PHASE I PRELIMINARY RISK ASSESSMENT OF LAND AT SOLAR FARM, WREXHAM

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1.0 INTRODUCTION

1.1 Instruction

1.1.1 GeoCon Site Investigations Ltd (GeoCon) have been commissioned by Innova Renewables Developments Limited to undertake a Phase I Preliminary Risk Assessment (PRA) on land at Solar Farm, Wrexham.

1.1.2 It is understood that a PRA is required to assist with a planning application for a proposed industrial development at the site.

1.1.3 This report is therefore provided to establish the potential for contamination at the site as a result of current and historic land uses both on site and within influencing distance of the site, to understand the potential type of contamination that may be present; and, to establish the potential risks from shallow coal mining.

1.1.4 This report is written in accordance with the guidance set out in Land Contamination Risk Management (LCRM), Guiding Principles for Land Contamination (GPLC) 1 – 3, and the National Planning Policy Framework (NPPF).

1.2 Scope of Works

1.2.1 Prior to commencing the site works the proposed scope of investigation was as follows, however the proposed scope will be subject to change dependent upon site conditions, access, restrictions and obstructions.

- To undertake a site walkover and reconnaissance.
- To appraise the land use history of the site by the examination of available historical plans.
- To assess the environmental setting of the site with specific reference to geology, mining & quarrying, hydrogeology and hydrology.
- To gain an understanding of any concerns of the regulatory authorities (Local Authority Planning, Building Control and Environmental Health departments and the Environment Agency) regarding local land filling, flooding, mining, quarrying and other concerns.
- To produce a Preliminary Conceptual Site Model (CSM).

1.3 Previous Investigations

1.3.1 GeoCon have not been provided with any previous investigation reports and are unaware that any have been carried out to date.

1.4 Reliance and Limitations

1.4.1 This report has been prepared using published information and information provided by the Client and their professional advisers which has been made available to GeoCon at the time of writing only. GeoCon accepts no liability for any changes resulting from new information which has become available since this time.

1.4.2 This report is provided for the sole use of the client and their professional advisors and is confidential to them unless agreed otherwise in writing. This report may only be used and relied on once the work has been paid for in full. GeoCon owes no duty of care and has no liability to any third party who is not authorised by GeoCon to use this report. Any unauthorised third parties using information contained in this report do so at their own risk.

1.4.3 This assessment has been carried out to determine the potential risks posed to future end users, along with other key receptors, resulting from potential contamination at the site, based on the proposed

development. Should any revisions in the development proposals result in a change in any assessment parameters detailed in this report, a re-assessment of the risk should be carried out.

1.4.4 Whilst this report may reference observations made regarding the presence of features/ issues such as invasive species, Asbestos Containing Materials (ACM), site drainage and evidence of structural abnormalities, this report does not constitute specialist surveys on these matters. Should further specialist surveys be carried out in this regard, the findings of these should be reported to GeoCon so that we may determine if this has any impact on the findings of this report.

1.4.5 The assessment and interpretation of the factual data obtained as part of this Phase I Preliminary Risk Assessment has been undertaken in accordance with standard consulting practise and with current national and international guidance.

1.4.6 This report presents the observations made during the Phase I Preliminary Risk Assessment and the factual data obtained. The conclusions and recommendations in this report are limited to those which can be made based on the findings of the survey and information provided by third parties. GeoCon assumes all third-party data to be true and correct. No responsibility can be accepted by GeoCon for inaccuracies in the information provided by any other party.

1.4.7 This report is written in the context of an agreed scope of works and should not be used in a different context. Furthermore, new information, improved practises, and changes in legislation may require the reinterpretation of the report in whole or in part after its original issue. GeoCon reserve the right to alter their conclusions and recommendations in the light of further information that may become available.

1.4.8 It should be noted that ground conditions including contaminant concentrations and groundwater levels may vary spatially with time. This factor should be given due consideration in the event that the information contained within this report is used after any significant period of time has elapsed.

2.0 SITE LOCATION AND DESCRIPTION

2.1 Site Location

2.1.1 The site is located at land adjacent to Williams Farm Solar, Wrexham, at approximate National Grid Reference NGR: 337930:348420 (centre of the site).

2.1.2 A site location plan is presented as Drawing No. GSI 2006/01 in Appendix A.

2.2 Site Reconnaissance

2.2.1 A site reconnaissance was carried out on the 21st November 2023. Details from the site walkover are included in the site description below.

2.3 Site Description

2.3.1 The site is an irregular shaped piece of land with an approximate area of 9.63Ha. The site is characterised as a thin corridor running to the east from the site entrance, becoming wider to the east and opening up to the north and south after the extents of the existing Solar Farm.

2.3.2 The topography of the site generally slopes down towards the north and river channel with localised undulations present.

2.3.3 The site is predominantly undeveloped agricultural grazing land, with small derelict bricked buildings located in the eastern portion of the site which have become overgrown with vegetation and rubble. Small amounts of fly tipping is present in small localised areas on the site including timber, plastics and car tyres. The structures on site show evidence of connected electric and power, and manhole covers along the connecting perimeter of site. An electric substation is present on the site boundary to the adjacent Solar Farm. Overhead power lines are in the west of site. The access track in the east of site is of poor condition. Ground conditions during the site walkover indicated soft and boggy ground with the most impacted area identified in the north of site located closer to the River Clywedog. The river at the northern extents has mature trees present along the low banks of the river channel. Standing surface water was also present towards this area.

2.3.4 An approximate distribution of the surface covering is given below in Table 2.1: Site Surface Covering.

Table 2.1: Site Surface Covering

Type of Surface Cover	Distribution (%)
Soft Ground (grassed and landscaped areas)	85
Hardstanding	0
Roadways	5
Buildings	10
Water (ponds, streams)	0

2.3.5 The site is bound by the River Clywedog northwest, fence line, hedges and established trees to the east. The south and west of site is bound by the adjacent fence line of Williams Solar Farm.

