South Tees Development Corporation

Former Steelworks Land, South Tees

Outline Remediation Strategy

Wood Environment & Infrastructure Solutions UK Limited – July 2019

Report for

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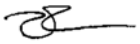

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Document revisions

No.	Details	Date
SO -PO1	Outline Remediation Strategy	25 June 2019
A-P01	Outline Remediation Strategy	27 June 2019
A-P02	Final following consultation with Redcar & Cleveland BC	19 July 2019

Contents

1. Introduction

1.1 Terms of Reference

Wood Environment & Infrastructure Solutions UK Ltd (Wood) was commissioned by **Tees Valley Combined Authority** (TVCA) on behalf of **South Tees Development Corporation** (STDC) to prepare an outline contaminated land remediation strategy, inclusive of a remediation options appraisal, for a proportion of STDC's current land holdings (referred to herein as 'the site') available to be brought forward for redevelopment. The commission was undertaken in accordance with Wood's proposal ref: 41825-WOD-XX-XX-proposal-OC-0001_S0_P01 dated 31 May 2019.

The outline remediation strategy has been developed based on information available for the site at the time of writing, as contained within the document.

The conclusions reached, and advice given in this report 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. In preparing this report we have assumed that all information provided by STDC is complete, accurate and not misleading.

1.2 Background

TVCA was formed in April 2016 to drive economic growth and job creation in the area. STDC was launched in August 2017 as a Mayoral Development Corporation.

STDC are responsible for the former TATA Steel (TATA) / Sahaviriya Steel Industries UK (SSI) Redcar Steelworks site as well as other industrial assets within its constitutional boundary. The South Tees Regeneration Master Plan was published in March 2019, setting out the vision for transforming the STDC area into a world-class example of a modern, large-scale industrial business park by providing a flexible development framework where land plots can be established in a variety of sizes to meet different occupier needs in the most efficient manner possible.

The site comprises a series of land parcels comprising approximately 285ha of the overall 618ha acquired from TATA by STDC. The condition of the land varies across the site and mostly consists of previously heavy industrial land uses.

This document comprises the outline remediation strategy and defines the proposed remediation required to render the site suitable for its proposed commercial and industrial end use. The current Regeneration Master Plan for the site defines the intended form of development. The Regeneration Master Plan should be read in conjunction with this remediation strategy. The document has been prepared in support of a detailed planning application for the site.

The outline remediation strategy will be further developed aligned to the form of development in each phase, this will be managed through the planning process with the use of a site-specific design statement.

1.3 Objectives & Scope of Work

The purpose of the outline remediation strategy is to assess and define an overarching approach to render the site suitable for use.

The outline remediation strategy comprises the following key components:

- Review of the environmental context (Section 2);
- Conceptual Model and Environmental Risk Evaluation (Section 3);
- Remediation Options Appraisal (Section 4); and
- Proposed Remediation Strategy (Section 5).

1.4 Regulatory Context

Development of the STDC area will be controlled under the Planning Regime.

Planning

Planning approval will be required for the remediation and redevelopment of the STDC land, including initial enabling activities such as demolition of structures and engineering operations associated with the ground preparation and the temporary storage of soils.

Redcar and Cleveland Borough Council (RCBC) are the local planning authority and their general requirements are set out on the RCBC planning portal, which also advises applicants to refer to the National Planning Policy Framework (NPPF) 2019.

RCBC have also prepared a Supplementary Planning Document (SPD) to support and guide future planning applications to assist the economic and physical regeneration of the South Tees Area. The SPD sets out how NPPF and adopted planning polices will be interpreted.

The NPPF sets out the Government's planning policies for England and how these should be applied. Planning guidance relating to the development of land potentially affected by contamination is detailed in the NPPF and states that:

- The natural environment should be conserved and enhanced by remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land;
- In preparing to meet development needs, the aim should be to minimise pollution and other adverse effects on the local and natural environment. Plans should allocate land with the least environmental or amenity value; and
- Planning policies and decisions should encourage the effective use of land by re-using land that has previously been developed (Brownfield land), provided that it is not of high environmental value.

Therefore, planning policies and decision should ensure that:

- A site is suitable for its new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining, pollution arising from previous uses and any proposals for mitigation including land remediation or impacts on the natural environment arising from that remediation;
- After remediation, as a minimum, land should not be capable of being determined as contaminated land under Part 2A of the Environmental Protection Act 1990; and
- Adequate site investigation information, prepared by a competent person, is presented.

