ZAMPELL HOLDINGS
c/o ENVIRONMENTAL ESSENTIALS LTD
ENVIRONMENTAL ASSESSMENT REPORT
VULCAN REFRACTORIES, CHEADLE
MAY 2011

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c/o Environmental Essentials Ltd
Environmental Assessment Report
Vulcan Refractories, Cheadle
May 2011

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Date: May 2011
Reference: VS/PJE/J-B0296.00 (R01)
Status: Final

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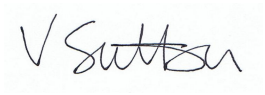
Client:	Zampell Holdings c/o Environmental Essentials Ltd
Site Name:	Vulcan Refractories, Cheadle
Document:	Environmental Assessment Report
Reference:	VS/PJE/J-B0296.00 (R01)
Date:	May 2011
Status:	Final

Originated:	
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CONTENTS

A. FACTUAL INFORMATION 1

1.0 INTRODUCTION 1

2.0 THE SITE 3
2.1 Location & Access 3
2.2 Site Description 3

3.0 DESK STUDY 5
3.1 Sources of Information 5
3.2 Site History 5
3.3 Geology, Hydrogeology and Hydrology 6
3.4 Environmental Considerations 7
3.5 Radon 8
3.6 Mineral Workings 9

4.0 PREMILINARY CONCEPTUAL SITE MODEL 10
4.1 Potential Sources of Contamination 10
4.2 Receptors of Contamination and Migration Pathways 10
4.3 Source-Pathway-Receptors Relationships 12

5.0 INVESTIGATION METHODOLOGY 13
5.1 Objectives 13
5.2 Clearance of Underground Services 13
5.3 Site Works 13
5.4 Chemical Laboratory Testing 13
5.5 Gas/Groundwater Monitoring 14

6.0 RESULTS OF INVESTIGATION 15
6.1 Strata Encountered 15
6.2 Groundwater Observations 15
6.3 Chemical Testing - Soils 16
6.4 Chemical Testing – Groundwater/Surface Water 17
6.5 Water Soluble Sulphate and pH Testing 18
6.6 Gas Monitoring 18

B. ASSESSMENT & RECOMMENDATIONS 20

7.0 INTRODUCTION 20

8.0 ENVIRONMENTAL ASSESSMENT 22
8.1 Soil Contamination Summary 22
8.2 Risk Assessments 23
8.3 Ground Gases 23
8.4 pH and Water Soluble Sulphate 24

9.0 RECOMMENDATIONS 25

DRAWINGS

J-B0296.00/501 Site Location Plan
J-B0296.00/502 Conceptual Site Model
J-B0296.00/503 Exploratory Hole Location Plan

APPENDICES

APPENDIX A Historical Maps
APPENDIX B Environmental Database Report
APPENDIX C Coal Authority Report
APPENDIX D Exploratory Hole Records
APPENDIX E Contamination Test Results
APPENDIX F Gas/Groundwater Monitoring Results

A. FACTUAL INFORMATION

1.0 INTRODUCTION

1.1 This report describes an Environmental Assessment Report undertaken for Zampell Holdings commissioned on their behalf by Environmental Essentials Ltd on a site at Vulcan Refractories, Cheadle.

1.2 This investigation has been carried out on the assumption that the site is to remain as Vulcan Refractories, and that no redevelopment of the site is to be undertaken.

1.3 The objectives of the investigation were to obtain information relating to the ground and groundwater conditions at the site in relation to the potential environmental liabilities of the site.

1.4 This report has been prepared by Opus with all reasonable skill, care and diligence within the terms of the Contract with The Client **(Zampell Holdings)**, and taking account of the information made available by The Client, as well as the manpower and resources devoted to it by agreement with the Client. Opus disclaims any responsibility to The Client and others in respect of any matters outside the scope of the above Contract.

1.5 This report has been produced on behalf of The Client and no responsibility is accepted to any Third Party for all or any part. This report should not be relied upon or transferred to any other parties without the express written authorisation of Opus. If any unauthorised Third Party comes into possession of this report, they rely on it at their own risk and the authors owe them no duty of care or skill.

1.6 The findings and opinions conveyed via the desk study section of this report are based on information obtained from a variety of sources, as detailed, which Opus believes are reliable. Nevertheless, Opus cannot and does not guarantee the authenticity or reliability of the information it has relied upon from these sources.

1.7 Whilst this report may express an opinion on the possible configuration of strata, contaminants or gases between or beyond exploratory hole positions or on the possible presence of features based on either visual, verbal or published evidence, this is for guidance only, and no liability can be accepted for its accuracy.

1.8 The comments on groundwater are based on observations made at the time of the investigation. It should be noted, however, that groundwater levels may vary from those reported due to seasonal or other effects.

1.9 Although every effort has been made to position exploratory holes in the least sensitive areas of the site, exploratory hole positions were located approximately as part of this investigation and no guarantee can be given as to their accuracy on this drawing.

1.10 Existing manhole covers were not lifted and drainage runs were not inspected during the course of this ground investigation.

1.11 The site plans enclosed in this report should not be used for scaling purposes.

2.0 THE SITE

2.1 Location & Access

2.1.1 The site is approximately 0.60 hectares in area and is situated off Draycott Cross Road, Cheadle. The site is located to the south west of Cheadle town centre. The site location, shown on the appended Drawing No. J-B0296.00/501, is centred on approximate National Grid Reference 399660, 342700.

