PHASE 1 & 2 ENVIRONMENTAL ASSESSMENT

PROPOSED OUTLINE RESIDENTIAL DEVELOPMENT OF LAND AT THE PANHANDLE SITE, WOOLLEY BRIDGE ROAD, HADFIELD, GLOSSOP

VOLUME 1

VOLUME 2

1.0 INTRODUCTION

1.01 Following instructions from Rossington Park Ltd on 16 July 2013, CoDA Structures have undertaken an appraisal of a proposed residential development on land at the Panhandle site, Woolley Bridge Road, Hadfield, Glossop.

1.02 The site is currently undeveloped.

1.03 It is proposed to develop the site for housing.

1.04 Sections 2.0 – 7.0 of this report undertake a desk based assessment to determine the environmental quality of the land at the site and to identify the potential for any environmental risks as follows:-

- to establish the likely extent of any potential contamination at the site as a result of its current and previous use;
- to establish the sensitivity of the site in relation to the site's geology, hydrogeology and hydrology;
- to assess the significance of any potential contamination at the site with respect to possible harm to the surrounding environment and site end users;
- to provide recommendations for further works as appropriate.

1.05 The interpretation provided in this report is based upon information gathered from public data sources.

1.06 The client has provided a geotechnical Investigation report for the site (reference 27332, dated August 2005) prepared by Eastwood and Partners (E&P). This report has been referred to for background information and relied upon for ground investigation data.

1.07 A trial pit ground investigation was undertaken on the site on 16 May 2005 by E&P.

1.08 The local authority is High peak Borough Council (HPBC).

2.0 LOCATION, TOPOGRAPHY & CURRENT CONDITION

2.01 The site is located to the north of Woolley Bridge Road and is approximately 2.0 miles to the northwest of Glossop Town Centre. A site location plan (Fig.1) is attached in Volume 2, Appendix B.

2.02 The Ordnance Survey co-ordinates for the centre of the site are 4013300mE, 396210mN.

2.03 The site is approximately 1.75 hectares in area.

2.04 The boundaries of the site are defined as follows:-

- North western boundary : embankment to the River Etherow
- North eastern boundary : back of footway to Graphite Way
- North western boundary : fence to adjacent industrial unit.
- South eastern boundaries : back of footway to Woolley Bridge Road..

2.05 The site can be accessed from Graphite Way.

2.06 A site walk-over was undertaken on 18 July 2013 and the following noted;-

- The site is generally overgrown.
- there are several mature trees at the south western end of the site.
- There are a number of unmade paths across the site.
- there are several piles of rubble in the north eastern sector.
- there is a large outfall structure to the river approximately midway along the northwestern boundary.

2.07 The site is currently disused.

2.08 The site varies in level from 132.46mAOD adjacent the roundabout at the junction of Woolley Edge Road and Graphite Way to 120.55 adjacent the River Etherow in the south western sector. The general fall of the site is towards the river.

2.09 A site topographical survey (Fig. 2) is attached in Volume 2, Appendix C.

2.10 Site photographs are attached in Volume 2, Appendix D.

3.0 HISTORIC SITE USAGE

3.01 Extracts from Ordnance Survey Sheets dating back to 1872 have been examined and the following constitutes a brief history of the entire site and the surrounding land:-

Map date & Scale	On-site Features	Features within 250m of site	Features within 1000m of site
1872/86 sheets 1 - 1:2,500 Maps incomplete	- a railway line crosses the site in a southwest to northeast direction - the northeast sector is undeveloped. - the railway siding in new sector	- the surrounding area is predominantly un-developed - Cotton mill to the south west. - print works to the west	Not applicable (N/A)
1881/82 sheets 1:10,000	- no significant changes noted;	- no significant changes noted;	- Town of Hadfield to the east. - Old quarry to the east. - Mills to the northeast, east and south. - railway line to the east. - gravel pit to the south. - village of Woolley Bridge to the south. - brickyard to the south - village of Hollingworth to the west. - gasometer to the north east. - resevoir to the north
1887 1:2,500	- no significant changes noted;	- no significant changes noted;	- N/A
1898 1:2,500	- no significant changes noted;	- residential development to the east;	- N/A
1899 1:10,000	- no significant changes noted;	- no significant changes noted;	- old quarry to the north. - expansion of Hadfield to the east. - clay pit to the southeast. - gas works to the west. - quarries to the west and north west.
1910 1:2,500 Map incomplete	- no significant changes noted;	- Bleach works to the west;	- N/A
1911 1:10,000	- no significant changes noted;	- expansion at the mill to the southwest	- Sewage works to the southwest.
1922 1:2,500	- no significant changes noted;	- no significant changes noted;	- N/A
1924 1:10,000	- no significant changes noted;	- no significant changes noted;	- filter beds to the northeast
1938 1:10,000	- no significant changes noted;	- no significant changed noted;	- no significant change noted
1954 1:10,000	- no significant changes noted;	- building to the southwest indicated as a works	- residential development to the north & east and northwest.
1971 1:2,500	- railway lines no longer present	- refuse tip adjacent northeast boundary	- N/A

		- Confectionary works to the northeast. - further residential development to the east and southeast.	
1974/75 sheet 1:2,500	- no significant changes noted;	- no significant changes noted;	- N/A;
1981/83 sheet 1:10,000	- no significant changes noted;	- residential development to the west.	- expansion of Hollingworth to the west. - expansion of Hadfield to the south. Southeast and east. - works to the northeast. - expansion of the works to the southwest. - Sewage works to the northeast.
1992 1:2,500	- no significant changes noted;	- no significant changes noted;	- N/A
2006 1:10,000	- no significant changes noted;	- no significant changes noted;	- Industrial estate to the south - further expansion of Hadfield to the northeast.
2013 1.10,000	- no significant changes noted;	- Industrial development to the north & northeast.	- no significant changes noted.

3.02 Historic Ordnance Survey plans are attached in Volume 2,Appendix E.

4.0 GEOLOGY AND HYDROGEOLOGY

4.01 GEOLOGY:

1:10,000 British Geological Survey (BGS) Sheet 86 indicates the following:-

- The site is overlain with alluvial deposits over sandstones of the Millstone Grit series
- There are no faults on or in the immediate vicinity of the site.

4.02 MINING & MINERALS:

A mining report has been prepared for the site by the Coal Authority and is summarised as follows:-

- There are no recorded coal workings below the site.
- There is coal in reserve below the site but no workings are currently planned.
- The site is not situated within the boundary of a former opencast mining site.
- There are no recorded mine entries on or within 20m of the site.
- The property has not been subject to a claim for alleged coal mining subsidence.

The Coal Authority mining report is attached in Volume 2, Appendix F

There are 9 No recorded BGS mineral sites within 1000m of the site. Of these 1 No is within 200m of the site and details are summarised as follows:-

Location	:	Hadfield 365m to the east.
Status	:	ceased
Commodity	:	sandstone

There are no recorded BGS mineral sites within 1000m of the site.

The Coal Authority mining report is attached in Volume 2, Appendix F.

4.03 HYDROGEOLOGY:

The site is not believed to be prone to flooding and the Environment Agency flood map indicates that the majority of the site is in Flood Zone 1. However, it should be noted that a small area of the site along the northwestern boundary is indicated as being in Flood Zone 2 and Flood Zone 3a. This is assessed further in CoDA Structures Flooding and Drainage Assessment report for the site.

The site is underlain by a bedrock aquifer designated as a Secondary Aquifer – A which is strata which contains 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.

The site is underlain by a superficial aquifer designated as a Secondary Aquifer – A which is strata which contains 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.

The overlying soils have been classified as having a low leaching potential.