The statutory definition of contaminated land is given under Part 2A of the Environmental Protection Act (EPA) 1990 (Part 2A). This generally does not include land that is already regulated through other means, such as Waste Management Legislation or the Environmental Permitting Regulations 2010.

In addition, the NPPF states that the planning system should contribute to and enhance the natural and local environment by preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affect by, unacceptable levels of soil, air, water or noise pollution or land instability.

Summary of Meeting Redcar and Cleveland Borough Council

A meeting was held with Mick Gent the Environmental Health Officer for RCBC on 24th May 2019 and it was agreed that a hybrid form of outline remediation strategy would be developed. This is subject to, as necessary, detailed ground investigation to back up/refine the requirements of the outline remediation strategy as areas of the site come forward for detailed development.

Contaminated Land Assessment Framework

There are a range of technical approaches to risk assessment of chemical contaminants, all of which broadly fit within a tiered approach. The tiered approach to assessing risks from land contamination is set out in the Department for Environment, Food and Rural Affairs (Defra) and Environment Agency (EA) publication 'Model Procedures for the Management of Land Contamination' (CLR11). CLR11 was archived from GOV.UK in 2016 and is currently scheduled to be withdrawn in November 2019, replaced by new guidance called Land Contamination Risk Management (LCRM), which builds upon the established CLR11 approach.

On the basis that LCRM was only released 5th June 2019 and the EA is looking for feedback on the technical content and structure for a period of 6 months, for the purposes of the remediation strategy where we refer to CLR11, guidance in LCRM have also been taken into consideration.

1.5 Information Sources

Guidance

- Contaminated Land: Applications in Real Environments (CL:AIRE) SP1010 – Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination. 20th December 2013 APPENDIX E PROVISIONAL C4SLs FOR BENZO(A)PYRENE AS A SURROGATE MARKER FOR PAHS.
- CULP, S.J., GAYLOR, D.W., SHELDON, W.G. GOLDSTEIN, L.W., BELAND, F.A., 1998. A comparison of the tumours induced by coal tar and benzo(a)pyrene in a 2-year bioassay. Carcinogenesis, 19, 117-124.
- Defra, December 2014, SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination, Policy Companion Document.
- Department for Communities and Local Government, National Planning Policy Framework, February 2019.
- Environment Agency, online guidance, Land Contamination: Risk Management (LCRM), June 2019. https://www.gov.uk/guidance/land-contamination-how-to-manage-the-risks
- Environment Agency and Defra, Contaminated Land Report 11, Model Procedures for the Management of Land Contamination (CLR 11), September 2004.
- Environment Agency, Updated Technical Background to the CLEA Model, Science Report SC050021/SR3, 2009.

- Environmental Industries Commission/Association of Geotechnical and Geoenvironmental Specialists/Contaminated Land: Applications in Real Environments (EIC/AGS/CL:AIRE, 2009). Soil Generic Assessment Criteria for Human Health Risk Assessment. December 2009.
- Health Protection Agency, 2010, HPA Contaminated Land Information Sheet, Risk Assessment Approaches for Polycyclic Aromatic Hydrocarbons (PAHs), Version 5.
- Land Quality Management/Chartered Institute of Environmental Health (LQM/CIEH), 2015. The LQM/CIEH S4ULs for Human Health Risk Assessment. Copyright Land Quality Management Limited reproduced with permission. Publication No. S4UL3076.
- Redcar & Cleveland Borough Council, South Tees Area Supplementary Planning Document, Adopted May 2018.
- Peter Bret Associates, South Tees Area Supplementary Planning Document: Environmental Report, March 2018.
- South Tees Development Corporation, South Tees Regeneration Master Plan, March 2019.

