

10 Ground Conditions and Contamination

10.1 INTRODUCTION

10.1.1 This chapter assesses the effect of the Proposed Development on the ground conditions, hydrogeology and contamination. In particular it considers the potential effects of the existing and historical use of the Site and its surrounds in relation to contamination and ground stability on the Site, and the potential effects on human health, controlled waters and the wider environment as a result of the Proposed Development.

10.1.2 Potentially significant effects to groundwater and degradation to surface water quality due to physical contamination (sediments) are addressed within **Chapter 11 –Water Resources & Drainage**.

10.1.3 This chapter is supported by a **Flood Risk Assessment (FRA)** prepared by WSP and submitted with the outline planning application. In addition, WSP has prepared a Phase 1 Geo Environmental Assessment (**Appendix 10.1**).

10.1.4 This chapter (and its associated figures and appendices) is not intended to be read as a stand alone assessment and reference should be made to **Chapters 1 – 5**, as well as **Chapter 16 Cumulative Effects** of this report.

10.2 LEGISLATION, POLICY AND GUIDANCE

Legislative Framework

10.2.1 The applicable legislative framework is summarised as follows:

- *Part IIA of the Environmental Protection Act 1990 (Ref 10.1)* describes a regulatory role for local authorities in dealing with contaminated land.
- *Environment Act 1995 (Ref 10.2)* creates a system whereby local authorities must identify and, if necessary, arrange for the remediation of contaminated sites. The provisions are set out in Section 57, which inserts Part IIA into the EPA 1990. In addition to these requirements, the operation of the regime is subject to regulation and statutory guidance.
- *The Contaminated Land (England) Regulations 2006 (Ref 10.3)* provides a definition of what constitutes Contaminated Land and sets out the responsibilities of the local authority and the EA in the identification and management of Contaminated Land. Under the Regulations, Contaminated Land is defined as, ‘land which in the opinion of the Local Authority to be in such a condition by reason of substances in on or under the land that:
 - I. Significant harm is being caused or there is significant possibility of significant harm being caused; and
 - II. Significant pollution of controlled waters is being caused or there is a significant possibility of significant pollution of controlled waters being caused’.

Harm is defined in relation to harm to the health of living organisms or other interference with the ecological systems of which they form a part, and in the case of man, includes harm to property.

The potential for harm to occur requires three conditions to be satisfied:

- I. ‘Presence of substances (potential contaminants/pollutants) that may cause harm (Source of Pollution);
- II. The presence of a receptor which may be harmed, e.g. the water environment or humans, buildings, fauna and flora (The Receptor); and
- III. The existence of a linkage between the source and the receptor (The Pathway)’.

Therefore, the presence of measurable concentrations of contaminants within the ground and subsurface environment does not automatically imply that a contamination problem exists, since contamination must be defined in terms of pollutant linkages and unacceptable risk of harm.

The nature and importance of both pathways and receptors, which are relevant to a particular site, will vary according to the intended use of the site, its characteristics and its surroundings.

- *Water Resources Act 1991* (**Ref 10.4**) sets out the regulatory controls and restrictions that provide protection to the water environment through controls on abstraction, impounding and discharges as well as identifying water quality and drought provisions.
- *The Water Environment (Water Framework Directive) (England & Wales) Regulations, 2003* (**Ref 10.5**). These Regulations establish a framework for protecting the water environment, with the aim of achieving chemical and ecological water quality targets by 2015.
- *The Groundwater (England and Wales) Regulations 2009* (**Ref 10.6**) transpose certain elements of the Water Framework Directive (2000/60/EC), as they relate to groundwater and Article 6 of 2006 Groundwater Directive (2006/118/EC). The Regulations are an environmental protection measure which provides enhanced protection for groundwater by preventing the input of 'hazardous' substances into groundwater and limiting the input of 'non-hazardous' pollutants into groundwater.
- *Controls of Asbestos Regulations 2006* (**Ref 10.7**) prohibit the importation, supply and use of all forms of asbestos. If existing asbestos containing materials are in good condition, they may be left in place; their condition monitored and managed to ensure they are not disturbed. The Asbestos Regulations also include the 'duty to manage asbestos' in non-domestic premises.
- *Construction (Design & Management) Regulations 2007* (**Ref 10.8**) make explicit duties that exist under the Health and Safety at Work Act 1974 and the Management of Health and Safety at Work Regulations 1999. This requires clients to use their influence to ensure that the arrangements made by other duty holders are sufficient to ensure health and safety of those working or those affected by that work.

Planning Policy

10.2.2 Planning policy at the national, county and local level is discussed in **Chapter 5 - Planning Policy Context**. A summary of relevant legislation and planning policy is included in **Table 10.7** of this chapter.

National Planning Policy

10.2.3 PPS23 Annex 2 '*Development on Land Affected by Contamination*' (2004) (**Ref 10.9**), gives detailed guidance on the development of land which may have been affected by contamination and also provides local authorities with the opportunity to require that land contamination is assessed and, if necessary, remediated as a condition of the planning system. The onus is put on the developer to show that risks from contamination are acceptable and that the site will be deemed 'fit for purpose'.

Local Planning Policy

10.2.4 Relevant local policies are contained within the Barnsley MBC Adopted Core Strategy (September 2011) (**Ref 10.10**) and include the following:

- *CSP 39 – Contaminated Land Developing Contaminated Land* states that where the future users or occupiers of a development would be affected by contamination or stability issues, or where contamination may present a risk to the water environment, proposals must be accompanied by a report which details the investigation and any necessary measures to remove and treat and where applicable address land stability issues.
- *CSP 40 – Pollution Control & Protection* states that development will be expected to demonstrate that it is not likely to result, directly or indirectly, in an increase in air, surface water and groundwater, noise, smell, dust, vibration, light or other pollution which would unacceptably affect or cause a nuisance to the natural and built environment or to people.

Guidance

12.1.1 The assessment will take account of a number of best practice documents which include:

- EA (2004) Model Procedures for the Management of Contaminated Land (CLR11) (**Ref 10.11**);
- British Standards Institution (BS) 10175 (2001) Investigation of Potentially Contaminated Sites – Code of Practice (**Ref 10.12**);

- BS EN 1997-1 (Eurocode 7: Geotechnical Design – Part 1) (**Ref 10.13**);
- BS 5930 (1999) The Code of Practice for Site Investigations (**Ref 10.14**);
- EA and NHBC (2000) Guidance for the safe development of housing on land affected by contamination, EA R&D Publication 66 (**Ref 10.15**);
- EA (2000) Technical Aspects of Site Investigation (2 volumes) R&D Technical Report P5-065 (**Ref 10.16**);
- EA (2000) Secondary Model Procedures for the Development of Appropriate Soil Sampling Strategies for Land Contamination, R&D Technical Report P5-066 (**Ref 10.17**);
- BS1377 (1990) Methods of test for soils for civil engineering purposes. General requirements and sample preparation (**Ref 10.18**);
- Building Regulations, 2009 (**Ref 10.19**);
- EA (2008) Groundwater Protection: Policy and Practice (GP3), Parts 1-4 (**Ref 10.20**);
- PPG 1 '*General Guide to the Prevention of Pollution*' (**Ref 10.21**);
- PPG 5 '*Works or Maintenance in or Near Water*' (**Ref 10.22**);
- PPG 6 '*Working at Construction and Demolition Sites*' (**Ref 10.23**);
- PPG 8 '*Safe Storage and Disposal of Used Oils*' (**Ref 10.24**);
- PPG 21 '*Pollution Incident Response Planning*' (**Ref 10.25**);
- Construction activities should be undertaken in accordance with CIRIA guidance '*C532 – Control of Pollution from Construction Sites*' (**Ref 10.26**);
- BS 8485 (2007) Code of Practice for the Characterisation and Remediation from Ground Gas in Affected Developments (**Ref 10.27**);
- NHBC/RSK Group Plc (2007) Guidance on Evaluation of Development Proposals on Sites where Methane and Carbon Dioxide are Present, Report Edition No. 4 (**Ref 10.28**); and
- CIRIA 665 (2007), Assessing Risks Posed by Hazardous Gases to Buildings, Wilson, Oliver, Hutchings and Card (**Ref 10.29**).
- *National Planning Policy Framework (NPPF), March 2012* (**Ref 10.30**). This is new national policy and replaces all the PPS and technical notes, however, as the policy is in its infancy, this chapter will refer to all. In relation to contamination, it states that the planning system and planning policies should:
 - Prevent both new and existing developments from contributing to, or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution.
 - Contribute to remediating and mitigating contaminated land, and re-using land that has previously been developed provided if it is not of high environmental value.
 - Ensure that the Site is suitable for its new use taking into account ground conditions, pollution arising from previous uses and any proposals for mitigation including land remediation. After remediation, as a minimum, the land should not be capable of being determined a contaminated land under Part IIA of the Environmental Protection Act 1990 (**Ref 10.1**). Adequate site investigation information should be presented.

10.3 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

Scope of the Assessment

10.3.1 No formal scoping process has been followed, however consultation with Barnsley MBC has been undertaken.

The following key aspects have been considered for the purposes of this assessment.

Site Preparation, Earthworks and Construction Phase (including Demolition)

- Presence of contamination (associated with historical and current land uses) and potential risks to human health through exposure (e.g. construction workers and third parties).
- Presence of Asbestos Containing Materials (ACM) within existing buildings and structures, the presence of asbestos in soils on-site and the potential risk to human health through exposure.
- Exposure to construction workers to hazardous ground gases (explosive and asphyxiant) generated from potential sources both on-site and off-site (potential Made Ground and landfill).
- Release/migration of contamination (existing contamination, or uncontrolled discharges/ accidental spillages) to controlled waters (underlying Principal and Secondary Aquifers, adjacent drainage ditch and subsequently potentially the River Stort and groundwater abstractions).
- Geotechnical risks to construction workers from potential underground structures (e.g. basements, culverted river channel) relating to current or former buildings on-site, chalk mining cavities and/or solution features.

