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Carter Jonas

Ruabon Park, Wrexham

Phase 1 Contamination Assessment Report

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Project Revision Sheet

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Executive Summary

Details	Summary of Main Text
Introduction	This report has been prepared on the instructions of Carter Jonas which proposes to market the site on behalf of their client for mixed industrial and residential purposes. It presents the results of a Phase 1 Contamination Assessment for the development.
Site Description	The 24.62 acre site consists of farmland.
Summary of Historical Mapping	Historical maps indicate the site has consisted of agricultural farmland, since the earliest editions. From 1900-1961 a football ground was present in the southwest corner of the site. A colliery was present directly to the west from 1873-1967 with the groundsure report indicating that this may have extended onto the site. The colliery was decommissioned in the 1960's. Railway sidings are noted 25m to the northwest from 1873-1960, with the groundsure report stating that these may have extended onto the site. A quarry was present 100m to the northwest from 1899-1961.
Environmental Setting	Published geology is of glaciofluvial deposits within the north east of the site with Glacial Till overlying the remainder of the site overlying the Etruria Formation (Mudstone) on the eastern and central sections of the site, Pennine Lower Coal Measures Formation on the western edge of the site. The glaciofluvial deposits are classified as a secondary (A) aquifer, the Till as unproductive strata, and the Etruria Formation and the Pennine Lower Coal Measures Formation as secondary (A) aquifers. The site is not within a groundwater source protection zone. The nearest surface water feature is a large pond in the centre of the site The site is bordered to the east by James Caravan Park with the A483 and fields beyond this, to the north by the A539 with residential properties beyond, to the west by Clwyd Caravan & Leisure with the B5605 beyond and to the south by farmland. The site is indicated to be within an area affected by radon as between 10 and 30% of properties are above the Action Level. Full radon protective measures are necessary.
Environmental Search Data	The following environmental search entries were identified that could potentially affect site condition: • Discharge consent – Container site (226m west) • Waste treatment plants – Tyre recycling plant (173m west) • Current industrial sites – Clwyd Caravans & Leisure Ltd (94m west), Electricity substation (133m north), Hopper (153m southwest), Civic Amenity site (201m west), Electricity substation (234m west).
Potential Contamination Sources	The desk study and site reconnaissance have identified the following potential sources of contamination that could affect site condition: • Infilled former ponds (on-site) • Made ground associated with former sports ground and suspected road feature(on-site) • Agricultural use of site associated with farming (on-site) • Former marshland (on-site) • Infilled unspecified mine (on-site) • Historical colliery (adjacent to western boundary) • Historical tanks (122m northwest) • Spoil heaps associated with former colliery (5m northwest) • Historical railway (adjacent to northwest and west)
Risk Ratings	Low to High
Recommendations	• Intrusive investigation to confirm desk study findings. To include: (i) sampling and testing of soils to determine contaminative nature of soils and groundwater, (ii) monitoring wells and an appropriate number of visits to establish the presence and levels of ground gas.

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	• The Mineral and Waste Planning Officer at Wrexham County Council should be contacted to confirm that the site does not lie over a potentially workable coal deposit.

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Desk Study General Notes

1 This report has been prepared by MLM Consulting Engineers Ltd (MLMCEL) and provides available factual data for the site at the time of the study and as obtained from the sources described in the text. The data is related to the site on the basis of the site location information provided by the Client.

2 It should be appreciated that the desk study information is not necessarily exhaustive and that further information relevant to the site and its proposed use may be available.

3 The accuracy of map extracts cannot be guaranteed and it should be recognised that different conditions on site may have existed between and subsequent to the various map editions.

4 Any borehole data from the British Geological Survey (BGS) sources is included on the following basis: 'The British Geological Survey accept no responsibility for omissions or misinterpretations of the data from their Data Bank as this may be old or obtained from non-BGS sources and may not represent current interpretation'.

5 Unless stated otherwise, the identification and assessment of potential of geotechnical issues is excluded from this report, although such assessments can be undertaken by MLMCEL on request.

6 The copyright in this report and other plans and documents prepared by MLMCEL in relation to this project is owned by MLMCEL and no such report, plan or document may be reproduced, published or adapted without their written consent. Complete copies of this report may, however, be made and distributed by the Client as an expedient in dealing with matters related to its commission.

7 The content of websites visited during internet searches has not been validated and is accepted *de facto* and without prejudice. Anyone relying upon the information obtained from such sources does so at their own risk. Notwithstanding, MLMCEL takes all reasonable care in utilising information only from reputable and professional sources.

8 This report was prepared only for our Client and was not intended to be relied on by any other party. Third parties should not rely on the facts, matters or opinions set out in this report without the express written permission of MLMCEL.

9 The data contained within the Groundsure report is subject to the copyright and database rights ownership of the Groundsure Ltd.

10 Ordnance Survey mapping included within the Groundsure report is protected by Crown Copyright and must not be used for any purpose outside the context of this report.

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1 Introduction

1.1 General

This report has been prepared by MLM Consulting Engineers Limited (MLMCEL) on the instructions of Carter Jonas on behalf of their client, which is proposing to market the site for mixed use including residential and commercial development.

1.2 Terms of Reference

The terms of reference for the work were set out in the MLMCEL proposal 773135-FEE-ENV-001 dated 22 July 2015.

