Stairfoot Quarry Restoration

Environmental Statement – Volume 2

Chapter 7.0: Geology, Hydrology, and Ground Conditions

Prepared for

GREEN EARTH
DEVELOPMENTS GROUP

Green Earth (Stairfoot) Limited

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7.0 GEOLOGY, HYDROLOGY AND GROUND CONDITIONS

7.1 Introduction

7.1.1 This Environmental Statement (ES) chapter has been prepared by Sirius Environmental Ltd on behalf of Green Earth (Stairfoot) Limited (hereafter referred to as 'Applicant'). It will support Axis Planning in the detailed application for the proposed restoration of the Yew Tree Quarry, Stairfoot, Barnsley (the 'Site') through the infill of non-hazardous excavated soil materials.

7.1.2 This Environmental Statement chapter has been prepared in accordance with the Town and Country Planning Act (Environmental Impact Assessment) Regulations 2017.

7.1.3 This chapter will provide an assessment of the ground conditions at the Site, with specific reference to geological and hydrogeological aspects. It will identify a set of baseline conditions, assess any potential effects, and propose any mitigation and monitoring measures required.

7.1.4 The ground conditions of the Site are extremely important in determining the environmental characteristics of an area. These conditions have direct and indirect effects on the development scheme, and vice versa. They can create restrictions on development plans, as well as create pathways for groundwater and / or contamination which can influence the short-term restoration activities, and long-term operation for recreation and Biodiversity.

7.1.5 This chapter should be read as part of the broader ES document.

7.2 Proposed Development

7.2.1 The Proposed Development comprises the restoration of Yew Tree Quarry. The Proposed Development would ensure the comprehensive restoration of the Quarry delivering biodiversity benefits and removing health and safety risks associated with the large waterbody.

7.2.2 The Site lies within the administrative area Barnsley Metropolitan Borough Council.

Description of the Infilling Works

7.2.3 The Applicant wishes to re-engineer the landform of the Site through the importation of non-hazardous non-degradable materials, subsequently introducing a new restoration scheme. Imported material would comprise excavated non-hazardous soils from development sites in the local area. It is estimated that circa 400,000m^3 of non-hazardous soil materials would be imported over a period of 111 weeks. This would equate to circa 80 HGV tippers on average per day. The cost of transporting soils hinders long distance imports, meaning the source of imported material would be market-dependant.

7.2.4 Imported material would be sourced on a 'campaign basis' and is therefore variable in composition and source. As such, average daily HGV traffic would be variable. It is anticipated that the number of HGVs to the Site per day would not exceed 200 two-way trips (i.e. 100 arrivals + 100 departures). Volumetrically, this would equate to 22 two-way HGVs per hour, on average. Such a level of trip generation would not be sustained over a long period of time and would be offset by days which are less intensive.

7.2.5 All incoming material would be subject to strict waste acceptance procedures that would be outlined within the Environmental Permit for The Site. The material would not include biodegradable waste and would therefore not require management of gas emissions or leachate.

7.2.6 The Proposed Development would require the construction of a new temporary site compound which would include a wheelwash, parking and welfare facilities.

7.2.7 The Site would receive material 5 days per week, Monday to Friday 07:30 – 16:30. Saturday operations would be limited from 08:00 – 13:00, there would be no vehicle movements during this time.

7.2.8 Restoration material would be delivered and deposited immediately, in accordance with the phasing plan. Stockpiling of materials would not typically be expected to occur.

7.2.9 It is proposed to use the following items of plant and machinery on site. These may be reviewed in accordance with the Site management requirements:

i) Dozers
i) Roller
ii) 8 wheel road tipper HGVs

Access

7.2.10 Access to the Site would be taken from the historical access into the former brickworks off Wombwell Lane.

Final Restoration

7.2.11 The Proposed Restoration scheme would include grassland species and shrub boundary planting.

7.2.12 In developing a restoration concept that delivers an appropriate level of Biodiversity Net Gain (BNG) i.e. development of the land so that it leaves biodiversity and ecological habitat in a measurably better state than before the development took place; the Applicant is also looking to ensure that restored site provides the opportunity for improved public access. The owner of the Site has historically been forced to maximise security to dissuade unauthorised access. By removing the risk to health via infilling the historical quarry voids, it allows for a new restoration scheme to be designed that both improves its appearance and allows for structured and functional public amenity.

7.3 Methodology and Scope of Assessment

Legislative and Guidance

7.3.1 During preparation of this chapter of the EIA report, consideration has been given to appropriate national legislation, policy and guidance. This includes, but is not limited to:

Legislation & Policy

i) The European Water Framework Directive (2000/60/EC) and Groundwater Directive (2006/118/EC).
ii) The Environmental Protection Act 1990
iii) The Environmental Damage (Prevention and Remediation) (England) Regulations 2015

iv) The Water Resources Act 1991
v) The Town and Country Planning (Environmental Impact Assessment) Regulations 2017
vi) Environmental Permitting (England & Wales) Regulations 2106 (as amended)
vii) National Planning Policy Framework

Guidance

i) Environmental Agency Guidance (August 2024) - Protect groundwater and prevent groundwater pollution
ii) Environmental Agency Guidance (March 2017) - Groundwater protection technical guidance
iii) Environmental Agency Guidance (v1.2; February 2018 – under review) - The Environment Agency's approach to groundwater protection
iv) Environmental Agency Guidance (June 2023) - Deposit for recovery operators: environmental permits
v) Environmental Agency Guidance (June 2023) - Waste recovery plans and deposit for recovery permits
vi) Environmental Agency Guidance (May 2025) - Landfill operators: environmental permits

Assessment Methodology

7.3.2 The assessment will consider potential effects related to geological, hydrogeological and ground condition variables.