Operational Phase

- Exposure of future site users to contamination.
- Risk of hazardous ground gas (explosive and asphyxiant) ingress into future properties and exposure to future site users.
- Release/migration of contamination (uncontrolled discharges or accidental spillages) to controlled waters (underlying Principal and Secondary Aquifers, adjacent drainage ditch, River Stort and groundwater abstractions).
- Exposure to geotechnical risks within the Proposed Development and associated effects on future populations and third parties.

Extent of the Study Area

10.3.2 The study area for ground conditions, hydrogeology and contamination is outlined on the site plan (ref: MH403-200) submitted with the planning application. For the purposes of discussion the site has been separated into two areas;

- The northern site (to the north of the river) where remediation works where a new link road is now constructed;
- The southern site (to the south of the river) where existing buildings are present and limited site investigation works have currently been undertaken.

Consultation

10.3.3 Formal consultation with the E.A. and Local Authority is yet to be undertaken.

Method of Baseline Data Collation

Desk Study

10.3.4 This chapter comprises a desk study which draws on the relevant findings of a number of documents. The most pertinent documents are as follows and other sources of desk study information are referenced throughout this chapter where relevant:

- WSP, *Old Mill Lane, Barnsley, Land Quality Desk Study*, ref 20470_P1- October 2011. (**Appendix 10.1**);
- British Gas East Midlands Scientific Services (BGEM) Site Survey, 1991 (included in WYG report 21306 from June 1998) (**Ref: 10.31**)
- White Young Consulting Engineers Ground Investigation Factual Report, Old Mill Lane, Barnsley – 1996 (included in WYG report 21306 from June 1998) (**Ref: 10.32**)
- White Young Green Environmental (WYGE) Ground Investigation Factual Report, Old Mill Lane, Barnsley – Ref: 21306/GI/F (June 1998) (**Ref: 10.33**)

- WYGE Additional Ground Investigation - Remediation Phase Factual Report, Old Mill Lane, Barnsley Ref: E1297-AdditionalGIFACT-Issue 1 (October 2003). (**Ref: 10.34**)
- WYGE Ground Investigation 2006 Factual Report, Old Mill Lane, Barnsley ref: E7773- GIFACT2006-Issue1 (Sept 2006) (**Ref: 10.35**)
- WYGE Ground Investigation 2007 Factual, Old Mill Lane, Barnsley Report ref: E7773- ADD207GIFACT-Issue 1 (August 2007). (**Ref: 10.36**)
- WYGE Detailed Quantitative Risk Assessment Report, Old Mill Lane, Barnsley Report Ref: E7773-DQRA-Issue 1 V2 (April 2007) (**Ref: 10.37**)
- WYGE Remediation Strategy Report, Old Mill Lane, Barnsley Ref: E7773RS-V3 (August 2007) (**Ref: 10.38**)
- WYGE Factual Post Remediation Verification Report, Old Mill Lane, Barnsley. Ref E7773-PRF-V1 Final Validation Report (August 2008) (**Ref: 10.39**)
- WYGE Groundwater Monitoring Interpretative Report, Old Mill Lane, Barnsley. Ref E7773-GWR-V2 (January 2010) (**Ref: 10.40**)

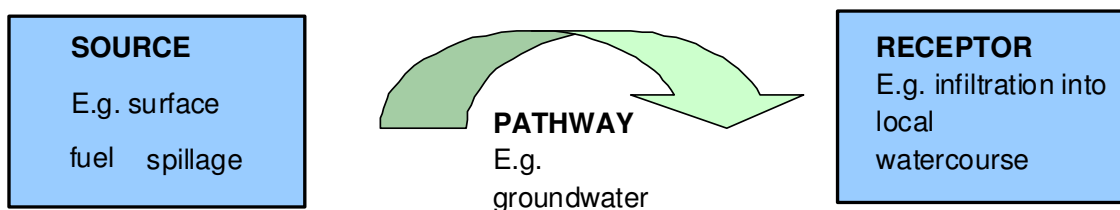
10.3.5 An external site walkover was undertaken by a representative of WSPE on 1 September 2011. Information collected on these visits is utilised in the assessments below.

Assessment Modelling

10.3.6 The information contained in the baseline and mitigation techniques sections in the remainder of this chapter was obtained from the sources referenced above and throughout the chapter. The effect sections were based on professional judgement following review of the information available.

Effect Assessment

12.1.2 Current guidance on the assessment of contamination risk advocates the use of a conceptual risk assessment model in an attempt to establish the links between a hazardous source and a sensitive receptor via an exposure pathway. The concept behind this approach is that, without each of the three fundamental elements (source, pathway, and receptor) there can be no contamination risk. Thus, the mere presence of a contamination hazard at a particular Site does not necessarily imply the existence of associated risks. The conceptual model may be illustrated as follows:



12.1.3 Generic Quantitative Risk Assessments, as set out in the EA Publication '*Model Procedures for the Management of Land Contamination, 2004*' (**Ref 10.11**), have been undertaken for the northern site as part of the ground investigation and are interpreted in **Appendix 10.1**. The findings of these supported the determination of remediation options for the which are discussed in Section 10.5. Generic Quantitative Risk Assessments will also be undertaken following a ground investigation at the southern Site; the ground investigation is included in the mitigation measures listed in Section 10.5.

12.1.4 If elevated concentrations of contamination are recorded at the site and significant risks to Human Health or Controlled Waters receptors are identified, a Detailed Quantitative Risk Assessment (DQRA) will be undertaken following the ground investigation to identify the potential effects of any contamination identified in both soils and groundwater. Such an assessment will identify potential sources of contamination along with potential pathways and receptors and consider the linkages.

12.1.5 Assessment of the ground gas regime at the southern site will be undertaken as part of the ground investigation with reference to the CIRIA publication C665 '*Assessing Risks Posed by Hazardous Ground Gases to Buildings 2007*' (**Ref. 10.29**) and the NHBC publication '*Guidance on Evaluation of Development Proposals on Sites*

Where Methane and Carbon Dioxide are Present, 2007 (Ref. 10.28). If required following the findings of the ground investigation, gas protection measures will be recommended as part of the mitigation measures at the site, as discussed in Section 10.5.

Significance Criteria

10.3.7 The assessments of potential effects as a result of the Proposed Development have taken into account both the site preparation, earthworks and construction and operational phases. The significance level attributed to each effect has been assessed based on the magnitude of change due to the development proposals, and the sensitivity of the affected receptor/receiving environment to change, as well as a number of other factors that are outlined in more detail in **Chapter 2 - Approach to EIA**. Magnitude of change and the sensitivity of the affected receptor/receiving environment are both assessed on a scale of high, medium, low and negligible (as shown in **Chapter 2 - Approach to EIA**).

Effect Significance

10.3.8 The following terms have been used to define the significance of the effects identified:

- **Major effect:** where the Proposed Development could be expected to have a very significant effect (either positive or negative) on ground and groundwater conditions and on associated sensitive receptors;
- **Moderate effect:** where the Proposed Development could be expected to have a noticeable effect (either positive or negative) on ground and groundwater conditions and on associated sensitive receptors;
- **Minor effect:** where the Proposed Development could be expected to result in a small, barely noticeable effect (either positive or negative) on ground and groundwater conditions and on associated sensitive receptors; and
- **Negligible:** where no discernible effect is expected as a result of the Proposed Development on ground and groundwater conditions and on associated sensitive receptors.

10.4 BASELINE CONDITIONS

Site Description, Activities and Storage

Northern Area

10.4.1 The site is open land, the previous buildings associated with the former gas works have been removed to ground level.

10.4.2 At the time of the site visit the new link road was undergoing construction and was noted to be a sub base level during the inspection.

10.4.3 The contractor office and compound area is located in the northwest corner of the site and comprised four porta cabins. An area storing machinery and equipment is also present. No fuel storage was noted, however, given that machinery is used on-site the presence of fuel / oils cannot be fully discounted.

10.4.4 A sub-station is present in southwest corner within a fenced compound, no access was gained to this area.

Southern Area

10.4.5 The southern area is occupied by warehouses, a former gas holder (still present) and an area of land which has been subject to demolition.

10.4.6 No access was gained into the former gas holder compound, it is understood that the gas holder will be decommissioned and removed from site prior to redevelopment.

10.4.7 In the southeast corner of the site a former depot and warehouse is present, some of which has been demolished and demolition materials including metal remain in stockpiles. Three buildings remain in situ and have yet to be demolished, no access was gained to these buildings.

10.4.8 The remainder of the site is occupied by three large warehouse units, one of the units is occupied by Plumber Centre (western boundary) and one is occupied by Comet (on the southern boundary adjacent to Twibell

Street). The central warehouse is currently vacant and was formerly occupied by Power House. Each of the warehouses has associated car parking and soft landscaping. No internal access was gained to the properties.

Surrounding Land Use

10.4.9 To the south of the site is a retail park (Peel Centre) with allotments and Barnsley Leisure centre beyond. The green corridor continues to the east of the site in the form of the Dearne Valley Park (Nature Reserve). A Wickes warehouse is present adjacent to the north with residential properties along Burton and Wakefield Road. To the west of the site is a supermarket with residential properties beyond. The Fleets lake is present to the northwest of the site and forms a continuation of the green corridor.

Site History

10.4.10 A review of historical Ordnance Survey maps contained within **Appendix 10.1** has been undertaken to identify a general site history and any potentially contaminative former land uses. Summaries for the parts of the site to the north and to the south of the River Dearne are presented in **Table 10.1** and **Table 10.2** respectively.

