TEESWORKS

LACKENBY ENVIRONMENTAL STATEMENT

VOLUME 2: CHAPTER G
GROUND CONDITIONS AND REMEDIATION

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Lackenby, South Tees
Volume 2: Environmental Statement (December 2020)
Chapter G: Ground Conditions and Remediation

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Contents

G1.0 Introduction

G1.1 This chapter of the Environmental Statement ('ES') has been prepared by Arcadis on behalf of the applicant, South Tees Development Corporation ('STDC'). It assesses the proposed development described in Chapter B and it considers the effects of the proposed development on the site's ground conditions and the need for remediation.

G1.2 The baseline situation is considered before the likely environmental effects of the development are identified, during the construction phase of the development. The operational phase of the development has been scoped out in relation to ground conditions and remediation, the rationale for which is provided in Chapter A of the ES and Section G3.0 of this chapter. Mitigation measures to reduce any adverse environmental effects are identified as appropriate before the residual environmental effects are assessed.

G1.3 This chapter is supported by the following technical appendices: -

1 **Appendix G1:** Site Layout and Areas Plan;

2 **Appendix G2:** Soil and Groundwater Baseline Characterisation Study Corus Teesside Works, Factual Report Volume 1 by Enviros Consulting Ltd, dated June 2004;

3 **Appendix G3:** Soil and Groundwater Baseline Characterisation Study Corus Teesside Works, Interpretative Report Volume 2 by Enviros Consulting Ltd, dated June 2004;

4 **Appendix G4:** Soil and Groundwater Baseline Characterisation Study Corus Teesside Works, Summary Report Volume 3 by Enviros Consulting Ltd, dated June 2004;

5 **Appendix G5:** Examination of 21 Samples from Former SSI Steelworks, Redcar for AEG by Thomas Research Services Ltd Report Ref: BG8A/AEG/R4155/TRS/05/18/RP2 dated May 2018;

6 **Appendix G6:** The Former SSI Steelworks, Redcar – Ground Investigation Contract – Priority Areas within SSI Landholdings Contract 3 by Allied Exploration and Geotechnics Ltd (AEG) Contract Number 4155 dated June 2018;

7 **Appendix G7:** The Former SSI Steelworks, Redcar: Priority Areas within SSI Landholdings Contract 3. Environmental Risk Assessment Report prepared by Arcadis for South Tees Site Company Ltd. REPORT NO. Redcar Steelworks-AUK-XX-XX-RP-GE-0001-01-SSI3_GI_ERA, dated August 2018;

8 **Appendix G8:** The Former SSI Steelworks, Redcar: Priority Areas within SSI Landholdings Contract 3. Site Condition Report prepared by Arcadis for South Tees Site Company Ltd. REPORT NO. Redcar Steelworks-AUK-XX-XX-RP-GE-0001-02-SSI3_GI_SCR, dated August 2018;

9 **Appendix G9:** The Former SSI Steelworks, Redcar: Priority Areas within SSI Landholdings Contract 3. Geotechnical Risk Assessment Report prepared by Arcadis for South Tees Site Company Ltd. REPORT NO. Redcar Steelworks-AUK-XX-XX-RP-GE-0001-P1-SSI3_GI_GRA, dated November 2018.

10 **Appendix G10:** The Former SSI Steelworks, Redcar: Priority Areas within SSI Landholdings Contract 3. Ground Remediation Options Appraisal Report prepared by Arcadis for South Tees Site Company Ltd. REPORT NO. Redcar Steelworks -AUK-XX-XX-RP-GE-0001-01-SSI3_GI_ROA, dated December 2018;

11 **Appendix G11:** Former Steelworks Land, South Tees Outline Remedial Strategy, Prepared for South Tees Development Corporation by Wood, Ref 41825-wood-XX-XX-RP-OC-0001_S0_P01 dated 25th June 2019 [Wood 2019];

12 **Appendix G12:** Regulatory Liaison with Redcar and Cleveland Borough Council (RCBC 2020);

13 **Appendix G13**: Regulatory Liaison with Environment Agency (NA/2019/114630/01-L01, August 2019) and Regulatory Liaison with Redcar and Cleveland Borough Council (RCBC 2019) (on Wood Report);

14 **Appendix G14**: Groundsure Enviro & Geo Insight [Groundsure 2020];

About the Author

G1.4 This chapter has been prepared by Alison Pugh BSc (Hons), MSc, C.WEM, CEnv, CSci, Principal Consultant at Arcadis UK Ltd. Alison has over 20 years' experience in contaminated land assessment, chemical analysis and remediation including the preparation of Environmental Statements for Environmental Impact Assessments (EIA) and other regulatory, permitting and planning support across a range of commercial, industrial, and residential development projects.

G1.5 This chapter has been reviewed by Chris Piddington PhD, BEng (Hons), Technical Director at Arcadis UK Ltd. Chris has over 18 years' experience in delivering bespoke contaminated land solutions and brownfield regeneration schemes. His work includes the preparation of Environmental Statements to support Environmental Impact Assessments in addition to providing support and guidance in relation to regulatory, permitting and planning challenges across a diverse range of development projects.

G1.6 Arcadis is a member of the IEMA EIA Quality Mark.

G2.0 Policy Context

National Policies and Legislation

G2.1 The legislation, policy and documentation applicable to Land Quality and Soil Contamination at the national level are listed in Section G10 (References) of this chapter and shown below. These documents are used to guide the assessment of potential risks posed by contamination, the significance of potential impacts as well as inform mitigation measures in line with industry good practice.

1 Environmental Protection Act 1990 Part II (Ref 1);

2 Environment Act 1995 (Ref 2);

3 Environment Agency 2008, An ecological risk assessment framework for contaminants in soil. Science Report SC070009/SR1 (Ref 3);

4 Derivation and use of soil screening values for assessing ecological risks Report – ShARE id26 (revised) (Ref 4);

5 BRE Special Digest (SD) 1: Concrete in Aggressive Ground, 2015 (Ref 5);

6 Environmental Permitting (England and Wales) Regulations 2010 (Ref 6);

7 Control of Pollution (amendment) Act 1989 (Ref 7);

8 Water Framework Directive 2000/60/EC (Ref 8);

9 Groundwater Directive 2006/118/EC (Ref 9);

10 Controlled Waste (Registration of Carriers and Seizure of Vehicles) Regulations 1991 (as amended) (Ref 10);

11 Controlled Waste (England and Wales) Regulations 2012 (Ref 11);

12 Construction (Design and Management) Regulations 2015 (Ref 12);

13 Hazardous Waste (England and Wales) Regulations 2005 (Ref 13);

14 Waste (England and Wales) Regulations 2011 (Ref 14);

15 Waste Framework Directive 2008/98/EC (OJEU, 2008) (Ref 15);

16 The Contaminated Land (England) Regulations 2006 (Ref 16);

17 The Environment Damage (Prevention and Remediation) Regulations 2015 (Ref 17);

18 National Planning Policy Framework, 2019 (Ref 18);

19 Environment Agency, Guiding Principles Land Contamination (GPLC2) (Ref 19);

20 Environment Agency, Land Contamination Risk Management (2019) (Ref 20);

21 Environment Agency, Land contamination groundwater compliance points: quantitative risk assessments, 2017 (Ref 21);

22 Environment Agency, Protect groundwater and prevent groundwater pollution, 2017 (Ref 22);

23 Environment Agency, Groundwater protection technical guidance, 2017 (Ref 23);

24 Environment Agency, The Environment Agency's approach to groundwater protection, 2018 (Ref 24);

25 British Standards 10175:2011+A2:2017 'Investigation of Potentially Contaminated Sites - Code of Practice' 2017 (Ref 25);

26 British Standards BS3882:2015 'Specification for Topsoil and Requirements for Use' 2015 (Ref 26);

27 British Standards BS EN 206:2013+A1:2016 'Concrete - Specification, Performance, Production and Conformity' 2013 (Ref 27);

28 BSI Standards Publication "Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings", BS 8485:2015+A1:2019 (Ref 28);

29 CIRIA C665 'Assessing risks posed by hazardous ground gases to buildings' 2007 (Ref 29);

30 CIRIA C552 Contaminated Land Risk Assessment A Guide to Good Practice. 2001 (Ref 30);

31 CIRIA C692 Environmental Good Practice on Site. 4th Edition 2015 (Ref 31);

32 National House Building Council, Environment Agency and Chartered Institute of Environmental Health 'R&D Pub 66: Guidance for the Safe Development of Housing on Land Affected by Contamination (Volumes 1 & 2), 2008 (Ref 32);

33 National House Building Council, Guidance on Evaluation of Development Proposal on Site Where Methane and Carbon Dioxide are Present Report Edition No.4 March 2007 (Ref 33);

34 EA's 'TR P5-065/TR: Technical Aspects of Site Investigation (Volumes 1 & 2)' 2002 (Ref 34);

35 DEFRA (2012) Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance; and DEFRA Guidance, Pollution Prevention for Businesses, July 2016 (Updated May 2019) (Ref 35).