Previous Site Investigations / information

- Allied Exploration & Geotechnics Limited, South Tees Industrial Area- Site C- Ground Investiga1ion, 12/07/99. AEG Contract No. l7JSH.
- Arcadis, The Former SSI Steelworks, Redcar: Replacement Cle3/8 Landfill Boreholes CQA Validation Report South Tees Site Company Limited.
- CH2M Hill, TS3 Grangetown Prairie – Phase 1 Geoenvironmental Desk Study, August 2017.
- CH2M Hill, TS2 Tear Drop Site – Phase 1 Geoenvironmental Desk Study, August 2017.
- CH2M Hill, Data Review TS1 Steel House and Surrounding Area – Phase 1 Geoenvironmental Desk Study, August 2017.
- Cleveland County Council, Waste Disposal Licence, CLE 31/2. 1980.
- CORUS UK LTD. Design of a Site Protection and Monitoring Programme for Cleveland Works, Teesside, October 2004.
- CORUS UK LTD. First Phase Reporting of the Site Protection and Monitoring Programme. 31 January 2008.
- Enviros, Soil and Groundwater Baseline Characterisation Study Teesside Works, Summary Report and appendices. June 2004.
- Enviros, Corus Cleveland Prairie Teesside Site, Phase 1 Environmental Review for Graphite Resources, 2007.
- Enviros, Corus Cleveland Prairie Teesside Site, Phase II Geoenvironmental Assessment for Graphite Resources, 2007.
- MD2, Former Corus Cleveland Prairie Site, Land off Clay Lane – Ground Investigation Report, July 2011.
- Shadbolt Environmental, Prairie Site, Ground Investigation Factual Report, July 2011.
- South Teesside Waste Disposal Sites, Currently Licenced Tips, Drawing No. X-108701 (undated). Groundsure reports, June 2019 (see Appendix A to D).
- Stantec, Warrenby Landfill HRA Review, 2018.

- Summary of Geoenvironmental Information, Cleveland Prairie, Teesside, July 2014.
- TATA Steel, Landfill Closure Report for CLE31, Teesside, June 2015.

2. Site Details and Environmental Context

2.1 Site Location

The site is located on the southern bank of the River Tees, covering an area of approximately 286 ha. Extending from National Grid Reference NZ 52965 22005 in the west to NZ 58083 24716 in the east.

The site location is shown in Figure 1, with Figure 2 defining the site boundary, which is irregular in shape and based on land ownership rather than current use.

2.2 Site Appraisal

The site comprises a series of land parcels, which have recently been acquired by STDC from TATA, and which total around 285ha of the overall 618ha acquired. The condition of the land varies across the site and mostly consists of previously developed land formerly in heavy industrial use. Most of the land surrounding the site is within the STDC area and planned for future regeneration.

The site and surrounding areas have a long and layered industrial history. The main land uses are dominated by extensive iron and steel works together with auxiliary industries, infrastructure, power generation and distribution, together with waste management.

The history of the site and surrounding area has been established through review of historical mapping (Appendix A to D) and review of available site investigation information. To assist review of site conditions, for the sole purpose of this report, the site was allocated into four distinct zones, as shown on Figure 2 and summarised below:

- South Bank Works
- Grangetown Prairie
- Lackenby Coil Plate Mill
- Coatham Marsh (including Warrenby Landfill)

These zones were defined solely for historical site review and environmental context appraisal. For each of the four appraisal zones the environmental context summarises the geology, hydrogeology and environmental sensitivity of the sites.

2.3 South Bank Works

Site Description

The South Bank Works is part of the former Redcar Iron Works site located on the south bank of the River Tees. The "area" as it will be known throughout this Section, refers exclusively to areas within the redline boundary shown in Figure 2 as Zone 1: Former South Bank Works (extract below showing area location). The area centred approximately on National Grid Reference (NGR) NZ 53818, 22134.

The area is approximately 119.5 ha and is irregular in shape. The area is bound to the north by the River Tees (albeit, the boundary of the site is set back from the river by 20 metres). To the south is the Darlington to Saltburn Railway line, which runs along the periphery of the area on an approximate east-west axis. To the east of the area is Tees Dock, where PD Ports operate, and to the west the boundary is demarcated by internal roads beyond which is the Teesport Commerce Park which contains commercial uses associated with

the port. To the south of the area is the Grangetown Prairie area (See Section 2.4), the South Tees Freight Park and an area used for landfill and waste management activities.

The area is largely free of active use and built development, however, it is interspersed by some active industrial uses, notably Hanson Concrete and Tarmac Teesside (part of the Tarmac Group) are currently operational in the central northern region of the South Bank area, however these commercial sites are excluded from the planning application site area. The Tarmac land is largely occupied by storage facilities in addition to large stockpiles of material. Land to the east and west of the former South Bank works is currently occupied by PD Ports.

