GEO-ENVIRONMENTAL REPORT
PROPOSED WASTE RECYCLING FACILITY, LLANTRISANT BUSINESS PARK

Prepared for:

Tom Pritchard Contracting Limited

April 2014

Report No. 12640

terrafirma

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REPORT TITLE	:	**Geo-Environmental Report – Proposed Waste Recycling Facility, Llantrisant Business Park, Llantrisant**
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PREPARED BY	:	..... **(Mr Mathew T. C. Lake)**
REVIEWED BY	:	..... **(Miss Louise J. Dow)**
APPROVED BY	:	..... **(Dr Gwyn C. Lake)**

Executive Summary

The site has remained unused until the early 1990's when evidence suggests the site was used as a landfill.

Geologically the site is underlain by the rocks of the Upper Coal Measures (Hughes Sandstone). Glaciofluvial Deposits overlie the solid geology. Made ground associated with landfilling is also present.

In order to confirm the shallow ground conditions a site investigation was carried out comprising ten trial pits. The ground conditions encountered within the trial pits comprised of a Soft to firm light grey gravelly CLAY/ Loose to medium dense light brown clayey GRAVEL with inclusions of red brick to depths of between 0.8m and greater than 2m.

Six representative disturbed representative samples were tested for selected elements/compounds. No contamination was noted at the site in relation to commercial guidelines.

The risk to the aquatic environment was also considered to be low as due to the inert nature of the made ground leachate levels would also be low.

The risk form ground gas was also considered to be low due to the fact that no biodegradable materials were encountered. However, as a precautionary measure, it was recommended that for any future covered buildings that the recommendations for Gas Characteristic 2 should be incorporated in the design of any structures.

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SECTION 1 Introduction and Proposed Development

Tom Pritchard Contracting Limited (the Client) is proposing a new waste recycling station to be constructed on land adjacent to Glanmychydd Fach Farmhouse, Llantrisant.

Terra Firma (Wales) Limited have been commissioned to carry out a geo-environmental assessment of the above site.

Planabuild Limited are the Civil and Structural Engineers for the project.

The main objectives of the geo-environmental assessment programme were to:

- Identify the potential environmental liabilities at the site associated with any soil and groundwater contamination from past site uses.
- Provide a summary of the environmental conditions at the site, together with any necessary remediation works to render the site fit for its intended use.
- Provide recommendations with regard to any other geo-environmental aspects pertaining to the development such as methane and radon gas emissions.

The main objectives of the geo-environmental site investigation were to:

- Determine the type, strength and bearing characteristics of the shallow superficial and underlying solid geology.
- Provide recommendations for a suitable and economic foundation/floor slab solution for the development.
- Provide recommendations with regard to any other geo-technical aspects pertaining to the development.

In order to achieve the above objectives, Terra Firma (Wales) Limited carried out an assessment programme including a review of existing data, followed by a field investigation to confirm the composition of any waste present on site and also to collect and analyse soil samples from selected locations around the site.

1.1 Limitations and Exceptions of Investigation

Tom Pritchard Contracting Limited has requested that a Geo-environmental Site Assessment (GSA) be performed in order to determine if contamination is present beneath the site, the affect if any of radon/landfill gas and to provide remedial recommendation (if necessary) for the safe development of the site.

The GSA was conducted and this report has been prepared for the sole internal reliance of Tom Pritchard Contracting Limited and its design and construction team. This report shall not be relied upon or transferred to any other parties without the express written authorisation of Terra Firma (Wales) Limited. If an unauthorised third party comes into possession of this report they rely on it at their peril and the authors owe them no duty of care and skill.

The report represents the findings and opinions of experienced geo-environmental consultants. Terra Firma (Wales) Limited does not provide legal advice and the advice of lawyers may also be required.

The subsurface geological profiles, any contamination and other plots are generalised by necessity and have been based on the information found at the locations of the exploratory holes and depths sampled and tested.

The site investigation was specifically limited by the following site constraints:

- water main crossing the site

SECTION 2 Review of Existing Data

2.1 Physical Setting, Current Use and Site Conditions

The site entrance is located off Pantybrad Road at a National Grid Reference of 304125 185122. The location of the site is shown in **Figure 2.1**.