2.1.2 Access to the site can be gained off Draycott Cross Road, which is located to the west of the site.

2.2 Site Description

2.2.1 The site is currently occupied by Vulcan Refractories who are a specialist manufacturer of infra-red heating systems and components for low temperature process heating applications, as well as high performance ceramics. The raw products generally are inert materials such as clay but also include zircon and silicon carbide, plus lube oils are also used on the machinery.

2.2.2 The site generally comprised two large works buildings with associated car parking.

2.2.3 A large steel-clad warehouse building, housing several large workshops and offices, was located within the centre of the site and contained production machinery. Possible asbestos cement roofing was noted on the building, but it is understood that a full asbestos survey has recently been undertaken.

2.2.4 A smaller warehouse building was located within the southern section of the site. The building housed various manufacturing materials on wooden pallets.

2.2.5 The remaining site area generally comprised concrete hardstanding and rough undeveloped land. The northernmost section of the site comprised a concrete car park. Within the eastern section of the car park was an above ground bunded diesel tank and nitrogen storage tank.

2.2.6 An undeveloped area comprising gravel surfacing, used for general storage including chemical drums, was present within the centre of the site. Several of the drums were noted to contain lubricating oils. The surface was noted to contain some staining and also, in places, some of the inert raw product.

2.2.7 A retaining wall, approximately 1.5m high, was present within the centre of the site, retaining the northern section of the site above the southern section. An access roadway was present on the northern side of the retaining wall, gaining access to the main workshop building. A concrete ramp/road, used for site vehicles (forklift trucks, etc), connected the northern and southern sections.

2.2.8 Along the eastern boundary was a steep bank leading down to a small watercourse, known as the River Tean. Trees and plants of varying types and maturities were located along the banks of the watercourse. Possible Japanese Knotweed was also noted along the banks of the river.

2.2.9 Adjacent to the warehouse building, in the southern section of the site, was an undeveloped area, overgrown with vegetation. To the rear of the warehouse building was a large overgrown pond.

2.2.10 Further oil drums/chemical drums were positioned on the undeveloped verge between the warehouse building and the adjacent watercourse.

2.2.11 The eastern boundary was defined by the River Tean running parallel to the site boundary. The southern site boundary was undefined and was located within an area of vegetation. Beyond the northern and western boundaries were several further industrial units.

2.2.12 The area surrounding the site generally comprised industrial units within Brookhouses Industrial Estate. Farmland was present to the west of the site.

3.0 DESK STUDY

3.1 Sources of Information

3.1.1 The following sources of information have been consulted as part of the desk study:

(a) Opus International Archives
(b) Landmark Information Group Ltd 'Envirocheck' database report
(c) Selected County Series and Ordnance Survey plans
(d) British Geological Survey 1:10,560 Sheet SJ 94 SE (Ashbourne) and BGS online Lexicon
(e) Environment Agency Website
(f) BR 211 Radon; Guidance on Protective Measures for New Dwellings, 2007 Edition
(g) Law Society Guidance Notes and Directory for Coal Mining Searches

3.2 Site History

3.2.1 A review of the site history has been undertaken in order to identify any previous potentially significant contaminative activities, located either on-site or off-site.

3.2.2 Potential on-site contamination sources may present a risk to future site users and underlying and/or adjacent 'controlled waters'.

3.2.3 Neighbouring potential off-site contamination sources may also present a risk to soils and, if present, groundwater underlying the site through cross boundary migration or deposition of waste materials.

3.2.4 The history of the site is recorded over selected periods by inspected maps, copies of which are presented in Appendix 'A'. The account presented in this report is restricted by specific time periods represented by these maps only.

3.2.5 The earliest plan of the site is dated **1880** and showed the site as generally undeveloped or farmland. A small residential property was shown within the north western corner of the site, in the area of the current access roadway. Three further residential properties and a public house (the Roebuck Inn) were shown beyond the north western site boundary. The northern, southern and western site boundaries were undefined. A road was shown along the north western boundary and the eastern boundary was defined by the River Tean flowing north-south approximately along the site boundary. Trees are shown along the boundary with the river. The area surrounding the site was generally undeveloped. A disused Brass Works was shown approximately 180m to the north of the site boundary with a gas works further to the north. A pond was shown approximately 240m to the north west of the site boundary. Delphhouse Colliery (disused) was shown approximately 280m to the north west of the site boundary and several old coal shafts were shown within the area surrounding the site.

3.2.6 The **1899** plan shows no significant changes within the site boundaries. The colliery to the north west of the site was no longer shown although spoil mounds were still shown. A railway line was beginning to be developed approximately

100m to the south of the site. A ditch/stream was shown to the west and north of the site and a small pond was shown approximately 200m to the south west of the site.

3.2.7 The **1924** plan showed no significant changes within the site boundaries. The railway had been constructed to the south and served a brick works and New Haden colliery approximately 300m south west of the site (New Haden Colliery Branch). A railway siding was shown as having been developed approximately 130m to the east of the site. The sidings joined a tramway, which extended to the north, approximately 200m north east of the site. Further residential developments were shown along Cheadle Road to the north and north east of the site boundary. An area of marshy ground was shown to the west of the site. The old brass works was no longer shown.

3.2.8 The **1937**, **1951** and **1955** plans showed no significant changes within the site boundaries or within the immediate surrounding areas. The railway siding and tramway were no longer shown on the 1937 map. The gas works was no longer shown although gas holders were still present to the north.

