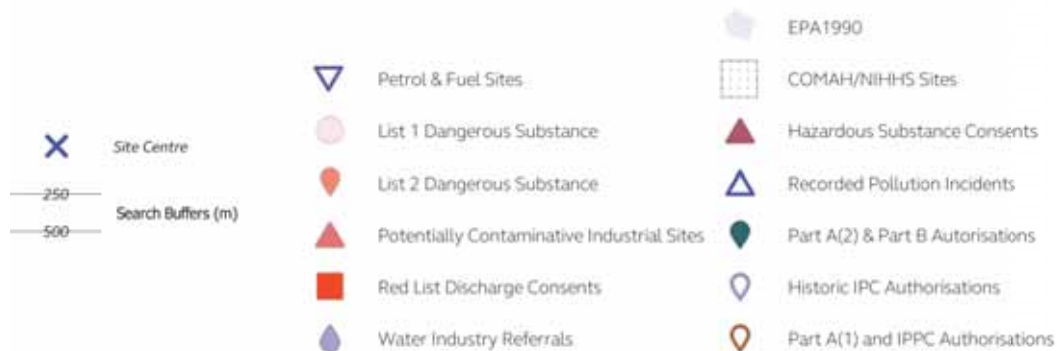
3. Industrial Sites and Processes

Industrial Sites and Processes Map



Industrial Sites and Processes Map

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3.1 Potentially Contaminative Industrial Sites

Are there any potentially contaminative industrial sites within 250m of the search centre?	No
Risk Assessment	Passed

Guidance: Groundsure has searched this database and no data was found. No further action is recommended.

3.2 Petrol and Fuel Sites

Are there any petrol and fuel sites within 250m of the search centre?	No
Risk Assessment	Passed

Guidance: Groundsure has searched this database and no data was found. No further action is recommended.

3.3 Historic IPC Authorisations

Records of historic IPC Authorisations within 500m of the study site:	No
Risk Assessment	Passed

Guidance: Groundsure has searched this database and no data was found. No further action is recommended.

3.4 Part A(1) Authorised Processes

Records of Part A(1) and IPPC Authorised Activities within 500m of the study site:	No
Risk Assessment	Passed

Guidance: Groundsure has searched this database and no data was found. No further action is recommended.

3.5 Part A(2) and Part B Authorised Processes and Enforcements

Are there any Part A(2) and Part B Authorised Processes and Enforcements within 250m of the search centre?	No
Risk Assessment	Passed

Guidance: Groundsure has searched this database and no data was found. No further action is recommended.

3.6 Red List Discharge Consents

Are there any Red List Discharge Consents within 250m of the search centre?	No
Risk Assessment	Passed

Guidance: Groundsure has searched this database and no data was found. No further action is recommended.

3.7 Water Industry Referrals

Are there any Water Industry Referrals within 250m of the search centre?	No
Risk Assessment	Passed

Guidance: Groundsure has searched this database and no data was found. No further action is recommended.

3.8 List 1 Dangerous Substances

Are there any List 1 dangerous substance inventory sites within 500m of the search centre?	No
Risk Assessment	Passed

Guidance: Groundsure has searched this database and no data was found. No further action is recommended.

3.9 List 2 Dangerous Substances

Are there any List 2 dangerous substance inventory sites within 500m of the search centre?	No
Risk Assessment	Passed

Guidance: Groundsure has searched this database and no data was found. No further action is recommended.

3.10 Dangerous or Hazardous Sites

Are there any COMAH & NIHHS sites within 500m of the search centre?	No
Risk Assessment	Passed

Guidance: Groundsure has searched this database and no data was found. No further action is recommended.

3.11 Sites Determined as Contaminated Land under Part 2A EPA 1990

Does the Local Authority hold information under Section 78R of the Environmental Protection Act 1990 for any sites within 250m of the search centre?	No
Risk Assessment	Passed

Guidance: Groundsure has searched this database and no data was found. No further action is recommended.

3.12 Environment Agency/Natural Resources Wales Recorded Pollution Incidents

Are there any Environment Agency/Natural Resources Wales recorded pollution incidents within 250m of the search centre?	No
Risk Assessment	Passed

Guidance: Groundsure has searched this database and no data was found. No further action is recommended.

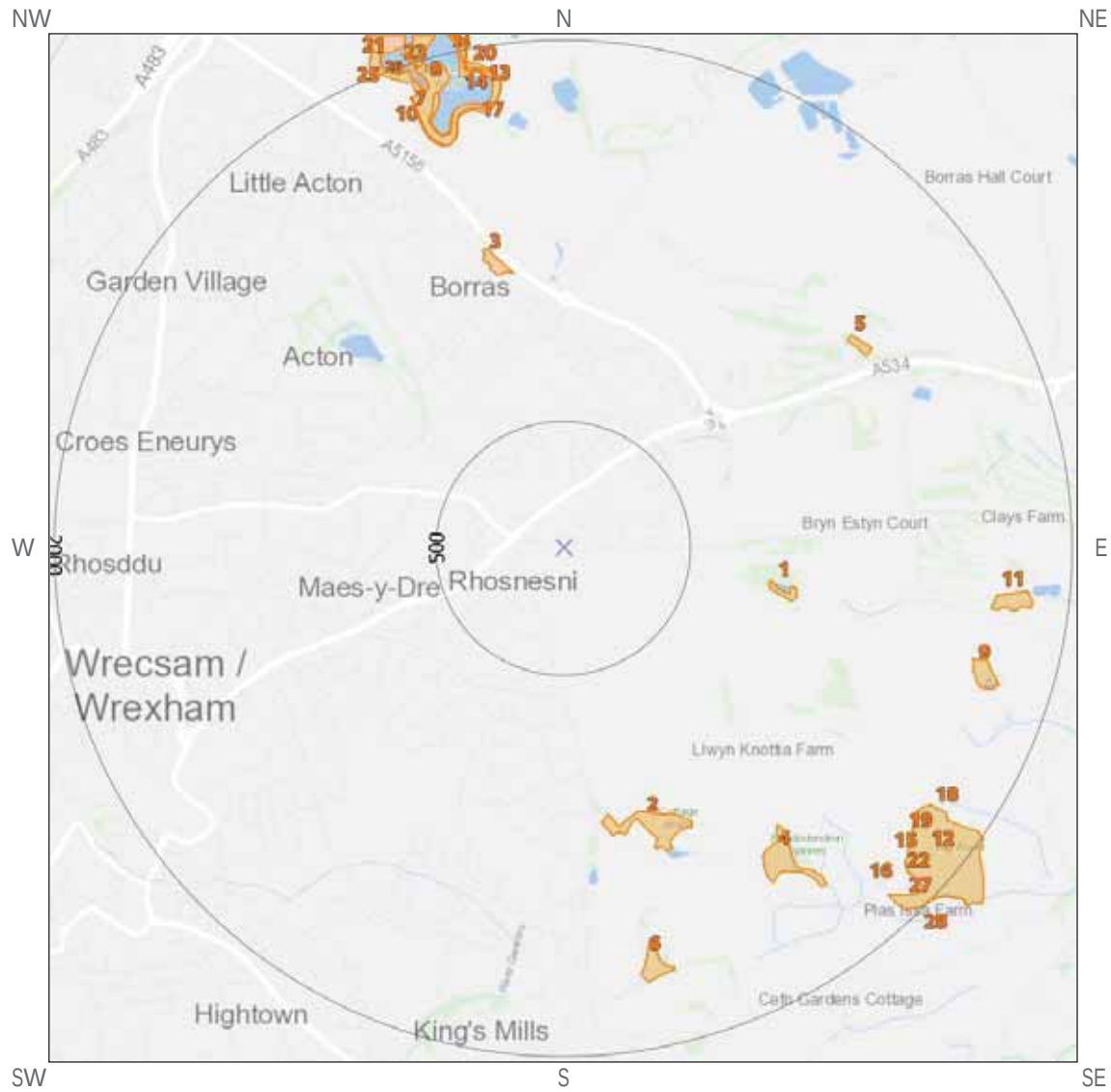
3.13 Hazardous Substance Consents and Enforcements

Are there any Hazardous Substance Consents or Enforcement within 500m of the search centre?	No
Risk Assessment	Passed

Guidance: Groundsure has searched this database and no data was found. No further action is recommended.

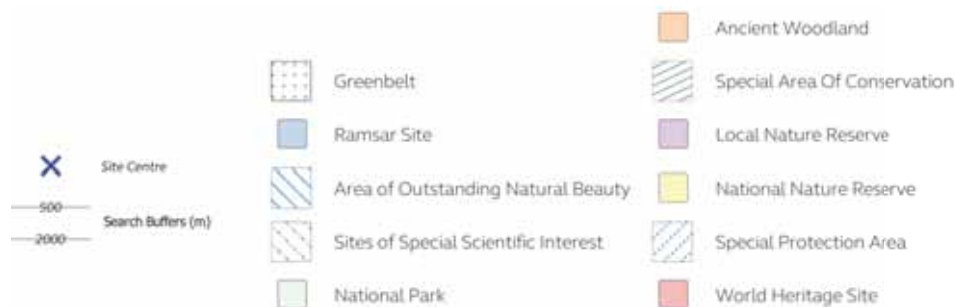
4. Designated Environmentally Sensitive Sites

Designated Environmentally Sensitive Sites Map



Designated Environmentally Sensitive Sites Map

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Designated Environmentally Sensitive Sites

Presence of Designated Environmentally Sensitive Sites within 2000m of the study site?	Yes
--	-----

4.1 Sites of Special Scientific Interest (SSSI)

Records of Sites of Special Scientific Interest (SSSI) within 2000m of the study site:	0
--	---

Database searched and no data found.

4.2 Ramsar sites

Records of Ramsar sites within 2000m of the study site:	0
---	---

Database searched and no data found.

4.3 National Nature Reserves

Records of National Nature Reserves (NNR) within 2000m of the study site:	0
---	---

Database searched and no data found.

4.4 Special Areas of Conservations (SAC)

Records of Special Areas of Conservation (SAC) within 2000m of the study site:	0
--	---

Database searched and no data found.

4.5 Special Protection Areas (SPA)

Records of Special Protection Areas (SPA) within 2000m of the study site:	0
---	---

Database searched and no data found.

4.6 Local Nature Reserves (LNR)

Records of Local Nature Reserves (LNR) within 2000m of the study site:	0
--	---

Database searched and no data found.

4.7 World Heritage Sites

Records of World Heritage Sites within 2000m of the study site:	0
---	---

Database searched and no data found.

4.8 Areas of Outstanding Natural Beauty

Records of Areas of Outstanding Natural Beauty (AONB)/National Scenic Areas within 2000m of the study site:	0
---	---

Database searched and no data found.

4.9 National Parks

Records of National Parks within 2000m of the study site:	0
---	---

Database searched and no data found.

4.10 Green Belt

Records of Green Belt land within 2000m of the study site:	0
--	---

Database searched and no data found.