Table 10.1: Summary of Map Information Relating to the Site north of the River Dearne

Date	Land Use
Pre 1855 to Pre 1892	The site is shown as open undeveloped land.
Pre 19882 to Pre 1931	The Old Mill Lane Gas works is presence comprising three building and two gas holder located to the east and west. A railway embankment is present along the eastern edge of the site and railway tracks lead into the subject site over the River Dearne onto the Southern Area.
1931 to 1962	Map annotations show the present of a number of tanks and chimneys associated with the gas works.
1962	Evidence of cut or fill activities or stockpiling of materials in the eastern part of the site.
1973 to 1982	Eastern Gas Holder no longer shown. Removal of buildings and replacement with a Gas Board Depot building in the northwest corner.
1982 to 1993	Western gas holder no longer shown and gas board depot remains.
1993 to present	Gas depot remains and area to south of depot is labelled as a Gas Compound and the layout is similar to the present day.

Table 10.2: Summary of Map Information Relating to the Site south of the River Dearne

Date	Land Use
1855 to 1892	The site is shown as open undeveloped land.
1892 to 1906	Part of a Tannery present inside the western boundary with possible water feature to the south of the building. Buildings which are labelled as a laundry house and Dearne Works are present within the eastern section.
1906 to 1931	The Laundry becomes a Sa Mill and is extended. The railway line leading from the Northern part of the site (Gas Works) is extended further south. Water features (possible ponds) are depicted to the south of the River.
1931 to 1962	Additional railway lines are depicted and much of the southern area is labelled as

	Allotment Gardens.
1962 to 1973	A further gas holder is present to the south of the River Dearne in a central position. The Saw Mill and the Tannery are labelled as a 'Works'.
1973 to 1982	The laundry is labelled as 'Cottages' and a sub-station is located on the southern boundary.
1982 to 1991	The former Tannery / Mill / works buildings are demolished and new warehouse style buildings are present.
1993	Further warehouse constructed on the southern boundary
1994 to present	The former Mill / Works is labelled as a depot and the site layout is similar to the present day.

10.4.11 Table 10.3 presents a summary of historical map information relating to the area surround the Site.

Table 10.3 – Summary of Map Information Relating To the Area Surrounding Site (North and South Area)

Date	Land Use	Direction	Approximate Distance (m)
1855 to 1894	Mount Osbourne Colliery	South	200
1892 to 1993	Paper works later labelled as Paper Works	West	Adjacent
1892 to 1982	Old Mill Glass Works later labelled as 'Works'	South	100
1894	Quarries	Northeast and South	200 / 300
1931 to 1962	Part of Old Mill Gas Works (extended off subject site to the north)	North	Adjacent
1931 to 1962	Various tanks / sluices associated with sites present along the western boundary of the site	West	Adjacent
1931 to 1962	Mottram Wood Colliery	East	75 to 200
1932 to 1956	Dock Works	West	300
1973 to post 1994	Animal By Product Factory (with tanks), later becomes depot in 1980s.	East	150
1973 map	Garage	South	50
1982 to 1991	Land labelled as 'tip' becoming disused in 1993 and forming part of Dearne Valley Park	East	20

Hydrology

10.4.12 Table 10.4 presents those surface water features within the potential influence of the Site.

Table 10.4: Surface Water Features

Surface Water Feature	Location	Details
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River Dearne	On site	The river bisects the site in a roughly east to west direction. The banks of the river have become tree lined since cessation of industrial activities in the area.
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10.4.13 **Table 10.5** presents information relating to the River Dearne

Table 10.5: River Dearne Details

Surface Water Feature	Water Quality (Chemical and Biological) ¹	Current Ecological Status ² (Predicted 2015 Status)	Flow Rate ³
River Dearne	D (Chemical), Biology not assessed	Moderate (Moderate)	Less than 0.62cumecs

¹ EA designated classification at New Lodge Old Mill approximately 200m east of the site as of 2009; ²as designated on the EA's website Surface water bodies - classification status and objectives for Water Framework Directive Cycle 1 (updated January 2011); ³ as stated in the Envirocheck report (obtained for **Appendix 10.1**) 208m east of the Site in 2000.

10.4.14 The Phase 1 Geo Environmental Assessment (**Appendix 10.1**) states that there are active discharge consents on site for Yorkshire Water permitting sewage discharge (storm water overflow) into the River Dearne. Several other similar consents applicable to Yorkshire Water are present within 1km of the site.

10.4.15 There are two licensed surface water abstractions within 1 km of the site, these are summarised in the following table.

Table 10.6 – Licensed Surface Water Abstractions

Licensee	Details	Direction	Distance (m)
Yorkshire Water	Non Specified	Northwest	350
Barnsley MBC	Make Up / Top Up Water	Southeast	480

Geology

The following geological mapping has been consulted;

- British Geological Survey (BGS) sheet at 1:50,000 scale, Sheet 87 (**Ref 10.41**); and,
- BGS online resource: Geology of Britain Viewer.

10.4.16 These show the site to be underlain by Alluvium deposits (Clay and Silt) in the vicinity of the River Dearne. The superficial deposits are shown to be underlain by the Carboniferous Coal Measures. Both the superficial geology and the bedrock are classified by the E.A. as being Secondary A Aquifers.

10.4.17 Several coal seams are identified to outcrop to the east of the site including the Two Foot, Abdy, and Top Beamshaw and Coal seams. The Low Beamshaw seam is identified to outcrop beneath the site trending north west to south east.

10.4.18 Two faults are shown to the north and south of the site, both faults trend in a northwest to southeast direction. The southern faults are shown to down throw to the north and the northern fault is shown to down throw to the south, which indicates that the site is located on a down thrown block.

10.4.19 Previous site investigations have identified "large amounts of spent oxide and coke/clinker/ash"; foundations of many of the former process buildings and in ground gasholder bases.

Hydrogeology

10.4.20 In accordance with the Water Framework Directive, the EA's Groundwater Protection Policy designates aquifers with respect to their importance as a resource for drinking water supply as well as their role in supporting surface water flows and wetland ecosystems.

10.4.21 The Environment Agency (EA) Groundwater Vulnerability mapping divides the underlying strata in England and Wales into Principal, Secondary A, Secondary B and Non Aquifers depending upon their potential for potable water supply.

10.4.22 According to the EA website, the majority of the site is underlain by a Secondary A Aquifers. Secondary A Aquifers are described as 'permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.'

10.4.23 The superficial alluvium deposits overlying the bedrock in the vicinity of the River Dearne are also defined by the EA as a Secondary A Aquifer.

10.4.24 The site is not located within a source protection zone as defined by the EA.

10.4.25 No active groundwater abstractions are identified within 1 km of the site.

10.4.26 The current aquifer quantitative quality beneath the Site is classified as good on the EA's website under their Water Framework Directive River Basin Management Plans and is predicted to remain as such until at least 2015. The current aquifer chemical quality is classified as poor beneath the Site and as poor a. It is predicted to remain poor until at least 2015.

10.4.27 Shallow perched groundwater has previously been identified in the northern site between 1.0 and 1.0mbgl. Groundwater within the Alluvium was generally around 6 to 7mbgl with peizometric levels around 2.0 to 2.5mbgl and was noted to have a noticeable hydrocarbon odour in some locations (pre remediation). The groundwater was identified in the WYG DQRA report (Ref 10.37) to be in hydraulic continuity with the River Dearne.

10.4.28 The predominantly intergranular groundwater flow direction in the Made Ground and superficial deposits beneath the Site is anticipated to be towards the River Dearne.

Natural and Mining Cavities

10.4.29 Information within the Coal Authority Mining report (**Appendix 10.1**) has not identified any shallow coal workings beneath the site. Historically coal is known to have been worked between 80m and 140m and depth.

10.4.30 However, coal seams are known to be present at or near surface in the vicinity of the site including the Low Beamshaw seam which is identified to outcrop beneath the site.

10.4.31 Although there is no evidence at present to suggest the seams have been worked, intrusive investigation would be required to further assess risk from potential undocumented shallow mine workings.

Existing Ground Investigation Information

1 *British Gas East Midlands Scientific Services (BGEM) Site Survey, 1991 (included in WYG report 21306 from June 1998 see below) (Ref 10.31)*

10.4.32 Site investigations by Scientifics in 1990 included 28 trial pits to the north of the River Dearne. This investigation identified "large amounts of spent oxide and coke/clinker/ash"; foundations of many of the former process buildings and in ground gasholder bases; and evidence of tar impacted materials was noted.

2. *White Young Consulting Engineers Ground Investigation Factual Report, Old Mill Lane, Barnsley – 1996 (included in WYG report 21306 from June 1998 see below) (Ref 10.32)*

10.4.33 Site investigations by White Young Consulting Engineering in 1996 comprised 25 trial pits and 5 boreholes. Soils were analysed for a suite of typical gasworks contaminants. Details of findings are not provided.

3 *White Young Green Environmental (WYGE) Ground Investigation Factual Report, Old Mill Lane, Barnsley – Ref: 21306/GI/F (June 1998) (Ref 10.33)*

10.4.34 This report provides a review of the History, Environmental Setting and Ground Conditions Encountered during this and previous phases of site investigation. Key facts are as follows:

10.4.35 The former gas works was constructed during the late 1860's until the early 1960's. By 1964 most of the gas plant had been demolished;

10.4.36 Historical plans show gas plant on site included three gas holders, a retort house, exhaustor house, engine house, two purifiers, above and below ground tar and liquor tanks, carburetted water gas plant, oxide shed, meter house, pump house, and petrol & diesel tanks associated with vehicle refuelling. Post demolition the site was later used as a Gas Board Depot; See Extracted Plan (EP) 1.

