Harras Moor Phase I Geo-environmental and Geo-technical Desk Study & Coal Mining Risk Assessment

Homes England

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Prepared by	Checked by	Verified by	Approved by
Robert Eaton Environmental Consultant	Fiona Endley Principal Environmental Consultant	Dr. Lawrence Bowden Associate Director	Fiona Endley Principal Environmental Consultant
Sophie Hooper Environmental Consultant	Colin Marshall CGeol Principal Engineering Geologist	Doug Lewis Associate Director	

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Project

Project Name	Harras Moor
Project Address	Land at Harras Road, Whitehaven, Cumbria
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Summary Description of Project / Proposed development
The project is for the Homes & Communities Agency for the production of a Phase 1 Desk Study Report and supporting Coal Mining Risk Assessment for the proposed residential development of the Harras Moor Site

The site is currently occupied by land tenants who use the site for animal grazing and was predominantly used for agricultural use throughout it's history. In the western area of the site there was sandstone quarrying with the void since being infilled with unknown materials.

The site is in an area of historic coal mining and the western portion of the site may be affected by shallow mining.

The project will be regulated under the Town and Country Planning act through submission to the Local Authority.

Document

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Regulator's Contact Details

Local Authority Details

Local Authority Name	Copeland Borough Council
Contact Name	Planning Liaison Officer
Contact Telephone	01946 598421
Contact Email	devcontrol@copeland.gov.uk
Contact Role	Planning Officer

Regulator Details

Regulator	N/A
Contact Name	N/A
Contact Telephone	N/A
Contact Email	N/A
Contact Role	N/A

SQP Details

SQP Name	Lawrence Bowden
SQP Registration No.	SQP0076
Telephone	0616 237 6038
Email	lawrence.bowden@aecom.com
Organisation	AECOM Infrastructure and Environment UK Ltd
Address	Bridgewater House, , Manchester, 0
Chartered or Professional Institution	The Geological Society
Chartered or Professional Institution Membership Reference	1014463

Declaration

I, Lawrence Bowden, confirm that I am the person described in the SQP Details section and hold current valid registration as a Suitably Qualified and Experienced Person Registration No. SQP0076 with the NQMS.

I have reviewed the document described in the Document Details section, in relation to the project and site described in the Site Details section, and I am satisfied that:

1. The work has been carried out by appropriately capable people with reference to the Brownfield Skills Framework.
2. That the work carried out is, to the best of my knowledge, undertaken with reasonable skill and care, and the information and data reported:
    i. describe an appropriate scope and objectives and
    ii. accord with relevant good practice guidance and standards and
    iii. are based upon appropriately robust science and
    iv. are factually correct and
    v. have been appropriately reviewed.
3. That all specialist aspects have been reviewed by an appropriately qualified/competent person with relevant skills and experience in that specialist area.
4. That the interpretation and conclusions are reasonable.
5. That proposals to mitigate actual potential or residual risks are appropriate.
6. I am competent to sign this Declaration and that
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Signed: [redacted]

Date: 15 MARCH 2018

0118-A2289

Name:
[Block capitals]

LAWRENCE IAN BOWDEN

Prepared for:

Homes England
Arpley House,
110 Birchwood Boulevard,
Birchwood,
Warrington,
WA3 7QH

Prepared by:

AECOM
4th Floor
Bridgewater House
Whitworth Street
Manchester
M1 6LT
UK

T: +44 (161) 907 3500
aecom.com

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Executive Summary

Homes England, formerly the Homes and Communities Agency (HCA), commissioned AECOM to complete a Phase 1 Geo-Environmental and Geotechnical Desk Study, which included a Coal Mining Risk Assessment (CMRA). The CMRA has been prepared based on the Coal Authority 'Guidance for developers on the risk based approach to development management', Version 4, (CA, 2017).

The proposed residential development is centred at National Grid Reference (NGR) NX 98641,18035 and is approximately 23 hectares (Ha) in plan area. The Site is located between the A595 Loop Road South and Harras Road, within Harras Moor in Whitehaven, as shown in Figure 1. AECOM understands that the Site is owned by Homes England. The proposed residential development is made as an outline application (with access) and will comprise up to 370 residential units, with access roads, open space provision and associated infrastructure.

Topographically, the Site slopes down towards the southwest. This gradient is most notable within the northern fields and particularly Area F1 (the site has been sub-divided into Areas F1-F9, as shown in Figure 2). The southern fields, while also falling to the southwest, tend to have an incline of a more gentle nature.

The Site comprised a number of coarse grassland fields with boundaries marked typically by timber post and wire fencing with lines of mature hedgerows and trees in some areas. At the eastern end of the Site, a disused playing field adjoins an industrial estate, which lies to its north. The surrounding land-use is predominantly residential, or open undeveloped ground including ancient woodland.

The surface in most of the fields was soft and boggy underfoot, and in places waterlogged with tall grasses. No direct evidence of potentially contaminative activities associated with previous land uses were observed onsite. However, Area F6 and Area F8 identified a number of mounds varying up to approximately 4m in height. These may include waste construction material and reworked natural soils.

Historically, the Site has been almost entirely undeveloped with little change up to about 2000, when an access road from the south and a playing field on the east were included. A small quarry was located in the north east from at least 1867 up to about 1979 when it was finally infilled.

Chemicals of Potential Concern (CoPCs) are limited onsite and in the vicinity. The main source relates to potential made ground (mounds, including the infilled former quarry). The offsite sources, focus primarily upon the industrial estate adjacent to the northeast, topographically uphill.

The Site does not lie within a groundwater Source Protection Zone and no groundwater abstractions were noted within 1km. The Site is not located within a flood zone or flood warning area or within an area likely to experience flooding from rivers (or sea) without defences. The Site is classified as having 'limited potential for groundwater flooding'.

The majority of the site is likely to be underlain by either Glacial Till or weathered bedrock (Middle Coal Measures Formation). These strata generally have a firm or stiff consistency which allows spread foundations to be constructed at shallow depth. However, it was noted during the site walkover that some areas were soft and others wet, which could locally increase the depth of foundations, or require alternatives such as piles. In addition, where soft / wet conditions are proven, this can have an adverse effect on retaining wall design.

A review of the BGS 1:50,000 Geological map (sheet 28 Whitehaven-Bedrock Edition 2004) showed that the site was divided into three distinctly different zones separated by faults. Within the western half of the Site (Area F1) the mapping identifies coal outcrops extending onsite. These features are identified as posing a 'High Risk Development Area'. In addition, the Coal Authority mine abandonment plans indicate:

- That there were workings in Whitehaven Mine within the Bannock and Main coal seams beneath the central parts of the site. Although considered unlikely, there is the potential for the Bannock coal seam, and possibly the Main coal seam, to be shallow enough to cause settlement at the surface.
- Across the eastern side, deeper mining operations in the Whitehaven Mine are believed to have worked the Main coal seam which lies below the Whitehaven Sandstone, a thick sandstone unit, and it is very unlikely that there are any shallow mine workings in this area.

It is recommended that a ground investigation be carried out to confirm the above assessment and determine what, if any, remedial measures are required.

- Intrusive works could include, trial pits and windowless sample boreholes to provide general coverage and allow the installation of shallow ground gas and groundwater monitoring boreholes. Deeper boreholes will be required across parts of the site, e.g. within the former quarry, and these could be drilled with cable percussive boreholes. All these boreholes should include standard penetration tests to assist with geotechnical design.
- In addition, further ground investigations are require to determine the shallow mining risk. This should comprise as a minimum a triangular array of three rotary boreholes to at least 30m into bedrock in the western part and the central part of the site. Drilling is also recommended beneath the eastern area to verify the assumption that there is no shallow mine workings.

Permission will be required from the Coal Authority for any intrusive investigations that may intersect their assets.

1. Introduction

1.1 Terms of Appointment

Homes England, formerly the Homes and Communities Agency (HCA), commissioned AECOM to complete a Phase 1 Geo-Environmental and Geotechnical Desk Study, which included a Coal Mining Risk Assessment (CMRA).

The works reported herein represent the Production of the Phase 1 Desk Study Report and CMRA for the proposed residential development of the Site area as described in AECOMs proposal dated 2nd November 2017, which was subsequently authorised by Homes England by Purchase Order IT74893 dated 18th December.

1.2 Project Background

The proposed residential development is an area of land between the A595 Loop Road South and Harras Road, within Harras Moor in Whitehaven, as shown in Figure 1 (hereafter referred to as 'the Site'). AECOM understands that the Site is owned by Homes England. The current tenants include framers and a football ground.

The site was identified in 2015 within the CBC Local Plan 'Site Allocations and Policies Plan Preferred Options' document for residential development. The proposed residential development plan is still being developed at the time of writing this report but is understood to comprise up to 370 residential units, with private gardens, soft landscaped areas, and associated access roads.

The Planning Statement produced by White Young Green (WYG) states that the new residential development will be in keeping with the surrounding residential developments. From this document it is anticipated that residential development will occupy the majority of the site with larger soft landscaped areas in areas F4 and F7 as shown on Figure 2. In the western part of areas F6 and F7 an ecological area will be retained and the western section of Area F1 is also to be retained as an ecological area.

On the basis of this plan it can be anticipated that supporting infrastructure would comprise residential roads and footpaths with limited areas of soft landscaping. AECOM believe the Site will have entrances developed from, Harras Road, Calderbeck Road and from the existing estate to the north.

1.3 Scope of Works

1.3.1 Phase 1 Desk Study

In accordance with the proposal agreed by the council, this report has been completed in consensus with the guidance set out in BS10175 (2011) 'Code of Practice for Potentially Contaminated Sites', CLR 11 (2004) 'Model Procedures for the Management of Land Contamination' and other relevant documentation including the Town and Country Planning Act 1990 (as amended), the National Planning Policy Framework (NPPF, 2012) and considers the potential implications of Part 2A of the Environmental Protection Act 1990 (Part 2A) and the associated Contaminated Land (England) Regulations 2006 and statutory guidance (2012), BS EN 1997 Eurocode & Geotechnical Design and BS 5930 2016 Code of Practice for Ground Investigation.

Specifically, the desk based assessment scope of works aims to:

- Identify potential contamination sources, such as historical and current operations, both on and adjacent to the Site.
- Evaluate plausible contaminant migration pathways.
- Evaluate the environmental sensitivity of the Site and the potential receptors at risk, such as future site users and controlled waters.
- Identify relevant contaminant linkages and assess the potential degree of risk associated with each.
- Identify geotechnical constraints including potential for mine voids / workings, quarrying, anthropogenic soils (formerly 'made ground' / reworked natural material), existing site infrastructure i.e. basements, existing foundations and retaining structures.

1.3.2 Coal Mining Risk Assessment

The desk based Coal Mining Risk Assessment has been prepared based on the Coal Authority 'Guidance for developers on the risk based approach to development management', Version 4, (CA, 2017).

The Coal Authority, using its extensive mining records has divided the UK coalfield into 2 spatial areas ('Development Low Risk Areas' and 'Development High Risk Areas'). Any site falling within a 'Development High Risk Area' now requires a Coal Mining Risk Assessment to be undertaken to inform any planning application. The Coal Authority, as a statutory consultee is required to review and approve the risk assessment.

The Coal Authority interactive map viewer has confirmed that part of the western end of the Site is within a Development High Risk Area, identified as requiring a coal mining risk assessment in accordance with the Coal Authority guidance (http://mapapps2.bgs.ac.uk/coalauthority/home.html).

The purpose of this Coal Mining Risk Assessment Report is to:

- Present a desk-based review of available information on the coal mining issues which are relevant to the application site;
- Use that information to identify and assess the risks to the proposed development from coal mining legacy, including the cumulative impact of issues;
- Set out appropriate mitigation measures to address the coal mining legacy issues affecting the site, including necessary remedial works and /or demonstrate how coal mining issues have influenced the proposed development layout; and
- Demonstrate to the Local Planning Authority that the application site is, or can be made, safe and stable to meet the requirements of NPPF 2012 with regard to development on unstable land.

To achieve this, the following tasks were performed:

- A review of the geology, hydrology, hydrogeology, shallow mining potential and potential for voids (mining and or natural).
- A review of the existing environmental information to assist in the determination of the environmental setting / sensitivity and current / historical land use of the Site and surrounding area.
- Preparation of an initial conceptual site model (CSM) and preliminary risk assessment (PRA).
- Assessment of geotechnical considerations which may impact upon the development / viability of the Site.
- Assessment of development risks from coal mining.

1.4 Information Sources

The primary information and documents reviewed for the purpose of this report are detailed in Section 12, references.

2. Site Setting

2.1 Site Description

The Site is located within an undeveloped area of greenfield land within Harras Moor on the eastern edge of Whitehaven, Cumbria. The Site is centred at National Grid Reference (NGR) NX 98641,18035 and is approximately 23 hectares (Ha) in area as shown in Figure 1. The site elevation is between 76m AOD in the south of the site and ~144m AOD in the north. The Site is irregular in shape occupying a series of open fields and rough grass areas between Loop Road South and Harras Moor Road, in part surrounding an industrial estate. For ease of reference the Site has been divided into broad areas each given a reference Area F1-F9, which is shown in Figure 2.

An AECOM suitably qualified and experienced person (SQEP) undertook a site reconnaissance on 11 January 2018, which is presented below. Selected photographs from the site reconnaissance are presented in Appendix A.

2.2 Surrounding Land Use

The land uses immediately surrounding the Site were noted as follows:

- North: Northwest of the Site lies an open coarse grass field beyond a mature tree line. The remaining area to the north of the Site comprised a residential development. The development was relatively low density with a combination of semi and detached two story properties with gardens. The majority of those houses on the boundary with the Site were constructed post 2000. The remainder had a late 1980s / early 1990s appearance. Some older houses including a short terrace row were noted on the north eastern boundary adjoining Harras Road.
- East: The eastern boundary of the Site was mostly defined by Harras Road, a one lane country 'A' road. Beyond the road were open rough grass land fields with powerlines running south to north. However, the eastern boundary cuts back from Harras Road to go around the boarder of an industrial estate. The estate originates sometime between 1985 and 1990, and comprised four main plots, accessed from an unnamed road off Harras Road. An electrical substation was present at the entrance to the Site in a slightly sunken brick lined area. The plot closest to Harras road included a large two story brick built office building currently repurposed as a children's play centre. The adjacent plot had a single part brick part metal depot building currently used as an engineering workshop. The western most plot adjacent to this had no buildings and was occupied by stockpiles of construction waste, soil mounds and haulage truck trailers. This plot extended to the north behind the other two plots, and adjacent to the site. The northern most area of the estate was occupied by stored mobile elevated work platforms (MEWPs), or 'cherry pickers'. The southernmost plot was occupied by a large single story part brick, part metal depot / shed. This was operated by 'A Plant', a construction equipment supplier, as a vehicle yard and the surrounding hard standing was filled by JCB vehicles.
- South: With the exception of the 'Midgey Wood', a wooded area to the south of Area F1, the Site was bordered by residential estates. The majority of these were developed between1957 and 1979 with those to the south of Area F7 being post 1979. The development comprised a mix of semi, detached and terrace houses including limited two story flats. The woods to the south of Area F1 were identified as ancient woodland and comprise a mixture of trees and shrubs. The woods are moderately dense and drainage channels run around the boundary of the Site, these are approximately 0.5m deep. Within the woods a natural stream runs from north east along the length of the woods to the south west. The drainage channels act as tributaries to this stream which deepens towards the south west forming a gorge at least 15m deep by the time it reaches Loop Road South which it passes beneath through a culvert.
- West: The western end of the Site is narrow forming the end of Area F1. The western boundary was formed by the gardens of a single row of houses on Loop Road South. A narrow access run, part of the Site, which extends from the field between two houses to the road. The boundary at this point was formed by a low old metal fence and a modern metal farm gate across two older stone posts. Over the road lies an electrical substation and a wooded area . A second stream was noted coming from the road and adjoining the main stream however its origin was not obvious.