There are 49 No. discharge consents within 1000m of the site. Of these 15no. are within 500m of the site and details are summarised as follows:-

-	storm sewage overflow	on site
-	process water (2 No).	on site
-	storm sewage overflow (2 No).	56m to the southwest
-	surface water	74m to the north
-	surface water	176m to the southwest
-	storm sewage overflow (2 No).	351m to the southwest
-	sewage discharges (pumping Station)	387m to the southwest
-	treated effluent (3 No)	467m to the northwest

There have been 74 No. pollution incidents within 1000m of the site of these 35no. have been within 500m of the site and details are summarised as follows:-

1no. category 2 Significant Incidents involving:-

-	oils/diesel	on site

There are 16no. water abstraction licenses held within 1000m of the site and details are summarised as follows:-

34no. category 3 Minor incidents involving:-

-	inert suspended solids	on site
-	unknown sewage	on site

-	detergents/surfactant	on site
-	unknown sewage	12m to the west
-	unknown pollutants	26m to the south
-	oils/diesel	56m to the north
-	miscellaneous pollutant	67m to the west
-	storm sewage	71m to the west
-	oils/ diesel	71m to the west
-	rubble/litter	75m to the north
-	unknown pollutant	79m to northeast
-	storm sewage	100m to the southwest
-	organic waste	103m to the north
-	inert suspended solids	199m to the west
-	detergents/surfactant	200m to the west
-	oils/diesel	283m to the northwest
-	fertiliser	359m to the southwest
-	oils	360m to the northeast
-	paints/dyes	408m to the southwest
-	unknown pollutants	411m to the southwest
-	paints/dyes	412m to the southwest
-	industrial effluent (2 No)	415m to the southwest
-	sewage	416m to the north
-	oils	419m to the southwest
-	sewage	430m to the southwest
-	sewage	460m to the northwest
-	sewage	463m to the northwest
-	sewage	464m to the northwest
-	oils/diesel	468m to the northwest
-	oils	464m to the east
-	sewage	471m to the northwest

There are 16no. water abstraction licenses held within 1000m of the site and details are summarised as follows:-

-	surface abstraction for manufacturing	68m to the north
-	surface abstraction for general cooling (2No)	74m to the north
-	groundwater abstraction for boiler feed	290m to the southwest
-	groundwater abstraction for process water	290m to the southwest
-	groundwater abstraction for boiler feed (2No)	312m to the northeast
-	groundwater abstraction for general cooling (4No)	312m to the northeast
-	groundwater abstraction for process water (2No)	312m to the northeast
-	spring water for manufacturing	716m to the northeast
-	surface abstraction for boiler feed	784m to the northeast
-	surface abstraction for public water supply	876m to the west

The site does not lie within a Source Protection Zone.

There have been no prosecutions relating to controlled waters within 1000m of the site.

5.0 POLLUTION CONTROLS & WASTE

5.01 Pollution Controls:

There are no Integrated Pollution Control Permits held within 1000m of the site.

There are no Integrated Pollution Prevention and Control Permits held within 1000m of the site.

There are 12no. Local Authority Pollution Prevention and Control Permits held within 1000m of the site.

There are no Local Authority Integrated Pollution Prevention and Control Permits held within 1000m of the site.

There are no registered radio active substance licences held within 1000m of the site.

There has been 1no. prosecution relating to authorised processes within 1000m of the site and details are summarised as follows:-

Location:	Etherow Industrial Estate, Glossop 197m to the south
Prosecution:	Dumping drums of diesel sludge on land without a waste management licence.
Verdict:	Guilty.

There are no Control of Major Asbestos Hazards Site (COMAH) within 1000m of the site.

5.02 Waste:

There are 7no. registered landfill sites within 1000m of the site. Of these 3 No are within 500m of the site and details are summarised as follows:-

Location:	Woolley Bridge Road, Hadfield 294m to the northeast.
Category:	Landfill, no restriction on source of waste.
Status:	Licence lapsed, cancelled, defunct, not applicable or surrendered.
Authorised: Waste	Construction and demolition waste; solid asbestos.

Location:	Disused railway line. Brickfield Glossop 488m to the south.
Category:	Landfill, no restriction on source of waste.
Status:	Licence lapsed, cancelled, defunct, not applicable or surrendered.

Authorised Waste: Clean brick and concrete; construction and demolition wastes; fully polymerised plastic; metal, stone; glass; slate; uncontaminated excavation materials;
(Note: There were two operators on the site).

There are no British Geological Survey recorded landfill sites within 1000m of the site.

There are 3no. Local Authority recorded landfill site within 1000m of the site. Of these 2no are within 500m of the site and details are summarised as follows:-

Location: Woolley Bridge Road, Hadfield – on site.
Status: Unknown.
Types of Waste: Unknown

Location: Bank Street, Hadfield 468m to the east
Status: Closed 31.12.66
Types of Waste: Domestic

There are 10no. historic landfill sites within 1000m of the site. Of these 4no. are within 500m of the site and details are summarised as follows:-

Location: Woolley Edge Road, Hadfield – on site
Last Input: 31 October 1992.
Types of Waste: Included inert waste.

Location: Woolley Bridge Road, Hadfield – on site
Last Input: No records.
Types of Waste: No records

Location: Paradise Street, Glossop 237m to the east
Last input: No record
Types of Waste: Included industrial, commercial and household waste.

Location: Barn Road, Hadfield 350m to the southwest.
Last input: 31 October 1991.
Types of Waste: Included inert waste.

There is 1no. waste treatment/disposal sites within 1000m of the site.

There are 3no. waste management facilities within 1000m of the site.

There are 3no. waste transfer sites within 1000m of the site.

6.0 IDENTIFIED POSSIBLE SOURCES OF CONTAMINATION

The past history of the site would indicate possible sources of contamination.

6.01 **Soil Contamination:**

It appears that part of the site has been filled in level to create a railway embankment above the River Etherow it also appears there has been some historical land filling. Therefore any fill that has been imported onto the site may have elevated levels of contamination, depending upon the source and nature of the material used.

The site has been used for the following activities:-

- Railway line and sidings (pre 1872 – approximately 1971).
- Un-developed (approximately 1971 – present of day)

The railway line use is considered to be a moderate risk contaminative activity.

If the site has been land filled this is considered to be a high risk contaminative activity.

Potentially contaminative activities in the vicinity (within 250m) of the site have included the following:-

- cotton mill - bleach works - refuse tip

- print works - works - industrial estate

Potentially contaminative activities in the surrounding area have included the following:-

- quarries - sewage works - railway lines - gravel pit

- mills - gas works - gasometer - brick yard

- clay pit - filter beds - works - industrial estate

If the site has been land filled and was part of a refuse tip it is possible that the site has been at risk from the uncontrolled tipping of waste products, residues or chemicals from surrounding past industries/activities.

It is possible there may be localised hydrocarbon contamination present on the site from the former railway use.

Contemporary Trade Directory entries in the vicinity of the site (within 250m) are as follows:-

- Boiler servicing replacements and repairs (active) 13m to the north east

There are no fuel station entries in the vicinity of the site (within 500m).

It is recommended that additional ground investigation works are undertaken on the site and soil sampling should be undertaken for contamination testing.

6.02 **Pollution of Controlled Waters:**

The possibility of leachate contamination from past uses or if any uncontrolled filling has taken place on the site, may need to be investigated to assess the potential for pollution to controlled waters (the underling Secondary Aquifer - A and the River Etherow).

6.03 **Gas Contamination:**

The development may be at risk from the migration of landfill gas onto the site from a known landfill site in the surrounding area within 250m of the development.

The development may be at risk from the generation of landfill gases in any of the fill materials on the site, particularly if the site was part of an historic landfill site; depending on the source and nature of the materials used.

