

References

- British Geological Survey sheet 223 "Monmouth" Solid and Drift edition (1:50,000) published 1974.
- 'Solar Farm, Junction of A40 & A4137, Herefordshire', H Fraser Consulting ref: 30317AWatton001.docx, dated 23rd April 2019.
- 'Solar Farm, Junction of A40 & A4137, Herefordshire', H Fraser Consulting ref: 30317AWatton002.2, dated 8th January 2020.

SUPPORTING INFORMATION

This section provides background details of a generic nature together with specific technical approaches adopted by EMS and details of the guidance documents that are commonly referenced in the report. The section also includes explanations of technical terms to assist non-specialist readers in understanding the Technical Report. It should be noted that not all the information within this section is necessarily applicable to this specific report.

SITE CHARACTERISTICS

The site characteristics are collated from various information sources, including but not limited to Ordnance Survey, British Geological Survey (BGS), GOV.UK / DATA.GOV.UK websites and local authorities.

EMS generally commission the Landmark Information Group to produce an Envirocheck Report for study sites and where employed this is included in the Appendices. It should be noted that some of the data provided in the Envirocheck report is not considered within EMS's interpretation for the site characteristics as it is not relevant, including:

- *Nitrate Sensitive Zones and Nitrate Vulnerable Zones are ignored as these are only applicable to agricultural activities relating to the application of manure and fertilisers to land.*
- *River Quality is ignored as at this preliminary stage of risk assessment as all surface water bodies are considered equally sensitive to contamination risks.*

In assessing site characteristics, EMS also consider the area within a surrounding 250m buffer zone extending from the site boundary.

HISTORY

Mapped History

The site history summarises the changes in use or layout of the site over time and is largely developed from a study of available Ordnance Survey maps. It should be noted that changes to the site may have occurred between the editions of the maps employed to assess the history of the site. Historical information of relevance within the 250m surrounding the site is also discussed in a separate section. The historical plans referred to in the text are generally included in an Appendix.

Aerial photography

As a minimum, current and historical aerial images of the site and surrounding areas are studied from the Google Earth program. Where additional historic aerial photographs have been purchased then these are referenced within the technical report.

Internet Searches

A simple search of the internet for relevant material relating to the use or history of the site is made. Information obtained from internet searches has been accepted as fact without validation by EMS except for ensuring the source is reputable. It should be recognised that due to programme and budgetary constraints the search conducted may not have revealed all the information available.

GEOLOGY

The geology relating to the site is assessed using information contained within the Envirocheck report and / or reference to the relevant British Geological Survey (BGS) 1:50,000 scale sheet in Bedrock and Superficial (historically Solid and Drift) edition. Many of these geological maps are relatively old with superseded terminology and descriptions. EMS therefore employ the BGS Open Geoscience website to determine current nomenclature of strata and to assist in determining geological boundaries against current topographic features. EMS also employ BGS Regional Geology Guides to assist in understanding the geological context of the site.

Ground Stability Hazards

Ground stability hazards caused by mining, ground dissolution, landslide potential, collapsible ground and natural cavities are identified by the Envirocheck database search of records held by The Coal Authority, British Geological Survey and studies completed by Ove Arup and Peter Brett Associates.

The Envirocheck database ground stability hazard entries for compressible ground, running sands and shrinking or swelling clays are not discussed directly. This is because these hazards are very common and are considered within the preliminary geotechnical assessment where necessary.

Radon

Radon is a naturally occurring colourless and odourless gas that is radioactive. It is formed by the radioactive decay of radium which in turn is derived from the radioactive decay of uranium, both of which are minerals that can be found in many soil types. Whilst it is recognised that the air inside every house contains radon, some houses built in certain defined areas of the country might have unacceptably high concentrations and require special precautions to be taken during construction to reduce this risk.

Radon can move through cracks and fissures in the soil into the atmosphere or into dwellings via basements and/or underfloor voids. If radon enters the living space of dwellings its concentration can potentially increase and provide a risk to human health as the inhalation of the radioactive decay products of radon gas can increase the risk of developing lung cancer.

The maps contained within BRE211:2007 'Radon: guidance on protective measures for new buildings' identify areas where no radon protection measures are necessary or where higher concentrations are present that either basic or full radon protection measures are required to be fitted to all new dwellings. However, some local authorities have local bylaws, that EMS may not be aware of, that insist on radon protection to all new dwellings within their area regardless of the recommendations of the BRE211 Radon report.

Basic radon protection measures comprise incorporation of a continuous gas resistant membrane sealed at joints and around service entries into the floor construction and extended across the cavity tray.

Full radon protection measures comprise incorporating a continuous gas resistant membrane into the floor construction together with a ventilated sub-floor void through either the use of suspended floor construction or a 'radon sump'. The membrane is sealed at joints and around service entries into the floor and extended across the cavity tray.

BRE211 should be referred to for detail on the construction of the protective measures.

HYDROGEOLOGY

Aquifer Designations

The Environment Agency's Groundwater Protection Policy uses designations that reflect the importance of aquifers in terms of groundwater as a drinking water resource, but also their role in supporting surface water flows and wetland ecosystems.

In defining groundwater vulnerability, both the superficial (drift) deposits and bedrock (solid) geology are considered separately with the following aquifer designations:

- *Principal Aquifers: These 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.*
- *Secondary Aquifers: These include a wide range of rock layers or drift deposits with an equally wide range of water permeability and storage. Secondary aquifers are subdivided into two types:*
 - *Secondary 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.*
 - *Secondary B - predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering.*
- *Secondary Undifferentiated - has been assigned in cases where it has not been possible to attribute either category A or B to a rock type.*
- *Unproductive Strata: These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.*

Source Protection Zones

The Environment Agency (EA) has defined Source Protection Zones for groundwater sources, such as boreholes and springs, that are used for public water supply. The EA uses the zones to target pollution prevention measures and monitor the activities of potential polluters within the affected area. There are three types Source Protection Zone:

- Zone 1 (Inner Protection Zone) is the most sensitive area within which pollution could reach the borehole within 50 days. Alternatively it is defined by a minimum 50m radius around the borehole.
- Zone 2 (Outer Protection Zone) are defined by the area within which pollution could reach the borehole within 400 days or 25% of the total catchment area.
- Zone 3 (Total Catchment) are defined by the total area required to support the removal of water from the borehole.