2.3 Site Reconnaissance Survey

The Site comprised a number of coarse grassland fields with boundaries marked typically by timber post and wire fencing with lines of mature hedgerows and trees in some areas. The ground in most of the fields was soft and boggy underfoot, and in places it is notably waterlogged with tall grasses during the visit in January. It was noted that this may vary with the season. Topographically, the Site sloped down towards the coast to the southwest. This gradient is most notable within the northern fields and particularly Area F1. The southern fields, while also falling to the south west, tend to have an incline of a more gentle nature.

The Site can be accessed from two roadways, the southern access road is Caldbeck Road, which extended onsite and permits access to Areas F1-F6, F8 and F9 and is open to the public, whereas Harras Moor allows access to the eastern boundary via the industrial estate (Area F7). The Site is generally soft underfoot and typically waterlogged around field entrances which may impede access to the Site.

For ease of review the following summary presents a description of each of the areas viewed during the site walkover (F1-F9), as shown in Figure 2. Access on to the site and between areas is shown on Figure 3.

2.3.1 Area F1

This area was one of the largest fields, rectangular in shape and extended north east to south west. The field had a relatively steep undulating slope down to the south west and was the most inclined field on the Site. The field comprised open rough grassland currently used for grazing. The ground was soft across the whole area and in places was water logged, locally very soft with ponding water and long grasses. These soft areas typically relate to the bases of the undulations. Approximately 150m along the field from the southern boundary a waterlogged boggy area extended from the northern boundary diagonally south to the woods on the southern boundary where an ‘issue’ was noted on the mapping in Figure 4.

The field borders Area F2 to the north east and separated by a predominantly collapsed wooden post and wire fence. Slightly south west of the fence were the remains of a dry stone wall approximately 1m thick with large stone posts of the former gate, approximately 2.5m wide. This wall varied in height from ground level to ~1m. The area between the two fence lines was notably boggy with ponding water and long grasses, this was more notable at the drystone wall which appears to inhibit drainage of the area. An animal water trough was identified in the north eastern portion of the Site close to the northern boundary. The trough was fed by a drain pipe presumed to be a shallow land drain feeding from the waterlogged shallow soils. The south western end of the field had an access run between the residential properties, extending to Loop Road South. This area was more level and drier than the rest of the Site and terminates at an old metal fence and locked modern farm gate.

2.3.2 Area F2

This area was rectangular in shape and extended north east to south west. The field ran parallel with the northern boundary of the Site and Area F3 to the south. The field was level and waterlogged at the eastern end where it can be accessed by a locked farm gate and cattle coral. A partially collapsed dry stonewall separates the Site from Harras Road. The remaining two thirds of the Site sloped down towards Area F1. This area was also soft underfoot with bands of very wet boggy ground and long grasses running north to south across the area following undulation in the topography, it is not known if these are natural or man made.

2.3.3 Area F3

This field extended parallel to Area F2 and was bounded by wire fencing with wooden posts. The field vegetation was notably coarser than Area F1 and F2 and comprised long clumped grasses covering the whole area. The field was generally soft underfoot. The southern boundary of this field along with Areas F5 and F6 bound a mature wooded linear feature ~15m in width with shrubs and trees on a band of raised land and similarly to the west where it boarders Midgey Wood. ‘Issues’ were identified running through these wooded areas in narrow 0.5m deep drainage channels.

2.3.4 Area F4

This area comprised a number of small rough grassland fields. Area F4 was separated from Area F3 by a wire and wooden post fence and was bound on all other sides by mature trees and shrubs. Those to the south and east appear more recent as a screen from the road and industrial estate. The small fields in this area were separated by old metal railing type fences in moderate repair and the smallest eastern area was lined by mature trees on a raised bund. All were accessed by locked modern farm style metal gates.

2.3.5 Area F5

This field was roughly square and appeared to be used for grazing horses. The field was relatively level and comprised short grasses over soft ground with areas of longer grass and standing water in the western end. The field was fenced on all sides with wire and wooden post fencing and separated from Area F6 by a mature tree lined wooden area. To the south beyond the fence a grass access track lead between Areas F5 and F8.

2.3.6 Area F6

This field had been sub-divided into a number of smaller areas for horse activities. The field was accessed from the turning point on the access road located at the central eastern boundary. A grass track extended from there, south west, to a track on the western boundary which matched up with a residential road west of the site with steps down to the road due to the change in elevation. A swath of woodland and grass was observed approximately 40m along the western boundary. Within this area, a number of drainage channels between 0.5m deep, increasing to 1.5m deep in the north western corner. The channels split, remerged and broadly followed the western boundary cutting between trees and the grassed areas. The track leading to the housing estate to the west extended over two of these drainage channels which passed through concrete culverts.

The remainder of the areas can be divided into two paddocks, one either side of the access track, both bound by wire and wooden post fencing. The field to the north was reality level with short soft grass land. An area towards the northern end of the paddock was separated by short plastic post and wire electric fencing, as is a very small area in the eastern corner. The boundary with Areas F3 and F5 as previously described, comprised a band of mature woodland approximately 15m wide with drainage channels within it. The paddock to the south comprised short but rough grassland which was soft underfoot. A small wooden stable block (approx. 2 horses) was noted close to the entrance to the paddocks near to the access road turning area. This had a stone flag patio area and stepping stones to access, as the areas was boggy underfoot. The stables were within a small fenced area within the main paddock. This paddock was separated from the main access road on its eastern boundary by a ditch filled with brambles and creeping plants. Area F6 was separated from Area F9 by a row of mature trees and shrubs.

2.3.7 Area F7

Area F7 is approximately rectangular and contains a playing field and woodland that bounds Area F8. Area F7 was accessed by a short roadway that enters from the north, off the industrial estate access road. This road has two ‘cut-off’ ends, as if in preparation for further development. One of these ‘cut-offs’ leads to a disused playing field with a goal post at the western end, and the other westwards towards the woodland.

Along the eastern boundary of Area F7, through a locked farm gate and an un-metaled track that passed through a small wooded area there was access to Harras Road.

Generally, the ground was wet and soft underfoot with rough long grass. The northern and southern ends of Area 7 were water logged with deep ponds and long rushes and reeds. Waste including a wheelbarrow and a second goal post were semi-buried in this soft ground. The eastern and southern boundaries were lined with mature trees, hedges and brambles. Barbed wire and wooden post fence were also noted along these boundaries.

Across the norther section, brambles and long grasses were separated from the disused playing field by a row of bushes and trees.

The woodland in the western end of the area was generally sparse with areas of bare soil. Mature thin trees make up the woods, with an understorey of brambles and bushes, which also forms the boarder to the woodland. This area was fenced with wire and wooden post fence, and a small soil bund was also noted along the eastern edge separating it from the access road to Area F8. To the west of the soil bund, the asphalt access road ended and became a soil track which led out into Area F8.

2.3.8 Area F8

This area comprised of two fields separated by a wire and wooden post fence with a gate system to allow isolation and moving of animals between. The northern field was accessed from the track separating Area F8 from Area F5, through a locked modern farm gate and the southern field directly accessed from a locked farm gate off the access road to the west.

Both fields comprised rough grassland and appeared to be soft wet ground with areas of long grasses. Ponding water was observed in the southern field particularly to the eastern side. Both fields also contained a wooden

fenced area with a telephone pole. At the time of the inspection a shire horse was present in the southern field with a food station on a square of hard standing concrete by the locked access gate.

To the south, outside of the field boundary but within the Site was an area of boggy land, filled with rushes and long grasses over 1m in height. This area separated the field from the residential properties further south. West and north west of the northern field were rough grassed, uneven mounds approximately 4m in height. The western mound had a telephone pole on top and was mostly over grown with brambles and shrubs. Both mounds appear man made and are likely deposited spoil material potentially associated with the residential developments and access road or even with the nearby industrial estate. Fly tipping of waste which can be seen in the surrounding hedge rows and embedded in the soils.

2.3.9 Area F9

Area 9 comprised rough grassland with broad areas of long grasses. The area appeared to be used for livestock with a small wood and metal gazebo in the northern end, which is believed to be used as an animal shelter. The field sloped down to the south west and the western boundary is similar to that of Area F6 with a wide band of woodland and rough long grasses over uneven ground with numerous drainage channels. The eastern side was separated from the access road by a locked metal fence.

2.3.10 Services

The only underground services identified onsite during the inspection was a manhole in the centre of the southern access road between Area F8 and Area F9 and surface water grates. A B.T. telecommunications manhole was observed in the pavement of the access road in Area F7, close to the former playing field.

Overhead cabling was limited to a series of telephone lines and associated wooden posts which cross through Area F8, and Areas F1-F3.

2.4 Evidence of contamination

No direct evidence of potentially contaminative activities associated with previous land uses were observed on site. However, Area F6 and Area F8 identified a number of mounds varying up to approximately 4m in height. These were roughly vegetated and are potentially spoil mounds from the adjoining development. These may include waste construction material and reworked natural soils. It is also apparent that this area has been used for fly tipping of waste which can be seen in the surrounding hedge rows and embedded in the soils.

Potential Asbestos Containing Materials (ACMs) were not identified during the site reconnaissance however there is the potential for ACM to be buried in the mounds at the turning area. No visual or olfactory evidence of contamination or evidence of vegetation distress or die-back was noted across the Site during the Site reconnaissance.

No obvious visual evidence of non-native invasive plant species were identified during site reconnaissance. However, as this survey was not carried out by a suitably qualified ecologist, the presence of non-native invasive plant species cannot be discounted.

3. Historical Development

3.1 Review of Historical Mapping Information

Historical Ordnance Survey (OS) maps of the Site and the wider environs were appended to WYG's Due-Diligence Geo-Environmental Input Report, 2017 (Appendix B). The mapping included 'small' scale maps at 1:10,000 and earlier 1:10,560 scale alongside 'large scale maps at 1:2,500 scale. All of the historical maps presented in the due-diligence have been reviewed as part of this desk study.

In brief, the mapping indicates that the Site has been almost entirely undeveloped with little change since 1867 to present day. A number of field boundaries extend across the Site and these have differed very little over time. Currently these field boundaries are predominantly wooden post and wire fences; however evidence of historic drystone walls were visible during the walkover. A small quarry was located in the north eastern end of the Site associated with a farm named 'standing stones'. This building which lies off site was demolished and the area now forms part of an industrial estate lies offsite, to the immediate east.

The quarry was noted on the earliest maps and evidence of the 'old quarry' remained on the OS plans up to 1979 but by 2000 was no longer shown. Mapping from 1926 and 1938 showed a wooded area crossed the centre of the Site east to west although this was not identified on later mapping and no evidence was identified onsite. The most significant change onsite was noted on the 2000 OS plans where the southern half of the Site had been reorganised including a new access road from the south, a number of new field boundaries and a playing field being denoted in the eastern end.

Table 3.1-1 presents a summary of the main features present on and within approximately 250m of the Site as identified on the available mapping. AECOM notes that only indicative map scales are provided. Where dates are stated, these refer to the dates of maps on which the features become present, have changed use or are no longer annotated, and do not necessarily refer to the exact dates of existence of a particular feature. The summary timeline is divided based upon the small scale mapping. The dates and date ranges for the large scale maps varies between differing parts of the Site and as such those features identified on the large scale maps have been associated within the most appropriate small scale map and any notable dates included in the descriptions.

Table 3.1-1-1: Historic Land Use Summary

Date	On-site land use	Off-site land use (<250m)
1867 1:10,560	• Open, presumed agricultural, land with multiple field boundaries. • A quarry or pit is noted in the north eastern end of the Site with a track leading offsite to 'Standing Stones' farm a collection of buildings presumed to be a farm.	• The majority of the surrounding area is open, presumed agricultural, land with multiple field boundaries. • A pit or quarry is noted ~10m east of site on the other side of the road which in part forms the Site boundary. • Residential properties nearby include: a number of houses noted from ~10m north of site at the north eastern end extending along the road (present day Harras Road) and includes the 'hope inn' public house and a well; 'Burton High' a large property noted ~30m north of site from the central northern boundary and Yew Bank another large property ~30 south of site. • 'Standing Stones' presumed to be a farm house and associated buildings is noted adjacent to site with the eastern boundary bending around the farm. An associated well is noted to the north of Standing Stones ~10m from site. • A woods and stream are noted immediately south west of the Site extending north east to south west. The stream flows south west away from the Site. • A second thin wooded band also follows a south west flowing steam ~150m north west of the western end of the Site. • A race course is noted ~180m north east of site including stands and a wrestling ring further north. • Two coal 'shafts' are noted 'North Pit' coal pit shaft ~200m north of site off Harras Road, and the 'old fool shaft' ~170m north east of site near the race course. • An air shaft is noted ~180msouth east of site. • More shafts and air shafts are noted to the north east and west beyond 250m from site. • Whitehaven Castle is noted ~450m west of site within a wooded area beyond which is Whitehaven Town.
1900	• The quarry or pit area is noted as	• The wooded area to the south west is noted to extend further north

Date	On-site land use	Off-site land use (<250m)
1:10,560	an 'old quarry'	east adjacent to the Site boundary matching the areas it covers at present day. The stream within the woods, which at its nearest is adjacent to site as a form of drainage channel is referred to as 'Midgey Gill' and the woods 'Midgey Woods' • The wooded area to the north west is now noted as 'Crowpark woods' • Old quarries are noted over 250m to the north west. • The pits to the north east are noted as disused or old and the race course is no longer present.
1926-1927 1:10,560	• A wooded area is noted crossing the central northern portion of the Site. The area is rectangular in shape extending south west to north east. The southern boundary of this area follows the previous field boundaries and passes just north of the quarry. The northern boundary of the woods cuts through the centre of the northern most field following one of the modern field boundaries. A track is noted running north east to south west through the woods.	• The quarry to the north east is noted as marsh or rough ground. • The wooded area around Whitehaven castle is noted as 'Castle Park'. • 1925 An air shaft is noted to the immediate west of 'North Pit'.
1938 1:10,560	• No significant change	• A road named 'loop road' is noted running north to south touching the westernmost boundary of the Site.
1950-1951 1:10,560	• No small scale mapping	• No small scale mapping
1957 1:10,000	• The wooded area onsite is noted as rough pasture land • 1961 a greenhouse is noted in the western corner of the Site.	• Houses are noted along the eastern side of Loop Road adjacent to site and further west. • Whitehaven Castle is now noted as a hospital. • Powerlines are noted running north to south cutting across Harras Road adjacent to the edge of the eastern most part of the Site. • 1966 an electrical sub-station is noted ~20m south west of site.
1979 1:10,000	• No significant change	• The majority of the open fields to the south of the Site are occupied by residential development, including two schools ~250m from site to the south and south east, and associated roads. • More houses are noted to the north of site along Harras Road. • The pits / shafts to the north are no longer noted with the exception of the former 'old fool shaft' which remains as a disused shaft.
2000 1:10,000	• The Site is generally as it stands at present • An access road is noted running north into the southern end of the Site including a turning area. The field boundaries have been revised in this area also. • A playing field is noted in the far eastern end of the Site with an access road from the industrial estate (former Standing Stones) • An 'issue' drainage run is noted along the northern boundary of the Site. • Issues are noted along the boundary of the Site with Midgey Wood.	• The development at Standing Stones has been redeveloped with a number of large buildings and is now noted as an industrial estate. (between 1985 and 1990). • The area immediately south east has now been residentially developed. • Barton High is no longer present to the north and a large area around this leading up to the northern boundary of the Site has been residentially developed.
2016 1:10,000	• No significant change	• The area between the residential development of Barton High and Harras Road has also been developed with housing extending up to the boundary of the Site as it is at present. • The shaft to the north west is no longer noted.