2.3.6 Access to the site is via unnamed road off the east of Bedwell Road.

2.3.7 A selection of photographs from the site walkover are presented as GSI 2006/02 in Appendix A.

2.4 Surrounding Area

2.4.1 The current surrounding land use to the site is generally grassland and agricultural properties in all directions, with the solar farm present adjacent to the site to the immediate south, and the meandering River channel to the north.

2.4.2 The topography of the surrounding area is sloping down towards the north; contour maps show a slight decline in elevation to the west.

2.5 Future Site Usage

2.5.1 It is currently proposed to construct additional extension to the preexisting solar farm development adjacent to the site, referenced WR-EX-258-06-01 and contained with Appendix A.

2.5.2 This assessment has been carried out with reference to this proposed development plan as provided by the client, any changes to the proposed development may result in this assessment requirement updating.

3.0 SITE HISTORY

3.1 General

3.1.1 The history of the site has been determined from available historical maps obtained as part of the Envirocheck Report and via the Envirocheck Analysis online historical mapping tool. The history of the site and of the surrounding area is summarised overleaf in Table 3.1: Site History. It should be noted that some of the maps come with little to no coverage.

3.1.2 The information presented overleaf in Table 3.1: Site History, is given based on the distance and direction from the closest point of each feature to the site. The table presents the data broken down into the following categories: - feature; the potential use of each feature where applicable; the date each particular feature is first observed; the direction of each feature from the site; the approximate distance of each feature from the site; the approximate area of each feature; and any other relevant information regarding the site and surrounding area in general.

3.2 Aerial Photography

1945 Aerial Photograph:

3.2.1 The 1945 aerial photograph, obtained from review of freely available online information, show the site in the southeastern extents of the image (GSI2006-03, Appendix A), with a Royal Ordnance Factory present across the site and wider surrounding area to the north. Unknown uniformed buildings are present and spaced at distant, regular intervals. Railway infrastructure is present, with a single track connecting all the identified buildings on site. Ponds are present on the site and wider area.

2003 Aerial Photograph:

3.2.2 The 2003 aerial photograph show the site relatively undeveloped with agricultural fields and associated barns and farm works. The surrounding area is comprising majority fields and farm buildings with commercial and industrial south, east and north of site.

Table 3.1: Site History

Feature	Date first observed	Date no longer shown	Direction (from site)	Distance (from site)	Area (m^2)	General notes
Royal Ordnance Factory	1954	1961	SE	On site	118	Appearing post WW2, relates to ROF production of explosive propellant, identical building units connected by railway across western site area. Further infrastructure 100m north of site beyond the river. Potential for burn pits, disposal sites, laboratories, smelting and chemical plants. Some structures remain in present day.
Pond	1879	1961	S	On site	706	No longer present from 1961 mapping, potentially infilled feature.
Electrical Powerline	1961	Present	W	On site	0	N/A
River Clywedog	1873	Present	W	On site	0	River Clywedog has changed course from 1873 to present, cutting across the majority of site during 1873 and moving further north overtime, flows west to east
Pond	1873	1899	NE	On site	111	No longer present from 1899 mapping, potentially infilled feature.
Pond	1873	1961	E	29	66	No longer present from 1961 mapping, potentially infilled feature.
Pond	1899	1961	SW	36	33	No longer present from 1961 mapping, potentially infilled feature.
Pond	1961	Present	N	46	864	N/A
Pond	1873	1961	S	64	193	No longer present from 1961 mapping, potentially infilled feature.
Wales Gas Board	1961	Present	SW	69	64451	From 1992 site is renamed on mapping as offices. Building are still present in 2023.
Pond	1873	1961	NE	70	479	No longer present from 1961 mapping, potentially infilled feature.
Pond	1961	1964	SW	75	72	No longer present from 1964 mapping, potentially infilled feature.
Pond	1873	1992	SE	79	113	No longer present from 1992 mapping, potentially infilled feature.
Pond	1873	2000	E	85	383	No longer present from 2000 mapping, potentially infilled feature.
Pond	1961	2000	N	89	2760	No longer present from 2000 mapping, potentially infilled feature.
Well	1881	1961	SW	91	0	No longer present after 1961 mapping, potentially infilled feature.
Factory (Disused)	1961	1988	N	96	7549	No longer present from 1988 mapping, later site if Wrexham Ind. Estate
Tanks	1961	1992	SW	100	585	
Pond	1899	1961	SW	101	77	No longer present from 1961 mapping, potentially infilled feature.
Pond	1873	2000	E	144	142	No longer present from 2000 mapping, potentially infilled feature.
Electrical Distribution Substation	1982	Present	W	170	799	Does not predate ban on PCBs
Tanks	1961	1982	SW	177	105	Gas works feature
Pond	1873	1954	NW	177	490	No longer present from 1954 mapping, potentially infilled feature.
Pond	1873	1899	SW	178	67	No longer present from 1899 mapping, potentially infilled feature.
Pond	1873	Present	SE	180	636	N/A

Feature	Date first observed	Date no longer shown	Direction (from site)	Distance (from site)	Area (m^2)	General notes
Tanks	1961	1982	SW	195	34	Gas works feature
Pond	1873	1899	SW	200	65	No longer present from 1899 mapping, potentially infilled feature.
Mineral Railway	1954	2023	SW	210	0	Mapping changed from mineral railway to dismantled railway from 1961 until present. Potentially linked to historical MoD activities
Site and surrounding area in general	From the earliest mapping records (1873), the site appears to be undeveloped, set amongst an area of agricultural activity. Following WW2, the site's eastern extent is occupied by the Royal Ordnance Factory for explosive propellants, forming part of the wider site to the north and southwest, with site buildings spaced apart but uniformly sized and spaced. Some of these structures are present on site today and potential features now hidden. The site underwent artificial landscaping following these activities. In 1961 the Wales gas board site appears south of the site which buildings are still present although renamed to office buildings in 1992. Another notable feature is a factory located north of site and active from 1961 to 1988. The former ROF footprint to the north is now Wrexham Industrial Estate. At present, the site has remained unchanged over the past decades, with the exception of the increase in surrounding potentially infilled pond due to increasing change in land use and construction of the adjacent Solar Farm.					