3.2.9 The plan dated **1956** (although possibly mis-dated as the buildings are not shown on the 1966, 1:10560 plan) showed a rectangular works building had been developed within the western section of the site. Several further works were shown within the area surrounding the site as part of the Brookhouses Industrial Estate. The ditch/stream to the north of the site appears to have been culverted as part of the development of Brookhouses Industrial Estate. New Haden engineering works and a scrap yard were shown approximately 280m to the south west of the site boundary in the area of the former brick works. Further residential developments were shown to the north east of the site and the railway was no longer shown.

3.2.10 The **1976** plan showed no significant changes within the site boundaries or within the surrounding site area.

3.2.11 The **1989** plan showed the site layout had changed however remained as a works. A large warehouse type building was shown within the centre of the site. Further industrial units were shown to the east of the site.

3.2.12 The **1992** planned showed the works building on site had increased in size. There were no significant changes within the areas surrounding the site.

3.2.13 The **1994, 1995, 2000, 2006** and **2010** plans show no significant changes within the site boundaries or within the surrounding areas.

3.3 Geology, Hydrogeology and Hydrology

Geology

3.3.1 According to the British Geological Survey Sheet SJ 94 SE (Ashbourne), the majority of the site is recorded to be underlain by Till (boulder clay) while the south eastern section of the site is recorded as being underlain by Alluvium. A further area of Alluvium is recorded to the west of the site.

3.3.2 Underlying the superficial deposits, the solid strata are recorded to represent the Westphalian B Coal Measures. These generally comprise interbedded grey mudstone, siltstone, pale grey sandstone and economically work coal seams.

3.3.3 The Four Foot Coal seam is anticipated to outcrop within the north western most corner and the southern corner of the site. The Litley Coal seam is recorded to outcrop to the west of the site. The strata dips to the west. A fault in the bedrock is recorded across the north eastern corner of the site, trending east west and with a downthrow to the north.

Hydrogeology

3.3.4 According to the Environmental Agency Website, the Coal Measures beneath the site are recorded as a Secondary A Aquifer.

3.3.5 Secondary A aquifers are 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.

3.3.6 The soils are classified as having a High Leaching Potential.

3.3.7 The site is not located within a groundwater source protection zone.

3.3.8 The nearest groundwater abstraction is located approximately 1284m to the north east of the site boundary and relates to a public water supply for portable water.

Hydrology

3.3.9 The nearest watercourse to the site is the River Tean located along the eastern site boundary, flowing north to south.

3.3.10 River quality chemistry sampling undertaken in the River Tean, approximately 47m to the north west of the site, recorded a grade B (good) in 2009.

3.3.11 The nearest surface water abstraction is located approximately 1217m to the north and relates to abstraction for process water for mineral products.

3.3.12 The Envirocheck report indicates the eastern section of the site as being located within an area that is considered to be at risk from extreme flooding from rivers with or without defences.

3.4 Environmental Considerations

3.4.1 The 'Envirocheck' report comprises a summary of statutory data held on public registers and identifies potential sources of contamination on the site and within a search radius of 500m surrounding the site. In addition, the report also identifies potential receptors of contamination on the site and within 1000m.

3.4.2 Specific details relating to the environmental setting of the site are presented within the 'Envirocheck' report, which is presented in Appendix 'B'.

- Four discharge consents are located within 250m of the site boundary, all for sewage effluent discharge to the River Tean. The nearest is

located approximately 9m to the south east of the site, although this license was revoked in 2000.

- The Vulcan Refractories site has a Local Authority pollution prevention and control for the spray drying of ceramics.

- Three pollution incidents to controlled waters were recorded within 250m of the site boundary with one from the Vulcan Refractories site in 1996 when inert suspended solids were released into the River Tean in a category 3/minor incident. The incident was caused by a treatment system failure. The other two incidents were also category 3/minor incidents, which occurred in 1996 and 1998.

- The nearest historical landfill site is located approximately 979m to the west of the site. The landfill was recorded to have accepted inert, industrial and household waste.

- A licensed waste management facility was located approximately 99m to the north east of the site boundary and relates to metal recycling at Brookhouse Way

- A registered waste transfer site is located approximately 138m to the east of the site and relates to industrial plastics and paper.

- A registered waste treatment or disposal site is located 58m to the east of the site and relates to a scrapyard at Brookhouse Industrial Estate, licensed to R.P. Howell.

- A contemporary trade directory entry is recorded on site and relates to Vulcan Refractories Ltd. A number of other processes are recorded in the surrounding area including precision engineers, scrap metal merchants, road haulers, ceramic manufacturers and garage services.

- The nearest fuel station entry is a petrol station located approximately 158m to the north east of the site boundary.

- No Control of Major Accident Hazards (COMAH) or Notification of Installations Handling Hazardous Substances (NIHHS) sites are located within 1000m of the site boundary.

- The site is located within a Nitrate Vulnerable Zone.

- An area of adopted green belt is recorded approximately 27m to the north west of the site.

3.5 Radon

3.5.1 Reference to the 'Envirocheck' report and BR211: 2007 indicates that the site lies within an area where 0% to 1% of homes are affected by radon and where no radon protection measures are required in new buildings.

3.6 Mineral Workings

3.6.1 Cheadle is listed within the Law Society's Guidance Notes and Directory for Coal Mining Searches as requiring a Coal Mining Report. A copy of the Coal Authority Report is included in Appendix 'C' and the findings of the report have been summarised below:

- The site is in the likely zone of influence from workings in 2 seams of coal at 70m to 260m depth and is recorded as being last worked in 1942.
- The property is in an area where the Coal Authority believe there is coal at or close to the surface.
- The property is not in the likely zone of influence of any present underground coal workings.
- The property is not in an area for which the Coal Authority is determining whether to grant a licence to remove coal.
- Within, or within 20m, of the site boundary there is a record of one mine adit. There is no record of what steps, if any, have been taken to treat the mine entry.