3.2 Contemporary Trade Directory

A review has been undertaken of the current and historical Contemporary Trade Directory Entries and other commercial services listed within the Envirocheck Datasheets. A summary of potentially contaminative former and current land uses located within a 500m radius of the Site is presented in Table 3.2-1. There are only four Contemporary Trade Directory Entries listed within 500m of the Site, only one of which is noted as active.

Table 3.2-1: Contemporary Trade Directory Entries

Name	Activity	Distance and direction from site (m)	Address
Identified land uses within 250m of site (currently active)			
Esso	Petrol Filling Stations	503m (SW)	Back Corkickle, Whitehaven, Cumbria, CA28 7TS
Identified land uses within 250m of site (currently inactive)			
Elliot & Black	Blinds, Awnings & Canopies	62m (E)	Unit 1, Red Lonning Industrial Estate, Red Lonning Ind Est, Whitehaven, Cumbria, CA28 6SJ
Lakeland Spring Soft Drinks Ltd	Soft Drinks - Manufacturers	62m (E)	Unit 1, Red Lonning Industrial Estate, Whitehaven, Cumbria, CA28 6SJ
Corkickle Service Station	Petrol Filling Stations	445m (SW)	Back Corkickle, Whitehaven, Cumbria, CA28 7TS

Of the four trade directories only the Esso listing is identified as listed as having a currently active license for a potentially contaminative activity. This has the same address as the inactive Corkickle Service Station and it is assumed, as there is currently only a single service station present at this address, that Esso replaced the former Corkickle Service Station.

It is also noted that the two of the inactive listings are located within the same industrial unit and it is assumed one replaced the other before both became inactive.

Further information on historical potentially contaminative land uses and active permitted activities can be found in Section 5 of this report.

4. Geology

4.1 Soils

Information obtained from Soilscapes describes the soils within the areas of the Site as 'soilscape 6' slightly acid loamy freely draining soils. These soils drain to local ground water and rivers and are described in relation to ground water contamination as having the 'potential for nitrate; siltation and nutrient enrichment of streams from soil erosion on certain of these soils'. The far western, eastern and southern ends of the Site are describes as 'soilscape 17' this is an acid loamy and clayey soil, seasonally wet and slowly permeable. These soils have impeded drainage and form seasonally wet pastures, draining predominantly to stream networks. In relation to contamination these soils main risks are 'associated with overland flow from compacted or poached fields. Organic slurry, dirty water, fertiliser, pathogens and fine sediment can all move in suspension or solution with overland flow or drain water'.

In review of the Site during the reconnaissance visit the description attributed to 'soilscape 17' would appear more representative of the bulk of the Site than the freely draining soils of 'soilscape 6'.

4.2 Published Geology

To assess the likely ground conditions beneath the site, AECOM has reviewed publically available superficial and bedrock geology mapping information (Sheet 28 Whitehaven, 1:50,000 series) published by the British Geological Survey (BGS) along with the online BGS 'GeoIndex' Tool and information provided within the Envirocheck report presented in Appendix A of the WYG Due Diligence report (Appendix B).

The available information identifies the geology of the Site to comprise:

Superficial Deposits: Devensian Diamicton Tills (Glacial Till). These strata typically relate to glacial clays commonly interbedded with glacial sands and gravels.

It is however noted that approximately half of the Site has no specifically recorded superficial deposits. These areas include:The northern half of F2 and F3, portions of F4, F8, the woods in F7; and all of F5.

Bedrock Geology: The western end of the Site (F1) is identified to be underlain by the Pennine Middle Coal Measures Formation. These include grey Mudstones, Siltstones and pale grey Sandstones, with subordinate coal seams.

The remainder of the Site is identified to be underlain by the Whitehaven Sandstone Formation. This is a red to purple-brown sandstone with bands of mudstone and siltstone and thin seams of coal, marl and limestone.

The eastern boundary of the Site is broadly bound by the New Monkwray Fault which downthrows in a generally southerly direction. Two further faults are also noted striking north west to south east across the western half of the Site (F1).

There are numerous coal seams indicated on the western half of the Site including coal outcrops, potential zones of influence from mine entries and past shallow coal mine workings. These are discussed further in Section 6.

There are no available BGS boreholes records listed onsite or within the immediate area. However, a number of boreholes are noted in the wider vicinity. The majority of these have no data available, with the exception of six boreholes undertaken by Norwest Holst in 1983. These six relate to a development in Midgey, between 350m to 440m from site at an elevation between 35 and 50m AOD. Being at the far end of the valley around Midgey Gill the geology may be notably different to that onsite. It is also noted the boreholes are located between 35mAOD and 45mAOD[1], notable lower than the Site which ranges between ~76m AOD to ~144m AOD based upon available mapping. The boreholes are summarised in Table 4.2-1 below.

[1] The BGS boreholes indicate the boreholes are between 91.9mAOD and 108.14mAOD but based on map contour lines these are not correct.

Table 4.2-1: Summary of BGS Borehole Records

BGS ID	Borehole/Trial Pit	Distance from Site (m)	Direction from Site	Approximate Exploratory Hole Elevation (mAOD)	Depth of Exploratory Hole (m)
NX91NE87/. A	A	350m	SW	45	15
NX91NE87/. B	B	440m	SW	35	25
NX91NE87/. C	C	385m	SW	35	20
NX91NE87/. D	D	400m	SW	40	21.3
NX91NE87/. E	E	425m	SW	40	16.3
NX91NE87/. F	F	410m	SW	40	21.5

The boreholes present a typical sequence of variable grey brown sandy gravelly clays ranging from firm to stiff. Bedrock was encountered across this sloping site between 4.8m bgl and 7.8m bgl (or 85.9mAOD and 101.25MAOD) and comprised weathered mudstones and sandstone boulders. No evidence of coal seams were observed within these boreholes. Copies of the BGS records are presented as Appendix C.

4.3 Made Ground / Anthropogenic Soils

Anthropogenic ground is identified within BS5930:2015 as strata which include anthropogenic (man-made) materials and / or reworked or re-lain natural materials.

A number of features have been identified as part of the historical mapping and site walkover, which may include made ground.

The main features which pose a potential for made ground onsite are:

- An underground culvert crossing the western corner of the Site (Area F1)
  - The culvert bridges the gap between a river from the housing estate to the immediate north of site, and its outfall to the west of site. The nature of the construction is unknown. Engineered fill may be present should the installation have been a ‘cut and cover’ operation.
- Two large mounds formed around the turning circle of the southern access road (Area F8).
  - From their appearance these are likely to contain made ground.
- The playing field access road (Area F7) and the southern access road (between Area F8 and Area F9).
  - Made ground is likely to be present below and in the immediate surrounding area of these roads / footpaths, as a result of their construction.
- Underground Services
  - Current service plans are not available at the time of this desk study. However, a manhole was noted in the turning area of the southern access road and a telecoms manhole was noted in the playing field access road (Area F7). Made ground may be present where underground services are identified.
- Standing Stones Quarry
  - Historically there has been a small quarry in the eastern end of site (Area F4), although this appears to have been infilled with unknown material.

Limited, localised made ground may also be present associated with:

- Potential buried construction material associated with adjacent residential development (Area F1, Area F2, Area F6, Area F8 and Area F9)
- Wooden stables with a concrete flag patio (Area F6)
- Concrete hard standing area (Area F8)
- A historic greenhouse (Area F1)
- Potential drain / land drain feeding a water trough (Area F1)

4.4 Economic Geology

The CON29M Non-Residential Mining Report identified that the Site is within an area that could be affected by underground mining. This relates to two seams of coal worked at shallow to 190m depth, and last worked in 1961. As the Site is underlain by the Pennine Middle Coal Measures, reserves of coal exist in the local area, which could have been worked in the past, and / or may be worked sometime in the future.

There is the potential for mine entries located within the local area, however the Coal Authority has no knowledge. Although no shafts were noted within 20m of the Site boundary, the historic plans note mineshafts and air shafts to the north east and east of the Site. Air shafts are also noted to the west of site although these appear to be associated with a railway tunnel in Whitehaven, ~off site 300m to the west running north south.

Based on a review of the online interactive Coal Authority (CA) map the area lies within a High Risk Development Area in relation to mining. There are numerous coal seams indicated on the western half of the Site including coal outcrops, potential zones of influence from mine entries and past shallow coal mine workings.

The historic plans show a former open cast sandstone mine named ‘Standing Stones’ in the eastern end of site associated with ‘Standing Stones’ farm.

Potential coal mining risks are discussed further in Section 6.

4.5 Hydrogeology

A review of the Environment Agency website and Envirocheck Report indicates:

Bedrock: The Pennine Middle Coal Measures and the Whitehaven Sandstone Formation are both identified as Secondary (a) aquifers. These are described by the EA 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’.

Superficial Deposits: The superficial deposits onsite are identified as a secondary (undifferentiated) aquifer. This is assigned by the EA ‘where it has not been possible to attribute either category A or B to a rock / soil 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 soil type’. The superficial deposits are identified as Diamicton Till and are anticipated to comprise predominantly Glacial Clays as noted in the wider BGS boreholes. It is likely that these clays would be of limited permeability however the nature of the material onsite is currently unknown, however, the presence of perched surface waters and wet ground supports this conclusion.

In addition the Site does not lie within a groundwater Source Protection Zone and no ground water abstractions are noted within 1km of the Site.

4.6 Hydrology

During the reconnaissance visit the Site was noted to be significantly water logged in many places and generally soft underfoot. A number of drainage channels and small man made or naturally cut streams were identified following field boundaries. The most notable of these were within the western boundary of Area F6, although others were noted within Areas F3, Area F5 and Area F9. The bulk of the channels identified were located around the centre of the Site and noted to converge on the northern end of Midgey Wood (ancient woodland). Midgey Wood lies to the immediate south of Area F1 and west of Area F3, in the western half of the Site. The wood was noted to be bordered by ‘issues’, deep ~1m drainage channels cut around its boundary. Within the western half of the woods these ‘issues’ run into a deep river gorge which cuts into the hillside before passing beneath Loop Road South through a culvert. The Envirocheck report records the ‘issues’ in Midgey Wood and the subsequent stream leaving site as a tertiary river.

The Envirocheck report also identifies a tertiary river running along the outside of the central northern site boundary of Area F1. This is then noted to pass through a culvert under the western corner of the Site and re-emerging as a tertiary river west of Loop Road South before connecting with the river from Midgey Wood. This tertiary river was not identified onsite. There was a shallow (~0.3m) indent along the northern boundary of Area F1 with boggy water logged soils. This extended the full northern boundary of the Site including Area F2 where it was deeper and more waterlogged in places than in Area F1. This boggy edge to the Site was all that was identified during the reconnaissance visit, no evidence of a river was present at the time of the visit on the northern boundary of Area F1, nor evidence of the culvert. However, the presence of the second stream west of Loop Road South was noted along with its connection to the other culverted stream.

A waterlogged band was identified stretching across area F1 from the central northern boundary to an 'issue' leading from the Site boundary to the river within Midgey Wood (Midgey Gill) as it enters the gorge. It is likely that this waterlogged band corals a portion of the surface runoff and near surface ground water towards the river forming this 'issue'. The feature appears to relate to the topography of the Site and does not appear of intentional design.

In summary, tertiary rivers and drainage channels leading to the river in Midgey Wood and the culverted river on the northern boundary of the Site are considered the nearest surface water courses. These ultimately converge into a single tertiary river west of the site, to the west of Loop Road South.

A site-specific flood risk & drainage assessment was undertaken in May 2018 by WYG for the proposed development on land within Harras Moor (reference number A090070-410), identifying that there are no significant flood risk issues that may prevent future development. Further conclusions indicate that there have been no historical records of any flooding within the application site.

5. Summary of Environmental Data

The following section summarises the Envirocheck report along with the Environment Agency 'What's in your backyard?' website, accessed January 2018.

Only entries that have been registered either on-site or within 1km of the Site have been presented below.

A copy of the Envirocheck report is presented in Appendix B.

5.1 Discharge Consents

The Envirocheck Datasheet provided information on ten discharge consents within 1km of the Site. Of these three are potentially active with the other five revoked or superseded by the others.

The nearest of the discharge consent is for one revoked consent for the National Coal Board relating the discharge of 'process water' 7m north east of the Site at the Site boundary of area F4 with an ultimate discharge to Midgey Gill. Two more entries relate to the National Coal Board both located 370m north west of site for process water. One is a renewal of the other and both are now revoked as of 1991.

The remaining seven discharge consents relate to United Utilities Water Plc and storm sewage overflow' from their 'storm tank/CSO on sewerage network'. These all relate to three locations for which each has a single active discharge consent and a number of inactive consents. The locations include Esk Avenue located between 707m and 749m south west of site, Winston Drive 738m south of site and Ribton Moorside Cso 818m to 835m south of the Site. It is of noted that all of these United Utilities Water Plc locations are down gradient of the Site towards the coast.

The active consents area summarised in Table 5.1-1 below:

Table 5.1-1: Part B Licensed Activities

Operator (Property Type)	Discharge Type (Discharge Environment)	Location and Distance and Direction From Site	Effective Date	Status
United Utilities Water Plc Storm Tank/Cso On Sewerage Network (Water Company)	Public Sewage: Storm Sewage Overflow	Esk Avenue, Whitehaven, Copeland, Cumbria (707m SW)	7th March 2005	No Revocation date – Potentially Active
United Utilities Water Plc Storm Tank/Cso On Sewerage Network (Water Company)	Public Sewage: Storm Sewage Overflow	Winston Drive, Whitehaven, Cumbria (738m S)	7th March 2005	No Revocation date – Potentially Active
United Utilities Water Plc Storm Tank/Cso On Sewerage Network (Water Company)	Public Sewage: Storm Sewage Overflow	Ribton Moorside Cso, Hensingham, Whitehaven, Cumbria (818m S)	4th March 2005	No Revocation date – Potentially Active

5.2 Part A(2) and Part B Licenced Activities

The Envirocheck information recorded eight entries for Part A(2) and Part B activities within a 1km radius of the site, summarised in Table 5.2-1.