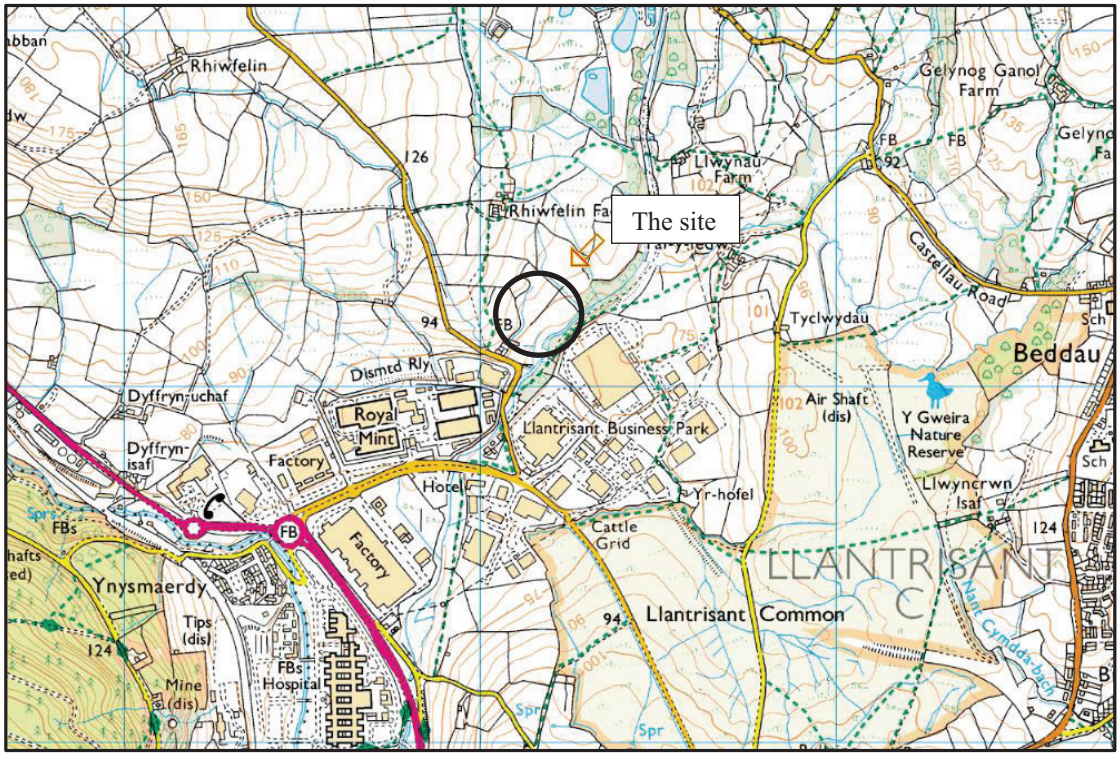

Figure 2.1 Site Location

The site is irregular in shape and covers an area of 2.33 hectares. The site is located in a large field. The south eastern boundary is formed by the Nant Muchudd watercourse. The remaining boundaries of the site are located within the field in which the site is located.

The topography of the site slopes down in a south easterly direction towards the Nant Muchudd watercourse.

2.2 Site History

An Envirocheck history report was obtained for the site. The full report is presented in **Annex A**. The most relevant editions are summarised below.

1875
The 1887 edition shows the site to be located across a number of fields. A river runs along the south eastern boundary of the site. There is a small building shown in the south western corner of the site. A small stream runs along the northern most boundary of the site. An old lime kiln is shown 60m south of the site.

1900 and 1919
The 1900 map shows a rail line which runs on the southernmost side of the river south of the site. There are no changes to the site. A trial shaft is shown 60m south of the site.

2.2 Site History (Continued)

1940, 1961 and 1978
The 1940, 1961 and 1978 editions show no significant change to the site. The railway previously shown is now disused. Development has taken place 70m south of the site, mainly consisting of industrial units.

1990
The 1990 map now shows marshy ground in the northern part of the site.

2006 and 2013
The 2006 and 2013 editions show no significant change to the site or surrounding area.

2.3 Geology

The 1:50000-scale geological map of the area (Sheet 249 solid and drift editions) show the site to be underlain by the Hughes Member (Pennant Sandstone Formation) of the Carboniferous Period. These rocks generally consist of Mudstone, Siltstone and Sandstone.

Superficial deposits in the form of Glaciofluvial Deposits consisting of Sand and Gravel are shown to overly the solid geology.

Some made ground is expected to overlie the superficial deposits.

2.4 Hydrology

Surface and perched groundwater flows from the site are likely to be in the direction of the Nant Muchudd watercourse, which flows south. Groundwater is likely to form part of the base flow of the watercourse.

2.5 Environment Agency Information

The 'What's in your back yard' feature on the Environment Agency website was consulted for information on the following:

Hydrogeology
According to the Environment Agencies Groundwater Protection Policy, the geology of the area is classed as a Secondary A Aquifer. Superficial deposits are not classified at the site.

Pollution
No incidents of pollution are noted within 400m of the site.

Landfill Records
The site itself is noted as a historic landfill. The site last received waste on the 10th January 1997. There is records of the site receiving inert and industrial waste.

Flooding
The site is not shown to be at risk of flooding, but a watercourse locates along the margin.

Groundwater Source Protection Zones
The site does not locate within a groundwater source protection zone.

SECTION 3 Preliminary Risk Assessment

The following sub-sections detail a preliminary risk assessment that is based on the desk study information.