HYDROLOGY

Flooding

The Environment Agency has zoned England and Wales in respect of the risk from flooding from 'highly unlikely' in Zone 1 to 'likely' in Zone 3. The zones ignore the presence of flood defences or certain other manmade structures and channel improvements.

National Planning Policy Framework, Department for Communities and Local Government, dated March 2012 states "A site-specific flood risk assessment is required for proposals of 1 hectare or greater in Flood Zone 1; all proposals for new development (including minor development and change of use) in Flood Zones 2 and 3, or in an area within Flood Zone 1 which has critical drainage problems (as notified to the local planning authority by the Environment Agency); and where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding".

ENVIRONMENTAL ASPECTS

Landfill

The database of the Environment Agency of active and historic landfills is searched for all sites. Sometimes additional historic landfill data is available from the British Geological Society and local authorities to identify nearby landfill sites. It should be noted that landfill sites that closed prior to 1974 and unlicensed disposal activities will not necessarily be revealed by this search.

Pollution Incidents

The Environment Agency ceased recording 'Pollution Incidents to Controlled Waters' in 2000, when they commenced the replacement 'Substantiated Pollution Incident Register'. EMS do not consider any 'Category 3 – Minor Incident' on the 'Pollution Incidents to Controlled Waters' database as relevant to assessing the site due to the time elapsed and the low level of impact that occurred. Again, due to the time elapsed and the fact that remedial measures would have been undertaken at the time, 'Category 1 – Major Incident' and 'Category 2 – Significant Incident' are only considered relevant if the impacted controlled water was on or immediately adjacent to the site.

On the 'Substantiated Pollution Incident Register', EMS approach to this information in the following manner:

- Pollution incidents impacting 'air' only are not considered relevant.

- Pollution incidents to 'water' are only considered where the surface water impacted is either on, flows through or is immediately adjacent to the site.
- Pollution incidents to 'land' are only considered where these are on or immediately adjacent to the site unless there are grounds to consider that the incident had the potential to impact groundwater that may have migrated beneath the site.
- Category 4 potential pollutant incidents are recorded, but upon investigation were found to have had no impact and accordingly are not considered relevant.

Ecologically Sensitive Land Use

The land uses that are identified as ecologically sensitive are those identified as Sites of Special Scientific Interest (SSSI), Special Areas of Conservation, Special Protection Areas, Ramsar sites, Natural Parks, Natural Nature Reserves, Marine Nature Reserves, Local Nature Reserves, Green Belt, Forest Parks, Environmentally Sensitive Areas, or Areas of Outstanding Natural Beauty.

Unexploded Ordnance

Guidance in CIRIA C681 'Unexploded Ordnance, A Guide for the Construction Industry' recommends that a preliminary risk assessment, comprising desk-based consideration of factors that affect the potential for unexploded ordnance (UXO) to be present, is undertaken at all sites at an early stage. This assessment ascertains whether specialist advice is required prior to ground disturbing activities. The assessment involves consideration of the site's location, history and planned investigation activities. The aim of the assessment is principally to avoid loss of life or injury in the rare event that unexploded ordnance is encountered. However, it is also extremely useful to consider this issue at an early stage to avoid costly delays in construction programmes later down the line.

At the date of publication of this CIRIA document there have been no recorded deaths in the UK resulting from UXO in recent decades (although there have been some fatalities in Europe). However, it is estimated that 15,000 items of ordnance (5 % estimated to be live) were removed from UK construction sites between 2006 and 2008.

The following table summarises the risk factors for a site against the potential for UXO to be present:

		Potential for aerial delivered UXO to be present			
		LOW		HIGH	
<i>Indicators of potential aerial delivered UXO hazards</i>					
Data item	Site location	Rural	Small towns	Brownfield sites Large towns	Cities
	Site description and historical land use	Greenfield site or agricultural land only	Near to wartime site of: Previous military use	Adjacent to wartime site of: Previous military use	Site of previous military use: Former wartime

			Railway marshalling yard Power station Gas works Port Industrial centre	Railway marshalling yard Power station Gas works Port Industrial centre	Site of previous military use Railway marshalling yard Power station Gas works Port Industrial centre	
	History of WWII bombardment	No history of WWII bombing	Near to area of known WWII bombing	Area of known WWII bombing	Area of high intensity WWII bombing	
Post-war development and the potential to remove aerial delivered UXO hazards						
Nature of development		Wholesale excavation				
		Significant post-war development				
		Moderate post-war development				
				Minimal post-war development		
				No evidence of post-war development		
Construction activities and the potential to encounter aerial delivered UXO						
Activity		Borehole drilling				
		Shallow trial pits				
		Excavations for services				
		Low density driven piles				
		Shallow excavations over extended area				
			Sheet piling			
			Deep excavations over limited area			
					High density piles	
					Deep excavation over extended area	

Notes: 1. Adapted from CIRIA C681.

Reference to the ZeticaUXO website (<https://zeticauxo.com>) also provides additional information with respect to the risk of unexploded ordnance beneath a site.

CONTAMINATION ASSESSMENT METHODOLOGY

UK Policy

The UK Government's policy in relation to land affected by historic contamination is based on a 'suitable for use' approach. The approach recognises that the risks presented by any given level of contamination will vary greatly according to the use of the land and a wide range of other factors, such as the underlying geology of the site. Contamination risks therefore need to be assessed on a site-by-site basis. The 'suitable for use' approach limits requirements for remediation to the work necessary to prevent unacceptable risks to human health or the environment in relation to either the current use or future use of the land.

The three main drivers for contamination assessment and remediation are:

- *Voluntary action.*
- *Development as part of the planning regime.*
- *Regulatory action to mitigate unacceptable risks e.g. Part 2A of the Environmental Protection Act 1990.*

Pollutant Linkages

For a contamination risk to exist there must be a 'pollutant linkage' from the contaminant (source) via a pathway (the route from contaminant to receptor) to a receptor (the entity that could be harmed). The absence of a contaminant, pathway or receptor breaks the pollutant linkage and therefore no contamination risk exists.

Contamination is typically present at a site (in the ground and/or in the underlying groundwater) as a result of a historic or current industrial use, usually as a result of leaks, spills or disposal of residues, wastes and excess raw materials from the industrial processes. Contamination may also be present due to:

- *The deliberate application of chemicals e.g. the spraying of herbicide/pesticide.*
- *Migration of pollutants from adjacent land.*
- *Naturally occurring processes e.g. elevated concentrations of particular heavy metals associated with specific geological strata.*

Conceptual Site Model

The conceptual site model can be defined as a textual or graphical representation of the identified pollutant linkages for a given site. The model forms the basis for designing the investigation as the aim will be to target all of the potential pollutant linkages to determine, through the subsequent phases of risk assessment, whether or not they pose an actual risk.