Table 5.2-1: Part A(2) and B Licensed Activities

Name	Address	Distance From Site	Description	Status
Npower Cogen Ltd	Whitehaven Works, Po Box 15, Whitehaven, Cumbria, CA28 9QQ	953m W	IPPC - Organic Chemicals; Oxygen Containing Compounds Eg Alcohols	Superseded By Variation
Mason Auto Repairs	Moresby Road, Hensingham, WHITEHAVEN, Cumbria, CA28 8TU	431m SE	LAPPC - PG1/1Waste oil burners, less than 0.4MW net rated thermal input	Authorisation Revoked / Revoked

Name	Address	Distance From Site	Description	Status
Corkickle Service Station	Back Corkickle, Whitehaven, Cumbria, CA28 7TS	445m SW	LAPPC - PG1/14 Petrol filling station	Authorised
Wm Morrison Plc Petrol Filling Station	Flatt Walks, WHITEHAVEN, Cumbria, CA28	562m W	LAPPC - PG1/14 Petrol filling station	Authorised
Lakeland Dry Cleaners	18 Church Street, Whitehaven, Ca28 7eb	815m W	LAPPC - PG6/46 Dry cleaning	Permitted
REXAM Medical Products	Moresby , WHITEHAVEN, Cumbria, CA28 8YD	880m N	LAPPC - PG6/17 Printing of flexible packaging	Authorised
Tesco Petrol Filling Station	Bransty Row, North Shore, Whitehaven, Cumbria, CA28 7XY	917m NW	LAPPC - PG1/14 Petrol filling station	Authorised
Whitehaven Accident Repair	Joe McBain Avenue, Moresby Parks, Cumbria, CA28 8EA	920m N	LAPPC - PG1/1Waste oil burners, less than 0.4MW net rated thermal input	Authorised

5.3 Part 2A Designated Contaminated Land Sites

The Envirocheck report records no entries for sites determined as contaminated land under Part 2A of the Environmental Protection Act (EPA) 1990 located within a 1km radius of the Site.

5.4 Known Landfill Sites (Active & Historical)

The Envirocheck report records additional information relating to historical and current landfill sites and waste management sites located within a 1km radius of the Site.

The nearest of these activities is 769m south east of site. This is a historical landfill relating to Eden Construction Limited for inert waste between July 1991 and October 1992. Two other historical landfills are noted, 966m SE and 970m SE named Overend Quarry and Overend Tip respectively. Little information is available on Overend Tip with regards to inert waste landfill however the quarry is noted as operating between 1942 and 1988. In addition to these landfill areas are two more, a Registered Landfill Site 802m south of site, a Local authority recorded landfill site 995m west of site.

With regards to waste management facilities, the nearest is a Registered Waste Treatment or Disposal Site 894m south west of site. This is registered to Partco Autoparts Ltd and recorded as Very Large (Equal to or greater than 250,000 tonnes per year). There is also a second Registered Waste Treatment or Disposal Site and a Licensed Waste Management Facility both 994m west of site, both registered to the same person. These are described as very small (Less than 10,000 tonnes per year) and relate to a scrapyard / scrap metal business. The registered sites within 1km of site are summarised in Table 5.4-1 below.

Table 5.4-1:Summary of Waste Management Records

Source of Record / Provider / Authority	Name / Location	Waste Type / Facility	Date and Licence Status	Distance and direction from site (m)
BGS Recorded Landfill Sites	Overend Tip / Hensingham, WHITEHAVEN, Cumbria	Unknown	Unknown	970 (SE)
Historical Landfill Sites	Land off Hensingham Road / Adjacent to Snebra Ghyll, Hensingham, Whitehaven, Cumbria	Inert Waste	6th July 1991 to 7th October 1992	769 (S)
Historical Landfill Sites	Overend Quarry / Overend Road, Overend, Hensingham, Whitehaven, Cumbria	Inert Waste	31st December 1942 to 31st December 1988	966 (SE)
Historical Landfill Sites	Overend Tip / Hensingham, Whitehaven, Cumbria	Unknown	Unknown	970 (SE)
Licensed Waste Management Facilities	Western Lakes Ltd / Whitehaven Golf Course, Red Lonning, Whitehaven, Cumbria, CA28 8UD	Unknown / Use of waste for reclamation etc <100,000 tps	10th February 2012 / End Unknown	438 (NW)
Licensed Waste Management Facilities	Hanratty Peter / 12/14 Albion Street, Whitehaven, Cumbria, CA28 9AD	Metal Recycling Sites (Mixed)	1st June 1994 to 14th October 2014	944 (W)
Local Authority Recorded Landfill Sites	Albion Street, Whitehaven	Unknown	Unknown	995 (W)
Registered Landfill Sites	Eden Construction Ltd / Hensingham Road, Snebra Ghyll, Hensingham, Whitehaven, Cumbria	H'core,concrete,brick,slate,glass,ceramics Inert mat'l consisting of soil,sand,clay,stone	1st June 1991 / Cancelled	802 (S)
Registered Waste Treatment or Disposal Sites	Partco Autoparts Ltd / Border Yard, Coach Road, WHITEHAVEN, Cumbria, CA28 9DF	Alcohols, Aldehydes And Ketones, Aliphatic Hydrocarbons, Aromatic Hydrocarbons, Ethers, Liq.Waste Cellulose Paint/Thinner Very Large (Equal to or greater than 250,000 tonnes per year) / Storage with Transport Facility	1st September 1992 / Cancelled	894 (SW)
Registered Waste Treatment or Disposal Sites	P Hanratty / Albion Street, WHITEHAVEN, Cumbria, CA28 9AD	No known restrictions Very Small (Less than 10,000 tonnes per year) / Scrapyard	1st June 1994 / Operational as far as is known	994 (W)

5.5 Petroleum Filling Stations

The Envirocheck report identified three fuel station entries located within a 1km radius of the site, of which all are noted as open. A summary of the nearby fuel stations has been provided in Table 5.5-1:

Table 5.5-1: Summary of Petrol Filling Stations

Name	Address	Distance from site (m)	Direction from site	Status
Corkickle Service Station	Back Corkickle, Whitehaven, Cumbria, CA28 7TS	458m	SW	Open
Morrisons Whitehaven	Flatt Walks, Whitehaven, Cumbria, CA28 7RJ	536m	W	Open
Tesco Whitehaven	Bransty Row, North Shore, Whitehaven, Cumbria, CA28 7XY	917m	NW	Open

5.6 Pollution Incident Register

The Envirocheck Report identified fourteen pollution incidents to controlled waters within 1km of the Site and two entries for the Substantiated Pollution Incident Register.

Most notable is the Substantiated Pollution Incident dated the 26th July 2016 28m east of the site within the industrial estate. The incident related to vegetable cuttings and deposits and was classed as having no impact (category 4) to air and water, and a significant impact (Category 2) regarding land. The remaining pollution incidents and are much further from site, the nearest of which is 341m south of site and rated a minor incident (category 3) relating to a wrong connection for domestic sewage.

A summary of pollution incidents has been provided within Table 5.6-1. Those categories indicating no impact regarding severity have not been included:

Table 5.6-1: Summary of Pollution Incidents

Pollutant and Incident Date	Incident Severity	Distance from site (m)	Direction from site
Substantiated Pollution Incident Register			
Vegetable Cuttings And Deposits 26th July 2016	Land: Category 2 - Significant Incident	28m	E
Oils - Diesel (Including Agricultural) 23rd October 2006	Water: Land: Category 2 - Significant Incident	965m	NW
Pollution Incidents to Controlled Waters			
Sewage Debris/Litter 20th June 1996	Category 3 - Minor Incident	341m	S
Sewage - Storm Overflow 18th December 1998	Category 3 - Minor Incident	362m	W
Organic Wastes: Other; Anoxic Sediment 19th September 1996	Category 3 - Minor Incident	464m	SW
Organic Wastes: Other; Fish Proccess Effluent 17th September 1996	Category 3 - Minor Incident	543m	SW
Oils - Diesel (Including Agricultural) 11th February 1993	Category 3 - Minor Incident	552m	SE
Chemicals - Detergents/Surfactant 7th November 1998	Category 3 - Minor Incident	656m	W
Sewage - Wrong Connection 18th April 1997	Category 3 - Minor Incident	694m	S
Storm Sewage 17th September 1996	Category 2 - Significant Incident	764m	S
Unknown Sewage 21st April 1993	Category 2 - Significant Incident	788m	S
Oils – Petrol 1st February 1995	Category 3 - Minor Incident	832m	W
Oils - Diesel (Including Agricultural) 28th November 1991	Category 2 - Significant Incident	861m	NE
Oils – Unknown 30th January 1998	Category 3 - Minor Incident	881m	NW
Oils – Unknown 3rd June 1991	Category 3 - Minor Incident	884m	S
Oils – Unknown 27th November 1994	Category 3 - Minor Incident	894m	SW
Oils - Waste Oil 17th June 1994	Category 3 - Minor Incident	944m	SW
Miscellaneous – Foam 5th December 1991	Category 3 - Minor Incident	983m	E

5.7 Flooding

According to the Environment Agency Flood Map for Planning (Rivers and Sea), the Site is not located within a flood zone or flood warning area.

The Envirocheck report includes the BGS Groundwater Flooding Susceptibility and the flooding type for the Site. The Site is classified as having Limited Potential for Groundwater Flooding to occur however areas only 3m to the west of the Site (& down gradient) are noted as having the 'Potential for Groundwater Flooding of Property Situated Below Ground Level'. The Envirocheck report does not identify the Site to be within an area likely to experience flooding from rivers (or sea) without defences.

As the Site is not within a flood zone or flood warning area it is considered that no flood risk assessment is required.

5.8 Nitrate Vulnerable Zone

According to information obtained from the DEFRA Magic website, the Environment Agency website and the Envirocheck report, the Site is not located within a surface water nitrate vulnerable zone (NVZ).

5.9 Designated Ecological Site & Sites of Biological Interest

According to the Envirocheck Report and DEFRA Magic website, within 250m of site there are no Areas of Outstanding Natural Beauty (AONB), Local Nature Reserve (LNR), RAMSAR, Site of Special Scientific Interest (SSSI), Special Areas of Conservation (SAC) or Special Protection Area (SPA) and there are no listed buildings recorded on the Site.

It is however noted that there are two ancient woodlands in the proximity of the Site. Midgey Wood directly boarders the Site to the south of area F1 and west of F3. Crowpark Wood is also noted close to the site, located 62m north west. Both of these are listed as ancient and semi-natural woodland.

5.10 Unexploded Ordnance (UXO) Risk

A review of publically available Unexploded Ordnance (UXO) mapping information (Zetica Regional Unexploded Ordnance (UXO) Risk Map of the Cumbria area) shows that the Site is located in an area of low risk from unexploded ordnance.

5.11 Radon

The Site is located within a 'lower probability' radon area where less than 1% of homes are estimated to be at or above the Action Level.

In England and Wales, no radon protection measures are required in the construction of new residential properties where probability is <3%. Public Health England notes that fitting basic radon protection measures in new buildings might still be considered, particularly if there is a high risk location such as a routinely occupied basement.

6. Identification and assessment of site specific Coal Mining Risk

6.1 Methodology

The coal mining risk assessment methodology has six stages:

i. Obtain Coal Authority information including Mining Report, interactive online viewer and mine abandonment plans;

ii. Obtain available geological data from British Geological Survey (BGS), Geology of Britain Viewer and Boreholes scan, and BGS geological Maps

iii. From the above information develop a ground model

iv. Identify what risks past, present or future coal mining poses to the proposed development;

v. Identify how coal mining hazards could influence or be influenced by the proposed development and whether any mitigation measures are required.

vi. Identify remedial options to mitigate the mining hazards at the Site.

The overall aim is to identify the mining risks present on site, if any, and to recommend any necessary further actions to mitigate the mining risks in order for the Site to be developed safely.

6.2 Coal Mining Information

6.2.1 Coal Authority Interactive Mapping

The review of the online interactive Coal Authority (CA) map (January 2018) identifies that the Site lies within a 'High Risk Development Area' in relation to mining.

There are numerous coal mining features indicated within the vicinity of the Site and some encroach onsite.

Within the western half of the Site (Area F1) the mapping identifies coal outcrops extending onsite. These features are identified as posing a 'High Risk Development Area'.

A wider portion of the western end of the Site is denoted as being in the potential zone of influence from 'past shallow coal mine workings' likely associated with coal outcrops.

Numerous mine entries are noted to the northwest, west and south west of the site. The closest mine entry to the Site shown on the historical mapping is noted to be the 'Old Fool Shaft' ~170m north east of site. All the recorded shafts within approximately 500m of the Site are identified to have been 'treated' on the Coal Authority interactive map.

Additionally, not identified within the coal mining report, there is a BGS recorded mineral extraction location onsite. This relates to the open cast quarry named 'Standing Stones' in the eastern end of the Site. The commodity extracted was identified as Sandstone.

6.2.2 Coal Mining Report

A CON29M non-residential mining report (reference number 51001373193001) was obtained for the whole site area and is included in full within the appendices.

The CON29M report provides a general overview of the coal mining history of the Site, the presence of current and potential for future coal mining, and comments on other associated risks such as reported ground stability issues and mine gas risks. A summary of the CON29M report is provided below:

The CON29M report identified evidence for coal workings on, or in the vicinity of the Site as follows:

- The Site is located within an area that could be affected by underground mining in two seams at shallow depth to 190m depth. These are identified to have been last worked in 1961.

- Although no licenses have been granted and it is not in an area likely to be mined in the future, reserves of coal do exist in the local area which could be worked at some time in the future.

The CON29M report assessment includes a review of the evidence for a number of potential mining features onsite and in the surrounding area. With the exception of the above, the report did not find any additional evidence. Below is a summary of these findings:

- There are no recorded mine shafts at or within 20m of the Site boundaries however shafts are noted within the wider Whitehaven area. It may be noted that although no shafts are noted within 20m of the Site the historic mapping notes mine shafts and air shafts to the north east and east of site. Air shafts are also noted off site to the west which are believed to relate to a railway tunnel running north-south approximately 300m to the west of the site.
- The Site is not within a surface area that could be affected by present underground mining.
- The Site is not in an area where a licence has been granted or where the Coal Authority has plans to grant a licence to remove coal using underground methods. However, reserves of coal exist in the local area which could be worked at some time in the future.
- The Site is not within the boundary of an opencast mine from which coal has historically been removed by opencast methods or within 200m of the boundary of an opencast site from which coal is being removed by opencast method at present.
- There are no granted licences or outstanding licence requests to remove coal by opencast methods within 800 metres of the Site boundary.
- The Site has not been subject to remedial works by or on behalf of the Coal Authority, under its Emergency Surface Hazard Callout Procedures.
- No notices have been given under Section 46 of the Coal Mining Subsidence Act 1991, stating the land is at risk of subsidence.
- There is no current Stop Notice delaying the start of remedial works or repairs at the Site and the Coal Authority is not aware of any request having been made to carry out preventive works before coal is worked under Section 33 of the Coal Mining Subsidence Act 1991.
- The Coal Authority has no record of a mine gas emission requiring action
- The Site is not within an area where a notice to withdraw support has been given or where a notice has been given under section 41 of the Coal Industry Act 1994, cancelling the entitlement to withdraw support. Nor is the Site in an area where an order has been made, under the provisions of the Mines (Working Facilities and Support) Acts 1923 and 1966 or any statutory modification or amendment thereof.
- The Site is not in an area where a relevant notice has been published under the Coal Industry Act 1975/Coal Industry Act 1994.