4.11 Designated Ancient Woodland

Records of Ancient Woodland within 2000m of the study site:

28

The following Ancient Woodland Records records are provided by Natural England/Natural Resources Wales:

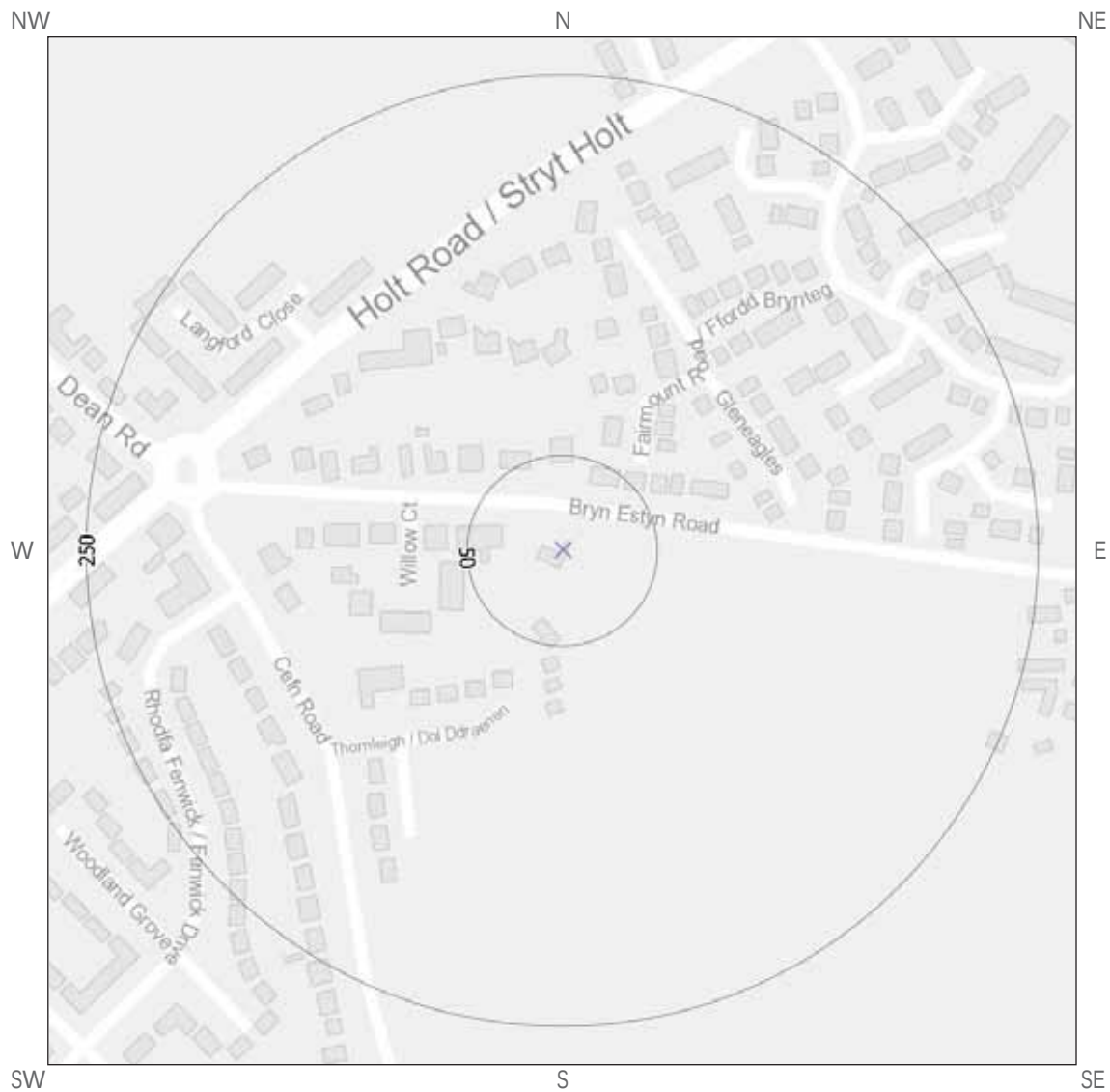
ID	Distance (m)	Direction	Ancient Woodland Name	Ancient Woodland Type
1	820	E	Unknown	Ancient and Semi-Natural Woodland
2	1061	S	Unknown	Ancient and Semi-Natural Woodland
3	1102	N	Unknown	Ancient and Semi-Natural Woodland
4	1375	SE	Unknown	Ancient and Semi-Natural Woodland
5	1383	NE	Unknown	Ancient and Semi-Natural Woodland
6	1597	S	Unknown	Ancient and Semi-Natural Woodland
7	1649	N	PANT-YR-OCHAIN WOOD	Ancient and Semi-Natural Woodland
8	1651	N	Unknown	Restored Ancient Woodland Site
9	1665	E	Unknown	Ancient and Semi-Natural Woodland
10	1690	N	PANT-YR-OCHAIN WOOD	Ancient and Semi-Natural Woodland
11	1698	E	Unknown	Restored Ancient Woodland Site
12	1731	SE	Unknown	Ancient and Semi-Natural Woodland
13	1772	N	PANT-YR-OCHAIN WOOD	Ancient and Semi-Natural Woodland
14	1783	N	PANT-YR-OCHAIN WOOD	Ancient and Semi-Natural Woodland
15	1824	SE	Unknown	Ancient and Semi-Natural Woodland
16	1833	SE	Unknown	Ancient and Semi-Natural Woodland
17	1836	N	PANT-YR-OCHAIN WOOD	Ancient and Semi-Natural Woodland
18	1837	SE	Unknown	Ancient and Semi-Natural Woodland
19	1845	SE	Unknown	Ancient and Semi-Natural Woodland
20	1852	N	PANT-YR-OCHAIN WOOD	Ancient and Semi-Natural Woodland
21	1854	N	PANT-YR-OCHAIN WOOD	Ancient and Semi-Natural Woodland
22	1870	SE	BIG WOOD	Ancient Replanted Woodland
23	1879	N	Unknown	Restored Ancient Woodland Site
24	1896	N	Unknown	Restored Ancient Woodland Site
25	1979	N	PANT-YR-OCHAIN WOOD	Ancient and Semi-Natural Woodland
26	1979	N	PANT-YR-OCHAIN WOOD	Ancient and Semi-Natural Woodland
27	1988	SE	BIG WOOD	Ancient Replanted Woodland
28	1997	SE	BIG WOOD	Ancient Replanted Woodland

5. Natural Hazards and Additional Factors

Environment Agency/Natural Resources Wales River and Coastal Flood Map



Environment Agency/Natural Resources Wales Recorded Historic Flood Events Map



Environment Agency/Natural Resources Wales Recorded
Historic Flood Events Map

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JBA Surface Water (Pluvial) Flood Map



JBA Surface Water (Pluvial) Flood Map

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5.1 Risk of Flooding from Rivers and the Sea (RoFRaS)

What is the risk of flooding at the centre of the study site?	Very Low
What is the highest risk of flooding within 25m of the centre of the study site?	Very Low

The Environment Agency/Natural Resources Wales RoFRaS database provides an indication of river and coastal flood risk at a national level on a 50m grid as used by many of the insurance companies. RoFRaS data is based on a 50m grid system, with the flood rating at the centre of the grid calculated and given below. The data considers the probability that the flood defences will overtop or breach, and the distance from the river or the sea.

RoFRaS data for the study site indicates the property has a Very Low (less than 1 in 1000) chance of flooding in any given year.

5.2 Areas Benefiting from Flood Defences

Are there any areas benefiting from Flood Defences within 250m of the study site?	No
---	----

Guidance: These are areas that may benefit from the presence of major defences during a 1% river (fluvial) or 0.5% coastal flood event. These areas would flood if the defence were not present, but may not flood because the defence is present. Details of flood defences and any areas benefiting from these defences can be seen on the Risk of Flooding from Rivers and the Sea Map.

5.3 Flood Defences

Are there any flood defences within 250m of the study site?	No
---	----

Guidance: This search consists only of flood defences present in the dataset provided by the Environment Agency/Natural Resources Wales.

5.4 Proposed Flood Defences

Are there any Proposed Flood Defences within 250m of the study site?	No
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Guidance: This search consists only of proposed flood defences present in the dataset provided by the Environment Agency/Natural Resources Wales. Please note that proposed flood defence schemes will not influence the current RoFRaS ratings for the site until they have been constructed.

5.5 Areas Used for Flood Storage

Are there any areas used for Flood Storage within 250m of the study site?	No
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Database searched and no data found

Flood Storage Areas are considered part of the functional floodplain, and are areas where water has to flow or be stored in times of flood. Technical Guidance to the National Planning Policy Framework states that only water-compatible development and essential infrastructure should be permitted within flood storage areas, and existing development within this area should be relocated to an area with a lower risk of flooding. Any relevant data is represented on the Risk of Flooding from Rivers and the Sea Map.

Notes on RoFRaS data

RoFRaS is an assessment of flood risk for England and Wales produced using local data and expertise. It shows the chance of flooding from rivers or the sea presented in categories taking account of flood defences and the condition those defences are in. The RoFRaS model uses local water level and flood defence data to model flood risk. It has divided England and Wales into 50m X 50m impact cells. Each cell has been assigned a flood risk likelihood from the categories below:

- Less than **1 in 1000 (0.1%)** chance in any given year: **Very Low**
- Less than **1 in 100 (1%)** but greater than or equal to **1 in 1000 (0.1%)** chance in any given year: **Low**
- Less than **1 in 30 (3.3%)** but greater than or equal to **1 in 100 (1%)** chance in any given year: **Medium**
- Greater than or equal to **1 in 30 (3.3%)** chance in any given year: **High**

Notes on Existing Flood Defences

Flood defences seek to reduce the risk of flooding and to safeguard life, protect property, sustain economic activity and the natural environment. Flood defences are designed to protect against flood events of a particular magnitude, expressed as risk in any one year.

Notes on Proposed Flood Defences

'Number of Households to Benefit' illustrates the number of households that move from 'very significant' or 'significant' to 'moderate' or 'low' probability of flood risk bands if the proposed flood scheme is to be implemented

This information is taken from the Environment Agency/Natural Resources Wales's database of Areas to Benefit from New and Reconditioned Flood Defences under the Medium Term Plan (MTP). The dataset contains funding allocation for the first financial year (from April). Funding for the following four financial years is not guaranteed, being only indicative, and will be reviewed annually.

Projects within the Medium Term Plan qualify for inclusion in this dataset if:

- the investment leads to a change in the current standard of protection (change projects);
- the investment is a replacement or refurbishment in order to sustain the current standard of protection (sustain projects);
- the project has an initial construction budget of £100,000 or more; and
- the project is included within the first five years of the MTP.

The data includes all the Environment Agency/Natural Resources Wales's projects over £100K that will change or sustain the standards of flood defence in England and Wales over the next 5 years. It also includes the equivalent schemes for all Local Authority and Internal Drainage Boards. The number of households and areas of land contributing to DEFRA's Outcome Measures (OM) are also attributed i.e. could benefit from major work on flood defences.

These data also contain Intermittence Flood Maintenance Programmes that show the annual maintenance programme of work scheduled to be carried out by the Environment Agency/Natural Resources Wales, Local Authority or Internal Drainage Board on flood defences. Data details routine maintenance as well as intermittent work that has been funded for the coming year. The data contains a start and end coordinate defining the relevant river section where work is planned.

Information Warning

Please note that the maps show the areas where investment is being made to reduce the flood and coastal erosion risk and are not detailed enough to account for individual addresses. Individual properties may not always face the same risk of flooding as the areas that surround them. Also, note that funding figures are indicative and any use or interpretation should account for future updates where annual values may change.

Every possible care is taken to ensure that the maps reflect all the data possessed by the Environment Agency/Natural Resources Wales and that they have applied their expert knowledge to create conclusions that are as reliable as possible. The Environment Agency/Natural Resources Wales consider that they have created the maps as well as they can and so should not be liable if the maps by their nature are not as accurate as might be desired or are misused or misunderstood, despite their warnings. For this reason, they are not able to promise that the maps will always be accurate or completely up to date.

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Flood Storage Areas

Flood Storage Areas may also act as flood defences. A flood storage area may also be referred to as a balancing reservoir, storage basin or balancing pond. Its purpose is to attenuate an incoming flood peak to a flow level that can be accepted by the downstream channel. It may also delay the timing of a flood peak so that its volume is discharged over a longer time interval.

A flood storage area may take the form of a wet or dry reservoir. A wet reservoir is a water storage facility in which storage can be effected by allowing water levels to rise during flood times. A dry reservoir is typically adjacent to a river and comprises an enclosed area that accepts water only at peak times. These areas are also referred to as Zone 3b or 'the functional floodplain' and has a 5% or greater chance of flooding in any given year, or is designed to flood in the event of an extreme (0.1%) flood or another probability which may be agreed between the Local Planning Authority and the Environment Agency/Natural Resources Wales, including water conveyance routes. Development within Flood Storage Areas is severely restricted.

5.6 Historic Flooding Events

Has the site or any area within 250m of the site been subject to historic flooding as recorded by the Environment Agency/Natural Resources Wales?	No
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This database shows the individual footprint of every flood event recorded in the Environment Agency/Natural Resources Wales's national database on historic flood events. Please note this doesn't include records held by individual local offices. This data is used to understand where larger-scale flooding has occurred in the past and provides details as available. Absence of a historic flood event for an area does not mean that the area has never flooded, but only that it doesn't appear in the Environment Agency/Natural Resources Wales national dataset. Equally, a record of a flood footprint in previous years does not mean that an area will flood again, and this information does not take account of flood management schemes and improved flood defences.

Historic flooding events: Database searched and no data found.

5.7 JBA Surface (Pluvial) Water Flooding

What is the risk of pluvial flooding at the centre of the study site?	Negligible
What is the highest risk of pluvial flooding within 25m of the centre of the study site?	Low to Moderate

Guidance: The site or an area in close proximity has been assessed to be at Low to Moderate risk of surface water (pluvial) flooding. This indicates that this area would be expected to be affected by surface water flooding in a 1 in 200 year rainfall event to a depth of between 0.1m and 0.3m.