National Planning Policy

G2.2 The National Planning Policy Framework (NPPF) 2019 sets out the Government planning policies for England and how these are to be applied. Chapter 11 (Making effective use of land) and Chapter 15 (Conserving and enhancing the natural environment) of the NPPF - contain the following paragraphs which are relevant to this assessment and are summarised below:

1 Paragraph 117 states that "Strategic policies should set out a clear strategy for accommodating objectively assessed needs, in a way that makes as much use as possible of previously-developed or 'brownfield' land".

2 Paragraph 118 (c) states that "planning policies and decisions should give substantial weight to the value of using suitable brownfield land within settlements for homes and other identified needs, and support appropriate opportunities to remediate despoiled, degraded, derelict, contaminated or unstable land".

3 Paragraph 170 requires that the planning policies and decisions should "contribute to and enhance the natural and local environment by: (a) protecting and enhancing valued landscapes, sites of biodiversity or geological value and soils; (b) recognising…the wider benefits from natural capital and ecosystem services…; (d) minimising impacts on and providing net gains for biodiversity…; (e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability…; and (f) by remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate".

4 Paragraph 178 requires that "planning policies and decisions should ensure that: (a) a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination. This includes risks arising from natural hazards or former activities such as mining, and any proposals for mitigation including land

remediation (as well as potential impacts on the natural environment arising from that remediation); (b) after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and (c) adequate site investigation information, prepared by a competent person, is available to inform these assessments".

5 Paragraph 179 states that "where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner".

G2.3 Guidance from the Ministry of Housing, Communities & Local Government includes online planning policy guidance on 'Land affected by contamination' (2019) and 'Land stability' (2019).

Local Planning Policy

G2.4 Redcar and Cleveland Borough Council (RCBC) will determine the outline planning application in accordance with Section 38(6) of the Planning and Compulsory Purchase Act 2004, which states that planning applications must be made in accordance with the development plan unless material considerations indicate otherwise.

G2.5 In this case, the relevant statutory development plan comprises:

1 Redcar and Cleveland Local Plan (adopted May 2018);

2 Local Plan Policies Map; and

3 The Tees Valley Joint Minerals and Waste Development Plan Documents, comprising:

(a) Minerals and Waste Core Strategy DPD (adopted September 2011); and

(b) Minerals and Waste Policies and Sites DPD (adopted September 2011).

G2.6 Planning policies relevant to ground conditions and remediation associated with the proposed development are set out below.

G2.7 Local Plan Policy LS 4 (South Tees Spatial Strategy) includes the following aims in relation to the environment;

1 enhance the environmental quality of employment through well planned boundary treatments;

2 secure decontamination and redevelopment of potentially contaminated land;

3 protect European sites, and safeguard and improve sites of biodiversity interest particularly along the River Tees and the estuary and encourage integrated habitat creation and management;

4 enhance the environmental quality of the River Tees and coastline; and

5 encourage improvements to access, interpretation and wildlife conservation and biodiversity across the area.

G3.0 Assessment Methodology & Significance Criteria

Assessment Methodology

G3.1 The assessment of impacts to and from the existing ground conditions and from the proposed development is undertaken using importance and significance criteria that have been developed by Arcadis, and successfully applied to other Environmental Impact Assessments. The methodology considers the potential presence of land and groundwater contamination as well as sites of geological/geomorphological significance such as geological conservation features or mineral resources. Geotechnical constraints e.g. differential settlement, subsidence and the potential for explosive ground gas accumulation are also highlighted with the built environment identified as the main sensitive receptor. The built environment includes foundations, below-ground structures, utilities equipment and buildings.

G3.2 The reports detailed below (listed as appendices in paragraph G1.3 above) and an up-to-date Groundsure Report have been used to establish the baseline conditions. All supporting information is consistent with the risk-based framework adopted by the Environment Agency: Land Contamination Risk Management (2020).

- The Former SSI Steelworks, Redcar – Ground Investigation Contract – Priority Areas within SSI Landholdings Contract 3 by Allied Exploration and Geotechnics Ltd (AEG) Contract Number 4155 dated June 2018.
- Examination of 21 Samples from Former SSI Steelworks, Redcar for AEG by Thomas Research Services Ltd Report Ref: BG8A/AEG/R4155/TRS/05/18/RP2dated May 2018.
- Soil and Groundwater Baseline Characterisation Study Corus Teesside Works, Factual Report Volume 1 by Enviros Consulting Ltd, dated June 2004.
- Soil and Groundwater Baseline Characterisation Study Corus Teesside Works, Interpretative Report Volume 2 by Enviros Consulting Ltd, dated June 2004.
- Soil and Groundwater Baseline Characterisation Study Corus Teesside Works, Summary Report Volume 3 by Enviros Consulting Ltd, dated June 2004.
- The Former SSI Steelworks, Redcar: Priority Areas within SSI Landholdings Contract 3. Site Condition Report prepared by Arcadis for South Tees Site Company Ltd. REPORT NO. Redcar Steelworks-AUK-XX-XX-RP-GE-0001-02-SSI3_GI_SCR, dated August 2018.
- The Former SSI Steelworks, Redcar: Priority Areas within SSI Landholdings Contract 3. Environmental Risk Assessment Report prepared by Arcadis for South Tees Site Company Ltd. REPORT NO. Redcar Steelworks-AUK-XX-XX-RP-GE-0001-01-SSI3_GI_ERA, dated August 2018.
- The Former SSI Steelworks, Redcar: Priority Areas within SSI Landholdings Contract 3. Geotechnical Risk Assessment Report prepared by Arcadis for South Tees Site Company Ltd. REPORT NO. Redcar Steelworks-AUK-XX-XX-RP-GE-0001-P1-SSI3_GI_GRA, dated November 2018.
- The Former SSI Steelworks, Redcar: Priority Areas within SSI Landholdings Contract 3. Ground Remediation Options Appraisal Report prepared by Arcadis for South Tees Site Company Ltd. REPORT NO. Redcar Steelworks -AUK-XX-XX-RP-GE-0001-01-SSI3_GI_ROA, dated December 2018.

G3.3 Potential and actual sources of contamination associated with the site are identified by considering:

1 Current and previous land use from a study of existing reports, current and historic maps, photographs, local history sources, environmental database information, and a site inspection; and

2 Available intrusive site investigation data and contamination/ground conditions assessments.

G3.4 Following the identification of potential sources of contamination, the presence and sensitivity of receptors at risk from potential or known contamination are identified by consideration of the following.

1 Surrounding land uses, based on mapping and site visits and existing planning designations;

2 Proposed end-use, based on the nature of the proposed development;

3 Type of construction operations that will be necessary during the construction phase of development;

4 Nearby Sites of Nature Conservation Interest (SNCIs), Special Protection Areas (SPAs), Sites of Special Scientific interest (SSSI) and other protected areas; and

5 Geology, hydrogeology and hydrology of the site and surrounding area.

G3.5 Where a significant source has been identified and potential sensitive receptors are present, the potential effects can be determined by considering the pathways through which the source/hazard may affect the receptors. The magnitude of effect and the significance of effect is then determined taking due account of the nature of the pathway between a source and a receptor.

G3.6 For each of the potential effects assessed to be likely, a qualitative assessment is made on the significance of the effect on the receptor.

Operational Phase – Scoped Out

G3.7 The operational phase of the proposed development has been scoped out from consideration in this chapter for the following reasons:

1 Contamination that is present at the site will be remediated and managed during the construction phase and therefore the risk from historic contamination during operation will be Negligible and Not Significant;

2 It is assumed further assessment of ground gas risks will be undertaken in order to identify appropriate gas protection measures, if required, based on specific development proposals. The required gas protection measures would be incorporated into the buildings during construction and therefore the risk to the occupiers would be Negligible and Not Significant;

3 Whilst the proposed operational site is industrial (Class B2 and B8) and therefore may use, handle and/or store hazardous substances or wastes, it is assumed appropriate permits will be in place and such operations would be governed by legislation in order to operate safely, therefore the risk from new contamination would be Negligible and Not Significant. Where required, storage tanks will be located within controlled areas and within bunding sufficient to contain liquids in case spillage or rupture;

4 It is also noted that post development the sites will mainly be covered by buildings and hardstanding (access roads and car parks etc) which will also reduce the risk of contamination in spillage events from adversely affecting surface water or groundwater as well as reducing leaching of residual soil contamination due to rainfall.

5 It is assumed areas of hardstanding will be designed to avoid uncontrolled discharges to drains. Site drainage and networks will be lined with impermeable geomembrane so there is no interaction with contaminated land. Soakaways will be not be employed to limit mobilisation of contaminants. The groundwater beneath the site is considered low sensitivity;

6 Materials used in infrastructure will be designed and specified accordingly taking due account of the potential for aggressive ground conditions such as those related to the possible presence of elevated sulphate or the presence of ground gas;

7 The preparation of a geotechnically suitable development platform for a specific redevelopment is the responsibility of the developer.