1.3 Scope of Work

This Phase 1 Contamination Assessment report presents the readily available information on and addresses the following:

- Current use and condition of the site based on a site walkover
- Previous uses of the site and surroundings based on available historical mapping and data
- Environmental setting in terms of geology, hydrogeology, hydrology and surrounding land use
- Environmental data searches
- Development of a preliminary conceptual site model and identification of potential risks to human health and environmental receptors
- Conclusions and recommendations

1.4 Technical Approach

The process of assessment adopted in this report generally follows the guidance provided in the following publications:

- Model Procedures for the Management of Land Contamination. Environment Agency Contaminated Land Report 11 (CLR11)
- GPLC1 – Guiding principles for land contamination. Environment Agency 2010
- National Planning Policy Framework (NPPF) (2012)
- NHBC Part 4 Foundations – Chapter 4.1 Land quality: Managing ground conditions

1.5 Proposed Development

It is understood that the proposed development will comprise the construction of 139,500 sq ft of office space, 50,000 sq ft of warehousing, 20,000 sq ft of retail, 30,000 sq ft of restaurant and/or hotel use, and 319 residential units. The existing pond in the centre of the site will remain.

An indicative site layout is shown on Bingham:Hall Associates drawing Combined Services Layout ref. 2978.100 rev P1 dated August 2015.

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2 The Site

2.1 Location

The site is located in Ruabon Park, Wrexham, LL14 3EH. The National Grid Reference for the site is 329736 343226.

A location plan of the site is presented as Figure 1.

2.2 Site Environmental Setting

2.2.1 Geology

Published geology is of Glacio-fluvial deposits in the north east of the site and Glacial Till deposits across the centre and south west. These superficial deposits generally overly a solid geology of the Etruria Formation (mudstone) which is recorded beneath the majority of the site with exception of the western extremity which is underlain by the Pennine Lower Coal Measures Formation.

The Groundsure Report (see section 3) indicates that the site is in an area affected by radon as between 10 and 30% of properties are above the Action Level. Full radon protective measures are likely to be necessary in new buildings.

The BGS borehole scan website indicates records of four boreholes having been drilled on site. One borehole encountered a strata sequence of topsoil (0.27m thick) and gravelly silty very sandy clay (4.35m thick).

2.2.2 Hydrogeology

The Environment Agency website provides the following hydrogeological information:

Table 2.1 Aquifer Properties

Aspect	Designation	Description
Groundwater Source Protection Zone	No SPZ	The site is not within a catchment area where groundwater is discharged to a source.
Superficial Aquifer Designation Glacio-fluvial deposits	Secondary Aquifer (A)	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.
Superficial Aquifer Designation Till	Unproductive Strata	These are deposits with low permeability that have negligible significance for water supply or river base flow.
Bedrock Aquifer Designation Etruria Formation	Secondary Aquifer (A)	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.
Bedrock Aquifer Designation Pennine Lower Coal Measures		

There is one historical groundwater abstraction within 2km for farming uses. It is located 1,992m to the northwest.

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There are no public water supply boreholes within 2km of the site.

2.2.3 Hydrology

The Groundsure report indicates that there are twelve significant surface water features within 250m of the site, including three that are on the site. The on site features include a small lake in the centre with a drain extending northwards, and ditches in the south and east.

The site is not shown to be in an area likely to be affected by sea or river flooding.

There are no abstractions from surface waters within 2km of the site.

2.2.4 Mining

A Coal Authority Mining Report has been obtained for the site and is summarised below. A full copy is attached as Appendix B.

The Coal Authority report states that the site is in the likely zone of influence from workings in nine seams of coal at 100 to 580m depth, and was last worked in 1927. The Coal Authority suggest that any ground movement associated with these coal workings should have ceased by now.

The report indicates that there are no known coal mine entries within, or within 20 metres of the boundary of the property. The Coal Authority is not aware of any evidence of damage arising due to geological faults or other lines of weakness that have been affected by coal mining.

The report indicates that there is no record of a mine gas emission requiring action by the Coal Authority within the boundary of the property.

The report states that the property is not in an area for which the Coal Authority is determining whether to grant a license to remove coal using underground methods. However, reserves of coal exist in the local area which could be worked at some time in the future.

The report does not indicate that there are records of notice of the risk of the land being affected by subsidence having been given under section 46 of the Coal Mining Subsidence Act 1991.

Review of the geological information available from the BGS and the information given within the Coal Authority Mining Report indicates that although coal horizons may exist beneath the site, they are at a significant depth and it is considered unlikely that any instability associated with these coal horizons would impact upon the site.

2.2.4.1 Groundsure Report

The Groundsure report states that there is one record of a coal mining area within 1000m of the site boundary. This is on site and is indicated to be an unspecified disused mine.

The report also states that there are three non-coal mining areas within 1000m of the site. These are also all on site and are listed as a potential for occasional small scale mining of veins and rare minor bedded iron ore mining.

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2.2.5 Mineral Resource and Safeguarding

From reference to the British Geological Survey (BGS) Mineral Resources Map for North East Wales, the western edge of the site is situated within an area of Secondary Shallow Coal resource which is considered a mineral safeguarding area. From review of the Coal Authority interactive map this appears to relate to the presence of shallow surface coal resource which could potentially be worked.

There is no direct evidence at this stage to confirm if any workable coal is actually present, and the closure of the adjacent colliery indicates that productive coal resources within the area would have been exploited during the working life of the colliery. In MLM's view, to extract coal from below the site as a standalone operation would not be economically viable. In addition, to extract coal from below the site would impact on the adjacent road and rail line.

It is recommended that confirmation of the above is sought from the Mineral and Waste Planning Officer at Wrexham County Council.

2.3 Previous Reports

Report	Summary
Geotechnical Engineering Ltd (2003) Ruabon Business Park Ref. 14991	Geotechnical Engineering undertook an intrusive investigation to determine ground conditions across a site area which approximates to the eastern section of the current Ruabon Park Development site. The fieldwork was carried out on the 18-19 September 2003 and comprised the excavation of twenty two trial pits with soakaway testing in five of those trial pits. The trial pits ranged in depth from 1.70m-3.30m bgl. Ground conditions generally comprised silty sand, coarse gravel and sandy clay deposits although made ground was recorded in three of the trial pits, TP05, TP05a and TP14 in the east and west of the site to a depth of 1.0m. No laboratory testing or interpretation of the results of the investigation works was undertaken.