6.2.3 Mine Abandonment Plans

The Coal Mining Report states that the Site is in the likely zone of influence from workings in two seams of coal at shallow to 190m depth, last worked in 1961. A search of the available Coal Mining Abandonment Records revealed information relating to a number of mine workings beneath most of the site and from the site boundary up to over 500m to the north and east of the site.

It should be noted that the depositing of mine abandonment plans was only required in law after the passing of The Metalliferous Mines Regulation Act 1872, and mines abandoned before this date may not be recorded.

Mine abandonment plans and other supporting documents available which were pertinent to the Site were obtained from the Coal Authority offices and reviewed. AECOM additionally obtained copies of select plans which are presented in Appendix D.

The Coal Authority Reviewer shows that past shallow coal mine workings were present on/off-site towards the A595 (Loop Road South) at the western corner of the Site. Coal outcrops were noted in the same area.

The mine plans show very closely spaced roadways, which could indicate the presence of pillar and stall workings which are more likely to remain open than the longwall mining method more often used in large collieries. The plans (NC176) are for the Moresby Coal Co, and include records for the Main, Bannock, Six Quarters and Cleator Moor Coal Seams.

Additionally plans NW472 (reviewed at the CA, but not purchased) corroborated NC176 identifying that between Burton High and the 'Standing Stones' there are no workings. However, there were workings near to the Standing Stones alongside 'Jackson Pit' (identified north east of site as an old shaft on the historic mapping). Jackson Pit appeared to be working the Six Quarter Seam.

The plans NW1380 outline the former workings of the Main Band coal seam at Whingill Colliery. These plans do not show any workings in the vicinity of the Site.

NW1393 identifies the extent of the Whitehaven Colliery this indicates potential mine workings within the eastern portion of the Site around the area of the 'standing stones' and up to 550m further west.

6.3 Risks Posed by Coal Mining to the Proposed Development

6.3.1 Introduction

The risks to the development resulting from coal mining are as follows:

i. Risk of shaft collapse: Risk of catastrophic collapse of ground resulting in engulfment of structures, infrastructure and any site users.

ii. Risk of collapse of former mine workings: giving rise to risk of subsidence at the surface resulting in loss of support to foundations. This in-turn could give rise to severe movement and potentially failure of structures and / or road pavement, service ducts etc.

To determine the likelihood of such occurrences, a systematic approach is required to determining the mining risk. This requires assessments of the following.

a) Available information from the Coal Authority, including the findings of a Coal Authority Mining report, the study of mining abandonment plans, and the study of Coal Authority records for shafts on or within 20m of the Site boundary.

b) Published geological maps and BGS shaft and deep borehole records.

c) Any other information from ground investigations on or near the Site.

From a to c above, geological sections should be generated and a ground model developed which shows the geology related to mining and coal seams. The ground model should then be used to determine areas at risk from mining related hazards.

If the site contains areas where significant mining risks are identified, a coal mining risk assessment should then be designed to identify, and where necessary delineate these risks. This may require several phases of investigation.

6.3.2 Summary of information supplied by the Coal Authority

Are there recorded coal mine entries within the Site or within 20 metres of the Site boundary?

The Coal Mining Report has recorded no mine entries within the Site or within 20 metres of the Site boundary. The historic mapping notes the closest mine shaft to be 'old fool shaft' ~170m north east of site.

All the mine entries within approximately 500m of the site boundary are shown to have been treated on the Coal Authority interactive map.

The risk from collapse of recorded shafts is therefore considered to be low.

Is the proposed development in the likely zone of influence of past underground coal mining?

According to the Coal Authority mining report for the site the proposed development is in the likely zone of influence from two seams of coal at shallow to 190m depth and last worked in 1961. The CA interactive mapping notes 'past shallow coal mining works within the western end of the Site (western half of Area F1). In addition the Coal Authority hold abandonment plans which indicate that mine workings underlie much of the eastern and central parts of the site. The levels of the workings are not shown on any of the abandonment plans.

Is the proposed development within the likely zone of influence of underground coal workings at shallow depth (depths of less than 30m)?

The review of historical records indicates there is the possibility for shallow mine workings within the western end of the Site associated with coal 'outcrops' (western side of Area F1). It is also possible that other workings exist in this area that the Coal Authority has no record.

A study of the geological mapping suggests that coal in the central part of the site (eastern side of Area F1) could potentially be at shallow depth. In the eastern part of the site, the Whitehaven Sandstone is shown at surface and the risk of shallow mine workings is considered to be low.

Is the proposed development in the likely zone of influence of any present (Current) underground coal workings?

From the Coal Authority Mining Report, the Site is not within the likely zone of influence of any current (active) underground coal mine.

Is the proposed development in an area for which the Coal Authority is determining or has granted a license to remove coal by underground methods?

The Coal Authority Mining Report states that the Site is not in an area where licence has been granted or where the Coal Authority has plans to grant a licence to remove coal using underground methods. However, reserves of coal exist in the local area which could be worked at some time in the future.

Is the proposed development within the boundary of a surface mining/opencast site from which coal has been removed by surface mining/opencast methods?

The Site is not within the boundary of an opencast site from which coal has been removed by opencast methods.

However, there is a BGS recorded mineral extraction point onsite. This relates to the open cast sandstone quarry named 'Standing Stones' located across the eastern side of the Site.

Is the proposed development within 200 metres of a surface mining/opencast site from which coal is being removed?

The proposed development does not lie within 200 metres of the boundary of an opencast site from which coal is being removed by opencast methods.

Is there a record of mine gas emissions within the Site boundary?

The Mining Report records no mine gas emissions within the Site boundary that required action by the authority.

Are there known faults or other lines of weakness due to coal mining at the site?

The Coal Authority is not aware of any evidence of damage arising due to geological faults or other lines of weakness that have been affected by coal mining.

Has the Site been subject to remedial works by, or on behalf of, the Coal Authority under its surface hazard call out procedures?

The Coal Authority Mining Report states that the Site has not been subject to remedial works, by or on behalf of the Authority, under its Emergency Surface Hazard Call Out procedures.

6.3.3 Summary of information available from BGS published maps, and Geology of Britain Viewer.

A review of the BGS 1:50,000 Geological map (sheet 28 Whitehaven-Bedrock Edition 2004) showed that the site was divided into three distinctly different zones separated by faults.

a) The western part of the Site (western side of Area F1) in which coal seams crop at or immediately adjacent to the site.

b) The central part of the Site (eastern side of Area F1) in which strata of the Pennine Middle Coal Measures Formation are shown, but no coal seams are exposed.

c) The eastern part of the Site (Area F2 to Area F9) is underlain by the Whitehaven Sandstone. Below the thick sandstone layer, the Pennie Middle Coal Measures Formation are suspected to contain coal workings, but at a depth unlikely to affect the Site.

These zones are shown in the geological cross section Figure 5, and on the Geotechnical Constraints Plan, Figure 6.

Zone A

The Yard coal seam crops immediately to the southwest and dips beneath the site, Coal Authority records indicate that shallow mining has taken place at and immediately down dip of the crop. There is a high risk of these workings encroaching onto the Site. The Main coal seam (also referred to as the main band) is shown cropping immediately to the northwest away from the Site, but depending on the accuracy of the mapping, could encroach onsite. There is the potential for unrecorded workings in the Main coal seam. The Main coal seam is indicated to be approximately 20m above the Yard coal seam in the geological succession.

Zone B

The strata in this zone are shown to be downfaulted relative to those in Zone A. The downthrow is substantial but the exact throw is not recorded, but likely to be greater than 50m. There is also no indication of the dip of the strata. There are recorded workings in the Main coal seam and in the Bannock coal seam, which lies approximately 20m above the Main coal seam. Although it is anticipated that the downthrow is sufficient to take the Main coal seam to a depth greater than 50m, there is a risk that the workings in the Bannock coal seam could be shallow enough to be within influencing depth of the surface.

Zone C

The strata in this area are shown to be downthrown by at least 100m relative to those in ZoneB and the Whitehaven Sandstone is shown to overlie the Pennine Middle Coal Measures Formation. There is no indication of the dip of the strata in this area. Coal Authority abandonment plans show that the Main coal seam was extensively worked beneath this area, although believed to be at depth. Nonetheless, the risk of encountering shallow mine workings should not be completely discounted.

6.4 Assessment of Site Specific Coal Mining Risks

Table 2 summarises the potential risks associated with coal mining, which are discussed in detail above. Appendix D presents the results of a site based Coal Authority interactive map search. Where a risk assessment is determined as being required these are assessed in Section 6.4.1 and 6.4.2.

Table 6.4-1. Summary of Coal Mining Risk

Coal Mining Issue	Yes	No	Risk Assessment
Underground coal mining (recorded at shallow depths)	✓		Required
Underground coal mining (probable at shallow depths)	✓		Required
Mine entries (shafts and adits)	✓		Not required (nearest mine entry c. 170m from site boundary)
Coal mining geology (fissures)		✓	Not required
Record of past mine gas emissions or potential	✓		Required
Recorded Coal mining surface hazard	✓		Not required
Surface mining (opencast workings)		✓	Not required

6.4.1 Risk from Collapse of Mine Entries

The risk from recorded mine shafts, all of which are greater than 170m from the site boundary, can be discounted, it is very unlikely that there will be unrecorded mine shafts into the workings of the Whitehaven Colliery on site as there are detailed abandonment plans for these workings.

There is a residual risk that there are recorded mine entries on site in the area of the shallow mine workings in the Yard coal seam. However it is very likely that these workings would have been entered from adits from the coal crop, which are likely to have been infilled and would, if open, be infilled as a result of any treatment to the workings prior to development. It is possible, though unlikely that shallow mine shafts could have been sunk down to the Yard coal seam on site.

Such shafts would be small diameter and difficult to locate by either geophysics or ground investigation. The current design masterplan indicates that this area of land will not be developed due to ecological restraints, and shall instead be designated a habitat creation area. Should development take place it would be prudent for the topsoil strip to be observed by an experienced engineering geologist or geotechnical engineer with experience in looking for indications of buried mineshafts. Such features may include brick lining or areas of shaft infill material, these are typically circular but could be elliptical, square or rectangular.

6.4.2 Risk of subsidence to the collapse of shallow mine workings

The risk from shallow mining is different in each of the three faulted blocks

Zone A

The principal mining risk is from the Yard coal seam, recorded within the southeast section of this faulted block. The Yard coal seam crops at or immediately southeast of the side boundary, it has a recorded thickness of approximately 0.85m with a likely zone of influence where it is present beneath less than 8.5m of bedrock. This is anticipated to give an area of risk from shallow mining up to approximately half way between the southeast and northwest boundaries.

The Main coal seam is shown to crop at or near to the northwest boundary of Zone A, and if exploited within the Site boundary, it would be as an excavation from ground level and there are unlikely to be underground workings of the Main coal seam within this area. However, adits or shallow shafts may exist.

To investigate the risk from shallow mine workings in Zone A it is recommended that a triangular array of boreholes are drilled to determine the dip, strike and thickness of the Yard coal seam, and from that, delineate the area at risk. This should include one borehole close to the southeast boundary, one borehole close to the northwest of the site boundary, which will also verify whether the Main coal seam is present onsite, and one borehole mid-way between the southeast and northwest site boundaries offset from a line between the other two so as to give a triangular array.

Zone B

There are former mine workings shown on the Coal Authority Mine abandonment plans in both the Bannock and the Main coal seams. Although it is likely that these coal seams at a depth, that will not affect shallow foundations etc.; this needs to be confirmed. It is recommended that this faulted block be drilled to prove the absence of shallow coal mine workings. The Bannock coal seam has a recorded thickness of up to 2.6m of coal and could have given rise to workings up to 3m in thickness which probably included thin beds of mudstone / siltstone.

It is recommended that three rotary open holes be drilled to at least 30m below rock head to determine whether the Bannock mine coal or workings are present within influencing depth of the surface.

The Main coal seam is present approximately 20m below the Bannock coal seam, this has a recorded thickness ranging from approximately 2.3m to 3m. Where it is present at depths of less than 50m bgl, there is the potential for workings to be open. Therefore if he Bannock Mine coal seam is present at depths of less than 30m then there could be a risk of settlement from the underlying Main coal seam which is approximately 20m below the Bannock coal seam.

It is recommended that within Zone B, three rotary open holes are taken to a depth of 30m below rock head in a triangular array, to determine whether the Bannock coal seam is within influencing depth of the surface. If this is the case then rotary open holes should be continued to 50m bgl, or the Main coal seam / workings.

Zone C

The Whitehaven Sandstone is shown as the top of the bedrock geology, which overlies the Pennine Middle Coal Measures Formation. Extensive workings in the Main coal seam are shown on the abandonment plans for the Whitehaven colliery, but these are present beneath the Whitehaven Sandstone and are likely to be deep.

The risk of shallow mining is considered to be low, but to verify the published information, it is recommended that two rotary open holes are taken to thirty metres below rock head in Zone C.

6.4.3 Recorded Coal mining surface hazard

As discussed above, in Zone A there is a low risk of surface hazards which may have also accessed the Main or Yard coal seams that were located close to the north west and south east boundaries respectively. After completion of the rotary boreholes, an assessment should be carried out to determine the risk of mining surface hazards. Where the hazards are shown to exist, these should be investigated further, possibly by using trial trenches. If it is proven that the Main or Yard coal seam does not encroach onsite, it is unlikely that mining surface hazards will exist.

7. Geotechnical Assessment

7.1 Anticipated Ground Conditions

The BGS data presented in Section 4 suggests, either topsoil or made ground overlies predominantly fine grained Glacial Till. Within the Glacial Till there may contain lenses / beds of coarse grained strata (sands and gravels).

The bedrock is anticipated to comprise the Pennine Middle Coal Measures across the western half and the Whitehaven Sandstone Formation across the east.

The Pennine Middle Coal Measures Formation comprises, mudstones, siltstones and thin sandstones, with subordinate coal seams. The Whitehaven Sandstone Formation comprises, mudstones and siltstones, with thin seams of coal, marl and limestone.

The BGS boreholes suggest the Glacial Till may vary in depth up to about 8m, which is likely to be overlain in parts by Made Ground.