Therefore it is recommended that gas monitoring is undertaken on the site.

A Radon report obtained from the BGS indicates that the site is in an area where Radon protection measures are not required.

The BGS Radon report is attached in Volume 2, Appendix G.

7.0 RISK ASSESSMENT

70.1 The following contaminated land risk assessment methodology is based on CIRIA C552 (2001) Contaminated Land Risk Assessment – 'A Guide to Good Practice', in order to quantify potential risk via risk estimation and risk evaluation, which can be adopted at the Phase 1 stage. This will then determine an overall risk category which can be used to identify likely actions. This methodology uses qualitative descriptors and is therefore a qualitative approach.

The methodology requires the classification of:

- the magnitude of the consequence (severity of risk occurring), and
- the magnitude of the probability (likelihood) of a risk occurring.

7.02 The potential consequences of contamination risks occurring at this site are classified in accordance with table 7.1, which is adapted from the CIRIA guidance.

Table 7.1 - Classification of Consequences:

Classification:	Definition of Consequence:
Severe	Short term (acute risks to human health). Short term risk of pollution of sensitive water resource or ecosystem. Catastrophic damage crops/buildings/property/infrastructure, including off-site soils.
Medium	Medium/long term (chronic) risks to human health. Medium/long term risk of pollution of sensitive water resource or ecosystem. Significant damage to crops/buildings/property/infrastructure (on or off-site). Contamination of off-site soils.
Mild	Easily preventable, permanent health effects on humans. Pollution of non-sensitive water resources. Localised damage to crops/buildings/property/infrastructure (on or off site).
Minor	Easily preventable non-permanent health effects on humans, or no effects. Minor, low level and localised contamination of on-site soils. Easily repairable damage to crops, buildings/property/infrastructure.

7.03 The probability of contamination risks occurring at this site will be classified in accordance with Table 7.2, which is also adapted from the CIRIA guidance. Note that for each category it is assumed that a pollution linkage exists. Where a pollution linkage does not exist the likelihood is zero, as is the risk.

Table 7.2 – Classification of Probability:

Classification:	Definition of Probability:
High Likelihood	Circumstances are such that an event appears very likely in the short term or almost inevitable in the long-term; or there is already evidence that such an event has occurred.
Likely	Circumstances are such that an event is not inevitable, but is possible in the short term, and is likely over the long-term.
Low Likelihood	Circumstances are such that it is by no means certain that an event will occur even over along period, and it is less likely in the short term.
Unlikely	Circumstances are such that it is improbable that an event would occur even in the long-term.

7.04 For each possible pollution linkage (source-pathway-receptor) identified the potential risk can be evaluated. Based upon this CIRIA C552 presents definitions of the risk categories, together with the investigatory and remedial actions that are likely to be necessary in each case, as indicated in Table 7.3. These risk categories apply to each pollutant linkage, not simply to each hazard or receptor.

Table 7.3 – Definition of Risk Categories and Likely Actions required:

Risk Category:	Definition of Likely Actions Required:
Very high	Severe harm to a defined receptor is very likely, or has already occurred. The risk is likely to result in a substantial liability. Urgent investigation (if not already undertaken) is likely to be required. Urgent remediation is likely to be required.
High	Harm to a defined receptor is likely. The risk, if realised, may result in a substantial liability. Urgent investigation (if not already undertaken) is likely to be required. Remediation is likely to be required in the long term, possibly sooner.
Moderate	Harm to a defined receptor is possible, but severe harm is unlikely. Investigation is likely to be required to clarify the level of potential liability and risk. Some remediation may be required in the long term.
Low	Harm to a defined receptor is possible, but is likely to be mild at worst. Liabilities could theoretically arise, but are unlikely. Further investigation is not required at this stage. Remediation is unlikely to be required.
Very low	Harm to a defined receptor is unlikely and would be minor at worst. No liabilities are likely to arise. Further investigation is not required at this stage. Remediation is unlikely to be required.

7.05 This relation ship can also be represented as a matrix, as indicated in Table 7.4.

Table 7.4 – Probability / Consequence Matrix:

Probability	Consequence			
	Severe	**Medium**	**Mild**	**Minor**
High Likelihood	Very High Risk	High Risk	Moderate Risk	Low Risk
Likely	High Risk	Moderate Risk	Moderate Risk	Low Risk
Low Likelihood	Moderate Risk	Moderate Risk	Low Risk	Very Low Risk
Unlikely	Low Risk	Low Risk	Very Low Risk	Very Low Risk

7.06 The following potential contamination pathways have been identified on the site:-

Horizontal and vertical migration pathways of leachate through the potentially permeable soils and geological formations.

Human Uptake Pathways (derived from CLEA model and LQA for residential use with plant uptake):

- Ingestion of soil
- Ingestion of indoor dust
- Dermal contact with soil
- Contact with indoor dust
- Inhalation of vapours outside
- Inhalation of vapours inside
- Vertical and lateral migration of volatile vapours and ground gas
- Indirect ingestion
- Airborne hazardous fibres
- Plant root uptake.

7.07 The following environmental receptors have been identified on site:-

- Groundwater residing in the underlying Secondary Aquifer – A.
- River Etherow
- Buildings/structures
- Flora/Fauna
- Underground services
- Third party land.

7.08 The following human receptors have been identified on the site:-

- Construction workers
- Maintenance workers
- End users

7.09 **Summary – Earthworks and Construction Phase:**

A Risk Assessment of the site is summarised in the table below:-

Source	Receptor	Pathway	Consequence	Probability	Risk Category	Comments
S1: Contamination in made ground if present on the site. S2: Uncontrolled tipping of waste products and residues from adjacent industries/activities.	R1: Groundwater (Secondary Aquifier – A and River Etherow)	P1: Horizontal and Vertical migration of leachate through potentially permeable soils and service trenches.	Medium	Likely	Moderate	Low permeability soils if present below the site, will prevent the migration of contaminants. Some types of contamination are likely to be localised. Site remediation works and measures can reduce risk.
S3. Hydrocarbon contamination from railway use.	R1 Groundwater (principle aquifier and watercourse).	P1. Horizontal and Vertical migration of Leachate through potentially permeable soils and service	Severe	Likely	High	Contamination is likely to be localised. Low permeability soils is present below the site will prevent the migration of contaminants. Site remediation works and measures can reduce risk
S1 Contamination in made ground if present on the site S2: Uncontrolled tipping of waste products and residues from adjacent industries/activities.	R2: Buildings and structures	P1: Horizontal and Vertical migration of leachate through potentially permeable soils and service trenches.	Medium	Likely	Moderate	The underlying made ground may contain elevated sulphate levels which could result in corrosion of buried concrete structures.. However, sulphate resisting cement can be used in concrete.
S3: Hydrocarbon Contamination from railway use.	R2: Buildings and structures	P1: Horizontal and Vertical migration of leachate through potentially permeable soils and service trenches.	Minor	Likely	Low	
S1: Contamination in made ground used to fill the site. S2: Uncontrolled tipping of waste products and residues from adjacent industries/activities.	R3: Construction workers.	P2: Human uptake pathways (see 7.06). P3: Vertical migration of volatile vapours and ground gas.	Severe	Likely	High	Site remediation works and measure can reduce risk. The risk to workers who do not use the appropriate PPE is likely to be significant.