It is important that the conceptual site model is updated with new information as the various investigation, risk assessment and remediation works are completed.

Technical Guidance

The technical and legal framework for contamination assessment is complex. The process adopted through this report for assessing contamination risks is in general accordance with the following guidance, as listed below:

- 'Investigation of Potentially Contaminated Sites - Code of Practice - BS 10175: 2011+A2:2017', BSi, 2017.
- 'Model Procedures for the management of Land Contamination - CLR Document No. 11', Environment Agency, 2004.
- 'Guidance for the safe development of housing on land affected by contamination - R&D66: 2008', NHBC/Environment Agency, 2008.

Risk Assessment Methodology

In line with the technical guidance, the contamination risk assessment follows a series of phased stages for each particular site:

PHASE	DESCRIPTION	RISK ASSESSMENT STAGE
PHASE 1	Generally limited to desk based research and a site walkover survey to develop an initial conceptual site model and identify what risks, if any, are likely to be presented by the site.	<p>Hazard Identification and Assessment</p> <p>A preliminary stage of risk assessment concerned with identifying and characterising the hazards that may be associated with a particular site and identifying potential pollutant linkages.</p>
PHASE 2	This phase is concerned with establishing whether contamination is present, usually through intrusive ground investigation, and then evaluating the degree and magnitude of the associated risks.	<p>Risk Estimation</p> <p>A stage concerned with estimating the likelihood that receptors will suffer adverse effects if they come into contact with, or are otherwise affected by, a hazardous substance or agent under defined conditions.</p> <p>Risk Evaluation</p> <p>A stage of risk assessment concerned with evaluating the acceptability of estimated risks, taking into account the nature and scale of the risk estimates, any uncertainties associated with the assessment and the broad costs and benefits of taking action to mitigate risks.</p>
PHASE 3	The appraisal and selection of remediation techniques, their implementation and verification.	<p>Risk Management</p> <p>The process whereby decisions are made to accept a known or assessed risk and/or the implementation of action to reduce the consequences or probabilities of occurrence.</p>

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Risk Classification

The objective of risk assessment is to identify the nature and magnitude of the potential risks and should be based on a consideration of both:

- The likelihood/probability of an event [taking into account both the presence of the hazard and receptor and the integrity of the pathway].
- The severity of the potential consequence [taking into account both the potential severity of the hazard and the sensitivity of the receptor].

There is a need for a logical, transparent and repeatable system in defining the categories of severity of consequence and likelihood as well as for the risk itself and therefore the following risk rating matrix is employed:

		SEVERITY OF CONSEQUENCE			
		SEVERE	MEDIUM	MILD	MINOR
PROBABILITY	HIGH LIKELIHOOD	Very High Risk	High Risk	Moderate Risk	Moderate/Low Risk
	LIKELY	High Risk	Moderate Risk	Moderate/Low Risk	Low Risk
	LOW LIKELIHOOD	Moderate Risk	Moderate/Low Risk	Low Risk	Very Low Risk
	UNLIKELY	Moderate/Low Risk	Low Risk	Very Low Risk	Very Low Risk

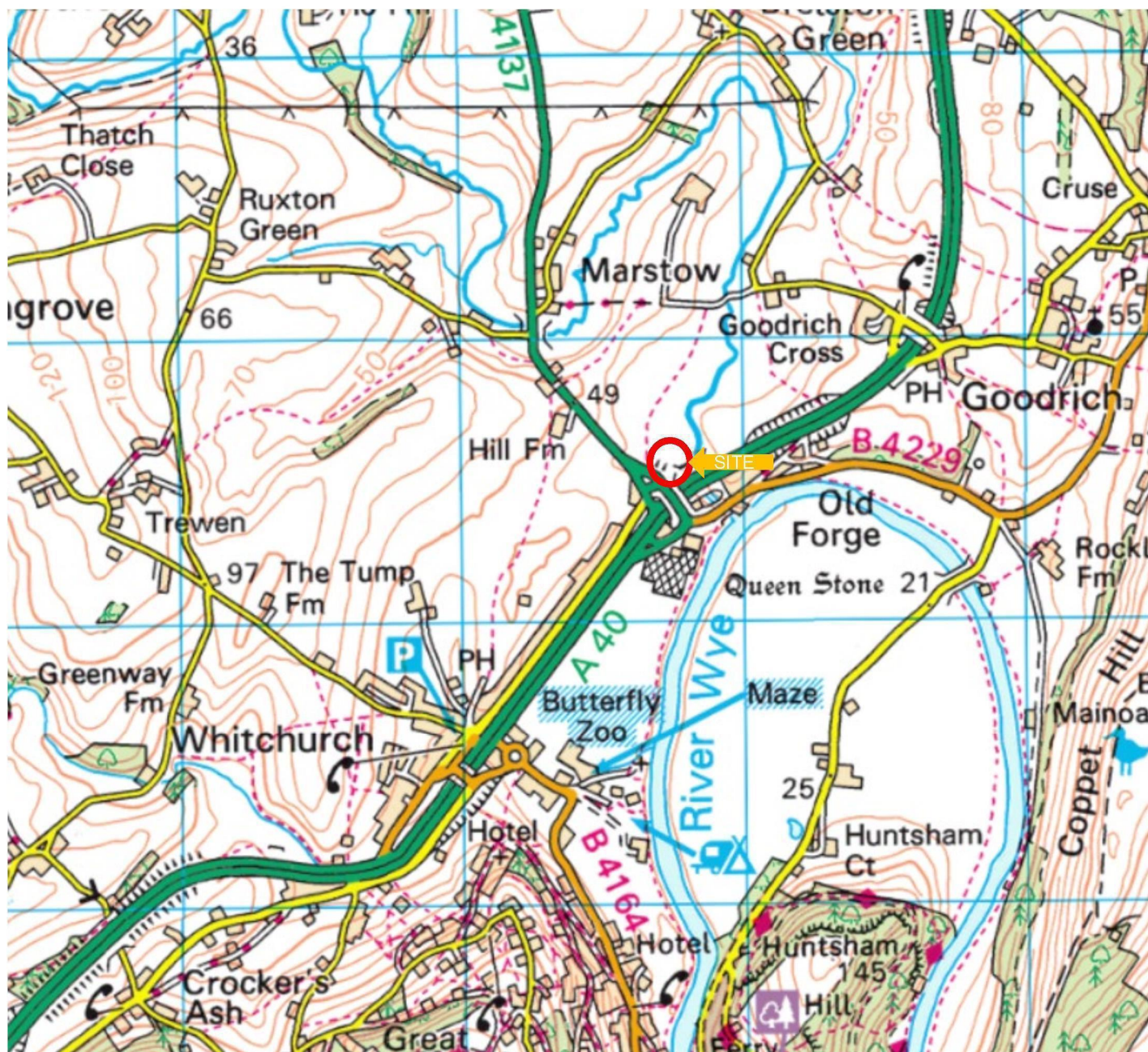
These risk classifications are defined as follows:

- **Very High Risk** - There is a high probability that severe harm could arise to a designated receptor from an identified hazard at the site without appropriate remediation action.
- **High Risk** - Harm is likely to arise to a designated receptor from an identified hazard at the site without appropriate remediation action.
- **Moderate Risk** - It is possible that without appropriate remediation action harm could arise to a designated receptor. It is relatively unlikely that any such harm would be severe, and if any harm were to occur it is more likely that such harm would be relatively mild.

- *Low Risk - It is possible that harm could arise to a designated receptor from an identified hazard. It is likely that, at worst if any harm was realised any effects would be mild.*
- *Negligible Risk - The presence of an identified hazard does not give rise to the potential to cause harm to a designated receptor.*

This preliminary risk assessment matrix and classification system is based on guidance produced by Department for Environment, Food and Rural Affairs (Defra) and the Environment Agency in connection with contaminated land assessment.

Appendix A – Drawings and Plans



KEY:

Site Location



0 km 1

Approximate Scale:

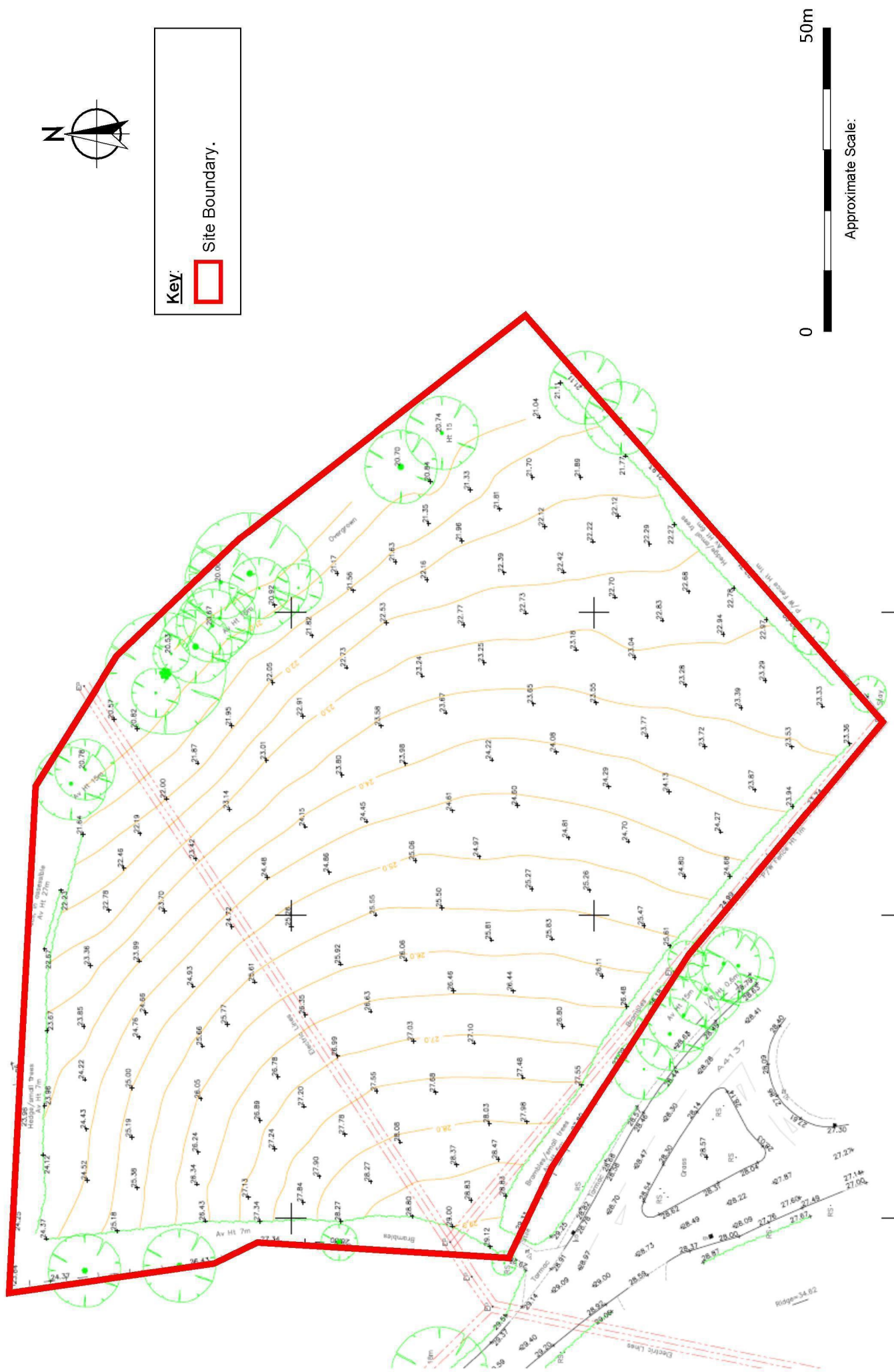
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Project Number:	E19717
Site:	Land adjacent to A4137 / A40 Junction to Burnthouse Green, Herefordshire HR9 6EG.
Drawing Title:	Site Location Plan



