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PHASE 1 DESK STUDY

CLIENT:	Mr A Archer		
PROJECT:	Land off Higher Woodcroft, Leek		
ELEMENT:	Phase 1 Desk Study		
PROJECT No:	A3564		
REPORT AUTHOR	Karen Murray	SIGNATURE	
CHECKED	Tim Major	SIGNATURE	

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1.0 INTRODUCTION

Aspin Consulting Ltd has been appointed by the Client, Mr A Archer, to undertake a Phase 1 Desk Study at a site located on land off Higher Woodcroft in Leek, Staffordshire, ST13 5QF.

1.1 Scope of Works

The report has been requested to satisfy the requirements of an Application for Planning Consent.

On-site photographs of the site have been supplied to Aspin Consulting by the client's representative and reproduced in Appendix A.

The scope of this Phase 1 Desk Study included the following:

- Review of available historical and contemporary Ordnance Survey publications relating to the site.
- Review of the site's geology, hydrology and hydrogeology, as appropriate
- Review the site's coal mining status and commission a Coal Mining Report from the Coal Authority (if required).
- Review of the site's radon status.
- Commission of a full detailed Landmark Envirocheck Report relating to the site.
- Production of a preliminary Conceptual Site Model (CSM) for the site.

1.2 Project Understanding

We understand that a Desk Study is required for an application for Planning Consent relating to the construction of twenty four residential properties with private gardens, areas of hardstanding and an access road. Where the proposed site end-use is not consistent with our current understanding, it would be necessary to review our assessment to ensure it continues to apply.

1.3 Limitations

This report is confidential and is written solely for the benefit of the Client, Mr A Archer and the Client's representatives and agents. Any comments are based on the understanding that the proposed development will be detailed as above. This report may not be used or relied upon by any unauthorised third party without the explicit written agreement of Aspin Consulting Ltd.

The conclusions and recommendations made in this report are limited to those that can be made based on the findings of the investigation. Where comments are made based on information obtained from third parties, Aspin Consulting Ltd assumes that all third party information is true and correct. No independent action has been undertaken to validate the findings of third parties.

This report has been prepared in accordance with our understanding of current best practice. However changes to best practice, guidance or legislation may necessitate revision of this report after the date of issue.



2.0 SITE DESCRIPTION

2.1 General

The site is located off land adjacent to Higher Woodcroft, approximately 750m south west of Leek town centre. The National Grid Reference for the centre of the site is approximately SJ 97690, 55990. The site comprises an area of land which is broadly rectangular in shape with maximum dimensions of approximately 140m x 70m. The total site area is approximately 0.89 Ha (2.2 Acres).

The site area is currently wasteland with areas of dense vegetation. Areas of hardstanding (tarmac) are shown in the north eastern area of the site. A further area comprising crumbling hardstanding is located in the south eastern area together with a brick ramp. The site boundary is defined by a brick retaining wall to the north east, concrete retaining wall to the south east, hedge/wall to the south west and with no defined boundary to the north-west.

The site is located on a slope with a fall of approximately 13m from the west to the east. Several steep slopes are located in the south west corner of the site and in the central area of the site predominantly covered by semi mature/mature trees.

A walk over of the site has not been undertaken but based on site photographs supplied by the client invasive plant species such as knotweed and giant hogweed cannot be discounted.

The location of the site may be viewed on the plans within this report and the Landmark Envirocheck report, which is presented in Appendix C of this report.

3.0 PREVIOUS SITE INVESTIGATIONS

3.1 Summary of previous site investigations

The client has supplied a copy of a report 'Former Leek Gasworks' B.20 (a) Documentary Review prepared by Atkins for the Environment Agency in 2005.

The findings of the review cover an area of land that borders the east/south east of the site and was previously occupied by a gas works dating back to 1845. The former gas works site was split into four areas with the section bordering the current site being identified as Area 4 in the report. In summary the findings of the report are based on Area 1 (northern area of gas works) of the site which is where a tar tank and purifier were located.

Within Area 1 remediation works including excavation and removal of gasworks structures and contaminated soil has taken place. Residual contamination remains at the site, beneath areas of clean cover.