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3 Site Reconnaissance and Desk Study

3.1 General

A desk study has been carried out using information obtained from a Groundsure EnviroInsight report for the area commissioned by MLMCEL; through a review of published information, information obtained from regulatory bodies and online and from a site walkover. The full Groundsure report has been included as Appendix A.

3.2 Site Reconnaissance

3.2.1 Site Description and Use

The 24.6 hectare site is irregular in shape, generally flat lying and is currently used as farmland. Access is via the A539 along the northern boundary or from a small side road on the western boundary.

It predominantly consists of well-maintained, agricultural fields which are currently farmed. No hardstanding was present within the site boundary although compacted unmade tracks are present along the western edge.

A small elongated lake with an island is present in the centre of the site. A drain extends northwards from the lake. Ditches are present along the southern boundary and extend off site from the eastern boundary. Trees surround the pond and are also present along the western and northern boundaries. Shrubs and smaller trees are present along the southern boundary.

No evidence of trespassing or flytipping was noted on site. Overhead electricity power lines cross the site from the southwest to the northeast corner, with an offshoot to the northwest corner from the centre.

Aerial photos show an unidentified structure to the north of the pond. However, at the time of the investigation only a large mound of soil was present in this location. The previous by Geotechnical Engineering Ltd ref report indicates that a road had been planned to be built across the site in 2003, but was never completed. It is possible that this feature is related to initial ground works associated with the proposed road.

3.2.2 Surrounding Land Use

A caravan sales yard is adjacent to the western boundary of the site. The A539 and B5605 is present to the north with fields and housing beyond. Agricultural fields are present to the south and James' Caravan Park and the A483 is present to the eastern with fields beyond it.

3.3 Site History

Historical maps have been obtained as part of the Groundsure Report and these are presented in Appendix A.

The historical information of relevance from within 200m of the site is presented as follows:

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Table 3.1 Historical Map Summary

Map Date	On Site	Surrounding Area
1873 (1:10,560), 1873 (1:2,500)	Site is indicated to be farmland with a small lake in the centre. The western edge of the site is shown as dense vegetation and trees. A line of trees is shown running along the eastern boundary. A pond is indicated in the north west.	Shrewsbury and Chester railway line is present approximately 50m to the north and west. Wynnstay Colliery is located directly to the west of the site. Agricultural fields are present immediately adjacent to the northern, eastern and southern boundaries. James' Farm is located approximately 100m to the east. Home Farm and a pond are shown approximately 100m south of the site. Pond 150m south. Railway sidings are shown 25m to the north west associated with the Wynnstay Colliery. Ditch adjacent southeast boundary.
1899, 1900 (1:2,500) 1900 (1:10,560)	Pond in northeast has been infilled. Football ground in south west corner.	Spoil heaps associated with colliery 150m to north west with old quarry marked to the north of it. Smithy 100m north.
1910, 1914, 1938, 1949 (1:10,560), 1912 (1:2,500)	Tennis ground indicated adjacent to football ground in the south west. Marshland indicated to the west of the lake.	Spoil heaps have expanded and have infilled the old quarry. Gravel pit 100m east.
1960, 1968 (1:10,560), 1961, 1967 (1:2,500)	Football ground and tennis courts are no longer present. Pond in eastern corner.	Railway sidings are no longer present. Wynnstay Colliery is shown as disused 'Mine' and 'The Green' and many of the buildings have been removed. Smithy to the north is shown as cottages.
1971 (1:2,500), 1974 (1:10,000)	Drain along southwestern boundary.	Spoil heap appears to have been flattened out.
1978 (1:2,500), 1985 (1:10,000)	Pond in east is shown as marshland	No significant change from previous editions.
1989, 1990, 1991, 1992(1:2,500), 1994 (1:10,000), 1994, 1995 (1:2,500)	No significant change from previous editions.	A483 constructed 150m to the south east and east of the site. Caravan park present 100m to the east. A539 constructed directly to the north. Wynnstay Technology Park 150m and a Civic Amenity Centre to west.
2002, 2010, 2014 (1:10,000),	No significant change from previous editions.	Gravel pit to west has been infilled.

3.4 Environmental Data Searches

Environmental data has been obtained for the site from a Groundsure report and from data provided by the Environment Agency and local authority or their websites. Table 3.2 summarises this data as presented by Groundsure.

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Table 3.2 Environmental Data

Aspect	On Site	0 – 250m	Details of Relevance
Historical Industrial Sites			
Potentially Contaminative Uses Identified from 1:10,000 scale mapping	5	84	On site: Railway sidings (1873 and 1898). Unspecified disused mine (1960). Colliery (1873 and 1898).
Historical tank database	0	10	Unspecified tank 122m northwest (1899).
Historical energy features database	0	6	Electricity Substation 174m east (1992).
Potentially Infilled Land	12	63	On site: Unspecified disused mine (1960) Colliery (1873 and 1898) Pond or water body (1873 to 1994)
Environmental Permits, Incidents and Registers			
Records of Licensed Discharge Consents	0	1	Unspecified effluent 226m west (expired 1993)
National Incidents Recording System, List 2	1	4	On site: Atmospheric Pollutants (2006), Ammonia / Amine Odour Off site: Sewage Materials – 69m east (2012), 153m east (2013 Other pollutant - 112m southwest (2002) Blood and offal – 171m southwest (2001)
Landfill and Other Waste Sites			
Operational and Non-Operational Waste Treatment or Disposal Sites	0	4	173m west. Tyre recycling plant and unspecified.

