



EARTH ENVIRONMENTAL
& GEOTECHNICAL

Phase I GeoEnvironmental Desk Study

Acrefair

Wrexham

December 2019

On behalf of

GAROB Acrefair Ltd

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**ACREFAIR
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FOR
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1.0 INTRODUCTION

Appointment

- 1.1 Earth Environmental & Geotechnical Ltd have been commissioned by GAROB Acrefair Ltd (the Client) to undertake a Phase I Environmental Desk Study for the former Air Products Engineering site, Llangollen Road in Acrefair, near Wrexham.
- 1.2 It is understood that the Client intends to develop the site for a commercial or residential end use. Access would be provided via Llangollen Road.

Objective

- 1.3 The purpose of the Desk Study is to collate available geological and environmental data for the site (and its environment) and provide a preliminary geotechnical and geo-environmental appraisal, with a site-specific conceptual model. This enables a preliminary assessment of geo-environmental risks to be undertaken and, if necessary, provides information for the design of a Phase 2 Ground Investigation.

Scope

- 1.4 The Phase I Environmental Desk Study comprises of a site reconnaissance visit and a review of the following information sources, some of which was provided by the client.
- British Geological Survey online maps.
 - Google Earth imagery.
 - Environment Agency online mapping data.
 - Historical Ordnance Survey maps.
 - The site and surrounding areas environmental, geological and mining data presented in the site specific GroundSure Reports (Appendix 1).
 - Coal Authority Interactive Viewer.
 - Wrexham Planning Portal.

1.5 Previous Site Investigation Reports

- Phase 1 Environmental Site Assessment, Parsons Brickerhoff, May 2010
- Phase II Assessment, WSP, July 2011
- Phase 1 Mining Investigation Report, NKC Geotech Ltd, March 2015. This report relates to land adjacent to the southern boundary.
- Extended Phase I Habitat Survey, Whitcher Wildlife Ltd, January 2017.
- Phase 2 Geotechnical and GeoEnvironmental Site Investigation, Eastwood & Partners, July 2015.
- Coal Mining Risk Assessment, Earth Environmental and Geotechnical, December 2019

2.0 SITE LOCATION AND DESCRIPTION

- 2.1 The site is located approximately 11km south west of Wrexham town centre and 16km north of Oswestry. The approximate National Grid Reference for the centre of the site is 328163, 343180 with the closest postcode being LL14 3HW.
- 2.2 The site is irregular in shape with maximum dimensions of approximately 150m north-south and 155m east-west. The area of the site is 1.12 ha.
- 2.3 The site is currently a disused parcel of land. The majority of the site is covered in macadam with small patches of soft cover where trees and shrubs are found around the boundaries. There may be asbestos remaining materials (ACM) in the areas where there were former buildings; such as site offices and car parking areas of the former Air Products Engineering site, which closed in 2009.
- 2.4 A location plan is shown below as Figure 1 together with a site photograph as Figure 2 (overleaf).

Figure 1 Site Location Plan



Figure 2 Site Photograph



Site Utility Services

- 2.5 Site service plans have not been obtained for the site on behalf of the client. The status of all services should be checked prior to any development (including site investigation) commencing.

3.0 ENVIRONMENTAL SETTING

- 3.1 The geology of the site is covered by British Geological Survey (BGS) online data and the site specific GroundSure GeoInsight report (Appendix 1).
- 3.2 Environmental conditions are covered by Environment Agency (EA) and British Geological Survey (BGS) online data, and the site specific GroundSure EnviroInsight report (Appendix 1).

Geology

- 3.3 The BGS states that the site is not underlain by artificial deposits.
- 3.4 The site is underlain by superficial deposits of Devensian Diamicton Till.
- 3.5 The solid geology beneath the site is shown to be the Pennine Lower Coal Measures Formation comprising mudstone, coal seams, siltstone and sandstone.
- 3.6 There are 3no. records of linear features within 500m of the site boundary. The closest record refers to two coal seams located on site.
- 3.7 There are no records of landslips within 500m of the site boundary.
- 3.8 There are 15no. borehole records identified within 250m of the site. The closest record is SJ24SE632, 165m to the west however the information on this borehole is confidential.
- 3.9 The site is in an area where the hazard rating is negligible to moderate with regard to natural subsidence, shrink-swell clays, landslides, soluble rocks, compressible deposits, collapsible deposits and running sands.
- 3.10 There is a moderate risk of landslides due to the steep slopes on the eastern boundary of the site.

Ground Workings

- 3.11 There are 127no. records of historical surface ground working features identified within 250m of the site boundary. The closest record refers to an unspecified heap located 6m to the north west of the site. Other records in the vicinity refer to reservoirs, ponds, unspecified heaps, unspecified ground workings, unspecified old quarries, cuttings, refuse heaps, unspecified pits, opencast workings and, brick and tile works.
- 3.12 There are 5no. records of current ground workings identified within 250m of the site boundary. The closest record refers to deep coal working located 107m to the north of the site. Production is noted to have ceased.

Mining and Other Underground Workings

- 3.13 There are 183no. records of historical mining areas within 1km of the site boundary. The closest record refers to unspecified old shafts located 102m to the north of the site.

- 3.14 The site is located within the specified search distance (1km) of an identified coal mining area. Reference to the Coal Authority Interactive viewer shows the site to be located within a Development High Risk Area, associated with 3no. associated coal seams and 1no. ironstone coal seam.
- 3.15 There is 1no. record for non-coal mining areas located within 1km of the site. The closest record refers to a bedded iron ore deposit located on site.
- 3.16 There are no areas of brine extraction, gypsum extraction, tin mining or clay mining within 1km of the site.
- 3.17 There are no records for non-coal cavities or natural cavities identified within 1km of the site.
- 3.18 There are 183no. records for historical underground working features identified within 1km of the site. The closest record refers to unspecified old shafts located 102m to the north of the site.

Radon Potential

- 3.19 The property is located in a Radon Affected Area as between 3 and 5% of properties are above the Action Level. Radon protection measures will therefore be necessary.

Hydrogeology and Hydrology

- 3.20 The superficial deposits are classified by the Environment Agency (EA) as a secondary undifferentiated Aquifer. The Devensian till deposits have a mixed flow type and low to high permeability. The BGS states the following:

'Assigned where it is not possible to attribute either category A or B to a rock type. In general, these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.'

- 3.21 The Pennine Lower Coal Measures Formation is classified by the Environment Agency (EA) as a Secondary A Aquifer with a fracture flow type and low to moderate permeability. The BGS states the following:

'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.'

- 3.22 The groundwater vulnerability and soil leaching potential of the soils at the site has been classified as a minor aquifer with high leaching potential with HU soil vulnerability the BGS states:

'Soil information for urban areas and restored mineral workings. These soils are therefore assumed to be highly permeable in the absence of site-specific information'

- 3.23 There are 2no. groundwater abstraction licence records within 2km of the site. The closest record refers to a historical license for general farming and domestic use at a site located 1.5km to the north of the site.