Several contaminants were found to be present within the former gas works Area 1 during site investigation works in 1997 and 2000, and included a range of metals, inorganics including cyanide and ammonia and organics including cresols, phenols, PAHs and other aliphatic and aromatic hydrocarbons. Contaminants are also considered likely to be present as dispersed sources within the other areas including Area 4.

The site is founded on Sherwood Sandstone and perched groundwater was recorded within the upper 3m of the ground. The main water table was at a depth of approximately 20m below the ground.

Contaminants within the underlying groundwater have also been identified and include ten contaminants (phenol, PAHs, cyanide, sulphate, ammonia, cadmium, lead, nickel, benzene and oil/fuel hydrocarbons) where the concentrations detected exceeded the UK drinking water standards.

A further 10 contaminants in groundwater had positive detections, but there was no relevant EQS, therefore a pollutant linkage is considered to exist however it was not possible to assess its significance.

It is considered likely that a source of contamination remains within Area 4 which may migrate and impact upon the controlled water receptor.

It should be noted however, that this Atkins report of 2005 is for land adjacent to our site and as such may not be directly relevant to the site of this report.



3.0 DESK STUDY

3.1 Site History

The historical and contemporary Ordnance Survey publications included within the Landmark Envirocheck Report have been reviewed by Aspin Consulting to establish the history and past-uses of the site. All available editions of the 25" to 1 mile and 6" to 1 mile County Series maps dating back to 1879, together with more recent National Grid 1:1,250, 1:2,500, 1:10,560 and 1:10,000 plans were examined to determine past site usage a summary of which is presented below. The historical Ordnance Survey maps are included in Appendix B of this report.

The key findings of the historical search are summarised in Table 1.

Table 1: Site History

TABLE 1 – HISTORICAL PUBLICATION DATA			
Date	Edition/ Scale	Features on Site	Features off Site
1879-1888	County Series 6" to 1 mile 25" to 1 mile	<ul style="list-style-type: none"> Fields bounded by wooded hedgerows in the south eastern third of the site. 	<ul style="list-style-type: none"> Fields with occasional small buildings in the immediate surrounding area. A gas works is located 30m to the east/southeast and includes three round structures (possible gas holder) and large buildings. A railway line 'Churnet Branch' runs approximately 32m along the north eastern site boundary within a cutting. A station and goods shed are located approximately 200m to the south east. An Iron Foundry is located approximately 180m to the east of the site. A wharf /canal basin relating to the Caldon Canal is located 200m to the south east.
1899-1900	County Series 6" to 1 mile 25" to 1 mile	<ul style="list-style-type: none"> Site is located within one large field. 	<ul style="list-style-type: none"> A second large round structure (further possible gas holder) is shown approximately 60m to the east/southeast of the site associated with the gas works. A large residential dwelling named 'Woodcroft' with



TABLE 1 – HISTORICAL PUBLICATION DATA			
Date	Edition/ Scale	Features on Site	Features off Site
			associated grounds, fountain, glass houses is located immediately to the south of the site.
1925	County Series 6" to 1 mile 25" to 1 mile	<ul style="list-style-type: none"> No significant change to the site area 	<ul style="list-style-type: none"> A third round structure (third gas holder) is shown approximately 60m from the eastern site boundary. The Iron foundry located approximately 180m to the east is no longer shown.
1937-1951	County Series 6" to 1 mile 25" to 1 mile	<ul style="list-style-type: none"> No significant change to the site area. 	<ul style="list-style-type: none"> No change to the gas works. 'Woodcroft' and associated gardens located immediately to the south of the site is now partially occupied by residential housing. Residential development beyond the rail line to the north of the site.
1964-1965	National Grid 1:1,250 1:10,000	<ul style="list-style-type: none"> The ground profile of the site has changed and now shows raised levels indicating possible tipping/spoil heap. 	<ul style="list-style-type: none"> Land immediately adjacent to the east of the site is now part of the gas works. A coal yard is shown approximately 90m to the north east of the site beyond the railway. By 1964 the wharf/canal basin is no longer shown.
1966-1971	National Grid 1:1,250 1:10,000	<ul style="list-style-type: none"> A building is shown located halfway along the eastern/south eastern site boundary and is associated with a coal yard which is shown encroaching the eastern/south eastern site boundary and the area immediately to the south east of the site. 	<ul style="list-style-type: none"> Significant demolition of the gas works has taken place. One gas holder and several buildings are no longer shown.
1970-1971	National Grid 1:1,250	<ul style="list-style-type: none"> No significant change to the site 	<ul style="list-style-type: none"> The 'Churnet Branch' railway line is now shown as dismantled.
1971 - 1976	National Grid 1:10,000	<ul style="list-style-type: none"> No significant change to the site area. 	<ul style="list-style-type: none"> Allotment gardens are now shown to the north of the site,