Historically there has been a small quarry in the eastern end Area F4 which is assumed to have been infilled.

7.2 Geotechnical Constraints

7.2.1 Former shallow mine workings

The most significant geotechnical constraint is shallow mine workings. These constraints are discussed in detail in Section 6.

7.2.2 Site topography

Parts of the Site are sloping and this may constrain the type of development. The western part of the site (Area F1) slopes at a gradient of approximately 1(v):10(h) which may cause access roads to become difficult to traffic in winter conditions and will require adjacent houses to be separated by retaining walls, of varying heights.

7.2.3 Former Quarry

It is likely that the former quarry identified near Standing Stones will have been infilled with loose tipped material of variable consistency, and potentially could be contaminated. This will require investigation by cable percussion boreholes to confirm the depth and trial trenches to confirm the location of the perimeter. The former quarry has been designated a no build zone within the development, and given the small area affected, it has been proposed to mitigate the land as public open space.

7.2.4 Trees on and adjacent to the Site

There are many areas with trees or woodland within and adjacent to the site boundaries. Consideration needs to be given to the distance of structures from the trees and the depth of foundations needed to extend beneath the zone of influence of tree roots (which may be removed, but still may affect foundations). In all cases NHBC Guidance shall be followed, i.e. NHBC Standards 2016 Chapter 4.2 Building Near Trees (2016).

7.2.5 Soft Ground

Areas of boggy ground have been noted in the south east of the site (Area F7 and Area F8) and there is a potential for these areas to be underlain by soft ground, which could include unrecorded shallow peat or organic clay. These areas should be targeted during the ground investigation.

7.3 Preliminary Geotechnical Design

7.3.1 Foundations

For low rise, up to 3 storey town houses, it is anticipated that shallow spread footings would be suitable for founding on the Glacial Till and weathered Pennine Middle Coal Measures Formation. Foundations would be

taken below the zone of seasonal moisture content variation, typically 0.9m below ground level in these materials. However, this must be verified by investigation, in particular in any poorly drained areas where soft ground may be deeper. Higher or larger buildings may require deeper foundations. In addition, raft foundations may be needed where there are mining risks.

7.3.2 Earthworks

It is envisaged that the majority of excavations for services and foundations will be in Glacial Till or highly weathered bedrock that can be dug using conventional plant. Small amounts of cut and fill for individual building plots should be accomplished with conventional excavation plant. The site won material is likely to be classified as mostly Class 2A, 'wet cohesive fill'. This may require drying prior to placement as fill given the wet nature of much of the ground. Where retaining walls are required between plots, imported Class 6N structural fill may be required behind the retaining walls.

7.3.3 Road Pavement

Design of road pavement can only be verified out following ground investigation after site development plans have been completed. However, for preliminary assessment, a CBR value of approximately 2.5% may be considered typical for medium plasticity cohesive Glacial Till. For the initial ground investigation it is recommended that insitu CBR tests are undertaken near to the proposed site entrance, which will have the main access road passing through it, and where know the access roads should also be tested.

8. Initial Conceptual Site Model (CSM)

8.1 Assessment Framework

The site, in terms of potential land contamination, will be regulated by the Copeland Borough Council , under the Town and Country Planning Act 1990 (as amended), taking account of the National Planning Policy Framework 2012, with the Environment Agency, Natural England and English Heritage acting as statutory consultees.

Environmental liabilities can arise through provisions contained within statutory legislation including Part 2A of the EPA 1990, the Water Resources Act 1991, the Groundwater Regulations 2009 and the Water Act 2003.

Current best practice recommends that the determination of health hazards due to contaminated land is based on the principle of risk assessment, as outlined in the Statutory Guidance to Part 2A (2012) and CLR 11.

As it is proposed for the Site to be redeveloped in the future, the “suitable for use” approach would be adopted for the assessment of contaminated land where remedial measures are only undertaken where unacceptable risks to human health or the environment are realised taking into account the use and proposed use of the land in question and the environmental setting.

The risk assessment process for environmental contaminants is based on a source-pathway-receptor analysis. These terms can be defined as follows:

- **Source:** hazardous substance that has the potential to cause adverse impacts;
- **Pathway:** route whereby a hazardous substance may come into contact with the receptor: examples include ingestion of contaminated soil and leaching of contaminants from soil into watercourses; and
- **Receptor:** target that may be affected by contamination: examples include human occupants/ users of site, water resources (surface waters or groundwater), or structures.

For a risk to be present, there must be a relevant contaminant linkage; i.e. a mechanism whereby a source impacts on a sensitive receptor via a pathway.

The following sections detail the preliminary conceptual site model (CSM) which has been developed for the Site with a view to assessing the potential risks/ liabilities and constraints associated with the Site in its current condition prior to any land transaction. Risks associated with the proposed future redevelopment are also assessed. The potential sources of contamination, potential receptors and potential contaminant pathways are identified for the Site. Figure 4 depicts the potential contamination sources within a CSM plan.

8.2 Sources of Potential Contamination

8.2.1 Onsite Sources of Potential Contamination

Detailed in Section 2 the Site area covers a number of soft and boggy, coarse grassland fields separated by wire fences and in places, lines of mature hedgerows and trees. The northern fields are predominantly used for agricultural livestock and the fields to the south are noted to be used for horses with slightly firmer ground conditions and shorter grass. The eastern most field is noted as a playing field and has goal posts but is currently in a state of disrepair with ground conditions similar to the northern fields.

The historic mapping reviewed in Section 3 indicates that the Site has, at least since 1867, been predominantly open agricultural land with little change. More recently a playing field was denoted at the eastern end of the Site along with an associated tarmacadam access road, and a winding access road with a turning circle was constructed in the central south of the Site.

Based on the identified historical and current land uses, the main potential on site source of contamination is considered to be historical farming activity. However, it is considered unlikely that this would have resulted in wide spread contamination across the Site.

While the Site is predominantly open agricultural land, a number of features have been identified in the desk based assessment and reconnaissance survey for the Site which present the potential for notable thicknesses of anthropogenic ground as identified in Section 4.3, which may provide a source of contamination onsite.

The main potential sources associated with anthropogenic ground onsite are:

- An underground culvert crossing the western corner of the Site (F1)
- Two large mounds formed around the turning circle of the southern access road (F8).
- Access roads onsite (The playing field access road (F7) and the southern access road (between F8 and F9))
- Underground Service excavations
- Infilled Standing Stones Quarry (F4)
- Other minor structures and above ground services (e.g. stables in F6)

Outside of historical farming activities and the potential areas of anthropogenic ground. There is notable fly tipping within the southern portion of the Site around the turning circle at the end of the access road. As well as the mounds, the ground in this area was noted to have anthropogenic material buried within in such as household waste, plastic bottles etc presumed to be as a result of this fly tipping. It is possible that liquid contaminants from household products may also have been deposited here and petroleum products e.g. oils, diesel and petrol may also be present due to the proximity to the roadway and the presence of parked cars / trailers along its sides.

8.2.2 Offsite Sources of Potential Contamination

The historical mapping and reconnaissance survey identify the area surrounding the Site to have been predominantly agricultural land until between 1957 and 1979 when the majority of the area to the immediate south of the Site was residentially developed. By 2000 the ‘standing stones’ farm to the east of site had been redeveloped as an industrial estate and by 2016 the area to the north of the Site had been predominantly residentially developed.

The industrial estate at the time of the reconnaissance survey was noted to include a repurposed office block used as a children’s play centre. Depot style engineering workshop, an empty plot currently occupied by stockpiles construction waste, soil mounds and haulage truck trailers, an open area with stored mobile elevated work platforms (MEWPs) ‘cherry pickers’ and another depot currently operated by ’A Plant’, a supplier of construction plant, as a vehicle and maintenance yard for JCB site vehicles.

The bulk of the activities in the industrial estate relate to vehicle maintenance, storage and haulage and may be a source of potential contaminants such as total petroleum hydrocarbons (TPH), Poly-Aromatic Hydrocarbons (PAH), chlorinated and non-chlorinated solvents, ethylene glycol (antifreeze), sulphuric acid and heavy metals. The buildings themselves were constructed between 1985 and 1990 and may pose a source of asbestos and / or asbestos containing material (ACM).

It is noted that a ‘Substantiated Pollution Incident’ dated the 26th July 2016 was recorded 28m east of site within the industrial estate. The incident related to vegetable cuttings and deposits and was classed as having no impact (category 4) to air and water, and a significant impact (Category 2) regarding land. The incident is located close to the office building used as a play area but may be related to another site operator or separate from the Site operation.

Three other electrical substations are noted in proximity to the site, one within the residential estate to the north of the Site (North of F2), one in the residential estate to the south of the Site (south of F1) site, and one to the west of the Site on the opposite side of Loop Road South.

The following potential off-site sources of contamination were identified:

- Industrial Estate: Depots and Vehicle maintenance / operation
- Former ponds: Anthropogenic ground / Infilled land
- Golf Course: Anthropogenic ground / Infilled land
- Electrical Substations: Leaks and spillages
- Substantiated Pollution Incident

8.2.3 Potential Sources of Contamination Summary

The potential sources of contamination at the Site are summarised in Table 8.2-1:

Table 8.2-1: Potential Sources of Contamination

Potential Sources	Main Associated Contaminants of Potential Concern (CoPC)
On-site	
Farming (Historic): *Historical Farming Activity*	Livestock sewage wastes, nitrates, phosphates, chloride, chemical sprays and dips, pathogenic microorganisms, pesticides / herbicides, fertilisers, automotive wastes such as gasoline, diesel and motor oils and welding residues, nutrients, inorganics and metals.
Infilled Quarry: *Anthropogenic Ground / Infilled Ground*	Metals, inorganics, phenols, PAHs, TPHs, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), asbestos / ACM, potential for putrescible materials.
Mounds: *Anthropogenic Ground / Infilled Ground*	Metals, inorganics, phenols, PAHs, TPHs, VOCs, SVOCs, asbestos / ACM.
Culvert and Underground Services: *Anthropogenic Ground / Infilled Ground*	Metals, inorganics, phenols, PAHs, TPHs, VOCs, SVOCs, asbestos / ACM.
Access Roads *Anthropogenic Ground / Infilled Ground*	Metals, inorganics, phenols, PAHs, TPHs, VOCs, SVOCs, asbestos / ACM.
Fly Tipping *Anthropogenic material / waste*	Metals, inorganics, phenols, PAHs, TPHs, VOCs, SVOCs, asbestos / ACM.
Other Minor Structures Onsite *Anthropogenic Ground / Infilled Ground*	Metals, inorganics, phenols, PAHs, TPHs, VOCs, SVOCs, asbestos / ACM.
Off-Site	
Former Ponds, golf course and residential developments *Anthropogenic Ground / Infilled Ground*	Metals, inorganics, phenols, PAHs, TPHs, VOCs, SVOCs, asbestos / ACM.
Industrial Estate *Vehicle Repair Garages / Vehicle Workshops*	TPH and PAH including: Oils (containing PAHs and metals) and fuels (petrol/diesel), chlorinated and non-chlorinated solvents, ethylene glycol (antifreeze), sulphuric acid and metals, asbestos / ACM.
Substantiated Pollution Incident	Significant impact (Category 2) regarding land: vegetable cuttings and deposits
Electrical Substations *Electrical Apparatus*	Dielectrics and coolant fluids (Polychlorinated biphenyls (PCBs)).

8.3 Potential Contaminant Linkages

8.3.1 Discussion of Risk during the Construction Works and to Construction Workers

The following assessment of the potential contaminant linkages does not discuss those risks associated with construction works or the risk to construction and maintenance workers.

Prior to any work commencing at the site, a health and safety risk assessment should be carried out by the principal contractor in accordance with current health and safety regulations. This assessment should cover potential risks to both construction staff and the local population. Based on the findings of this risk assessment, appropriate mitigation measures should be implemented during the construction period.

The greatest potential for generation of dust will be during any future site works and therefore dust generation should be kept to a minimum in accordance with general best practice, as outlined in, for example, 'Environmental Good Practice on Site', CIRIA Publication C692 to reduce this risk.

The risk to construction workers during any potential demolition and construction phases in terms of potential exposure to high concentrations of contaminants is considered to be low to moderate given the historical land uses identified at the Site and in close proximity. Where locally high concentrations of contamination are identified during the construction phase, these may pose a potential acute risk to construction workers however these can be effectively managed through good health and safety practices and protocols. Adoption of appropriate dust suppression techniques would also mitigate the degree of potential particulate migration off-site.

8.3.2 Potential Contaminant Linkages Summary

The potential contaminant linkages and associated risks identified for the current land use and proposed residential development are presented in Table 8.3-1 in relation to their respective receptors.

Table 8.3-1: Potential Contaminant Linkages

Source	*Pathway*	*Receptor*
CoPC within the Anthropogenic ground and from historical land uses	Direct dermal contact	On-site Receptors – Current: Site visitors and general public in publically accessible areas (chronic). On-site Receptors – Future: Human health: Future site visitors (acute). Human health: Future residents and site workers (chronic).
	Inhalation and ingestion of particulate	On-site Receptors – Current: Site visitors and general public in publically accessible areas (chronic). On-site Receptors – Future: Human health: Future site visitors (acute). Human health: Future residents and site workers (chronic). Off-site Receptors: Human Health: Nearby residents and workers (chronic).
	Inhalation of soil vapours	On-site Receptors – Current: Site visitors and general public in publically accessible areas (chronic). On-site Receptors – Future: Human health: Future site visitors (acute). Human health: Future residents and site workers (chronic). Off-site Receptors: Human Health: Nearby residents and workers (chronic).
	Plant uptake	On-site Receptors: Flora and Fauna: Growing medium used for gardens and landscaping around potential future residential properties including plants grown in residual soils.
	Direct contact	Development Infrastructure: Buried structures including concrete foundations, services and public water pipeline supplies.
CoPC in leachate generated from Anthropogenic ground and historic land uses	Lateral migration of CoPC within shallow groundwater	Onsite Receptors: Surface water: onsite drainage leading to Midgey Gill adjacent to site, flowing south west. Groundwater Superficial Strata: Potential ground water within granular glacial till if present. (Secondary undifferentiated aquifer). Ground Water Bedrock: Groundwater within the weathered mudstone deposits of the Middle Pennine Coal Measures and the Sandstones of the Whitehaven Sandstone Formation. (Both Secondary A aquifers).
	Lateral migration of CoPC within deeper groundwater	Off-site Receptors: Surface water: onsite drainage leading to Midgey Gill adjacent to site, flowing south west. Groundwater Superficial Strata: Potential ground water within granular glacial till if present. Ground Water Bedrock: Groundwater within the weathered mudstone deposits of the Middle Pennine Coal Measures and the Sandstones of the Whitehaven Sandstone Formation. (Both Secondary A aquifers).
	Lateral migration of CoPC through drainage systems	On and off-site Receptors: Surface water: onsite drainage leading to Midgey Gill adjacent to site, flowing south west.
CoPC in leachate generated from	Vertical migration of CoPC in shallow and deep groundwater	On-site Receptors: Surface water: onsite drainage leading to Midgey Gill adjacent to site, flowing south west. Groundwater Superficial Strata: Potential ground water within granular glacial till if present. Ground Water Bedrock: Groundwater within the weathered mudstone deposits of the