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Industrial Land Use			
Current industrial sites	0	5	Vehicle hire 94m west Electricity substation 133m north Hoppers and silos 153m southwest Refuse disposal facilities 201m west Electricity substation 234m northwest
Ground Workings			
Historical surface ground working features from small scale mapping	8	46	Pond (1873-1949) Pond (1974-1985) Water body (1960) Colliery (1873)
Historical underground workings from small scale mapping	2	1	Unspecified disused mine (1960) Colliery (1873)
Current ground workings	0	2	Wynnstay Colliery 73m west (ceased) Wynnstay 175m northwest (ceased)
Mining, Extraction and Natural Cavities			
Historical Mining	2	1	Colliery (1873) Unspecified disused mine (1960)
Coal Mining	1	0	Potential for coal mining within the vicinity of the site
Non-Coal Mining	3	0	Identified potential for occasional minor vein mineral mining and/or rare and localised small scale iron ore mining

The Groundsure Report records that the historical colliery and features associated with the colliery including railway sidings and infilled land are within the site boundary. Review of the historical mapping indicates that these features are not within the boundary of the proposed development site but are recorded adjacent to this boundary. These features are therefore considered to be off site.

The records of non-coal mining indicate a possibility for occasional small scale vein mineral and/or iron ore workings within the site. There was no evidence during the site walkover or on historical mapping of vein mineral or iron ore mining within the site and the risk of vein or iron ore mining is considered to relate to the Pennine Coal Measures strata underlying the western edge of the site.

The records from the National Incidents Recording System indicate ammonia / amine odour on site in 2006 and a spillage of sewage within the caravan site 69m

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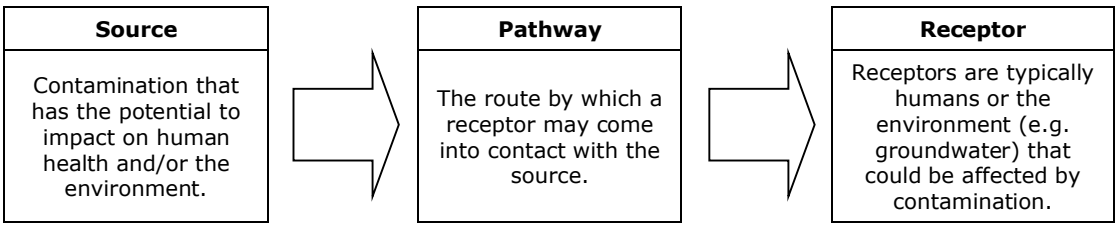
east of the site in 2012. Neither of these incidents are considered to have significantly impacted the site.

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4 Conceptual Site Model and Preliminary Assessment

4.1 General

The assessment of risk from contamination follows the source-pathway-receptor approach. Each of these elements is described as follows.



Without a source-pathway-receptor linkage in place, it is considered that there is no risk of harm.

If, however, there is a linkage between source and receptor then a risk-based assessment called a Qualitative Risk Assessment (QRA) is used to determine the significance or potential impact of the SPR-linkage.

The QRA process involves the identification of sources based on historical mapping, data searches and site walkover, together with identification of the exposure pathway and sensitive receptor. A Conceptual Site Model (CSM) is then developed and presented that shows the possible pollution linkages.

In terms of identifying *significant* pollution linkages (i.e. those that could require remediation), MLMCEL assigns a level of risk to each (ranging from Very High to Very Low). Where the level of risk is Moderate or greater, then the pollution linkage is considered to be 'significant' and further investigation would be required.

4.2 Review of Potential Sources of Contamination

Based on the information presented in the previous sections, potential sources of contamination that could impact on receptors have been identified and are summarized in tables 4.1 and 4.2 below.

Table 4.1 Potential Sources of Contamination – On Site

Source	Location On Site	Activity	Potential Contaminants
Infilled ponds	Northwest and west	Infilled land	Metals, TPH, PAH, ground gas.
Made ground	Southwest and north	Former sports ground and unidentified structure	Metals, TPH, PAH, ground gas, asbestos.
Agricultural use of the site	Entire site	Use of pesticides and fertilisers	Metals, pesticides.
Former marshland	Centre and west	Decomposition of organic matter in natural soils	Ground gas.
Infilled land	West	Infilled coal mining entry	Metals, TPH, PAH, ground gas, asbestos.

As discussed within Section 3.4, the former colliery and former railway sidings have been noted on the historical mapping to be adjacent to the site boundary to the

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west and are not considered to have been present within the boundary of the proposed development area.

Table 4.2 Potential Sources of Contamination – Off Site

Source	Location Off Site	Activity	Potential Contaminants
Former colliery site	Adjacent to west	Former colliery. Infilled land, possible tanks.	TPH, ground gas
Historical tanks	122NW	Industrial	TPH, hydrocarbons, organic vapour
Infilled land	5NW	Spoil heaps associated with the former colliery site.	Ground gas
Former railway	Adjacent to northwest and west	Leaks and spills of fuels	TPH

4.3 Review of Potential Exposure Pathways

Table 4.3 below presents a review of the identified potential pathways that could exist at the site, whether or not a source of contamination has been identified above.