G3.8 As discussed below, consultation has taken place and the Environment Agency has agreed to the operational phase being scoped out of this chapter.

Significance Criteria

G3.9 The impact is assessed in terms of the sensitivity or importance of a receptor or feature, and the magnitude of change or scale of impact during the construction phases of the proposed development. The importance of potentially affected geological/geomorphological features and the sensitivity of receptors, which may be affected by land contamination impacts, have been assessed according to the four-point scale shown in Table G3.1 below.

Table 3.1 Significance criteria - sensitivity of receptors

Sensitivity / Value of Receptor	Receptors Susceptible to Land Contamination and Ground Hazard Impacts	Soil and Geological Resources
Very High	Residential areas or schools within 50 m of construction works Construction workers involved in below ground works Water features deemed to be of high value Ecological features deemed to be of high value Allotments, arable farmland, livestock or market gardens on or adjacent to the site	Internationally and nationally designated sites Regionally important sites with limited potential for substitution High quality agricultural soils (Grade 1 and 2) or soils of high nature conservation or landscape importance Presence of significant mineral reserves and within a Mineral Consultation Area Soil/materials disposal required following earthworks resulting in a significant increase in demand on waste management infrastructure
High	Residential areas or schools within 50 to 250 m of construction works Commercial areas within 50 m of construction works Construction workers involved in above ground works Water features deemed to be of medium value Ecological features deemed to be of medium value The built environment including buildings and infrastructure	Regionally important sites with potential for substitution Locally designated sites with limited potential for substitution Good quality agricultural soils (Grade 3a) or soils of medium conservation or landscape importance Site within a Mineral Consultation Area Soils/materials disposal required following earthworks resulting in a moderate increase in demand on waste management infrastructure
Medium	Residential areas >250 m from construction works Commercial areas within 50 to 250 m of construction works Water features deemed to be of low value Ecological features deemed to be of low value	Undesignated sites of some local earth heritage interest Moderate or poor quality agricultural soils (Grade 3b or 4) or soils of low nature conservation or landscape importance Limited potential for mineral reserves and site not within a Mineral Consultation Area Soil/materials disposal required following earthworks resulting in a limited or minor increase in demand on waste management infrastructure
Low	Areas where there are no built structures, crops, or livestock Commercial areas within >250 m of construction works Ecological and water features deemed to be of negligible value	Other sites with little or no local earth heritage interest Very poor quality agricultural soils (Grade 5) or soils of negligible nature conservation or landscape importance. Negligible potential for mineral reserves to exist

G3.10 Table G3.2 below sets out the magnitude criteria used to assess the magnitude of impacts in this chapter.

Table 3.2 Significance Criteria - Magnitude of Impacts

Magnitude of Impact	Receptors Susceptible to Land Contamination and Ground Hazard Impacts	Soil and Geological Resources
High	Human Health: Acute risk to human health Surface waters and/or groundwater: Substantial acute pollution or long term degradation of sensitive water resources (Principal Aquifer, groundwater source protection zone, surface waters of good or very good quality) Ecology: Significant change to the number of one or more species or ecosystems Built Environment: Catastrophic damage to buildings, structures or the environment Landscaping/Agriculture: Loss in value of livestock or crops as a result of death, disease, or physical damage.	Loss of feature or attribute Earthworks resulting in high volume of surplus soil for off-site disposal Classification of surplus soil as Hazardous Waste where the intention is to discard
Medium	Human Health: Chronic risk to human health Surface water and/or groundwater: Pollution of non-sensitive water resources or small scale pollution of sensitive water resources (Principal or Secondary Aquifers of water courses of fair quality or below1) Ecology: Change to population densities of non-sensitive species Built Environment: Damage to buildings, structures or the environment Landscaping/Agriculture: Non-permanent health effects to vegetation/crops from disease or physical damage, which results in a reduction in value.	Impact on integrity of or partial loss of feature or attribute Earthworks resulting in moderate volume of surplus soil for off-site disposal

Low	Human Health: Slight reversible short-term effects to human health Surface waters and/or groundwater: Slight pollution of non- sensitive water resources Ecology: Some change to population densities of non- sensitive species with no negative effects on the function of the ecosystem Built Environment: Easily reparable effects of damage to buildings or structures Landscaping/Agriculture: Slight or short term health effects which result in slight reduction in value	Minor impact on feature or attribute Earthworks resulting in low volume of surplus soil for off-site disposal
Negligible	Human Health: No measurable effects on humans Surface waters and/or groundwater: Insubstantial pollution to non-sensitive water resource Ecology: No significant changes to population densities in the environment or in any ecosystem Built Environment: Very slight non structural damage or cosmetic harm to buildings or structures Landscaping/Agriculture: No significant reduction in landscape value.	Impact of insufficient magnitude to affect use or integrity of feature or attribute No off-site disposal of surplus soil required

G3.11 The significance of the effect of the impact has been determined in accordance with the matrix shown in Table G3.3 below.

Table 3.3 Significance Criteria - Significance of Effect

	Magnitude of Impact			
Sensitivity/value of a Receptor	High	Medium	Low	Negligible
Very High	Substantial	Substantial	Moderate	Minor
High	Substantial	Moderate	Minor	Negligible
Medium	Moderate	Minor	Negligible	Negligible
Low	Minor	Negligible	Negligible	Negligible

G3.12 The above significance of effects criteria are all considered to be Adverse. It is considered that any potential impact determined with a significance of Moderate Adverse or Substantial Adverse is a significant impact for the purposes of this EIA.

Consultation

G3.13 Arcadis (UK) Ltd undertook consultation regarding this chapter with Mick Gent, Contaminated Land Officer, RCBC on 9th November 2020 and Caitlin Newby, Environment Agency on 4th December 2020 concerning the basis for the assessment including the available sources of information, scoping out the operational phase of the assessment and the suitability of the Significance Criteria described above.

G3.14 Mick Gent agreed via email dated 7th December (see Appendix G12) that the Significance Criteria are acceptable. No formal response has been received by Caitlin Newby, but she confirmed in the meeting that scoping out the operational phase was acceptable.

Assumptions and Limitations

G3.15 The conclusions reached within this ES chapter are based in part upon information and/or documents that have been prepared by third parties. In view of this, we accept no responsibility or liability of any kind in relation to such third-party information and no representation, warranty or undertaking of any kind, express or implied, is made with respect to the completeness, accuracy or adequacy of such third party information.

G3.16 There are currently a number of data gaps regarding the geochemical and geotechnical characterisation of ground conditions and contamination at the site which will likely require further site investigation and risk assessment in order to further inform the CSM (conceptual site model) and confirm the significance of the potential Source Pathway Receptor ('SPR') linkages.

G3.17 The assessment undertaken within this chapter is supported by a Remedial Options Appraisal report (Appendix G10) which identifies the relevant SPR linkages (based on current data) and a possible approach to addressing the potential risks to identified receptors. It is assumed that no active groundwater remediation is required on the site due to previous discussions with the Environment Agency regarding the Outline Remediation Strategy (Appendix G11) which was prepared for other areas within the Teesside area. Comments on the Woods strategy have been obtained from the Environment Agency (NA/2019/114630/01-L01, August 2019 (Appendix G13). These state that past industrial activity is considered to pose a medium risk of pollution to controlled waters. The Outline Remediation Strategy also considers that the potential hazard to controlled waters is medium but that given the low likelihood of occurrence and low sensitivity of the controlled water receptors the significance of this risk is moderate / low, and that no active remediation of groundwater is required. Comments received from RCBC (Appendix G13) state that they are satisfied that the Wood strategy adequately covers parts (a) (Site characterisation) and (b) (Submission of a Remediation Scheme) of the standard contaminated land conditions. Therefore, it is assumed that the overarching remediation scheme described within the Outline Remediation Strategy is acceptable and that active remediation of groundwater is not required (subject to any further data that may be obtained as part of addressing identified data gaps). Whilst this strategy does not cover the proposed development site, it is assumed that the groundwater across the whole Teesworks site would be considered the same and therefore no active groundwater remediation is required. The effect of the proposed development on groundwater is however still considered in this EIA (see Sections G5 and G7 below).

G3.18 It is assumed that the buildings currently located on site will be subject to an application for demolition under a separate consenting process which will include a Demolition Method Statement and specification for the appropriate infilling of voids such as basements. Demolition has not, therefore been considered in this chapter.

G3.19 It is assumed that the minimum finished floor level (FFL) will be 10m AOD. The maximum development height is anticipated to be 36m and this allows for a greater FFL dependant on developer requirements. As such, this ES assumes that the construction phase of the site will be cut and fill neutral and that excavated material can be reused onsite to construct the development platforms.

G3.20 It is assumed that existing permits associated with specific areas within the proposed development area, including permitted activities regulated by the Environment Agency ('EA')

and by RCBC, will be surrendered in accordance with relevant regulations and guidance to the satisfaction of the relevant authority alongside remediation works prior to site redevelopment.