Distance (m)	Direction	Risk
2	S	Low
3	E	Low to Moderate
8	NW	Low
9	N	Low
12	W	Low to Moderate
12	W	Low
14	NW	Low
17	W	Low to Moderate
17	W	Low
18	W	Low to Moderate
22	W	Low
25	SW	Low

Distance (m)	Direction	Risk
31	SW	Low
36	SW	Low

Notes on Surface water (Pluvial) Flooding data:

JBA Risk Management surface water flood map identifies areas likely to flood following extreme rainfall events, i.e. land naturally vulnerable to surface water or “pluvial” flooding. This data set was produced by simulating 1 in 75 year, 1 in 200 year and 1 in 1000 year rainfall events. Modern urban drainage systems are typically built to cope with rainfall events between 1 in 20 and 1 in 30 years, though older ones may even flood in a 1 in 5 year rainstorm event.

The model provides the maximum depth of flooding in each 5m “cell” of topographical mapping coverage. The maps include 7 bands indicating areas of increasing natural vulnerability to surface water flooding. These are:

- Less than **0.1m** in a **1 in 1000** year rainfall event: **Negligible**
- Greater than **0.1m** in a **1 in 1000** year rainfall event: **Low**
- Between **0.1m and 0.3m** in a **1 in 200** year rainfall event: **Low to Moderate**
- Between **0.3m and 1m** in a **1 in 200** year rainfall event: **Moderate**
- Greater than **1m** in a **1 in 200** year rainfall event: **Moderate to High**
- Between **0.1m and 0.3m** in a **1 in 75** year rainfall event: **High**
- Between **0.3m to 1m** in a **1 in 75** year rainfall event: **Significant**
- Greater than **1m** in a **1 in 75** year rainfall event: **Highly Significant**

5.8 Groundwater Flooding Susceptibility

What is the susceptibility to Groundwater Flooding in the search area based on the underlying geological conditions?	Potential for groundwater flooding of property below ground level
Does this relate to Clearwater Flooding or Superficial Deposits Flooding?	Superficial Deposits Flooding

Guidance: Where potential for groundwater flooding of property situated below ground level is indicated, this means that given the geological conditions there may be a groundwater flooding hazard to basements and other below surface infrastructure. Unless other relevant information, e.g. records of previous flooding, suggests groundwater flooding has occurred before in this area you need take no further action in relation to groundwater flooding hazard. If there are records of previous incidences of groundwater flooding, then is recommended that other information e.g. rainfall history, property type, and land drainage information in addition to previous records of flooding be investigated in order to establish relative, but not absolute, risk of groundwater flooding.

Groundwater flooding is defined as the emergence of groundwater at the ground surface or the rising of groundwater into man-made ground under conditions where the normal range of groundwater levels is exceeded. The BGS Susceptibility to Groundwater Flooding hazard dataset identifies areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the ground surface. The susceptibility data is suitable for use for regional or national planning purposes where the groundwater flooding information will be used along with a range of other relevant information to inform land-use planning decisions. It might also be used in conjunction with a large number of other factors, e.g. records of previous incidence of groundwater flooding, rainfall, property type, and land drainage information, to establish relative, but not absolute, risk of groundwater flooding at a resolution of greater than a few hundred metres. The susceptibility data should not be used on its own to make planning decisions at any scale, and, in particular, should not be used to inform planning decisions at the site scale. The susceptibility data cannot be used on its own to indicate risk of groundwater flooding.

Notes on Groundwater Flooding

The BGS Susceptibility to Groundwater Flooding hazard dataset identifies areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the ground surface.

Groundwater flooding is assessed on a fourfold scale:

- The area is not considered to be prone to groundwater flooding based on rock type.
- There is limited potential for groundwater flooding to occur and further relevant information should be considered to determine this assessment.

- There is potential for groundwater flooding of property situated below the surface such as basements and other below surface infrastructure. Further relevant information should be considered to determine whether groundwater flooding has previously occurred.
- There is potential for groundwater flooding to occur at the surface and groundwater flooding hazard should be considered in all land use planning decisions. Other relevant information should be considered to establish the risk of groundwater flooding to property.

5.9 Natural Ground Subsidence

What is the potential for natural ground subsidence* within the search area?	Negligible - Very Low
--	-----------------------

Guidance: The natural ground subsidence rating is obtained through the evaluation of six natural ground stability hazard datasets, which are supplied by the British Geological Survey (BGS). These datasets indicate the hazard posed by the occurrence of: Swell-Shrink Clay, Landslide, Compressible Ground, Collapsible Ground, Dissolution of Soluble Rocks and Running Sand. Many factors may contribute to ground subsidence problems. For instance, significant problems can arise in conurbations underlain by clay rich bedrock, such as over clay strata in the South East of England, or South Wales. Whilst surveyors are normally aware of local problem areas, data provided by the BGS can highlight areas where a significant potential for natural ground subsidence exists and which may need particular consideration.

Where negligible - very low potential is indicated, this means that you need take no further action in relation to natural ground subsidence in this area.

*The term "Subsidence" refers to ground movement that could cause damage to foundations in domestic or other properties.

5.10 Radon Affected Areas

Is the property in a radon Affected Area as defined by Public Health England (PHE) and if so what percentage of homes are above the Action Level?	The property is in a Radon Affected Area, as between 1 and 3% of properties are above the Action Level
---	--

Guidance: Public Health England (PHE) recommends a radon 'Action Level' of 200 becquerels per cubic metre for the annual average of the radon gas concentration in a home. Where 1% or more of homes are estimated to exceed the Action Level (i.e. are in an Intermediate or Higher probability radon area) the area should be regarded as a radon Affected Area.

This report informs you whether the property is in a radon Affected Area and the percentage of homes that are estimated to be at or above the radon Action Level. This does not necessarily mean there is a radon problem in the property; the only way to find out whether it is above or below the Action Level is to carry out a radon measurement in an existing property.

PHE advises that radon gas should be measured in all properties within radon Affected Areas and that homes with radon levels above the Action Level (200 Bq m⁻³) should be remediated, and when achievable to below the Target Level of 100 Bq m⁻³. Householders with levels between the Target Level and Action Level should seriously consider reducing their radon level, especially if they are at greater risk, such as if they are current or ex smokers. Whether or not a home is in fact above or below the Action Level or Target Level can only be established by having the building tested. PHE provides a radon testing service which can be accessed at www.ukradon.org.

The information in this report provides an answer to one of the standard legal enquiries on house purchase in England and Wales, known as CON29 Standard Enquiry of Local Authority (part 1); 3.13 Radon Gas: Location of the Property in a Radon Affected Area.

If you are buying a currently occupied property in a Radon Affected Area, you should ask the present owner whether radon levels have been measured in the property. If they have, ask whether the results were above the Radon Action Level and if so, whether remedial measures were installed, radon levels were re-tested, and the results of re-testing confirmed the effectiveness of the measures.

Further information on radon is available from PHE or www.ukradon.org

5.11 Radon Protective Measures

Is the property in an area where radon protection measures are required for new properties or extensions to existing ones as described in publication BR211 by the Building Research Establishment?	No radon protective measures are necessary
---	--

Combined Radon Guidance: Radon is a colourless, odourless radioactive gas which is present in all areas of the United Kingdom, usually at levels that pose a negligible risk to homebuyers. However, in some areas levels of radon are much higher than in others, and in these cases it can pose a health risk. The data supplied by the Public Health England (PHE) and the British Geological Survey (BGS) is not able to determine exact Radon levels, as this information can only be obtained through site-specific, in-situ testing. As 1-3% of properties in the area may be radon affected PHE recommend carrying out a site-specific radon assessment. This costs £49.80 including VAT and the results are confidential to the client. Please contact PHE (020 7654 8000) for further information and advice.

Notes on Radon

RISKS OF RADON

Radon is a radioactive gas which occurs naturally. It has no taste, smell or colour. Special devices are needed to measure it. Radon comes out of the ground. Outdoors, it is diluted to very low levels. However, in some cases the radon level indoors can build up to high concentrations. In such cases, it does pose a serious risk to health.

ACTION LEVEL FOR RADON

Public Health England (PHE) recommends that radon levels should be reduced in homes where the average is more than 200 becquerels per cubic metre of air (Bq m⁻³). This recommendation has been endorsed by the Government. This Action Level refers to the annual average concentration in a home, so radon measurements are carried out with two detectors (in a bedroom and living room) over three months, to average out short-term fluctuations.

RADON AFFECTED AREAS

PHE defines radon Affected Areas as those with a 1% probability or more of a home having radon above the Action Level. PHE recommends that people in Affected Areas should test their homes for radon.

HOW TO REDUCE RADON LEVELS

PHE advises that radon gas should be measured in all properties within radon Affected Areas and that homes with radon levels above the Action Level (200 Bq m⁻³) should be remediated, preferably to below the Target Level of 100 Bq m⁻³. Householders with levels between the Target Level and Action Level should seriously consider reducing their radon level, especially if they are at greater risk, such as if they are current or ex smokers.

Indoor radon levels can usually be substantially reduced at a cost comparable to many home improvements, such as replacing carpets. Details of methods of reducing radon levels are given on the Building Research Establishment Website.

6. Mining

6.1 Coal Authority Coal Mining Records

Is the property within an area which may be affected by past, present or proposed underground coal mining?	Yes
--	-----

Guidance: The study site is located in an area which may be affected by surface or sub-surface coal mining. A Coal Mining Search is recommended. This can be ordered through the Coal Authority or your preferred search provider.

6.2 BGS Non-Coal Mining Hazards

What is the potential for undermining as a result of underground mineral extraction, excluding coal and minerals extracted as a consequence of coal mining?	Unclassified
---	--------------

Guidance: The study site lies in an area which is unclassified in relation to non-coal mining. This means that there is no known hazard from underground mine workings because the rock types present are such that no commodities or metal ores have been worked by underground mining methods. It should be noted, however, that there is always the possibility of the existence of other sub-surface excavations, such as wells, cess pits, follies, air raid shelters/bunkers and other military structures etc. that could affect surface ground stability but which are outside the scope of this dataset.

The mining hazard data (not including coal) layer draws together a diverse range of material derived from geology, which constrains distribution, supplemented by literature searches for historic locations and expert knowledge to assemble, interpret, and organise this information. Mining of coal is specifically excluded from this data set and information on Coal Mining areas can be found in the Coal Authority Coal Mining Records section above.

The data provides an assessment of the likelihood that past underground mining may have occurred in the area. It does not consider the depth of the extraction nor whether any remediation has previously been undertaken. Where extraction of such minerals has taken place in workings close to the surface (meaning to approximately 50m depth) the workings can pose a subsidence risk because they sometimes cause surface collapse. Old mine shafts and other mine openings in such areas can also lead to unexpected surface collapse.

The data provided by the British Geological Survey (BGS) are rated on a five point scale ranging from Rare, through Highly unlikely, Unlikely and Likely to Highly Likely that indicate how likely it is that past underground mining activities may have occurred.

6.3 Mining Cavities

Is the site located in an area of mining cavities?	No
--	----

Guidance: This information is obtained from the mining cavities dataset, which is supplied and digitally combined by Peter Brett Associates. There are no records within 250m of the site.

6.4 Natural Cavities

Is the site located in an area of natural cavities?	No
---	----

Guidance: This risk rating is obtained from the natural cavities dataset, which is supplied and digitally combined by Peter Brett Associates. There are no records within 250m of the site.

6.5 Historical Mining Features from Detailed Mapping

The systematic analysis of data extracted from standard 1:10,560 and 1:10,000 scale historical maps provides the following information.

Are there any Mining features within 500m of the centre of the study site?	No
--	----

Guidance: No further action required.

6.6 Historical Underground Workings Features from Detailed Mapping

The systematic analysis of data extracted from standard 1:10,560 and 1:10,000 scale historical maps provides the following information.

Are there any Historical Underground Working Features within 500m of the centre of the study site?
--

No

Guidance: No further action required.

7. Energy

7.1 Existing oil, gas, shale gas or coalbed methane wells

Count of records of existing oil, gas, shale gas or coalbed methane wells within 5km of the property	0
--	---

Guidance: No records of oil, gas, shale gas or coalbed methane wells have been identified within 5km of the property. The dataset is taken from the Oil and Gas Authority (OGA) register of onshore wells and is updated monthly. No further action is recommended in regard to this aspect of the report.

7.2 Proposed oil, gas, shale gas or coalbed methane wells

Count of Proposed oil, gas, shale gas or coalbed methane wells within 5km of the property	1
---	---

Guidance: This dataset identifies one or more planning applications relating to oil, gas, shale gas or coalbed methane exploratory or extraction wells that have been submitted to the planning authority since 2009. The dataset is unique to Groundsure and is derived from local authority planning records. The data is updated weekly. Further details of the application(s) identified can be found in a full Groundsure Energy report.