TABLE 1 – HISTORICAL PUBLICATION DATA			
Date	Edition/ Scale	Features on Site	Features off Site
			south of the dismantled railway.
1983-1992	National Grid 1:1,250 1:10,000	<ul style="list-style-type: none"> Little or no change to the site. 	<ul style="list-style-type: none"> By 1986 a works building is shown located immediately to the east/south east of the site on part of the former gas works site.
1993-2000	National Grid 1:1,250 1:10,000	<ul style="list-style-type: none"> No further change to the site area 	<ul style="list-style-type: none"> No significant changes in the surrounding area.
2015	National Grid 1:10,000	<ul style="list-style-type: none"> No change to the site area 	<ul style="list-style-type: none"> The two remaining gas holders have now been demolished. The dismantled railway is no longer shown.



4.0 GEOLOGY

4.1 Geological References

The following geological publications were referred to:

- BGS 1:50,000 Series Sheet 111 'Buxton' Solid and Drift Edition.
- British Geological Survey (BGS) Website.

4.2 Geology

The site is indicated to be underlain by bedrock geology of the Sherwood Sandstone Group of Triassic age. The site is shown to be devoid of any superficial deposits.

The Sherwood Sandstone Group typically comprises fine to coarse grained, commonly pebbly sandstone.

4.3 Faults

No faults are indicated to be present within the boundary of the site, or within the vicinity of the site. There are several geological faults located approximately 1km from the site boundary located to the east; the net effect on the site is considered negligible.

4.4 Hydrology

The nearest named surface watercourse is a tributary flowing into the River Churnet located approximately 643m to the south east of the site. The tributary has a flow direction from the north to the south with the River Churnet having a flow direction from the west to the east. The River Churnet has a river quality rating of good (B).

The site is shown to lie in an area identified as having a limited potential for groundwater flooding to occur. The closest area of risk from flooding is located 100m to the south of the site associated with flooding from the River Churnet.

4.5 Hydrogeology

The Environment Agency records indicate the bedrock (Sherwood Sandstone) is regarded as a Principal Aquifer – with the soils of high leaching potential.

The Environment Agency describes a Principal Aquifer as having layers of rock or drift deposits that have intergranular and/or fracture permeability that provide a high level of water storage. The site is located within a Zone III source protection zone.



There are no abstraction licences within 500m of the site boundary, the closest being located 674m to the south west of the site to the Westwood golf club.

4.6 Radon

Reference to the BRE document 211 “Radon: guidance on protective measures for new dwellings” indicates that no radon protective measures are necessary in the construction of new dwellings.

4.7 Coal Mining

The site lies in an area not affected by coal mining.



5.0 ENVIRONMENTAL DATA

5.1 Landmark Envirocheck Report

A Landmark Envirocheck report was commissioned to assist in ascertaining the environmental setting of the site. The full Envirocheck report is presented in Appendix C and has revealed the following relevant information (details are only listed where they are within 250m of the site):

5.2 Landfills and Waste Disposal/Treatment

There is one recorded historical and registered landfill site facility indicated within potential influencing distance of the site (i.e. <250m). This is located 22m to the east of the site to C&C Diesels for inert waste. The licence has now lapsed.

One registered waste transfer site is located 330m to the north east for general waste. The licence for this site has now lapsed.

5.3 Environmental Setting

The site is not in an area designated by DEFRA as being in a Nitrate Vulnerable Zone.

The site is not located within 250m of any other environmentally sensitive receptors such as Sites of Special Scientific Interest (SSSI), Areas of Outstanding Natural Beauty, National Parks, Special Protection Areas, Special Areas of Conservation, Nature Reserves or Ramsar Sites.