Source	*Pathway*	*Receptor*
Anthropogenic ground and historic land uses		Middle Pennine Coal Measures and the Sandstones of the Whitehaven Sandstone Formation. (Both Secondary A aquifers).
	Plant uptake	On-site Receptors - Current: Flora and Fauna: Current vegetation and growing mediums including existing woodland and pastoral land. On-site Receptors – Future: Flora and Fauna: vegetation and growing medium for gardens and landscaped areas, including retained pastoral land.
		Off-site Receptors – current & future: Flora and Fauna: Ancient woodlands to the immediate south west and west of site (Midgey Wood, Crowpark Wood). Current vegetation and growing medium used for nearby landscaping at surrounding properties and agricultural land.
	Direct contact	On-site Receptors: Development Infrastructure: Buried structures of future developments including concrete foundations, buried services and public water pipeline supplies, and the buried culvert in the west end of site.
Asbestos	Inhalation of particulate	On-site Receptors – Current: Site staff including contractors / maintenance workers and trespassers (acute). Site visitors and general public onsite (acute).
		On-site Receptors – Future: Human health: Future site visitors (acute). Human health: Future site residents and workers (chronic).
		Off-site Receptors: Human Health: Nearby residents and visitors (acute). Human Health: Workers in nearby commercial buildings (acute).
Ground gases associated with the Anthropogenic ground (e.g. infilled quarry)	Inhalation	On-site Receptors – Current: Site staff including contractors / maintenance workers and trespassers (acute). Site visitors and general public onsite (acute).
		On-site Receptors – Future: Human health: Future site visitors (acute). Human health: Future site residents and workers (chronic).
		Off-site Receptors - Current: Human Health: Residents and workers at nearby commercial buildings (chronic). Human Health: Visitors to nearby properties (acute). Off-site Receptors - Future Human Health: Nearby residents and workers at nearby commercial buildings (chronic). Human Health: Visitors to nearby properties (acute).
	Plant uptake	On-site Receptors - Current: Flora and Fauna: Current vegetation and growing mediums including existing woodland and pastoral land. On-site Receptors – Future: Flora and Fauna: vegetation and growing medium for gardens and landscaped areas, including retained pastoral land.
	Migration into enclosed spaces	On-site Receptors: Development Infrastructure: Current and future structures (acute). Human health: Future site visitors (acute). Human health: Future site residents and workers (chronic).
		Off-site Receptors: Development Infrastructure: Current and future structures (acute). Human health: Current and future visitors (acute). Human health: Current and future nearby residents and workers at nearby commercial buildings (chronic).

8.4 Risk Assessment Principles

Current good practice recommends that the determination of hazards due to contaminated land is based on the principle of risk assessment, as outlined in the Environment Agency guidance on Model Procedures for the Management of Land Contamination.

For a risk to be present, there must be a viable pollutant linkage; i.e. a mechanism whereby a source impacts on a sensitive receptor via a pathway.

Assessments of risks associated with each of these pollutant linkages are discussed in the following sections.

Using criteria broadly based on those presented in EA, Chartered Institute of Environmental Health (CIEH) and National House Building Council (NHBC) R&D Publication 66 'Guidance for the Safe Development of Housing on Land Affected by Contamination' (2008), the magnitude of the risk associated with potential contamination at the Site has been assessed. To do this an estimate is made of:

- The magnitude of the potential consequence (i.e. severity); and
- The magnitude of probability (i.e. likelihood).

The severity of the risk is classified according to the criteria in Table 8.4-1:

Table 8.4-1 Summary of Potential Contaminant Linkages

Severity	*Definition and Examples*
Severe	Acute risks to human health, likely to result in "significant harm" (e.g. very high concentrations of contaminants/ ground gases). Catastrophic damage to buildings/ property (e.g. by explosion, sites with high gassing potential, extensive VOC contamination). Major pollution of controlled waters (e.g. surface watercourses or Principal aquifers/ source protection zones). Short term risk to a particular ecosystem.
Medium	Chronic (long-term) risk to human health likely to result in "significant harm" (e.g. elevated concentration of contaminants/ ground gases). Pollution of sensitive controlled waters (e.g. surface watercourses or Principal/ Secondary aquifers). Significant effects on sensitive ecosystems or species.
Mild	Pollution of non-sensitive waters (e.g. smaller surface watercourses or non-aquifers). Significant damage to crops, buildings, structures or services (e.g. by explosion, sites with medium gassing potential, elevated concentrations of contaminants).
Minor	Non-permanent human health effects (requirement for protective equipment during site works to mitigate health effects). Damage to non-sensitive ecosystems or species. Minor (easily repairable) damage to buildings, structures or services (e.g. by explosion, sites with low gassing potential).

The probability of the risk occurring is classified according to the criteria in Table 8.4-2:

Table 8.4-2– Likelihood of Risk Occurrence

Likelihood	*Explanation*
High	Contaminant linkage may be present that appears very likely in the short-term and risk is almost certain to occur in the long term, or there is evidence of harm to the receptor.
Likely	Contaminant linkage may be present, and it is probable that the risk will occur over the long term.
Low	Contaminant linkage may be present and there is a possibility of the risk occurring, although there is no certainty that it will do so.
Unlikely	Contaminant linkage may be present but the circumstances under which harm would occur even in the long-term are improbable.

An overall evaluation of the level of risk is gained from a comparison of the severity and probability, as shown in Table 8.4-3:

Table 8.4-3 Risk based on Comparison of Likelihood and Severity

		Severity			
		HIGH	MEDIUM	MILD	MINOR
Likelihood	HIGH	Very High	High	Moderate	Moderate/Low
	LIKELY	High	Moderate	Moderate/Low	Low
	LOW	Moderate	Moderate/Low	Low	Very Low
	UNLIKELY	Moderate/Low	Low	Very Low	Very Low

8.5 Preliminary Risk Assessment

A preliminary assessment of the potential risks associated with the identified potential sources of contamination at the Site to the various potential receptors is discussed and presented in the following section (Refer to Table 8.5-1).

The level of risk is determined based on the current condition of the Site (i.e. the effects of mitigation measures are not included).

Table 8.5-1 Potential Sources, Pathways and Receptors

Source	*Pathway*	*Receptor*	*Potential Severity*	*Likelihood of Occurrence*	*Level of Risk*	*Discussion*
CoPC within the Anthropogenic ground and from historical land uses	Direct dermal contact	<u>On-site Receptors – Current:</u> Human health: Site visitors and general public in publically accessible areas (chronic.	Medium	Low	Moderate / Low	1. The Site comprises open grasslands with limited areas of hardstanding. Mature trees are present across a number of the field boundaries and although private land, the southern half of the Site is open to public access. As such there is limited protection from site users coming into contact with CoPCs within the shallow soils. However, previous land use indicates a low potential for near surface contamination to be present and therefore the likelihood of contact is considered low
		<u>On-site Receptors – Future:</u> Human health: Future site visitors (acute). Human health: Future residents and site workers (chronic).	Medium	Unlikely	Low	2. Post construction, where the residential development shall be predominantly covered with hard standing and residential properties, the potential for contact with near surface soils shall be limited to areas of landscaping and gardens which should comprise a suitable clean growing medium to an appropriate depth. As such it is unlikely that future site uses should come into contact with current near surface soils as they would be stripped and stockpiled and then tested before reuse or off site disposal/ sale.
	Inhalation and ingestion of particulate	<u>On-site Receptors – Current:</u> Human health: Site visitors and general public in publically accessible areas (chronic).	Medium	Low	Moderate / Low	3. As discussion 1 above.
		<u>On-site Receptors – Future:</u> Human health: Future site visitors (acute). Human health: Future residents and site workers (chronic).	Medium	Unlikely	Low	4. As discussed in section 2 above. Post construction, within the developed areas, exposure shall be limited to areas of landscaping and residential gardens which should be constructed with a clean suitable growing medium. As such it is unlikely that future site users shall come into contact with near surface soils.
		<u>Off-site Receptors:</u> Human Health: Nearby residents and workers (chronic).	Mild	Low	Low	5. The construction process could lead to the potential mobilisation of contaminants on site. Depending on weather conditions and construction methods, mobilised contaminants have the potential to move off-site as windblown soil particulates and dusts. However, the risk posed during the construction phase should be reduced through good health and safety practices during site works and the implementation of suppressive operations onsite if required such as watering down of materials and covering stockpiles.

Source	Pathway	Receptor	Potential Severity	Likelihood of Occurrence	Level of Risk	Discussion
	Inhalation of soil vapours	On-site Receptors – Current: Human health: Site visitors and general public in publically accessible areas (chronic).	Mild	Low	Low	6. As per discussion in point 1 above. The Site is currently open ground with limited areas of enclosed spaces. The potential for vapour inhalation is therefore limited due to the open air nature of the Site where vapours area free to disperse.
		On-site Receptors – Future: Human health: Future site visitors (acute). Human health: Future residents and site workers (chronic).	Medium	Low	Moderate/Low	7. Although limited some site areas such as within the area of the infilled quarry have the potential for significantly thickness of anthropogenic ground. Where present, there is the potential for soil vapours and landfill gases produced by an anthropogenic ground to accumulate within the future above / below ground structures associated with the proposed residential developments. However, as recommended within Section 7, made ground is not considered a suitable founding medium and should be removed prior to development. Should this be the case then the risk shall be negligible post construction. Removal of material / development may not be suitable for the infilled quarry. Gases may migrate laterally posing a risk even if the area itself were not developed.
		Off-site Receptors: Human Health: Nearby residents and workers (chronic).	Mild	Unlikely	Very low	8. As per discussion in point 7, the limited potential for CoPCs onsite means it is unlikely that volumes of soil vapour significant enough to pose a risk to offsite receptors shall be mobilised. Mobilisation of those soil vapours realised onsite, if any, is considered more likely to migrate upwards dispersing within the atmosphere.
	Plant uptake	On-site Receptors: Flora and Fauna: Growing medium used for gardens and landscaping around potential future residential properties including plants grown in residual soils.	Medium	Unlikely	Low	9. No evidence of stress was apparent on any vegetation during the Site reconnaissance suggesting levels of CoPC on site are not affecting current established vegetative growth. Mobilisation of CoPC in soils could have an adverse effect on future planting areas, however it is anticipated that areas of landscaping and residential gardens shall comprise a suitable cover of clean soils providing a suitable growing medium. As such the level of risk is anticipated to be low.

Source	Pathway	Receptor	Potential Severity	Likelihood of Occurrence	Level of Risk	Discussion
	Direct contact	Development Infrastructure: Buried structures including concrete foundations, services and public water pipeline supplies.	Mild	Low	Low	10. Suitable chemical assessment for those soils anticipated to come into contact with buried services should be undertaken as part of any future ground investigation and the appropriate specification of materials should be used for supply pipes, buried services and gas/ damp protective membranes in order to mitigate potential risks.
CoPC in leachate generated from Anthropogenic ground and historic land uses	Lateral migration of CoPC within shallow groundwater	On and off-site Receptors: Surface water: onsite drainage leading to Midgey Gill adjacent to site, flowing south west. Groundwater Superficial Strata: Potential ground water within granular glacial till if present. (Secondary undifferentiated aquifer). Ground Water Bedrock: Groundwater within the weathered mudstone deposits of the Middle Pennine Coal Measures and the Sandstones of the Whitehaven Sandstone Formation. (Both Secondary A aquifers).	Medium	Likely	Moderate	11. The Site is underlain by a Secondary A aquifer associated with the bedrock and a secondary undifferentiated aquifer associated with the superficial deposits. The topography of the Site slopes significantly down to the west / south west, in the direction of the nearby Midgey Gill river and the coast. Shallow ground water may locally have a hydraulic gradient broadly line with the topographical gradient from site towards the river assuming a suitable hydraulic continuity and baseflow within the strata. It is possible that shallow groundwater may outfall onsite where topography or porosity of the shallow soils varies. The Midgey Gill is within a deep cutting towards the west of site and it is possible that shallow groundwater may outfall through the side walls. However, a Secondary A and undifferentiated aquifer may have limited resources of groundwater available for the wider area so lateral migration may be restricted. It is also noted that the Site does not lie within a groundwater Source Protection Zone and no ground water abstractions are noted within 1km of the Site.
	Lateral migration of CoPC within deeper groundwater	Off-site Receptors: Surface water: onsite drainage leading to Midgey Gill adjacent to site, flowing south west. Groundwater Superficial Strata: Potential ground water within granular glacial till if present. Ground Water Bedrock: Groundwater within the weathered mudstone deposits of the Middle Pennine Coal Measures and the Sandstones of the Whitehaven Sandstone Formation. (Both Secondary A aquifers).	Medium	Low	Moderate / Low	12. The Site is underlain by a Secondary A aquifer. This may be in hydraulic continuity with the regional groundwater and surface water features including outfalling to the nearby coast, although groundwater resources for the wider area in a Secondary A aquifer may be limited. In addition it is also noted that the Site does not lie within a groundwater Source Protection Zone and no ground water abstractions are noted within 1km of the Site.

Source	Pathway	Receptor	Potential Severity	Likelihood of Occurrence	Level of Risk	Discussion
	Lateral migration of CoPC through surface waters and drainage systems	On and off-site Receptors: Surface water: onsite drainage leading to Midgey Gill adjacent to site, flowing south west.	Medium	Likely	Moderate	13. A stream is identified to cross the western end of the Site through an underground culvert. This culvert diverts a stream from the north of the Site under Loop Road South to the west of site, ultimately adjoining an open river to the west. An open system of drainage channels adjoined by semi-natural drainage channels are noted though the centre of the Site along with areas of ponding onsite suggesting runoff flow within the western fields. The drainage channels and waters onsite appear to flow towards the Midgey Gill river immediately south west of the site. This river broadens into a small gorge over which the Loop Road South passes with the stream passing under it through a culvert. Both the Midgey Gill and the river from the underground western culvert, meet up west of the Loop Road South. Any residual CoPC present in the drainage systems (if present) from past land uses or the nearby pollution incident may potentially discharge into the Midgey Gill river.
	Vertical migration of CoPC in shallow and deep groundwater	On-site Receptors: Surface water: onsite drainage leading to Midgey Gill adjacent to site, flowing south west. Groundwater Superficial Strata: Potential ground water within granular glacial till if present. Ground Water Bedrock: Groundwater within the weathered mudstone deposits of the Middle Pennine Coal Measures and the Sandstones of the Whitehaven Sandstone Formation. (Both Secondary A aquifers).	Medium	Low	Moderate	14. Superficial deposits onsite are defined as a secondary undifferentiated aquifer. The Site is noted in the BGS mapping to be only part covered by the superficial deposits. Vertical migration of CoPC from the anthropogenic ground into the aquifers may be possible. However, given the Site is not located within a SPZ and the groundwater available in a Secondary A or undifferentiated aquifer as a resource for the wider area may be limited, and as such the sensitivity of the underlying groundwater is lower.
	Plant uptake	On-site Receptors - Current: Flora and Fauna: Current vegetation and growing mediums including existing woodland and pastoral land. On-site Receptors – Future: Flora and Fauna: vegetation and growing medium for gardens and landscaped areas, including retained pastoral land.	Medium	Unlikely	Low	15. As discussion 9 above.