10.4.37 The site investigation included 37 trial pits and 5 boreholes with soil and groundwater sampling and analysis. The investigation assessed the structure of the tar well, gasholders 1 & 2 and the purifiers. Ground conditions were recorded as a variable thickness of Made Ground over Alluvial clay with many buried former process structures. Made ground comprised a heterogeneous mix of ash, clinker, slag, rubble, masonry, clays and sands with occasional coke and coal. Tars and free phase hydrocarbons were noted on site. Laboratory analysis reported substantially elevated concentrations of typical gasworks contaminants (PAHs, cyanides, sulphur, strongly acid and alkali ground, BTEX, phenols) in soils and groundwater.

4. *WYGE Additional Ground Investigation - Remediation Phase Factual Report, Old Mill Lane, Barnsley Ref: E1297- AdditionalGIFACT-Issue 1 (October 2003). (Ref 10.34)*

10.4.38 Works were commissioned to update the existing information and provide information for design/cost planning purposes. Investigation comprised 25 trial pits, 12 boreholes permeability testing, river sampling; soil and groundwater sampling; and soil gas and groundwater elevation monitoring. Observations of contamination included spent oxide and oxide staining, tarry sheens and odours, hydrocarbon sheens and odours, strong creosote type odours. Laboratory analysis reported substantially elevated concentrations of typical gasworks contaminants (PAHs, cyanides, sulphur, BTEX, TPH, phenols) in soils and/or groundwater.

5. *WYGE Ground Investigation 2006 Factual Report, Old Mill Lane, Barnsley ref: E7773- GIFACT2006-Issue 1 (Sept 2006) (Ref 10.35)*

10.4.39 The report provides a summary report of previous site investigation locations within the footprint of the corridor of a proposed new road through the site with a strip 6m wide on either side of the road.

6. *WYGE Ground Investigation 2007 Factual, Old Mill Lane, Barnsley Report ref: E7773- ADD207GIFACT-Issue 1 (August 2007). (Ref 10.36)*

10.4.40 Works were commissioned to provide site specific information relating to near surface and subsurface contamination and to install groundwater monitoring boreholes to assess the potential risk to the proposed commercial redevelopment of the site and to the River Dearne. Investigation comprised 10 trial pits, 7 boreholes; soil and groundwater sampling; and soil gas and groundwater elevation monitoring. Observations of contamination included spent oxide staining and hydrocarbon sheens and odours. Laboratory analysis reported substantially elevated concentrations of typical gasworks contaminants (PAHs, cyanides, sulphur, BTEX, TPH, phenols) in soils and/or groundwater. See EP2 for summary of investigation positions.

7. *WYGE Detailed Quantitative Risk Assessment Report, Old Mill Lane, Barnsley Report Ref: E7773-DQRA-Issue 1 V2 (April 2007) (Ref 10.37)*

10.4.41 The works were commissioned to assess the risks associated with the proposed redevelopment of the site with the A61 Quality Bus Corridor, and commercial area in the central and northern areas of the site (Zone A), with the southern and south western areas (Zone B) utilised as vegetated open space with access restricted and discouraged with a 'waist high fence'. See EP 3. The DQRA considered risks to Human Health, and to Controlled Waters (i.e. groundwater and more specifically the River Dearne as the most sensitive receptor).

10.4.42 The report concludes that for Human Health, given the proposed end use of Zone A, it was unlikely that significant pathways would exist such that site users would be impacted in this area and no remedial actions were required. For Zone B, given the proposed open space end use, a suitable capping layer would be required.

10.4.43 The report concludes that, in relation to impacts to Controlled Waters from Zone A, works would be required to address contamination within/around Gasholder 1 (soils impacted by PAHs with a down gradient plume in groundwater); contamination in shallow soils within/around the former Exhaustor & Retort Houses (shallow soils impacted with Ammonia and PAHs); contamination within/around the former purifiers (cyanides in shallow soils).

10.4.44 The report concludes that in relation to impacts to Controlled Waters from Zone B, works would be required to address Gasholder 2 (hydrocarbons/ammonia/cyanide in groundwater posing a risk to the River); contamination within/around the former Scrubbers and Oil Tank (shallow soil and perched groundwater impacted with hydrocarbons); localised benzene impacts around BH103 (more delineation required); widespread moderate groundwater impacts (post remediation monitoring to assess if impacts to groundwater reduce).

8. *WYGE Remediation Strategy Report, Old Mill Lane, Barnsley Ref: E7773RS-V3 (August 2007) (Ref 10.38)*

10.4.45 This document details a remediation strategy designed to address the potential for adverse impacts to the River Dearne from contamination in soils and groundwater on site. Remedial areas are shown on EP4. The main elements of proposed remediation are:

- Excavation and treatment/disposal for contaminated soils in Areas A1 to A8 and Area B2;
- Removal of contaminated perched groundwater from Areas A1 to A8 and Area B2;
- Localised removal of free phase hydrocarbons in BH201;
- Potentially localised remediation of groundwater in the vicinity of Bh103 (Area B3) where isolated Benzene impact was identified;
- Remediation of groundwater within Former Gasholder 2 (Area B1);
- Groundwater monitoring prior to, during and after source removal to determine if any natural attenuation trends can be identified to determine the residual risk to groundwater in the Alluvial River Terrace Gravels and to the River Dearne such that the need for further groundwater remediation works could be reviewed.

10.4.46 The report defines soil remediation target criteria for a range of hydrocarbons, phenols, BTEX, PAHs and ammonia for Zone A and Zone B.

10.4.47 Barnsley MBC confirmed their general agreement with the proposed Strategy in a letter dated 30 August 2007, though made requests for further information on a number of issues.

9. *WYGE Factual Post Remediation Verification Report, Old Mill Lane, Barnsley. Ref E7773-PRF-V1 Final Validation Report (August 2008) (Ref 10.39)*

10.4.48 This report provides information on the remediation works undertaken in line with the remediation strategy above. It provides a summary and detail on works completed in each of the remediation areas (A1 to A8, B1-B3.). Works for each area generally comprised excavation of pre-classification trial pits to pre-classify materials for re-use or offsite disposal; selective excavation of contaminated Made Ground and underlying natural strata; dewatering and on site treatment of perched groundwater with discharge under licence to foul sewer; confirmatory chemical and geotechnical testing of the material stockpiled for re-use; removal of tar pipes and drainage channels encountered; excavation of all visually impacted materials, validation sampling of the base and sides of remediation excavations with associated chemical analysis; and back filling of remediation voids. The report also details disposal routes and tonnages, environmental monitoring completed, infilling works completed and regulatory body involvement.

10.4.49 The report concludes that the works “generally achieved the Remediation Criteria within the remaining Made Ground and within the natural ground”. Exceptions to this are reported on two samples collected adjacent to the northern boundary in Area A3 and western boundary in Area A4 and in two samples from natural clay at depths of greater than 2mbgl in Area B2A and B2B. The report concludes that residual contamination may be present beneath the PRS compound and within the 3metre easement of the live gas main as excavation was not possible due to the presence of live gas plant. These areas are concluded in the report to be unlikely to represent a substantial risk as historical site investigation works and window sampling carried out around the PRS station did not indicate significant contamination in these areas.

10.4.50 The report states the site is suitable for the end uses defined in the document i.e. hard cover retail, hard cover road and soft cover public open space.

Development issues identified within the report include:

- Differential settlement of between areas of deep and shallow backfilled materials;

- Relic structures;
- Services;
- The operational PRS compound;
- A bat colony (Duabenton Bats) in the northern end of the culvert running down the western boundary of the site;
- The southern half of the eastern area of the site being subject to a Tree Preservation Order;
- A badger sett noted in the area of the site containing the TPO;
- Japanese Knotweed and Giant Hogweed present on site;

10. *WYGE Groundwater Monitoring Interpretative Report, Old Mill Lane, Barnsley. Ref E7773-GWR-V2 (January 2010) (Ref 10.40)*

10.4.51 This report presents a review of groundwater monitoring undertaken prior to, during remediation and 12 rounds of post remediation monitoring. 9 pre-remediation 6 during remediation and 12 post-remediation groundwater sampling events were completed on site.

10.4.52 Groundwater contaminants were reported to be primarily in two separate plumes. One plume generally to the southeast of former gasholder 1, the other is located adjacent to Gasholder 2. Contaminants present within the plumes include Benzene, naphthalene, phenol, TPH Cyanide and Ammonium.

10.4.53 The report concludes that source removal works were completed in 2008 and the groundwater monitoring results have generally indicated the presence of stable contaminant plumes in groundwater. The report therefore states the remediation of the site is complete and no further monitoring is required.

Contamination Risks – Conceptual Model

Potential Sources

10.4.54 There is considered to be a **moderate** potential for ground contamination to be present on the site. Although the site to the north of the River Dearne has been subject to remedial actions it is acknowledged with the WYG Verification report (**Ref 10.39**) that there may be areas of residual contamination associated with a 3 metre easement around the live gas plant. The report does conclude that this is unlikely to represent a substantial risk as site investigation works within the area of the plant did not identify significant contamination.

10.4.55 There is also potential for contaminants (e.g. hydrocarbon sludge) within the base of the decommissioned gas holder and within soils in the site to the south of the river where there is limited available ground investigation information.

10.4.56 Potential sources of contamination identified on site include;

- Residual contamination in the north of the site associated with the former gasworks
- Residual contaminant or hydrocarbon sludges within and around the decommissioned gas holder to the south of the River Dearne.
- Historic contamination associated with the former tannery in the south west of the site and laundry (later a saw mill) in the south east of the site.
- Alluvial deposits and underlying Coal Measures strata (including former workings) are potential sources of ground gas.
- Potential asbestos containing materials with the fabric of the buildings to the south of the River Dearne and potentially within Made Ground materials.
- An electricity sub station has been present on the site west of the site since the mid 1970s; this has the potential to contain or have contained Polychlorinated Biphenyl (PCB) bearing oils;

Potential Exposure Pathways

10.4.57 Potential exposure pathways at the Site with respect to human health include ingestion, inhalation of dusts, dermal contact, and inhalation of vapours both on and off-site.