7.3.3 As such, the objectives of this chapter are to:

i) Establish the geological, hydrogeological and ground conditions of the Site as well as any other relevant characteristics.
ii) Identify the geo-environmental hazard linkages and risks present and assess their residual risk in the context of mitigation techniques.
iii) Recommend potential further mitigation measures for identified risk and assess the subsequent residual risks.

7.3.4 A desk-based study has been carried out using publicly available information sources.

Information Sources

7.3.5 The main sources of information used to create this report are listed below:-

i) Envirocheck Report by Landmark (2025) *[Order number: 76781372_1]*
ii) British Geological Survey, BGS Boreholes Records (2021)[1],
iii) BGS 1:50,000 Series Barnsley Bedrock and Superficial Geology
iv) BGS Index: Geology of the Barnsley district — a brief explanation of the geological map Sheet 87 Barnsley.
v) Crimes (1985) Land Reclamation at Stairfoot Brickworks Pit: Geological Aspects of Phase 2

7.3.6 Within this chapter, the study area is considered to include the planning application boundary and an area up to 1km from this depending on the context.

7.3.7 As the Applicant's proposed activities are expected to be relatively low risk (Recovery of non-degradable, non-hazardous wastes) smaller distances have been used where appropriate. For example, the Environment agency groundwater risk assessment guidance stipulates that the distance to the nearest notable features (e.g. abstractions, surface water) must be stated. For the Site, the closest are typically between 250-500m.

7.3.8 The risk assessment was conducted using a Source-Pathway-Receptor model, which each risk being classified according to the *Likelihood* of occurrence, and the *Severity* if it were to occur.

7.3.9 The selection of Receptors was based on their presence in official datasets (For example, Groundwater vulnerability maps), as well as their proximity to the Site and the viability of expected pathways.

[1] *BGS, 2025. GeoIndex (onshore). https://www.bgs.ac.uk/map-viewers/geoindex-onshore/*

Assessment of Significance / Assessment Criteria

7.3.10 This risk assessment is based on the proposed activities outlined in this Environmental Statement. The assessment identifies the *severity* of the impacts, as well as the *likelihood* of the impact occurring. These are then considered together to identify whether or not the effect is significant.

7.3.11 This is based on the Risk Classification Matrix recommended in the '*Contaminated Land Risk Assessment: A Guide to Good Practise'* report by the CIRIA (C552).

Severity of Impact

7.3.12 The severity of impact is defined here as the qualitatively defined cumulative spatial and temporal size, permanence, and effect of a particular impact.

7.3.13 The risk severities are defined below in **Table 7.1**

Table 7.1 - Definitions of risk severities with examples

Severity	Description
Very Low	Limited damage to non-sensitive ecosystems or species Non-structural damage to buildings or structures No measurable change in site surface water runoff regime No measurable change in surface and groundwater quality No measurable change in fluvial flow regime No measurable change in fluvial morphology No measurable change in groundwater Levels
Low	Pollution of non-sensitive waters Damage to buildings or structures Requirement for some protective equipment during works Measurable short-term change in surface and groundwater water quality but no change with respect to EQS Small increase in (<10%) in site surface water runoff regime; Measurable change in fluvial flow regimes of up to 2%; Slight change in fluvial bed morphology and sedimentation pattern, minor erosion; Measurable change in groundwater levels, but no appreciable change in groundwater flow regime;
Medium	Chronic risk to human health Moderate increase (10%-50%) in site surface water runoff regime; Change in fluvial flow regimes of between 2-5% resulting in a measurable change in dilution capacity; Some change in fluvial deposition and erosion regimes; Change in water quality, changing site status with respect to short-term EQS, or for less than one month with other EQS Change in groundwater levels leading to an identifiable change in groundwater flow regime

Severity	Description
High	Acute Risks to human health Catastrophic damage to buildings/ property Change in water quality, changing status of controlled water with respect to Environmental Quality Standards (EQS) for more than one month; Large increase (>50%) in site surface water runoff regime; Change in fluvial flow regimes of >5% resulting in a measurable change in dilution capacity; Large changes in fluvial erosion and deposition, with conservation interests affected; Change in water quality, changing river status with respect to Environmental Quality Standards (EQS) for more than one month Change in groundwater levels leading to an identifiable change in groundwater flow regime and artesian flows

Probability of Impact

7.3.14 The probability classes are shown in **Table 7.2.**

Table 7.2 – Probability Classes

Risk	Description
Very Low	Risk linkage may be present but the circumstances under which harm would occur are improbable.
Low	Risk linkage may be present and there is a possibility of the impact occurring, although there is no certainty that it would do so.
Medium	Risk linkage may be present, and it is probable that the impact would occur over the long term.
High	Risk linkage may be present, and impact is almost certain to occur in the long term, or there is evidence of harm to the receptor

Significance of Effects

7.3.15 The significance of effects is determined by taking into account the potential severity of the impact, and the probability of it occurring. For the purposes of this Environmental Statement, these are either considered significant or not significant.