4.0 ENVIRONMENTAL SETTING

4.1 General

4.1.1 A number of third parties have been approached to collate information relating to the site, its environmental setting, and any issues pertaining. The following third-party sources have been utilised which are outlined in Table 4.1: Sources of Information:

Table 4.1: Sources of Information

Source	Information
Landmark	Envirocheck Report Geology Report Mining & Ground Stability Report
British Geological Survey (BGS)	BGS Open Geoscience online geological mapping tool
Ordnance Survey	OS Open Data online mapping tool
Coal Authority	Online Gazetteer of England and Wales Coal Mining Report Coal Authority Interactive Viewer
Environment Agency (EA) Online	Water Quality Data and Aquifer designation

4.1.2 The Landmark Envirocheck report is provided in Appendix B.

4.2 Published Geology

4.2.1 The British Geological Survey shows the site to be underlain by the geological succession outlined below Table 4.2: Published Geology.

Table 4.2: Published Geology

Geology	Description /strata	BGS General Description (Lexicon)
Artificial	Landscaped Ground – south and east site area	Artificially modified ground.
Superficial	Alluvium – North & West	"Alluvium is a general term for clay, silt, sand and gravel. It is the unconsolidated detrital material deposited by a river, stream or other body of running water as a sorted or semi-sorted sediment in the bed of the stream or on its floodplain or delta, or as a cone or fan at the base of a mountain slope."
	Till – East and south site area	"No BGS description is available; however, these deposits are generally gravelly clay with cobbles and varying silt sand and gravel content."
Bedrock	Kinnerton Sandstone Formation	Sandstone, red-brown to yellow, generally pebble-free, fine- to medium-grained, cross-stratified.

4.2.2 There are no geological faults located within 250m of the site.

4.2.3 There are no relevant historical BGS borehole records are available for the site.

4.3 Potential Contamination Sources

4.3.1 The following potential sources of contamination have been identified.

Fuel Storage

4.3.2 There are no fuel station entries within 500m of the site. Ground storage tanks are shown on available mapping associated with the Wales Gas Board located 69 south west of site.

Contemporary Trade Directories

4.3.3 There is one contemporary trade directory within 250m of the site, located approximately 233m to the south east for gas supplies.

Local Authority Pollution Prevention and Controls

4.3.4 There is one point of interest for pollution prevention and controls, for air pollution control which is located 233m south east of site, relating to the Gas Works.

Substantiated Pollution Incident Register

4.3.5 There is one point of interest for pollution incident register, located 239m west of site relating to an unidentified pollutant.

Hazardous Substances

4.3.6 Hazardous substances have been used and recorded within 500m of the site. Located at Maelor Gas Works located 220m south, relating to liquefied and extremely flammable gas (including LPG) and natural gas (whether liquefied or not) and associated 6km pipeline.

Landfills and Waste

4.3.7 There are no landfill sites or other waste associated sites within 250m of the site boundary.

4.3.8 Information provided by Landmark indicates that there are five areas within 250m of the site where the potential for infilling is possible. These include five former ponds, may have been infilled within unknown materials.

4.3.9 There are seventeen areas identified on the historical maps within 250m of the site where the potential for infilling is possible which include former ponds that are no longer shown on map records indicating that they may have been potentially infilled within unknown materials; some of these are accounted for.

4.3.10 Made Ground may be present on the site with unknown thickness and composition.

4.4 Radon

4.4.1 The Envirocheck report shows the site is located within a lower probability radon area, as less than 1% of homes are above the action level. Therefore, no radon protection measures are necessary in the construction of new dwellings or extensions.

4.5 Hydrogeology

Superficial Deposits

4.5.1 The Environment Agency aquifer classification scheme indicates that the superficial aquifer designation for part of the site (east and south area) is classed as Secondary Undifferentiated aquifer which are generally described as having been '*assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.'* (EA general description).

4.5.2 The Environment Agency aquifer classification scheme indicates that the superficial aquifer designation for part of the site (north and west) is classed as Secondary A aquifer which are generally described as *'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'* (EA general description).

Bedrock

4.5.3 The Environment Agency aquifer classification scheme indicates that the bedrock aquifer designation for the site is classed as Principal Aquifer which are generally described as 't*hese are layers of rock or drift deposits that have high intergranular and/or fracture permeability- meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer'* (EA general description).

Groundwater Abstractions

4.5.4 There are 12 licenced groundwater abstraction points within 1000m of the site. The nearest to the site is located approximately 234m to the north east for process water and general agricultural, with no others within 250m of the site.

4.5.5 The nearest public drinking water abstraction is located approximately 1897m to the south of the site.

4.5.6 It is possible that there may be private unlicensed water abstractions that exist locally in the area.

4.5.7 There are three Source Protection Zones (SPZ) within 2000m of the site. Further details are given below:

- Zone two (Outer Protective Zone), onsite
- Zone three (Total Catchment), onsite
- Zone one (Inner Protective Zone), 308m northeast

4.6 Hydrology

4.6.1 The nearest surface watercourse to the site is River Clywedog located adjacent the northern boundary, flowing from the north east to south west.

4.6.2 There is no EA General Quality Assessment (GQA) data available within relevant distance to the site.

Surface Water Abstractions

4.6.3 There are no licenced surface water abstraction points within 1000m of the site. The nearest to the site is located approximately 1691m to the southeast for general industrial use.

4.6.4 It is possible that there may be private unlicensed water abstractions that exist locally in the area.

4.7 Mining, Subsidence and Foundations

4.7.1 There are no BGS recorded mineral sites within 250m of the site boundary.

4.7.2 The Coal Authority indicates that the site is located within a coal mining area and that a Coal Authority mining report is required for the site. Subsequently a Coal Authority mining report has been commissioned for the site; and the details are given below.