- 3.24 There are 5no. surface water abstraction licence records within 2km of the site. The closest record refers to a historical license for general use at a site located 1.5km to the southwest of the site.
- 3.25 There are 2no. potable water abstraction licence records within 2km of the site. The closest record refers to a historical license for potable water supply storage at a site located 1.6km to the southwest of the site.
- 3.26 The site is not located within 500m of a Source Protection Zone or Source Protection Zone within a confined aquifer.
- 3.27 There are 26no. water network entries within 500m of the site. The closest record refers to an inland river located 432m to the east of the site.
- 3.28 There are no surface water features identified within 250m of the site.
- 3.29 There are 2no. Biological river quality records within 1.5km of the site. This refers to the Tref-y-nant Brook located 845m to the southwest of the site, which was grade A in 2009.
- 3.30 There are 2no. Chemical river quality records within 1.5km of the site. This refers to the Tref-y-nant Brook located 845m to the southwest of the site, which was grade A in 2008.

Landfill & Waste Management Activity

- 3.31 There are 354no. records of historical potentially infilled features identified within 500m of the site. The closest record refers to an unspecified located 6m to the northwest of the site. Other records in the vicinity refer to ponds, reservoirs, unspecified heaps, unspecified ground workings, old coal shafts, unspecified old quarries, unspecified disused shafts, cuttings, unspecified pits, refuse heaps, opencast workings, brick and tile works, coal shafts, disused brick works, a grave yard and clay shafts. These features are generally the same as the historical ground working features discussed previously.
- 3.32 There are no records for current Environment Agency landfill records within 1km of the site.
- 3.33 There are 9no. records of historic Environment Agency landfill sites within 1.5km of the site. The closest record refers to a site located 17m to the northwest of the site. The site received inert, industrial waste between 1950 and 1960.
- 3.34 There are no records of a BGS/DoE non-operational landfill sites within 1.5km of the study site.
- 3.35 There are 10no. records of landfills from the Local Authority and Historical Mapping Records within 1.5km of the site. The closest record refers to a refuse tip located 169m to the southeast of the site.
- 3.36 There are no records of waste treatment, transfer or disposal sites within 500m of the study site.
- 3.37 There are 18no. records of Environment Agency/Natural Resources Wales licensed waste sites within 1.5km of the site. The closest record refers to a household waste amenity site located 881m to the east of the site.

Industrial Land Use Information

- 3.38 There are 444no. records of potentially contaminative historical land uses identified within 500m of the site, including engineering works, unspecified works, railway sidings, unspecified tanks, unspecified commercial/industrial and iron works recorded on-site dated 1873-1994. The closest record refers to unspecified tanks located 3m to the south of the site. Other records in the vicinity refer to unspecified tanks, unspecified heaps, railway buildings, unspecified kilns, unspecified ground workings, coke ovens, unspecified old shafts, old coal shafts, unspecified old quarries, unspecified disused shafts, cuttings, railway sidings, unspecified pits, refuse heaps, opencast workings, railways stations, brick and tile works, tramway sidings, coal shafts, unspecified disused quarries, a smithy, unspecified commercial/industrial works, disused brick works, abattoir, a delph, a grave yard, gas works and gasometer.
- 3.39 There are 3no. records of potentially contaminative current land uses identified within 250m of the site. The closest record refers to unspecified works or factories located 117m to the southwest of the site. Other records in the vicinity refer to unspecified works or factories and gas features.
- 3.40 There are 37no. records of historical tanks identified within 500m of the site. The closest record refers to an unspecified tanks located on site in 1873 and 1899.
- 3.41 There are 22no. records of historical energy features identified within 500m of the site. The closest record refers to an electricity substation located 339m to the northeast of the site.
- 3.42 There is 1no. record for current petrol or fuel sites within 500m of the site. The record refers to an obsolete site located 433m to the southwest of the site.
- 3.43 There are no records of historical petrol or fuel sites within 500m of the site.
- 3.44 There are 5no. historical garage and motor vehicle repair site records identified within 500m of the site. The closest record refers to a garage located 376m to the southwest of the site.
- 3.45 There are no National Grid high voltage underground electricity transmission cables within 500m of the site.
- 3.46 There are no National Grid high-pressure gas transmission pipelines within 500m of the site.
- 3.47 There are 39no. historical railway and tunnel features identified within 250m of the site. 10no. records can be found on site, all of which are railway sidings dated between 1873 and 1949.
- 3.48 There are 10no. historical railway lines identified within 250m of the site. The closest record is for an abandoned railway located 33m to the west of the site.
- 3.49 There are no current active railway lines identified within 250m of the site.
- 3.50 There are no underground railway lines or tunnels identified within 250m of the site.
- 3.51 The site is not within 5km of the route of the High Speed 2 rail project.
- 3.52 The site is not within 500m of the route of the Crossrail 1 rail project.

Environmental Permits, Incidents and Registers

- 3.53 The Groundsure Report includes records of environmental permits, incidents and registers within 500m of the site, which are summarised in Table 1 below.

Table 1: Environmental Permits, Incidents and Registers within 500m of the Site

Permit/Incident/Register	Number
Historic IPC Authorisations	0
Part A (1) and IPPC Authorised Activities	0
Red List Discharge Consents	0
List 1 Dangerous Substances Inventory Sites	0
List 2 Dangerous Substances Inventory Sites	0
Part A (2) and Part B Activities and Enforcements	0
Category 3 or 4 Radioactive Substance Authorisations	0
Licensed Discharge Consents	1
Water Industry Referrals	0
Planning Hazardous Substance Consents and Enforcements	0
Dangerous or Hazardous (COMAH and NIHHS) Sites	1
National Incidents Recording System (Pollution Incidents), List 2	4
National Incidents Recording System (Pollution Incidents), List 1	0
Sites Determined as Contaminated Land under Part 2A EPA1990	0

- 3.54 There is 1no. record for Licensed Discharge Consent within 500m of the study site. The closest record refers to an historical licence for a site located 475m to the east of the site.
- 3.55 There is 1no. record for Dangerous or Hazardous (COMAH and NIHHS) Sites within 500m of the study site. The closest record refers to an historical COMAH Site located 454m to the southwest.
- 3.56 There are 4no. records for National Incidents Recording System (Pollution Incidents), List 2 within 500m of the study site. The closest record refers to an incident involving solvents at a site located 345m to the southwest of the site, in 2003. The incident had a minor impact on water and land.

Environmentally Sensitive Sites

- 3.57 There are 2no. Sites of Special Scientific Interest (SSSI) within 2km of the study site. The closest is the River Dee located 1.4km to the southeast of the site.
- 3.58 There are 2no. Special Areas of Conservation (SAC) within 2km of the study site. The closest is the River Dee and Bala Lake located 1.4km to the southeast of the site.
- 3.59 There are no Special Protection Areas within 2km of the study site.

- 3.60 There are 79no. records of Ancient Woodland within 2km of the study site. The closest is a restored ancient woodland located 675m to the southeast of the site.
- 3.61 There are no records of Local Nature Reserves (LNR) within 2km of the study site.
- 3.62 There site is not located within a Nitrate Vulnerable Zone.
- 3.63 There are no records of National Parks (NP) within 2km of the study site.
- 3.64 There are 88no. records of Designated Environmentally Sensitive Areas within 2km of the study site. The closest is the Pontcysyllte Aqueduct and Canal Buffer Zone located 212m to the southwest of the site.
- 3.65 There are no records of Greenbelt land within 2km of the study site.
- 3.66 There are no other records for Designated Environmentally Sensitive Sites within 2km of the study site.

Ecology

- 3.67 An ecological assessment of the site falls outside the brief of this report. Where considered necessary, advice should be sought from an ecological specialist in this respect.