Source	Pathway	Receptor	Potential Severity	Likelihood of Occurrence	Level of Risk	Discussion
		Off-site Receptors – current & future: Flora and Fauna: Ancient woodlands to the immediate south west and west of site (Midgey Wood, Crowpark Wood). Current vegetation and growing medium used for nearby landscaping at surrounding properties and agricultural land.	Minor	Low	Low	16. Due to the limited potential for anthropogenic ground onsite it is unlikely that there would be significant volumes of CoPC leachate to impact groundwater at significant volumes to facilitate the lateral off site migration of mobile contamination allowing an effect on nearby flora and fauna.
	Direct contact	On-site Receptors: Development Infrastructure: Buried structures of future developments including concrete foundations, buried services and public water pipeline supplies, and the buried culvert in the west end of site.	Medium	Low	Moderate / Low	17. As discussion 10 above.
Asbestos	Inhalation of particulate	On-site Receptors – Current: Human health: Site staff including contractors / maintenance workers and trespassers (acute). Human health: Site visitors and general public onsite (acute).	Medium	Unlikely	Low	18. There is the potential for asbestos to be present onsite. However, this is likely to be limited to those areas identified to potentially contain notable thicknesses of anthropogenic ground. Unless the current site works shall involve ground breaking activities in these areas it is unlikely that they shall pose a risk to human health as the anthropogenic ground in these areas is below the ground surface. However it is possible that fly tipping in the vicinity of the southern access road and potentially any discarded waste around the industrial site may include ACM laying above ground which may pose a risk to human health.
		On-site Receptors – Future: Human health: Future site visitors (acute). Human health: Future site residents and workers (chronic).	Medium	Unlikely	Low	19. During the construction phase it is likely that the anthropogenic ground (if present) across the Site will be exposed. Anthropogenic ground found to be contaminated with asbestos should be reviewed during the construction phase and suitable mitigation measure be emplaced such as removal / capping prior to any potential development. Post development the potential likelihood for contact with ACM shall be unlikely due to the Site being predominantly covered with hardstanding where future users are concerned and contact with soils shall be limited to landscaping and gardens comprising a suitable cover of clean soil providing a suitable growing medium.

Source	Pathway	Receptor	Potential Severity	Likelihood of Occurrence	Level of Risk	Discussion
		Off-site Receptors: Human Health: Nearby residents and visitors (acute). Human Health: Workers in nearby commercial buildings (acute).	Medium	Unlikely	Low	20. As discussion 19 above.
Ground gases associated with the Anthropogenic ground	Inhalation	On-site Receptors – Current: Site staff including contractors / maintenance workers and trespassers (acute). Site visitors and general public onsite (acute).	Mild	Low	Low	21. It is likely that anthropogenic ground is present beneath at least some limited part of the Site associated with historical site activities e.g. the former quarry and mounds. The presence of a thickness of anthropogenic ground (specifically in the location of the quarry) may allow for the potential risk of bulk ground gas generation. Ground gases may also be present should significant organic soils be identified onsite, however this is not anticipated based upon available geological information. The Site is currently open ground with limited areas of enclosed spaces and ground gases should they be present would likely disperse to the atmosphere if released.
		On-site Receptors – Future: Human health: Future site visitors (acute). Human health: Future site residents and workers (chronic).	Medium	Low	Moderate / Low	22. As discussed in point 21 above. There is the potential for an accumulation of ground/ landfill gas to build up in future above / below ground structures proposed for the Site including service trenches. The potential risk from chronic exposure is considered to be a low risk associated with anthropogenic ground deposits if they are retained on-site and an appropriate clean cover system is not constructed as part of any future redevelopment.
		Off-site Receptors - Current: Human Health: Nearby residents and workers at nearby commercial buildings (chronic). Human Health: Visitors to nearby properties (acute). Off-site Receptors - Future Human Health: Nearby residents and workers at nearby commercial buildings (chronic). Human Health: Visitors to nearby properties (acute).	Mild	Low	Low	23. There is the potential for ground gas (if present) to migrate off-site via shallow Anthropogenic ground or granular superficial deposits. However it is not currently anticipated that significant granular strata shall be present onsite.

Source	*Pathway*	*Receptor*	*Potential Severity*	*Likelihood of Occurrence*	*Level of Risk*	*Discussion*
	Plant uptake	On-site Receptors - Current: Flora and Fauna: Current vegetation and growing mediums including existing woodland and pastoral land. On-site Receptors – Future: Flora and Fauna: vegetation and growing medium for gardens and landscaped areas, including retained pastoral land.	Mild	Unlikely	Very low	24. As discussion 9 above.
	Migration into enclosed spaces	On-site Receptors: Development Infrastructure: Current and future structures (acute). Human health: Future site visitors (acute). Human health: Future site residents and workers (chronic).	Medium	Low	Moderate / Low	25. Currently the Site is open ground with limited areas of enclosed spaces. The future development should utilise the appropriate specification of materials for supply pipes, buried services and gas / damp protective membranes to mitigate any potential risks.
		Off-site Receptors: Development Infrastructure: Current and future structures (acute). Human health: Current and future visitors (acute). Human health: Current and future nearby residents and workers at nearby commercial buildings (chronic).	Mild	Low	Low	26. As discussion 10 above.

9. Conclusions

Homes England commissioned AECOM to complete a desk study and coal mining risk assessment to support the outline planning application for the site. In addition the report informs what ground investigations are required. These intrusive works will confirm, or prove the absence of the risks identified within this report, which in turn will inform the master planning team who will take the project forward.

9.1 Site Setting Review

The principal findings of the desk study are:

- The proposed residential development is an area of land between the A595 Loop Road South and Harras Road, within Harras Moor in Whitehaven, as shown in Figure 1. The Site is owned by Homes England and is currently leased to tenant farmers and a football club.
- The proposed residential development is still being developed at the time of writing this report but is understood to comprise up to 370 residential units, with private gardens, soft landscaped areas, and associated access roads.
- History: The Site has been almost entirely undeveloped with little change up to about 2000, when an access road from the south and a playing field on the east were included. A small quarry was located in the north east from at least 1867 up to about 1979 when it was finally infilled. In addition, parts of the Site contain ancient woodland.
- Reconnaissance: The Site was pastoral agricultural land, with a number of draining channels / ditches, separated into a number of fields. The fields were generally wire fenced, but soft and boggy underfoot, and in places notably waterlogged, with tall grasses. The southern fields were used by horses and were firmer underfoot with shorter grass but still wet in places. The former playing field on the eastern side of the Site was disused, with long grass and localised fly tipped material. Trafficking between the fields will require multiple access points from the surrounding infrastructure.
- Topography: The Site slopes down towards the coast, which is located to the southwest. The gradient generally increases westwards, up to about 20 degrees along the western boundary (Area F1). The southern fields, while also falling to the southwest, tend to have an incline of a more gentle nature.
- Geology and Hydrogeology: The review identifies the underlying superficial geology to comprise at least in part Glacial Till deposits, anticipated to be predominantly clays with bands of granular strata. These are identified as a secondary undifferentiated aquifer. The underlying bedrock is noted to be mudstones of the Middle Pennine Coal Measures and Sandstone of the Whitehaven Sandstone Formation. Both of these bedrock formations are identified as Secondary A aquifers.
- Hydrology: An open system of drainage channels were noted though the centre of the Site. The drainage channels and water onsite appeared to flow towards the Midgey Gill River immediately southwest . This river broadens into a small gorge over which Loop Road South passes with the stream culverted below the road. In addition, a stream was identified to cross the western end of the Site through an underground culvert.
- Contamination Sources: Chemicals of Potential Concern (CoPCs) are limited based upon the sites current and historic use. The main source relates to potential for anthropogenic ground, including the infilled former quarry. The offsite sources focus primarily upon the industrial estate adjacent to the northeast, topographically uphill.
- Environmental Data: The Site does not lie within a groundwater Source Protection Zone and no ground water abstractions are noted within 1km. The Site is not located within a flood zone or flood warning area or within an area likely to experience flooding from rivers (or sea) without defences. The Site is classified as having ‘limited potential for groundwater flooding’.

9.2 Environmental Risk Assessment Review

The findings of the preliminary risk assessment suggest a very low to moderate risk:

- Human Health:
  - The risk to human health through dermal contact, inhalation and ingestion of soils and soil vapours is considered to be low to moderate / low. In the sites current usage a moderate / low rating is associated with dermal contact and ingestion / inhalation of particulates. This is primarily due to the potential site users coming into direct contact with contaminated soils. Post redevelopment these risks are considered low, as any identified contamination will be removed or remediated.
  - The risk posed by asbestos is anticipated to be low. It is possible that fly tipping in the south may include ACM however this area is very small and no ACM was identified on the surface of the mounds during the site visit. Post construction ACM identified during the works should be removed.
  - Ground Gas: The proposed residential development has been considered as a moderate / low risk. This is due to the new development presenting enclosed spaces onsite and a potential for chronic risk associates with site workers / users during and following development.
- Controlled waters:
  - The risk to controlled waters is considered to be moderate / low to moderate. It is possible that surface water and leachate from potential shallow Made Ground may migrate both vertically and laterally to the underlying aquifers.
  - Surface waters are also of a moderate / low to moderate risk. The Site appears to drain largely to the Midgey Gill, a river to the southwest. The former quarry and the industrial estate are at the highest point, giving the potential for leachates to migrate onto the Site. The potential for surface drainage from the industrial estate entering the Site is supported by a substantiated pollution incident recorded at the estate indicating a link between drainage in the industrial estate and the Midgey Gill west of the Site.
- Fauna and Flora:
  - The risk to fauna and flora is considered very low to low. The risk to fauna and flora from direct uptake of CoPCs from soils and soil leachate is low. This risk is attributed to the low sensitivity of fauna and flora onsite along with the limited amount of Made Ground.

9.3 Geotechnical Review and Potential Constraints

Based on the desk study :

- The majority of the site is likely to be underlain by either Glacial Till or weathered bedrock. These strata generally have a firm or stiff consistency which allows spread foundations to be constructed at shallow depth. However, it was noted during the site walkover that some areas were soft and others wet, which could locally increase the depth of foundations, or require alternative foundations. In addition, where soft / wet conditions are proven, this can have an adverse effect on retaining wall design.
- Ground investigations should be carried out to determine the groundwater and geotechnical properties for onward foundation / retaining wall design. This should also include slope stability analyse.
- The potential for chemical attack on buried concrete structures cannot be assessed at this stage, although pyritic ground is expected. As part of the ground investigation, tests should be carried out to determine the aggressivity of the ground to buried concrete.
- If any made ground or below ground structures are encountered these should be grubbed out and replaced with suitable engineered fill.
- The 1:50,000 BGS geological map Sheet 28 Whitehaven (Bedrock and Superficial Edition), indicates that the shallow mine workings were associated with the Yard coal seam which crops to the southeast. The other coal crop is that of the Main coal seam, which is shown cropping at or just to the northwest of the site boundary.

9.4 Coal Mining Review and Mitigation Measures

A review of the available information indicates that there are potential risks from shallow workings as shown in Figure 6. The Coal Authority Mining Report (CON29M report) identified that the Site could be affected by underground mining in two seams at shallow depth to 190m depth. These are identified to have been last worked in 1961.

The Coal Authority mine abandonment plans indicate:

- That there were workings in Whitehaven Mine within the Bannock and Main coal seams beneath the central parts of the site. Although considered unlikely, there is the potential for the Bannock coal seam, and possibly the Main coal seam, to be shallow enough to cause settlement at the surface.
- Across the eastern side, deeper mining operations in the Whitehaven Mine are believed to have worked the Main coal seam which lies below the Whitehaven Sandstone, a thick sandstone unit, and it is very unlikely that there are any shallow mine workings in this area.

10. Recommendations

It is recommended that a ground investigation be carried out to confirm the above assessment and determine what, if any, remedial measures are required.

Intrusive works could include, trial pits and windowless sample boreholes to provide general coverage and allow the installation of shallow ground gas and groundwater monitoring boreholes. Deeper boreholes will be required across parts of the site, e.g. within the former quarry, and these could be drilled with cable percussive boreholes. All boreholes should include standard penetration tests to assist with geotechnical design.

In addition, further ground investigations are required to determine the shallow mining risk. This should comprise as a minimum a triangular array of three rotary boreholes to at least 30m into bedrock in the western part and the central part of the site. Drilling is also recommended beneath the eastern area to verify the assumption that there is no shallow mine workings.

If shallow mine workings or coal seams with the potential to contain shallow mine workings are proved, mitigation will be required beneath built development and infrastructure. This should comprise a closely spaced grid or extended diamond pattern of boreholes to identify the presence and extent of any workings within the coal seam or seams targeted. These boreholes should then be used to grout the workings. The detailed drilling and grouting specification should be prepared following the findings of the ground investigation.

Permission will be required from the Coal Authority for any intrusive investigations that may intersect their assets.

12. References

1. White Young Green, The Homes & Communities Agency 'Harras Moor, Whitehaven Planning Appraisal', (January 2017)
2. White Young Green, Flood Risk & Drainage Assessment, Harras Moor, Whitehaven, Cumbria, A090070-410, (May 2018)
3. White Young Green, Design and Access Statement, Harras Moor, Whitehaven, (May 2018)
4. Google maps (www.maps.google.co.uk) accessed January 2018;
5. Environment Agency (EA) website (www.environment-agency.gov.uk), including the 'What's in Your Back Yard' tool accessed January 2018;
6. British Geological Survey (BGS) website (www.bgs.ac.uk) including the 'Geoindex' tool, accessed January 2018;
7. BGS Geological Map sheet 28, Whitehaven (Bedrock and Superficial edition), 1:50,000 scale, 2004;
8. Coal Authority Interactive Map Viewer (http://mapapps2.bgs.ac.uk/coalauthority/home.html) accessed January 2018;
9. The Department for Environment, Food and Rural Affairs (DEFRA) MAGIC interactive mapping tool (http://magic.defra.gov.uk/MagicMap.aspx) accessed January 2018;
10. DEFRA/Environment Agency Contaminated Land Report CLR11 'Model Procedures for the Management of Land Contamination';
11. The Coal Authority (2017), Risk based approach to development management. Guidance for developers. Version 4 – 2017;
12. The Coal Authority Mine Abandonment Plans, Information obtained from a visit to The Coal Authority's Mining Records Office in Mansfield Nottinghamshire on 18th January 2018;
13. BS EN 14688-1:2002 Geotechnical Investigation and Testing – Identification and classification of soil.
14. BS EN ISO 14689:2002 Geotechnical investigation and testing – Identification and classification of rock.
15. NHBC Standards 2016 Chapter 4.2 Building Near Trees (2016).