5.4 Identified Potential Contamination Sources

Reference to the Envirocheck report indicates that there are no active discharge consents within 250m of the site. A discharge consent for a single property was located 270m east for sewage and trade into a freshwater stream. The application was refused in 1963.

There are two fuel stations recorded within 250m of the site. One has a status open and is located 168m to the east, the other is classified as closed. There is one Control of Major Accident Hazards Sites (COMAH) and one notification of installations handling hazardous substances (NIHHS) both are inactive.

None of the following are located within 250m of the site:-

- Integrated Pollution Controls
- Pollutions Incidents to Controlled Waters
- Water Abstractions

And none of the following within 1000m of the site:-

- Explosive Sites
- Planning Hazardous Substance Enforcements
- Enforcement and Prohibition Notices



There are seven active Contemporary Trade Directory Entries within 250m of the site: the closest being located 48m to the south for garage services and 84m to the north east also for garage services.

5.5 Geological

The BGS has classified the site as having very low or no perceived hazard risk rating associated with collapsible ground subsidence, compressible ground, ground dissolution stability hazards, running sand and shrinking or swelling clay ground stability hazards.



6.0 PRELIMINARY CONCEPTUAL SITE MODEL

6.1 General

This section uses information from sections 1 to 5 of this report to provide a representation of the risk posed to human health and environmental receptors from potential on- and off-site contamination sources.

This assessment is based on CLR 11 Model Procedures for the Management of Contaminated Land (DEFRA), and presented as a 'source-pathway-receptor' model which is the methodology adopted as the procedure for identifying 'Contaminated Land' under Part IIA of the Environmental Protection Act (1990) and in accordance with current best practice.

Where potential concerns are identified – contamination or physical (geotechnical), recommendations for an intrusive basic or detailed investigation may be made.

6.2 Potential Contaminant Sources

Information gathered from the desk study has been used to identify the likely contaminants, their sources and their spatial distribution. A 'contaminant' is defined as a substance that is in, on or under the land and has the potential to cause harm to human health or to cause pollution of controlled waters. Such contaminant sources may arise from natural geological influences or as a direct result of past uses of the site and in those cases man's impact and residual contaminant sources.

On-site

The current and historical on-site potential sources of contamination are as follows:

Current

- No current sources located on site

Historical

- Made Ground associated with past tipping (possible soils from former gas works)
- Coal yard (eastern/south eastern area of the site)

The likely contaminants associated with these uses are indicated in Table 2.



Table 2 – Potential Contaminants Associated with on-Site Activities

TABLE 2 – POTENTIAL CONTAMINANTS ASSOCIATED WITH ON-SITE ACTIVITIES			
Potential Source	Metals, semi metals, non-metals, inorganic chemicals and others	Organic Chemicals	Appropriate Industry Profile
Coal Yard	May include Cd, Cr, Cu, Pb, Hg, Zn, As, Se, free CN^- , NO_3^- , SO_4^{2-} , Asbestos, pH	Oil/fuel hydrocarbons, PAHs	Charcoal works
Made Ground (possible gas works spoil)	May include Cd, Cr, Cu, Pb, Hg, V, Zn, As, S_0 , complex and free CN^- , SO_4 , S^2 , Asbestos, pH, ground gas	May include Oil/fuel hydrocarbons, PAHs, phenol	Made Ground

Off-Site

The potential current and historic off-site sources of contamination within 100m of the site boundary which are considered likely to pose a potential risk to the site have been detailed below. This criterion of 100m was chosen for being a conservative estimate of the potential migration distance of the respective contaminants.

Current

- Garage services 48m to the south

Historical

- Gas works adjacent to the eastern site boundary
- Former railway

The contaminants associated with these uses as indicated in CLR8, Potential Contaminants for the Assessment of Land (DEFRA, March 2002) where relevant, are detailed in Table 3.