7.3.16 A matrix of significance is shown in **Table 7.3** which cross-references the severity of each.

7.3.17 It is important to note that, for the purposes of this assessment, any impacts classified as 'Moderate' or above, as per **Table 7.3**, below, are, in EIA terms, considered to be 'Significant'. Any impact classified below the 'Moderate / Low' significance level are *not* considered to be significant.

Table 7.3 – Significance Matrix

Likelihood	Severity			
	Very Low	**Low**	**Medium**	**High**
Very Low	Very Low	Very Low	Low	Moderate / Low
Low	Very Low	Low	Moderate / Low	Moderate
Medium	Low	Moderate / Low	Moderate	High
High	Moderate / Low	Moderate	High	Very High

*Ratings 'Moderate / Low' or *above* are considered 'Significant'

7.3.18 Any discussions of an impact's significance outside of its initial matrix rating, which will be shown to provide context and justification, will hereby be referred to alongside the 'Significant' or ''Insignificant' terminology.

Limitations

7.3.19 It is considered that there are no notable limitations to the assessment criteria as data has been obtained from a range of reliable sources, and the widest range of data available for a desk study has been utilised.

7.3.19.1 However, this statement may recommend that further investigations be undertaken to close this gap.

Scope of Assessment

7.3.20 This assessment has considered the responses of technical consultees with respect to the development and its potential impacts returned in the Scoping Opinion. These are summarised in **Table 7.4**, below.

Table 7.4 – Summary of consultee responses

Name of consultee	Issue Raised / Comment
Barnsley Metropolitan Borough Council	Full assessment required for geology, hydrogeology and ground conditions
Environment Agency	The contamination of Soils and Groundwater at the site should be investigated.
Natural England	The impacts upon local geological sites should be considered.
The Coal Authority	Site lies within a Low Risk Area. No comments.
Trans Pennine Trail National Office	The site has the potential to affect foot/cycle/horse traffic on the Trans Pennine Trail.

Name of consultee	Issue Raised / Comment
Sheffield Area Geology Trust (SAGT)	The Site is adjacent to a former Regionally Important Geological Site which is now delisted. There is SSSI exposing the Mansfield Marine Band adjacent to the Trans-Pennine Trail and should not be disturbed.

7.4 Baseline

7.4.1 Paragraph 3, Schedule 4 of The Town and Country Planning (Environmental Impact Assessment) Regulations 2017 requires Environmental Statements to provide a 'baseline scenario' that is "*A description of the relevant aspects of the current state of the environment".*

7.4.2 This section outlines a baseline scenario of the contemporary state of the environment at the development site, from which linkages will be established.

7.4.3 As this assessment covers the geological, hydrogeological and ground conditions, and considering the fact this quarry has been inactive for many years, significant recent changes are not expected to be a problem.

General Information and Site History

7.4.4 Yew Tree quarry is one of several in the bounds of the historic Stairfoot brickworks complex which has undergone varying degrees of restoration. It is located at National Grid Reference: SE 38145 05179.

7.4.5 Historically, these were clay pits provided material for the manufacture of bricks as far back as the turn of the 19th century.

7.4.6 A new brickworks was built in the 1920's when the Site and surrounding quarries were acquired by the Yorkshire Brick Company Ltd. These were mostly derelict by the mid-1970s.

7.4.7 The brickworks continued to operate in a reduced capacity through the 1980s to the mid-1990s. During this period, the Site adopted some conservation and sustainability measures. This included public access to the geologically important exposed Marine Bands located ~120m to the west of the Site, as well as the landfilling of defunct quarries and the use of subsequent landfill gas (LFG) to partially power the remaining furnaces.

7.4.8 Historic aerial imagery indicates that Hanson continued working Yew Tree Quarry up until 2008, with restoration to current levels completed in 2009.

7.4.9 The Site is roughly triangular with steep sides. There is limited vegetation on the lower slopes, with some trees and shrubs on the upper levels where there are remnants of thin soils. Footpath 324 runs across the Site to the northwest.

7.4.10 The former Stairfoot Quarry complex is approximately 18 hectares in size and located approximately 2km east of the centre of Barnsley. The area surrounding the former brickworks complex is largely residential, made up of a mix of semi-detached properties built between 1950 and 1975. Further north is the A635 which connects Barnsley in the west to Doncaster in the east. Directly to the northwest of the Quarry is Oakhill Primary School, adjacent to which are a number of industrial units and businesses.

7.4.11 Separating the Quarry from Barnsley is Stairfoot Roundabout which connects the A635 and A633 to the northwest. The A633 ('Wombwell Lane') runs north/south to the west of the site and features a number of retail units and industrial buildings, along with a number of terraced properties along the eastern portion of the main road. Access to the site is from the former brickworks site off Wombwell Lane.

7.4.12 The former brickworks complex comprises numerous defined quarry and landfill areas. 'North Quarry', which is located to the immediate northwest of the Site and has been restored via landfilling. Local Authority and EA Historic landfill records indicate that varying sections of the North Quarry was landfilled by different operators between 1979 and 1992. The landfill operators include the Yorkshire Brick Company Limited and Barnsley Metropolitan Borough Council (MBC) for the western sections of the quarry footprint, with the south-eastern section of the North Quarry being landfilled by BDR Waste Disposal Limited. Although closed to further deposits of waste, the eastern section of North Quarry continues to be regulated under an Environmental Permit (Ref: EA/EPR/YP3990ZT), with some management of landfill gas (venting) and water management activities implemented around the some peripheries of the landfill. All LA and EA landfill records indicate that the waste types deposited in all sections of North Quarry included household, commercial, industrial and special wastes.