10.4.58 Potential exposure pathways at the Site with respect to controlled waters include leaching of contaminants from soils, migration under gravity to groundwater, migration of groundwater through permeable superficial deposits, surface water runoff and migration through the surface water drainage system.

Potential Receptors

12.1.6 **Table 10.7** presents the potential receptors which could be affected by the Site currently, and during the construction and operational phases of the Proposed Development, and an assessment of the environmental sensitivity of the receptor groups with respect to potential contamination.

Table 10.7: Potential Receptors with Respect to Potential Contamination

Receptor Group	Sensitivity	Justification
Human Health (current site users)	Medium	Land uses at the Site currently include vacant land and the new link road to the north of the river, retail, and warehouse units. Residential land uses are also located adjacent to the south of the site along with commercial premises. Risks to human health at the site are minimised by the low exposure times to the general public when on site, the presence of hardstanding across the majority of the site. It is understood that with the exception of the link road, there is no general public access to the site to the north of the River Dearne (former gasworks and depot).
Human Health (construction workers)	High	Construction workers may be directly exposed to contaminated ground and groundwater at the Site during the earthworks and construction phase if appropriate mitigation measures are not adopted.
Human Health (future site users)	Medium	Although commercial/retail land uses will be the predominant land use post development it is also proposed to create a community park via an extension of the green corridor alongside the river. With the retail development the presence of hard standing post development would significantly reduce the potential for exposure to contaminants. However, the presence of a community park green space could potentially increase the probability of exposure to contaminants within soils without the application of appropriate mitigation measures.
Controlled Waters (Groundwater)	Medium	The underlying Alluvial and solid geology are classified as Secondary A Aquifers and are not locally abstracted.
Controlled Waters (Surface Water)	High	The River Dearne bisects the site and has a ' <i>moderate</i> ' water quality with a current ' <i>good</i> ' biological quality. However no surface water abstractions were identified within 1km of the site.

10.4.59 The controlled waters receptors (groundwater and surface water) are assessed together in Section 10.5 as they could potentially be affected via the same pathways. They are classed together as medium to consider the most sensitive receptors and therefore the worst case scenario.

10.4.60 Potential receptors with respect to geotechnical risks are human health receptors, including construction workers and future site users. All human health receptors with respect to geotechnical risks are considered to be of high sensitivity.

Future Baseline

10.4.61 Should the Site remain in its current use, the risks to human health and controlled waters from contamination are likely to be low to moderate. The previous remedial work north of the river, the presence of hardstanding and small areas of vegetated landscaping across much of the site south of the river will limit much of the risk to human health, and prevent migration of any contamination present via leaching/ flushing mechanisms. The risks from potential volatile organic contamination and ground gas may present a risk to Site users. Potential free phase hydrocarbons within soils or groundwater may also still pose a risk to Controlled Waters.

10.4.62 Should the site remain undeveloped, the risks to human health from contamination are likely to be low. There are potential risks to human health via the inhalation, ingestion and dermal contact pathways; however, the risks are minimised by the low exposure times to the north of the river (the former gas works is understood to be secure and vacant as such exposure would be short from trespass or maintenance work) and by hard standing in the part of the site to the south of the river.

10.4.63 Should the site remain undeveloped, the risks to controlled waters from contamination are considered to be medium due predominantly to the proximity of the river. It is understood from the WYG report (**Ref 10.37**) that contaminant plumes are present beneath the site albeit anticipated to be contracting following remediation (source

removal). However, there is currently limited available information with regards the area south of the river, in particular the area of the former tannery.

10.5 ASSESSMENT OF EFFECTS, MITIGATION AND RESIDUAL EFFECTS

10.5.1 Further assessment of the land to the south of the River Dearne is considered necessary with a remedial strategy produced as required.

10.5.2 It was concluded from the WYG post remediation monitoring report (**Ref 10.40**) that additional monitoring is not required and that groundwater contamination plumes in the north of the site were declining following the source removal exercise. As such no further works have been recommended for part of the site north of the river, part of which is undergoing construction of the new link road.

10.5.3 The scope of the assessment has been determined based on the presence of receptors where a plausible pollutant linkage may exist as a result of routine activities associated with the construction and operation of the site.

Site Preparation, Earthworks and Construction Phase (including Demolition)

Presence of contamination (associated with historical and current land uses) and potential risks to human health through exposure (e.g. demolition, earthworks and construction workers and third parties)

10.5.4 Although a ground investigation has not been undertaken to date on the area to the south of the river, there is considered to be a moderate potential for ground contamination to be present. Many of the potentially contaminative historical uses were present more than 100 years ago with redevelopment to the present day configuration occurring in the 1980s. It is not known if any remediation took place prior to the redevelopment. There is therefore potential for contaminants to be present within the soils beneath the southern site from historical contamination as well as present day uses (e.g. substation).

10.5.5 Only residual contamination following completed remediation work is anticipated to be present in the northern site associated with the former gasworks.

10.5.6 Significant excavations will be required at the Site in accordance. Excavation of potentially contaminated soils can pose a health risk to demolition, earthworks and construction workers on the Site through dermal contact (i.e. direct skin contact with contaminated soils and groundwater), ingestion (e.g. via the transfer of contaminated soils from unwashed hands during eating) inhalation of dusts (i.e. breathing in contaminated dusts and particulate matter generated by excavation activities) and inhalation of vapours (i.e. breathing in vapours from volatile contaminants in the soil and groundwater).

10.5.7 Excavation of potentially contaminated soils can also pose a health risk to the general public in the immediate vicinity of the Site, through inhalation of contaminated dusts and particulate matter generated by excavation activities.

10.5.8 Should human health receptors be exposed to contaminants above critical concentrations there is potential for both temporary and permanent effects to arise dependent on a number of factors including type of contaminant, characteristics of receptor and duration of exposure.

10.5.9 The sensitivity of demolition, earthworks and construction workers and third parties is high and the magnitude of change, prior to mitigation, is high. Therefore, there is likely to be a direct, temporary and/or permanent, medium-term effect on demolition, earthworks and construction workers and third parties of **major negative** significance prior to the implementation of mitigation measures.

Mitigation

10.5.10 A ground investigation will be undertaken at the southern Site prior to the detailed design phase to identify potential sources of contamination. Quantitative Risk Assessments for human health will be undertaken as part of this investigation. The findings of the risk assessments will be utilised to develop appropriate mitigation measures to protect demolition, earthworks and construction workers and the general public from potential effects to health.

10.5.11 All site works and ground works will be undertaken in accordance with the Considerate Contractors Scheme to help ensure a well-managed operation which minimises environmental risks. Effects to the health of construction workers and the general public from potentially contaminated soils and materials will be controlled under the Construction (Design & Management) Regulations 2007 (**Ref 10.8**) and a risk assessment will be prepared for the Site

to ensure the protection of workers and the general public during the demolition, earthworks and construction phases, which will specify appropriate safe working practices.

10.5.12 Due to the potential for elevated concentrations of contaminants in the soil and groundwater at the Site specific personal protective equipment (PPE) will be utilised, particularly during ground works. PPE will also be utilised at the northern Site due to the potential presence of remedial contaminants. Generic safe working practices will be adhered to at the Site and will include, but are not limited to:

- Use of appropriately qualified persons for the intended task;
- Use of PPE;
- Provision of on-site washing facilities;
- Washing of hands at the end of every work period (including forearms, face etc if they become dirty);
- No eating rule on-site and confining of smoking areas away from work site, and only after decontamination;
- Reporting of any ill health; and
- The damping down of exposed surfaces during periods of dry/windy weather.

10.5.13 All of the above measures and other relevant good site practices to avoid/minimise the likely significant effects at source, will be included within the Construction Environmental Management Plan (CEMP) and enforced throughout this phase. Consideration should also be given in the CEMP to the treatment of invasive species at the Site. The effect of invasive species is assessed in **Chapter 12 – Ecology & Nature Conservation**.

10.5.14 In addition, all persons engaged in demolition, earthworks and construction will be made aware of the findings of the intrusive ground investigation and previous remedial works. If contamination is identified, the associated hazards of handling potentially contaminated materials will be conveyed to all site workers and all works will be conducted in accordance with the Health and Safety Executive publication entitled '*Protection of Workers and the General Public during the Development of Contaminated Land*', 1991 (**Ref 10.33**).

Residual Effects

10.5.15 Although the effect of contamination on construction workers has the potential to be of high significance, the magnitude of change following implementation of mitigation measures is considered to be negligible as the risk of an event occurring is considered to be slight. The sensitivity of demolition, earthworks and construction workers and third parties is high and the magnitude of change, following mitigation, is negligible. Therefore, there is likely to be a **negligible** effect on demolition, earthworks and construction workers and third parties following the implementation of appropriate mitigation measures.

Presence of Asbestos Containing Materials (ACM) within existing buildings and structures, the presence of asbestos in soils on-site and the potential risk to human health through exposure

10.5.16 Given their age, there is potential for the buildings present on site to contain ACMs. ACMs were not detected within soils samples on the northern site however ACM debris had previously been identified and there is an inherent potential for Made Ground materials to contain ACMs.

10.5.17 Demolition of the existing buildings and structures which contain ACM and excavation of soils containing asbestos may pose a health risk to demolition, earthworks and construction workers, and the general public in the immediate vicinity of the Site, through inhalation of contaminated dusts and particulate matter generated by excavation activities.

10.5.18 The sensitivity of demolition, earthworks and construction workers and third parties is high and the magnitude of change, prior to mitigation, is high. Therefore, there is likely to be a direct, permanent, medium-term effect on demolition, earthworks and construction workers and third parties of **major negative** significance prior to the implementation of mitigation measures.