G4.0 Baseline Conditions

Existing Conditions

G4.1 The development site is 35.8 ha in size. It is brownfield industrial land and is extensively occupied by buildings and structures associated with its former use for steel making. It is located within the southern part of the Teesworks area and lies between the Grangetown Prairie (also known as Dorman Point) area and the British Steel area. It is immediately north west of the Wilton International area and the A1085 trunk road and is to the south east of the Landfill and Waste Management Facilities area as identified in the STDC Master Plan.

G4.2 A site location plan is included in Appendix G1.

G4.3 The site is immediately bounded by the internal Teesworks road infrastructure to the north west, the east and the south; and Tees Dock Road to the west.

G4.4 The development site is approximately rectangular in shape and is defined by existing surrounding road infrastructure. The site is extensively occupied by buildings and structures associated with the former SSI Basic Oxygen Steel (BOS) and continuous casting (CONCAST) steelmaking facilities. Prior to its use for steelmaking the site had not been used for industry and was open fields up to the mid-1950s.

G4.5 Most of the site is covered by buildings, structures, or hardstanding, however there is some scrub type vegetation in the south eastern part of the site and in the northern corner. The buildings on the site are mostly large industrial shed style buildings, although there are also a few smaller brick-built buildings. It is understood that there are significant basements under the structures on site. The built structures on the site include tanks, chimneys, industrial style pipes and conveyors. To the south of the central cluster of industrial sheds, the ground cover includes a number of mounds of material associated with former uses on the site. A redundant railway line is also present on the south western and northern parts of the site.

G4.6 The internal STDC road network runs across the site. A road runs in a north south direction along the western side of the site, and various spurs into the site connect to the former industrial buildings and infrastructure.

G4.7 The former Hot Metal Transfer Railway extends into the southern part of the site, connecting to the large industrial buildings on the site. The freight rail line has spurs entering the northern part of the site and also connecting to the large industrial buildings. One of these spurs extends a significant way into the site.

G4.8 The site contains an electricity pylon in the northern corner and an electricity substation is present just outside the site adjacent to the southern boundary. Several large industrial transformers are present within and adjacent to the BOS plant. A power transmission line is also present under the southern part of the site.

G4.9 The Boundary Beck runs in a north south direction across the eastern side of the site via an underground culvert. A cross connector, which links the Boundary Beck to the Kinkerdale Beck, also via an underground culvert, is present at the northern extent of the site. These all discharge into Lackenby Channel and then the River Tees.

G4.10 In the north of the site there is infrastructure associated with a large water treatment facility. Other water infrastructure present on the site comprises; potable water supply pipes that skirt the north western edge of the site and cross the northern part of the site in an east west direction; industrial water mains which are present under the southern, western, and north western edges of the site and extend southwards under the eastern part of the site; and an NWL

water mains that is present under the western edge of the site running in a north south direction. There is a heavy fuel oil line running down the eastern boundary and a gas main for the Coke Oven in the north.

Historical Setting

G4.11 A review of the historical development of the site was undertaken based primarily on a Groundsure Report (Appendix G14) and associated historical OS maps.

G4.12 Large scale historic maps are available between 1857 and to 2020. The table below provides a summary of significant changes on the site and surrounding area.

Table G4.1 Summary of Historic Site Development across Site

Date	Description	
	Within Site Boundary	Outside Site Boundary
1856 - 1857	Site is undeveloped farmland	Surrounding area is undeveloped.
1894 – 1895	Clay pits encroach on to the north western section of the site. Allotment gardens associated with Eston Grange are also in this area. Kinkerdale Beck watercourse flowing in a northerly direction is shown in north east of site.	To the north is Lackenby Iron Works with infrastructure indicated. Railway line is running north east to south west with Eston Grange station to the north west. Cleveland Steel Work is indicated to the west of the site. Kettle Beck watercourse is indicated to the south east which merges with Kinkerdale Beck to the east of the site boundary.
1913 – 1915	Buildings and rail infrastructure associated with Grangetown Power Station are present in the north western section.	No significant changes in the surrounding area.
1929	The buildings now associated with the Tees Valley Water Board in the north west have expanded and tanks / chimneys are indicated. Several reservoirs are also indicated in this area.	An Engineering Works is indicated to the west of the site.
1952	Tees Dock Road been constructed to the west and forms the western boundary of the site. Electricity Sub-station is indicated in the area of the power station / Tees Valley Water Board but is marked as disused. Reservoirs are present but annotated as disused.	Lackenby Steel Works is no longer indicated. A small Tees Slag Wool works is shown on the eastern side of the railway line with the Lackenby Slag Breaking Plant on the west.
1974	The site is part of South Teesside Works Lackenby and is mainly covered with buildings and associated rail infrastructure.	Lackenby Works extends to the east and west of the site. Lackenby Tank Farm is to the north on opposite side of railway line.
1988 - 2020	No significant changes have occurred on site, with the buildings remaining on site.	The Tank farm to the north is no longer indicated on the 1992 edition. Teesside Works Cleveland is indicated to the north.

		Buildings to the west of the site have been demolished

Summary of Site History

G4.13 The earliest maps indicated that the site remained predominantly as open fields traversed approximately north to south by Kinkerdale Beck until the late 1950s. Minor areas were developed prior to this including small clay pits in the north west of the site in late 1890s and Grangetown Power Station from 1919 until after 1960 along with associated cooling reservoirs and transformers. Ordnance Survey mapping also indicates extensive filling / reprofiling works across the site in the 1960s.

G4.14 The current structures were constructed by 1974 and are shown on historic mapping generally in its present-day arrangement. The layout includes numerous storage areas and tanks.

Previous Environmental Assessments

G4.15 Available and relevant historic reports and exploratory location records have been identified by Arcadis and these are used to inform the baseline assessment to this EIA.

The scope and relevance of previous intrusive environmental site investigations is given in Table G4.2 below

Table G4.2 Summary of Previous Site Investigations

Relevant & Available Reports	Relevant Site Area	Outline Scope
Enviros Ltd (Appendices G2 to G4)	Lackenby Area	5 boreholes (groundwater monitoring) and 12 trial pits Approximately 17 soil samples analysed for metals, pH, sulphate cyanide and PAHs, phenol, and Total Petroleum Hydrocarbons (TPH) were taken from within the site boundary Five groundwater samples from wells for metals, pH, sulphate, cyanide and PAHs, phenol and TPH analysis
Arcadis (UK) Ltd (Appendices G7 to G10) Allied Exploration and Geotechnics (AEG) Ltd (Appendix G6)	Area B – BOS/CONCAST Plant	75 no machine excavated trial pits Drilling of 4 no. boreholes using Cable-Percussive drilling techniques and one advanced with rotary drilling; and Installation of 3 no. groundwater monitoring wells, and 1 no. combined groundwater / ground gas monitoring well
TRS Report (Appendix G5)	Area B – BOS/CONCAST Plant	Analysis of 15 bulk samples to identify the range and relative concentrations of iron and steelmaking slags present, and whether there was any potential for volumetric instability from the materials

Data Gaps

G4.16 There are currently a number of data gaps regarding the geochemical and geotechnical characterisation of ground conditions and contamination at the site which will likely require

further site investigation and risk assessment in order further inform the CSM and confirm the significance of the potential SPR linkages. These are as follows:

1 Soil and Ground Contamination - Site investigation has not taken place under the footprint of the buildings on the site. The ground conditions both geochemically and geotechnically under the structures is therefore unknown. It is anticipated that supplementary ground investigation within these areas will be required to support specific proposed developments and land parcels as they are brought forward for development.

2 Ground Gas – Limited gas monitoring has taken place across the site. Further monitoring and an associated Gas Risk Assessment should be undertaken, and the necessary protection measures incorporated into the design of the proposed development to protect from ground gasses.

3 Groundwater quality and soil leaching potential - There remains a data gap with respect to groundwater quality and soil leaching potential across the site and further investigation and/or groundwater monitoring may be required to inform the CSM and confirm the overall significance of likely impact to groundwater and surface water.

4 Geotechnical properties – Limited data is available from previous site investigations in relation to the geotechnical properties of ground underlying the proposed development area especially in the areas of existing structures. Further assessment is likely required to inform, for example, foundation and infrastructure design.

G4.17 Other Assumptions and Limitations are detailed in Section G3.15 to G3.20.

Geology

G4.18 The British Geological Survey (BGS) solid and drift geological map (Sheet 33 -1987) 1:50,000, the BGS GeoIndex Onshore (online resource), historical and current exploratory location records have been reviewed in order to assess the geological composition of the site which is summarised in this section.

Made Ground

G4.19 The BGS 1:50,000 scale Solid and Drift map (Sheet 33 - 1987) identifies the site as being mainly covered by Made Ground. As the site and the wider area are known to comprise reclaimed marshland it is likely that this is what is referred to as Made Ground by the BGS mapping. The Made Ground is not indicated in the south east corner of the site. The level of the site sits above the adjacent Tees Dock Road.