Archaeology

- 3.68 An archaeological assessment falls outside the brief of this report. Where considered necessary, advice should be sought from an archaeological specialist in this respect.

Potential Flood Risks

- 3.69 Detailed assessment of flood risks is outside the scope of this report.
- 3.70 However, the site does not lie within 250m of an Environment Agency Zone 2 or Zone 3 floodplain.
- 3.71 There are no records of flood defences, areas benefitting from flood defences or areas used for flood storage within 250m of the site.
- 3.72 According to the Environment Agency the highest risk of flooding on site is very low.
- 3.73 According to the BGS there are areas within 50m of the site boundary that may be susceptible to superficial deposits flooding. The highest susceptibility to groundwater flooding is potential below and the BGS confidence rating is high. The BGS states:

'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.'

Previous Site Investigations

- 3.74 Earth Environmental & Geotechnical Ltd are not aware of any previous site investigations carried out for the site.

4.0 SITE HISTORY

- 4.1 The historical development of the site has been determined by reference historical plans and Google Earth imagery. The reviewed historical plans comprise only readily available records and may be limited; however, the information available to date indicates that additional searches are unlikely to add to our understanding of the site. The earliest available historical mapping covering the site dates back to 1873.
- 4.2 The site history is summarised in Table 2, below, followed by selected extracts from maps and aerial photographs.

Table 2: Summary of Site History

Date	On-Site History	Surrounding Land Use History
1873 1:2500 1:10560	On site are railway tracks running through the centre of the site. In the S section of the site is a factory thought to be New British Iron Works. There are also buildings in the N and W areas of the site. There is an embankment along the E boundary. A weighbridge is located on the site. Railway lines appear to cross the road.	Directly north of the site is a road beyond which are further railway sidings 50m N alongside two large reservoirs. 50m W is another reservoir. There are kilns 70m E. 80m SE are coke ovens. 100m N and S are old coal shafts. There are further shafts 120m N, 200m SW, 200m NE, 250m NW, and 250m SW. There are embankments 30m NW, 100m SW and 200m NW. There are residential properties 90m N and 150m NW. There are quarries 175m, 250m E. A railway track runs NE-SW 200m N of the site. There is a station 250m S alongside which passes a railway track running NW-SE. 250m SE and SW are residential properties. 450m SW is a gas works. Brick and tile works with kilns are 400m NW and 720m NE. There are residential properties 500m S and SE. Another railway track runs NE-SW 550m SE of site. An iron foundry is 750m SW. There are fire clay works 750m NW and 850m SW.
1898 1:10560 1899 1:2500	The factory is no longer on site and in the footprint of the building are embankments. The site is called British House. The number of railway tracks are reduced.	The kiln to the west is no longer present. 100m south is Acrefair engineering works. 100m NE and 250m SW are residential properties There are shafts 500m SW.

Date	On-Site History	Surrounding Land Use History
		750m SW is a chemical works.
1909-1910 1:10560 1912 1:2,500 1938 1:10560	Site remains unchanged.	The areas to the E and S are wooded. General increase in residential properties. Multiple shafts 700m NW.
1949 1:10560	Site remains unchanged.	General increased in assumed residential properties.
1960 1:10560 1960-1961 1:2500	Building in N section of site no longer present. There is 1no. large building in the S area of site. E border of site has wooded area followed by embankment. No railway lines on site.	Directly E of the site is a residential housing estate. Reservoir 50m N is reduced in size 100m S Acrefair engineering works has expanded towards the site. Reservoir 100m NW is no longer present. Residential properties 100m NE. Quarry 175m E is no longer present. 250m E is a refuse tip. Increased residential properties 400m NE, 600m SE,
1962-1967 1:2500	There is a building along the S boundary the footprint of which very slightly encroaches onto site.	None of the reservoirs remain. Entire former quarry 250m E is now a refuse tip
1971-1972 1:2500 1972-1977 1:2500	Another building along the S boundary is present. Another embankment in E section, reducing amount of wooded area.	There is now a bowling green 20m N of site. Residential area 350m E. Large opencast workings 200m NW where there were formerly many old shafts. Railway 250m S of the site running NW-SE is no longer present
1979-1980 1:2500 1988-1991 1:2500	Site remains unchanged.	Residential properties 100m N.
1989-1994 1:2500 1991-1994 1:2500 1993-1994 1:2500 1994 1:10000 2001 1:10000 2003 1:1250	The buildings along the southern border have joined 1no. large building.	Acrefair engineering works S of site has expanded. Refuse tip 250m E is no longer present. There is a lake 400m N of site.

Date	On-Site History	Surrounding Land Use History
2010 1:10000	The site remains unchanged.	General increase in green spaces.
2019 1:10000	There are no buildings on site.	Acrefair engineering works is no longer present.
Google Earth Aerial Imagery 2006	There is 1 no. building in the S section of the site. The N part of the site is used as a car park. The majority of the site is covered in macadam hard cover. There are areas of soft cover around the edges of the site, which are covered by trees and shrubs.	Generally residential areas. Lots of grassy fields. Railway 600m SE of the site. 410m N is a lake. 700m SW of site is an industrial estate
Google Earth Aerial Imagery 2010	The site remains the same.	No significant change.
Google Earth Aerial Imagery 2018	The site is now vacant. The hard-standing macadam is still visible. The vegetation and soft standing are also still present.	The industrial estate S of site is no longer present. Otherwise, no significant change.