3.1 General

The contaminated land regime is set out in Part IIA of the Environmental Protection Act (EPA) 1990 and was introduced on the 1st April 2000 in England and 1st July 2001 in Wales.

Part IIA was introduced to achieve two aims:

(1) The identification of contaminated land
(2) The remediation of contaminated land that poses an unacceptable risk to human health and/or the environment

Under Part IIA the statutory definition of 'contaminated land' is:

"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."

For land to be classified as 'Contaminated Land' there must be a '**pollutant linkage'**. A pollutant linkage requires three essential elements:

(1) A **CONTAMINANT** (hazard) - a substance that is in, on or under the land and has the potential to cause harm or to cause pollution of **controlled waters**

(2) A **RECEPTOR** (target) - something which could be adversely affected by a contaminant

(3) A **PATHWAY** – a route or means which either allows the contaminant to cause significant harm to that receptor, or that there is a significant possibility of such harm being caused to the receptor, or that pollution of controlled waters is being or likely to be caused.

The term 'Risk' is widely used in different contexts and situations, but a prescriptive definition is given by the Guidelines for Environmental Risk Assessment and Management (DEFRA *et al*, 2000):

'Risk is a combination of the probability, or frequency, of occurrence of a defined hazard and the magnitude of the consequences of the occurrence'.

A 'Hazard' is defined as '*a property or situation that in particular circumstances could lead to harm'.*

The classification of consequences and probability and determining the risk category are defined in the following sections.

3.2 Classification of Consequence

Table 3.1 Classification of Consequence	
Classification	**Definition**
Severe	• Short term (acute) risk to human health likely to result in significant harm • Short term risk to controlled waters • Catastrophic damage to buildings/structures • Short term risk to an ecosystem or organism within the particular ecosystem
Medium	• Chronic damage to human health (long term risk) • Pollution of a sensitive water resource • A significant change in an ecosystem or organism within the ecosystem
Mild	• Pollution of non-sensitive water resources • Significant damage to buildings/structures
Negligible	• Harm (not necessarily significant) which may result in financial loss • Non-permanent health effects to humans (easily prevented by PPE for example) • Easily repairable effects of structural (building) damage

3.3 Classification of Probability

Table 3.2 Classification of Probability	
Classification	**Definition**
High	• There is a complete pollution linkage and an event appears very likely to occur in the short term and is inevitable in the long term. • Evidence of harm to the receptor
Medium	• There is a complete pollution linkage which means that is it probable that an event will occur • The event is not inevitable but possible in short term and likely in the long term
Low	• There is a complete pollution linkage and circumstances are possible under which an event could occur • It is not certain that an event will occur in the long term, and it is less likely to occur in the short term
Negligible	• There is a complete pollution linkage but circumstances are such that it is improbable that an event would occur even in the long term

3.4 Risk Assessment Matrix

By comparing the consequences of a risk and the probability of the risk of a pollution linkage, the likely risk category can be determined as shown in Table 3.3 below.

Table 3.3 Risk Assessment Matrix

Increasing acceptability ↘		Consequence			
		Severe	**Medium**	**Mild**	**Negligible**
Probability	**High**	High	High	Medium / Low	Near zero
	Medium	High	Medium	Low	Near zero
	Low	High / medium	Medium / Low	Low	Near zero
	Negligible	High / medium / Low	Medium / Low	Low	Near zero

High Risk
There is a high probability that severe harm could risk a receptor, or there is evidence that a receptor is being harmed. The risk if realised is likely to result in liability, and urgent investigation or remediation will be required.

Medium Risk
It is probable that harm will arise to a receptor. However it is relatively unlikely that such harm would be severe, or if harm does occur the harm is likely to be relatively mild. Investigation will be required to determine the liability, and some remedial works may be required in the long term.

Low Risk
It is possible that harm may arise to a receptor, but it is likely that the harm would be mild.

Near Zero Risk
There is a very low risk of harm to the receptor. In the event of harm being realised the harm is not likely to be severe.

The following sub-sections detail a preliminary risk assessment, based upon the desk study information.

3.5 Potential Sources of Contamination

The potential contamination beneath the site, whether in the matrix of soil or any groundwater will be related to the sites past use.

The site is has been mainly agricultural throughout the years researched.

Significant contamination, is therefore, not expected over the majority of the site. However, landfilling has occurred on site which could pose a risk in regards to potential low level contamination and ground gas.

3.6 Potential Receptors

The potential receptors of any contamination are taken to be:

During Construction

- Construction workers
- Neighbouring site users
- Passers-by
- The Aquatic Environment - Surface waters, perched groundwater, rivers

Following Construction

- Site End Users - residents, visitors, maintenance contractors
- The Aquatic Environment - Surface waters, perched groundwater, watercourses.
- Building Materials - these are potentially at risk from aggressive ground conditions involving sulphates, sulphides, magnesium ions, ammonium ions, carbon dioxide, chloride ions and phenols.
- Vegetation upon the site is potentially at risk from phytotoxic contaminants.