7.3 Existing wind farms

Count of existing wind farms	0
------------------------------	---

Guidance: No records of wind projects registered with the UK Wind Energy Database (UKWED) have been identified within 5km of the property. The dataset is taken from Renewables UK and is provided for information only, with no guarantee given as to its completeness or accuracy. Renewables UK are excluded from any liability for any such inaccuracies or errors. Groundsure would advise further independent research of any sites of interest to determine exact locations and details of projects. No further action is recommended in regard to this aspect of the report.

7.4 Proposed wind power projects

Count of proposed wind power projects within 5km of the property	0
--	---

Guidance: No records of planning applications relating to wind turbine developments (with two turbines or more) have been identified within 5km of the property. This dataset is unique to Groundsure and is derived from local authority planning records, updated quarterly. No further action is recommended in regard to this aspect of the report.

7.5 Existing solar farms

Count of existing solar farms	7
-------------------------------	---

Guidance: This dataset identifies one or more operational solar farms and those under development within 5km of the property. The dataset is taken from the Department of Energy and Climate Change (DECC) and is updated on a monthly basis. Further details of the project(s) identified can be found in a full Groundsure Energy report.

7.6 Proposed solar farms

Count of proposed solar farms within 5km of the property	6
--	---

Guidance: This dataset identifies one or more planning application relating to solar farm developments within 5km of the property. The dataset is unique to Groundsure and is derived from local authority planning records. The data is updated weekly. Further details of the project(s) identified can be found in a full Groundsure Energy report.

7.7 Existing power stations

Count of existing power stations within 5km of the property	0
---	---

Guidance: No existing power stations have been identified within 5km of the property. These datasets show power generating establishments with a generation capacity of 1MW or greater. The data is derived from records within the Digest of United Kingdom Energy Statistics (DUKES). No further action is recommended in regard to this aspect of the report.

7.8 Existing Nuclear Establishments

Count of existing nuclear establishments within 5km of the property	0
---	---

Guidance: No nuclear establishments have been identified within 5km of the property. This dataset shows nuclear establishments and is derived from records within the Health and Safety Executive, the Nuclear Decommissioning Authority, the National Infrastructure Planning Programme and the Nuclear Advanced Manufacturing Centre. No further action is recommended in regard to this aspect of the report.

7.9 Proposed Energy and other large Infrastructure Projects

Count of proposed Energy and other large Infrastructure Projects within 5km of the property

1

Guidance: This dataset identifies one or more proposed energy infrastructure projects within 5km of the property. This dataset is derived from information provided by the Planning Inspectorate and shows major national infrastructure projects only. Further details of the project(s) identified can be found in a full Groundsure Energy report.

8. Additional Information

8.1 Ofcom Sitefinder Mobile Phone Mast Records

Have any mobile phone transmitters registered with Ofcom been identified within 250m of the study site?	No
---	----

Database searched and no data found

This database is taken from Ofcom's Sitefinder database, the Government's database of mobile phone base stations. The last update to this database was applied in May 2012, although some operators ceased providing updates some years before then. Neither Ofcom nor Groundsure can accept any liability for any inaccuracies or omissions in the data provided within Sitefinder.

The most recent update is based on the following datasets received at the specified times by Ofcom: O2 (May 2012), Network Rail (April 2012), Hutchison (February 2012), Vodafone (October 2011), Airwave (February 2010), Orange (February 2010) and T-Mobile (August 2005). Sites added since these dates will not appear in the database.

8.2 Mobile Phone Mast Planning Records

Have any planning records relating to telecommunication masts been identified within 250m of the study site?	No
--	----

Database searched and no data found

This database is taken from Glenigan's collection of planning records dating back to 2006 and relates to sites which have applied for planning permission involving mobile phone masts. The database is normally updated quarterly.

8.3 Pylons and Electricity Transmission Lines

Have any overhead transmission lines been identified within 500m of the study site?	No
---	----

Database searched and no data found

Guidance: None required.

9. Guide to our Professional Assessment

Introduction

This report is designed for residential conveyancers and their clients and satisfies standard environmental due diligence enquiries, recommended by the Law Society. This information is not always covered by Standard Con 29 Enquiries made to Local Authorities.

Purpose of this Assessment

As part of this report Groundsure provide a professional assessment of the risks posed by key environmental information which could lead to the property being designated as 'Contaminated Land' as defined under Part 2A of the Environmental Protection Act 1990. This assessment is based on the following data:

- 1 Historical land use (compiled from 1:10,000 1:10,560 maps)
- 2 Additional Information Historical land use (compiled from 1:1,250 1:2,500 maps) – for selected areas.
- 3 Landfill and waste transfer/treatment or disposal sites (including scrap yards)
- 4 Current industrial uses (as defined by PointX data)
- 5 Catalyst Petrol Station
- 6 Part A(1), Part A(2) and Part B Authorisations
- 7 Control of Major Accident Hazards Sites (COMAH) and Notification of Installations Handling Hazardous Substances (NIHHS)
- 8 Dangerous Substances Inventory Releases (DSI)
- 9 Radioactive Substance Authorisations (RAS)
- 10 Discharge and Red List Discharge Consent
- 11 Sites Determined as Contaminated Land under Part 2A EPA 1990
- 12 Environment Agency/Natural Resources Wales Recorded Pollution Incidents
- 13 Historic Military / Ordnance Sites
- 14 Planning Hazardous Substance Consents

From this information Groundsure provide a statement regarding the likely designation of the property under Part 2A of EPA 1990 and the level of risk associated with the property is either Passed or In Need of Further Assessment. If the site is In Need of Further Assessment it does not necessarily mean that the site is unsuitable for purchase, but only that further assessment of the risk associated with the site is required. When a site is In Need of Further Assessment then the practitioner may, if required, discuss the case with one of the Groundsure consultants. Where a site is 'In Need of Further Assessment' Groundsure will, on request, attempt to arrange appropriate environmental insurance.

Method Statement

In assessing specific site risk, Groundsure follows principles used extensively throughout the environmental consultancy sector. Our system looks at the potential for specific industries to have generated residual contamination and for this contamination to remain at a site, or to have migrated to neighbouring sites. Sites are scored based on this system and if a site scores highly it indicates a high level of risk.

Limitations of the Study

This screening process reviews historical mapping and a range of current databases. The historical land use database reviewed for this study does NOT include 1:2,500 or 1:1,250 scale maps except for Groundsure's additional information database of selected features namely tanks, energy features, petrol filling stations and garages. This additional information database covers the majority of the UK, but not all. Where no assessment has been made "No Data Available" is presented in the report. Where 1:2,500 or 1:1,250 scale maps are utilised all relevant and available map epochs to Groundsure are used. Additionally, this review does NOT include specific enquiries to the Local Authority who may hold additional information and it does NOT include a site visit/inspection. Your attention is drawn to the Terms and Conditions of Groundsure Limited under which this service is provided.

Remediation

This report is covered by Groundsure's remediation contribution. For the purpose of this condition, 'Claimant' shall mean one of: (a) the Beneficiary, (b) the purchaser of the site from the Beneficiary or (c) the funder of (a) or (b) as applicable.

This condition shall apply solely to Groundsure Homebuyers, Homescreeen, Enviroplus, Enviro Full Flood & Planning, Enviro All-in-one and Home Environmental reports with "Passed" rather than "In Need of Further Assessment" statuses.

Groundsure may, at its sole discretion without any admission of liability, make a contribution to the Claimant towards the costs of any clean up works required to be carried out under a notice served on a Claimant in respect of a site under Part II (A) Environmental Protection Act 1990 ("Remediation Notice") on the terms of this condition ("Clean up Award").

The Clean up Award: (a) is only available once in respect of a site and to one Claimant only; (b) shall only apply where the site is a single residential dwelling house or a single residential flat within a block of flats. For the avoidance of doubt, a Clean up Award will not be considered in respect of commercial property or to any site being developed or redeveloped whether for residential purposes or otherwise; and (c) shall only apply to contamination or a pollution occurring as at or prior to the date of Groundsure Homebuyers.

The Clean up Award will not be paid in respect of any of the following, including without limitation: (a) asbestos; (b) radioactive contamination arising directly or indirectly from or in connection with ionising radiations or contamination by radioactivity from any nuclear waste or fuel; from the combustion of nuclear fuel or the radioactive toxic explosive or other hazardous properties of any explosive nuclear assembly or nuclear component thereof; (c) naturally occurring materials or their removal except where such materials are present in excess of their natural concentration; (d) any condition caused by acts of war or an act of terrorism; (e) any condition which is known or ought reasonably to have been known to the Claimant prior to the purchase of Groundsure Homebuyers; (f) non-compliance by the Claimant or any other person with respect to the site with any statute, regulation, byelaws complaint, or notice from any regulatory authority; (g) any property belonging to or in the custody or control of the Claimant which does not form a fixed part of the site or the structure; (h) any losses incurred following a material change in use of, alteration or development of the site; or (i) financial loss in respect of loss of rental, profit, revenue, savings, business or any consequential, indirect or economic loss, damages or expenses, including the cost of temporary accommodation or business interruption.

In the event the Claimant wishes to apply for a Clean up Award, it shall notify Groundsure in writing within 3 months of the date of the Remediation Notice. The Claimant shall comply with all reasonable requirements of Groundsure with regard to the commission and conduct of the clean up works to be carried out under the Remediation Notice. In the event that the Claimant breaches this provision including, without limitation, failing to obtain Groundsure's prior written consent in respect of estimates for such works Groundsure shall not be required to pay a Clean up Award.

Groundsure shall only pay a Clean up Award where a Remediation Notice is served within 36 months of the date of Groundsure Homebuyers. The maximum sum of any Clean up Award shall be £60,000 and shall be paid subject to the Claimant having paid to Groundsure an excess in respect of its claim of £5,000. Groundsure reserves the right at any time to withdraw the offer of payment of a Clean up Award. The Claimant shall take all reasonable steps to appeal such Remediation Notice and mitigate any costs incurred in connection with the remediation works required under the terms of any Remediation Notice. Groundsure reserves the right to withhold or reduce the amount of its Clean up Award in the event of a breach of this condition or an appeal is still active.

The Claimant shall take all reasonable steps to appeal such Remediation Notice and mitigate any costs incurred in connection with the remediation works required under the terms of any Remediation Notice. Groundsure reserves the right to withhold or reduce the amount of its Clean up Award in the event of a breach of this condition or an appeal is still active.

Contact Details

Groundsure Limited

Sovereign House, Church St, Brighton, BN1 1UJ
info@groundsure.com
08444 159 000

**Natural Resources Wales**

Tel: 0300 065 3000
Ty Cambria
29 Newport Road, Cardiff, CF24 0TP
Email: enquiries@naturalresourceswales.gov.uk

**JBA Risk Management**

South Barn, Broughton Hall, Skipton, BD23 3AE

**Local Authority**

Wrexham - Wrexham County Borough Council. Address: The Guildhall, Wrexham, Wrexham, LL11 1AY. Web: <http://www.wrexham.gov.uk/>. Tel: 01978 292 000

British Geological Survey Enquiries

Kingsley Dunham Centre, Keyworth, Nottingham
enquiries@bgs.ac.uk
Tel: 0115 936 3143. Fax: 0115 936 3276
www.bgs.ac.uk

**The Coal Authority Property Search Services**

200 Lichfield Lane, Berry Hill, Mansfield, Nottinghamshire, NG18 4RG, DX 716176 MANSFIELD 5
Email: groundstability@coal.gov.uk
Phone: 0345 7626 848
Web: www.groundstability.com

**Public Health England**

Public information access office, Public Health England, Wellington House, 133-155 Waterloo Road, London, SE1 8UG
Email: enquiries@phe.gov.uk
Main switchboard: 020 7654 8000
www.gov.uk/phe



Ordnance Survey

Adanac Drive, Southampton, SO16 0AS

Tel: 08456 050505

**Getmapping PLC**

Virginia Villas, High Street, Hartley Witney, Hampshire RG27 8NW

Tel: 01252 845444

**CoPSO**

The Old Rectory, Church Lane, Thornby, Northants NN6 8SN

www.copso.org.uk

Tel: 0871 4237191



This report is produced by Groundsure Ltd, whose correspondence address is Groundsure Ltd, Sovereign House, Church Street, Brighton, BN1 1UJ (Tel: 08444 159 000, Email: info@groundsure.com).

Groundsure's registered address is Groundsure Ltd, c/o Ascential Group Limited, The Prow, 1 Wilder Walk, London W1B 5AP. United Kingdom Registration Number: 3421028. VAT Number 486 4004 42.