Table 4.3 Potential Exposure Pathways and Receptors

Receptor	Pathway	Present	Notes
Human Health			
Future Site Users	Dermal contact, ingestion or inhalation of soil and soil dust	YES	Residential development including gardens is proposed.
	Migration in permeable strata and inhalation of gas and/or organic vapour	YES	New buildings are proposed. Shallow soils are mixed and considered permeable.
	Migration in permeable strata, accumulation and risk of explosion	YES	New buildings are proposed. Shallow soils are considered permeable.
Adjacent Site Users	Ingestion/inhalation of windblown dust	YES	Residential development is adjacent including a caravan park.
	Migration in groundwater and direct contact	NO	Off site residents are unlikely to come into contact with groundwater.
	Migration in groundwater and inhalation of organic vapour	YES	Organic contaminants in groundwater could migrate off site and release organic vapour
Construction Workers and Services Repair Staff	Dermal contact, ingestion or inhalation of soil and soil dust	YES	Site workers could be exposed to soil contamination during groundworks.
Development			

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Future Plant Life	Plant uptake in garden or landscape area	YES	Residential development including gardens is proposed.
Water Supply Pipes	Contact with contaminated material	YES	New services will be constructed below ground.
Environment			
Surface Water:	Surface runoff	YES	Site is generally level however there is a lake in the centre of the site which runoff could enter.
	Groundwater movement	YES	Groundwater may be in hydraulic connection with surface water via Glacio-fluvial Deposits.
Superficial aquifer (Glaciofluvial deposits)	Leaching from soil and vertical fluid movement	YES	Glacio-fluvial superficial aquifer is unconfined. Potential for leaching of contaminants into Glacio-fluvial soils.
Superficial aquifer (Glacial Till)	Leaching from soil and vertical fluid movement	NO	Superficial aquifer materials are unproductive strata
Bedrock aquifer (Etruria Formation and the Pennine Lower Coal Measures Formation)	Leaching from soil and vertical fluid movement	YES	Secondary (A) aquifer is unconfined beneath Glacio-fluvial deposits.

4.4 Potentially Complete SPR-Linkages

Based on the sources, pathways and receptors identified above, tables 4.4 and 4.5 below summarise all potentially complete pollutant linkages for the site and identifies the level of risk from each. Risk definitions are provided in Appendix C.

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Table 4.4 Potentially Complete SPR-Linkages (on site sources of contamination)

Source	Location	Contaminants	Pathway	Receptor	Probability	Consequence	Overall Risk	Justification and/or Mitigating Factors
Infilled Ponds	Northeast and east	Metals, TPH, PAH	Ingestion, dermal contact and fugitive inhalation	Site users	Likely	Medium	Moderate	Site users could be exposed to soil contamination within garden and soft landscaped areas.
				Construction and services repair workers	Likely	Medium	Moderate	Site workers could be exposed to soil contamination during groundworks.
				Adjacent site users	Low	Medium	Low	Residential development is adjacent. However the exposure period will be short term.
			Leaching (Glacial Till deposits)	Shallow groundwater	Unlikely	Medium	Low	Superficial Till is unproductive strata.
			Leaching (Glacio-fluvial deposits)	Shallow groundwater	Likely	Medium	Moderate	Superficial aquifer is Secondary 'A' aquifer and is unconfined.
			Leaching from soil and vertical fluid movement	Superficial aquifer groundwater (Glacial Till deposits)	Unlikely	Medium	Low	Superficial Till is unproductive strata.
			Leaching from soil and vertical fluid movement	Superficial aquifer groundwater (Glacio-fluvial deposits)	Likely	Medium	Moderate	Glaciofluvial soils are a Secondary 'A' aquifer and is unconfined.
			Leaching from soil and vertical fluid	Bedrock aquifer groundwater	Likely	Medium	Moderate	In part of the site, the Secondary (A) aquifer is overlain by

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			movement					permeable superficial strata.
			Surface runoff	Surface water	Low Likelihood	Medium	Low	Site is generally level however there is a lake in the centre of the site which surface runoff could impact.
		Metals	Plant uptake	Planting	Likely	Mild	Low	Residential development is proposed including garden areas
		TPH	Migration and contact	Water supply pipes	Likely	Medium	Moderate	New services will be constructed below ground.
		Organic contaminants	Migration in groundwater and inhalation of organic vapour	Adjacent site users	Likely	Medium	Moderate	Organic contaminants in groundwater could migrate off site and release organic vapour.
		Ground gas	Migration and inhalation	Site users	Likely	Medium	Moderate	New buildings are proposed. Possible accumulation of carbon dioxide within enclosed spaces could impact on proposed housing.
				Construction and services repair workers	Likely	Medium	Moderate	
			Migration and explosion	Site users	Likely	Severe	High	New buildings are proposed. Possible accumulation of methane within buildings.
Former sports ground – made ground materials	South west	Metals, TPH, PAH, asbestos	Ingestion, dermal contact and fugitive inhalation	Site users	Likely	Medium	Moderate	Site users could be exposed to soil contamination in gardens or soft landscape areas.

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Unidentified feature	North			Construction and services repair workers	Likely	Medium	Moderate	Site workers could be exposed to soil contamination during groundworks.
				Adjacent site users	Low	Medium	Low	Residential development is adjacent. However the exposure period will be short term.
			Shallow groundwater	Leaching (Glacial Till deposits)	Unlikely	Medium	Low	Superficial Till is unproductive strata.
			Leaching from soil and vertical fluid movement	Superficial aquifer groundwater (Glaciofluvial deposits)	Unlikely	Medium	Low	Glaciofluvial soils are unconfined.
			Leaching from soil and vertical fluid movement	Bedrock aquifer groundwater	Unlikely	Medium	Low	Secondary (A) aquifer is overlain by unproductive strata.
		Metals	Plant uptake	Planting	Likely	Mild	Low	Residential development is proposed including garden areas
		Hydrocarbons	Migration and contact	Water supply pipes	Likely	Medium	Moderate	New services will be constructed below ground.
		Ground gas	Migration and inhalation	Site users	Likely	Medium	Moderate	New buildings are proposed. Possible accumulation of carbon dioxide within enclosed spaces could impact on proposed housing.
				Construction and services repair workers	Likely	Medium	Moderate	
			Migration and	Site users	Likely	Severe	High	New buildings are