Table 3 – Potential Contaminants Associated with off-Site Activities

TABLE 3 – POTENTIAL CONTAMINANTS ASSOCIATED WITH OFF-SITE ACTIVITIES			
Potential Source	Metals, semi metals, non-metals, inorganic chemicals and others	Organic Chemicals	Appropriate Industry Profile
Gasworks	May include Cd, Cr, Cu, Pb, Hg, V, Zn, As, S ₂ , complex and free CN ⁻ , SO ₄ , S ²⁻ , Asbestos, pH	May include Oil/fuel hydrocarbons, PAHs, phenol	Gasworks, coke works and other coal carbonisation plants
Railway	May include Cd, Cr, Cu, Pb, Ni, V, SO ₄ Asbestos, pH	May include Oil/fuel hydrocarbons, PAHs, PCBs	Railway Land
Garage Services	May include Cr, Cu, Pb, Zn, Asbestos, pH	May include Oil/fuel hydrocarbons, PAHs	Road vehicle servicing and repair: garages and filling stations

In addition to the findings of the desk study information there is, however, a possibility that naturally occurring determinants may pose a risk to the development or future site users. These risks are discussed below:

- Certain chemicals e.g. sulphates can pose a risk to proposed structures via concrete attack.
- Natural soils may contain elevated concentrations of inorganic compounds that could represent a potential hazard to human health.
- Certain compounds, for example, phenol and acidic pH can present a risk to certain types of water supply pipes.

6.3 Potential Contaminant Pathways

CLR11 defines a pathway as ‘a route or means by which a receptor can be exposed to or affected by a contaminant’. To assess the potential risks posed by the contaminants to vulnerable receptors the pathways through which contaminants may impact sensitive receptors need to be identified.

For a residential end use, the CLR10 report indicates six potential exposure routes via which future users of the development may be exposed to contaminants (arising on- or off-site).

- Dermal exposure
- Inhalation of soil dust
- Inhalation of soil vapour/gas
- Direct ingestion of soil



- Ingestion of soil attached to vegetables
- Ingestion of contaminated vegetables

Information to date indicates that the underlying geology may comprise Made Ground overlying the Sherwood Sandstone. The soils are classified as being of high leaching potential and are within a Zone III source protection zone, therefore the following pathways may exist:

- Lateral migration through soils
- Downward migration through soils
- Groundwater transport

6.4 Potential Contaminant Receptors

It is envisaged that the receptors of potential contamination associated with the site are:

- **End Users** – based on the proposed residential end use, the critical receptor is considered to be a young female child.
- **Neighbouring buildings** – the residential properties surrounding the site are considered to be at risk due to their proximity.
- **Shallow Groundwater** – the site may be located over varying thickness of Made Ground. The Made Ground materials may allow the migration of potential contaminants to deeper groundwater and therefore is considered as an intermediary receptor.
- **Deep Groundwater** – the site is located over strata classified as a principal aquifer. The site is located within a Zone III groundwater source protection zone; however the nearest water abstraction licence is located 674m south west from the site.
- **Proposed structures/underground services** – certain contaminants can have a detrimental effect on the materials used in the construction of services and structures, for example concrete can be vulnerable to sulphate attack.

These receptors have been excluded for the following reasons:-

- **Construction Workers** – certain contaminants may represent a risk to site workers involved in the construction process via direct contact, inhalation, or ingestion of contaminated soil or vapours. On the basis that exposure will only be on a short term basis, it is proposed that the risks are addressed via the use of normal working practices/methods and the wearing of appropriate PPE and Health and Safety measures.
- **Controlled Surface Water** – the nearest surface water receptor is a tributary to the River Churnet located 643m to the south east of the site. The river is down the hydraulic gradient however given the distance it is considered unlikely that surface water would be adversely impacted by any residual site derived contaminants.



6.5 Potential Significant Pollutant Linkages Considered

This section assesses the significance of the potential receptors within a source-pathway-receptor model. A significant 'pollutant linkage' requires the presence of a pathway, a receptor and a pollutant. All three elements of a pollutant linkage need to be present for a risk to exist.