3.7 Potential Pollution Linkages

The potential pollution linkages relating to human health and the protection of the aquatic environment on the site are as follow:

- Ingestion of soil and soil dust
- Ingestion of home grown vegetables
- Inhalation of soil dust, both indoors and outdoors
- Dermal contact with soil and soil dust
- Inhalation of radon gas
- Indoor migration of landfill gas/ground gas leading to potential risk of explosion
- Surface water runoff
- Leaching into the groundwater
- Groundwater transport
- Permeation of water pipes - Organic contaminants have the potential to be adsorbed into plastic water pipes which may be used for drinking water supply. Toxic and corrosive contaminants may also enter the potable water source.

3.8 Qualitative Preliminary Risk Assessment

A Qualitative Preliminary Risk Assessment (QPRA) aims to make initial assumptions about potential risks posed towards the human health and to the aquatic environment during all stages of the development. Where it is assumed that a potential pollution pathway exists, there is a potential source, a potential receptor and a likely pathway, which links the two. The QPRA can be refined into a qualitative and quantitative risk assessment once the site investigation and laboratory soil chemical testing/environmental assessment has been undertaken. The risk assessment is presented in Table 3.4 on the following page.

3.8 Qualitative Preliminary Risk Assessment (Continued)

Table 3.4 Preliminary Risk Assessment

Potential Source	Potential Pathway	Potential Target	Preliminary Risk Assessment
Made Ground and contaminated soils	Ingestion Dermal contact Inhalation of soil/dust	Construction workers Site end Users	Site is a historic Landfill **High Risk**
Made ground and contaminated soils	Surface runoff Leaching Groundwater transport	Groundwater/surface water	Secondary A Aquifer The site does not lie within a SPZ **Medium Risk**
Made ground and contaminated soils	Surface runoff Leaching Groundwater transport	Building Materials	High levels of sulphate can damage building materials. **Low Risk**
Landfill Gas	Inhalation	Site end users Construction workers Neighbouring site users/passersby	Site is a historic Landfill **High Risk**

3.9 Preliminary Site Conceptual Model

A preliminary site conceptual model is presented in **Figure 3.1** below. It should be noted that the SCM is generalised and not to scale.