Mitigation

10.5.19 Asbestos surveys, if not already undertaken, will be required on all structures to be demolished. If existing surveys or management plans for these buildings are available they should be reviewed as part of the pre-demolition

works. An asbestos management plan or safe system of work for dealing with any asbestos found must be produced. Any asbestos found must be removed by appropriate persons and in accordance with the Control of Asbestos Regulations 2006 (**Ref 10.7**) to ensure the potential risks are appropriately managed.

10.5.20 Asbestos testing will be undertaken in Made Ground on the Site during the future ground investigation.

10.5.21 The removal and disposal of asbestos-containing soils, if required, should be undertaken in accordance with the *Hazardous Waste Regulations 2009* (**Ref 10.35**).

10.5.22 Safe working practices as specified above and contained in the CEMP to mitigate exposure to contamination are also relevant to mitigate exposure to asbestos, particularly the use of PPE and the damping down of exposed surfaces.

Residual Effects

10.5.23 The sensitivity of demolition, earthworks and construction workers and third parties is high and the magnitude of change, following mitigation, is negligible. Therefore, there is likely to be a **negligible** effect on demolition, earthworks and construction workers and third parties following the implementation of mitigation measures.

Exposure of demolition, earthworks and construction workers to hazardous ground gases (explosive and asphyxiant) generated from potential sources both on-site and off-site (potential Made Ground, Alluvium and underlying Coal Measures strata and potential associated workings).

10.5.24 Made Ground and Alluvium were encountered during previous ground investigations by others (see summary list at Section 10.3.4). These strata could result in the generation of hazardous ground gases. Piling techniques at the Site and potentially other excavations undertaken could result in demolition, earthworks and construction workers being exposed to hazardous ground gases causing an adverse effect to health.

10.5.25 The sensitivity of demolition, earthworks and construction workers is high and the magnitude of change, prior to mitigation, is high. Therefore, there is likely to be a direct, temporary, medium-term effect on demolition, earthworks and construction workers of **major negative** significance prior to the implementation of mitigation measures.

Mitigation

10.5.26 Prior to demolition, earthworks and construction, an appropriate intrusive ground investigation and subsequent monitoring will be undertaken at the southern Site to assess the potential for hazardous ground gases. Ground gas monitoring undertaken on the northern site did not identify significantly elevated concentrations of ground gases. The investigation will be undertaken as part of the investigation required to assess potential contamination associated with historical and current Site usage.

10.5.27 In the event that elevated concentrations of hazardous ground gases are identified, where entry into confined spaces and/or excavations is required by demolition, earthworks or construction workers a combination of appropriate PPE/RPE, monitoring equipment and safe entry procedures will be utilised to mitigate any potential risk of exposure to hazardous gases/vapours.

10.5.28 All works will be conducted in accordance with the Health and Safety Executive publication entitled 'Safe Work in Confined Spaces', INDG258, 2006 (**Ref 10.35**).

Residual Effects

10.5.29 The sensitivity of demolition, earthworks and construction workers is high and the magnitude of change, following mitigation, is negligible. Therefore, there is likely to be a **negligible** effect on demolition, earthworks and construction workers following the implementation of mitigation measures.

Release/migration of contamination (existing contamination, or uncontrolled discharges/ accidental spillages) to Controlled Waters (Underlying Secondary A Aquifers and the River Dearne)

10.5.30 There is potential for contaminants within soils to be mobilised if they are disturbed during earthworks or construction activities and potentially impact up controlled waters. Additionally, the presence of site drainage and culverts would act as preferential migration pathways towards the River Dearne.

10.5.31 There is potential for sources of soil and groundwater contamination to be present at the Site. Increased leaching of contaminants and increased mobility of contaminants to and in groundwater may be possible following the removal of hardstanding and exposure of bare soils during the site preparation, earthworks and construction phase.

10.5.32 Shallow perched groundwater has previously been identified in the northern site between 1.0 and 1.0mbgl. Groundwater within the Alluvium was generally around 6 to 7mbgl with peizometric levels around 2.0 to 2.5mbgl and was noted to have a noticeable hydrocarbon odour in some locations (pre remediation). The groundwater was identified in the WYG DQRA report (**Ref 10.37**) to be in hydraulic continuity with the River Dearne.

10.5.33 Disturbance and mobilisation of potential contamination could reduce the quality of the shallow groundwater across the Site, which in turn could migrate and reduce the quality of controlled waters receptors including the underlying Secondary A Aquifers, and the River Dearne.

10.5.34 The presence of machinery and plant associated with site clearance, demolition, earthworks and construction activities (including the development of a Site construction compound) and excavation and backfilling activities on the Site gives rise to further risk to soils, groundwater and surface water bodies from contaminants through accidental fuel/oil spills and leaks.

10.5.35 During demolition and construction works, there will be a greater risk of contaminated runoff, including hydrocarbon contamination and high-suspended solid loads associated with the operation of vehicles providing pathways for contamination across the Site.

10.5.36 Piled foundations, should they be adopted, may create a potential pathway for downward migration of contamination from shallow soils to the Alluvial gravels (Secondary A Aquifer). The use of certain foundation techniques can involve the use of cementaceous material. Such materials are very alkaline when wet and consequently have the potential to reduce the quality of groundwater.

10.5.37 The sensitivity of the groundwater receptors (Secondary A Aquifer) is medium and the sensitivity of the surface water receptor (River Dearne) is high. The controlled waters receptors (groundwater and surface water) are assessed together as they could potentially be affected via the same pathways. They are classed together as high to consider the most sensitive receptors.

10.5.38 The potential impacts on surface water quality from an increase in physical contaminants are assessed in **Chapter 11 –Water Resources & Drainage**.

10.5.39 The sensitivity of controlled water receptors is high and the magnitude of change, prior to mitigation, is high. Therefore, there is likely to be a direct, temporary, medium-term effect on controlled water receptors of **major negative** significance prior to the implementation of mitigation measures.

Mitigation

10.5.40 A ground investigation will be undertaken at the Site prior to the detailed design phase to identify potential sources of contamination. The findings of the investigation will be utilised to develop appropriate mitigation measures to protect controlled water receptors from mobilisation of contamination. Ground workers will also be made aware of the findings of the intrusive site investigation and previous WYG investigations, if necessary.

10.5.41 All site works and ground works (Site) will be undertaken in accordance with CIRIA guidance '*C532 – Control of Pollution from Construction Sites*' (**Ref 10.26**). All site works and ground works will also be undertaken in accordance with the Considerate Contractors Scheme to help ensure a well-managed operation which minimises environmental risks.

10.5.42 Mitigation measures shall be included within the CEMP for the Site and may include, but are not limited to:

- Remediation of contamination hotspots;
- Segregation of contaminated waste types for appropriate off site disposal;
- Use of wheel washes and covered wagons to reduce the potential for migration of contaminants off-site;

- Working areas shall be clearly defined to ensure minimal disturbance of soils. The contractor shall appraise the suitability of such working areas in this respect as part of working method statements;
- Haul routes and accesses shall be clearly defined to minimise the risk of accidents;
- Construction vehicles will be regularly maintained to reduce the risk of hydrocarbon contamination associated with leaks and spillage and will only be active when required;
- Designated areas for the storage of hazardous materials, fuels and chemicals. All designated areas will be of hard-standing within bunds (110% the volume of the vessel) and all filler points/valves will be located within the extent of said bund or appropriate drip trays will be provided;
- Implementation of a temporary drainage network to prevent untreated surface runoff from leaving the Site or entering surface water drains;
- Controlled, and covered, waste storage areas;
- Provision of fuel emergency spill kits, located at strategic points;
- Provision of environmental awareness training for site workers; and
- Adopting the EA Pollution Prevention Guidelines (outlined below).

10.5.43 All site works will be undertaken in accordance with the EA's Pollution Prevention Guidelines, in particular;

- PPG1 '*General Guide to the Prevention of Water Pollution*' (**Ref 10.21**);
- PPG5 '*Works or Maintenance in or Near Water*' (**Ref 10.22**);
- PPG6 '*Working at Construction and Demolition Sites*' (**Ref 10.23**);
- PPG8 '*Safe storage and disposal of used oils*' (**Ref 10.24**); and
- PPG21 '*Pollution Incident Response Planning*' (**Ref 10.25**).

10.5.44 The findings of the intrusive ground investigation will also be used to determine suitable foundation solutions for the proposed structures across the Site. Based on the findings of this investigation, appropriate mitigation measures will be developed to minimise the potential reduction in the groundwater quality of the underlying aquifer. These measures may include, but are not limited to, the following:

- Use of shallow strip foundations situated above the groundwater table, where possible;
- Use of ground improvement techniques to enable the use of shallow concrete footings above the groundwater table; and
- Use of pre-cast piled foundations in accordance with the EA document '*Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention (NC/99/73)*' (**Ref 10.36**).

10.5.45 Careful excavation of Made Ground material will be undertaken on Site to minimise disturbance of the material and thus minimise mobilisation of potential contaminants therein. Surplus excavated material will also be removed as soon as possible from the Site and will not be stockpiled on-site for significant time periods.

10.5.46 If any further unexpected gross contamination is encountered during excavation and earthworks at the Site, expert advice will be sought prior to the removal of any effected material.

10.5.47 Prior to the commencement of the site preparation, earthworks and construction phase, site run-off will be controlled to mitigate (potentially contaminated) sediment loading. At this Outline stage the proposed drainage strategy for this phase has not been developed. This will be addressed during the detailed design stage. It is anticipated that site run-off will be collected and attenuated on-site prior to discharge ensuring the protection of water quality in receiving waterbodies from an increased (potentially contaminated) sediment load.