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			explosion					proposed. Possible accumulation of methane within buildings.
		Asbestos	Fibre inhalation	Site users	Likely	Severe	High	Site users could be exposed to soil contamination within gardens and soft landscaped areas.
				Construction and services repair workers	Low Likelihood	Severe	Moderate	Site workers could be exposed to soil contamination during groundworks.
				Adjacent site users	Low Likelihood	Severe	Moderate	Residential development is adjacent. Potential for dust generation during redevelopment of site, however exposure period will be short term.
Agricultural use of the site	Entire site	Pesticides	Ingestion, dermal contact and fugitive inhalation	Site users	Low Likelihood	Medium	Low	Site users could be exposed to soil contamination within gardens and soft landscaped areas. Pesticides would be at low levels within soils across fields.
				Construction and services repair workers	Low Likelihood	Medium	Low	Site workers could be exposed to soil contamination during groundworks. Pesticides would have been applied at low levels within soils across the fields and therefore significant

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								residual concentrations are not anticipated.
				Adjacent site users	Low Likelihood	Medium	Low	Residential development is adjacent. Pesticides would have been applied at low levels within soils across the fields and therefore significant residual concentrations are not anticipated.
			Shallow groundwater	Superficial aquifer (Glacial Till deposits)	Unlikely	Medium	Low	Superficial Till is unproductive strata. Pesticides would have been applied at low levels within soils across the fields and therefore significant residual concentrations are not anticipated.
			Leaching from soil and vertical fluid movement		Unlikely	Medium	Low	
			Shallow groundwater	Superficial Secondary 'A' Aquifer (Glacio-fluvial deposits)	Low Likelihood	Medium	Low	Superficial 'A' aquifer is unconfined. Pesticides would have been applied at low levels within soils across the fields and therefore significant residual concentrations are not anticipated.
			Leaching from soil and vertical fluid movement		Low Likelihood	Medium	Low	
			Leaching from soil and vertical fluid movement	Bedrock aquifer groundwater	Unlikely	Medium	Low	Secondary (A) aquifer is overlain by unproductive strata. Pesticides would have been applied at low

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								levels within soils across the fields and therefore significant residual concentrations are not anticipated.
			Surface runoff	Surface water	Low Likelihood	Medium	Low	Site is generally level however there is a lake in the centre of the site which runoff could enter. Pesticides would be at low levels within soils across fields.
			Plant uptake	Planting	Low Likelihood	Mild	Low	Residential development is proposed including garden areas. Pesticides would have been applied at low levels within soils across the fields and therefore significant residual concentrations are not anticipated.
Former marshland	Centre and west	Ground gas	Migration and inhalation	Site users	Likely	Medium	Moderate	New buildings are proposed. Possible accumulation of carbon dioxide within enclosed spaces.
				Construction and services repair workers	Likely	Medium	Moderate	
			Migration and explosion	Site users	Likely	Severe	High	New buildings are proposed. Possible accumulation of methane within buildings.

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Infilled land associated with historical mine entry	West	Metals, TPH, PAH, asbestos	Ingestion, dermal contact and fugitive inhalation	Site users	Likely	Medium	Moderate	Site users could be exposed to soil contamination during groundworks.
				Construction and services repair workers	Likely	Medium	Moderate	Site workers could be exposed to soil contamination during groundworks.
				Adjacent site users	Low	Medium	Low	Residential development is adjacent. However exposure period will be short term.
			Shallow groundwater	Superficial groundwater (Glacial Till deposits)	Unlikely	Medium	Low	Superficial materials is unproductive strata.
			Leaching from soil and vertical fluid movement		Unlikely	Medium	Low	
			Shallow groundwater	Superficial Secondary 'A' Aquifer (Glacio-fluvial deposits)	Low Likelihood	Medium	Low	Superficial glaciofluvial aquifer is unconfined.
			Leaching from soil and vertical fluid movement		Low Likelihood	Medium	Low	
			Bedrock aquifer groundwater	Leaching from soil and vertical fluid movement	Unlikely	Medium	Low	Secondary (A) aquifer is overlain by unproductive strata.
		Metals	Plant uptake	Planting	Likely	Mild	Low	Residential development is proposed including garden areas

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		Hydrocarbons	Migration and contact	Water supply pipes	Likely	Medium	Moderate	New services will be constructed below ground.
		Ground gas	Migration and inhalation	Site users	Likely	Medium	Moderate	New buildings are proposed. Possible accumulation of carbon dioxide within enclosed spaces could impact on proposed housing.
				Construction and services repair workers	Likely	Medium	Moderate	
			Migration and explosion	Site users	Likely	Severe	High	New buildings are proposed. Possible accumulation of methane within buildings.
		Organic contaminants	Migration in groundwater and inhalation of organic vapour	Adjacent site users	Low Likelihood	Medium	Low	Organic contaminants in groundwater could migrate off site and release organic vapour.
		Asbestos	Fibre inhalation	Site users	Likely	Severe	High	Site users could be exposed to soil contamination in gardens or landscaped areas.
				Construction and services repair workers	Likely	Severe	High	Site workers could be exposed to soil contamination during groundworks.
				Adjacent site users	Low Likelihood	Severe	Moderate	Residential development is adjacent. Potential for dust during redevelopment of site. However, the exposure period will be short term.