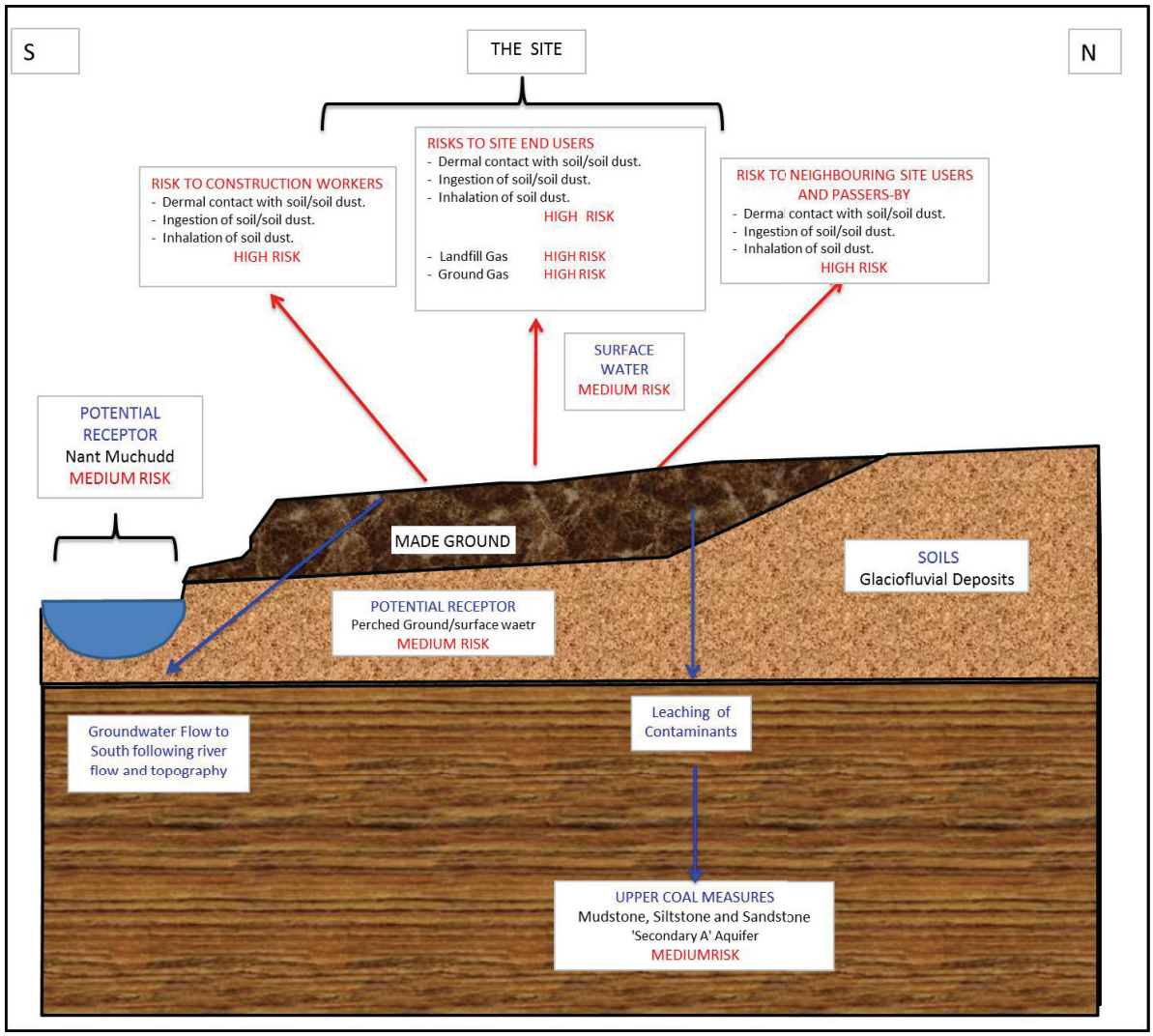

Figure 3.1 Preliminary Site Conceptual Model

SECTION 4 Field Investigation

4.1 Site Works

A geo-environmental site investigation was undertaken in accordance with BS5930:1999, during March 2014. The investigation comprised the excavation of ten trial pits, and chemical testing.

The trial pits were excavated using a tracked 360^{o} excavator.

The fieldworks were supervised by Terra Firma (Wales) Limited, who also logged the trial pits to the requirements of BS5930: 1999.

The detailed trial pit logs are presented in **Annex B**. The locations are presented in **Drawing 01**.

4.2 Exploratory Strategy

It is considered that the number and spacing of trial pits was adequate to provide a general characterisation of the waste present at the site.

4.3 Sampling Regime

During the intrusive investigation small disturbed soil samples were collected. The sample locations and depths are illustrated in the **Table 4.1**.

Table 4.1 Sample Descriptions

Sample No.	Depth (m)	MCERTS Description
TP3	0.50	Brown gravelly sandy CLAY with odd rootlets
TP3	1.2	Dark brown clayey gravelly SAND
TP4	0.5	Dark brown gravelly sandy CLAY with numerous rootlets
TP7	1.00	Brown gravelly sandy CLAY
TP8	0.50	Brown dark brown gravelly sandy CLAY with odd rootlets
TP9	0.5	Brown gravelly sandy CLAY with odd rootlets

4.4 Quality Assurance

Care was taken to ensure that sampling quality assurance occurred during site works. This included the following measures:

- The use of nitrile gloves at each sampling point.
- Stainless steel shovels were used to collect soil samples. The tool was cleaned with distilled water between each sample point.
- Soil samples were stored at a temperature below 4 degrees.
- No head space was left in sample containers.

4.5 Ground Conditions

The shallow ground conditions encountered by the exploratory holes can in general be summarised as shown in **Table 4.2**.

Table 4.2 Summary of Ground Conditions

Depth (m)			Thickness (m)	Stratum
GL	-	0.8/>1.8	0.8/-	**MADE GROUND**. Soft to firm light grey gravelly **CLAY**/ Loose to medium dense light brown clayey **GRAVEL** with inclusions of red brick
0.8	-	> 2.0	-	Soft orange brown silty gravelly **CLAY**

No Groundwater was encountered.

4.6 Laboratory Chemical Testing

During the current site works a number of soil samples were taken and despatched to the laboratories of Derwentside Environmental Testing Services for laboratory chemical testing.

The following chemical tests were undertaken:

4.6.1 Soils

Metals	**Semi Metals/Non-Metals**	**Inorganic Chemicals**	**Others**
Cadmium	Arsenic	Cyanide	pH
Chromium	Selenium	Sulphate	Asbestos
Lead		Sulphide	
Mercury			
Nickel			
Zinc			
Copper			

Organic Chemicals
Phenol
Polyaromatic Hydrocarbons (PAH)

The results of the above chemical tests for soil are presented in **Annex C.**

4.7 Soil Plasticity Testing

During the investigation three samples of the in-situ superficial clay was taken and submitted for plasticity testing. The test results are presented in **Annex D**. The sample from TP1 at 1.5m was found to be of very high plasticity. The sample taken from TP6 at 1.2m was found to be of intermediate plasticity. The sample taken from TP9 at 1.0m was found to be of high plasticity. In line with the NHBC (Chapter 4.2), the samples was calculated as having a modified plasticity indices of 13.5%, 23% and 19%. Soils with an index value of 20-40% are classified as having a medium volume change potential. Values below this are deemed to have a low shrinkage potential.