3.6.2 It did not become a requirement to keep records of underground mining operations until 1872 by which time much mining had already been carried out. Hence, there is the possibility that unrecorded mining and further mine entries are located beneath the site.

3.6.3 The British Geological Survey shows the Four Foot Coal is anticipated to outcrop within the north western corner and southern corner of the site. The Litley Coal is recorded to outcrop to the west of the site.

3.6.4 The Coal Authority Report records the mine adit along the western riverbank, trending beneath the site. The recorded position of the mine adit shows it running beneath the site, in line with the roadway to the rear of the workshop building.

3.6.5 There are a number of BGS Recorded Mineral sites in the surrounding area, for both underground and opencast mining. All have now ceased and included underground mining for coal and opencast mining for clay/shale, coal and colliery spoil.

4.0 PREMILINARY CONCEPTUAL SITE MODEL

4.1 Potential Sources of Contamination

4.1.1 The following potential **on site** sources of ground contamination have been identified:

- Potentially contaminated Made Ground beneath floor slabs and hardstanding surfaces from previous development of the site. Contaminants may include heavy metals, PAH's, phenols and asbestos.

- Potential minor leakage of hydrocarbons from parked cars within the car parking area. Contaminants may include TPH (Total Petroleum Hydrocarbons) and BTEX (Benzene, Toluene, Ethylbenzene and Xylene).

- Potential historical leakage/spillage of hydrocarbons from the above ground diesel tank in the north eastern corner of the site.

- Potential spillage of materials, particularly from the unprotected drums stored in the unsurfaced area in the south of the site, between the main production building and warehouse.

- Potential ground gas generation from organic matter within Made Ground materials. Typical ground gases include methane and carbon dioxide.

4.1.2 No potential off site sources of ground contamination have been identified. A brass works and gas works were formerly present to the north adjacent to the River Tean and hence these areas have the potential to have an impact on the water quality of the River Tean.

4.2 Receptors of Contamination and Migration Pathways

4.2.1 Receptors are defined as human or non-human organisms that have the potential to experience adverse effects from direct or indirect exposure to contaminated material.

4.2.2 Migration pathways are defined as the courses chemicals take from a source to an exposed organism or receptor. The exposure pathway can be direct (i.e. stays within the same exposure media) or indirect were transport from one medium to another takes place.

4.2.3 The following potential human health and environmental receptors have been identified:

- Site Workers
- Buried concrete and plastics (e.g. water supply pipes)
- Secondary aquifer/groundwater beneath the site
- River Tean

4.2.4 The following potential migration pathways have been identified:

- **Inhalation**
  Breathing dust and vapours from contaminated soil in outdoor air. Vapours can also migrate into buildings resulting in inhalation by the occupants.

- **Ingestion**
  Eating and swallowing of contaminated soil either by deliberate consumption, indirectly by eating or smoking with dirty hands or by ingestion of fugitive dust.

- **Dermal Contact**
  Direct contact with contaminated soil and groundwater, causing skin conditions such as dermatitis etc. Certain contaminants can be absorbed into the body through the skin or enter directly through open cuts or abrasions

- **Leaching**
  Infiltration of water through soil can leach out soluble contaminants resulting in groundwater and/or surface water pollution.

- **Migration of Contaminated Water**
  Contaminated groundwater can migrate laterally or vertically dependent on permeability, preferential pathways, man-made voids etc.

- **Leaking Tanks, Pipelines and Drains**
  Hydrocarbon based contaminants can leak due to cracks in tanks, pipes and drains and spillages can occur during tank filling operations. Escaped hydrocarbons can significantly impact surrounding soil, groundwater and surface waters.

- **Migration of Ground Gas**
  Ground gases can migrate laterally or vertically through permeable or voided ground and accumulate within unprotected buildings.

- **Aggressive Attack**
  Building materials can be damaged by direct contact with aggressive ground conditions, for example sulphate attack on concrete and hydrocarbon attack on plastics.

4.3 Source-Pathway-Receptors Relationships

4.3.1 The potential **Source-Pathway-Receptor** relationships identified for the site are summarised in the following table and also in diagrammatical form on drawing J-B0296.00/502.

Source	Pathway	Receptor
Contaminated Made Ground in unsurfaced areas. Potential contaminants include: **1. Metals** **2. TPH** **3. PAH** **4. Asbestos**	Ingestion Dermal contact Inhalation (outdoor air) Lateral migration of mobile contaminants (i.e. TPH)	Site workers River Tean
Contaminated Made Ground beneath hardstandings. Potential contaminants include: **1. TPH** **2. PAH**	Inhalation (indoor air) Aggressive attack	Site workers/maintenance workers Building materials
Contaminated groundwater Potential contaminants include: **1. TPH** **2. Metals**	Lateral migration Aggressive attack	Secondary aquifer/Groundwater River Tean Building materials
Ground gases (on-site and off-site) and hydrocarbon vapours	Generation, migration, accumulation inside confined spaces	Site workers/maintenance workers

5.0 INVESTIGATION METHODOLOGY

5.1 Objectives

5.1.1 The objectives of the investigation were to assess the environmental impact of the refractory works in relation to the underlying ground conditions, groundwater and adjacent watercourse and to identify any potential liabilities with the purchase of the property for continued use.