S3: Hydrocarbon contamination from railway use.	R3: Construction workers.	P2: Human uptake pathways (see 7.06). P3: Vertical migration of volatile vapours and ground gas.	Severe	Likely	High	Sire remediation works and measure can reduce risk. The risk to workers who do not use the appropriate PPE is likely to be significant.
S4: Gas generation in landfill sites within 250m of the site.	R3: Construction workers.	P3: Vertical migration of volatile vapours and ground gas.	Severe	Likely	High	The risk to workers who do not use the appropriate PPE is likely to be significant.
S5: Gas generation from fill materials on the site.	R3: Construction workers.	P3: Vertical migration of volatile vapours and ground gas.	Severe	Low Likelihood	High	The risk to workers who do not use the appropriate PPE is likely to be significant.
S1: Contamination in made ground if present on the site. S2: Uncontrolled tipping of waste products and residues from adjacent industries/activities.	R4: Neighbouring Sites.	P1: Horizontal and Vertical migration of leachate through potentially permeable soils and service trenches.	Medium	Low Likelihood	Moderate	Contamination is likely to be localised. Low permeability soils if present below the site, will prevent the migration of contaminants. Site remediation works and measures can reduce risk.
S3: Hydrocarbon contamination from railway use.	R4: Neighbouring Sites.	P1: Horizontal and Vertical migration of leachate through potentially permeable soils and service trenches.	Medium	Low Likelihood	Moderate	Contamination is likely to be localised. Low permeability soils if present below the site, will prevent the migration of contaminants. Site remediation works and measures can reduce risk.

7.10 Site Risk Assessment Summary Post Development:

Source	Receptor	Pathway	Consequence	Probability	Risk Category	Comments
S1: Contamination in made ground if present on the site. S2: Uncontrolled tipping of waste products and residues from adjacent industries/activities S3: Hydrocarbon	R5: Maintenance Workers.	P2: Human uptake pathways. P3: Vertical migration of volatile vapours and ground gas.	Severe	Likely	High	Site remediation works such as hot spot removal will reduce risk to Low. Low permeability soils if present below the site, will prevent the migration of contaminants. The risk to maintenance workers who do not use the appropriate PPE is likely to

contamination from railway use.						be significant.
S4: Gas generation in landfill sites within 250m of the site.	R5: Maintenance Workers.	P3: Vertical migration of volatile vapours and ground gas.	Severe	Likely	High	The risk to workers who do not use the appropriate PPE is likely to be significant.
S5: Gas generation from fill materials on the site.	R5: Maintenance Workers	P3: Vertical migration of volatile vapours and ground gas.	Severe	Low Likelihood	Moderate	The risk to workers who do not use the appropriate PPE is likely to be significant.
S1: Contamination in made ground if present on the site. S2: Uncontrolled tipping of waste products and residues from adjacent industries/activities S3: Hydrocarbon contamination from railway use.	R6: Site end users.	P2: Human uptake pathways. P3: Vertical migration of volatile vapours and ground gas.	Severe	Likely	High	Hardcover areas will act as a barrier between contamination and end users. Remediation works such as contamination hot spot removal and provision of an inert capping layer to garden areas will reduce risk to Low. Low permeability soils if present below the site, will prevent the migration of contaminants. Gas Protection measures can be incorporated into buildings to reduce risk to Low.
S4: Gas generation in landfill sites within 250m of the site.	R6: Site end users.	P3: Vertical migration of volatile vapours and ground gas.	Severe	Likely	High	Gas protection measures can be incorporated into buildings to reduce risk to Low.
S5: Gas generation from fill materials on the site.	R6: Site end users	P3: Vertical migration of volatile vapours and ground gas.	Severe	Low Likelihood	Moderate	Gas protection measures can be incorporated into buildings to reduce risk to Low.
S1: Contamination in made S2: Uncontrolled tipping of waste products and residues from adjacent industries/activities P3: Vertical migration of volatile vapours and ground gas.	R7: Flora and Fauna	P4: Plant root uptake.	Medium	Likely	Moderate	Remediation works such as contamination hot spot removal and provision of an inert capping layer to garden areas will reduce risk to Low.
S1: Contamination in made ground if present on the site S2: Uncontrollable tipping	R8: Services	P1: Horizontal and Vertical migration of leachate through	Medium	Likely	Moderate	Site remediation works such as hot spot removal will reduce risk to Low. Service trenches to be back filled with inert

of waste products and residues from adjacent industries/activities.		potentially permeable soils and service trenches.				materials. 'Protection line' water pipes can be used if necessary.
S3: Hydrocarbon contamination from railway use.	R8: Services.	P1: Horizontal and Vertical migration of leachate through potentially permeable soils and service trenches.	Severe	Likely	High	Contamination is likely to ne localise. Site remediation works such as hot spot removal will reduce risk to Low. Service trenches to be back filled with inert materials. 'Protection line' water pipes can be used if necessary.

8.0 GROUND INVESTIGATION

8.01 Fieldwork:

6 No. trial pits were excavated by Eastwood & Partners (E&P) to depths between 2.10 and 3.70m using a mechanical excavator on 16 May 2005.The purpose of the trial pits was to allow an insitu visual inspection of the superficial soils, recover samples for laboratory testing and undertake insitu testing trial pits.

The location of the trial pits are indicated on the Site Topographical Survey (Fig. 2) attached in Volume2, Appendix C.

8.02 Laboratory Testing:

To provide an assessment of soil contamination with respect to the proposed residential development soil samples were screened by E&P for a range of potential general contaminants. The screening included the following:-

Arsenic	Mercury	Zinc	PAH (16EPA)
Cadmium	Selenium	Sulphate (total)	Sulphide
Chromium	Copper	Sulphate (ws)	Phenols
Lead	Nickel	pH	

8.03 Ground Conditions:

The following typical soil profile was encountered in the E&P trial pit investigation:-

Make ground	1.20 – 3.00m
Soft/firm clay	0.60 – 0.80m
Sandstone	

No topsoil was recorded as being present on the site.

Made ground was encountered in all the trial pits and comprised of sandy/silty clay, sandstone gravel, mudstone gravel, brick and concrete fragments, cobbles of sandstone and occasional brick and concrete, whole bricks, and occasional wire, organic pockets, timber, barbed wire, floor boards, concrete blocks and lintels.

In TP1 and TP3 the made ground was underlain by sandstone.

In TP2 the made ground was underlain by a 0.70m thick band of silty, gravelly sand over a 0.60m band of soft clay over a 0.30m of sandstone and mudstone gravel. The thickness of the gravel band was not proved.

In TP4 the made ground was underlain by soft firm clay. The thickness of this strata

was not proved.

In TP5 the made ground was underlain by firm very sandy, slightly gravelly clay. The thickness of this strata was not proved.

In TP6 the made ground was underlain by river gravel in a sandy clay matrix..

Bedrock was encountered in the investigation as follows:-

TP1: moderately strong sandstone at 2.40 begl.
TP2: not encountered.
TP3: moderately strong sandstone at 2.80m begl.
TP4: not encountered.
TP5: not encountered.
TP6: possible weak sandstone at 2.10m begl.

The trial pit logs are attached in Volume 2, Appendix H.

8.04 **Groundwater:**

Groundwater was encountered during the E&P investigation as follows:-

TP2 - ground water ingress at 3.30m begl.
TP4 - slight groundwater seepage at 3.70mb begl.
TP5 - groundwater entry at 2.40m begl.

8.05 **Excavations:**

The trial pits were generally stable whilst open except TP6 which was very unstable.

8.06 **Laboratory Testing:**

Soils:

The results of the chemical analyses on the soil samples are summarised below.

Chemical Test result certificates are attached in Volume 2, Appendix I.