- The property is not within the likely zone of influence from any coal workings from any present or future planned underground coal mining or any past, present or future planned opencast or underground coal mining.
- There are no known mine entries within the site boundary or within 20m of the site boundary.
- The Coal Authority has not received any damage notices for the property or properties within 50 m of the site since 31st October 1994.
- There is no record of any mine gas emissions requiring action by the Coal Authority at the site.
- The property has not been subject to remedial works by or on behalf of the Coal Authority.

4.7.3 The Coal Authority Report is presented in Appendix D.

4.7.4 Landmark indicates that the risk from non-coal mining is negligible.

4.7.5 The British Geological Survey provide risk ratings for the potential geological hazards outlined below in Table 4.3: Potential Geological Hazards.

Table 4.3: Potential Geological Hazards

Potential Geological Hazard	Hazard Potential
Collapsible Ground	No hazard / Very low
Compressible Ground	No hazard / Moderate
Ground Dissolution	No hazard
Landslides	Very low
Running Sands	No hazard / Very low / Low
Shrinking or Swelling Clay	No hazard / Very low

4.8 Environmentally Sensitive Sites

4.8.1 There are no significant environmentally sensitive sites within 250m of the site.

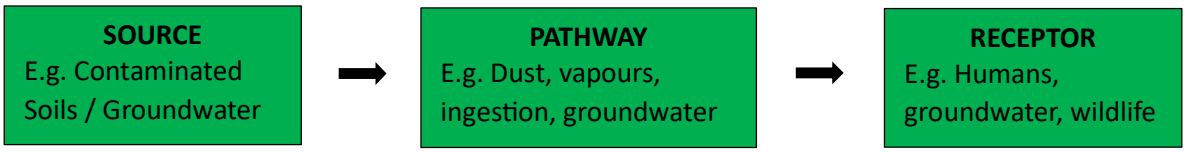
5.0 PRELIMINARY ENVIRONMENTAL RISK ASSESSMENT

5.1 Introduction

5.1.1 In statutory guidance regarding potentially contaminated land, risk assessments are used as a technique on a site-specific basis to identify potential environmental issues. As recommended by BS 10175 an Initial Conceptual Generic Model has been formulated which defines the 'pollutant linkage' through source, pathway and receptor methodology. All three must be present in order to pose a risk to the end users and to the environment; i.e., if there is no pathway between the source and the receptor, then there is no 'pollutant linkage' and hence negligible risk to the receptor.

5.2 Risk Assessment Methodology

5.2.1 The purpose of a Phase I Preliminary Risk Assessment (PRA) is to obtain information regarding the site to gain a preliminary understanding of potential environmental issues and the potential for land contamination. This information includes existing and proposed site uses, the history of the site and surrounding area, and the environmental setting. The information obtained is used to develop a Conceptual Site Model (CSM), which describes sources (potential hazards), pathways, and receptors, which may be relevant to the site. The following definitions have been adapted from Part IIA of the Environmental Protection Act (EPA) 1990:



5.2.2 **Source** – A source can be defined as a potential contaminant, substance, or condition that has the potential to cause harm to the environment, humans or other flora and fauna.

5.2.3 **Pathway** – A pathway is defined as the route by which a source is brought into contact with a receptor. This can include the transport of contamination via groundwater, wind borne dust, vapours, excavation and deposition, dermal contact, ingestion and inhalation.

5.2.4 **Receptor** – Receptors are defined as anything that can be affected by a source such as human beings, flora and fauna, other living organisms, groundwater and surface water, physical systems and built structures.

5.2.5 Some of the above, such as groundwater, surface water, flora, and fauna can be considered as both pathways and receptors.

5.2.6 A risk may be considered present if all three of the above exist and thereby form a "**pollutant linkage**".

5.3 Outline Conceptual Site Model

5.3.1 As part of this Phase I Preliminary Risk Assessment, the following potential sources, pathways and receptors have been considered and are discussed below.

Potential Sources (on and off site):

5.3.2 The following are potential sources of contamination that have been considered: -

- Made Ground / reworked soils and rock beneath the site associated with construction and demolition on site and of the surrounding area.

- Potential for contamination to have occurred at the site as a result of historical and contemporary land uses and processes on the site and within influencing of the distance.
- Potential for mobile and leachable contamination at the site associated with historical and contemporary land uses and processes both on site and within influencing of the distance.
- Potential for volatile and semi-volatile contamination at the site associated with historical and contemporary land uses and processes both on site and within influencing of the distance.
- Historic electrical substations on the site and within influencing of the distance.
- Potential for hazardous ground gasses associated with any Made Ground, landfill sites and other areas of potentially infilled land both on site and within influencing distance of the site.

Potential Pathways

5.3.3 The following potential pathways have been identified at the site:

- Ingestion of contaminated soils.
- Inhalation of site generated particulates.
- Dermal contact with contaminated materials.
- Ingestion of home grown produce.
- Inhalation of hazardous ground gasses.
- Build-up of hazardous ground gasses in confined spaces.
- Groundwater.
- Surface water courses within influencing of the distance.

Potential Receptors

5.3.4 The following potential receptors have been identified:

- Current site end users.
- Future site end users.
- Construction workers.
- Members of the public and neighbouring site users.
- Neighbouring land.
- Aquifers and drinking water.
- Surface water courses within influencing of the distance.
- Flora and fauna.
- Other ecosystems.

5.4 Preliminary Risk Assessment

5.4.1 The Preliminary Risk Assessment has been evaluated using a probability / consequence matrix, which is provided in Appendix C.

5.4.2 The underlying geology of the site and surrounding area is indicated to be Alluvium (vicinity of River) or Till (East and south area) overlying Kinnerton Sandstone Formation which are of varying permeability from medium to high.