Figure 3 OS Map Extract 1873

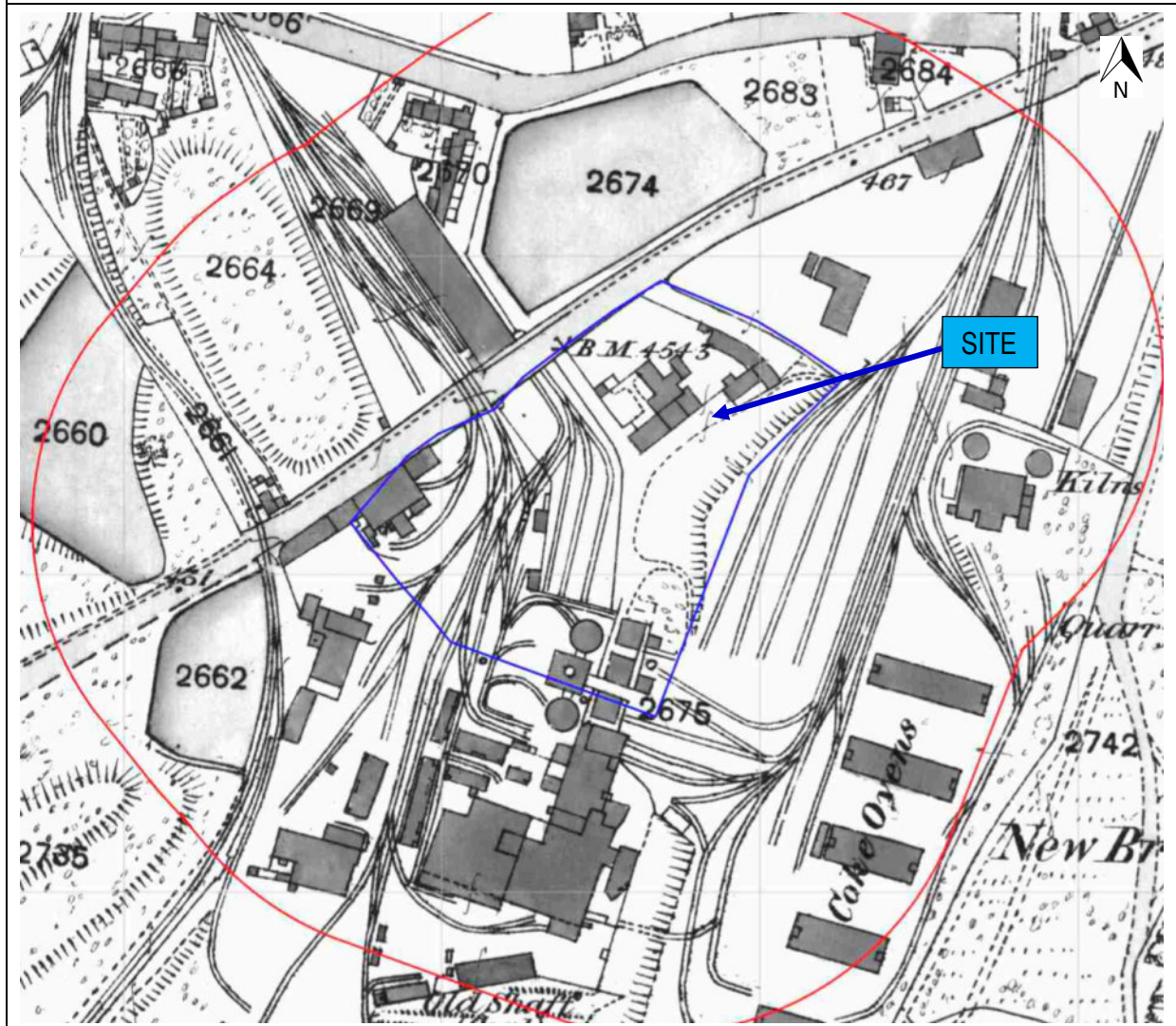


Figure 4 OS Map Extract 1912

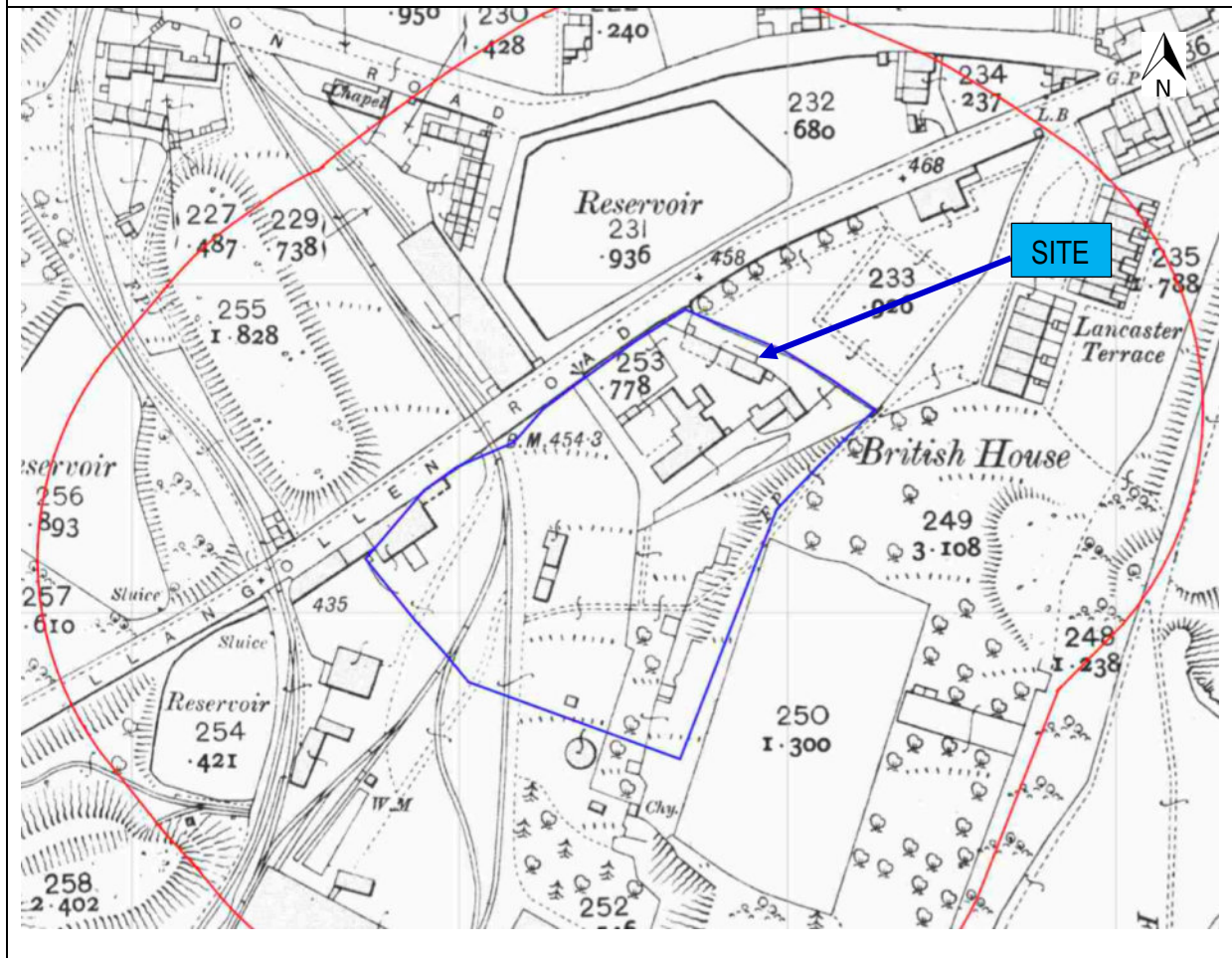