Residual Effects

10.5.48 The sensitivity of the controlled waters receptors is high and the magnitude of change, following mitigation, is negligible. Therefore, there is likely to be a **negligible** effect on the controlled waters receptors following the implementation of mitigation measures.

10.5.49 Careful excavation of the Made Ground will be undertaken at the Site and every measure will be taken to reduce the risk; however, there will be an unavoidable residual risk that the disturbance of the material during excavation which might mobilise contaminants to groundwater. Therefore, the sensitivity of the controlled waters receptors is high and the magnitude of change, following mitigation, is low. Therefore, there is likely to be a direct, temporary, medium-term effect on controlled waters of **minor to moderate negative** significance following the implementation of mitigation measures.

Geotechnical risks to earthworks and construction workers from potential underground structures (e.g. basements) relating to current or former buildings on-site and potential shallow mine workings.

10.5.50 It is understood that a brick culvert is present along the western boundary with another culvert crossing the centre of the site. It is not known whether any of the current buildings at the southern Site have basements, or whether any remain from historic buildings/structures. Therefore there is a potential for underground infrastructure.

10.5.51 Additionally, although there is no evidence at this stage for shallow coal workings to be present beneath site, coal seams are indicated to be present at shallow depth which may have been subject to undocumented historical workings. The potential however for mining related cavities at the Site is considered to be low although their presence cannot be entirely discounted.

10.5.52 Although the risk to human health if an underground void/structure or an area of unstable ground is encountered unexpectedly during earthworks and construction activities is high, the likelihood is considered to be low and therefore for the purposes of this assessment, magnitude has been considered to be medium. The reversibility of the effect is dependent on the nature and severity of the consequence of encountering underground voids or ground instability; therefore, the effect may be temporary or permanent.

10.5.53 Therefore, the sensitivity of earthworks and construction workers is high and the magnitude of change, prior to mitigation, is medium. Therefore, there is likely to be a direct, temporary and/or permanent, medium-term effect on earthworks and construction workers of **moderate negative** significance prior to the implementation of mitigation measures.

Mitigation

10.5.54 The proposed intrusive ground investigation at the southern Site will allow for a more accurate assessment of the geotechnical risks and potential mitigation options to protect earthworks and constructions workers from ground instability.

Residual Effects

10.5.55 The sensitivity of earthworks and construction workers is high and the magnitude of change, following mitigation, is negligible. Therefore, there is likely to be a **negligible** effect on earthworks and construction workers following the implementation of mitigation measures, in particular the further assessment of geotechnical risks and potential options to protect sensitive receptors following the intrusive ground investigation at the Site.

Operational Phase

Exposure of future site users to contamination

10.5.56 As discussed above, the northern site has already been remediated suitable for use as part hard cover retail, part hardcover public highway and part soft cover public open space. The Phase 1 Geo Environmental Assessment (**Appendix 10.1**) has identified the potential for ground contamination associated with historical and current activities on the land to the south of the River Dearne. The required remedial scope for this area will be determined following intrusive site investigation works.

10.5.57 Potential remedial options may involve the removal of Made Ground and installation of an appropriate cover system in landscaped areas. Additionally, the presence of hardstanding/buildings across large areas of the site would further reduce risks to end users.

10.5.58 These remediation options are primarily focused on reducing the risk of to site end users. This will be implemented by effectively removing the source or the pathway with respect to potential harm human health (site users) receptors in accordance with *The Contaminated Land (England) Regulations 2006 (Ref 15.3)*. The relevant human health exposure pathways which would be broken include ingestion, inhalation of dusts, dermal contact, and inhalation of vapours. Therefore, the result is a positive effect on future site users.

10.5.59 Should human health receptors be exposed to contaminants above critical concentrations there is potential for both temporary and permanent effects to arise dependent on a number of factors including type of contaminant, characteristics of receptor and duration of exposure.

10.5.60 The sensitivity of future site users at the Site is medium and the magnitude of change, prior to mitigation, is medium. Therefore, there is likely to be a direct, temporary and/or permanent, long-term effect on future site users of **moderate negative** significance prior to the implementation of mitigation measures.

Mitigation

10.5.61 Potential sources of contamination will be investigated at the Site during the proposed ground investigation. An appropriate remediation strategy will be proposed depending on the extent and location of contamination. This will protect future site users and maintenance workers from potentially contaminated soil and groundwater. It is possible that as part of this strategy it will be necessary to remove soils from site or undertake on site treatment of soils.

10.5.62 Should residual contamination remain at levels which could pose a risk to human health then mitigation measures will be developed using the data obtained during the intrusive investigation. These measures may include, but are not limited to, the following:

- Construction of a cover layer in appropriate areas to break the pathway between the source and the receptor;
- Use of 'clean' service trenches; and
- Use of upgraded water supply pipes.

Residual Effects

10.5.63 The risks to human health at the Site will be reduced below current levels following remediation of contamination (if required).

10.5.64 The sensitivity of future site users at the Site is medium and the magnitude of change, following mitigation, is low. Therefore, there is likely to be a direct, permanent, long-term effect on future site users at the Site of **minor to moderate positive** significance following the implementation of mitigation measures.

Risk of hazardous ground gas (explosive and asphyxiant) ingress into future buildings and exposure to future site users.

10.5.65 The presence of Made Ground and potential shallow coal seams and mine workings beneath the Site could result in the generation of hazardous ground gases. If ground gas accumulates within buildings this could lead to asphyxiation or explosion.

10.5.66 The sensitivity of future site users at the Site is medium and the magnitude of change, prior to mitigation, is high. Therefore, there is likely to be a direct, temporary, long-term effect on future site users at the Site of **moderate to major negative** significance prior to the implementation of mitigation measures.

Mitigation

10.5.67 Prior to construction, an appropriate intrusive ground investigation will be undertaken to assess the potential for hazardous ground gases at the southern Site. The investigation will be undertaken at the same time as the intrusive investigation required to assess potential contamination associated with historical and current site usage and

will be in accordance the guidance document CIRIA C665 'Assessing risks posed by hazardous ground gases to buildings' (**Ref 15.29**).

10.5.68 In the event that elevated concentrations of hazardous ground gases are identified, data from the intrusive ground investigation and associated monitoring will be utilised to ensure appropriate gas protection measures are developed in accordance with CIRIA C665 'Assessing risks posed by hazardous ground gases to buildings'.

10.5.69 The proposed supermarket store is to be constructed on 'stilts' which will effectively mitigate against ground gas ingress across the majority of the building footprint.

Residual Effects

10.5.70 The risks to human health at the Site will be reduced below current levels following installation of gas protection measures (if required).

10.5.71 The sensitivity of future site users at the Site is medium and the magnitude of change, following mitigation, is low. Therefore, there is likely to be a direct, permanent, long-term effect on future users at the Site of **minor positive** significance following the implementation of mitigation measures.

Release/migration of contamination (uncontrolled discharges or accidental spillages) to controlled waters (underlying Secondary A Aquifers, River Dearne)

10.5.72 Any material used for backfilling remedial excavations to appropriate ground levels will be certified 'clean' and will therefore not present a risk to controlled waters. It has been assumed that the material will be won from the Site subject to chemical testing and geotechnical suitability.

10.5.73 As part of the scheme a petrol filling station will be present within Development Site 2 to north of the River Dearne as well as car parking in for the supermarket in Development Site 1 and for the offices in Development Site. There is potential for uncontrolled discharges of fuels due to spillages and improper fuel storage.

10.5.74 Following development, there is the potential for surface water runoff over the Site to contain elevated concentrations of contaminants, particularly from car parking areas and the petrol filling station, which may be carried to the River Dearne via surface water drainage.

10.5.75 The sensitivity of controlled water receptors is high and the magnitude of change with regards to the Site, prior to mitigation, is medium. Therefore, there is likely to be a direct, temporary, long-term effect on controlled waters of **moderate to major negative** significance prior to the implementation of mitigation measures.

Mitigation

10.5.76 Potential sources of contamination will be investigated at the Site during the proposed ground investigation. An appropriate remediation strategy will be undertaken depending on the extent and location of contamination to protect controlled water receptors from potentially contaminated soil and groundwater.

10.5.77 The extent of hardstanding covers the majority of the Site. This will therefore limit the potential for leaching of contaminants from soil to groundwater and will limit the effect of accidental spillages on controlled waters

10.5.78 The majority of the surface water would be collected in an attenuation tank/pond and all surface water would ultimately discharge to the existing culvert. Proposed pollution control measures include trapped road and car park gullies and oil interceptors which will attenuate physical contaminants to an acceptable concentration before discharging to the culvert. These facilities will be subject to routine maintenance.

The petrol filling station will be subject to appropriate design and control guidance including;

- Environment Agency, Pollution Prevention Guidelines, PPG21, Pollution Incident Response Planning
- Health and Safety Executive (HSE), HS(G)41, 1990, Petrol Filling Stations: Construction and Operation.....

Residual Effects

10.5.79 The risks to controlled waters at the Site will be reduced below current levels following remediation of contamination (if required).

10.5.80 The sensitivity of controlled water receptors is high and the magnitude of change with regards to the Site, following mitigation, is low. Therefore, there is likely to be a direct, permanent, long-term effect on controlled waters of **minor to moderate positive** significance following the implementation of mitigation measures.

Exposure to geotechnical risks within the Proposed Development and associated effects on future populations and third parties

10.5.81 The Phase 1 Geo-Environmental Assessment (**Appendix 10.1**) identified geotechnical risks to the Proposed Development at the Site in the form of below ground obstructions, potential voids, potential undocumented shallow mine workings and variable depth of variable quality superficial deposits and Made Ground that may compromise the structure stability. Potential contamination within soils may also chemically 'attack' future below ground structures (e.g. foundations). Geotechnical hazards at the Site may result in harm to human health receptors through loss of integrity of structures at the Site.