SECTION 5 Risk Assessment and Evaluation of Analytical Results

5.1 Risk Assessment

5.1.1 Introduction

The results obtained from the investigation, which are discussed in detail in Section 5.2, were used to conduct an environmental risk assessment for the site. The risk assessment aimed to:

- Identify sensitive receptors
- Determine pathways for contaminant migration to the receptors
- Estimate contaminant impact on receptors
- Establish whether remedial action is required
- Calculate remediation target levels if required

The future use of the site i.e. whether it is to be used for residential or commercial purposes has an impact on any risk assessment.

In this case commercial guidelines are appropriate.

5.1.2 Methodology

Environmental risk assessment evaluates the risk to receptors via an analysis of the 'source-pathway-target' linkage. In order for a risk to be present, there must be a contaminant source capable of causing a health risk, a vulnerable receptor, and a pathway linking the two.

This sort of risk assessment is usually conducted using a tiered approach. Tier 1 consists of a comparison of the analytical results obtained from the site investigation with Soil Guideline Values (SGV's) specific to the type of development obtained from The Environment Agency Contaminated Land Exposure Assessment (CLEA) Guidelines.

Where SGV values are not available reference has been made to or Generic Assessment Criteria (GAC) provided by Land Quality Management Limited (LQM) and the Chartered Institute of Environmental Health (CIEH).

Should Tier 1 levels be exceeded, a choice is made either to remediate the site to conservative Tier 1 levels, or proceed to Tier 2. Tier 2 makes use of site-specific data to evaluate acceptable concentrations of chemicals for the particular conditions present at the site.

At each tier, the amount and detail of investigation work increases as more site-specific data are needed to refine the characterisation of the site. Conversely, as site conditions are better understood, a more site-specific remediation strategy can be determined.

For Tier 1, the site itself is considered to be the receptor. Therefore, attenuation of contaminants between the source and receptor is not considered.

A summary of the chemical test results which include the regulatory SGVs or GACs used in the Tier 1 assessment is given in the tables on the following pages.

5.1.3 Sources

The sources of contamination considered in the risk assessment are taken to be concentrations of chemicals beneath the site.

The made ground at the site is considered the source of potential contamination, but the risk assessment does not take into account the origins of the chemicals.

5.1.4 Pathways

The various pathways considered in the risk assessment are given below:

- Direct contact/inhalation/ingestion of affected superficial soils, up to 1.0m in depth
- Wind born dust from affected superficial soils
- Leaching from soils to groundwater and surface water
- Groundwater and surface water transport

5.1.5 Potential Receptors

Potential receptors include site workers, future on site users and visitors, businesses and residents in the area surrounding the site, surface waters, persons who may come into contact with water in the vicinity of the site, and aquatic life within these waters.

5.2 Evaluation of Analytical Results

5.2.1 Soils

For Tier 1, the site itself is considered to be the receptor. Therefore, attenuation of contaminants between the source and receptor is not considered.

A summary of the chemical test results which include the regulatory Soil Guideline Values (SGV's) /Generic Assessment Criteria (GAC) used in the Tier 1 assessment are given in Table 5.1 on the following page:

5.2.1 **Soils** (Continued)

Table 5.1 Summary of Soil Chemical Test Results Standard Suite

Substance	SGV/ GAC (mg/kg)	Source	Measured Concentrations of Tested Substances (mg/kg)		95% UCL	Number of exceedences
			Minimum	Maximum		
Arsenic	640	CLEA	7.9	12	8.49	0
Cadmium	230	CLEA	0.5	0.7	0.58	0
Chromium III	30400	CIEH	20	28	23.44	0
Chromium	30400	CLEA	20	28	23.44	0
Hexavalent Chromium	35	CIEH	<1.0	<1.0	0.90	0
Copper	71700	CLEA	16	30	19.07	0
Lead	750	CLEA	15	31	30.00	0
Mercury	3600	CLEA	<0.05	0.17	0.08	0
Nickel	1800	CLEA	17	24	18.60	0
Selenium	13000	CLEA	<0.5	<0.5	0.45	0
Zinc	665000	CIEH	40	83	57.62	0
Cyanide total	480	CLEA	<0.1	0.2	0.13	0
Organic matter	-	-	1.7	5.7	3.22	0
Total Sulphate as SO4	2400	BRE	300	500	340	0
pH	-	-	7.5	8.9	7.34	0
PAH	*	-	<1.6	37	13.92	-
Phenol – Monohydric	3200	CLEA	<0.3	<0.3	<0.3	0

Notes:

- CLEA - Soil Guideline Values for residential development
- CIEH - Generic Assessment Criteria for a commercial setting, developed as Land Quality Management by the Chartered Institute of Environmental Health
- BRE - British Research Establishment (buried concrete risk assessment only, not human health related)
- A total of six samples were tested for all substances apart from asbestos
- Three samples were tested for asbestos
- *See speciated PAH results