Samples taken from the made ground (TP1, TP2, TP3, TP4, TP5, and TP6):-

Contaminant	Concentration in soils mg/kg*	Number of samples tested
Arsenic	15.0 - 129	6
Cadmium	1.0 – 2.9	6
Chromium	19.0 – 55.0	6
Lead	97.0 – 602	6
Mercury	<0.1 – 0.68	6
Selenium	<3.0	6
Copper	55.0 – 694	6
Nickel	31.0 – 102	6
Zinc	102 - 295	6
Sulphate (total)	<0.5 – 0.05%	6
Sulphate (water soluble)	<0.03 – 0.20g/l	6
pH	6.6 – 7.7	6
PAH	5.0 – 288	6
Sulphide	2.0 – 10.0	6
Phenols	<1.0 – 5.0	6

* unless stated otherwise

The results of a sulphate and pH determinations indicate sulphate content expressed as 2:1 aqueous extract of <0.30 - 0.20 g/L SO_4 with a pH values of between 6.6 – 7.7.

No samples were taken by from the topsoil or the natural ground underlying the made ground for contamination testing.

No samples were taken by E&P for geotechnical testing.

8.08 **Gas Monitoring:**

No gas monitoring was under by E&P.

9.0 CONTAMINATION - DESIGN OBJECTIVES & PHILOSOPHY

9.01 Identification of Potential Hazards:

In March 2002 DEFRA and the Environment Agency published a series of technical research papers introducing a new approach to the assessment of risk to human health from land contamination. This research includes the development of the new CLEA model and Soil Guideline Values (SGVs). However, these guidelines at present only address a few contaminants and development of the model and SGVs is ongoing. The soil guidelines are based on assumptions on soil conditions, the existence of exposure pathways behaviour and type of contaminants. The apparent exceedence of the quoted SGV is taken as indicating that further detailed assessment is required or that remedial actions should be taken.

9.02 Sensitivity of Development:

The presence of elevated concentrations of particular analytes may present hazards in terms of personal health, damage to plant life and other environmental issues. The CLEA model and SGVs classified particular end uses on a scale of sensitivity.

Residential with plant uptake
Residential without plant uptake
Allotments
Commercial/Industrial

9.03 Design Life:

It is important to recognise when considering a particular problem that the solution has finite life, a concept with which those in the construction industry are familiar. The design life is influenced by the materials used in construction, the environment and the degree of maintenance carried out to extend the design life.
Monitoring is required to determine whether a design is functioning correctly, commensurate with the prevailing environmental conditions. It is essential that future users are aware of today's solutions since historically most buildings and infrastructure works continue in service. The effect of an increased design life should not be allowed to prejudice the original design principles.

9.04 Legislation:

The principle legislation relating to a potential pollution and contamination problems addressed in the Environmental Protection Act 1990 and Environmental Act 1995.

For ‘contaminated’ land to exist a significant ‘pollution linkage’ must be present, that is, there should be a source of contamination, a pathway by which the contamination can migrate, to an identified ‘receptor’ where it could cause ‘significant harm’.

Should any link within this chain be severed then the land may not strictly be regarded as 'contaminated land' under the Environmental Protection Act 1990.

9.05 **Investigation:**

Due to the historic site usage it was anticipated that there may be contamination from the former site use.

A ground investigation was commissioned to investigate soils and the chemical constituents of these soils, especially any made ground. The site was not expected to be severally contaminated and therefore a comprehensive testing regime based on the current industry standard BS 10175 : 2001 was not considered necessary. However, a contamination survey was undertaken with a provision that return visits would have to be made if contamination was exposed at a sufficient concentration to justify more extensive investigations.

9.06 **Design Objectives:**

i) The objective of reclamation works is to improve any marginal land into ground suitable for its use for residential use with plant uptake. The standard of work would be to that normally considered acceptable for residential use with plant uptake, but not forming part of the food production system. The standards would be in accordance with the parameters established by DEFRA and the Environment Agency.

ii)

These guidelines are incomplete and a set of Assessment Criteria is proposed utilising LQM/ CIEH Generic Assessment Criteria for Human Health Risk Assessment (2nd Edition), as attached in Volume 2 Appendix J, to provide a more complete set of initial screening values. The Assessment Criteria values are based upon an SOM of 1.0%. If considered appropriate a further quantitative risk assessment will be undertaken using calculated site specific target values.

ii) Risk Assessment
A qualitative risk assessment of any contaminants identified on the site will be undertaken. This will consider the significance of the contaminants identified in terms of source, pathway, receptor (ie. pollution linkage).

10.0 DISCUSSION

10.01 **Soils:**

The investigation had revealed the presence of made ground on site. The results have been assessed using the proposed Assessment Criteria for residential use attached in Volume 2 Appendix J.

The test results from samples taken from the made ground on the site from the E&P investigation are compared in the following tables:-

Contaminant	Concentration in soils mg/kg*	No. of samples tested	Assessment Criteria mg/kg	No. of samples exceeding Assessment Criteria
Arsenic	15.0 – 129	6	32	2
Cadmium	1.0 – 2.9	6	10	0
Chromium	19.0 – 55.0	6	3000	0
Lead	97.0 - 602	6	450	1
Mercury	<0.1 – 0.68	6	169	0
Selenium	<3.0	6	350	0
Copper	55.0 - 694	6	2330	0
Nickel	31.0 – 102	6	130	0
Zinc	102 – 295	6	3750	0
Sulphate (total)	0.05 – 0.05%	6	291	-
Sulphate (Water Soluble)	<0.03 – 0.20g/l	6	-	-
pH	6.6 – 7.7	6	<5	0
PAH	5.0 – 288	6	#	#
Sulphide	<2.0 – 10.0	6	250	0
Phenols	<1.0 – 5.0	6	255	0

* unless stated otherwise
# see following table

Speciated PAH analysis of samples from the made ground on the site from the E&P investigation are summarised in the following table:-

PAH 16 EPA	Concentrations in soils mg/kg	No. of Samples tested	Assessment Criteria mg/kg	No. of Samples exceeding Assessment Criteria
Acenaphthene	<0.1 – 8.0	6	210	0
Acenapthylene	<0.1	6	170	0
Anthracene	<0.1 – 19.0	6	2300	0
Benzo (a) Anthracene	<1.0– 23.0	6	3.1	3
Benzo (a) Pyrene	<1.0– 23.0	6	0.83	6
Benzo (b) & (k) Fluoranthene	<0.4 – 38.0	6	5.6	3
Benzo (g,h,i) Perylene	<1.0 – 14.0	6	44.0	0
Chrysene	<1.0 – 24.0	6	6.0	3
Di-benzo (a,h) Anthracene	<1.0 – 4.0	6	0.76	6
Indeno (1, 2, 3-cd) Pyrene	<1.0 – 15.0	6	3.2	3
Fluoranthene	2.0 – 50.0	6	260	0
Fluorene	<1.0 – 10.0	6	160	0
Napthalene	<1.0 – 1.0	6	1.5	0
Phenanthrene	<1.0 – 48.0	6	260	0
Pyrene	2.0 – 45.0	6	560	0
Total	5.0 - 288	6	-	-

When compared with the proposed Assessment Criteria in relation to residential use the following determinants with levels in excess of Assessment Criteria were encountered in the made ground on the site:-