G4.20 Based on previous ground investigation data (Arcadis 2018, Appendices G7 to G10), the Made Ground encountered during the investigation is predominantly granular material with a fine-grained component and medium to high cobble/boulder content which includes slag, brick, concrete and occasionally clinker, coke, coal and/or metal. However, variably sandy, variably gravelly clay with low to medium cobble/boulder content was also encountered. The maximum depth recorded was 3.8m bgl (below ground level).

G4.21 An area of fused slag was identified at the surface in the north west of the site (S3-TPB09 and S3-TPB11), and the full extent and thickness of the deposit was not proven.

G4.22 The depth of Made Ground was noted to be generally dictated by ground elevation; Made Ground was encountered in greater thicknesses in areas of higher elevation.

G4.23 During the investigation, trial pits were terminated due to obstructions (in eight of 75 trial pits excavated, three due to collapse/instability of the pit, and 30 due to groundwater ingress). Where groundwater ingress occurred, this was typically at the base of the Made Ground.

Superficial Deposits

G4.24 The BGS 1:50,000 scale map shows the superficial deposits underlying the Made Ground as Glaciolacustrine Deposits, predominantly comprising laminated clays and silt. These deposits are likely to be underlain by Glacial Till predominantly comprising slightly gravelly clay. Additionally, a thin strip of Alluvium is also indicated to be present in the northern part of Area B (BOS/CONCAST Plant).

G4.25 From the previous ground investigations, in all exploratory holes, a thin layer of firm sandy gravelly clay was observed beneath the Made Ground. This material may represent an upper layer of Glacial Till. This layer is not recorded on geological maps but has been observed during several phases of investigation.

G4.26 Where encountered, the majority of trial pits terminated in this material, so its full thickness is only observed in a limited number of boreholes. The maximum depth of this layer of Glacial Till recorded is 4.6m bgl.

G4.27 Although indicated as present on the geological maps of the area Glaciolacustrine Deposits were only recorded in boreholes. Where identified, the Glaciolacustrine Deposits were generally noted to be interbedded with and generally between two layers of Glacial Till, although in some cases the overlying till layer was absent. The deposits were also identified to be difficult to distinguish in some cases.

G4.28 Where identified the deposits were generally described as a soft to firm brown laminated clay often with sand or silt partings along laminations. The full thickness of this material was not determined; however, it does appear to be a very localised feature.

G4.29 Glacial Till was found below the Glaciolacustrine Deposits in boreholes described as a firm to stiff red brown slightly sandy slightly gravelly clay, with gravel composed of mixed lithologies, including sandstone, limestone, and rare coal. Glacial till is distributed widely across the site and was noted to sandwich a layer of Glaciolacustrine deposits in some boreholes. Boulders were identified within the base of the Glacial Till in one of the boreholes (S3-BHB01).

G4.30 These findings are in line with the previous environmental investigation of the Lackenby Works conducted by Enviros.

Solid Geology

G4.31 BGS mapping identifies the bedrock beneath the majority of the site is anticipated to comprise Redcar Mudstone Formation, part of the Lias Group. The north-western section of the site (approximately 10%) is anticipated to be underlain by the Mercia Mudstone Group. The Penarth Group is indicated to be present between the Redcar Mudstone Formation and the Mercia Mudstone.

G4.32 Where encountered in previous investigations, the Redcar Mudstone Formation has been identified to be an extremely weak highly weathered grey mudstone recovered as a clayey gravel or gravelly clay. The maximum depth of this bedrock was recorded at 10.3m bgl.

G4.33 The Penarth Group was recorded to depth of 11.7m bgl and was recovered as brown mudstone or grey limestone gravel, but this was from one borehole. Likewise, the Merica Mudstone was only recorded in one borehole to a depth of 37.2m bgl and was described as a weak to extremely weak red green sandy marl partially weathered with numerous gypsum veins and inclusions.

Geotechnical and Geological Hazards

G4.34 The site is identified by the Groundsure report as being at low risk from shrink swell, a very low or low risk from running sand and a very low risk from landslide hazards. It is also identified as being at very low to moderate risk from compressible ground hazards.

G4.35 With reference to the Coal Authority Interactive Map, the Lackenby site is not within a Coal Mining Reporting Area. This is consistent with BGS mapping and as such coal mining is not discussed further within this report.

G4.36 Limited data is available from previous site investigations in relation to the geotechnical properties of ground underlying the proposed development area.

G4.37 The significant thickness of Made Ground present beneath the site (up to 4m), and normally consolidated tidal flat deposits, indicates the potential requirement for piled foundations or ground improvement works in relation to structures sensitive to movement.

G4.38 Expansive slag has been identified on site typically recorded 28-day expansion values of <1%, however one sample encountered up to 3.19% this sample was noted to contain a large proportion of basic steel slag. Approximately half of the trial excavations were terminated due to obstructions, groundwater inflow or instability in the Made Ground.

G4.39 Extensive basements, service conduits and other structures exist beneath the existing buildings on site. Infilled lagoons are known to be present in the north-west of the site associated with the historic power station.

G4.40 Elevated sulphate concentrations in the slag within the Made Ground are considered likely to make ground conditions aggressive to concrete.

G4.41 Magnetic anomalies have been identified at two locations elsewhere within the wider SSSI site. It has not been possible to confirm whether these were in fact UXO, or other features. In the Lackenby site in particular (which was not developed during World War 2), it should be assumed that UXO could present a potential risk.

Hydrology and Hydrogeology

Hydrology

G4.42 Kinkerdale Beck crosses the northern end of the site in an approximate east to west orientation with a westerly flow direction. A second culverted stream known as the Boundary Beck enters the site approximately midway along the southern boundary and flows approximately north to join the Kinkerdale Beck which, after joining the Knitting Wife Beck, eventually discharges via the Lackenby Channel into the River Tees which is classified by the EA as a Main River.

G4.43 A surface water pond approximately 100m long by 20m wide is located to the south of the site just beyond the Hot Metal Route.

Hydrogeology

G4.44 Information from the Groundsure report indicates that the bedrock beneath the site is mainly classified as a Secondary Undifferentiated aquifer (Redcar Mudstone Formation, Penarth Group). A narrow strip in the north west of the site is however indicated as a Secondary B aquifer (Merica Mudstone). The overlying superficial deposits are classified as an Unproductive aquifer (Glacial Till) with a small area in the north east shown as a Secondary A (Alluvium) aquifer.

G4.45 The EA describe a Secondary B Aquifer as "predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering". A Secondary Undifferentiated aquifer is defined as "assigned in cases where it has not been possible to attribute either category A or B". This generally means that the horizon has variable characteristics allowing it to function as both a minor and non-aquifer in different locations. A Secondary A aquifer is 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. These are generally aquifers formerly classified as minor aquifers". Whilst an unproductive aquifer is described as "These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow".

G4.46 The site is not located within a Groundwater Source Protection Zone, nor within a surface water, groundwater, or eutrophic Nitrate Vulnerable Area. The site has a Groundwater Vulnerability Classification of high to medium depending on the geological strata.

G4.47 From the Enviros (Appendices G2 to G4) works, groundwater ranged between at 0.87m bgl and 2.37m bgl and the report inferred a general northwards groundwater flow direction with localised depressed groundwater levels in the south of the BOS area.

G4.48 Groundwater monitoring undertaken by AEG (Appendix G6) indicated that there was consistency in the order of the groundwater elevation data collected from the monitoring wells screened across the Made Ground with S3-BHB04s consistently recording the highest groundwater elevation and S3-BHB03 recording the lowest. Based on the elevation data recorded groundwater flow within the Made Ground is inferred to be in an easterly or north easterly direction. It should however, be noted that this is based on a limited dataset given the size of the site and groundwater flow including in bedrock is likely be influenced by the significant foundations and sub surface structures (basements estimated at 40m deep) associated with the BOS/CONCAST Plant and the road cutting to the west of the site, therefore a consistent flow across the site is considered unlikely.

G4.49 Groundwater monitoring data also indicated that the groundwater recorded within the superficial deposits is likely to be continuity with the Made Ground.

G4.50 Groundwater was encountered in 38 out of 75 trial pits at depths of between 0.7m and 3.4m bgl, and noted to be associated with the interface between Made Ground and natural cohesive deposits; inflow rates were described as between slow and heavy. It is likely that this represents "perched" water and may not be representative of the regional groundwater elevation.

Environmental Information – Landfill Sites

G4.51 Information is provided in the Site Condition Report (Appendix G8) and Groundsure report on the historic and active landfill sites around the site. There are two active landfill sites and a further four historic landfill sites within 500m of the Lackenby site. These are summarised in the table below.