7.4.13 Stairfoot Quarry No. 2 (also known as Marine Band Quarry) is located to the immediate west of Yew Tree Quarry. LA and EA Historic landfill records indicate that this void was restored by Barnsley MBC between 1982 and 1987. The waste deposits are recorded to comprise household, commercial, industrial special and liquid sludge wastes.

7.4.14 Anecdotal evidence suggest that presence of 'Area 3 Quarry' / 'Area B' to the east of both Yew Tree Quarry and Marine Band Quarry. The history of this site is unclear.

Environmentally Sensitive Sites

7.4.1 There is one SSSI, 'Stairfoot Brickworks' located approximately 250m SSE of the Site. Another, 'Dearne Valley Wetlands' is located 983m South. The Stairfoot Brickworks SSSI relates to the exposure of Geologically important Marine Bands.

7.4.2 The Site is located within an Area of Adopted Green Belt, as well as a Nitrate Vulnerable Zone (NVZ)

Geology

Made Ground

7.4.3 No artificial or made ground is indicated within the Site boundary in the Envirocheck® report **(Appendix 7.1)** or the BGS 1:50,000 series 'Bedrock and Superficial Geology' maps. However, it is important to note that BGS data does not include deposits shallower than 2.5m.

7.4.4 Historical aerial imagery also indicates partial infilling of the quarry to date with soils and similar non-degradable materials, the exact depth of the existing restoration fill has not be established, but depths in excess of 5m are estimated from the available aerial imagery.

Superficial Deposits

7.4.5 There are no superficial deposits indicated onsite. The closest area with superficial deposits identified is approximately 430m Southwest / West, which are Alluvial deposits of clay, silt, sand, and gravel.

Bedrock Geology

7.4.6 An understanding of the localised bedrock geology has been obtained through the following sources:

i) BGS 1:50,0000 Series Bedrock and Superficial Geology Maps (Including cross-sectional maps where available)
ii) BGS Geoindex: borehole records
iii) BGS Index: Geology of the Barnsley district — a brief explanation of the geological map Sheet 87 Barnsley
iv) Crimes (1985). Land Reclamation at Stairfoot Brickworks Pit Geological Aspects of Phase 2

7.4.7 Crimes (1985) report focuses on the 'North Quarry' adjacent to the Northwest of Yew Tree Quarry, and is one of the only document that provides insight into geological characteristics local to The Site.

7.4.8 The regional geology within the local area is shown in **Appendix 7.1.**

7.4.9 Yew Tree quarry is located near Stairfoot, Barnsley, South Yorkshire. Barnsley sits within the Pennine Basin, to the east of the Peak District's raised moorland, which was deposited during the Carboniferous period.

7.4.10 As a result, the bedrock geology in this area is characterised by a Westphalian-stage Middle Coal Measures comprising interbedded mudstones, siltstones and sandstones. Locally there sandstones bands are quite substantial, including the Ackton Rock sandstone unit (previously named Warmfield Rock) that is shown by BGS 1:50,000 scale solid geology maps to outcrop within the site footprint, with a approximate northwest-southeast strike. The more substantial Oak Rock unit outcrops ~700m west of the Site, with further uplifted outcrop ~500m to the south. The Glass Houghton Rock sandstone unit outcrops ~175m to the east of the site, beyond which it ties in with downfaulted sections of the Mexborough Rock sandstone unit.

7.4.11 The Marine Band that outcrops ~120m to the south of the Site consists of black carbonaceous shales lying on ~1.3m of hard fractured fossiliferous limestone

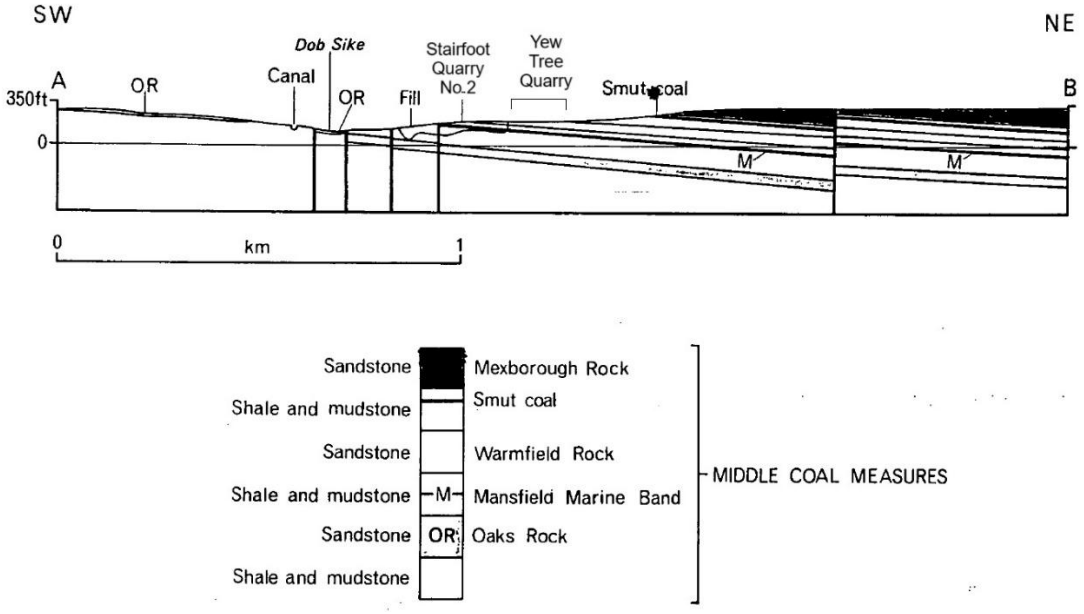
(Crimes, 1985)[2]. The southern edge of this band is where the Marine Band is partially exposed, particularly concerning the area bounded by the related SSSI.