Figure 5 OS Map Extract 1962-67

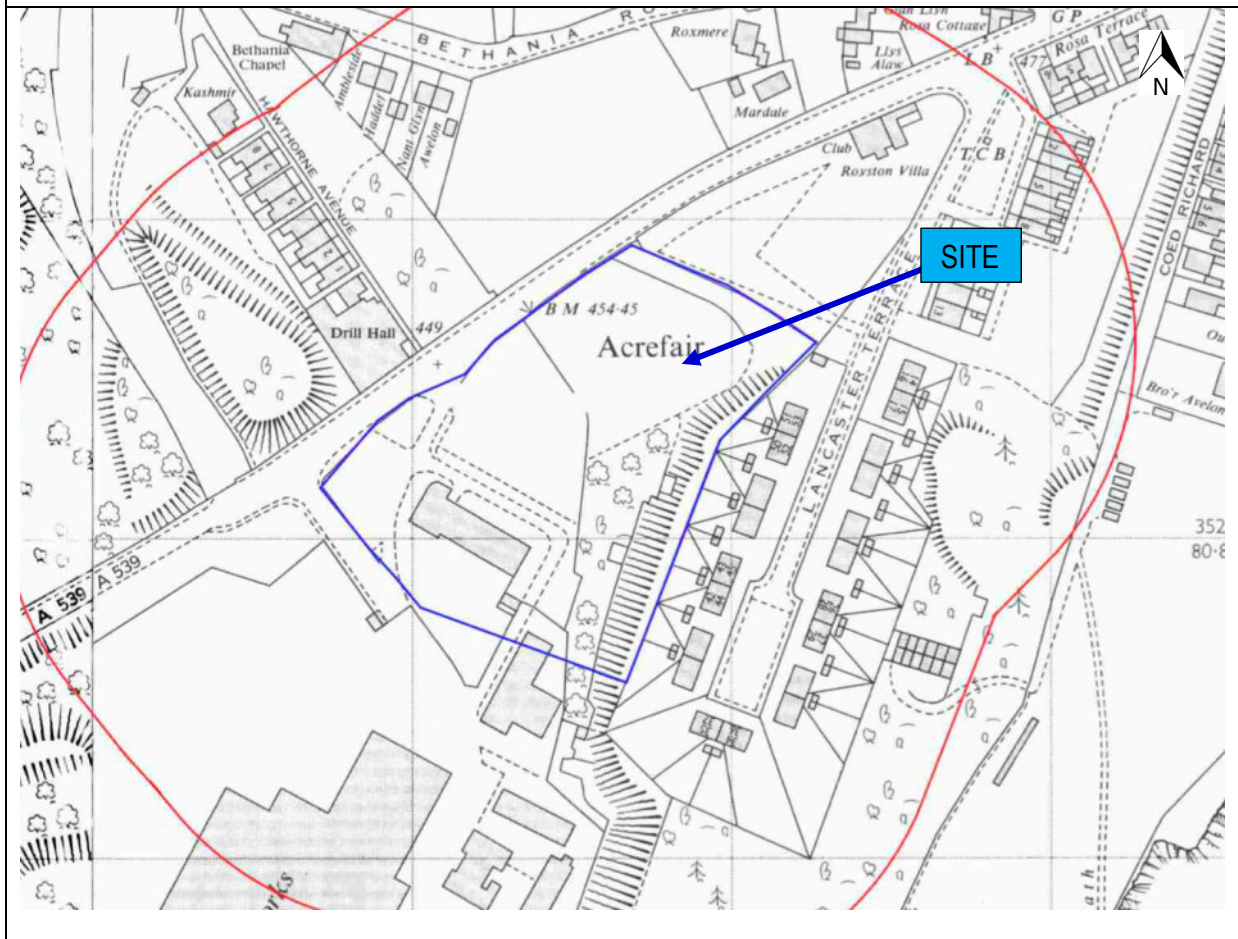
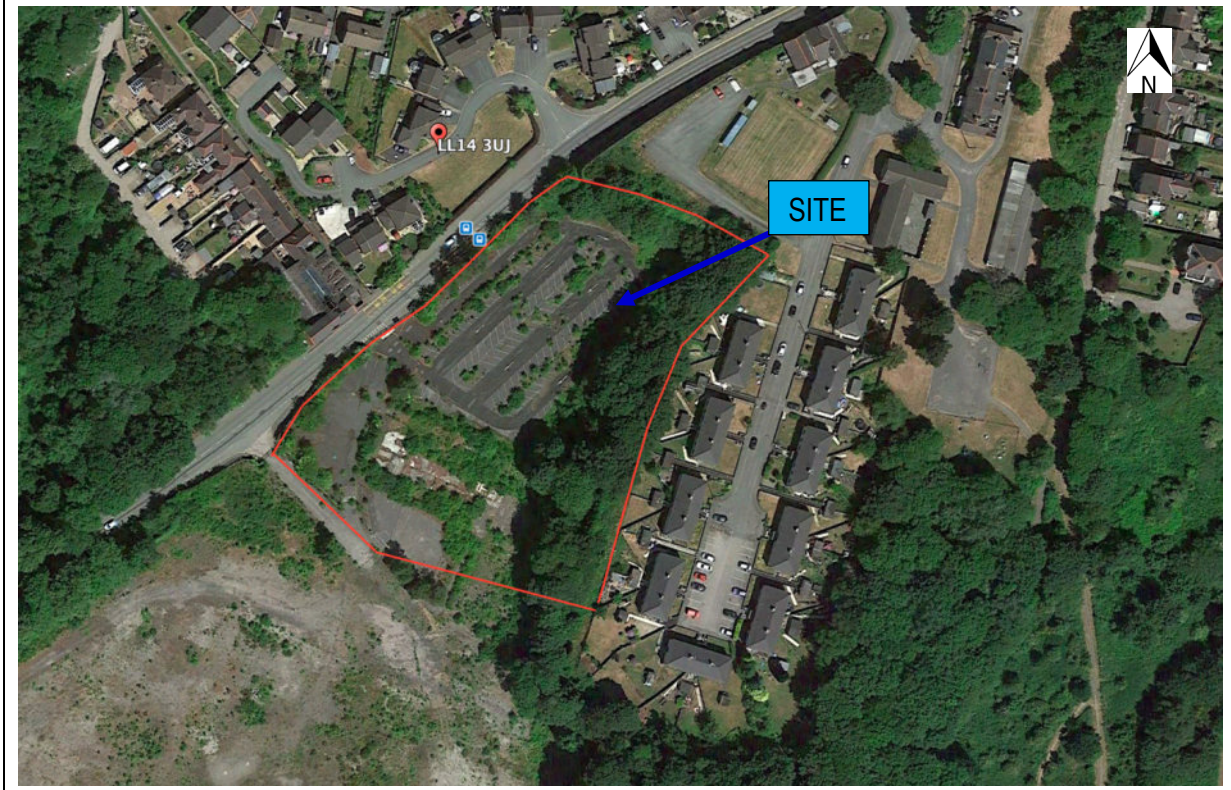