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Table 4.5 Potentially Complete SPR-Linkages (off site sources of mobile contamination)

Source	Location	Mobile Contaminants	Pathway	Receptor	Probability	Consequence	Overall Risk	Justification and/or Mitigating Factors
Former Colliery Site	Adjacent to west	TPH	Migration and contact	Site users	Unlikely	Moderate	Low	Low permeability superficial strata will restrict contaminant migration.
				Construction and services repair workers	Unlikely	Moderate	Low	
		Ground gas	Migration and inhalation	Construction workers	Unlikely	Moderate	Low	Low permeability superficial strata will restrict contaminant migration. Diffusion to atmosphere will be the preferential pathway.
			Migration and explosion	Site users	Unlikely	Severe	Low	
Historical tanks	122m NW	TPH	Migration and contact	Site users	Unlikely	Moderate	Low	Low permeability superficial strata will restrict contaminant migration.
			Migration and inhalation	Site users and construction workers				
Infilled land	5m NW	Ground gas	Migration and inhalation	Site users	Unlikely	Moderate	Low	Diffusion to atmosphere from spoil heaps will be the preferential pathway.
			Migration and explosion	Site users	Unlikely	Severe	Low	
Former railway	Adjacent to northwest and west	TPH	Migration and contact	Site users	Unlikely	Moderate	Low	Low permeability superficial strata will restrict contaminant migration.
				Construction and services repair workers	Unlikely	Moderate	Low	

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5 Summary and Recommendations

5.1 Summary

The 24.62 ha site consists of farmland with a lake in the centre, with an unidentified structure possibly relating to a partially constructed road to the north of the lake and other surface water features on site.

The review of the historical mapping indicates that the site has predominantly been used for farming. Ponds were indicated to have been present in the northeast and east of the site and are assumed to have been infilled in 1899 and 1978 respectively. Sports facilities including tennis courts and a football ground were recorded in the south west of the site between 1900 and 1967.

A historical colliery was present to the northwest of the site from 1873 to 1967. In 1967 it is shown as a disused mine and was redeveloped.

Published geology is of Glacio-fluvial deposits in the north east of the site and Glacial Till deposits across the centre and south west. These superficial deposits generally overly a solid geology of the Etruria Formation (mudstone) which is recorded beneath the majority of the site with exception of the western extremity which is underlain by the Pennine Lower Coal Measures Formation.

The glacio-fluvial deposits are classified by the EA as a secondary (A) aquifer, the Till as unproductive strata, and the Etruria Formation and the Pennine Lower Coal Measures Formation also as secondary (A) aquifers. The site is not indicated to be within a groundwater source protection zone.

The site is bordered to the east by James Caravan Park with the A483 and fields beyond this, to the north by the A539 with residential properties beyond, to the west by Clwyd Caravan & Leisure with the B5605 beyond and to the south by farmland.

The site is in an area affected by radon as between 10% and 30% of properties are above the Action Level. Full radon protective measures are indicated by the Groundsure report, to be necessary in new structures.

The desk study and site reconnaissance have identified potential sources of contamination as follows:

- Made ground associated with former sports facilities and use as farm land.
- Infilled land associated with adjacent historical colliery, mine and on-site former pond.
- Pesticides and fertilisers used on site
- Former marshland on site
- Historical colliery (adjacent to west)
- Historical tanks (122m northwest)
- Spoil heaps associated with former colliery (5m northwest)
- Historical railway (adjacent to northwest and west)

Qualitative risk assessment has identified potentially complete SPR-linkages as follows:

- Low risks to High

5.2 Recommendations

The moderate and high risks (above) warrant further investigation and a more

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detailed assessment to establish what, if any, remediation or mitigation is necessary for development.

MLMCEL has undertaken an intrusive investigation which will be reported under separate cover. The investigation included the following:

- Sampling of made ground materials to determine their nature and contaminative status.
- Monitoring wells and an appropriate number of visits to establish the presence and levels of ground gas

An invasive plant survey to establish presence or otherwise of controlled species is recommended.

Although recorded within the Groundsure Report as being on-site, the former colliery is shown within the historical mapping as being adjacent to the west of the site and is not considered to have impinged on the site area. There is therefore considered to be a low risk of ground instability associated with the former colliery site. The risk associated with contamination associated with the colliery including mine gas emissions has been considered within the conceptual site model and risk assessment within Section 4 of this report.

It is recommended that the Mineral and Waste Planning Officer at Flintshire County Council is contacted to confirm that the site does not lie over a potentially workable coal deposit.

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6 References

1 Environment Agency (2004) Model Procedures for the Management of Land Contamination Contaminated Land Report 11 (CLR11)