5.4.3 The following risk assessment has been based on the above information and the proposed development as detailed in Section 2.0.

5.4.4 The discussion below assesses the likelihood of potential Contaminants of Concern (CoC's) with a justification on whether they would likely be present. The CSM in Table 5.1 then provides a risk rating for the site.

Land Contamination

5.4.5 From the information available, the site itself has had significant historical use as a Royal Ordnance Factory during the period of WW2, with geological mapping records indicating artificially landscaped ground in the footprint of the east and south portion of the site. It is therefore likely that Made Ground will be present beneath the site associated with past construction and demolition and site generated processes. Therefore, the probability for heavy metals, metalloids & inorganics, and PAH to be present on or beneath the site is considered to be **likely.**

5.4.6 Historical and contemporary land uses likely to produce mobile, organic and leachable contamination both on the site and within influencing distance have been identified. Considering the distances between the features and the site, and the medium to high permeability of the underlying geology beneath the site, the probability for mobile, organic and leachable contamination to be present at the site is considered to be **low likelihood.**

5.4.7 Historical and contemporary land uses likely to produce volatile contamination (VOC's & SVOC's) both on the site and within influencing distance have been identified. Considering the distances between the features and the site, and the medium to high permeability of the underlying geology beneath the site, the probability for VOC's & SVOC's to be present at the site is considered to be **low likelihood.**

5.4.8 There is one electric distribution substation within influencing distance of the site which may be a source of Polychlorinated Biphenyls contamination (PCB's). Further details are given below.

- Substation located approximately 170m to the west, first observed on the 1982 map.

5.4.9 This doesn't predate the 1981 ban on PCB's. However, given the presence of historical railway and MoD activities, this may have given rise to PCB contamination. Therefore, considering the distances between the features and the site, and the medium to high permeability of the underlying geology beneath the site, the probability for PCB contamination at the site is **low likelihood**.

5.4.10 It is possible that further electric substations or former electric substations are present within influencing distance to the site associated with the surrounding area that have not been identified on the historical maps.

5.4.11 Asbestos fibres and Asbestos Containing Materials (ACM's) could be present within any Made Ground and or shallow natural soils beneath the site as a result of historic site uses, and phases of construction

and demolition. Therefore, the probability for ACM's to be present at the site is considered to be **low likelihood**.

5.4.12 Given the identified presence of MoD production of explosive propellants on portion of the site and wider surrounding area, the risk of explosive materials is yet to be determined and should be assessed by a person trained and qualified with suitable experience in Explosive Safety Management (ESM) and the ability to identify buildings, processes, materials associated with explosive operations during the site inspection. Buildings that have been used for the manufacture or processing of explosives are likely to contain residues of explosives and represent a significant potential explosives hazard.

5.4.13 Therefore, based on the above, the site history, and the environmental information available, the potential contaminants identified on this site include heavy metals, metalloids & inorganics; PAH's; leachable contamination, hydrocarbons & organic contamination; volatiles; PCB's; and asbestos, and the risk to human health is considered to be **Moderate.**

Hazardous Ground Gasses

5.4.14 There are no landfill or waste facilities within 250m, however, there are a number of potentially infilled pond features on the site and within 250m of the site. Furthermore the site has had historical use as a Royal Ordnance Factory for production of explosive propellant.

5.4.15 Considering the distances between the features and the site, the probability of hazardous gases being present beneath the site is likely, and therefore the risk from hazardous ground gases is considered to be **Moderate**.

5.4.16 Landmark indicates that the site is within a lower probability radon area, as less than 1% of homes are above the action level. Therefore, no radon protection measures are necessary in the construction of new dwellings or extensions.

Groundwater

5.4.17 The Environment Agency aquifer classification scheme indicates that the superficial aquifer designation for east and south area of the site is classed as Secondary Undifferentiated aquifer and the designation for north and west site area is classed as Secondary A aquifer. The underlying bedrock aquifer is classed as Principal Aquifer and the site located in a Source Protection Zone two (Outer Protective Zone).

5.4.18 The nearest public drinking water abstraction is located approximately 1897m to the south of the site.

5.4.19 The potential contaminants identified on this site include heavy metals, metalloids and inorganics; PAH's; leachable contamination, hydrocarbons & organic contamination; volatiles; and PCB's.

5.4.20 Therefore, based on the above, the environmental information available, and considering the medium to high permeability of the underlying geology, the proximity of the nearest potable groundwater abstraction point, the probability for contamination at the site to impact the groundwater is low likelihood, and therefore the risk to groundwater is considered to be **Low to moderate.**

Surface Water

5.4.21 The River Clywedog borders the site to the north, flowing west to east. There are no surface water abstraction points within 1000m.

5.4.22 The potential contaminants identified on this site include heavy metals, metalloids and inorganics; PAH's; leachable contamination, hydrocarbons & organic contamination; volatiles; and PCB's.

5.4.23 Therefore, based on the above, the environmental information available, and considering the medium to high permeability of the underlying geology, and the proximity of the nearest surface water feature, the probability for contamination at the site to impact the surface water courses is low likelihood, and therefore the risk to surface water courses is considered to be **low to moderate.**

Plants and Native Grasses

5.4.24 Any plants that may be grown at the site in areas of landscaping may potentially be at risk from phytotoxic elements in any artificial soils beneath the site.

5.4.25 Therefore, based on the above, the site history, and the environmental information available, the potential contaminants identified on this site may include heavy metals, metalloids & inorganics, the risk to plants is considered to be **Low**.

Water Supply / Plastic Pipes

5.4.26 Any organic contamination present in the soils or groundwater beneath the site would pose a risk of premature failure to below ground services via chemical reaction.

Preliminary Conceptual Site Model

5.4.27 From the above information a CSM has been produced showing the preliminary conceptual model and potential pollutant linkages for the site and is presented overleaf in Table 5.1

5.4.28 At this stage only contaminants of concern that are considered potentially present from the information available have been included in the CSM.