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Search Code

IMPORTANT CONSUMER PROTECTION INFORMATION

This search has been produced by Groundsure Ltd, Sovereign House, Church Street, Brighton, BN1 1UJ. Tel: 08444 159 000. Email: info@groundsure.com which is registered with the Property Codes Compliance Board (PCCB) as a subscriber to the Search Code. The PCCB independently monitors how registered search firms maintain compliance with the Code.

The Search Code:

- provides protection for homebuyers, sellers, estate agents, conveyancers and mortgage lenders who rely on the information included in property search reports undertaken by subscribers on residential and commercial property within the United Kingdom
- sets out minimum standards which firms compiling and selling search reports have to meet
- promotes the best practice and quality standards within the industry for the benefit of consumers and property professionals
- enables consumers and property professionals to have confidence in firms which subscribe to the code, their products and services.

By giving you this information, the search firm is confirming that they keep to the principles of the Code. This provides important protection for you.

The Code's core principles

Firms which subscribe to the Search Code will:

- display the Search Code logo prominently on their search reports
- act with integrity and carry out work with due skill, care and diligence
- at all times maintain adequate and appropriate insurance to protect consumers
- conduct business in an honest, fair and professional manner
- handle complaints speedily and fairly
- ensure that products and services comply with industry registration rules and standards and relevant laws
- monitor their compliance with the Code

COMPLAINTS

If you have a query or complaint about your search, you should raise it directly with the search firm, and if appropriate ask for any complaint to be considered under their formal internal complaints procedure. If you remain dissatisfied with the firm's final response, after your complaint has been formally considered, or if the firm has exceeded the response timescales, you may refer your complaint for consideration under The Property Ombudsman scheme (TPOs). The Ombudsman can award compensation of up to £5,000 to you if they find that you have suffered actual loss as a result of your search provider failing to keep to the Code.

Please note that all queries or complaints regarding your search should be directed to your search provider in the first instance, not to TPOs or to the PCCB.

TPOs Contact Details:

The Property Ombudsman scheme

Milford House

43-55 Milford Street

Salisbury

Wiltshire SP1 2BP

Tel: 01722 333306

Fax: 01722 332296

Website: www.tpos.co.uk

Email: admin@tpos.co.uk

You can get more information about the PCCB from www.propertycodes.org.uk.

PLEASE ASK YOUR SEARCH PROVIDER IF YOU WOULD LIKE A COPY OF THE SEARCH CODE

COMPLAINTS PROCEDURE

If you want to make a complaint, we will:

- Acknowledge it within 5 working days of receipt.
- Normally deal with it fully and provide a final response, in writing, within 20 working days of receipt.
- Keep you informed by letter, telephone or e-mail, as you prefer, if we need more time.
- Provide a final response, in writing, at the latest within 40 working days of receipt.
- Liaise, at your request, with anyone acting formally on your behalf.

Complaints should be sent to: Operations Director, Groundsure Ltd, Sovereign House, Church Street, Brighton, BN1 1UJ. Tel: 08444 159 000. Email: info@groundsure.com

If you are not satisfied with our final response, or if we exceed the response timescales, you may refer the complaint to The Property Ombudsman scheme (TPOs): Tel: 01722 333306, E-mail: admin@tpos.co.uk.

We will co-operate fully with the Ombudsman during an investigation and comply with their final decision.

Standard Terms and Conditions

Groundsure's Terms and Conditions can be viewed online at this link:

<https://www.groundsure.com/terms-and-conditions-sept-2016/>

APPENDIX E

Exploratory Hole Records

Trial Pit Log

TerraConsult

Personnel:		Equipment & methods:		Dimensions:		Coordinates & level:		Dates:	
Logged by:	J Lewis	Method:	TP Excavation	Width:	0.30	Grid:	OSGB	Start:	14/11/2017
Date logged:	14/11/2017			Length:	1.00	Easting:	335296.00m	End:	14/11/2017
Checked by:		Plant:	1.5 tonne excavator	Orientation:		Northing:	351189.00m		
		Shoring:	None	Bearing =	85	Level:	28.00m		

Backfill/ Instal'n	Water- strike	Legend	Level & Depth (Thickness)	Stratum Description	Samples & In Situ Testing		
					Depth	Type & No	Results
			(0.70)	(MADE GROUND) Light brown clayey gravelly cobbly SAND. Gravel is comprised of fine to medium pieces of plastic and concrete and cobbles of bricks. Rootlets	0.30	ESTP01-ES1	
			27.30 0.70 (0.50)	(MADE GROUND) Dark brown gravelly SAND with medium rounded gravel particles of sandstone and granite. Rootlets.			
			26.80 1.20 (0.30)	Soft dark grey sandy slightly gravelly CLAY. Rare fine gravel of sandstone and granite. Rootlets. (Buried Topsoil)			
			26.50 1.50 (0.60)	Grey clayey slightly gravelly coarse SAND. Medium to coarse gravel comprised of sandstone. Rootlets.			
			25.90 2.10	Trial pit terminated at 2.10m			
					Depth	Type & No	Results

Groundwater entries: Struck: Rose to: Inflow rate: 1.20		Depth related remarks: From - to: Remarks:		General remarks: Weather: Overcast Stability: Stable Remarks: None Termination: Target depth reached	
 Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in meters. Log issue: DRAFT Scale: 1:20		Project: Project No: 3564 Client:		Exploratory position reference: TP01 Sheet 1 of 1	

TerraConsultSheet 1 of 1

Trial Pit Log

TerraConsult

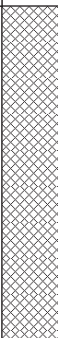
Personnel:		Equipment & methods:		Dimensions:	Coordinates & level:	Dates:
Logged by:	J Lewis	Method:	TP Excavation	Width: 0.30	Grid: OSGB	Start: 14/11/2017
Date logged:	14/11/2017			Length: 1.00	Easting: 335297.00m	End: 14/11/2017
Checked by:		Plant:	1.5 tonne excavator	Orientation:	Northing: 351208.00m	
		Shoring:	None	Bearing = 325	Level: 28.00m	

Backfill/ Instal'n	Water- strike	Legend	Level & Depth (Thickness)	Stratum Description	Samples & In Situ Testing		
					Depth	Type & No	Results
			(0.80)	(MADE GROUND) Dark brown very sandy cobbly bouldery GRAVEL. Angular boulders of concrete and cobbles of brick. Fine to medium rounded gravel of sandstone and granite. Rootlets.			
			27.20 0.80 (0.20)	Light brown rounded coarse SAND comprised predominantly of quartz and some feldspar.			
			27.00 1.00 (0.20)	Dark brown clayey gravelly SAND with fine to medium rounded gravel of sandstone and granite. Top of layer has very thin band of black material. Rootlets.			
			26.80 1.20 (0.70)	Dark brown clayey gravelly SAND with fine to medium rounded gravel of sandstone and granite. Rootlets.			
			26.10 1.90 (0.10)	Soft dark brown sandy CLAY with sand comprised of quartz.			
			26.00 2.00	Trial pit terminated at 2.00m			

Groundwater entries:		Depth related remarks:		General remarks:		
Struck:	Rose to:	Inflow rate:	From - to:	Remarks:	Weather:	Overcast
1.10					Stability:	Stable
					Remarks:	None
					Termination:	Target depth reached
Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in meters.		Project: Project No: 3564 Client:		Exploratory position reference: TP03		
Log issue: DRAFT Scale: 1:20				Sheet 1 of 1		

TerraConsultSheet 1 of 1

TerraConsult

Backfill/ Instal'n	Water strike	Legend	Level & Depth (Thickness)	Stratum Description	Samples & In Situ Testing		
					Depth	Type & No	Results
			(0.90)	(MADE GROUND) Brown gravelly cobbly bouldery SAND. Gravel is comprised of medium pieces of plastic, concrete and brick. Angular cobbles of bricks and paving slabs. Angular boulders of concrete. Rootlets	1.50	ESTP05-ES1	
			27.10 0.90 (1.10)	Greyish brown clayey slightly gravelly coarse SAND. Medium to coarse gravel comprised of sandstone. Rootlets.			
			26.00 2.00	Trial pit terminated at 2.00m			
					Depth	Type & No	Results
Groundwater entries: Struck: Rose to: Inflow rate: 0.90				Depth related remarks: From - to: Remarks:		General remarks: Weather: Overcast Stability: Stable Remarks: None Termination: Target depth reached	
 Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in meters. Log issue: DRAFT Scale: 1:20				Project: Project No: 3564 Client:		Exploratory position reference: TP05	
Sheet 1 of 1							

APPENDIX F

Laboratory Chemical Test Results



Chris Eccles
TerraConsult Ltd
Bold Business Centre
Bold Lane
Sutton
St Helens
Merseyside
WA9 4TX

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t: 01622 850410
russell.jarvis@qtsenvironmental.com

QTS Environmental Report No: 17-67161

Site Reference: Bryn Estyn, Wrexham

Project / Job Ref: 3564

Order No: PO - 002118

Sample Receipt Date: 16/11/2017

Sample Scheduled Date: 16/11/2017

Report Issue Number: 1

Reporting Date: 22/11/2017

Authorised by:

Russell Jarvis
Associate Director of Client Services

Authorised by:

Dave Ashworth
Deputy Quality Manager

QTSE is the trading name of DETS Ltd, company registration number 03705645



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Soil Analysis Certificate					
QTS Environmental Report No: 17-67161	Date Sampled	14/11/17	14/11/17	14/11/17	14/11/17
TerraConsult Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Bryn Estyn, Wrexham	TP / BH No	TP01 - ES1	TP05 - ES1	TP02 - ES1	TP04 - ES1
Project / Job Ref: 3564	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied
Order No: PO - 002118	Depth (m)	0.30	1.50	0.30	1.20
Reporting Date: 22/11/2017	QTSE Sample No	302115	302116	302117	302118

Determinand	Unit	RL	Accreditation				
pH	pH Units	N/a	MCERTS	7.7	6.7	8.0	6.8
Total Cyanide	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2
Total Sulphate as SO ₄	mg/kg	< 200	NONE			322	609
Total Sulphate as SO ₄	%	< 0.02	NONE			0.03	0.06
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	19	29	40	50
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	0.02	0.03	0.04	0.05
Organic Matter	%	< 0.1	MCERTS			1.7	4.3
Total Organic Carbon (TOC)	%	< 0.1	MCERTS	2.3	5	1	2.5
W/S Chloride (2:1)	mg/kg	< 1	MCERTS			39	44
W/S Chloride (2:1)	mg/l	< 0.5	MCERTS			19.4	21.8
Arsenic (As)	mg/kg	< 2	MCERTS	5	< 2	6	9
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	1.2	< 0.2	0.3	< 0.2
Chromium (Cr)	mg/kg	< 2	MCERTS	9	4	19	9
Copper (Cu)	mg/kg	< 4	MCERTS	21	8	17	14
Lead (Pb)	mg/kg	< 3	MCERTS	125	9	88	71
Mercury (Hg)	mg/kg	< 1	NONE	< 1	< 1	< 1	< 1
Nickel (Ni)	mg/kg	< 3	MCERTS	8	3	14	8
Selenium (Se)	mg/kg	< 3	NONE	< 3	< 3	< 3	< 3
Zinc (Zn)	mg/kg	< 3	MCERTS	146	15	96	66
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2
DRO (C10 - C24)	mg/kg	< 6	MCERTS			28	10
Oil (C25 - C40)	mg/kg	< 6	MCERTS			28	24
Mineral Oil (C10 - C40)	mg/kg	< 10	MCERTS			< 10	< 10

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C
Subcontracted analysis (S)



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Soil Analysis Certificate - Speciated PAHs					
QTS Environmental Report No: 17-67161	Date Sampled	14/11/17	14/11/17	14/11/17	14/11/17
TerraConsult Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Bryn Estyn, Wrexham	TP / BH No	TP01 - ES1	TP05 - ES1	TP02 - ES1	TP04 - ES1
Project / Job Ref: 3564	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied
Order No: PO - 002118	Depth (m)	0.30	1.50	0.30	1.20
Reporting Date: 22/11/2017	QTSE Sample No	302115	302116	302117	302118