Generally, the area is predominantly flat following historic reclamation and development. Much of the area is in a derelict state with several permanent roads and tracks intersecting various parts of the site. Land in the north-west of the area is primarily constituted of unoccupied low-lying shrub and grassland. Large areas of land to the north-east are currently used for material storage and stockpiling in addition to an operational fuel oil depot.

The former Metals Recovery area is located to the east of the area. It is bound to the east by the Main Lackenby outfall, to the south by the Cleveland Channel and to the north and east by internal roads. It has previously been used for heavy industrial uses relating to the recovery of metals and the topography is more variable than the rest of the area, ranging from a platform approximately 19.0m AOD to existing ground level at approximately 7.0m AOD at its lowest point.

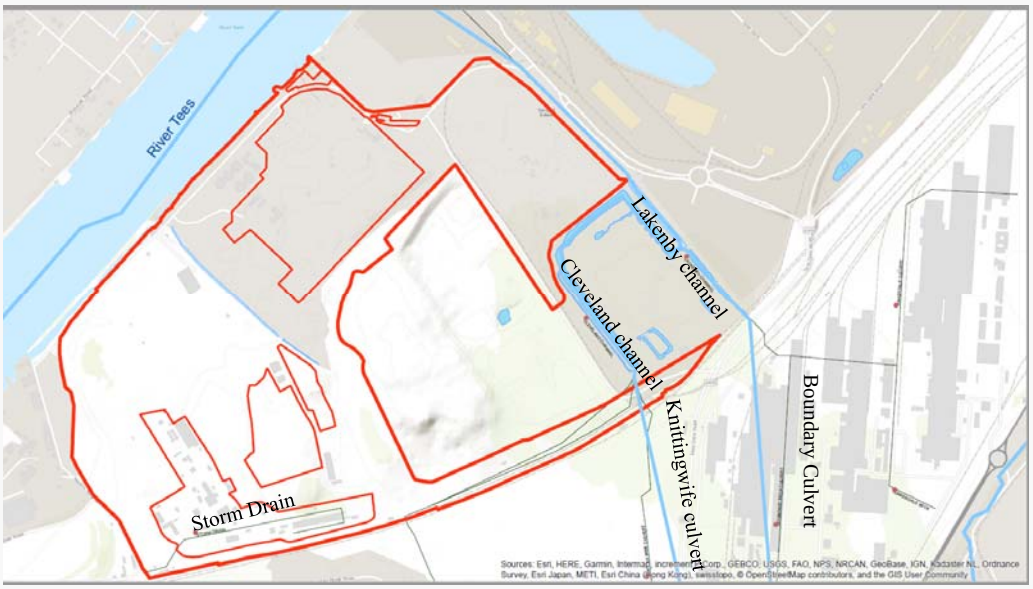
Environmental context

Geology & Hydrogeology

Information taken from British Geological Survey's (BGS) mapping website (http://mapapps.bgs.ac.uk/geologyofbritain/home.html), previous site reports, the Groundsure report (Appendix A, which includes extracts of the geological mapping) and the following publicly available exploratory records from the BGS GeoIndex web portal:

- NZ52SW15054/AS2, AS4, AS6, AS8 & AS10 – Main Works Site
- NZ52SW181/M – Eastern edge of Metal Recovery Plant
- NZ52SW315 – Southern Edge of Metal Recovery Plant

Strata	Brief Description of typical constituents	Average thickness (m)	Aquifer and approximate water level if known*	Notable features
Made Ground	Light grey to dark grey slag with occasional ash and clinker	3.3 – 10.2	1.0 – 9.0m bgl (2.2 to -1.3m AOD)	Not present in Borehole 181/M.
Tidal Flat Sand	Medium dense predominantly laminate black, dark grey, greyish brown or brown silty SAND with occasional shells and gravel	1.2 – 5.6	Tidal Flat-Undifferentiated Aquifer Not Recorded	Not present in Borehole AS10
Tidal Flat Clay	Firm laminated brown silty CLAY	0.6 – 2.0	Tidal Flat-Undifferentiated Aquifer Not Recorded	Only present in Boreholes AS8 and AS10
Glaciolacustrine Deposits	Firm brown or grey mottled silty CLAY	1.20 – 2.25	Not classified Not recorded	Only present around metal recovery plant area
Glacial Till	Firm or stiff, locally soft to firm, locally hard, reddish brown, locally dark brown locally fissured silty sandy gravelly CLAY with rare sand layers.	1.8 – 11.2	Not classified 15.8 – 20.2m bgl (-9.3 to -14.05m AOD)	Groundwater only recorded at 3 locations