7.4.1 The interbedded shales, mudstones, sandstones and marine band are reported by Crimes (1985)[2] to generally dip between 3 and 6 degrees to the Northeast within the vicinity of the former brickworks complex.

7.4.2 The quarry activities within Yew Tree Quarry will have worked the interbedded shales, mudstones and Ackton (Warmfield) Rock sandstones of the Pennine Middel Coal Measures. The sidewalls are therefore likely to comprise outcrops of interbedded shales, mudstones and sandstone, with the quarry base likely to have extracted to the Marine Band.

7.4.3 A geological cross-section through Yew Tree Quarry adapted from that prepared by Crimes (1985) is presented in **Image 7.1.**

Image 7.1 – Geological Stratigraphy of The Site and surroundings *(adapted from Crimes, 1985)*



[2] *Crimes TP, 1985. Land Remediation at Stairfoot Brickworks Pit Geological Aspects of Phase 2.*

Hydrogeology

7.4.4 The Coal Measures forms a complex multilayered aquifer. Argillaceous strata predominate, acting as aquitards or aquicludes, isolating the occasional thicker sandstone horizons which effectively act as separate aquifers.

7.4.5 Pennine Middle Coal Measures located within the footprint of the Site and the surrounding areas is classified as 'Secondary A Aquifer', due to the presence of permeable layers of rock that can support local water supplies and which may contribute to river base flow. The absence of any superficial deposits in the area means that the groundwater vulnerability of the Coal Measures aquifer is classed as high.

7.4.6 Coal Measures sandstones are generally fine grained, very well cemented, extremely hard and dense and in consequence possess very little primary porosity or intergranular permeability. Groundwater storage and movement occurs predominantly within and through fractures in the sandstones. Under natural conditions the sandstones act as individual aquifers separated by the intervening impermeable argillaceous horizons and constitute a complex multi-layered aquifer.

7.4.7 A summary of BGS Aquifer Properties Database by Jones et al (2000)[3] indicates that the permeabilities of the sandstones in the PMCM range up to only 0.01 m/d (20 mD) and porosity values generally range from 5 to 15%. The majority of these results were obtained from boreholes, with both porosity and permeability likely to be greater for outcrop locations. Samples of the mudstones and siltstones, which likely form the original base of the quarry void, are reported to have a laboratory determined permeability of $2x10^{-10}$ m/s (Crimes, 1985).

7.4.8 No intrusive investigations have been carried out to support this application and current groundwater levels beneath and surrounding the Site have not be established. Observations recorded by Crimes (1985) for the North Quarry area identified significant groundwater flow at ~53mAOD in the northeastern corner of the pit, at which the Ackton Rock outcrops. It was also noted that groundwater levels in

[3] *Jones, H K, Morris, B L, Cheney, C S, Brewerton, L J, Merrin, P D, Lewis, M A, MacDonald, A M, Coleby, L M, Talbot, J C, cKenzie, A A, Bird, M J, Cunningham, J, and Robinson, V K. 2000. The physical properties of minor aquifers in England and Wales. British Geological Survey Technical Report, WD/00/4. 234pp. Environment Agency R&D Publication 68.*

wells located in the then infilled Stairfoot Quarry No. 2 to the immediate west of the Site had rebounded to 52mAOD.

7.4.9 There are no source protection zones (SPZs) within 1km of the Site.

7.4.10 There are 2No. water abstractions within 1km of the Site, the details of which are summarised in **Table 7.5**. Both abstractions are made from springs located with upper reaches of a river valley at an elevation of between 85 and 90mAOD. This spring line coincides with the lower geological boundary of the Mexborough Rock sandstone unit where it bounds with underlying shales and mudstones dominated units. This sandstone aquifer unit is hydraulically segregated from the Ackton Rock by a significant thickness of intervening shale and mudstone units that sandwich the Glass Houghton Rock located towards the northwest of the Site. These abstractions are therefore not in hydraulic continuity with groundwater beneath the Site.

Table 7.5 – Summary of Licensed Groundwater Abstraction within 1km of the Site.

Distance & Direction	Details
740m; NE	Operator: Low Laithes Dairy Farm Ltd License: 2/27/08/029 Location: Spring No1 – Low Laithes Source: Groundwater Rate (daily/yearly m^3): 20/7300 Usage: General Farming and Domestic Start Date: 9th January 1990
773ml; NE	Operator: Low Laithes Dairy Farm Ltd License: 2/27/08/029 Location: Spring No2 – Low Laithes Source: Groundwater Rate (daily/yearly m^3): 216/4160 Usage: Other Industrial/Commercial/public Services: General Washing / Process Washing Start Date: 14th July 1999

Hydrology

7.4.11 The nearest water course to the Site is the Bob Sike which is located ~420m to the southwest of the Site at the nearest point. The fluvial channel flows approximately northwest to southeast, confluencing with the River Dove ~850m to the southeast of the Site, along the northern edges of the town of Wombwell.

7.4.12 A network of drainage ditches and attenuation ponds have been constructed around the periphery of the former brickworks complex. This network discharges to the southwest into the Bob Sike.