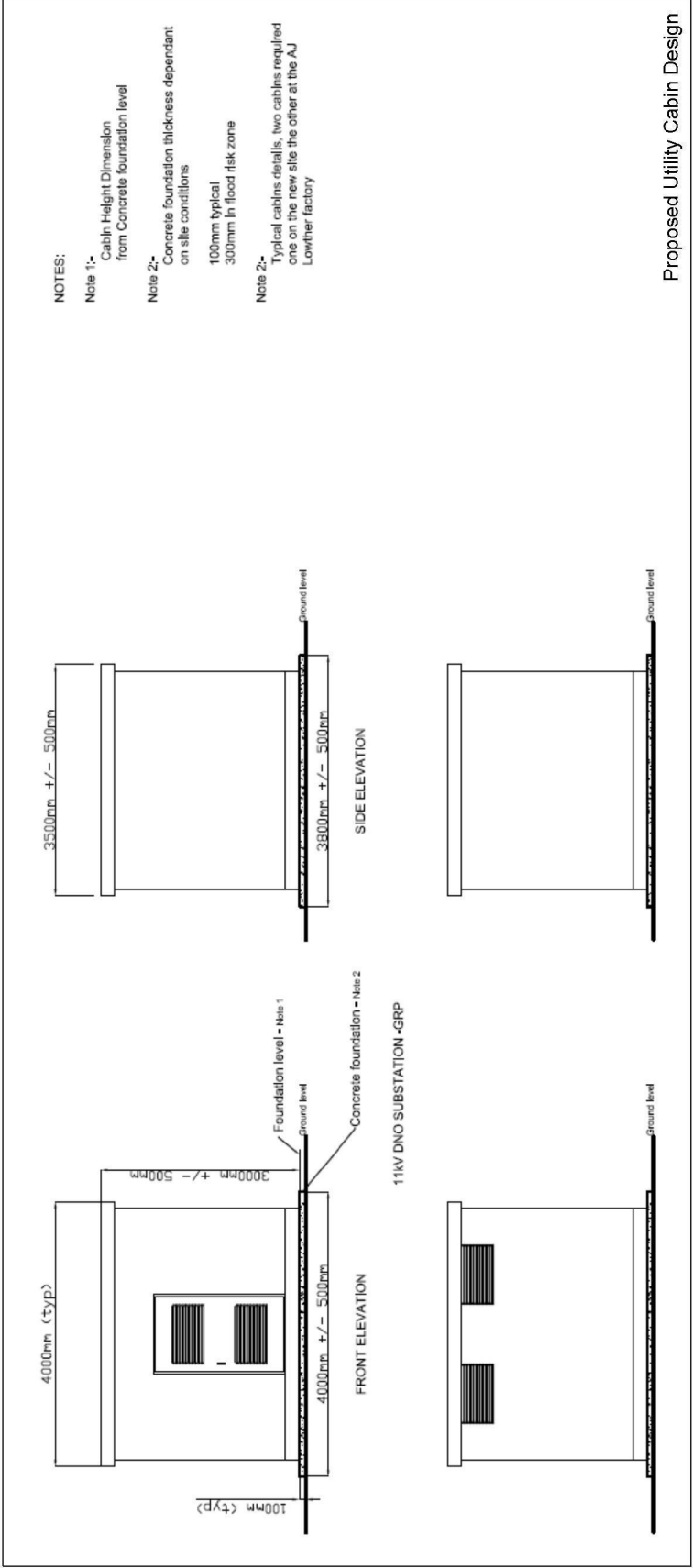
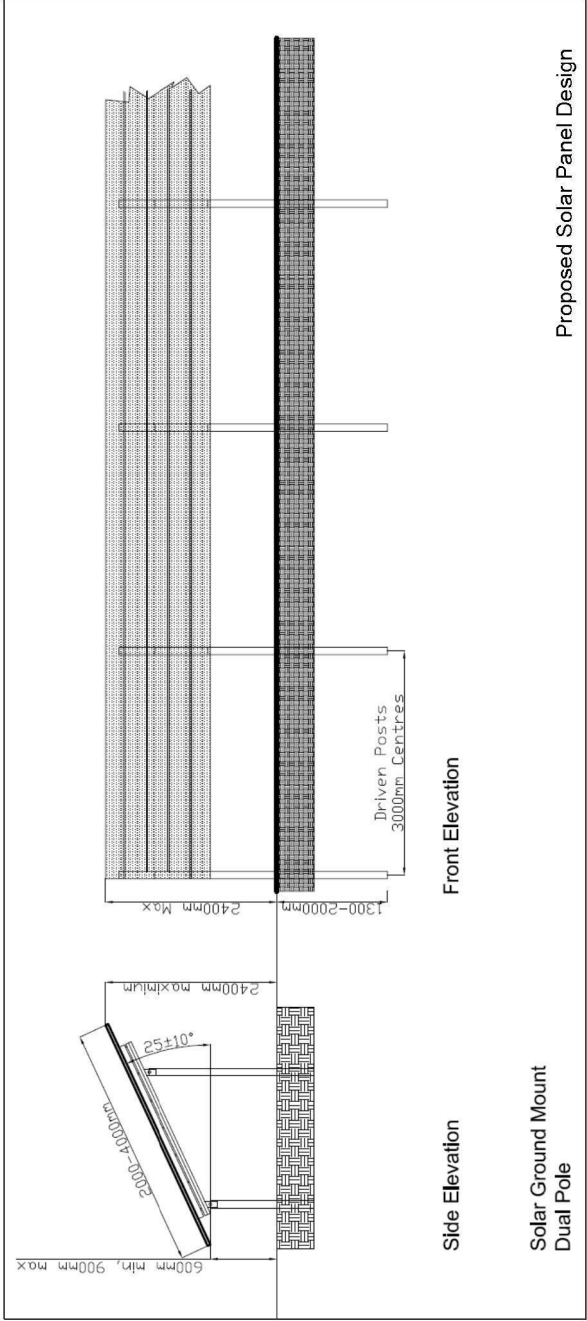
Key:

Site Boundary.


Approximate Scale:

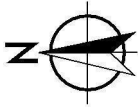
 ENVIRONMENTAL MANAGEMENT SOLUTIONS <small>EMSasbestos EMSgeotech EMSwater</small>	Project Number:	E19717
	Site:	Land adjacent to A4137 / A40 Junction to Burnthouse Green, Herefordshire HR9 6EG.
	Drawing Title:	Existing Site Layout Plan.

Extract taken from JPP Drawing: 1215/2459/1, dated 24th November 2018.