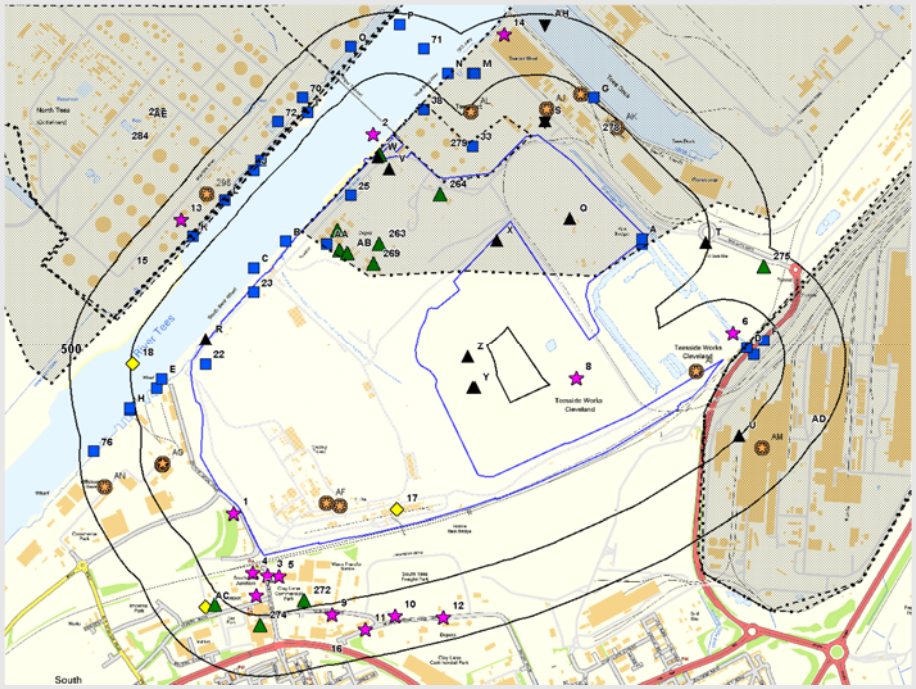
Mercia Mudstone	Reddish brown occasionally green weathered MUDSTONE	Not Proved	Not Recorded
Hydrogeological sensitivity[1]	The superficial deposits are classified as an undifferentiated secondary aquifer. There are no abstraction or source protection zones (SPZ) within 1km of the area.		
Groundwater Sensitivity	The superficial deposits in the vicinity of the area are classified as an undifferentiated Secondary Aquifer. There are no licensed abstractions within 1km of the site and Groundwater Sensitivity is assessed as being Low.		
Hydrology	 The south bank of the River Tees runs parallel to within 20m of the northern boundary of the area and is classified by the EA as a Main River. The Tees is part of the Teesmouth and Cleveland Coast SSSI. There are several culverts within the wider site entering from the south flowing into the River Tees.		
Hydrological sensitivity	The principal surface water feature is the adjacent River Tees. There are no culverts known to cross the area and no named surface watercourses within the area boundary, however a storm drain/linear water feature is shown within the site to the west of the tank farm. A soakaway and a discharge to the River Tees at Cleveland Oil Farm are both regulated under PPC consent. Overall surface water sensitivity is assessed as being Moderate/high.		
Ecology	The area is adjacent to the Teesmouth and Cleveland Coast SSSI, the Teesmouth and Cleveland Coast SPA and Ramsar site.		
Ecological sensitivity	The area is close to this ecologically sensitive area the ecological sensitivity is assessed as being Moderate. An Ecological Assessment has been undertaken by the Industry Nature Conservation Association (INCA) in respect of Remediation Strategy area. Except for nesting birds, no protected species were observed in the surveys carried out as part of the assessment.		

Other Regulatory Database Information

Only regulatory data within 250m of the area with the potential to impact the area has been detailed below, please refer to Appendix A for the complete regulatory data set.

[1] Private water supplies are not included in the database and as such are not considered within the risk assessment, however, there remains the potential for risks to private water supplies however this is considered unlikely in the context of the site and its locality.