Arsenic	2 No.	TP1 TP2	0.48m 0.80m	46.0 12 9	mg/kg mg/kg
Lead	1 No.	TP2	0.80m	694	mg/kg
Benzo (a) Anthracene	3 No.	TP1 TP4 TP6	0.40m 1.00m 0.40m	7.0 14.0 23.0	mg/kg mg/kg mg/kg
Benzo (a) Pyrene	6 No.	TP1 TP2 TP3 TP4 TP5 TP6	0.40m 0.80m 0.10m 1.00m 0.60m 0.40m	7.0 <1.0 10.0 10.0 2.0 23.0	mg/kg mg/k mg/kg mg/kg mg/kg mg/kg
Benzo (b) & (k) Fluoranthene	3No.	TP1 TP4 TP6	0.40m 1.00m 0.40m	12.0 17.0 38.0	mg/kg mg/kg mg/kg
Chrysene	3 No.	TP1 TP4 TP6	0.40m 1.00m 0.40m	7.0 13.0 24.0	mg/kg mg/kg mg/kg
Di-benzo (a,h) Anthracene	6 No.	TP1 TP2 TP3 TP4 TP5 TP6	0.40m 0.80m 0.10m 1.00m 0.60m 0.40m	<1.0 <1.0 <1.0 <1.0 <1.0 4.0	mg/kg mg/kg mg/kg mg/kg mg/kg mg/kg
Indeno (1, 2, 3-cd) Pyrene	3No.	TP1 TP4 TP6	0.40m 1.00m 0.40m	5.0 5.0 15.0	mg/kg mg/kg mg/kg

The Upper Bound Values (US95) for the determinands with concentrations in excess of Assessment Criteria in the made ground, have been calculated as follows:-

Arsenic	78.1 mg/kg	> AC of 32 mg/kg
Lead	403 mg/kg	<AC of 450 mg/kg
Benzo (a) Anthracene	15.3 mg/kg	> AC of 3.1 mg/kg
Benzo (a) Pyrene	14.3 mg/kg	> AC of 0.83 mg/kg
Benzo (b)&(k) Fluoranthene	23.9 mg/kg	< AC of 5.6 mg/kg
Chrysene	15.6 mg/kg	< AC of 6.0 mg/kg
Di-benzo (a,h) Anthracene	2.5 mg/kg	< AC of 0.76 mg/kg
Indeno (1,2,3-cd) Pyrene	13.5 mg/kg	< AC of 3.2 mg/kg

In the view of the above there is a significant pollution linage present in relation ot Arsenic and several PAH compounds in the made ground on the site.

Based on the test results from Eastwood & Partners investigation assessment the following remediation measures are recommended.

- Where made ground is retained in garden areas, a 600mm inert capping layer including a minimum of 150mm of topsoil should be provided to all private garden areas. A layer of Terram 1000 should be placed between the made ground and capping layer as a demarcation layer.

- Service trenches are to be backfilled with clean inert materials

However, it is recommended that additional phase 2 ground investigation works are undertaken on the site with further chemical testing of the made ground and the underlying natural ground prior to finalising a remediation statement for the site.

10.02 **Controlled Waters:**

Based on the testing undertaken in the E&P investigation no assessment at the risk of controlled waters can be made.

However, it should be noted that:-

- the strata directly below the made ground is clay which will be relatively impermeable this will prevent the downward migration of contamination.

- the redeveloped site will be approximately 60% positively drained hardcover, which will limit the amount of rainwater percolating through the soils.

- there are no groundwater abstractions within 300m of the site.

In order to assess the contamination risk to controlled waters it is recommended that additional phase 2 ground investigation works undertaken on the site with leachate chemical testing of the made ground and groundwater sampling and chemical testing.

10.03 **Mining:**

The development is not affected by shallow coal workings or mine entries as the site is not in a mining area.

10.04 **Gas:**

Sources of Gas:

The site is not affected by Radon gas.

Potential sources of methane and carbon dioxide gas have been identified as follows. The table also gives an indication of the likely gas generation potential and the risk of gas generation increasing in the future.

Source Area	Generation potential of source	Risk of gas generation increasing in future
	Low, since any waste is likely to be relatively old	Low
	Low/Moderate, since any waste is likely to be relatively old	Low

Gas Pathways:

The typical ground conditions encountered during the investigation indicated made ground over sands, clays, gravels and sandstone. Consequently a gas migration pathway from off-site to the surface of the site exists. In addition a direct pathway from the ground on the site to the surface exists.

Gas Monitoring:

The most recent guidance on gas risk assessment (CIRIA C665) includes recommendations for periods and frequencies for monitoring visits. These recommendations take into account the nature of the proposed development and the likely generation potential of the source, which are shown in the table below.

		Generation potential of source				
		Very Low	Low	Moderate	High	Very High
Sensitivity of development	High (residential with gardens)	6/3	9/6	12/6	24/12	24/24
	Moderate (flats)	6/2	6/3	9/6	12/12	24/24
	Low (commercial)	4/1	6/2	6/3	12/6	12/12
6/3 indicates 6 readings over 3 months. At least 2 readings should be taken during periods of low and falling atmospheric pressure						

The proposed development comprises houses. It is considered that the generation potential of the gas source (taking into account the likelihood of future increases in gas

generation) is low, i.e. 9 readings over 6 months.

Therefore it is recommended that gas monitoring is undertaken on the site as part of the Phase 2 ground investigation works.

10.05 **Foundations:**

The made ground on the site is considered unsuitable to support the proposed buildings on the site. In addition the site is likely to require lifting in level to achieve minimum finished floor levels in relation to the 1 in 100 year flood level of the River Etherow.

It is therefore recommended a piled foundation supporting reinforced concrete ground beams should be utilised on the development. However, additional ground investigation works would be required to establish pile lengths. It is envisaged a driven pile solution (steel tube or precast) would be appropriate but advice should be sought from specialist piling companies.

10.06 **Ground Floor Construction:**

It is recommended that a suspended ground floor structure with a 250mm minimum under floor void should be utilised on the development.

10.07 **Sulphate attack on Buried Concrete**:

The results of the sulphate analysis compared to BRE Special Digest 1, 'Concrete in Aggressive Ground' indicate Class DS-1 conditions and ACEC site classification AC-1s.

10.08 **Excavations:**

Excavations in the made ground and granular horizons are likely to be unstable whilst excavations in clays are likely to be stable. However, trench support should be provided in accordance with current Health & Safety Guidance.

Groundwater may be encountered in shallow foundation or drainage excavations and seepages should be expected in made ground and granular horizons. It should also be noted that the groundwater table is likely to be subject to seasonal variations and river levels.

10.09 **Pavements:**

CBR values on the made ground is likely to be variable and potentially low (<1%) and without treatment pavements may be prone to excessive and damaging settlement. It is therefore recommended, subject to CBR testing that where made ground is present under the access roads it is excavated to a depth of 0.5m below proposed sewers or a minimum of 1.0 begl screened and re-compacted suitable reclaimed material to an

engineered specification.

Consideration should also be given to the provision of a geotextile within the sub-base of the access road where the formation is in re-engineered made ground.

CBR values on natural firm clay are likely to be reasonable (circa 2%). However, localised soft spots may be present that will require excavation and replacement with compacted granular material.

10.10 **Drainage:**

A conventional granular bed and surround can be adopted to drainage in natural horizons. The use of a geotextile reinforced granular bed may need to be considered in made ground horizons if the made ground is not re-engineered.

11.0 CONTAMINATION RISK ASSESSMENT

11.01 **General:**

In order to evaluate the environmental risks identified during the investigation, a simple source-pathway-target model has been developed and is summarised at the end of this section in table form. The model has been used to determine significant pollutant linkages and identify suitable risk management proposals on which the remediation design is based.

11.02 **Sources:**

Chemical analyses of samples have indicated elevated levels of Arsenic and several PAH compounds in the made ground on the site.

11.03 **Pathways:**

The following potential contamination pathways have been identified on the site:-

Horizontal and vertical migration pathways of leachate through the potentially permeable soils.

Human Uptake Pathways (derived from CLEA model and LQA for residential use):

- Ingestion of soil
- Ingestion of indoor dust
- Dermal contact with soil
- Contact with indoor dust
- Inhalation of vapours outside
- Inhalation of vapours inside
- Vertical and lateral migration of volatile vapours and ground gas

- Indirect ingestion
- Airborne hazardous fibres
- Plant root uptake.