Table G4.3 Summary of Historic and Active Landfill sites

Landfill Site	Distance from Site	Dates of Operation / Type of Waste
Active		
Wilton, Perimeter Mounds	Approximately 230m & 300m south of the site	Types of waste unknown, however, it is recorded as an A07 Industrial Landfill (Factory Curtilage) from ICI Chemicals & Polymers Ltd. Permit reference: EAEPR\EA/EPR/UP3090ZF/A001

Landfill Site	Distance from Site	Dates of Operation / Type of Waste
ICI No 2 Teesport EPR/RP3631DA	Approximately 350m northwest of the site.	Types of waste unknown; however current licence allows 10 tonnes per day with a capacity for ≈25,000 tonne (excluding inert waste). Operated by Highfield Environmental Limited.
Historic		
Redcar Trunk Road Landscaping	Approximately 100m south-west.	Received inert and industrial waste between 1977 and 1979.
Area adjacent to Tees Dock Road	Approximately 150m south west.	Received inert and commercial waste between 1982 and 1983.
Bolckow Road	Approximately 230m south.	Received inert waste between 1st February and 6th March 1993
Mushroom Grove Allotments	Approximately 230m south.	Received inert and commercial waste between 1984 and 1985

Land Contamination

Potential Sources of On-Site Contamination

G4.52 Notable historic and contemporary features within the area which may have implications for land contamination include but are not limited to:

1 Grangetown Power Station

2 Historic Clay Pits

3 Railway lines and Sidings

4 BOS and Concast Plant (Steelmaking areas, Storage areas and tanks, Garages and workshops, Water treatment plant) Figure 4 in Site Condition Report (Appendix G8 - Arcadis, 2018) shows potential areas of concern across the site

5 Substations

6 Made Ground (slag deposits)

Potential Source of Off-Site Contamination

G4.53 Notable historic and contemporary features outside of the site boundary which may have implications for land contamination include but are not limited to

1 Surrounding Landfills

2 Disused Coil Mill, Current British Steel Facility, and Former Cleveland Iron and Steelworks and Mill

3 Sub stations

4 Torpedo Ladle Repair Shop

Enviros 2004 (Appendices G2 to G4)

G4.54 Soils across the site are characterised by uniformly alkaline pH conditions and occasionally elevated concentrations of sulphide and sulphate, reflecting the widespread presence of slag materials in the Made Ground.

G4.55 Toxic and phytotoxic metals in the soils were below guideline values (current in 2004) apart from locally elevated copper, lead, zinc, and boron. Copper was slightly elevated with respect to the guideline values in shallow soils at the southern part of the Lackenby Works near the Slag Transporter Workshop.

G4.56 Hydrocarbons were below guideline values in the soil at the Lackenby Works apart from isolated levels of PAHs in the shallow soils, which are most likely as a result of localised spillages. Localised black oily staining and hydrocarbon odours, indicative of localised spillages/loss of hydrocarbon, were observed near the north-western boundary adjacent to the Concast and BOS Plant.

G4.57 Compared with UK Drinking Water Standards, shallow groundwater beneath the site has widespread elevated concentrations of sulphate and copper in addition to isolated exceedances of other contaminants such as cyanide and phenol; some locations exhibit pH levels indicative of alkaline groundwater conditions.

TRS Report 2018 (Appendix G5)

G4.58 Blast furnace slag was a dominant constituent in the majority of the samples examined. The slag was mainly crystalline although minor amounts of glassy and ceramic material were seen. The slag showed some alteration due to weathering. Old, weathered blast furnace slag may occasionally contain pockets of potentially expansive material.

G4.59 Further testing of samples consisting predominantly of blast furnace slag (with only minor amounts of basic steel slag) recorded expansion results of between 0.04 and 0.19 percent. Thermal analysis indicated some evidence of past expansion of the blast furnace slag (presence of ettringite and possibly thaumasite). Some of the sulphate values were high and should be taken into consideration when specifying concrete that may come into contact with the slag.

G4.60 Minor amounts of basic steel slag were seen in most of the samples. However, more dominant amounts were present in 4 samples from the site under consideration. This material may present a significant risk of expansion. Minor amounts of basic refractory material were also seen in several of the samples examined, which can be a significant source of expansion.

G4.61 Expansion testing of these five samples recorded expansion results of between 0.29 and 3.19 percent (The two samples consisting predominantly of basic steel slag recorded expansion values of 0.98 and 3.19 percent).

G4.62 Other products seen in the samples, in varying amounts, included alumino-silicate refractories, quartz (mainly as sand but also silt and sandstone), silicic slag, cinder & clinker (from heating furnaces), iron ore, fume, metallic iron, rust, clay, coal, coke and used Portland cement.

Arcadis (UK) Ltd 2018 (Appendices G7 to G10)

G4.63 The results of chemical analysis from 100 soil samples indicated that the highest metal concentrations were identified in the slag dominant and granular Made Ground. Concentrations of manganese, mercury and vanadium were notably higher in slag dominant deposits, and lead in granular Made Ground. Distribution plots are included within the Site Condition Report (Arcadis, 2018 – Appendix G12).

G4.64 Levels of cyanide and thiocyanate were generally low across the site, more variation was noted in soluble sulphate concentrations with higher levels noted in slag dominant and cohesive Made Ground. The pH of the Made Ground samples was noted to be strongly alkaline with mean values of 11.4 and 11 noted for slag dominant and granular Made Ground respectively.

G4.65 Concentrations of PAH were measured in almost all the samples of slag dominant material and granular made ground tested as well as the majority of samples of cohesive Made Ground. Concentrations of TPH were detected above the limit of detection in the majority of soil samples. Concentrations above 500mg/kg were recorded in seven locations mainly located to the south of the site. No elevated concentrations of VOC, SVOC, or PCBs were measured in any of the soil samples analysed.

G4.66 From the Environmental Risk Assessment Report (Arcadis 2020), none of the contaminants where Generic Assessment Criteria (GAC) are available, recorded concentrations above the commercial land use criteria.

G4.67 During analysis, asbestos was detected in 18No. samples (19% of those analysed) as loose bundles of fibres. Chrysotile was detected 17 times and amosite just once. Asbestos was detected in samples from 0.5m to 2.6m bgl. Asbestos quantification by gravimetric methods was carried out on 17No. samples with nine samples recorded an asbestos mass lower than the limit of quantification (<0.001 % m/m). The remaining 8No. samples recorded concentrations of asbestos fibres between 0.001 and 0.005% m/m.

G4.68 Groundwater samples were obtained from four boreholes across the site. Dissolved concentrations were compared to Water Quality Standards and exceedances of metals, TPH and PAH compounds (low levels) were recorded.

Ground Gas

G4.69 Limited gas monitoring was undertaken in four boreholes across the site. Concentrations of carbon dioxide and methane recorded were below levels that would indicate a significant risk to human health receptors from the accumulation of ground gases. Gas flow from all boreholes was below detection limits, as were concentrations of methane and hydrogen sulphide. The highest concentration of carbon dioxide (0.9 % v/v) is consistent with a low generation potential gas source such as small amounts of organic matter in Made Ground.

G4.70 Carbon monoxide was recorded with a maximum concentration of 32 ppm. This may be associated with blast furnace wastes such as slag and if so are residual and unlikely to be still being generated in large volume.

G4.71 Based on the existing monitoring data for the site, there is no evidence of an unacceptable risk to human health or built receptors from the accumulation of ground gas. However, as the investigation was not designed with a particular redevelopment scenario in mind the gas data monitoring was limited and may not be representative of the entire extent of the site under a particular redevelopment.

Relevant Sensitive Receptors

G4.72 The following receptors have been identified for the site:

Table G4.4 Identified Receptors

Receptor	Phase	Sensitivity (as defined in Table G3.1)
	Construction	
Human Health Receptors		
Construction Workers	Applicable	Very High

Receptor	Phase	Sensitivity (as defined in Table G3.1)
	Construction	
Offsite Human Health Receptors	Applicable	Medium to High
Environmental Receptors		
Surface Waters	Applicable	Medium
Groundwater	Applicable	Medium
Built Environment		
Waste Management Infrastructure	Applicable	Medium

Sources

G4.73 The following key sources have been defined from the previous investigations with regard development of the site:

1 **Made Ground** –The site is known to extensively comprise reclaimed land, made up of slag, and a range of contaminants including heavy metals, elevated pH, and sulphate/sulphides. Whilst the current concentrations recorded are below the Commercial GACs, assessment below the buildings has not been undertaken. The abundant nature of such materials across the site and its prevalence at the surface is one of the key sources of contamination regarding development of the site.

2 **Hazardous Ground Gases** – Limited gas monitoring on site has identified low levels of ground gases (methane (flammable gas) and carbon dioxide) which are likely to be derived from the historical legacy of landfilling, infilling, and reclamation both on and off the site. Further monitoring is recommended to understand the gas regime. Based on ground gas concentrations and a range of exposure pathways, the presence of ground gases may present a risk to current and future onsite and offsite human health (e.g. asphyxiation) as well as onsite and offsite properties (e.g. explosion). Based on available data, no volatile compounds are present within the underlying soils.

3 **Asbestos** – Investigation data has identified the presence of asbestos in Made Ground which is likely to be derived from the historical legacy of landfilling, infilling, and reclamation activities as well as operational aspects associated with the site. This is considered within the Remediation Option Appraisal Report (Appendix G10).

Source Pathway Receptor Linkages

G4.74 Key contaminant linkages (CL) identified as requiring some form of mitigation are summarised in the table below.