Activity	On-Site	0-250m	Details
Current Ground Works	3	3	Presence of South Bank Iron Works Clay pit, a surface mineral works on the southern area boundary, as well as small scale underground localised Brine wells situated in the centre. Grangetown Slag Works located in the south-west area of the site. Adjacent land is occupied by a number of brick works and yards and clay pits.
Potentially Contaminative Land Uses	248	356	Since the mid-19th century much of the area has undergone significant industrialisation. Within the area 248 potentially contaminative land uses have been identified inclusive of unspecified depots, warehouse, tanks and pits in addition to pumping stations, refuse heaps and railway infrastructure. Within the site area a number of iron, steel, concrete, brick and tile works have been operational largely up until the mid-twentieth century. Land adjacent to the area has undergone similar historical development.
Historic Landfill Sites	1	2	A small proportion of a single historic landfill appears to be within the area boundary with the main landfill body situated to the east. An additional two historic landfill sites associated with the Cargo Fleet Wharf Area and Clay Lane Steel Works are situated to the south-west and south of the area, respectively, in close proximity to the boundary.
Registered Landfill Sites and waste management sites	4	0	Three landfills are currently operational within the area. Principally the landfills are situated outside of the area site boundary however small areas of demarcated landfill boundary extent appear to be within the area boundary on the central eastern boundary line. • SSI High Tip: a licensed facility (CLE 3 and CLE 8) utilised for disposal of bi-products from iron and steel making operations. • SSI SLEMS: a waste handling and treatment facility (CLE 9) for BOS oxide waste that is marketed for re-use in the cement industry. • Highfield Environmental Facilities: Highfield operates various licenced landfill facilities (CLE 119 and CLE 170) along the central zone of this area, for both hazardous and non-hazardous wastes, that were previously designated as ICI landfills.  A Metals Recovery Area: an area leased by SSI from Tata Steel, that has previously been leased to Harsco who have been engaged in recycling materials from iron and steelmaking for recovery of metals (PP3338MT).
IPC	4	43	Four historical IPC permits are recorded within the area but appear to relate to one permit that has been transferred three times. The permit relates to the process of Iron and Steel.

Activity	On-Site	0-250m	Details
			Three historical IPC permits 5m northwest of the area, which appear to be one permit transferred three times. The permit relates to the process of Coating Processes and Printing. 
IPPC	3	131	Three IPPC Authorised Activities are recorded within the area, which appear to be the same permit transferred twice. The permit relates to the process of waste landfilling >10 tonnes per day with a capacity of >25,000 tonnes excluding inert waste. Five further IPPC Authorised Activities are recorded in close proximity to the area boundary, but again appear to be the same permit transferred four times. The permit relates to the process of waste landfilling >10 tonnes per day with a capacity of >25,000 tonnes excluding inert waste. A further twenty-seven IPPC Authorised Activities are recorded within 20m of the area, but these also appear to be the same permit transferred multiple times. The permit also relates to disposal or recovery of hazardous waste with a capacity exceeding 10 tonnes per day involving physico-chemical treatment.
Red Discharge Consents	0	0	No consents within 500m of the area.
Petrol and Fuel Sites	0	0	No sites within 500m of the area.
Tank database	314	356	Largely unspecified tanks within the area. Oil tanks listed within the area in 1968.