Table 5.1: Preliminary Conceptual Site Model and Potential Pollutant Linkages

Potential Sources	Contaminants of Concern	Potential Pathway	Potential Receptor	Potential Pollutant Linkage	Probability	Consequence	Risk Classification	Action / Mitigation / Justification
Made Ground both on site and within influencing distance of the site Current and former land uses both on site and within influencing distance of the site	Heavy metals, sulphates and inorganics PAH's Asbestos Mobile organic contamination SVOC's and VOC's PCB's Leachable contamination UXO	Ingestion Inhalation Dermal Contact	**Human health** Including current site users, future site users	Considered active	Unlikely	Medium	**Low**	Site to be completely covered by a solar farm with very limited site users, thus creating limited exposure to the pollutant linkage. Given the site's historical use, site investigation required.
			Human health Construction workers	Considered active	Likely	Medium	**Moderate**	Identified UXO risk from explosive manufacturing on the site. Potential contamination associated with these ROF activities requires specialist UXO study and a site investigation to understand the risk from contamination and inform on ground conditions following the UXO assessment. Works to be conducted with extreme care to a written protocol under the supervision of an experienced person trained in explosives safety management.
			Human health Neighbouring residents	Considered active	Unlikely	Mild	**Very low**	No further action, however, if Made Ground or any visual or olfactory evidence of contamination is encountered on site then this risk will need to be reassessed.
Landfill sites Potentially infilled Land (ponds, quarries, reservoirs etc)	Hazardous ground gases including CO_2, CH_4 CO, H_2S Vapours	Inhalation Explosion	**Human health** Including current site users, future site users, neighbouring residents and constructions workers	Considered potentially active	Unlikely	Severe	**Low to Moderate**	Given the proposed development consists of extension of the adjacent solar farm, with no enclosed or confined spaces being included, it is considered that there is not an active pathway. However, no construction workers are to enter excavations without appropriate clearance and PPE.

Potential Sources	Contaminants of Concern	Potential Pathway	Potential Receptor	Potential Pollutant Linkage	Probability	Consequence	Risk Classification	Action / Mitigation / Justification
Explosives Manufacturing (ROF) Made Ground Natural organic soils Coal mining Fuel Stations (on and off-site sources)		Explosion	**Buildings**	Considered potentially active	Low likelihood	Medium	**Moderate**	Given the proposed development consists of extension of the adjacent solar farm, with no enclosed or confined spaces being included, it is considered that there is not an active pathway to future site users. However, no construction workers are to enter excavations without appropriate clearance and PPE. Existing ROF buildings on site require UXO assessment and inspection, as explosive propellant can accumulate under floor spaces over time.
Made Ground on site Current and former land uses on site	Heavy metals, sulphates and inorganics PAH's Mobile organic contamination SVOC's and VOC's PCB's Leachable contamination	Lateral and vertical migration and leaching of contaminants into local groundwater	**Underlying Aquifer** (Potable water)	Considered potentially active	Low likelihood	Medium	**Low to Moderate**	Given the site's historical use, site investigation required to understand potential for contamination in the area of ROF activities.

Potential Sources	Contaminants of Concern	Potential Pathway	Potential Receptor	Potential Pollutant Linkage	Probability	Consequence	Risk Classification	Action / Mitigation / Justification
Made Ground on site Current and former land uses on site	Heavy metals, sulphates and inorganics PAH's Mobile organic contamination SVOC's and VOC's PCB's Leachable contamination	Lateral and vertical migration and leaching of contaminants into surface water bodies via permeable strata and features.	Local **water courses** and associated flora and fauna	Considered potentially active	Low likelihood	Medium	**Low to moderate**	Given the site's historical use, site investigation required to understand potential for contamination in the area of ROF activities and the adjacent water course to the north.
Made Ground beneath the site Current and former site uses	Phytotoxic elements	Plant uptake	**Plants and vegetation**	Considered potentially active	Low likelihood	Minor	**Very low**	No further action, however, if Made Ground or any visual or olfactory evidence of contamination is encountered on site then this risk will need to be reassessed.

6.0 PRELIMINARY GEOTECHNICAL ASSESSMENT

6.1 General

6.1.1 The underlying shallow geology is likely to consist of Alluvium, Till overlying Kinnerton Sandstone Formation which generally comprises sandstone.

6.1.2 Made Ground may also be present on site.

6.1.3 Based upon the information reviewed, a list of potential geotechnical risks has been outlined below in Table 6.1: Potential Geotechnical Risks, which presents a summary of the likely geotechnical risks potentially present at the site.

Table 6.1: Potential Geotechnical Risks

Features of Concern	Geotechnical Consideration	Geotechnical Risk to Proposed Development	Likelihood
Made Ground	Any potential Made Ground beneath the site.	Made Ground can cause total and differential settlement of any new structures.	**Likely**
Trees and vegetation	Large mature trees on site or within close proximity to the site boundaries.	Tree roots have the potential to cause clay soils to shrink causing settlement of new structures.	**Possible**
Shrinkage and expansion of clay soils	Clay soils beneath the site.	Potential for shrinkage and / or heave of clay soils causing damage to new structures.	**Possible**
Groundwater ingress	Shallow groundwater beneath the site.	Shallow ground water can have an impact on construction and foundation excavations. Pumping and / or dewatering may be required.	**Likely**
Existing / former foundations and underground structures	New buildings may be situated upon the sites of former demolished buildings or buildings that will be demolished as part of the proposed development.	Uneven founding, inconsistent ground conditions, and unsuitable bearing capacity for new structures.	**Likely**
Aggressive ground	Chemical content of the soils beneath the site.	Chemically aggressive ground may have the potential to attack buried concrete.	**Possible**
Soft / loose / weak soils and / or rock beneath the site	Unsuitable founding strata beneath the site.	Soft and lose soils or weak rock may be in adequate to found on. A suitable foundation option should be selected based on the actual ground conditions beneath the site.	**Possible**
Embankments	Unstable slopes and embankments.	Collapse onto or into any new developments	**Unlikely**
Shallow mine workings beneath the site	Coal seams or mine entries present on or beneath the site which may have been worked in the past. Non coal related mining.	Worked mine seams or areas of mineral extraction leave voids underground that have the potential to settle when new loads are placed above them.	**Unlikely**
Ground Dissolution	Dissolution of carbonaceous geology beneath the site.	Carbonaceous ground beneath the site can dissolve over time with groundwater percolating through causing sink holes giving rise to settlement or complete collapse of structures.	**Negligible**

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

Environmental

7.1.1 A review of the preliminary information reveals that future end users of the site are potentially at **Low** risk of being affected by contamination in soils and / or groundwater beneath this site.