5.2.1 **Soils** (Continued)

Table 5.2 Summary of Soil Chemical Test Results Speciated Polycyclic Aromatic Hydrocarbons

Substance	GAC (mg/kg)	Source	Measured Concentrations of Tested Substances (mg/kg)		95% UCL	Number of exceedences
			Minimum	Maximum		
Acenaphthene	85000	LQM/CIEH	<0.1	0.7	0.27	0
Acenaphthylene	84000	LQM/CIEH	<0.1	0.2	0.11	0
Anthracene	530000	LQM/CIEH	<0.1	0.8	0.31	0
Benzo(a)anthracene	90	LQM/CIEH	<0.1	3.3	1.25	0
Benzo(a)pyrene	14	LQM/CIEH	<0.1	3.8	1.44	0
Benzo(b)fluoranthene	100	LQM/CIEH	<0.1	3.4	1.27	0
Benzo(k)fluoranthene	140	LQM/CIEH	<0.1	1.6	0.61	0
Benzo(g,h,i)perylene	650	LQM/CIEH	<0.1	2.4	0.91	0
Chrysene	140	LQM/CIEH	<0.1	3.8	1.42	0
Dibenzo(a,h)anthracene	13	LQM/CIEH	<0.1	0.7	0.35	0
Fluoranthene	23000	LQM/CIEH	<0.1	5.4	2.00	0
Fluorene	64000	LQM/CIEH	<0.1	0.6	0.24	0
Indeno(1,2,3-c,d)pyrene	60	LQM/CIEH	<0.1	2.4	0.90	0
Naphthalene	200	LQM/CIEH	<0.1	0.2	0.11	0
Phenanthrene	22000	LQM/CIEH	<0.1	3.1	1.18	0
Pyrene	54000	LQM/CIEH	<0.1	4.5	1.69	0

Notes:

- CIEH - Chartered Institute of Environmental Health Generic Assessment Criteria for a commercial development
- Six samples was tested for Speciated PAH
- PAH - Polycyclic Aromatic Hydrocarbons

5.3 Contaminants of Concern in Soils

Contaminants of concern are those whose measured concentrations are found to be above the relevant Tier 1 CLEA Soil Guideline Value, CIEH Generic Assessment Criteria or laboratory detection limits.

All of the substances tested for were found to be below the Tier 1 threshold values (commercial).

SECTION 6 Quantitative Risk Assessment/Mitigation Measures

The following risk assessment and mitigation measures are based upon information compiled in the desk study, site investigation and the chemical test results.

6.1 Site Summary

The site entrance is located off Pantybrad Road at a National Grid Reference of 304125 185122.

The site is irregular in shape and covers an area of 2.33 hectares. The site is located in a large field. The south eastern boundary is formed by the Nant Muchudd watercourse. The remaining boundaries of the site are located within the field in which the site is located.

The topography of the site slopes down in a south easterly direction towards the Nant Muchudd watercourse.

6.2 Risks to Human Health

The site has been assessed using Human Health Guidelines for commercial use.

Chemical testing of soil samples revealed no exceedences in any contaminant tested for.

A site risk assessment is presented below and considers the following receptors/targets:

- Future Site Occupiers
- Site Visitors/Passers-by and neighbours during construction phase
- Construction workers

The potential routes of exposure (pathway) considered are:

- Ingestion of soil
- Ingestion of soil dust
- Dermal contact with soil/dust
- Inhalation of fugitive soil

6.2 Risks to Human Health (Continued)

A Qualitative and Quantitative Risk Assessment is presented in the following table.

Table 6.1 - Human Health Risk Assessment

Source	Pathway	Target	Risk Assessment	Mitigation Measures
In-Situ Soils	Dermal contact with soil/dust Inhalation of soil/dust/vapours Ingestion of soil/dust	Construction workers	**Low risk** to construction workers involved in excavation phase of development	COSHH assessment and good level of PPE/ hygiene by site workers/ staff; dust suppression measures if required.
	Inhalation of fugitive soil dust/vapours Ingestion of soil dust Dermal contact with soil dust	Passersby, neighbouring site occupants	**Low risk** during construction phase	The site should be managed well including screening and dust suppression measures if required
	Dermal contact with soil dust Inhalation of soil/dust Ingestion of soil/dust/vegetation	Site end users – residents and visitors	**Low risk** to future site users from contamination.	Site will be capped with hardstanding removing pathway
Landfill /Ground Gas	Inhalation of gas Explosions	Site end users	**Low Risk** to future site users	Waste was recovered as inert fill with no biodegradable materials and unlikely to produce significant gas

During construction phases, potential human health risks should be mitigated by:

- COSHH Assessment and good standards of site hygiene, PPE etc;
- Appropriate H&S instructions being in place to cover the above;

It should be noted that the appointed contractor should provide Method Statements and Risk Assessments to deal with these matters.