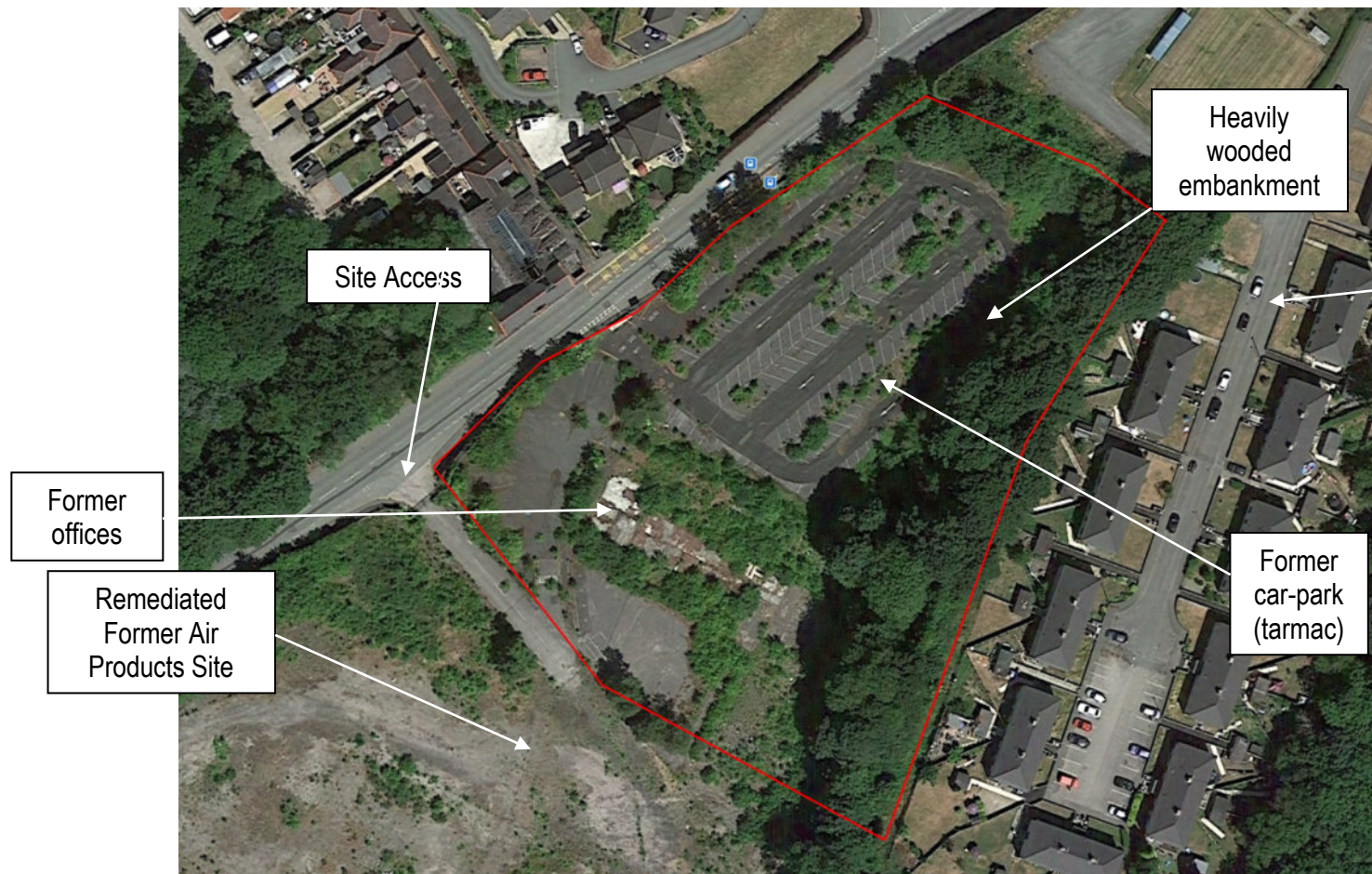
Figure 6 Aerial Photograph 2018



5.0 WALKOVER SURVEY

- 5.1 A walkover survey was completed on the 4th December 2019. The photographs and notes from this survey are appended to this report as Appendix 2 and Appendix 3 respectively.
- 5.2 The site is located approximately 11km south west of Wrexham town centre and 16km north of Oswestry. The approximate National Grid Reference for the centre of the site is 328163 343180 with the closest postcode being LL14 3HW.
- 5.3 The site formed part (where site offices and car parking areas were located) of the former Air Products Engineering site, which closed in 2009. The site is located off the south eastern side of A593 Ruabon to Llangollen Road.
- 5.4 Residential properties border the site to the west and east with a bowling green to the north. To the south there is a large area of vacant land that once formed part of the main Air Products Engineering facility. It is understood that the site was cleared of all structures in 2015 with the crushed demolition rubble left spread across the site. Ground slabs and foundations were broken up and removed.
- 5.5 The site is separated from the bowling green by a large stone built retaining wall, that is structurally distressed.
- 5.6 Old kilns/furnaces are set into the eastern tree lined embankment.
- 5.7 Site levels fall by approximately from 140mAOD on the northern boundary to 135mAOD on the southern boundary.
- 5.8 A site features plan is presented as Figure 7 overleaf.

Figure 7 Site Features Plan



6.0 PRELIMINARY CONTAMINATION RISK ASSESSMENT

Introduction

- 6.1 The following paragraphs outline a Preliminary Risk Assessment (PRA) for the site based on the above desk study information as defined by DEFRA and the EA Model Procedures for the Management of Land Contamination, CLR11⁽²⁰⁰⁴⁾.
- 6.2 Table 5 provides a Preliminary Conceptual Model (PCM) which considers the source-pathway-receptor linkages present alongside the likelihood, severity and risk level as defined within Table 3 and Table 4 below. The assessment of probability, a modified risk table, and certain consequence definitions are based on CIRIA C552 and CLR11.
- 6.3 Table 5 considers whether a pollution linkage is potentially present and provides a preliminary qualitative assessment of risk based on the information currently available. Where a possible linkage is identified, it does not necessarily mean that a significant risk exists but indicates that further information is required through appropriate site investigation to substantiate the conceptual model.
- 6.4 The PCM/PRA is based on a proposed commercial and residential end use.

Table 3: Consequence, Probability and Risk

Probability	Consequence,	Risk
High Likelihood- There is a pollution linkage and an event either appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution	Very High – acute risk to the human health likely to result in significant harm. Risk of severe or irreversible effect on ground/surface water quality. Catastrophic damage to buildings / property.	Very High – there is a high potential that the source-pathway-receptor scenarios may give rise to harm to human health or the environment and remedial action is likely to be required.
Likely – there is a pollution linkage and all the elements are present, which means that it is probable an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.	High – Severe or irreversible effect on human health. Temporary severe or irreversible effect on ground/surface water quality. Reduction of water quality rendering groundwater or surface water unfit to drink and/or substantial adverse impact on groundwater dependant environmental receptors.	High – it is likely that the source-pathway-receptor scenarios may give rise to an impact on human health or the environment, which may require remediation and/or control measures to mitigate risks
Low likelihood– there is a pollutant linkage and circumstances are possible for an event could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter term	Moderate – Long term or short-term moderate effect on human health. Moderate effect on ground/surface water quality, reversible with time. Reduced reliability of a supply at a groundwater or surface water abstraction source	Moderate – it is possible that the source-pathway-receptor scenarios may give rise to an impact on human health or the environment, however it is either relatively unlikely that such are would be severe, or if any harm were to occur it is more likely that harm would be mild.
Unlikely – there is a pollution linkage, but circumstances are such that it is doubtful that an event would occur even in the very long term.	Low – Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc.) Slight effect on ground/surface water quality, reversible with time. Marginal reduced reliability of a supply at a groundwater or surface water abstraction source.	Low – it is possible that harm could arise at the source, however it is likely that this would at worst be mild.
		Very Low – it is unlikely that the source-pathway-receptor scenarios will give rise to an impact on human health or the environment.

Table 4: Estimation of Level of Risk by Comparison of Consequence and Probability

		Consequence			
		High	Moderate	Low	Very low
Probability	High Likelihood	Very High	High risk	Moderate risk	Moderate to low risk
	Likely	High risk	Moderate risk	Moderate to low risk	Low risk
	Low Likelihood	Moderate risk	Moderate to low risk	Low risk	Very low risk
	Unlikely	Moderate to low risk	Low risk	Very low risk	Very low risk

Potential Sources

- 6.5 The site was previously used as an iron works, and then was developed into offices and car parks for the nearby Acrefair engineering works which was closed in 2009. Since then the buildings have been removed from the site, which is currently vacant and disused.
- 6.6 There is potential for the presence of contamination associated with the following:
- Made Ground from various phases of on-site development and railway land
 - Asbestos containing materials (ACM) from former structures
 - Ground gas associated with deep made ground, and infilled features from railway land
- 6.7 Contaminants may therefore include heavy metals, polycyclic aromatic hydrocarbons (PAH), total petroleum hydrocarbons (TPH), BTEX compounds, Volatile Organic Compounds (VOC), Polychlorinated Biphenyls (PCB), asbestos and ground gases (Carbon dioxide and methane).