7.4.13 Artificial water-filed voids are present in the eastern most section of the Site, which extends across approximately 2/3 of the area, deepening towards the northeast. Another water-filled body is present in the north-eastern section of the North Quarry area. These water bodies have resulted from previous restoration activities where rainwater ponds on the surface of the existing restoration fill that are likely to restrict infiltration, with the water levels varying significantly over the course of a year in response to periods of rainfall or drought.

7.4.14 BGS flood data indicates that most of the Site, and large areas of the surroundings are at 'Limited' potential for groundwater flooding. Some areas to the southwest and west of the site have potential for groundwater flooding either below ground level, or at the surface. The eastern portion of the quarry void at the Site is reported to have potential for groundwater flooding below ground level, which is directly attributable to its excavated condition.

Ground Contamination

General Conditions

7.4.15 The Site comprises a former clay quarry which supplied the brickworks situated approximately 250m South, with related activities occurring on much of the surrounding area. Several historic household, commercial and industrial landfills are situated nearby, one of which was used for the harvesting of landfill gas to power brick furnaces.

7.4.16 The potential for contamination onsite arises from the former quarrying and brickmaking activities, including undocumented backfilling; spilling, pollution incidents and general contamination; as well as proximity to offsite historic landfills.

7.4.17 Potential sources of historic contamination are listed in **Table 7.6**, below.

Table 7.6 – Potential Sources of Historic Contamination

Details	Distance
Clay Pit – Sand, Gravel and Clay Extraction and Merchants.	9m
Clay Pit – Sand, Gravel and Clay Extraction and Merchants.	93m

Details	Distance
Clay Pit – Sand, Gravel and Clay Extraction and Merchants.	138m
Clay Pit – Sand, Gravel and Clay Extraction and Merchants.	157m
Clay Pit – Sand, Gravel and Clay Extraction and Merchants.	243m
Clay Pit – Sand, Gravel and Clay Extraction and Merchants.	244m
Workings (Dis) – Unspecified Quarries or Mines	248m
Works – Unspecified Works or Factories	309m
Works – Unspecified Works or Factories	281m
Clay Pit – Sand, Gravel and Clay Extraction and Merchants	311m

Soil Chemistry

7.4.18 The characteristics of the existing restoration fill material placed within the quarry void have not been established to support this assessment.

7.4.19 Future restoration materials would be sourced from uncontaminated development sites, that would meet with strict waste acceptance criteria to be derived as part of the application for a permit under the Environmental Permitting (England & Wales) Regulations 2016.

Nearby Landfills

7.4.20 There are numerous overlapping historic permitted landfills in the immediate area, with various superseding licenses and license holders. It is unclear exactly where the boundaries for each one are. Many were licensed long before the implementation of the Landfill Directive (19999/31/EC). These are shown in the Landmark® report presented in **Appendix 7.1**.

7.4.21 The most significant of these include a landfill to the immediate west and the immediate northwest of the Site. Public records indicate that these landfills include deposits of household, commercial, industrial, special and liquid sludges wastes.

7.4.22 The permitted landfill facility to the immediate north of the Site continues to be managed in in relation to landfill gas and leachate. Gas management is currently in the form of vents pipes and monitoring boreholes and manholes. These seem to be strategically located around the landfill periphery where properties are at potential risk from gas migration from the landfill. Two leachate wells are also located on the northern most section of the landfill.

Other Potential Contamination Sources

7.4.23 There are 3No. discharge consents located within 250m of the Site. The first of these was located immediately adjacent (4m) to the Site. This was a Sewage Pumping Station operated by Yorkshire Water Services Limited, for which the consent was revoked in 2005. A similar site is located ~137m away, with a consent issued in 1996, and a second issued in 2002.

7.4.24 There are no pollution incidents to controlled waters, or events recorded in the substantiated pollution incident register within 250m. Details of nearby pollution incidents within 500m of the Site are summarised in **Table 7.7**.

Table 7.7 – Nearby Pollution Incidents

Distance	Details
432m	Property Type: Misc. Premises, Unknown Easting: 437800 Northing: 404795 Pollutant: Unknown Sewage Reference: 103812 Receiving Water: No Pollution Severity: Category 3 – Minor Incident

7.4.25 There are several Local Authority regulated Part B installation activities located in the Stairfoot industrial estate located to the west of Wombwell Lane (A633). Several metal recycling and End-of-Life Vehicle (ELV) dismantling facility facilities are also established in the Stairfoot industrial estate. These industrial activities have the potential to lead to discharge of fuels and oils to ground if containment failures occur. No known incidents are reported in the public pollution incidents register.

7.5 Assessment of Effects

Conceptual Model

Potential Sources of Pollution

7.5.1 **Table 7.8**, below, outlines the potential sources of pollution onsite.

Table 7.8 – Potential Sources of Pollution

Source	Description
Non-degradable non-hazardous waste	Soils imported onsite are anticipated to be locally sourced. There is a possibility for misclassified waste, unknown physical or chemical contaminants, and particulate emissions.

Source	Description
Historic Quarry Usage	The Site has extensive industrial history, with the potential for undocumented activities. Made ground / backfilling is likely present, with the potential for localised contamination.
Adjacent Historic Landfills (Landfill gas and leachate)	There are many surrounding permitted and unlicensed landfill sites. There is potential for leachate and landfill gas migration, as well as the presence of old infrastructure, contaminated soils or perched water.
Local Ground Conditions	Naturally occurring contaminants may exist as part of the local geology. The oxidization of exposed material, or the mobilisation of contaminants poses a risk.
Restoration / Waste Recovery Activities	Potential for leaks and spills of hazardous liquids (e.g. oils, fuels) or various ground disturbances.