10.5.82 No mining cavities were definitively identified in the Phase 1 Geo Environmental Assessment (**Appendix 10.1**). Although the records should not be considered conclusive, the potential for shallow mine workings beneath the Site is considered to be low.

10.5.83 The reversibility of this effect is dependent on the nature and severity of the consequence of exposure to geotechnical hazards in the operational phase; therefore, the effect may be temporary or permanent.

10.5.84 The sensitivity of future populations and third parties is high, and the magnitude of change, prior to mitigation, is high. Therefore, there is likely to be a direct, temporary and/or permanent, long-term effect on future populations and third parties of **major negative** significance prior to the implementation of mitigation measures.

Mitigation

10.5.85 Prior to demolition, earthworks or construction, an appropriate intrusive ground investigation will be undertaken to assess potential significant areas of ground instability and inform on the most suitable foundation solution for the Site. The findings of the intrusive investigation will be utilised to develop appropriate mitigation measures to protect the future development from potential impacts arising from ground instability and aggressive ground conditions. These measures may include, but are not limited to, the following:

- Development of a below ground obstruction removal strategy;
- Development of an appropriate foundation zoning strategy;
- Use of ground improvement techniques (possibly including grouting); and
- Concrete specification in line with BRE SD1 (**Ref 15.37**).

Residual Effects

10.5.86 The risks to human health will be reduced below current levels following the implementation of the above mitigation measures.

10.5.87 The sensitivity of future populations and third parties is high, and the magnitude of change, following mitigation, is low. Therefore, there is likely to be a direct, permanent, long-term effect on future populations and third parties of **minor to moderate positive** significance following the implementation of mitigation measures.

Monitoring and Follow Up

10.5.88 A ground investigation will be undertaken at the Site that will consider the following items:

- Ground conditions including the full depth of Made Ground and superficial deposits which may affect foundation options;
- Assessment of potential shallow mine workings
- Geotechnical parameters to support foundation and building design;
- The contaminant profile of both soil and groundwater including general site wide conditions and specific areas of concern;

- Groundwater elevation and flow direction beneath the Site;
- The ground gas regime from Made Ground, coal measures and potential shallow mine workings;
- Characterisation of excavated materials to inform disposal or re-use options;
- Completion of an informed Generic Quantitative Risk Assessment (and Detailed Quantitative Risk Assessment if required) following the ground investigation to determine the risks to human health and controlled waters receptors; and
- Completion of a remediation strategy, if necessary.

10.5.89 A CEMP for control and management of potential risks at the Site will be developed and implemented by the Principal Contractor for the preparatory and construction phases of the Site. The CEMP will incorporate the mitigation measures recommended above to reduce the significance and, where possible, eliminate the identified effects.

10.5.90 The CEMP will be a live document setting out the management system to be adopted on site. Detailed risk assessments for all operations from which a safe system of work is required shall be developed. The Principal Contractor will be required to monitor this process and develop assessments and working methods appropriate to changes in work activities.

Limitations and Assumptions

10.5.91 In the absence of the results from an intrusive ground investigation at the Site to the south of the River Dearne (Development Site 1), assumptions have been made in relation to the potential presence of contaminated soils materials and geotechnical hazards. Proposed mitigation measures have been developed based on these assumptions which are considered to represent a worst case scenario.

10.5.92 Targeted intrusive ground investigations and a review of asbestos register and management plans should the be available for the existing buildings have been proposed in order to assess the presence or absence of existing soil contamination and ACMs. On completion of these investigations the findings will be incorporated in to the CEMP to ensure that an appropriate level of mitigation is provided.

10.5.93 It is assumed that the decommissioned gas holder to the south of the River Dearne will be appropriately removed and backfilled by a third party under the instruction and procedures defined by National Grid.

Table 15.7: Summary of Effects Table for Ground Conditions, Hydrogeology and Contamination

Description of Likely Significant Effects	Significance of Effects					Summary of Mitigation / Enhancement Measures	Significance of Residual Effects					Relevant Policy	Relevant Legislation
	(Major, Moderate, Minor, Negligible)	Positive / Negative	(P/T)	(D/I)	ST/MT/LT)		(Major, Moderate, Minor, Negligible)	Positive / Negative	(P/T)	(D/I)	ST/MT/LT)		
Site Preparation, Earthworks and Construction Phase (including Demolition)													
Presence of contamination (associated with historical and current land uses) and potential risks to human health through exposure (e.g. demolition, earthworks and construction workers and third parties).	Major	Negative	T &/or P	D	MT	■ Ground investigation, and remediation if required (southern Site). ■ Control under Construction Regulations 2007. ■ Considerate Contractors Scheme. ■ CEMP.	Negligible	N/A	N/A	N/A	N/A	PPS23: Planning and Pollution Control (2004) CSP 39 Contaminated Land Development Contaminated Land	Part IIA of the EPA 1990 Contaminated Land Regulations 2006 Construction (Design & Management) Regulations 2007
Presence of Asbestos Containing Materials (ACM) within existing buildings and structures, the presence of asbestos in soils on-site and the potential risk to human health through exposure.	Major	Negative	P	D	MT	■ Asbestos survey of existing buildings and appropriate management. ■ CEMP.	Negligible	N/A	N/A	N/A	N/A	PPS23: Planning and Pollution Control (2004) CSP 39 Contaminated Land Development Contaminated Land	Controls of Asbestos Regulations 2006 Construction (Design & Management) Regulations 2007
Exposure to demolition, earthworks and construction workers to hazardous ground gases (explosive and asphixiant) generated from potential sources both on-site and off-site (potential Made Ground and underlying coal measures and potential workings)	Major	Negative	T	D	MT	■ Ground investigation ■ PPE. ■ H&S management procedures.	Negligible	N/A	N/A	N/A	N/A	PPS23: Planning and Pollution Control (2004) CSP 39 Contaminated Land Development Contaminated Land	Construction (Design & Management) Regulations 2007

Description of Likely Significant Effects	Significance of Effects					Summary of Mitigation / Enhancement Measures	Significance of Residual Effects					Relevant Policy	Relevant Legislation
	(Major, Moderate, Minor, Negligible)	Positive / Negative	(P/T)	(D/I)	ST/MT/LT)		(Major, Moderate, Minor, Negligible)	Positive / Negative	(P/T)	(D/I)	ST/MT/LT)		
Release/migration of contamination (existing contamination, or uncontrolled discharges/ accidental spillages) to controlled waters (underlying Secondary A Aquifers and River Dearne).	Major	Negative	T	D	MT	- Ground investigation - Foundation Solutions. - CIRIA guidance and Considerate Contractors Scheme. - CEMP. - EA's PPGs. - Careful and timely excavation	Negligible	N/A	N/A	N/A	N/A	PPS23: Planning and Pollution Control (2004) CSP 39 Contaminated Land Development Contaminated Land CSP 40 Pollution Control & Protection	Part IIA of the EPA 1990 Contaminated Land Regulations 2006 Groundwater Regulations 1998 The Water Environment Regulations, 2003 The Groundwater Regulations 2009
Geotechnical risks to earthworks and construction workers from potential underground structures (e.g. basements or culverts) relating to current or former buildings on-site, or potential shallow mine workings.	Moderate	Negative	T &/or P	D	MT	- Culvert stand-off zone (if required) - Ground investigation and further assessment.	Negligible	N/A	N/A	N/A	N/A	N/A	Construction (Design & Management) Regulations 2007
Operational Phase													
Exposure of future site users to contamination.	Moderate	Negative	T &/or P	D	LT	- Ground Investigation - Remediation (if required)	Minor to moderate	Positive	P	D	LT	PPS23: Planning and Pollution Control (2004) CSP 39 Contaminated Land Development Contaminated Land	Part IIA of the EPA 1990 Contaminated Land Regulations 2006
Risk of hazardous	Moderate	Negative	T	D	LT	Ground	Minor	Positive	P	D	LT	PPS23:	

Description of Likely Significant Effects	Significance of Effects					Summary of Mitigation / Enhancement Measures	Significance of Residual Effects					Relevant Policy	Relevant Legislation
	(Major, Moderate, Minor, Negligible)	Positive / Negative	(P/T)	(D/I)	ST/MT/LT)		(Major, Moderate, Minor, Negligible)	Positive / Negative	(P/T)	(D/I)	ST/MT/LT)		
ground gas (explosive and asphyxiant) ingress into future buildings and exposure to future site users.	to Major					■ investigation ■ Appropriate gas protection measures (if required) ■ Proposed supermarket store is built on 'stilts'						Planning and Pollution Control (2004) CSP 39 Contaminated Land Development Contaminated Land	
Release/migration of contamination (uncontrolled discharges or accidental spillages) to controlled waters (underlying Secondary A Aquifers, River Dearne).	Moderate to Major	Negative	T	D	LT	■ Ground investigation (southern Site) ■ Remediation (if required) ■ Installation of appropriate drainage system with interceptors and attenuation	Minor to moderate	Positive	T	D	LT	PPS23: Planning and Pollution Control (2004) CSP 39 Contaminated Land Development Contaminated Land	Part IIA of the EPA 1990 Contaminated Land Regulations 2006 The Water Environment Regulations, 2003 The Groundwater Regulations 2009
Exposure to geotechnical risks within the Proposed Development and associated effects on future populations and third parties.	Major	Negative	T &/or P	D	LT	■ Ground investigation ■ Foundation design solution. ■ Remedial works if necessary (e.g. grouting)	Minor to Moderate	Positive	P	D	LT	N/A	N/A

Key to table:

P/T = Permanent or Temporary, D/I = Direct or Indirect, ST/MT/LT = Short Term, Medium Term or Long Term, N/A = Not Applicable

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