Site History

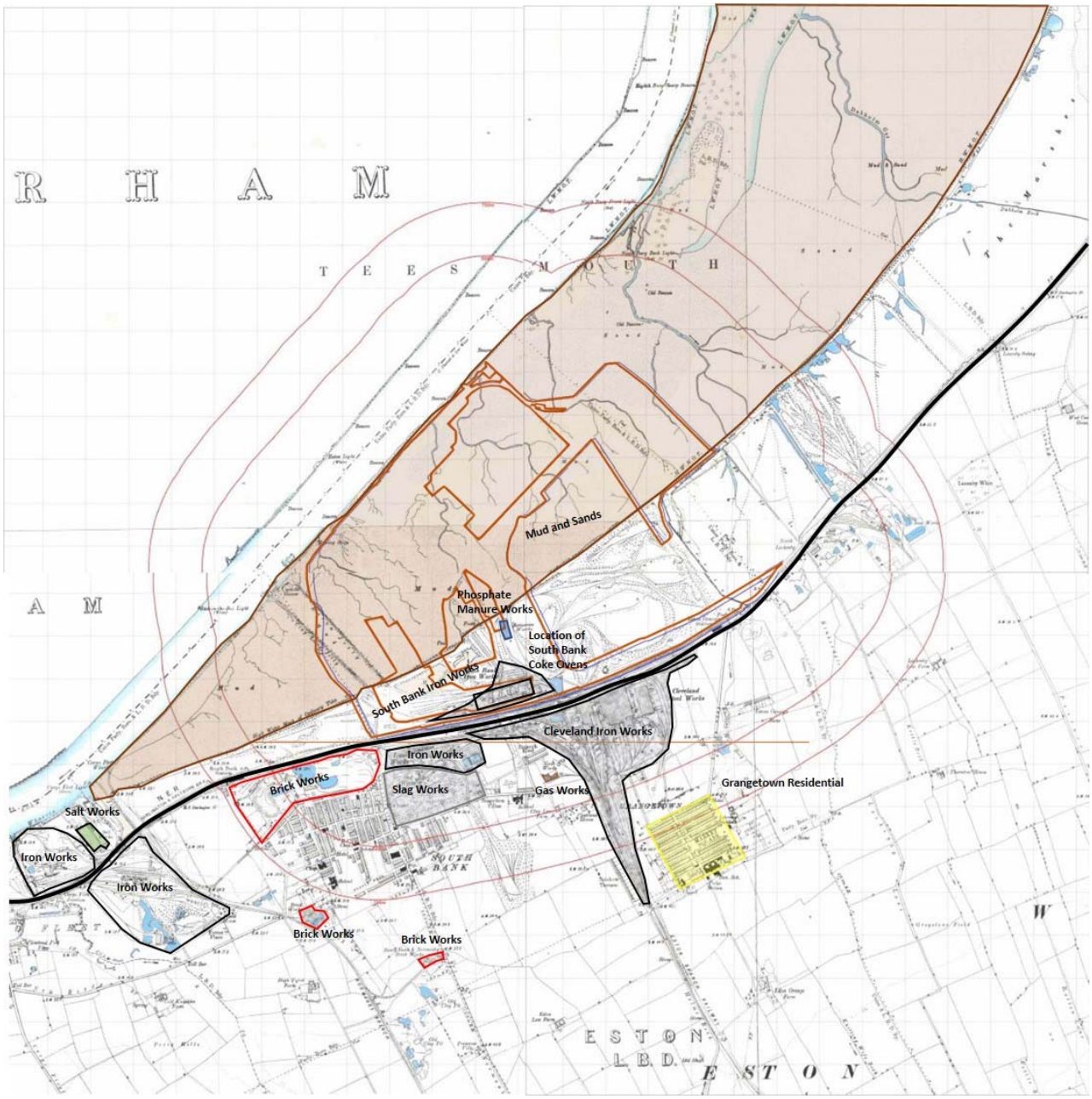
A summary of the historical development of the area, based on historical OS maps, is presented below. The historical maps can be found within the Groundsure Environinsight report in Appendix A. Where relevant, interpretation of the maps is supported by knowledge from the discussions with the client and other stakeholders and previous reports for the area.

Large scale historic maps are available between 1856 and to 2014. Since 1856 the area has undergone significant development following land reclamation between 1897 and 1913.

On-Site: Earliest historic maps available demonstrate minimal development within the area and surrounding areas. Land was principally constituted of low lying scrub land. In closer proximity to the River Tees to the north of the area large areas of land were constituted of mud, sand and marshes.

Off-site: Middlesbrough and Redcar Railway line runs adjacent to the southern boundary of the area (1857). Lands towards the south east of the area is occupied by pasture. A number of becks and streams flow through the area and the surrounding area flowing into the River Tees.