11.04 **Targets:**

The following environmental receptors have been identified on site:-

- Groundwater residing in the underlying geology
- The River Etherow.
- Buildings / structures
- Flora / Fauna
- Underground services
- Third party land.

The following human receptors have been identified on the site:-

- Construction workers
- Maintenance workers
- End users.

11.05 **Assessed Risk - Made Ground – Arsenic and Benzo (a) Pyrene**

SOURCES	PATHWAYS	TARGETS	LIKELIHOOD OF OCCURRENCE	SEVERITY OF CONSEQUENCE	RISK RATING	RISK MANAGEMENT ACTION TAKEN
Made Ground	Direct Ingestion/ Inhalation or Contact	End Users	Likely	Severe	High	Where made ground is retained in garden areas it should be capped with 600mm on inert capping to reduce the risk to Low.
	Direct Ingestion/ Inhalation or Contact	Construction workers	Likely	Severe	High	Induction, PPR, high standard of personal hygiene. Where made ground is retained in garden areas it should be capped with 600mm on inert capping to reduce the risk to Low. All services trenches to be backfilled with clean imported materials.
	Indirect Ingestion	End Users	Low Likelihood	Severe	Moderate	Where made ground is retained in garden areas it should be capped with 600mm on inert capping to reduce the risk to Low.
	Indirect Ingestion	Construction workers	Likely	Severe	Low	Induction, PPE, high standard of personal hygiene.
	Root Uptake	Plants	Likely	Medium	Moderate	Where made ground is retained in garden areas it should be capped with 600mm on inert capping to reduce the risk to Low.
	Vertical/ lateral migration to controlled waters	Aquifer River Etherow	Likely	Medium	Moderate	It is recommended further ground investigation works are undertaken on the site which should include leachate and ground water testing and associated risk assessment,. Where the site is underlain by clay which will be relatively impermeable, this will prevent the downward migration of contaminants. Approximately 60% of the site will be positively drained hardcover, there will therefore be limited rainwater percolating through the ground. There are no groundwater abstractions within 300m of the site. The site is not within a source protection zone.

The above risk assessment is subject to the results and assessment of the recommended Phase 2 ground investigation works.

12.0 RECLAMATION PROPOSALS

12.01 Subject to the results and assessment of the recommended additional Phase 2 ground investigation works the proposed works shall include the following, although this does not necessarily indicate the order or full extent of the works.

- Disconnect and/or divert any live services on the site.
- Grub out all vegetation and remove from site. Any vegetation to be retained, should be adequately protected from the works.
- Inspect the site for hazardous materials visible on the surface, remove from site together with any fly tipping and rubbish to a suitably licensed tip, using approved methods and a suitably licensed contractor.
- Any topsoil encountered on the site should be excavated and removed from site to a suitably licensed tip.
- After the initial site strip the formation is to be inspected. Any areas of deleterious material or contamination not identified in the ground investigation identified by visual or olfactory evidence and subsequent chemical testing is to be remediated if necessary, in accordance with a risk assessment.
- Where made ground is retained in private garden areas a 600mm inert capping should be provided including a minimum of 150mm topsoil. A layer of Terram 1000 should be placed between the made ground and capping as a demarcation layer.
- Any imported engineering fill material should be compacted in accordance with the Dpt. Highways Specification.
- Arisings from the made ground on the site may be classified as contaminated. Guidance should therefore be sought from the local Waste Management Regulation Office regarding the disposal of soils from the site.
- Subject to chemical testing excavated natural ground can be stockpiled and used for capping.

13.0 ADDITIONAL INVESTIGATION WORKS REQUIRED

13.01 Ground Investigation

A further window sampling borehole investigation should be undertaken on the site with sampling of the made ground and natural ground for chemical and geotechnical testing. In addition 6no. gas/groundwater monitoring wells should be installed on the site.

14.0 SUMMARY

Site Name & Location	Land at the Panhandle site, Woolley Bridge Road, Hadfield, Glossop.
Proposal	Housing
Local Authority	High Peak Borough Council
Site History	Whilst the site does not appear to have been developed railway lines and siding have been present on the site from pre 1872 to approximately 1971. The site appears to be infilled to accommodate the railway and site may possibly have been part of an historic land fill site. Potentially contaminative activities in the vicinity (within 250m) of the site have included cotton mills, bleach works, refuse tip, print works, industrial estate, quarries, sewage works, gravel pit, gravel pit, mills, gas works, gasometer, brick yard, clay pit, litter beds, and industrial estate. Potentially contaminative activities in the surrounding area to the site have included quarries, sewage works, , quarries, sewage works, gravel pit, gravel pit, mills, gas works, gasometer, brick yard, clay pit, litter beds, and industrial estate.
Geology	1.10,000 British Geological Survey (BGS) Sheet 86 indicates the following:- The site is overlain with alluvial deposits over sandstones of the Millstone Grit series.
Hydrogeology	The site is in a sensitive hydrogeological area as it lies adjacent the River Etherow and there is ground water abstraction within 500m of the site. However, the site is in a Source Protection Zone.
Flooding	See CoDA Structure Flooding and Drainage Assessment.
Coal Mining	The development is not affected by shallow coal workings or mine entries.
Ground Conditions	The following typical soil profile was encountered in the E&P trial pit investigation:- Make ground 1.20 – 3.00m Soft/firm clay 0.60 – 0.80m Sandstone No topsoil was recorded as being present on the site. Made ground was encountered in all the trial pits and comprised of sandy/silty clay, sandstone gravel, mudstone gravel, brick and concrete fragments, cobbles of sandstone and occasional brick and concrete, whole bricks, and occasional wire, organic pockets, timber, barbed wire, floor boards, concrete blocks and lintels. In TP1 and TP3 the made ground was underlain by sandstone. In TP2 the made ground was underlain by a 0.70m thick band of silty, gravelly sand over a 0.60m band of soft clay over a 0.30m of sandstone and mudstone gravel. The thickness of the gravel band was not proved. In TP4 the made ground was underlain by soft firm clay. The thickness of this structure was not proved. In TP5 the made ground was underlain by firm very sandy, slightly gravelly clay. The thickness of this strata was not proved. In TP6 the made ground was underlain by river gravel in a sandy clay matrix.. Bedrock was encountered in the investigation as follows:- TP1: moderately strong sandstone at 2.40 begl. TP2: not encountered. TP3: moderately strong sandstone at 2.80m begl. TP4: not encountered. TP5: not encountered. TP6: possible weak sandstone at 2.10m begl. Groundwater was encountered during the Eastwood & Partners investigation as follows:- TP2 - ground water ingress at 3.30m begl. TP4 - slight groundwater seepage at 3.70mb begl. TP5 - groundwater entry at 2.40m begl.
Foundations	The made ground on the site is considered unsuitable to support the proposed buildings on the site. In addition the site is likely to require lifting in level to achieve minimum finished floor levels in relation to the 1 in 100 year flood level of the River Etherow. It is therefore recommended a piled foundation supporting reinforced concrete ground beams should be utilised on the development. However, additional ground investigation works would be required to establish pile lengths. It is envisaged a driven pile solution (steel tube or precast) would be