Potential Pathways

7.5.2 **Table 7.9**, below, outlines the potential pathways onsite.

Table 7.9 – Potential Pathways of Pollution

Pathway	Description
Soils, bedrock and Groundwater	Migration through unsaturated zones including waste, as well as groundwater through aquifers or permeable / fractured geological units.
Surface runoff	Contaminated soils or wastes have the potential to contaminate nearby waterbodies through surface discharge.
Gas / Vapour Pathways	Hazardous ground gases (including landfill gas) have to potential to migrate through soils or permeable geological units, including deposited wastes.
Direct Contact	Transfer of contaminated material offsite (e.g. on vehicles, contaminated clothes or footwear)

Potential Receptors

7.5.3 **Table 7.10**, below, outlines the potential receptors.

Table 7.10 – Potential Pathways of Pollution

Source	Description
Controlled Waters (Surface and Groundwater)	Controlled Waters must not be polluted, as outlined in the Water Resources Act (1991).
Site Soils	Potential for soils to be affected.
Surrounding Structures	Potential for nearby buildings and businesses to be affected.
Human Receptors	Potential for workers, nearby inhabitants, visitors or local businesses to be impacted.

Incorporated Mitigation

7.5.1 This section takes into account the primary mitigation measures and standard procedures or practices which are considered as part of the assessment.

Waste Acceptance

7.5.2 Strict waste acceptance procedures would be implemented to ensure that only suitable uncontaminated soils will be imported to restore the quarry. These measures would form part of the Environmental Permit secured for the restoration of the quarry. Wastes that are non-compliant would be rejected from the Site, minimising the risk of contaminated or otherwise unsuitable wastes being deposited.

Site Engineering

7.5.3 The Site engineering, including the design, placement and processes of waste infilling would be carried out in such a way that minimises risks to people or the environment.

7.5.4 A phasing plan is in place which manages the impact of infilling by limiting the exposure of unvegetated or loose ground during works which allows for tailored water management for each step of the process.

7.5.5 The progressive infilling of the Site also allows for greater control of ground-stability and controls erosion.

7.5.6 The attenuation capacity of the existing restoration materials would be assessed to establish their attenuation capacity to contaminant movements to underlying groundwater taking into account the waste acceptance criteria to be established as part of quantitative risk assessment to be prepared in support of the application for an Environmental Permit. If enhanced attenuation is determined through quantitative risk assessment methods, a artificial attenuation layer may be established along the base and/or sidewall as necessary.

Surface Water Management

7.5.7 A sustainable drainage system (SuDS) would be used onsite. These aim to mimic natural drainage by managing water at the location where it falls, rather than collecting in specific areas.

7.5.8 The use of a SuDS scheme means that the profile of the land, in addition to other engineered features like ditches or bunds, would be used to manage runoff and prevent erosion and waterlogging.

7.5.9 These can also be used to direct water away from vulnerable locations in and around the Site.

Pollution Prevention

7.5.10 Pollution prevention measures would be employed onsite and considered as part of the broader management plans. Such measures includes:-

i) spill response procedures, as well as spill kits to deal with any incidents relating the release of chemicals, oils or fuels that may be present.
ii) Plant or vehicles would only be refuelled or maintained in designated areas upon impermeable surfaces.
iii) Fuels, oils and chemicals, if stored, would only be kept in bunded areas.
iv) Following acceptance, waste is expected to be deposited onsite immediately meaning storage measures are not required.
v) Dedicated wheel-wash facilities and speed limits would be present onsite, which would reduce the likelihood of vehicle-borne contaminants being deposited onto the ground or via dust and air emissions.

Other Site Management and Health and Safety Procedures

7.5.1 The Site would be run in such a way that minimises the risk of harm to people and the environment, which would be assessed and outlined in the broader management plans.

7.5.2 This would include appropriate training and awareness for staff or site visitors, including site inductions and PPE requirements where appropriate.

7.5.3 Emergency response protocols would be in place for any hazards identified onsite.

Monitoring and Record Keeping

7.5.4 The Environmental Permitting Regulations would require that landfill gas, groundwater and surface water monitoring is undertaken to demonstrate that the appropriate measures implemented to control the risk to the environment are working within the design parameters.

7.5.5 Site management would ensure that routine inspections and record keeping are adhered to, such that compliance with any mitigation measures is achieved.

Restoration and Aftercare

7.5.6 The end use of the Site is a restored landform which would provide new habitats and Biodiversity Net Gain (BNG).

7.5.7 The final state of the Site for this purpose would continue to mitigate and manage any residual hydrological / geotechnical impacts, and this would continue to be managed according to the plans after completion.

Assessment of Potential Effects

7.5.8 This section outlines an assessment of the potential effects with respect to the source of potential hazards.

Groundwater / Surface Water Contamination

7.5.9 The restoration proposals would only seek to import uncontaminated soils for deposit via strict waste pre-acceptance procedures implemented to limit the likelihood of any contaminated soils being imported to the Site. The probability of the effect is considered **Low.**

7.5.10 The underlying aquifer is considered High Sensitivity Secondary 'A' Aquifer, for which no local abstractions are present from the underlying sandstone aquifer unit. This aquifer is also likely to be impacted by the surrounding dilute an disperse landfill facilities. The quarry also currently benefits from the presence of existing restoration fill which provides attenuation capacity to any rogue load inadvertently deposited. The severity of the risk to the Coal Measures aquifer is therefore **Low.**

7.5.11 The overall effect of contamination of groundwater from misclassified waste is considered **Low**, and therefore **Not Significant**.