5.2 Clearance of Underground Services

5.2.1 Before intrusive works were undertaken, the positions of exploratory holes were cleared by Tower Surveys in order to avoid underground services.

5.3 Site Works

5.3.1 Seven window sample boreholes (WS1 to WS7) were excavated using a tracked window sampling rig to depths ranging between 2.00m and 5.00m below ground level (bgl).

5.3.2 The approximate locations of the exploratory holes are shown on the appended Drawing No. J-B0296.00/503 and the exploratory hole logs are presented in Appendix 'D'.

5.3.3 Disturbed samples were taken at selected intervals from the strata encountered, placed in appropriate containers and submitted for geotechnical and chemical testing.

5.3.4 Gas/groundwater monitoring standpipes were installed within window sample holes WS1 to WS5. The standpipes were constructed using slotted pipe within a gravel surround and bentonite seal near surface, and fitted with a gas tap assembly at ground level suitable for connection to propriety gas monitoring equipment. A stop cock box was installed to provide protection at ground level.

5.3.5 A visual investigation to ascertain any evidence of the potential location of the abandoned mine adit was undertaken during the investigation however, no visible evidence was identified. The recorded location of the mine adit (as per Coal Authority records) is beneath the roadway to the rear of the workshop building.

5.4 Chemical Laboratory Testing

5.4.1 As part of the assessment for potential contamination at the site, soil samples were subjected to appropriate chemical analysis. This analysis was carried out at the MCERTS accredited laboratory of QTS Environmental for a suite of determinands chosen bearing in mind the Conceptual Model for the site presented in Section 4.3.

5.4.2 The following analyses were carried out:

Soils

- General Screening suite (including metals + cyanide) - 9 samples
- Speciated polynuclear aromatic hydrocarbons (PAH) - 9 samples
- Petroleum hydrocarbons to TPHCWG methodology - 7 samples
- BTEX - 7 samples
- Asbestos screening - 7 samples
- Volatile Organic Compounds (VOCs) - 2 samples
- Soil Organic Matter - 10 samples
- Total Phenols - 9 samples
- pH and Water Soluble Sulphate - 9 samples

Groundwater

- General Screening suite (including metals + cyanide) - 5 samples
- Speciated polynuclear aromatic hydrocarbons (PAH) - 5 samples
- Petroleum hydrocarbons to TPHCWG methodology - 5 samples
- BTEX - 5 samples

Surface Waters

- General Screening suite (including metals + cyanide) - 3 samples
- Speciated polynuclear aromatic hydrocarbons (PAH) - 3 samples
- Petroleum hydrocarbons to TPHCWG methodology - 3 samples
- BTEX - 3 samples
- Hardness - 2 samples

5.4.3 Results of the chemical testing are presented in Appendix 'E'.

5.5 Gas/Groundwater Monitoring

5.5.1 Monitoring of gas and groundwater levels has been undertaken on one occasion since completion of the site work.

5.5.2 Measurements of concentrations of methane, carbon dioxide, oxygen and hydrogen sulphide were taken using a Geotechnical Instruments (UK) Limited Infra Red Gas Analyser. Atmospheric pressure, gas flow rates and groundwater levels were also recorded.

5.5.3 The results of the monitoring are presented in Appendix 'F'.

6.0 RESULTS OF INVESTIGATION

6.1 Strata Encountered

Made Ground

6.1.1 Made Ground was encountered within all of the exploratory holes with the exception of WS5. The Made Ground generally comprised gravelly sandy clay and sandy gravel to depths of between 0.50m and 1.80m bgl. Admixed materials recorded within the Made Ground included brick, concrete, mudstone, hardcore, quartzite and clinker.

6.1.2 Deeper Made Ground, to depths of between 1.50m and 1.80m, was recorded within exploratory holes WS2, WS3 and WS6, located adjacent to the river.

6.1.3 Overlying the Made Ground, concrete hardstanding was encountered within exploratory holes WS1-WS3 to depths of up to 0.40m bgl.

Natural Strata

6.1.4 Underlying the Made Ground, natural strata was encountered within all of the exploratory boreholes to the full depth of the investigation. The natural strata generally comprised orange/brown soft/firm consistency clay. Underlying the clays, very weak grey mudstone was encountered within exploratory holes WS1-WS5 to the full depth of investigation, between 3.00m and 5.00m bgl.

6.1.5 Topsoil comprising silty gravelly clay was encountered within WS5, overlying the natural strata to a depth of 0.30m bgl.

6.1.6 A layer of coal was encountered within WS1 between 1.40m and 2.80m bgl.

6.1.7 Underlying the Made Ground, a thin layer of sandy grey silt to a depth of 1.80m bgl was encountered within WS3.

6.1.8 A thin layer of sandy grey/orange quartzite gravel was encountered within exploratory holes WS3-WS5 and WS7 to depths of between 1.70m and 3.50m bgl.

6.2 Groundwater Observations

6.2.1 Groundwater was encountered during the investigation within exploratory holes WS1-WS5 at depths of between 1.00m and 4.00m bgl, generally within the natural superficial deposits, or at the interface between the superficials and the underlying mudstone. Within WS1, groundwater was encountered at 3.00m however it rose to 1.60m bgl within 5 minutes.

6.2.2 During the subsequent monitoring visit, groundwater rest levels of between 0.42m and 2.64m bgl were encountered. Shallower groundwater rest levels were generally recorded within the lower level of the site however a rest of level of 0.42m was recorded within WS1, located on the higher section of the site.