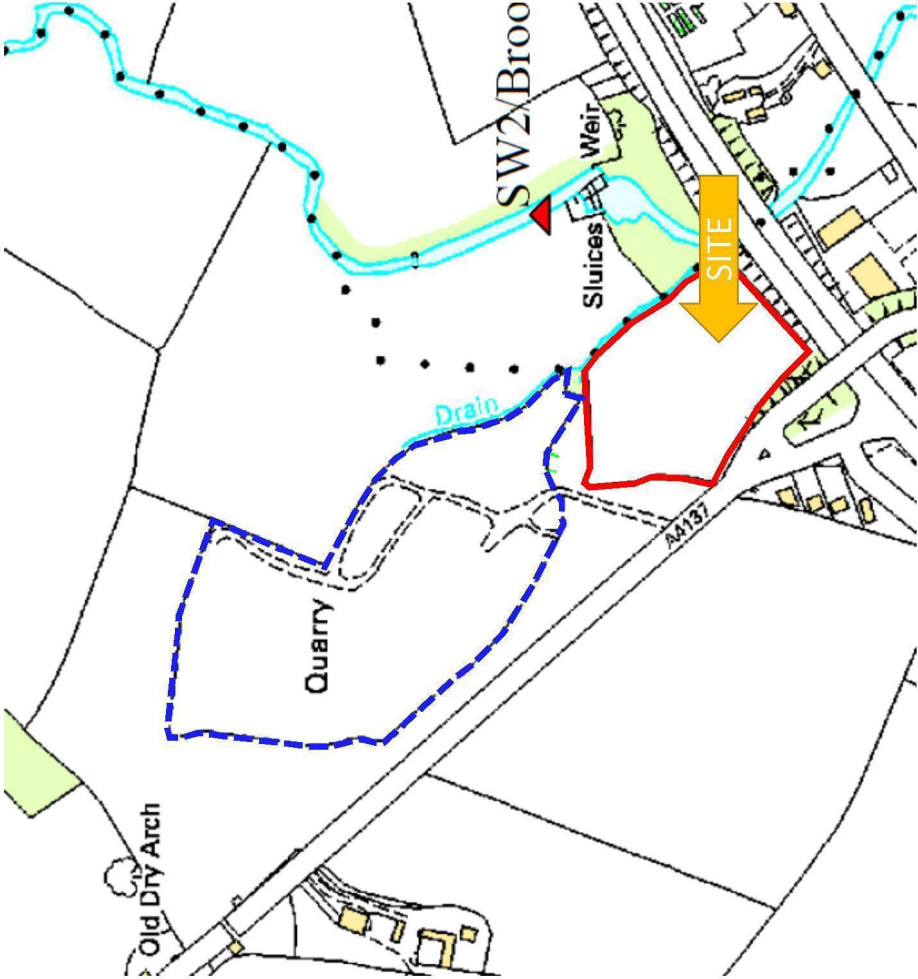


Extract taken from Bourne Valley Associates Drawing: 00131-01-A, dated 18th April 2019.

 ENVIRONMENTAL MANAGEMENT SOLUTIONS EMSasbestos EMSgeotech EMSwater	Project Number:	E19717
	Site:	Land adjacent to A4137 / A40 Junction to Burnthouse Green, Herefordshire HR9 6EG.
	Drawing Title:	Proposed Site Layout Plan.



Historic OS Map, dated 2002.

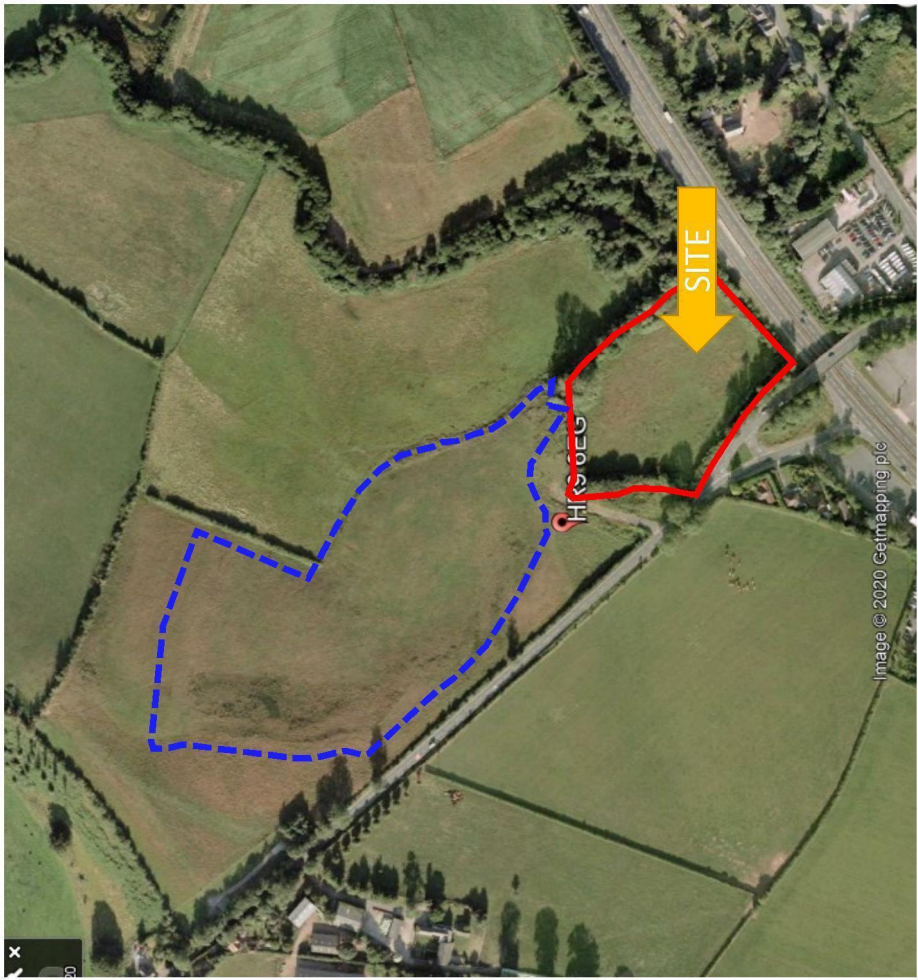


Key:

Site Boundary.


Former Quarry Boundary.