Altered Groundwater Regimes

7.5.12 The quarry is already partially restored. The proposed restoration would not introduce significant preferential pathways beyond the baseline scenario, therefore the likelihood is considered **Very Low**.

7.5.13 Given the underlying aquifers are sandstone and considered High Sensitivity 'A' Secondary Aquifers, the severity is considered **Medium**.

7.5.14 The overall effect of altered groundwater regimes is considered **Moderate/Low**, and therefore **Not Significant**.

Altered Surface Water Regimes

7.5.15 During infilling, all surface waters would be managed within the Site and pumped for discharge to surface water in accordance with an Environmental Permit.

7.5.16 The restoration scheme would result in a raised final landform that would encourage surface water run-off to shed towards a the perimeter of the Site These waters would be captured by SuDS scheme, therefore no significant changes to surface water regimes are expected and the likelihood is considered **Low**.

7.5.17 There are no surface water features within close proximity of the Site therefore the severity is considered **Low.**

7.5.18 The overall effect of altered surface water regimes is considered **Low**, and therefore **Not Significant**.

Migration of Landfill Gas from Adjacent Degradable Waste Landfill Facilities

7.5.19 The restoration of the remaining quarry void would be carried out with non-degradable soils materials. These would typically comprise cohesive soils which would have a permeability that is lower than the surrounding sandstone bedrock. This is likely to impede the flow of hazardous gas. Gas control measures are also already in place along the boundary located between the Site and the North Quarry landfill which minimises the risk of gas migration. As such, the likelihood is considered **Very Low**.

7.5.20 Due to the hazardous nature of landfill gas, the severity of risk posed by landfill gas is regarded and **High**

7.5.21 The overall effect of the creation of preferential pathways for LFG or VOCs via infilling is considered **Low**, and therefore potentially **Significant**.

Disturbance of Hazardous or Non-Hazardous Wastes from adjacent landfills

7.5.22 The Site is physically separated from the adjacent landfill facilities to the northwest and west underwork sections of Coal Measures, over which the PRoWs are located. The likelihood of any disturbance of any adjacent landfill facilities is **Very Low**.

7.5.23 Any disturbance of the adjacent landfill facilities could result in releases of leachate that could result and short-lived contamination of controlled waters. The severity of these releases are **Medum**.

7.5.24 The overall effect of the disturbance of the adjacent landfills is considered **Low,** and therefore **Not Significant**.

Disturbance of the Stairfoot Brickworks SSSI

7.5.25 The Stairfoot Brickworks SSSI, where the Coal Measures Mansfield Marine Band is poorly exposed is located close to the Site meaning there is a potential for impacts.

7.5.26 The SSSI is 140m south of the Site, and is not near any of the proposed access routes, as such the likelihood is considered **Very Low**.

7.5.27 The Site is designated solely because it is a location where the Marine Band strata are exposed. These are unlikely to be indirectly affected by any works at the Site, although it may be accessed by larger numbers of people in future. As such, the severity is considered **Very Low**.

7.5.28 The overall effect of the disturbance of the Stairfoot brickworks SSSI is considered **Very Low**, and therefore **Not Significant**.

7.6 Mitigation

7.6.1 The restoration soils, which by their compacted and low risk nature, would hence not require active management. The surrounding geological and hydrogeological systems are not considered at risk based on the information reviewed to date.

7.6.2 Whilst gas generation in the adjacent landfill has not been quantified, for the purpose of this assessment it is considered that in light of the ongoing permitting requirements of the North Quarry landfill, it is assumed that a potential risk to nearby properties from landfill gas migration remains. However, the current risks are assumed to be

adequately managed by the existing control measures (perimeter venting). The development proposals would not alter the current risk. Moreover, the Environmental Permit to be secured for the proposed development would necessitate pre-cautionary ground gas monitoring to be carried out around the periphery of the Site, pending subsequent surrender of the permit.

7.7 Residual Effects and Conclusions

7.7.1 This chapter has drawn upon a range of information sources including existing site reports and British Geological Survey data to describe the geological and hydrogeological conditions immediately underlying and in the local environs of the Site.

7.7.2 The restoration of Yew Tree Quarry would be carried out using uncontaminated soils carefully selected and imported from low-risk development sites on a campaign basis. These soils would be deposited over existing restoration materials deposited across the based of the quarry void. Any further enhancement of the attenuation capacity across the base and sidewalls within the quarry would be established as part of an application for an Environmental Permit, which would regulate the importation and deposit of the soils to ensure that the underlying groundwater and surrounding surface water resources are protected.

7.7.3 The Environmental Permit would implement monitoring schedules to validate design and associated risk assumptions. These are likely to include schedules to monitor changes in surface water quality, groundwater quality and hazardous ground gases. However, the nature of the restoration materials would not require any active in-waste management controls to be implemented e.g. leachate of landfill gas extraction.

7.7.4 It is concluded that the Proposed Development is unlikely to result in any residual significant effects in relation to geology, hydrology and ground conditions in the vicinity of the Site. The restoration scheme has a lesser pollution than the historic adjacent landfilling activities meaning the development would not result in any significant environmental effects.