6.2.3 Groundwater rest levels of 0.85m (WS5) and 0.92m (WS4) were recorded within the lower level of the site, whilst groundwater rest levels of 2.44m (WS3) and 2.64m (WS2) were recorded within the upper section of the site.

6.3 Chemical Testing - Soils

6.3.1 The results of the chemical testing on soil samples have been reviewed in accordance with current legislative framework and criteria to assess the risk to human health.

6.3.2 The soil test results have been compared to Opus's in-house Tier 1 screening values (IHSV's) derived using CLEA 1.06 to be protective of human health in accordance with the methodology outlined within Appendix 'E'. In this case a commercial end use has been adopted.

6.3.3 Where appropriate, the results of the metals and PAH analyses have been statistically assessed in accordance with the CL:AIRE and CIEH document titled 'Guidance on Comparing Soil Contamination with a Critical Land Concentration' published in May 2008. To this end the ESI Contaminated Land Statistical Calculator software has been utilised. Under the planning regime scenario the objective is to determine the 'suitability for use' of the land under consideration and hence demonstrate that there is a 95% probability that the true population mean (μ) is below the set critical concentration (C_c), such as published Soil Guideline Values and in their absence Opus Tier 1 soil screening values (SSVs) for commercial use. The statistical assessment tables are presented in Appendix 'E' of this report.

6.3.4 Under the land use planning system where the aim is to demonstrate 'suitability for use' the Null and Alternative Hypotheses are as follows:

> Null Hypothesis (H_0) : "Is the true mean concentration greater or equal to that of the critical concentration?" ($\mu \geq C_c$)
>
> Alternative Hypothesis (H_1) : "Is the true mean concentration less than the critical concentration?" ($\mu < C_c$)

6.3.5 No materials of significant concern were identified during the investigation and hence nine selected samples were tested for a general screening suite of heavy metals and speciated PAHs. Seven samples of Made Ground were also screened for the presence of asbestos fibres. In addition seven samples were tested for speciated petroleum hydrocarbons and two samples for VOCs in the areas of the above ground diesel tank and the unsurfaced area where the drums were stored. The results are summarised below.

Made Ground

Metals and PAHs

6.3.6 Chemical analysis of the selected samples of Made Ground did not record any determinands (heavy metals or individual PAHs) to be in excess of the adopted screening values.

6.3.7 Based on the above, the null hypothesis was rejected for all heavy metals and individual PAHs.

Total Petroleum Hydrocarbons and BTEX

6.3.8 The seven samples tested for speciated petroleum hydrocarbons recorded a single concentration of Aliphatic C_{12}-C_{16} of 58mg/kg within WS4 (0.20m-0.40m) which in excess of the adopted screening value of 22mg/kg. The Opus Tier 1 screening value has been held at this low concentration as this is the theoretical level at which free product could be present. The actual concentration at which there is considered to be a risk to human health is in excess of 8000mg/kg.

6.3.9 A Total TPH concentration of 1012mg/kg was recorded within WS6 (0.20m-0.40m) however, none of the individual petroleum hydrocarbon fraction within this sample were in excess of the adopted screening values.

6.3.10 BTEX were not recorded above the adopted screening values.

Volatile Organic Compounds (VOCs)

6.3.11 The two samples tested for VOCs did not record any concentrations of individual compounds in excess of the adopted screening values, and almost all were below the detection limit of the laboratory.

Phenols

6.3.12 The nine samples tested for Total Monohydric Phenols within the Made Ground did not record concentrations above the instrument detection limit.

Asbestos

6.3.13 The seven samples tested for asbestos within the Made Ground did not record any fibrous materials within the screen.

Topsoil

Metals, PAHs and Phenols

6.3.14 Chemical analysis of the selected sample of Topsoil did not record any determinands (heavy metals, individual PAHs or Total Phenols) to be in excess of the adopted screening values.

Natural Strata

Metals and PAHs

6.3.15 Chemical analysis of the selected sample of natural strata did not record any determinands (heavy metals or individual PAHs) to be in excess of the adopted screening values.

Phenols

6.3.16 The sample tested for Total Monohydric Phenols within the natural strata did not record a concentration above the instrument detection limit.

6.4 Chemical Testing – Groundwater/Surface Water

6.4.1 In view of the close proximity of the site to the River Tean, the results of chemical testing carried out on the samples of groundwater taken from the monitoring wells have been assessed against the Environmental Quality Standards (EQS) for freshwater, or, where these are not available, the UK Drinking Water Standards 2000 (UKDWS). This screening allows potential 'contaminants of concern' to be identified with regard to Controlled Waters.

6.4.2 Five groundwater samples were taken from standpipes WS1-WS5 and three water samples from the River Tean, upstream, midstream and downstream of the site, and were sent to the laboratory of QTS for a suite of analysis which comprised metals, speciated PAHs, speciated petroleum hydrocarbons and BTEX.

6.4.3 None of the individual metals, PAHs or BTEX were recorded at concentrations in excess of the adopted screening values.

6.4.4 A total concentration of Aliphatic Hydrocarbons C5–C34 of 71ug/l was recorded within WS5, marginally in excess of the adopted screening value of 50ug/l.