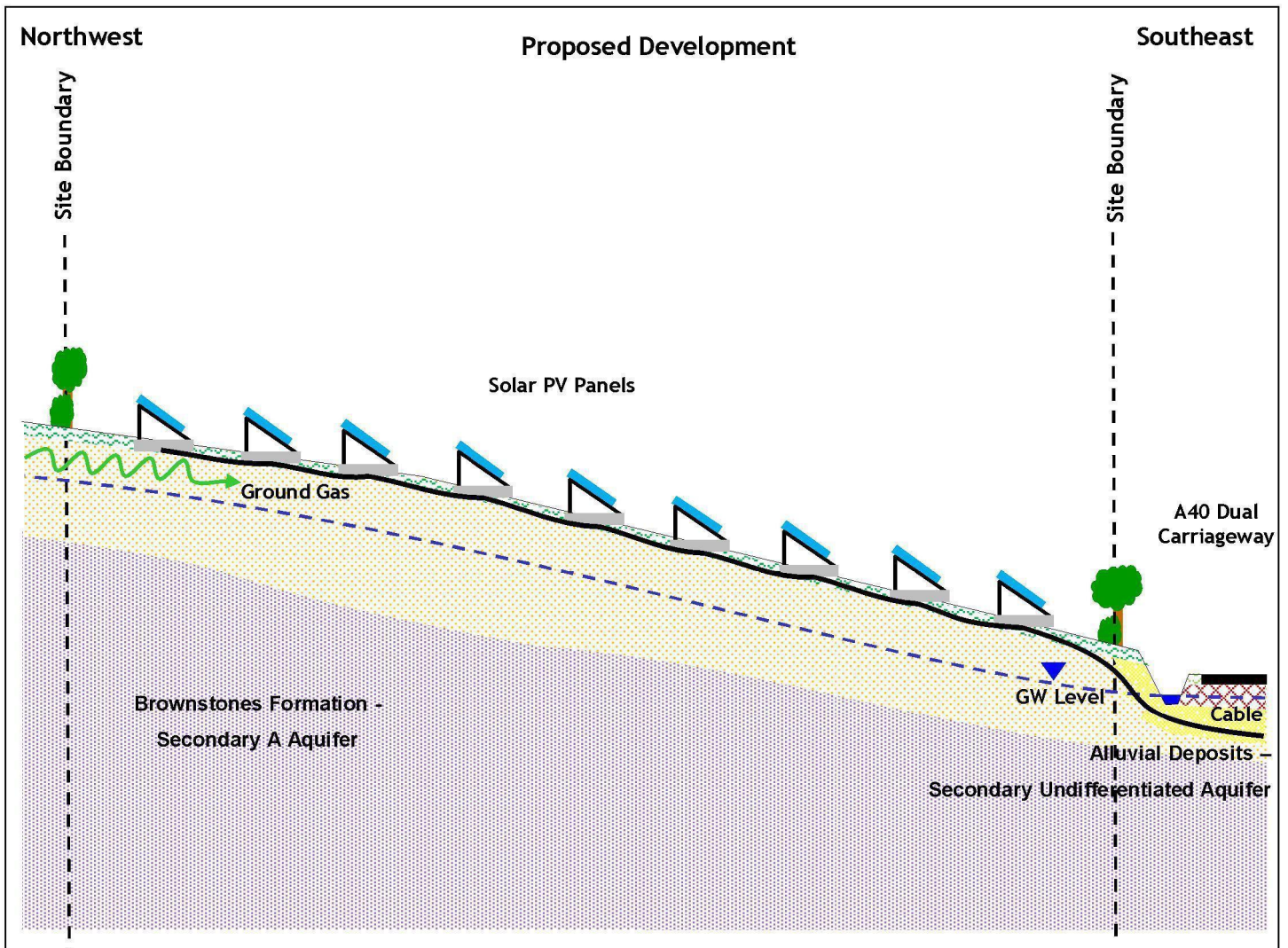
Google Earth Image, dated December 2006.



Approximate Scale:

Extracts taken from Envirocheck Historic OS Map, dated 2002 and Google Earth Imagery, dated December 2006.

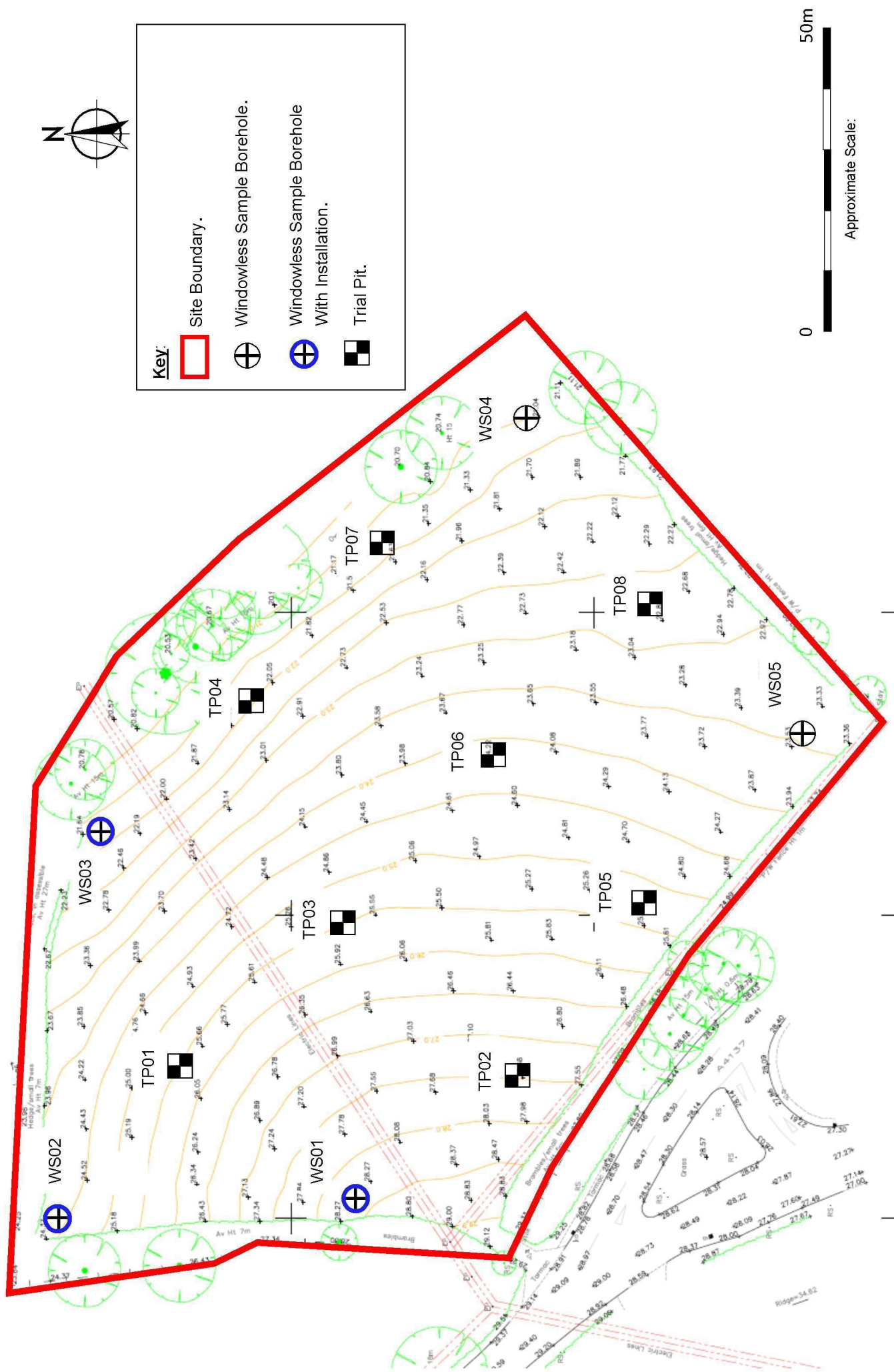
 ENVIRONMENTAL MANAGEMENT SOLUTIONS EMS asbestos EMS geotech EMS water	Project Number:	E19717
	Site:	Land Adjacent to A4137 / A40 Junction to Burnthouse Green, Herefordshire HR9 6EG.
	Drawing Title:	Map and Aerial Photo of Former Quarry.