Determinand	Unit	RL	Accreditation				
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	< 0.1	MCERTS	0.12	< 0.1	0.69	0.14
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.22	< 0.1
Fluoranthene	mg/kg	< 0.1	MCERTS	0.51	< 0.1	1.45	0.51
Pyrene	mg/kg	< 0.1	MCERTS	0.48	< 0.1	1.18	0.44
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	0.33	< 0.1	0.75	0.28
Chrysene	mg/kg	< 0.1	MCERTS	0.35	< 0.1	0.67	0.39
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	0.50	< 0.1	0.85	0.42
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	0.20	< 0.1	0.29	0.14
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	0.37	< 0.1	0.60	0.20
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	0.25	< 0.1	0.36	0.15
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	0.25	< 0.1	0.34	0.13
Coronene	mg/kg	< 0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1
Total Oily Waste PAHs	mg/kg	< 1	MCERTS	2	< 1	3.5	1.6
Total Dutch 10 PAHs	mg/kg	< 1	MCERTS	2.4	< 1	5.3	1.9
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	3.4	< 1.6	7.4	2.8
Total WAC-17 PAHs	mg/kg	< 1.7	NONE	3.4	< 1.7	7.4	2.8

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C



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Soil Analysis Certificate - TPH CWG Banded						
QTS Environmental Report No: 17-67161	Date Sampled	14/11/17	14/11/17			
TerraConsult Ltd	Time Sampled	None Supplied	None Supplied			
Site Reference: Bryn Estyn, Wrexham	TP / BH No	TP02 - ES1	TP04 - ES1			
Project / Job Ref: 3564	Additional Refs	None Supplied	None Supplied			
Order No: PO - 002118	Depth (m)	0.30	1.20			
Reporting Date: 22/11/2017	QTS Sample No	302117	302118			

Determinand	Unit	RL	Accreditation				
Aliphatic >C5 - C6	mg/kg	< 0.01	NONE	< 0.01	< 0.01		
Aliphatic >C6 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05		
Aliphatic >C8 - C10	mg/kg	< 2	MCERTS	< 2	< 2		
Aliphatic >C10 - C12	mg/kg	< 2	MCERTS	< 2	< 2		
Aliphatic >C12 - C16	mg/kg	< 3	MCERTS	< 3	< 3		
Aliphatic >C16 - C21	mg/kg	< 3	MCERTS	< 3	< 3		
Aliphatic >C21 - C34	mg/kg	< 10	MCERTS	< 10	< 10		
Aliphatic (C5 - C34)	mg/kg	< 21	NONE	< 21	< 21		
Aromatic >C5 - C7	mg/kg	< 0.01	NONE	< 0.01	< 0.01		
Aromatic >C7 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05		
Aromatic >C8 - C10	mg/kg	< 2	MCERTS	< 2	< 2		
Aromatic >C10 - C12	mg/kg	< 2	MCERTS	< 2	< 2		
Aromatic >C12 - C16	mg/kg	< 2	MCERTS	< 2	< 2		
Aromatic >C16 - C21	mg/kg	< 3	MCERTS	< 3	< 3		
Aromatic >C21 - C35	mg/kg	< 10	MCERTS	< 10	< 10		
Aromatic (C5 - C35)	mg/kg	< 21	NONE	< 21	< 21		
Total >C5 - C35	mg/kg	< 42	NONE	< 42	< 42		

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C



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Soil Analysis Certificate - BTEX / MTBE					
QTS Environmental Report No: 17-67161	Date Sampled	14/11/17	14/11/17		
TerraConsult Ltd	Time Sampled	None Supplied	None Supplied		
Site Reference: Bryn Estyn, Wrexham	TP / BH No	TP02 - ES1	TP04 - ES1		
Project / Job Ref: 3564	Additional Refs	None Supplied	None Supplied		
Order No: PO - 002118	Depth (m)	0.30	1.20		
Reporting Date: 22/11/2017	QTS Sample No	302117	302118		

Determinand	Unit	RL	Accreditation				
Benzene	ug/kg	< 2	MCERTS	< 2	< 2		
Toluene	ug/kg	< 5	MCERTS	< 5	< 5		
Ethylbenzene	ug/kg	< 2	MCERTS	< 2	< 2		
p & m-xylene	ug/kg	< 2	MCERTS	< 2	< 2		
o-xylene	ug/kg	< 2	MCERTS	< 2	< 2		
MTBE	ug/kg	< 5	MCERTS	< 5	< 5		

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C



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Soil Analysis Certificate - Sample Descriptions

QTS Environmental Report No: 17-67161

TerraConsult Ltd

Site Reference: Bryn Estyn, Wrexham

Project / Job Ref: 3564

Order No: PO - 002118

Reporting Date: 22/11/2017

QTSE Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
302115	TP01 - ES1	None Supplied	0.30	11.8	Black sandy clay with stones and plastic
302116	TP05 - ES1	None Supplied	1.50	21.8	Black sandy clay with coal
302117	TP02 - ES1	None Supplied	0.30	12.8	Black sandy clay
302118	TP04 - ES1	None Supplied	1.20	21.2	Black sandy clay with stones

Moisture content is part of procedure E003 & is not an accredited test

Insufficient Sample ^{u/s}

Unsuitable Sample ^{u/s}



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Soil Analysis Certificate - Methodology & Miscellaneous Information

QTS Environmental Report No: 17-67161

TerraConsult Ltd

Site Reference: Bryn Estyn, Wrexham

Project / Job Ref: 3564

Order No: PO - 002118

Reporting Date: 22/11/2017

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazine followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 - C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received

APPENDIX G

Summary of Chemical Test Results of Soil Samples

Site: Bryn Estyn, Wrexham

CHEMICAL STATISTICAL ANALYSIS - based on CLEA v1.06 (Sandy Loam 1% SOM)

Job No: 3571

Analyte	Limit of Detection	TerraConsult				Statistical Analysis				SGV / GAC			SGV / GAC		pC4SL		pC4SL		pC4SL		pC4SL		LQM/ClEH S4UL		LQM/ClEH S4UL		LQM/ClEH S4UL		
		TerraConsult	TerraConsult	TerraConsult	TerraConsult	n	Standard Deviation	Minimum	Average	Maximum	Statistical Results		Criteria Source		Screening Criteria		Screening Criteria		Screening Criteria		Criteria Source		Screening Criteria		Screening Criteria		Criteria Source		
		Black sandy clay with stones and plastic	Black sandy clay with coal	Black sandy clay	Black sandy clay with stones						Commercial & Industrial Tier 1 Screening Threshold	Pass/ Fail	Source of Screening Criteria	Source of Toxicological Data	Commercial	Pass / Fail	POS(res)	Pass / Fail	POS(park)	Pass / Fail	Source of Screening Criteria	Source of Toxicological Data	Commercial	Pass / Fail	POS(res)	Pass / Fail	Source of Screening Criteria	Source of Toxicological Data	
		16/11/17	16/11/17	16/11/17	16/11/17																								TP01
		0.30	1.50	0.30	1.20																								
Stone Content	<0.1 %					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Asbestos Screen	Positive / Negative																												
Metals																													
Arsenic (total)	<2 mg/kg	5.0	2.0	6.0	9.0	4	2.89	2	6	9	9.00	635	Pass	SC050021*	SC050021	640	Pass	79	Pass	170	Pass	CLEA v1.06	Defra 2014	640	Pass	79	Pass	CLEA v1.06	LQM/ClEH 2014
Cadmium (total)	<0.2 mg/kg	1.2	0.2	0.3	0.2	4	0.49	0	0	1	1.20	230	Pass	SC050021*	SC050021	420	Pass	220	Pass	560	Pass	CLEA v1.06	Defra 2014	190	Pass	120	Pass	CLEA v1.06	LQM/ClEH 2014
Chromium (total) (III for S4ULs)	<2 mg/kg	9	4	19	9	4	6.29	4	10	19	19.00	30400	Pass	CLEA v1.06	LQM 2009	-	-	-	-	-	-	-	-	8600	Pass	1500	Pass	CLEA v1.06	LQM/ClEH 2014
Copper (total)	<4 mg/kg	21	8	17	14	4	5.48	8	15	21	21.00	71700	Pass	CLEA v1.06	LQM 2009	-	-	-	-	-	-	-	-	68000	Pass	12000	Pass	CLEA v1.06	LQM/ClEH 2014
Lead (total)	<3 mg/kg	125.0	9.0	88.0	71.0	4	48.40	9	73	125	125.00	N/A	-	-	-	6000	Pass	760	Pass	1400	Pass	CLEA v1.06	Defra 2014	-	-	-	-	-	-
Mercury (total inorganic)	<1 mg/kg	1	1	1	1	4	0.00	1	1	1	1.00	3640	Pass	SC050021*	SC050021	-	-	-	-	-	-	-	-	1100	Pass	120	Pass	CLEA v1.06	LQM/ClEH 2014
Nickel (total)	<3 mg/kg	8.0	3.0	14.0	8.0	4	4.50	3	8	14	14.00	840	Pass	CLEA v1.071	EFSA	-	-	-	-	-	-	-	-	980	Pass	230	Pass	CLEA v1.06	LQM/ClEH 2014
Selenium (total)	<3 mg/kg	3	3	3	3	4	0.00	3	3	3	3.00	13000	Pass	SC050021*	SC050021	-	-	-	-	-	-	-	-	120000	Pass	1100	Pass	CLEA v1.06	LQM/ClEH 2014
Zinc (total)	<3 mg/kg	146	15	96	66	4	54.87	15	81	146	146.00	662000	Pass	CLEA v1.06	LQM 2009	-	-	-	-	-	-	-	-	730000	Pass	81000	Pass	CLEA v1.06	LQM/ClEH 2014
Inorganic																													
pH Value	pH Units	7.7	6.7	8.0	6.8	4	0.65	6.7	7	8.0	8.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyanide (total)	<2 mg/kg	2.0	2.0	2.0	2.0	4	0.00	2	2	2.0	2.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chloride (2:1)	<0.5 mg/l			19.4	21.8	2	1.70	19.4	21	21.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sulphate (2:1)	<0.01 g/l	0.02	0.03	0.04	0.05	4	0.01	0.02	0	0	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sulphate (total)	<200 mg/kg			322	609	2	202.94	322.00	466	609	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Organic																													
Soil Organic Matter	<0.1 %			1.7	4.3	2	1.84	1.7	3	4.30	4.30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOC	<0.1 %	2.3	5.0	1.0	2.5	4	1.67	1.0	3	5.00	5.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol	0.1 mg/kg					0	#DIV/0!	0	#DIV/0!	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenol (Total Monohydric)	<2 mg/kg	2.0	2.0	2.0	2.0	4	0.00	2	2	2.0	2.00	24200	Pass	CLEA v1.06	SC050021	-	-	-	-	-	-	-	-	760	Pass	760	Pass	CLEA v1.06	LQM/ClEH 2014
PAH																													
Naphthalene	<0.1 mg/kg	0.1	0.1	0.1	0.1	4	0.00	0.1	0	0.1	0.10	200	Pass	CLEA v1.06	LQM 2009	-	-	-	-	-	-	-	-	190	Pass	4900	Pass	CLEA v1.06	LQM/ClEH 2014
Acenaphthylene	<0.1 mg/kg	0.1	0.1	0.1	0.1	4	0.00	0.1	0	0.1	0.10	84000	Pass	CLEA v1.06	LQM 2009	-	-	-	-	-	-	-	-	83000	Pass	15000	Pass	CLEA v1.06	LQM/ClEH 2014
Acenaphthene	<0.1 mg/kg	0.1	0.1	0.1	0.1	4	0.00	0.1	0	0.1	0.10	8500	Pass	CLEA v1.06	LQM 2009	-	-	-	-	-	-	-	-	84000	Pass	15000	Pass	CLEA v1.06	LQM/ClEH 2014
Fluorene	<0.1 mg/kg	0.1	0.1	0.1	0.1	4	0.00	0.1	0	0.1	0.10	64000	Pass	CLEA v1.06	LQM 2009	-	-	-	-	-	-	-	-	63000	Pass	9900	Pass	CLEA v1.06	LQM/ClEH 2014
Phenanthrene	<0.1 mg/kg	0.1	0.1	0.1	0.1	4	0.09	0.1	0	0.7	0.69	22000	Pass	CLEA v1.06	LQM 2009	-	-	-	-	-	-	-	-	22000	Pass	3100	Pass	CLEA v1.06	LQM/ClEH 2014
Anthracene	<0.1 mg/kg	0.1	0.1	0.2	0.1	4	0.06	0.1	0	0.2	0.22	530000	Pass	CLEA v1.06	LQM 2009	-	-	-	-	-	-	-	-	520000	Pass	74000	Pass	CLEA v1.06	LQM/ClEH 2014
Fluoranthene	<0.1 mg/kg	0.5	0.1	1.5	0.5	4	0.57	0.1	1	1.5	1.45	23000	Pass	CLEA v1.06	LQM 2009	-	-	-	-	-	-	-	-	23000	Pass	3100	Pass	CLEA v1.06	LQM/ClEH 2014
Pyrene	<0.1 mg/kg	0.5	0.1	1.2	0.4	4	0.45	0.1	1	1.2	1.18	54400	Pass	CLEA v1.06	LQM 2009	-	-	-	-	-	-	-	-	54000	Pass	7400	Pass	CLEA v1.06	LQM/ClEH 2014
Benzo(a)anthracene	<0.1 mg/kg	0.3	0.1	0.8	0.3	4	0.28	0.1	0	0.8	0.75	92	Pass	CLEA v1.06	LQM 2009	-	-	-	-	-	-	-	-	170	Pass	29	Pass	CLEA v1.06	LQM/ClEH 2014
Chrysene	<0.1 mg/kg	0.4	0.1	0.7	0.4	4	0.23	0.1	0	0.7	0.67	138	Pass	CLEA v1.06	LQM 2009	-	-	-	-	-	-	-	-	350	Pass	57	Pass	CLEA v1.06	LQM/ClEH 2014
Benzo(b)fluoranthene	<0.1 mg/kg	0.5	0.1	0.9	0.4	4	0.31	0.1	0	0.9	0.85	100	Pass	CLEA v1.06	LQM 2009	-	-	-	-	-	-	-	-	44	Pass	7.1	Pass	CLEA v1.06	LQM/ClEH 2014
Benzo(k)fluoranthene	<0.1 mg/kg	0.2	0.1	0.3	0.1	4	0.08	0.1	0	0.3	0.29	140	Pass	CLEA v1.06	LQM 2009	-	-	-	-	-	-	-	-	1200	Pass	190	Pass	CLEA v1.06	LQM/ClEH 2014
Benzo(a)pyrene	<0.1 mg/kg	0.4	0.1	0.6	0.2	4	0.22	0.1	0	0.6	0.60	14	Pass	CLEA v1.06	LQM 2009	77	Pass	10	Pass	21	Pass	CLEA v1.06	Defra 2014	35	Pass	5.7	Pass	CLEA v1.06	LQM/ClEH 2014
Indeno(1,2,3-cd)pyrene	<0.1 mg/kg	0.3	0.1	0.4	0.2	4	0.12	0.1	0	0.4	0.36	60	Pass	CLEA v1.06	LQM 2009	-	-	-	-	-	-	-	-	500	Pass	82	Pass	CLEA v1.06	LQM/ClEH 2014
Dibenz(ah)anthracene	<0.1 mg/kg	0.1	0.1	0.1	0.1	4	0.00	0.1	0	0.1	0.10	13	Pass	CLEA v1.06	LQM 2009	-	-	-	-	-	-	-	-	3.5	Pass	0.57	Pass	CLEA v1.06	LQM/ClEH 2014
Benzo(ghi)perylene	<0.1 mg/kg	0.3	0.1	0.3	0.1	4	0.11	0.1	0	0.3	0.34	650	Pass	CLEA v1.06	LQM 2009	-	-	-	-	-	-	-	-	3900	Pass	640	Pass	CLEA v1.06	LQM/ClEH 2014
Coronene	<0.1 mg/kg	0.1	0.1	0.1	0.1	4	0.00	0.1	0	0.1	0.10	1900	Pass	CLEA v1.06	LQM 2009	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Oily Waste PAHs	<1 mg/kg	2.0	1.0	3.5	1.6	4	1.07	1.0	2	3.5	3.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Dutch 10 PAHs	<1 mg/kg	2.4	1.0	5.3	1.9	4	1.86	1.0	3	5.3	5.30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total EPA-16 PAHs	<1.6 mg/kg	3.4	1.6	7.4	2.8	4	2.51	1.6	4	7.4	7.40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total WAC-17 PAHs	<1.7 mg/kg	3.4	1.7	7.4	2.8	4	2.49	1.7	4	7.4	7.40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BTEX																													
Benzene	<0.002 mg/kg			0.002	0.002	2	0.00	0.002	0	0.002	0.00	43.6	Pass	CLEA v1.06	SC050021	100	Pass	140	Pass	110	Pass	CLEA v1.06	Defra 2014	27	Pass	72	Pass	CLEA v1.06	LQM/ClEH 2014
Ethyl Benzene	<0.005 mg/kg			0.005	0.005	2	0.00	0.005	0	0.005	0.00	86000	Pass	CLEA v1.06	SC050021	-	-	-	-	-	-	-	-	56000	Pass	56000	Pass	CLEA v1.06	LQM/ClEH 2014
Xylene (o)	<0.002 mg/kg			0.002	0.002	2	0.00	0.002	0	0.002	0.00	25000	Pass	CLEA v1.06	SC050021	-	-	-	-	-	-	-	-	5700	Pass	24000	Pass	CLEA v1.06</	