Potential Receptors

- 6.8 The following receptors have been considered for the construction and operational stages of the proposed redevelopment.
- Current site users;
 - Adjacent land users;
 - Future land users;
 - Construction workers during site development works;
 - Groundwater within the underlying aquifer.

Potential Pathways

- 6.9 The following pathways have been considered for the construction and operational stages of the proposed redevelopment.
- Dermal contact, ingestion, inhalation pathways of potentially contaminated soils;
 - Downward vertical migration of leachate to shallow groundwater;
 - Vertical or lateral migration of ground gas.

Table 5: Preliminary Conceptual Model

Source	Pathway	Receptor	Probability	Consequence	Risk	Comment
Made Ground across site (Heavy Metals, PAH & TPH)	Dermal contact, ingestion and inhalation of soils dust	Current Site Users	Unlikely	Moderate	Low risk	The site is currently unoccupied. There is therefore no potential for direct contact between contaminated soils and receptors. The risk is therefore considered to be LOW .
		Adjacent land users	Low Likelihood	Moderate	Moderate to Low risk	Residential properties partially surround the site. The risk is considered MODERATE to LOW and usual dust control measures should be implemented as part of good site working practices during construction to reduce dust generation.
		Future land users	Unlikely	Moderate	Moderate to Low risk	The proposed development will be a commercial property so there will be minimum contact with soils by future land users. The site will be covered by hardstanding further reducing any possible exposure. The risk to future site users is thought to be LOW . This assessment is based on the sensitivity of the receptor and the potential for contamination to be present beneath the proposed garden area.
		Construction Workers	Low Likelihood	Moderate	Moderate to Low risk	Construction workers are likely to be exposed to potentially contaminated Made Ground materials during construction works, however exposure duration will be short-term only. Assuming appropriate health and safety measures are adopted (in line with CDM and other relevant health and safety guidance) a MODERATE to LOW risk to construction workers is anticipated.
	Downward vertical migration of leachate to shallow groundwater	Groundwater within the Underlying Aquifer	Low likelihood	Moderate	Moderate to Low risk	Shallow ground water may be present below the site, there are nearby abstraction licenses and the underlying superficial soils have potentially high permeability. Therefore, the risk to groundwater is thought to be MODERATE to LOW .
	Vertical or lateral migration of ground gas	Current Site Users	Unlikely	Moderate	Low risk	There is potential for Made Ground soils beneath the site due to the various stages of on-site development. However, the site is currently vacant therefore the risk to current site is therefore considered LOW .
		Adjacent land users	Unlikely	Moderate	Moderate to Low risk	There is potential for made ground on site. As the superficial soils have possibly high permeability there is a risk of ground gas migration. However, the extent of this is unclear. The risk from ground gas migration is MODERATE to LOW .

Source	Pathway	Receptor	Probability	Consequence	Risk	Comment
		Future land users	Low Likelihood	Moderate	Moderate to Low risk	There is potential for Made Ground from former structures and potentially organic soils beneath the site. However, given the proposed commercial use of the site, and the fact it is likely to be covered in hardstanding means the risk to future site users from ground gas is therefore considered MODERATE to LOW .
		Construction Workers	Low Likelihood	Moderate	Moderate to Low risk	Construction workers may be exposed to ground gas/depleted oxygen conditions in confined spaces and excavations; however, the duration will be short term. The risk to construction workers from ground gas is considered MODERATE to LOW .
Asbestos Containing Material (ACM)		Current Site Users	Unlikely	Moderate	Low risk	Asbestos may be present in the Made Ground soils beneath the site. However, asbestos is only harmful when disturbed. The site is currently unoccupied and there is therefore no plausible pollutant linkage. The risk to current site users is considered to be LOW .
		Adjacent land users	Low Likelihood	Moderate	Moderate to Low risk	Asbestos may be present in the Made Ground soils beneath the site. Disturbance of soil during the construction phase may allow fibres to become airborne. The risk is therefore considered MODERATE . Dust control measures (dampening down) should be implemented as part of good site working practices in order to reduce the risk to LOW .
		Future land users	Low Likelihood	Moderate	Moderate to Low risk	There is potential for asbestos beneath the site. However, given the proposed commercial use of the site, and the fact it is likely to be covered in hardstanding means the risk to future site users is therefore considered MODERATE to LOW .
		Construction Workers	Low Likelihood	Moderate	Moderate to Low risk	Construction workers will be exposed to potential asbestos in soils during the construction phase. The risk is considered MODERATE . A contamination assessment of the existing on-site soils would be required to determine the level of risk and necessary mitigation measures.

7.0 CONCLUSIONS & RECOMMENDATIONS

Conclusions

- 7.1 The site is currently vacant and almost entirely covered in hardstanding. Previously the site was an ironworks, followed by offices and car parking for an engineering works. There is contamination potential from the past uses as ironworks, the on-site railway and from former structures on site.
- 7.2 The proposed development of the site is not finalised at time of issue; however, the development is thought to be of a commercial or residential end use.
- 7.3 The site is underlain by Devensian Till deposits (Secondary Undifferentiated Aquifer) and the Pennine Lower Coal Measures Formation of mudstone, coal seams, siltstone and sandstone.
- 7.4 The overall risk from soil contamination to commercial end users and construction workers is concluded to be **MODERATE to LOW**.
- 7.5 The risk to controlled waters is concluded to be **MODERATE TO LOW** based on the underlying geology and presence of a nearby abstraction.
- 7.5 Given the anticipated extent and age of made ground and presence of railway land on site the risk from ground gas to end users is considered to be **MODERATE to LOW**.

Recommendations

- 7.6 An intrusive investigation should be undertaken to establish geotechnical parameters for the design of foundations, floor slabs and pavement construction for the proposed new structures and surrounding area.
- 7.7 As part of the geotechnical investigation, it is recommended that samples of soil are recovered for contamination testing and to confirm whether there are any potential risks.
- 7.8 Ground gas and groundwater monitoring standpipes should be also installed to facilitate future monitoring of the ground gas regime and allow sampling of groundwater for contamination testing.
- 7.9 Given that the site is over 1ha in size, a flood risk assessment should be carried out for the site.
- 7.10 The site lies within a Radon Affected Area and therefore radon protection measures will be necessary for any development. Alternatively, the radon risk could be assessed by use of in-situ soil radon monitors.

APPENDIX 1

GROUNDSURE REPORTS

APPENDIX 2

SITE PHOTOGRAPHS

Earth Environmental & Geotechnical Ltd Tel: 0161 975 6088 Email: info@earthenvironmental.co.uk Web: www.earthenvironmental.co.uk	SITE PHOTOGRAPHS 
Job No.: A3341/19	Site: Acrefair, Wrexham
Plate 1 View of site looking north	Plate 2 View across site looking north along eastern boundary
	
Date: 4th December 2019	Date: 4th December 2019
Plate 3 Former kiln on eastern boundary	Plate 4 Distressed stone retaining wall
	
Date: 4th December 2019	Date: 4th December 2019

APPENDIX 3

SITE WALKOVER NOTES

WALK OVER SURVEY REPORT

Site: Acrefair, Wrexham

Date: 4th December 2019

Job No: A3341/19

Undertaken By: A Czarnecki

Purpose of Site Walkover:

- 1) Provide further information for the Desk Study Report;
- 2) Identify potential contamination sources, pathways and receptors;
- 3) Identify geotechnical features and potential geohazards;
- 4) Determine locations for exploratory boreholes.