7.1.2 Risks to construction workers from the site are considered to be **Moderate** at this stage.

7.1.3 Risks to neighbouring residents from the site are considered to be **Low** at this stage.

7.1.4 The risks of hazardous ground gasses affecting the site are considered to be **Moderate** at this stage.

7.1.5 The risks to drinking water and groundwater are considered to be **Low to Moderate** at this stage.

7.1.6 The risks to surface waters are considered to be Low to Moderate at this stage.

7.1.7 Risks to plants and native grasses are considered to be **Very Low** at this stage.

Geotechnical

7.1.8 The nature and distribution of geotechnical properties of the near surface strata have not been fully identified within this study, therefore it is not possible at this stage, to give meaningful advice as to the type, nature, and construction of any foundations for the proposed development.

7.1.9 Inadequately designed buried concrete may be at risk from potentially elevated sulphates and low pH in the soils and groundwater beneath the site.

7.1.10 The site is not considered to be affected shallow coal mining. Therefore, risks from shallow coal mining are considered to be **Very Low** at this stage.

7.1.11 The site is not considered to be affected by ground dissolution. Therefore, risks from ground dissolution are considered to be **Very Low** at this stage.

7.2 Recommendations

7.2.1 It is required that a detailed UXO assessment is carried out at the site prior to intrusive work be undertaken.

7.2.2 It is recommended that a suitable combined phase II environmental and geotechnical site investigation is carried out at the site to establish the presence, type and nature of any contamination at the site and provide a Generic Quantitative Risk Assessment (GQRA); and, to identify the ground conditions and provide details of their engineering properties in order to facilitate foundation design for the proposed development. All works, depending on the anticipated risk following completion of a UXO desk study, should be either supervised or conducted by a person trained and qualified with suitable experience in explosive safety management (ESM).

7.2.3 It is recommended that the above conclusions and recommendations are agreed in principle with the Local Planning Authority (LPA) to gain their approval prior to commencement of the development to avoid unnecessary complications or delays at a later stage.

7.3 Other Considerations

Unexploded Ordnance

7.3.1 It is required that a detailed UXO assessment is carried out at the site. Any subsequent intrusive works may then require on-site UXO clearance subject to the findings of the initial UXO report.

7.3.2 All site inspections and intrusive works, depending on the anticipated risk, should be either supervised or conducted by a person trained and qualified with suitable experience in explosive safety management (ESM).

Plastic Water Pipes

7.3.3 Any organic contamination present in the soils or groundwater beneath the site would pose a risk of premature failure to below ground services via chemical reaction.

7.3.4 Any subsequent Phase II Site Investigation would be primarily concerned with human health risk assessment.

7.3.5 Considerations should be given to sampling and chemical analysis of the materials that any plastic water supply pipes will be laid in.

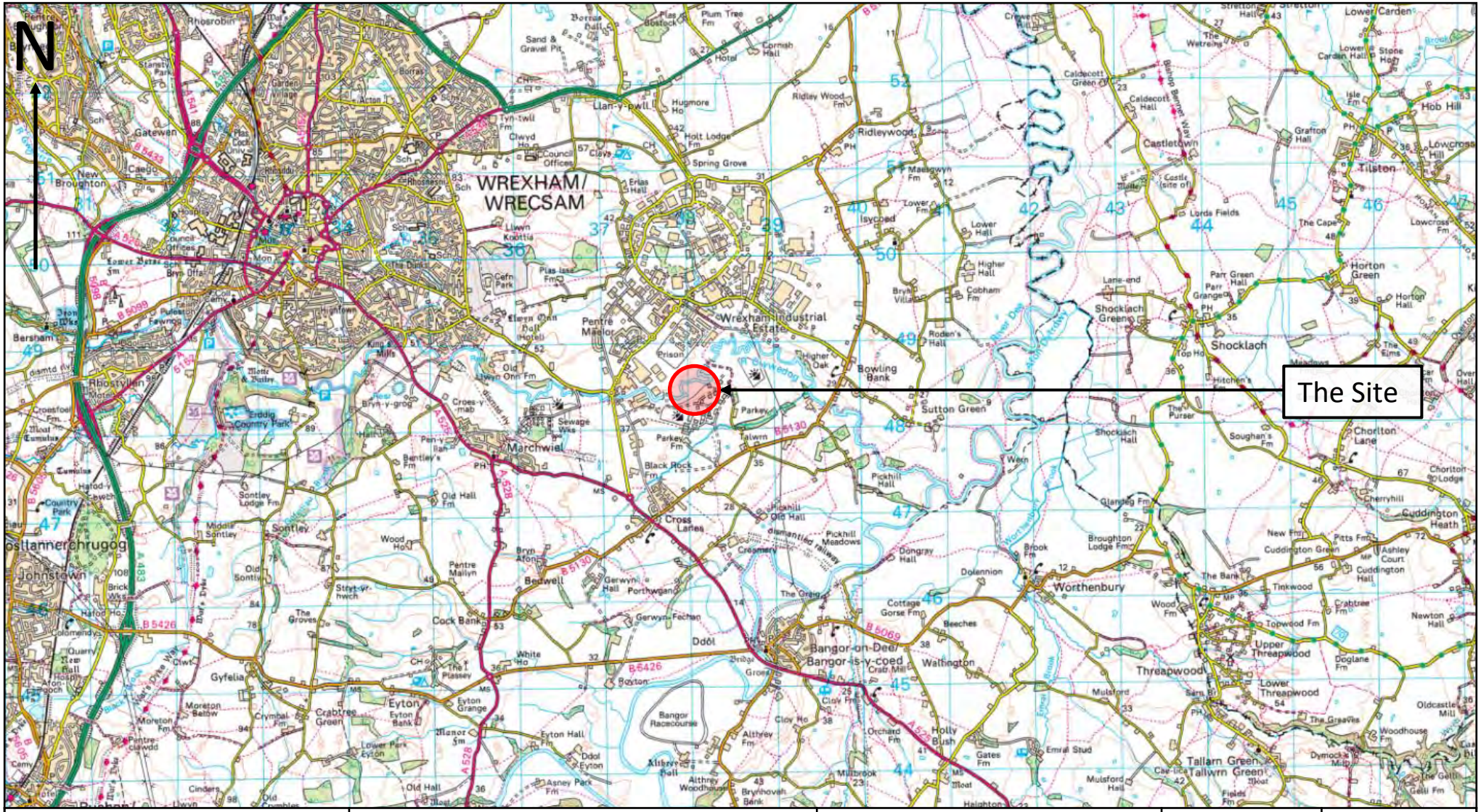
7.3.6 It is also likely that the water utilities provider will require their own risk assessment to be completed.