APPENDIX H

Summary of Guidance for Classification of Soil as a Waste Material

Guidance for Classification of Soil for Off Site Disposal at a Landfill Site

Many site developments create a portion of excess soils and Made Ground which if not re-usable, are required to be disposed off-site at a suitably licensed landfill site. The regulations and associated guidance published by the Environment Agency is relatively complex and lengthy. This guidance provides a summary of the following documents which should be referred to when assessing soil (and common constituents found within Made Ground on remediation sites) for off-site disposal:

- Guidance for Waste destined for disposal in landfills: Interpretation of the Waste Acceptance Requirements of the Landfill (England and Wales) Regulations 2002 (as amended) (EA, 2004);
- Guidance on Sampling and Testing of Wastes to Meet Landfill Waste Acceptance Procedures (EA, April 2005);
- WM3 - Hazardous Waste: Interpretation of the Definition and Classification of Hazardous Wastes (EA, May 2015);
- European Regulation No 1272/2008 on Classification, Labelling and Packaging of substances 2015 (CLP 2015);
- Guidance on Waste Destined for Disposal in Landfill (EA, June 2006);
- Treatment of Non-hazardous wastes for Landfill (EA, February 2007).

It is important to distinguish between the waste classification system and the designation of materials as “suitable for use” on site. A material may be retained on site for an appropriate end use if that end-use is clearly designated and that a site-specific risk assessment ensures that it does not pose a risk to human health or controlled waters. However, if this material is excavated and sent for disposal, the material is then subject to waste management regulations and the two systems cannot be directly correlated. It is therefore important to note that classifying a material as hazardous (should it be excavated and become a waste) does not necessarily indicate that it might not be suitable to be kept on site for re-use. Separate guidance in the form of a Code of Practice (CL:AIRE Version 2, 2011) has been developed jointly between the development industry and the Environment Agency to provide best practice when assessing whether materials are wastes or not, and for determining when waste can cease to be waste for a particular use.

In accordance with the current waste regulations (or Landfill Directive, as they are more commonly known), from 30th October 2007 all waste materials produced from construction sites have to be pre-treated prior to disposal. Pre-treatment includes waste minimisation, recovery (e.g. separation of demolition waste to be used as hardcore) and separation of materials into different waste categories (e.g. separate inert waste from hazardous waste etc). Mixing of different waste types shall be avoided and intentional mixing of inert materials with hazardous waste to ‘dilute it’ and hence change its waste classification, is illegal.

The current waste regulations (based on the EU landfill directive) introduced a two tier classification system for waste materials, defining them as either being hazardous or non-hazardous. Landfills are licensed to take wastes based on a three tier classification system with the non-hazardous waste divided into two sub-categories:

- Non-Hazardous - inert;
- Non-Hazardous - non-hazardous;
- Hazardous.

Waste materials are categorised with a six figure numeric code in the European Waste Catalogue. Commonly found construction and demolition wastes including excavated soil from contaminated sites and Made Ground with their waste codes are summarised below (this is not a comprehensive list):

Waste Code	What is it?	Likely Waste Category–		
		Inert Waste	Non-Hazardous	Hazardous Waste
17 01 01 Concrete	Concrete, possibly with reinforcement (from Construction & Demolition)	✓		
17 01 02 Bricks		✓		
17 01 06* Mixtures of concrete, bricks, tiles & ceramics containing dangerous substances	These are not normally considered hazardous but if they are contaminated (e.g. by asbestos) then could be hazardous – see comment above			✓
17 01 07 Mixtures of concrete, bricks, tiles & ceramics other than those in 17 01 06	This is mixed inerts c.f. 17 09 04	✓		
17 05 03* soils and stones containing dangerous substances				✓
17 05 04 soils and stones other than those mentioned in 17 05 03	Soil and stones only (excluding top soil, peat, soil and stones from contaminated sites)	✓		
17 06 05* Construction materials containing asbestos	e.g. corrugated asbestos sheeting			✓
17 08 02 Gypsum-based construction materials other than those mentioned in 17 08 01	Plaster & plasterboard (although specific disposal requirements are required for high sulphate waste – see EA guidance ‘Understanding the Landfill Directive’ version 1.0 March 2010.		✓	
17 09 01* Construction & demolition wastes containing mercury				✓
17 09 02* Construction & demolition wastes containing PCBs	Waste with more than 50 mg/kg of PCB’s are hazardous			✓
17 09 03* Other mixed construction & demolition wastes containing dangerous substances	Broad range of potentially (see notes below – if asterix the waste is hazardous) hazardous wastes			✓
17 09 04 Mixed construction & demolition wastes other than those mentioned in 17 09 01, 17 09 02 & 17 09 03	Mixed inerts with soil, tarmac, cables, vegetation, plaster, etc. (this waste can only be considered inert if it passes the waste acceptance criteria identified in the regulations).	✓	✓	

Note: all wastes with an asterix code are hazardous regardless of whether they are mirror or absolute entries in the EWC list the decision to with regard to composition must come before applying the code for mirror entries.

Some materials are classified as Inert Waste based in its origin (e.g. 17 01 01 Concrete, or glass) without any requirement for laboratory chemical analysis.

However, most soils will require laboratory testing to confirm whether they are classified as Hazardous Waste. The protocol for assessing these materials and the appropriate threshold values is complicated and are set out in the Environment Agency's "Technical Guidance WM3 Hazardous Waste – Interpretation of the Definition and Classification of Hazardous Waste" (2015). If the test results for the waste indicates that it is not hazardous then further analysis of the waste is required to determine whether it is Inert Waste. If the waste does not meet the criteria for either Hazardous or Inert, then it is by default classified as Non-hazardous Waste.

As an alternative location to landfills for off-site disposal of inert and non-hazardous waste, there are a number of sites which have Waste Permit Exemptions that can accept certain categories of inert and non-hazardous wastes. Additionally some quarries can accept certain types of wastes to be used for quarry restoration material. For both alternatives to disposal at landfill sites the material still requires chemical testing as these sites have site specific acceptance criteria for wastes. It should also be noted that these types of site do not incur landfill tax which in the 2017/18 tax year is £2.70 for inactive waste (inert and some types of non-hazardous waste) and £86.10/Tonne for active waste (some types of non-hazardous waste and hazardous waste. Note that the Inland Revenue uses a different classification scheme for waste for tax purposes to the European Waste Classification scheme.

Waste Categorisation

The process of determining the category of wastes is a three stage process:

- Stage 1 – is the waste either Hazardous or Inert by definition without the requirement for chemical analysis (if it is then Stages 2 and 3 are not required);
- Stage 2 - Waste characterisation;
- Stage 3 - WAC classification.

Waste characterisation determines if a waste is hazardous or not. Excavated soil is characterised using a system based on the contaminants present and their hazardous properties. The system uses total concentrations of the contaminants. Thresholds (as a percentage of the waste) have been set for the various hazardous properties.

Fourteen hazardous properties together with other scenarios where material could cause a hazard have been defined:

- Hazardous properties: explosive, oxidising, highly flammable/flammable, irritant, harmful, toxic, carcinogenic, corrosive, infectious, toxic for reproduction, mutagenic and ecotoxic;
- Substances which can release toxic/very toxic gases in contact with water, acid or air;
- Substances which, after disposal, can yield another substance, e.g. a leachate, which possesses any of the above hazardous properties.

Some of the hazardous properties are sub-divided e.g. there are three categories of carcinogenic, mutagenic and toxic for reproduction substances. The hazardous properties were originally defined in the European Hazardous Waste Directive 91/689/EC. Should a waste contain a contaminant with one or more of the listed hazardous properties at a concentration equal to or above the threshold value for the particular

property, then the waste is hazardous. The hazardous properties of a wide range of chemicals are sourced from CLP 2015.