Job Title: Land Adjacent to A4137 / A40 Junction to Burnthouse Green, Herefordshire HR9 6EG.
 Job Number: E19717
 Drawing Title: Preliminary Conceptual Site Model

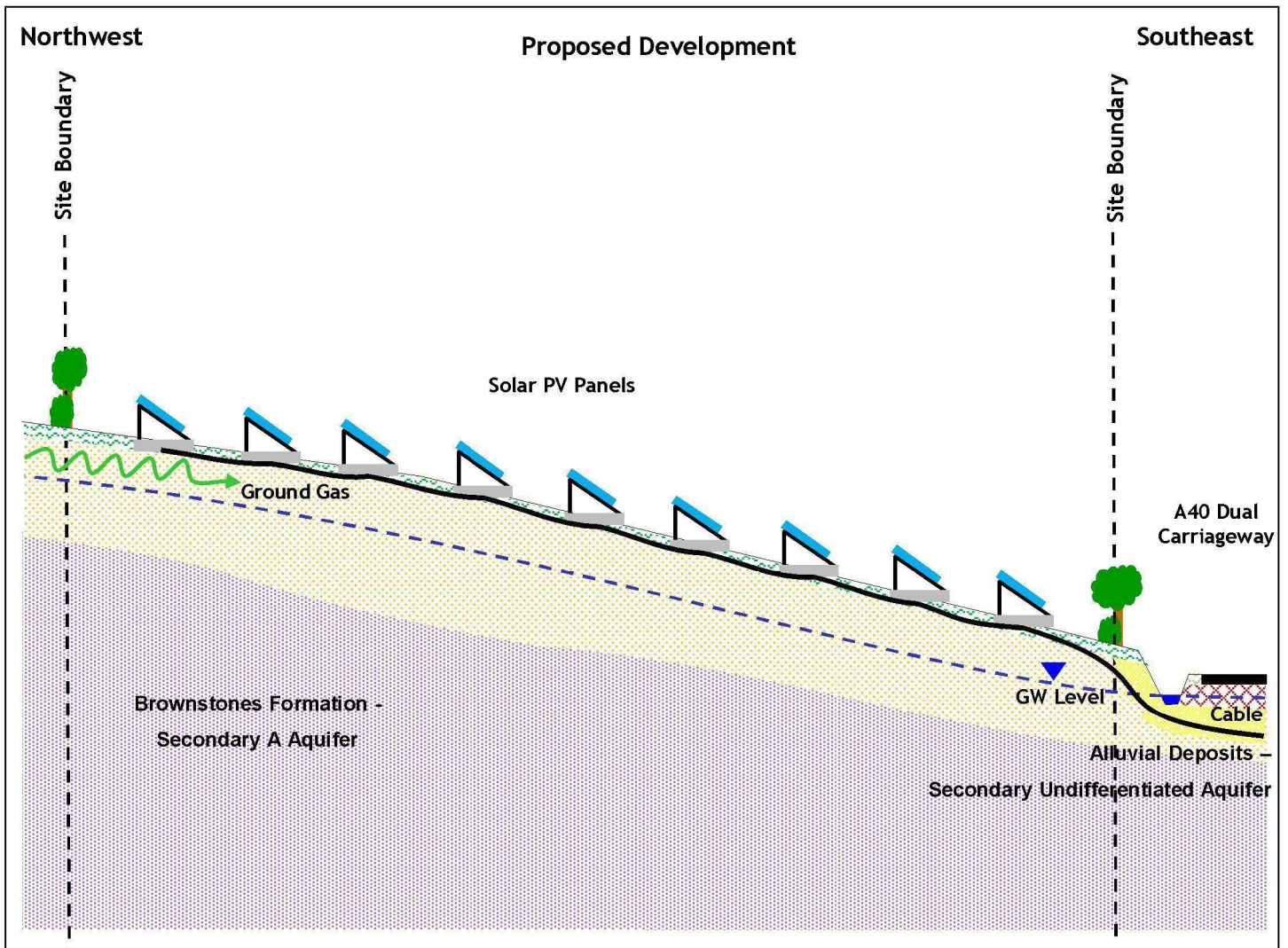


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Extract taken from JPP Drawing: 1215/2459/1, dated 24th November 2018.

 ENVIRONMENTAL MANAGEMENT SOLUTIONS EMS asbestos EMS geotech EMS water	Project Number:	E19717
	Site:	Land Adjacent to A4137 / A40 Junction to Burnhouse Green, Herefordshire HR9 6EG.
	Drawing Title:	Exploratory Hole Location Plan.



Job Title: Land Adjacent to A4137 / A40 Junction to Burnthouse Green, Herefordshire HR9 6EG.
 Job Number: E19717
 Drawing Title: Revised Conceptual Site Model



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Appendix B – Photographic Record - Site Walkover



Photo 1: Northern Boundary



Photo 2: Eastern Boundary



Photo 3: Southern Boundary



Photo 4: Western Boundary



Photo 5: North of site facing Northeast



Photo 6: South of site facing Southeast



Photo 7: East of site facing East



Photo 8: South east of site facing Southeast.