2 Environment Agency (2010) GPLC1 – Guiding Principles for Land Contamination

3 NHBC Standards (2011) Part 4 Foundations – Chapter 4.1 Land Quality: Managing Ground Conditions

4 National Planning Policy Framework (NPPF) (2012)

5 British Geological Survey (1993) Sheet 121 Wrexham 1:50,000 scale, Solid and Drift Edition

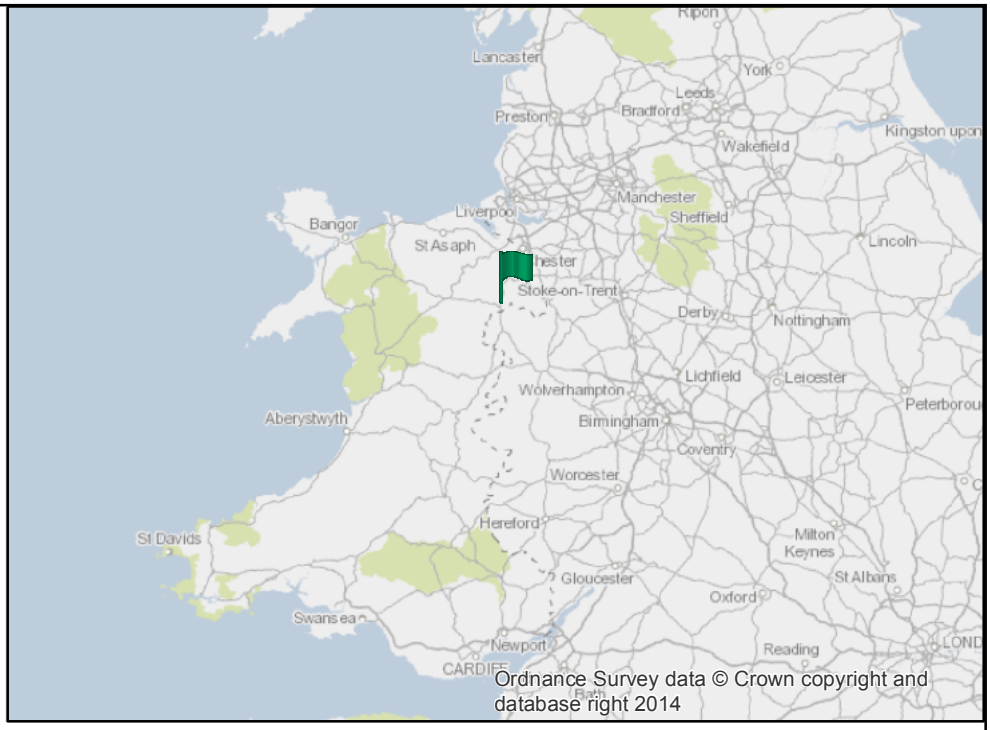
6 Groundsure EnviroInsight Report Ref: 773135 (20/08/2015)]

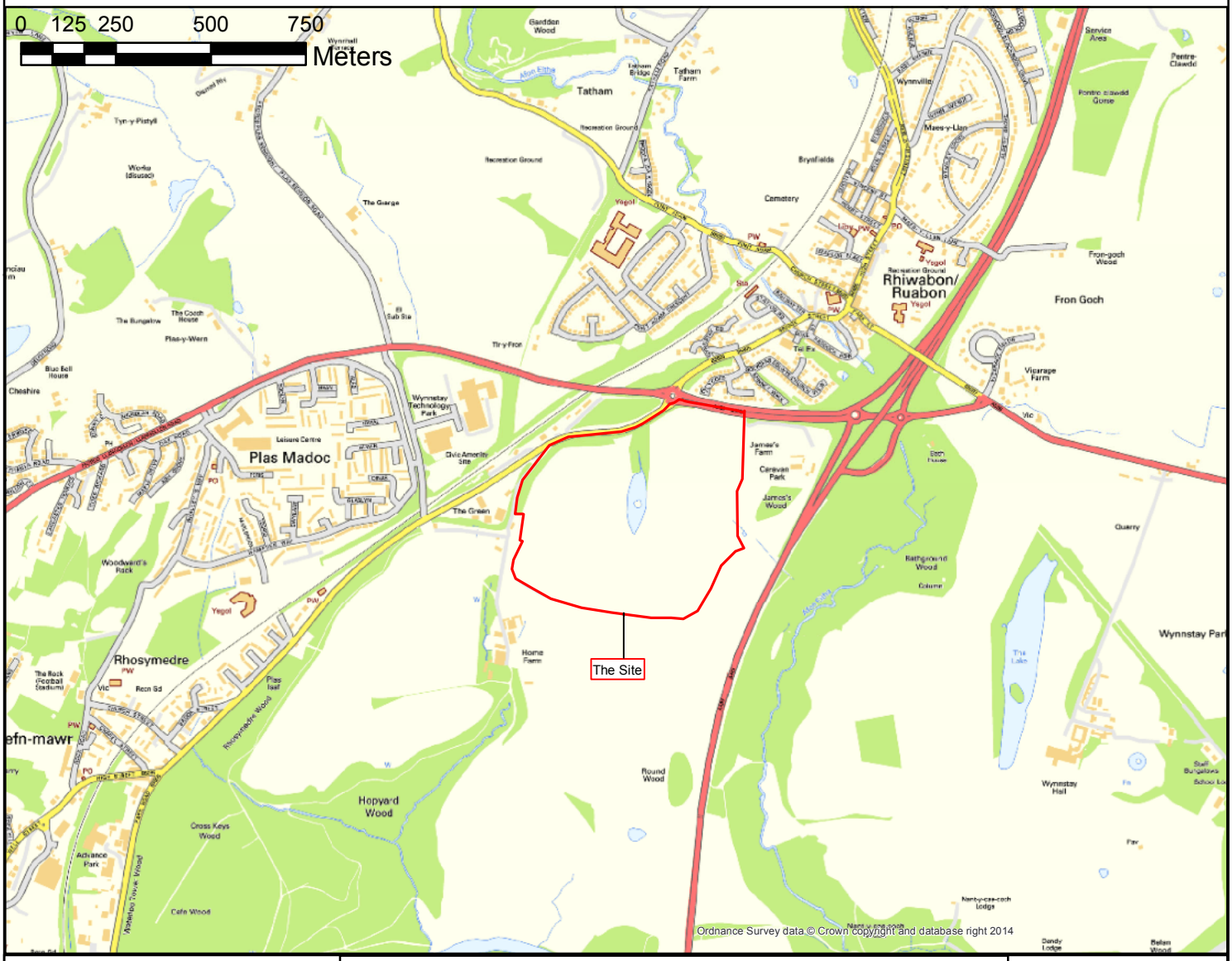
7 Coal Authority Report Ref: GS-2480871 (06/10/2015)

8 Geotechnical Engineering Ltd (2003) Ruabon Business Park Ref. 14991

Figures

Figure 1: Site Location Plan





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Site Location Plan

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Figure No.
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