Table G4.5 Potential Contaminant Linkages requiring mitigation

Contaminant Linkage No.	Contaminant Linkage Description
CL1	Construction workers, future site users and offsite human health receptors via inhalation of asbestos fibres associated with Made Ground.
CL2	Construction workers, site users and offsite human health receptors via dermal contact, accidental ingestion and dust inhalation of contamination within Made Ground (asbestos and unforeseen contamination).
CL3	Leaching of contaminants within the Made Ground into the groundwater and migration into surface water

Future Baseline

G4.75 The site preparation and infrastructure installation is assumed to commence in 2028 with first floor space delivered in 2029. Completion is assumed to be in 2031 in line with market demand.

G4.76 As described in Section H4 (Existing Conditions), there are a number of potential on site sources of contamination as well as potential off-site sources. The identified contamination beneath the site to date predominantly relates to historic land use and it is considered that no significant deterioration in ground conditions will occur in the absence of development. It is assumed that any ongoing operations / procedures of current works / industry will be controlled in line with modern industry regulations and best practice.

G4.77 Therefore, existing baseline conditions with respect to geology, hydrogeology and land quality would be unlikely to change significantly between now and the completion of the works in the absence of the proposed development.

G5.0 Potential Effects

Embedded Mitigation

G5.1 The proposed embedded mitigation measures relevant to ground conditions include:

1 Earthworks: for the purpose of this EIA it is assumed that the construction stage of the development will be cut and fill neutral;

2 Site Levels: the proposed minimum finished floor level will be 10m AOD.

3 Implementation of Construction Environmental Management Plan (the CEMP principles outlined in Section B7.0 of Chapter B will be conditioned and there will be a requirement to provide an updated and detailed CEMP for each development phase based on these principles);

4 All temporary construction works will be designed to meet engineering and health and safety standards;

5 Further site and ground investigation surveys will be undertaken in order to identify the need, or otherwise, for additional survey work and / or remediation work. This work would include soil and groundwater analysis and gas monitoring as required;

6 Construction of construction compounds and waste, fuel, and storage areas ahead of construction work commencing. Materials for active phase of development only to be stored onsite;

7 Hazardous and non-hazardous waste to be sent to the Highfield landfill site;

8 A piling risk assessment is to be prepared for each phase of development;

G5.2 These embedded mitigation measures have been considered during this assessment when assessing potential effects. Measures included in the Framework CEMP will not be repeated below or in Section G6.0: Mitigation and Monitoring.

Major Hazards and Accidents

G5.3 Major Hazards and Accidents have been considered in the assessment below. It is assumed that COMAH related risks would be removed during the demolition of the site. The main aspects are therefore considered to be explosion from UXO, land instability and risk from contamination. Mitigation is detailed, in Section G6.0, with regards to UXO and risk from contamination. With regards to land instability, this would be mitigated during the detailed design stage of the buildings / structures on site which would consider the ground conditions present. No significant effects from major hazards and accidents from a ground conditions perspective are considered likely. Phasing

G5.4 Remediation and other measures to manage potential risks to identified receptors due to ground contamination and other ground conditions will be undertaken prior to and during the construction phase. Therefore, the subsequent phasing of future developments is not considered relevant for this chapter.

During Construction

Impacts on Human Health Receptors

G5.5 The use of heavy equipment and activities such as excavation, backfilling, and compaction willl disturb the soil and could result in dust generation, as well as provide opportunities for direct contact and inhalation of contaminants. Made Ground is present across the site with a proven

maximum depth recorded of 3.8m bgl although deeper Made Ground may exist elsewhere. The site is known to extensively comprise infilled land, made up of slag, together with supplementary Made Ground deposits slag, brick, concrete and occasionally clinker, coke, coal and/or metal.

G5.6 Asbestos screening was undertaken on soil sampled from across the site and fibres have been identified within the Made Ground. Further assessment will be required and a conservative approach to defining protective measures will be adopted (see the following section of the chapter).

G5.7 Analysis of the Made Ground to date have indicated that the potential contaminant concentrations are generally below commercial end use criteria, however the entire site has not been investigated.

G5.8 During construction there is a risk of disturbance of UXO which may be present on the site. The main risk from explosions is to Construction Workers and off-site human health receptors.

G5.9 Low concentrations of ground gases are present on the site. During construction this could pose a risk to construction workers, however as detailed in the CEMP, appropriate health and safety measures would be put in place to safeguard the workforce.

G5.10 Based on existing survey data available, the sensitivity of the human receptors is very high for construction workers and medium to high for off-site receptors. The magnitude of impact prior to mitigation but considering the embedded mitigation is medium due to the presence of asbestos fibres within the Made Ground. This could lead to impacts of **Substantial Adverse** in relation to construction workers and at worst **Moderate Adverse** in relation to off-site receptors (considered 'Significant' in EIA terms) if mitigation actions are not carried out.

Impact on Environmental Receptors (Surface Waters and Groundwater)

G5.11 As detailed above limited groundwater samples were obtained from across the site and dissolved concentrations of metals, TPH and PAH compounds (low levels) were recorded above the Water Quality Standards. A risk to groundwater resources through leaching of contaminants was identified. A potential linkage into the deeper bedrock aquifer was not discounted.

G5.12 As detailed in section G3.17, the EA has reviewed the Outline Remediation Strategy (Appendix G11) and confirmed that active remediation of groundwater is not required.

G5.13 The sensitivity of the controlled water receptors (surface waters and groundwater) is considered to be medium (reflecting a water receptor deemed to be of low value) and that given the low magnitude of likely impact from construction when embedded mitigation is considered, the significance is considered Negligible and therefore Not Significant.

Impact on the Built Environment

G5.1 For the purpose of this EIA process it is assumed that the proposed development site will be cut and fill neutral and that excavated material can be reused onsite to construct the development platform. However, some excavated material may not be suitable for remediation or reuse and it is assumed that all hazardous and non-hazardous waste will go to the Highfield Landfill Site in the South Bank area as detailed above.

G5.2 The sensitivity of the built environment is medium and the magnitude of impact prior to mitigation is medium. This is due to the potential for soil/materials disposal required following earthworks resulting in a limited or minor increase in demand on waste management infrastructure and the potential for damage to buildings, structures or the environment. Thus the impact on the built environment – principally waste management facilities, is considered to

be of Minor Adverse significance which is considered 'Not Significant' in terms of this EIA assessment.

G6.0 Mitigation and Monitoring

During Construction

G6.1 Embedded mitigation is detailed in G5.1 above which includes further investigation, a piling risk assessment and best practice detailed within the Framework CEMP. Additional mitigation is detailed below.

Remediation

G6.2 A Remediation Option Appraisal (Appendix G10) has been prepared based on the information known to date and includes several elements which will mitigate potential environmental risks as part of the proposed remedial works, such as:

- Capping in situ to reduce the risk from the asbestos fibres that have been encountered to date.
- Engineering controls to address the geotechnical issues identified.

G6.3 The detailed design for each of the development plots will determine the detailed remediation approach based on the intended layout and form of development and further investigation and assessment. The Remediation Option Appraisal would provide a basis for this and be developed into a Detailed Remediation Strategy for each phase of development.

Unanticipated Contamination

G6.4 In the event that contamination is encountered at any time when carrying out the remediation and enabling works that was not previously identified, an investigation and risk assessment will be undertaken and where remediation is considered necessary additional mitigation will be agreed with the relevant authorities.

G6.5 Where unanticipated contamination is encountered within excavated material that is similar to that encountered elsewhere within the site, then the process set out below will be followed:

1 Sampling for, and undertaking chemical analysis;

2 Assessment of chemical data; and,

3 Sentencing for remediation and/or processing, as necessary.

G6.6 The location of any such unanticipated contamination encountered will be recorded, including the results of chemical testing, the volumes sentenced for treatment by remediation, the validation data showing compliance with the relevant remediation objectives and the location of the area of use of the remediated material within the development platform.

Measures to Protect Human Health Receptors

G6.7 Based on the results of the previous ground investigations as well as any further investigation undertaken (detailed as embedded mitigation), areas that pose a risk to human health as a result of identified contamination would be delineated and remediated prior to construction works. Further assessments are recommended to include, but are not limited to, the following tasks which will identify the need for further mitigation.

- Additional ground gas monitoring at greater density is recommended prior to any specific redevelopment to determine the risk from ground gases on the site, the scope of this investigation would depend on the proposed redevelopment scenario.

- A risk of UXO is considered to be present for this site. Further mitigation activities such as detailed risk assessment or site mitigations are considered essential to reduce the UXO risk on the site to As Low As is Reasonably Practicable (ALARP).
- Areas of the site are currently inaccessible e.g. beneath building footprints which require investigation to assess the ground conditions both geotechnically and geo chemically. If any contamination is identified, this would be assessed, and remediation/removal undertaken as appropriate.