6.5 Water Soluble Sulphate and pH Testing

6.5.1 Water soluble sulphate and pH testing has been carried out on samples of Made Ground, Topsoil, natural soil, groundwater and river water with the following results:

Made Ground

- pH values of between 6.6 and 7.9
- Water soluble sulphate values of between 10mg/l to 128mg/l

Topsoil

- pH value of 6.8
- Water soluble sulphate value of 10mg/l

Natural Strata

- pH value of 6.6
- Water soluble sulphate value of 40mg/l

Groundwater

- pH values of between 6.0 and 6.8
- Total Sulphate values of between 4mg/l to 90mg/l

River Water

- pH values of between 7.1 and 7.4
- Total Sulphate values of between 56mg/l to 57mg/l

6.6 Gas Monitoring

6.6.1 Gas monitoring results have been compared to guidance presented in CIRIA Report C665, Assessing Risks Posed by Hazardous Ground Gases to Buildings, 2007.

6.6.2 The above guidance indicates that gas protection measures may be necessary in new buildings on sites where methane concentrations exceed 1% v/v and/or where carbon dioxide concentrations exceed 5% v/v. The gas flow rate is also considered in the required level of protection.

6.6.3 Maximum methane (CH_4) and carbon dioxide (CO_2) concentrations, as percentage volume in air (%v/v), maximum carbon monoxide (CO) and hydrogen sulphide (H_2S) concentrations, as parts per million (ppm), oxygen (O_2) concentrations (%v/v) and gas flow rates in litres per hour (l/hr), have been monitored within the standpipes on one occasion.

6.6.4 The results of the single gas monitoring visit are presented in Appendix 'F' and the findings summarised below:

- A maximum carbon dioxide concentration of 2.5% v/v was recorded.
- Methane was not recorded above the instrument detection limit.
- A maximum flow of 0.1 l/hr was recorded.
- A peak concentration hydrogen sulphide of 12ppm was recorded.
- Carbon monoxide was not recorded above the instrument detection limit.

6.6.5 The atmospheric pressure at the time of the monitoring visit was recorded at 1000mb and at a rising pressure trend.

B. ASSESSMENT & RECOMMENDATIONS

7.0 INTRODUCTION

7.1 At the time of the investigation, the site was occupied by Vulcan Refractories comprising workshop and warehouse buildings, offices, car parking and an unsurfaced area used for general storage. It is understood that no redevelopment of the site is to be undertaken and that the site is to continue production in its current form. The investigation was to assess the site in relation to any potential environmental liabilities.

7.2 For the propose of this Environmental Assessment the site is considered to correspond to the '**Commercial**' end use model in the context of the potential impact of contamination on human health.

7.3 The ground conditions are typified by the presence of Made Ground within all of the exploratory holes, within the exception of WS5, to depths of between 0.50m and 1.80m bgl. The Made Ground generally comprised gravelly sandy clay and sandy gravel. Admixed materials recorded within the Made Ground included brick, concrete, mudstone, hardcore and quartzite and clinker.

7.4 Underlying the Made Ground, natural strata was encountered within all of the exploratory boreholes to the full depth of the investigation. The natural strata generally comprised orange/brown soft/firm consistency clay. Underlying the clays, very weak grey mudstone was encountered within exploratory holes WS1-WS5 to the full depth of investigation between 3.00m and 5.00m bgl.

7.5 A layer of coal was encountered within WS1 between 1.40m and 2.80m bgl. Underlying the Made Ground, a thin layer of sandy grey silt to a depth of 1.80m bgl was encountered within WS3. A thin layer of sandy grey/orange quartzite gravel was encountered within exploratory holes WS3-WS5 and WS7 to depths of between 1.70m and 3.50m bgl.

7.6 Groundwater was encountered during the investigation within exploratory holes WS1-WS5 at depths of between 1.00m and 4.00m bgl, generally within the natural superficial deposits, or at the interface between the superficials and the underlying mudstone.

7.7 Within WS1, groundwater was encountered at 3.00m however it rose to 1.60m bgl within 5 minutes. During the subsequent monitoring visit, groundwater rest levels of between 0.42m and 2.64m bgl were recorded.

7.8 Chemical analyses of the Made Ground samples recorded one sample where the aliphatic C_{12}-C_{16} was marginally in excess of the adopted screening value. A concentration of 58mg/kg was recorded in excess of the adopted screening value of 22mg/kg. The Opus Tier 1 screening value has however been held at this low concentration as this is the theoretical level at which free product could be present. The actual concentration at which there is considered to be a risk to human health is in excess of 8000mg/kg.

7.9 Heavy metals, PAHs, VOCs or BTEX were not recorded in excess of the adopted screening values. The samples did not record any fibrous asbestos materials within the screen.

7.10 Chemical analysis of the selected samples of Topsoil and natural strata did not record any determinands (heavy metals or individual PAHs) to be in excess of the adopted screening values.

7.11 Groundwater samples were taken from standpipes and water samples taken from the adjacent River Tern did not record concentrations of individual metals, PAHs or BTEX in excess of the adopted screening values. A total concentration of Aliphatic Hydrocarbons C_5–C_{34} of 71ug/l was recorded within WS5, marginally in excess of the adopted screening value of 50ug/l.

8.0 ENVIRONMENTAL ASSESSMENT

8.1 Soil Contamination Summary

Topsoil

8.1.1 Chemical analysis of the selected Topsoil sample did not record any determinands (heavy metals or individual PAHs) to be in excess of the adopted screening values.

Made Ground

8.1.2 Chemical analysis of the selected Made Ground samples recorded a concentration of aliphatic C_{12}-C_{16} of 58mg/kg in WS4 (0.20m-0.40m) marginally in excess of the adopted screening value of 22mg/kg for a commercial end use.