There are many reasons why waste soil is classified as being hazardous but the majority of reasons can be divided into the following four groups:

- Hydrocarbons – this is probably the most common reason for the hazardous classification of soils. For most soils hydrocarbon analysis will be required for both Polycyclic Aromatic Hydrocarbons (PAH) and speciated Petroleum Hydrocarbons (PHCs) but depending on the site's history other groups of organic contaminants may also be included in any analysis suite for soil samples;
- Metals – Particularly sites from former metal processing or mining sites and also some types of ash have metal concentrations that are sufficiently high to characterise materials requiring disposal as hazardous waste.
- Asbestos;
- Anions – e.g. sulphate in plasterboard (there are special disposal requirements for high sulphate waste and specific WAC requirements); it is possible that sulphate salts of metals and semi-metals could make the waste hazardous – the sulphate concentration could possibly be significant under H12, H13 and H14.

The characterisation of wastes with significant metal concentrations involves some processing of the analysis data. The chemical analysis results for inorganic substances are generally reported as total concentrations e.g. total lead, total arsenic, total sulphate etc. However, CLP 2015 deals with the hazardous properties of actual compounds e.g. lead sulphate, arsenic pentoxide, nickel carbonate. Therefore, the total metal results have to be converted into assessed chemical analysis results for the compound most likely to be present in the soil samples. For example, if the sample contains high total lead concentrations and high sulphate concentrations, then the lead is likely to be present in the soil as lead sulphate. The most likely compounds can often be determined from a desk study or previous site uses. If the site has been derelict for a number of years, consideration should be given as to whether water soluble compounds should or should not be chosen, as rainfall could have removed them from the soil (this does not apply if the soil has been taken from below under a concrete slab etc). Chemical knowledge and common sense needs to be used in choosing a suitable compound.

If no data is available, then a worst case scenario has to be assumed and the most hazardous compound likely to be present has to be chosen. For example, metal chromates (lead chromate, nickel chromate) are often the most hazardous compounds formed by many metals, but if the chromium concentrations in the soil are low, chromates are unlikely to be present. It should also be noted that for many of the hazard categories, the cumulative hazard from different compounds is added (e.g. add the concentrations of the copper, lead and zinc compounds together to assess the Hazard Category H14 Ecotoxicity).

If the results of the above assessment determine that the waste is hazardous, it must then be analysed for the Waste Acceptance Criteria (WAC) analysis contained within appropriate Environmental Permitting Regulations (this comprises mainly leachate but also analysis for TOC and Loss on ignition). WAC limit values have been set for the listed determinands. If any of the determinands exceed their limit value, the waste must be pre-treated to reduce concentrations to below the limit values before the waste may be disposed of at a landfill site licensed to take hazardous waste.

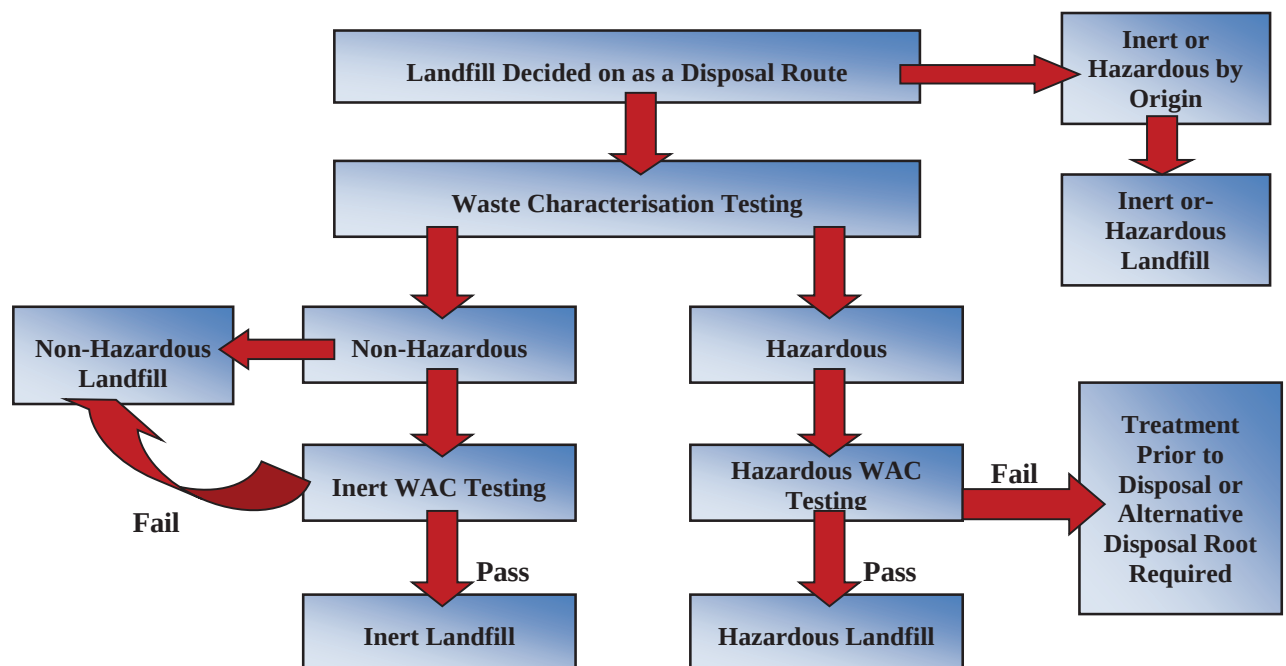
For waste classified as not being hazardous, then there are two options available. Currently, waste correctly characterised as not being hazardous may be disposed of without WAC testing to a non-hazardous landfill. Alternatively WAC testing for Inert Waste can be carried out (this is similar to the list for hazardous waste

with the addition of PAH's, BTEX and Mineral Oil). If the results pass the Inert WAC criteria it can be disposed of at an Inert Waste Landfill. If any of the WAC test results exceed the Inert WAC criteria the waste has to be disposed at a non-hazardous landfill. There are WAC limits for non-hazardous waste set for pH and TOC. If these two criteria are not met then the waste must be pre-treated so that it meets the criteria before it can be disposed.

If materials fail the WAC criteria they can be pre-treated on site or taken to a soil treatment centre for pre-treatment (such as at the facility run by Biffa at Risley near Warrington). Here the soil's hazardous properties may be reduced (e.g. by bioremediation of hydrocarbons).

It should be noted that in order to dispose of Hazardous Waste, the site must register as a producer of Hazardous Waste with the Environment Agency. When disposing of waste materials to landfill sites the appropriate Duty of Care Waste Transfer procedures must be followed.

Landfilled Waste Decision Tree



Landfill Tax

It should be noted that HM Revenue and Customs (HMRC) classify wastes for tax purposes using a different scheme to the three fold landfill EU Landfill Directive scheme (i.e. the hazardous, non-hazardous and inert). HMRC have a two-fold system for landfill tax. The Standard Landfill Tax is currently £86.10/T and applies to all wastes unless they qualify for the reduced rate of landfill tax of £2.70/T. The wastes that qualify for the reduced rate of Landfill Tax are set out in The Landfill Tax (Qualifying Material) Order 2011 with supplementary information on the interpretation of these regulations in HMRS "Notice LFT1 – A General Guide to Landfill Tax" (May 2012) and HMRC Briefing Notes 15/12 and 18/12.

APPENDIX I

Unforeseen Ground Contamination

Unforeseen Ground Contamination

There is the potential for areas of previously unexpected contamination to be present, as is the case with any “brownfield” site. Any significant quantities of asbestos, significant ashy soils, unusual, brightly coloured or significantly oily or odorous material should be considered in this category. If unexpected contamination is found the following procedures should be adhered to:

1. All site works at the position of the suspected contamination will cease.
2. A suitably trained geo-environmental specialist should assess the visual and olfactory observations of the condition of the ground and the extent of contamination and the Client and the Local Authority should be informed of the discovery. Should the contamination be likely to affect controlled waters the Environment Agency shall also be informed.
3. The suspected contaminated material will be investigated and tested appropriately in accordance with the assessed risks. The investigation works will be carried out in the presence of a suitably qualified geo-environmental engineer. The investigation works shall commence to recover samples for testing and, using visual and olfactory observations of the condition of the ground, delineate the area over which contaminated materials are present.
4. The unexpected contaminated material will either be left in situ or be stockpiled whilst testing is carried out and suitable assessments completed to determine whether the material can be re-used on site or requires to be disposed as appropriate.
5. Where the material is left in situ awaiting results it will be reburied or covered with plastic sheeting.
6. Where the potentially contaminated material is to be temporarily stockpiled it will either be placed either on a prepared surface of Glacial Till, or on 2000 gauge Visqueen sheeting (or other impermeable surface) and covered to prevent dust and odour emissions.
7. Any areas where unexpected visual or olfactory ground contamination will be surveyed, a photographic record kept and testing results incorporated into the Verification Report.
8. A photographic record will be made of relevant observations.
9. The testing suite will be determined by the independent geo-environmental specialist on the basis of visual and olfactory observations.
10. Test results will be compared against current assessment criteria suitable for the future use of the area of the site affected.
11. The results of the investigation and testing of any suspect unexpected contamination will be used to determine the relevant actions. After consultation with the Local Authority and if necessary the Environment Agency, materials should either be:
 - re-used in areas where test results indicate that it meets compliance targets so it can be reused without treatment; or
 - treatment of material on site to meet compliance targets so it can be reused; or
 - removal from site to a treatment centre or to a suitably licensed landfill or permitted treatment facility.
12. Verification Report will be produced for the work.

Asbestos

Asbestos cement products and asbestos fibres have not been encountered in the soils at the site, but based on the age of the Made Ground material containing asbestos could be expected to be encountered. If non-notifiable asbestos (e.g. chrysotile asbestos cement board) is encountered in excavations then it will be dealt with in accordance with the Control of Asbestos Regulations 2012 (CAR 2012) and the HSE's ACoP for asbestos (2013). Finding non-notifiable asbestos is a very common occurrence on brownfield sites and is a relatively low risk activity and can be dealt with as a matter of routine. Therefore it is not proposed that the Council will be notified but an appropriate record will be kept of confirmatory testing and disposal. This will be included in remediation verification reports.

If suspect notifiable asbestos is encountered then the Council and the HSE will be notified. An appropriate action plan will be agreed with the Council and the HSE in accordance with CAR 2012. The action plan will include the preparation of the Risk Assessment and Plan of Work in accordance with CAR and other statutory requirements including:

- Site mobilisation;
- Excavation methodology;
- Handling, movement and storage on site of excavation arisings;
- Any processing of excavation arisings containing ACMs;
- Movement and placement of arisings to final destination;
- Placing of cover system over soils with and ACMs remaining on site;
- Off-site disposal of ACMs;
- Licences;
- PPE & RPE;
- Dust and fibre monitoring.

Potential mitigation measures that would be required include:

- Site investigation and risk assessment;
- Removal or treatment of asbestos hotspots;
- Use of PPE and RPE by construction workers; and
- Compliance monitoring.

Unexpected Tanks

No buried underground fuel storage tanks have been encountered during the site investigation works; however, there remains a low risk that tanks are present on site. Should an underground tank be encountered, operations should cease in the area. Additionally there may be pipework associated with these tanks which could have oily residues. The following procedures are to be adhered to if tanks and pipework are identified:

1. All site works at the position of the tanks/pipework should stop.

2. A description of the tank should be made by the geo-environmental engineer including; condition and surround, along with visual and olfactory observations should any contents in the tank be apparent. A photographic record will also be made of relevant observations.
3. The tank's position and depth should be determined and marked on a plan of the site.
4. The independent geo-environmental engineer will inform Client and the Local Authority.
5. During the presence of the independent geo-environmental engineer, investigation works should be undertaken to obtain samples of any liquid or sludge contents and to establish dimensions of the tank.
6. Testing will be determined on the basis of visual and olfactory observations by independent geo-environmental engineer.
7. Test results will be compared against current assessment criteria and proposals for disposal of any contents determined in agreement with the appropriate Regulatory Parties.
8. Emptying the tank and disposal of contents to a suitable licenced disposal facility.
9. Degassing and removal of the tank by a suitably qualified contractor will be required, and a Naked Flame Certificate should be provided.
10. Once the tank has been emptied in accordance with the above proposals, it is to be removed for disposal to a licensed waste management facility. Copies of the relevant waste consignment notes are to be kept and included in the Verification Report.
11. Excavation and remediation of any contaminated soils around the tank will be carried out.
12. Samples of the base and sides of the resultant hole will be sampled and supervised by the independent geo-environmental engineer to confirm whether risks to human health or controlled waters.

All of the above information will be incorporated into the Verification Report and submitted to the regulatory parties, the Local Authority and the Environment Agency where groundwater may potentially have been impacted.



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