If during the development materials are encountered that are significantly different to those encountered in the investigation, the occurrence should be reported to the Engineer and appropriate action taken prior to continuing with the works.

6.3 Risks to the Aquatic Environment

The chemical test results have shown low levels of the determinants tested for. Leachate levels will also be similarly low.

In addition, the site will be capped with hard standing, reducing infiltration and the potential for leaching of contaminants.

There should therefore be no risk to the aquatic environment.

6.4 Assessment of the Risk from Ground Gas

It is understood that that development will not consist of any covered buildings other than a gate house. The type of development combined with the lack of biodegradable materials in the made ground makes the potential risk from ground gas negligible.

However, as a precaution it is recommended that for any covered buildings to be constructed on site that Gas Characteristic Situation 2 is used and the recommended measures incorporated for the future buildings.

Such measures will include the use of a methane membrane and underfloor venting.

6.4 Refined Site Conceptual Model

The site conceptual model (SCM) is presented in **Figure 6.1** below. It should be noted that the SCM is generalised and not to scale.

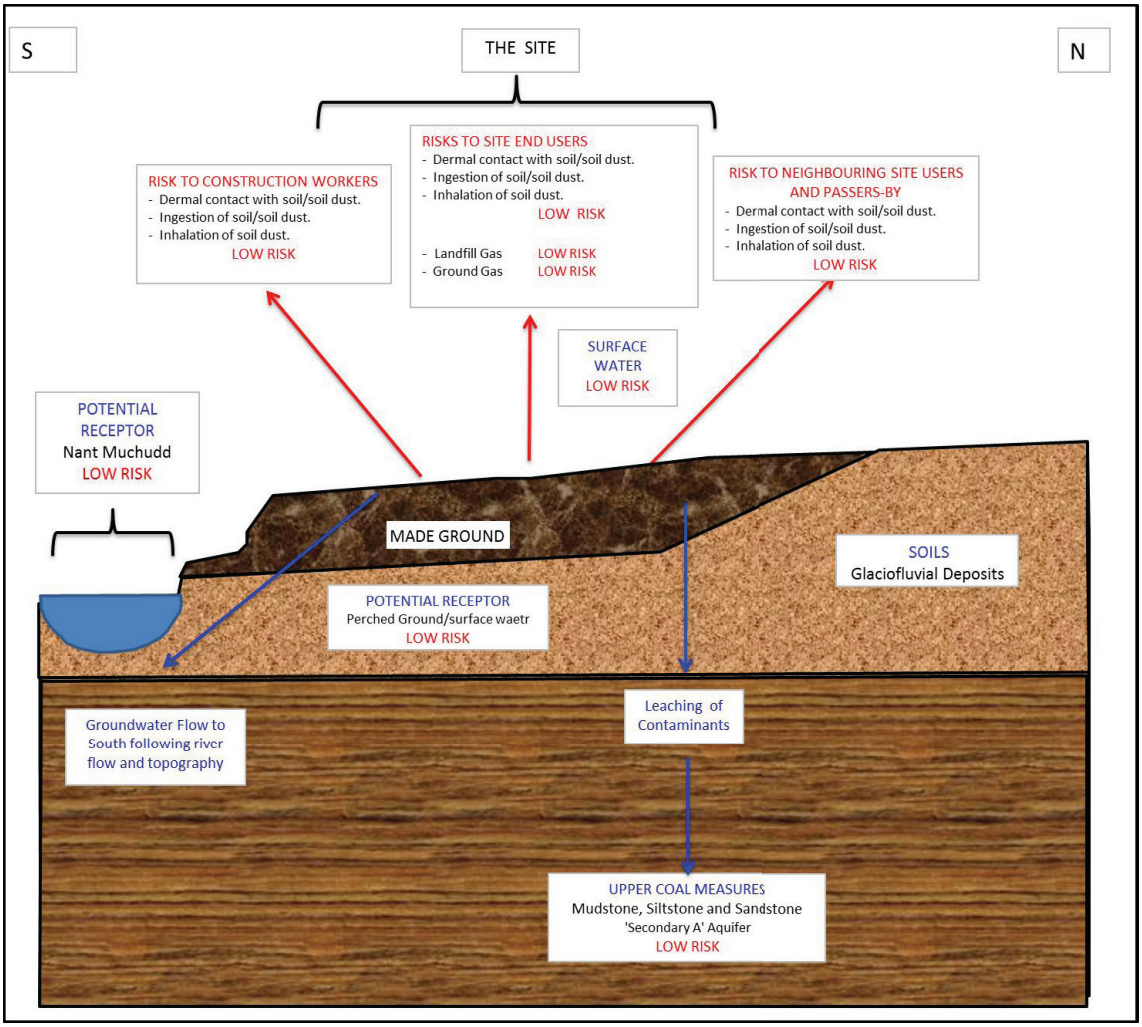

Figure 6.1 Final Site Conceptual Model