8.1.3 The recorded concentration of aliphatic C_{12}-C_{16} recorded within the Made Ground exceeds the Tier 1 screening value however this value has been held at a low concentration as this is the theoretical level at which free product could be present. The actual concentration at which there is considered to be a risk to human health is in excess of 8000mg/kg.

8.1.4 On the above basis, as no visual or olfactory evidence of hydrocarbon free product was noted within the sample, the realistic screening value can be raised and therefore the recorded concentration of 58mg/kg within WS4 (0.20m-0.40m) is not considered to pose a potential risk to site personnel.

8.1.5 Chemical analysis of the selected Made Ground samples did not record any heavy metals, individual PAHs, VOCs or BTEX to be in excess of the adopted screening values.

8.1.6 The seven samples tested for asbestos within the Made Ground did not record any fibrous materials within the screen.

Natural Strata

8.1.7 Chemical analysis of the selected natural strata sample did not record any determinands (heavy metals or individual PAHs) to be in excess of the adopted screening values.

Groundwater

8.1.8 Chemical analysis of the groundwater from the site recorded an marginally elevated concentration of Aliphatic C_5-C_{34} in WS5 which exceeded the EQS value adopted for the site. No other determinands were recorded at concentrations in excess of the adopted screening values.

Surface Waters

8.1.9 Chemical analysis of the River Tean did not record elevated concentrations of any determinands, including heavy metals, PAHs, hydrocarbons or BTEX, in excess of the adopted screening values.

8.2 Risk Assessments

Soils

8.2.1 At the time of the investigation the site comprised an active refractory. The purpose of the investigation was to assess the environmental liabilities of a proposed purchase of the refractory works in view of the underlying ground conditions, groundwater and adjacent watercourse.

8.2.2 The chemical analysis only recorded a potential issue with a single Made Ground sample which recorded a concentration of aliphatic C_{12}-C_{16} of 58mg/kg in WS4 (0.20m-0.40m) however as no visible or olfactory evidence of contamination was identified within the sample during the investigation, a screening value of 8000mg/kg can be adopted. Therefore, the sample is not in excess of the screening value and is not considered to represent a risk to human health.

Groundwater

8.2.3 The marginally elevated concentration of Aliphatic C_5-C_{34} within WS5 is considered to represent a negligible risk to the underlying aquifer however procedures should be put in place to prevent further leakage/spillage from the drums within the unsurfaced area.

Surface Water

8.2.4 The recorded concentrations within the River Tean confirms that the site is not currently having an impact on the water quality within the adjacent river.

8.3 Ground Gases

8.3.1 The level of risk from ground gases has been assessed using current guidance for new buildings which indicates that gas protection measures may be necessary on sites where methane concentrations exceed 1% v/v and/or where carbon dioxide concentrations exceed 5% v/v. The gas flow rate is also considered to derive a gas screening value from which a site characteristic situation can be determined.

8.3.2 Based on the single round of gas monitoring and in line with the recommendations provided in CIRIA C665, a preliminary Gas Screening Value (GSV) of 0.0025 l/hr has been calculated for carbon dioxide using the maximum recorded flow rate. No significant methane concentrations have been detected.

8.3.3 The GSV for carbon dioxide put the site within '**Characteristic Situation 1**' (Very Low Risk) in accordance with CIRIA 665.

8.3.4 In view of the above classification, no protection measures would be considered necessary in new buildings and hence there is considered to be negligible risk to the existing building and site workers from ground gases.

8.4 pH and Water Soluble Sulphate

8.4.1 The pH and sulphate concentrations recorded would, in accordance with current design, require buried concrete to be Design Sulphate Class DS1 and ACEC Class AC-1. No specific protection measures would be required for new concrete and hence on this basis the risk proposed by the ground conditions to the existing buried concrete is considered to be negligible.

9.0 RECOMMENDATIONS

Contamination

9.1 Although no significant contamination of concern was encountered during the investigation, it is recommended that some controls are implemented with regards to the chemical/oil drum storage within the southern section of the site.

9.2 We would recommend a shallow scrape (approx. 100mm-200mm) of the surface materials be undertaken in the unsurfaced area to remove any waste products/staining, etc, and the area be covered within concrete hardstanding. Following the scrape, the exposed formation should be inspected to confirm there are no materials of concern exposed.

9.3 The drums should be stored in a more formal way on drip trays or in an appropriately bunded area whereby the volume of the tray/area is equivalent to 110% of the drum volume and hence could accommodate a catastrophic failure. This will contain any product, should any leakage or spillage from the drums occur, and therefore limit the environmental risk to the underlying strata, groundwater and adjacent watercourse.

9.4 The above ground diesel tank and its bund should be regularly inspected, as part of a general maintenance programme to confirm its current integrity is maintained.

Mining

9.5 A visual inspection of the recorded location of the mine adit was undertaken during the investigation however, no visible evidence was identified. Based on the information with the Coal Authority Report, it is anticipated that the mine entry runs beneath the site, in line with the roadway to the rear of the workshop building.

9.6 At present, no redevelopment of the site is being considered however, should future development of the site take place it is recommended that a full intrusive investigation be undertaken to identify the exact location of the mine adit and allow for suitable mine working/adit stabilisation to be undertaken prior to development.

Flood Risk

9.7 The desk study identified the area of the site adjacent to the watercourse to be at risk from extreme flooding. We would recommend that the Environment Agency are contacted to obtain their calculated flood levels for the River Tean and the levels compared against the existing site levels to assess the level of risk to the site in its current form.


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