Based on the information contained in Sections 6.2 to 6.4 the significant pollutant linkages that cannot be discounted without further information being retrieved by intrusive investigation are as follows:-

Table 4 – Source-Pathway-Receptor Linkages

SOURCE		PATHWAY		RECEPTOR	RISK RATING	JUSTIFICATION
Contaminated Soil, Made Ground and naturally occurring contaminants	→	Dermal exposure Inhalation of soil dust Inhalation of soil vapour Direct ingestion of soil	→	Future users	LOW/MODERATE	The use of appropriate PPE can limit the risk to construction workers. The risk to future users is limited to gardens and landscaped areas.
	→	Migration of soil vapour and dust	→	Neighbouring existing buildings	MODERATE	The site is surrounded by residential properties to the south and a commercial building to the east therefore sensitive land use.
	→	Migration of soil vapour and dust	→	Proposed residential dwellings	MODERATE	Soils in back garden/landscaped areas will be left exposed.
	→	Leaching through soils	→	Primary aquifer, Zone III source protection zone	MODERATE/HIGH	Is a high risk rating as primary aquifer and zone III source protection zone.



	→	Leaching through soils	→	Proposed structures foundations/ services	MODERATE	Residual contaminants in the Made Ground may necessitate requirement for specific types of water supply pipe/ sulphate resistant concrete
Gases and vapour	→	Migration of soil vapour and gases to indoor and outdoor air	→	Future site users, nearby properties and proposed properties	MODERATE	Uncertainty until gas monitoring undertaken. Made Ground is considered likely given the site history.
Groundwater contamination	→	Transport via shallow groundwater	→	Deep Groundwater	HIGH	Made Ground maybe permeable and allow migration of any residual contaminants to underlying primary aquifer.
	→	Transport via shallow groundwater	→	Neighbouring properties. Proposed structures, foundations and services.	LOW	Made Ground maybe permeable and allow migration of residual contaminants.

The assessed risk from the Conceptual Site Model (CSM) is that there is risk from contamination on this site from localised Made Ground associated with possible tipping and stock piling of soils from the former gas works located adjacent to the site. There is also the potential for historic land use on neighboring sites (former railway, coal yard), to have further contributed to contamination within the area. Based on the conceptual site model, the following information is required to quantify the relevance and severity of the potential pollutant linkages. This information will be obtained by ground investigation and confirm the following:-

- Actual presence and extent of contaminants in soil;
- Actual presence of contaminants in groundwater (if significant soil or leachability concentrations identified or suspected);
- Actual generation of gas.

Proposed Phase II Exploratory Works should be undertaken in accordance with current industry good practice. Based on our current understanding (preliminary site model) it is recommended that the Phase II works comprise the following as a minimum:



- A programme of exploratory holes across the site to provide an initial inspection of any Made Ground materials and near surface soils.
- Appropriate geotechnical and environmental soil analysis. Soils to be tested will largely be dependent on the materials encountered across the site, however as a minimum it would comprise a range of contaminants based on those likely to be present due to the neighbouring historical gas works and possible stockpiling/ tipping of gas waste materials.
- Installation of gas/groundwater monitoring wells to allow groundwater sampling and a program of monitoring visits to determine the gas regime below the site in accordance with CIRIA 665.
- Ground water samples (if encountered) to be tested for a range of contaminants primarily those that have been identified within the Former Leek Gasworks' B.20 (a) Documentary Review prepared by Atkins and in soil samples in concentrations that would pose a risk to groundwater/surface water bodies.



7.0 RECOMMENDATIONS

The Desk Study outlined in this report has identified there are potential Pollution Linkages on the proposed development of the site for a residential housing end use.

The former gas works site located immediately to the east and any material arising from it now on the site have identified contaminants that are considered a significant risk to human health and/or controlled waters. The potential for these contaminants on the current site is considered possible due to tipping/stock piling of materials that may include gasworks wastes.

Plausible pathways exist to a number of receptors – mainly future site users and the underlying primary aquifer being the most pertinent.

At this stage, we would recommend a program of intrusive ground investigation to be undertaken across the site area. Further consultation with the Local Authority Environmental Health Officer (EHO) and Environment Agency may be required to confirm the scope of works.

If off-site disposal of contaminated soils is required, it may be necessary to categorise these and undertake Waste Acceptance Criteria (WAC) testing.

A walk over of the site has not been undertaken but based on site photographs supplied by the client invasive plant species such as knotweed and giant hogweed cannot be discounted. It is recommend a specialist is contacted to provide further confirmation.



DRAWINGS



APPENDIX A

Site Photographs



APPENDIX B

Historical Plans



APPENDIX C

LANDMARK ENVIROCHECK REPORT