Desk Study features checked during site visit	Feature and Information required	Present	Description / Comments
Site Setting	Description required for: Town/Country/Suburb Setting Industrial/Residential/Retail Usage Current Site use (if undertaking security and access to the site)		Vacant
Evidence of Past Activities	Are there: Any relevant street names in area? Features or relics which indicate past history?	Yes /No Yes/ No	Former kiln on eastern boundary
Geographic Setting	Description required for: Low lying flood plain/dry valley/rolling hills etc.		The site lies within a countryside setting on the fringe of an urban area.
Ground Conditions	Is there any evidence of: Mining, Mine entries Subsidence Landslip/slope erosion Former investigation works	Yes /No Yes /No Yes/ No	Evidence of former drilling activities at two locations

Desk Study features checked during site visit	Feature and Information required	Present	Description / Comments
Topography	Description required for: Are there apparent differences between site and surrounding area? (If yes describe the presence of retaining walls, and slopes). Is there evidence of Made Ground / Fill on site?	Yes/No Yes/No	The eastern boundary of the site is a wooded embankment Demolition fill spread across the site.
Site Boundaries and Neighbours	Description required for: Type of boundary demarcation (if any) on each side of site, usage of adjacent land and name of industrial/commercial occupiers. Note any adjacent features such as water course and other potentially environmentally sensitive uses (residential, school, infirmary, SSSI etc)		
Vegetation	Are there any vegetation/trees on or close to site (if yes describe locations, type, maturity, etc) Is there any evidence of poor health / distress?	Yes/No Yes/No	Eastern boundary is heavily wooded.
Ground Surface	Are there areas of hardstanding and estimate the split between hard and soft cover? (If yes describe locations, types and conditions). Is there any evidence of any spillages or staining?	Yes/No Yes/No	Former car-park tarmac surface.

Desk Study features checked during site visit	Feature and Information required	Present	Description / Comments
Site Drainage	Are there any drain covers / soakaways (if yes describe locations) Are there any outfalls/water courses on site (note the condition of water courses in open water courses. discolouration, odour, eutrophication, oily sheen, gas bubbling water, clear or cloudy) Where a watercourse runs alongside or crosses a site are there any differences in visible water quality upstream and downstream of the site?	Yes/No Yes/No Yes/No	
Electrical Equipment	Are there any electricity sub stations on or adjacent to the site? Are there any electrical transformers, capacitors, pylons etc on site?	Yes /No	N/A
Buildings	Is there any evidence of asbestos construction materials e.g. roofing, insulation materials. Do any buildings have basements? Do any buildings have a boiler room (if yes, describe fuel type and storage arrangements)?	Yes/No Yes/No Yes/No	N/A

Desk Study features checked during site visit	Feature and Information required	Present	Description / Comments
Landfilling	Is there any evidence of gas protection measures (gas membrane, gravel-filled trenches, venting pipes, etc)?	Yes /No	N/A
Process Air Emissions	Point Source: Are there any stacks / vents / cooling towers / abatement equipment?	Yes /No	N/A
	Fugitive Source: is there any stockpiled material / windblown dust / vapour process?	Yes /No	N/A
Storage of fuels & Chemicals	Are there any drums / containers (if yes, describe quantity, full /empty, stored on hard standing / soft landscaping, bunding)?	Yes /No	
	Are there any above ground fuel tanks (if yes, describe locations, volumes, how many, bunding, used / disused, condition?)	Yes /No	
	Is there any evidence of underground fuel tanks (fuel pumps, covers, vent pipes, how many and how large, fill point, used / disused, and condition)?	Yes /No	
Accidents	In the event of a large spillage would runoff affect any vulnerable watercourse/culverts?	Yes /No	N/A
	Are emergency procedures / equipment in place?	Yes /No	

Desk Study features checked during site visit	Feature and Information required	Present	Description / Comments
Waste	Are there any waste skips present on site? Are waste storage facilities adequate? Is there any litter/fly tipped material?	Yes/No Yes/No Yes/No	N/A
Atmospheric	Are there any fumes, odours originating from site or affecting site from neighbouring sites?	Yes/No	
Access / Further Investigations	If a Phase 2 Investigation is likely to be required, describe any access problems including headroom where relevant, services, overhead cables, restricted access areas, confined spaces, trafficked areas, etc that are likely to affect investigation scope/techniques. Identify possible site office and storage locations. Identify possible water supply		
Site Environs	Are there any local features that could have a harmful influence e.g. landfill, industrial processes, railway land? Are there any sensitive water features/courses near to the site?	Yes/No Yes/No	
Local Knowledge / Anecdotal Evidence			
Site Dimensions	Describe shape of Site in plan and measure dimensions.		

APPENDIX 4

REPORT LIMITATIONS

LIMITATIONS

This contract was completed by Earth Environmental & Geotechnical Ltd on the basis of a defined programme and scope of works and terms and conditions agreed with the client. This report was compiled with all reasonable skill, and care, bearing in mind the project objectives, the agreed scope of works, the prevailing site conditions, the budget and staff resources allocated to the project.

Other than that, expressly contained in the above paragraph, Earth Environmental & Geotechnical Ltd 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 Earth Environmental & Geotechnical Ltd.

If a third party relies on this report, it does so wholly at its own and sole risk and Earth Environmental & Geotechnical Ltd disclaims any liability to such parties.

It is Earth Environmental & Geotechnical Ltd understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was an important 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 will no longer be valid and any further use of, or reliance upon the report in those circumstances by the client without Earth Environmental & Geotechnical Ltd review and advice shall be at the client's sole and own risk.

The report was written in 2019 and should be read in light of any subsequent changes in legislation, statutory requirements and industry best 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 Earth Environmental & Geotechnical Ltd. In the absence of such written advice of Earth Environmental & Geotechnical Ltd, reliance on the report in the future shall be at the client's own and sole risk. Should Earth Environmental & Geotechnical Ltd be requested to review the report in the future, Earth Environmental & Geotechnical Ltd shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between Earth Environmental & Geotechnical Ltd 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 Earth Environmental & Geotechnical Ltd. Earth Environmental & Geotechnical Ltd has not performed any observations, investigations, studies or testing not specifically set out or mentioned within this report.

Earth Environmental & Geotechnical Ltd 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, Earth Environmental & Geotechnical Ltd did not seek to evaluate the presence on or off the site of electromagnetic fields, lead paint, radon gas or other radioactive materials.

The services are based upon Earth Environmental & Geotechnical Ltd observations of existing physical conditions at the site gained from a walkover survey of the site together with Earth Environmental & Geotechnical Ltd 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 Earth Environmental & Geotechnical 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 Earth Environmental & Geotechnical Ltd 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. Earth Environmental & Geotechnical Ltd is not liable for any inaccurate information, misrepresentation of data 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 Earth Environmental & Geotechnical Ltd and including the doing of any independent investigation of the information provided to Earth Environmental & Geotechnical Ltd save as otherwise provided in the terms of the contract between the client and Earth Environmental & Geotechnical Ltd.

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 Earth Environmental & Geotechnical Ltd] 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.