<table>
<tr><td></td><td>appropriate but advice should be sought from specialist piling companies.</td></tr>
<tr><td>Ground Floor Slabs</td><td>A suspended ground floor structure with a 250mm minimum under floor void can be utilised on the development.</td></tr>
<tr><td>Building Near Trees</td><td>Applicable, as clay soils are present on the site.</td></tr>
<tr><td>Pavements</td><td>CBR values on the made ground is likely to be variable and potentially low (<1%) and without treatment pavements may be prone to excessive and damaging settlement. It is therefore recommended, subject to CBR testing that where made ground is present under the access roads it is excavated to a depth of 0.5m below proposed sewers or a minimum of 1.0 begl screened and re-compacted suitable reclaimed material to an engineered specification.
Consideration should also be given to the provision of a geotextile within the sub-base of the access road where the formation is in re-engineered made ground.
CBR values on natural firm clay are likely to be reasonable (circa 2%). However, localised soft spots may be present that will require excavation and replacement with compacted granular material.</td></tr>
<tr><td>Dewatering</td><td>Groundwater may be encountered in shallow foundation or drainage excavations and seepages should be expected in made ground and granular horizons. It should be noted that the groundwater table is likely to be subject to seasonal variations.</td></tr>
<tr><td>Excavations</td><td>Excavation in made ground and granular horizons are likely to be unstable whilst excavations in clay are likely to be stable. However, trench support should be provided in accordance with current Health & Safety Guidance.</td></tr>
<tr><td>Sulphate Classification</td><td>The results of the sulphate analysis compared to BRE Special Digest 1 ‘Concrete in Aggressive Ground’ indicate Class DS-1 conditions and ACEC site classification AC-1s.</td></tr>
<tr><td>Contamination Assessment</td><td>No samples were taken by E&P from the topsoil or the natural ground underlying the made ground for contamination testing.
When compared with the proposed Assessment Criteria in relation to residential use the following determinants with levels in excess of Assessment Criteria were encountered in the made ground on the site:-
<table>
<tr><td>Arsenic</td><td>2 No.</td><td>TP1
TP2</td><td>0.48m
0.80m</td><td>46.0
12 9</td><td>mg/kg
mg/kg</td></tr>
<tr><td>Lead</td><td>1 No.</td><td>TP2</td><td>0.80m</td><td>694</td><td>mg/kg</td></tr>
<tr><td>Benzo (a) Anthracene</td><td>3 No.</td><td>TP1
TP4
TP6</td><td>0.40m
1.00m
0.40m</td><td>7.0
14.0
23.0</td><td>mg/kg
mg/kg
mg/kg</td></tr>
<tr><td>Benzo (a) Pyrene</td><td>6 No.</td><td>TP1
TP2
TP3
TP4
TP5
TP6</td><td>0.40m
0.80m
0.10m
1.00m
0.60m
0.40m</td><td>7.0
<1.0
10.0
10.0
2.0
23.0</td><td>mg/kg
mg/k mg/kg
mg/kg
mg/kg
mg/kg</td></tr>
<tr><td>Benzo (b) & (k) Fluoranthene</td><td>3No.</td><td>TP1
TP4
TP6</td><td>0.40m
1.00m
0.40m</td><td>12.0
17.0
38.0</td><td>mg/kg
mg/kg
mg/kg</td></tr>
<tr><td>Chrysene</td><td>3 No.</td><td>TP1
TP4
TP6</td><td>0.40m
1.00m
0.40m</td><td>7.0
13.0
24.0</td><td>mg/kg
mg/kg
mg/kg</td></tr>
<tr><td>Di-benzo (a,h) Anthracene</td><td>6 No.</td><td>TP1
TP2
TP3
TP4
TP5
TP6</td><td>0.40m
0.80m
0.10m
1.00m
0.60m
0.40m</td><td><1.0
<1.0
<1.0
<1.0
<1.0
4.0</td><td>mg/kg
mg/kg mg/kg
mg/kg
mg/kg
mg/kg</td></tr>
<tr><td>Indeno (1, 2, 3-cd) Pyrene</td><td>3No.</td><td>TP1
TP4
TP6</td><td>0.40m
1.00m
0.40m</td><td>5.0
5.0
15.0</td><td>mg/kg mg/kg
mg/kg</td></tr>
</table>
The Upper Bound Values (US95) for the determinands with concentrations in excess of Assessment Criteria in the made ground, have been calculated as follows:-
Arsenic 78.1 mg/kg > AC of 32 mg/kg
Lead 403 mg/kg < AC of 450 mg/kg
Benzo (a) Anthracene 15.3 mg/kg > AC of 3.1 mg/kg
Benzo (a) Pyrene 14.3 mg/kg > AC of 0.83 mg/kg</td></tr>
</table>

	Benzo (b)&(k) Fluoranthene 23.9 mg/kg < AC of 5.6 mg/kg Chrysene 15.6 mg/kg < AC of 6.0 mg/kg Di-benzo (a,h) Anthracene 2.5 mg/kg < AC of 0.76 mg/kg Indeno (1,2,3-cd) Pyrene 13.5 mg/kg < AC of 3.2 mg/kgIn the view of the above there is a significant pollution linage present in relation ot Arsenic and several PAH compounds in the made ground on the site.
Controlled Waters	Based on the testing undertaken in the E&P investigation no assessment at the risk of controlled waters can be made. However, it should be noted that:- - the strata directly below the made ground is clay which will be relatively impermeable this will prevent the downward migration of contamination. - the redeveloped site will be approximately 60% positively drained hardcover, which will limit the amount of rainwater percolating through the soils. - there are no groundwater abstractions within 300m of the site. In order to assess the contamination risk to controlled waters it is recommended that additional phase 2 ground investigation works undertaken on the site with leachate chemical testing of the made ground and groundwater sampling and chemical testing.
Remediation Proposals	Where made ground is retained in garden areas, a 600mm inert capping layer including a minimum of 150mm of topsoil should be provided to all private garden areas. A layer of Terram 1000 should be placed between the made ground and capping layer as a demarcation layer. Service trenches are to be backfilled with clean inert materials. However, it is recommended that additional Phase 2 ground investigation works are undertaken on the site with further chemical testing of the made ground and the underlying natural ground prior to finalising a redemption statement for the site.
Remediation Statement	A Remediation Statement will be required for the site.
Gas Protection	Subject to gas monitoring.
Radon	No protection measures are required on the development.
Unforeseen Circumstances	Should any areas of previously unidentified potentially contaminated soil be encountered during site construction works we would recommend consultation with CoDA Structures to ensure that the recommendations continue to apply.
Construction Works	It is recommended that construction personnel with direct contact with the soils at the site use appropriate PPE equipment (i.e. gloves and overalls) together with welfare facilities in accordance with general health and safety guidelines.
Utilities	We would recommend that a copy of the ground investigation report when available, is supplied to Utility Companies, and that their recommendations relating to appropriate supply pipes are adhered to.
Statutory Consultation	We would recommend that a copy of the ground investigation report once prepared is issued to the Local Authority for comment and approval prior to the development of the site.
Further Investigation Work	A further window sampling borehole investigation should be undertaken on the site with sampling of the made ground and natural ground for chemical and geotechnical testing. In addition six gas/groundwater monitoring wells should be installed on the site.

15.0 CAVEATS

15.01 The comments given in this report and recommendations made are based on the information that could be obtained from reasonably accessible sources. Discussions have not yet been held with statutory bodies and the local authority.

15.02 The comments and recommendations made in this report are based on the ground conditions encountered during the site work, and on the results of laboratory testing on a selected number of samples taken in the field. There may be conditions prevailing at the site with respect to ground conditions and contamination that have not been encountered during the investigations, and which have therefore not been taken into account in this reports.

15.03 This report has been prepared on information contained in a report prepared by Eastwood and Partners. CoDA Structures cannot be held responsible for any inaccuracies within third party information that has been relied upon in the preparation of this report.

15.04 This report has been prepared for the sole use of unless agreed otherwise in writing by CoDA Structures.

Signed: ……
J Lawrence B Eng C Eng M I Struct E