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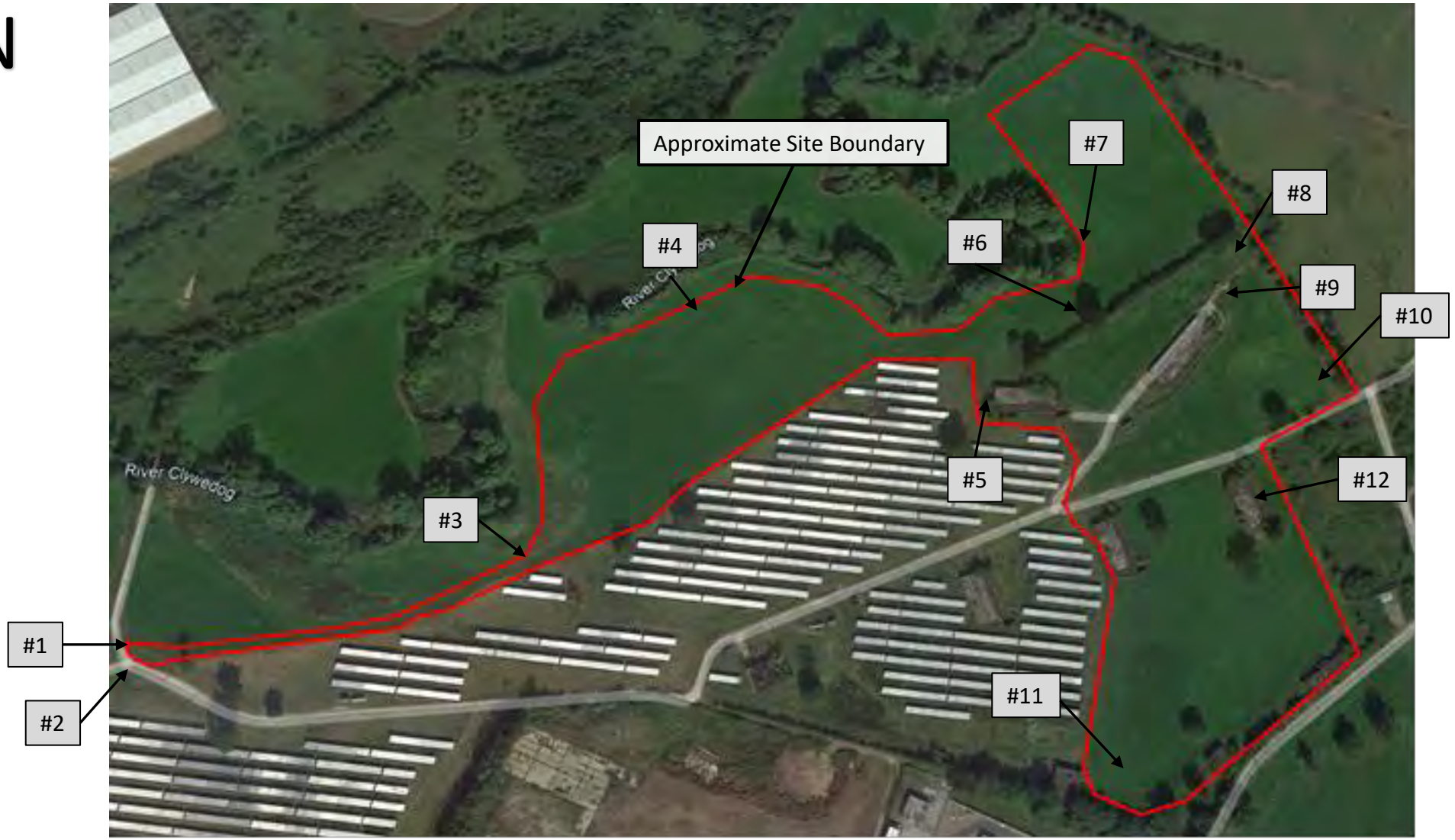
APPENDIX A

DRAWINGS



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TITLE	**DATE**	**DRAWN BY**
Site Location Plan	December 2023	MP



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#4



#5



#6

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Site Walkover Plan	December 2023	MP

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PROJECT ID	DRAWING NUMBER	SCALE
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TITLE	**DATE**	**DRAWN BY**
Historical Photography: ROF Wrexham 1946	December 2023	MP