G6.8 In the event that suspected asbestos materials are observed associated with excavations then sampling will be undertaken to confirm the asbestos type and quantification. Where Asbestos Containing Materials (ACM) have to be excavated or removed to facilitate removal of structures it shall be separately stockpiled and covered to control potential dust generation. If soils containing asbestos also require remediation / processing to make them suitable for reuse they will not be subject to mechanical screening where free fibres have been detected or are suspected. All soils containing asbestos will be managed by maintaining mist sprays to keep the soils wet whilst handled and covered when stockpiled. The requirement for additional asbestos control measures will be determined subject to further assessment of the nature and type of asbestos present.

G6.9 In the event, that materials are impacted with visible fragments of ACM, the ACM materials shall be handpicked by a suitably licenced asbestos contractor with additional control measures implemented based on the sampling results.

G6.10 Where soils contain Contaminants of Concern (CoC) in excess of the reuse criteria and, due to the presence of asbestos cannot be safely handled or successfully treated, they will be disposed of offsite. Where concentrations are below the reuse threshold soils may be reused as infill to excavation voids at depths below 0.6 m of final ground level.

G6.11 Asbestos should be presumed to be within all Made Ground deposits, and therefore will need to be included in a foundation works risk assessment.

Impacts on Environmental Receptors (Surface Waters and Groundwater)

G6.12 No specific additional measures to reduce the impact on controlled waters are currently proposed. There remains a data gap with respect to groundwater quality and soil leaching potential across the site and further investigation and/or groundwater monitoring may be required to inform the CSM and confirm the overall significance of likely impact to groundwater and surface water determined within this assessment.

G6.13 Remediation of soils as detailed above, will however reduce the impact on these environmental receptors providing overall quality betterment.

Impacts on Built Environment

G6.14 The disposal of solid waste, contaminated or otherwise to landfill sites will be best mitigated by prevention or minimisation of the overall quantities of waste generated during construction and by ensuring that excavated material consigned to landfill is deposited within the existing adjacent Highfield Landfill. This approach would be considered when the detailed remediation strategy for the site is prepared. Further consideration of this is set out in Chapter K: Waste and Materials Management.

G6.15 As part of the Materials Management Plan the records of all materials movements on-site and off-site will be kept by the Reclamation / Earthworks Contractor in paper and electronic format for a minimum period of 2 years following completion of the works and production of the Validation / Verification Report. To allow auditing of the Materials Management Plan (detailed

in CEMP - embedded mitigation); data will be stored electronically in a specifically designed database on site. Daily data uploads would be undertaken. All data would be geo-referenced, and all stockpile sample nomenclature would ensure individual identification. This soil audit would include records of all materials excavated, treated, and re-used on site.

G7.0 Residual Effects

During Construction

Impacts on Human Health Receptors

G7.1 The sensitivity of human receptors (construction workers and off-site human health receptors) is very high to high to medium respectively and the magnitude of impact following mitigation, outlined in Section G6.0 above, is negligible. Following the implementation of the additional mitigation measures outlined in Section G6.0, there are likely to be impacts on construction workers of Minor Adverse significance and impacts on nearby residents of Negligible significance. These effects are considered Not Significant in EIA terms.

Impact on Environmental Receptors (Surface Waters and Groundwater)

G7.2 The sensitivity of the surface water and/or groundwater is medium and the magnitude of impact following additional mitigation, e.g. soil remediation, is negligible. Therefore, the impacts after the implementation of mitigation measures are considered to be of Negligible significance. This is considered Not Significant in EIA terms.

Impacts on Built Environment

G7.3 The sensitivity of the waste management facilities is medium and the magnitude of impact following mitigation identified in Section G6.0 is Low and thus the impact on waste management facilities during the construction phase is considered to be of Negligible significance. This is considered 'Not Significant' in EIA terms.

G8.0 Summary & Conclusions

G8.1 A number of potential impacts of varying significance to receptors, associated with land quality, ground conditions and contamination have been identified. These potential impacts have been considered and assessed within the context of the proposed construction. The operational phase has been scoped out of assessment.

G8.2 There are currently a number of data gaps regarding the geochemical and geotechnical characterisation of ground conditions and contamination at the site which will likely require further site investigation and risk assessment in order to inform detailed design statements (in line with the overall remedial strategy) produced to support the development of specific areas during subsequent phases of development.

G8.3 The sensitivity of the human receptors (construction workers and residents/visitors of surrounding properties) is very high and high to medium respectively while the groundwater and principal surface water feature (River Tees) are considered of low value and hence considered a medium sensitivity. The built environment mainly waste management facilities are considered to have medium sensitivity.

G8.4 Mitigation that is designed to protect the identified receptors susceptible to impacts from contamination in Made Ground soils have been set out below in Table G8.1. The residual significance of the impacts identified is considered to be Minor Adverse / Negligible and Not Significant following the implementation of the mitigation measures.

Table G8.1 Summary of Effects

Receptor	Impact	Potential Effects (taking account of embedded mitigation)	Additional Mitigation and Monitoring	Residual Effects
During Construction				
Construction Workers and Offsite Human Health Receptor	Exposure to contaminated soils, asbestos fibres and ground gas mainly during earthworks. Risks associated with UXO.	Substantial Adverse: Construction workers and at worst Moderate Adverse: off site human health receptors and Significant	Remediation / Unforeseen Contamination Remediation Design Statement Additional ground gas monitoring Detailed UXO risk assessment Investigation beneath building footprints. Best practice Asbestos Mitigation	Minor Adverse: Construction workers and Negligible off site human health receptors Not Significant
Surface Water Groundwater	Potential leaching of contaminants impacting the groundwater / surface water	Negligible and Not Significant	Remediation / Unforeseen Contamination	Negligible and Not Significant
Built Environment: waste facilities	Soil/materials disposal required following earthworks resulting	Minor Adverse and Not Significant	Minimisation of waste materials generated Material disposed in Highfield Landfill	Negligible and Not Significant

Receptor	Impact	Potential Effects (taking account of embedded mitigation)	Additional Mitigation and Monitoring	Residual Effects
	in a limited or minor increase in demand		Materials Management Plan	

G9.0 Abbreviations & Definitions

1	AOD	Above Ordnance Datum
2	BOS	Basic Oxygen Steelmaking
3	BGS	British Geological Society
4	C4SL	Category 4 Screening Levels
5	CSM	Conceptual Site Model
6	CEMP	Construction Environmental Management Plan
7	DEFRA	Department Environment Food and Rural Affairs
8	DPD	Development Plan Document
9	EA	Environment Agency
10	EPR	Environmental Permit Regulations
11	ES	Environmental Statement
12	GAC	Generic Assessment Criteria
13	MMP	Materials Management Plan
14	NPPF	National Planning Policy Framework
15	PPE	Personal Protective Equipment
16	PAH	Polycyclic Aromatic Hydrocarbons
17	RCBC	Redcar and Cleveland Borough Council
18	SVOC	Semi Volatile Organic Compounds
19	SNCI	Sites of Nature Conservation Interest
20	SPR	Source Pathway Receptor
21	STDC	South Tees Development Corporation
22	TPH	Total Petroleum Hydrocarbons
23	VOC	Volatile Organic Compounds

G10.0 References

National Policies and Legislation

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2 Environment Act 1995

3 Environment Agency 2008, An ecological risk assessment framework for contaminants in soil. Science Report SC070009/SR1

4 Derivation and use of soil screening values for assessing ecological risks Report – ShARE id26 (revised)

5 BRE Special Digest (SD) 1: Concrete in Aggressive Ground, 2015

6 Environmental Permitting (England and Wales) Regulations 2010

7 Control of Pollution (amendment) Act 1989

8 Water Framework Directive 2000/60/EC

9 Groundwater Directive 2006/118/EC

10 Controlled Waste (Registration of Carriers and Seizure of Vehicles) Regulations, 11991 (as amended)

11 Controlled Waste (England and Wales) Regulations 2012

12 Construction (Design and Management) Regulations 2015

13 Hazardous Waste (England and Wales) Regulations 2005

14 Waste (England and Wales) Regulations 2011

15 Waste Framework Directive 2008/98/EC (OJEU, 2008)

16 The Contaminated Land (England) Regulations 2006

17 The Environment Damage (Prevention and Remediation) Regulations 2015

18 National Planning Policy Framework, 2019

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28 BSI Standards Publication "Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings", BS 8485:2015+A1:2019

29 CIRIA C665 'Assessing risks posed by hazardous ground gases to buildings' 2007

30 CIRIA C552 Contaminated Land Risk Assessment A Guide to Good Practice. 2001

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Previous Environmental Reports

36 The Former SSI Steelworks, Redcar – Ground Investigation Contract – Priority Areas within SSI Landholdings Contract 3 by Allied Exploration and Geotechnics Ltd (AEG) Contract Number 4155 dated June 2018

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41 The Former SSI Steelworks, Redcar: Priority Areas within SSI Landholdings Contract 3. Site Condition Report prepared by Arcadis for South Tees Site Company Ltd. REPORT NO. Redcar Steelworks-AUK-XX-XX-RP-GE-0001-02-SSI3_GI_SCR, dated August 2018

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