1893 – 1897



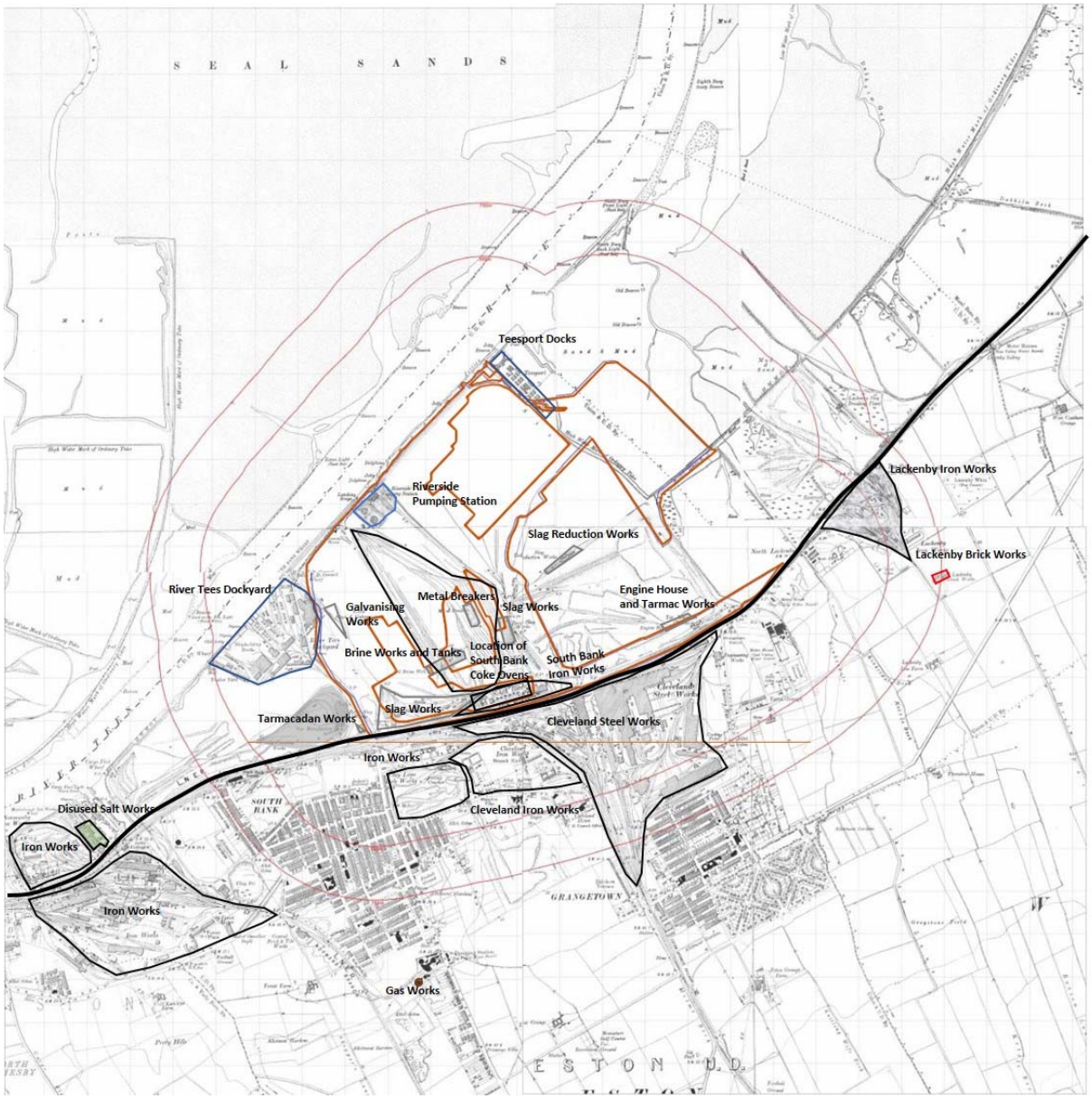
On Site: By 1893 the southern part of the area underwent significant development with the emergence of the South Bank Iron Works and Antonien Works (Phosphate Works) north of the Railway Line. Development of concrete works, and additional slag works in the south-west corner of the area in 1897.

Much of the northern areas of the area are occupied by large areas of sand and mud as a result of tidal action in the Tees. Several wharf buildings and docks were constructed on the banks of the Tees with a jetty connecting the buildings to the mainland. Rail tracks and infrastructure cross the area connecting peripheral areas to the main works.

Off-Site: Areas south of the railway line outside of the area was subject to extensive industrialisation during this period. Much of the land to the south and south-west of the site is occupied by iron, brick, salt and gas works.

Most notable features include the South Bank Iron Works and the Cleveland Steel Works. Some residential development around Grangetown characterised by construction of a large market.

1913 – 1938

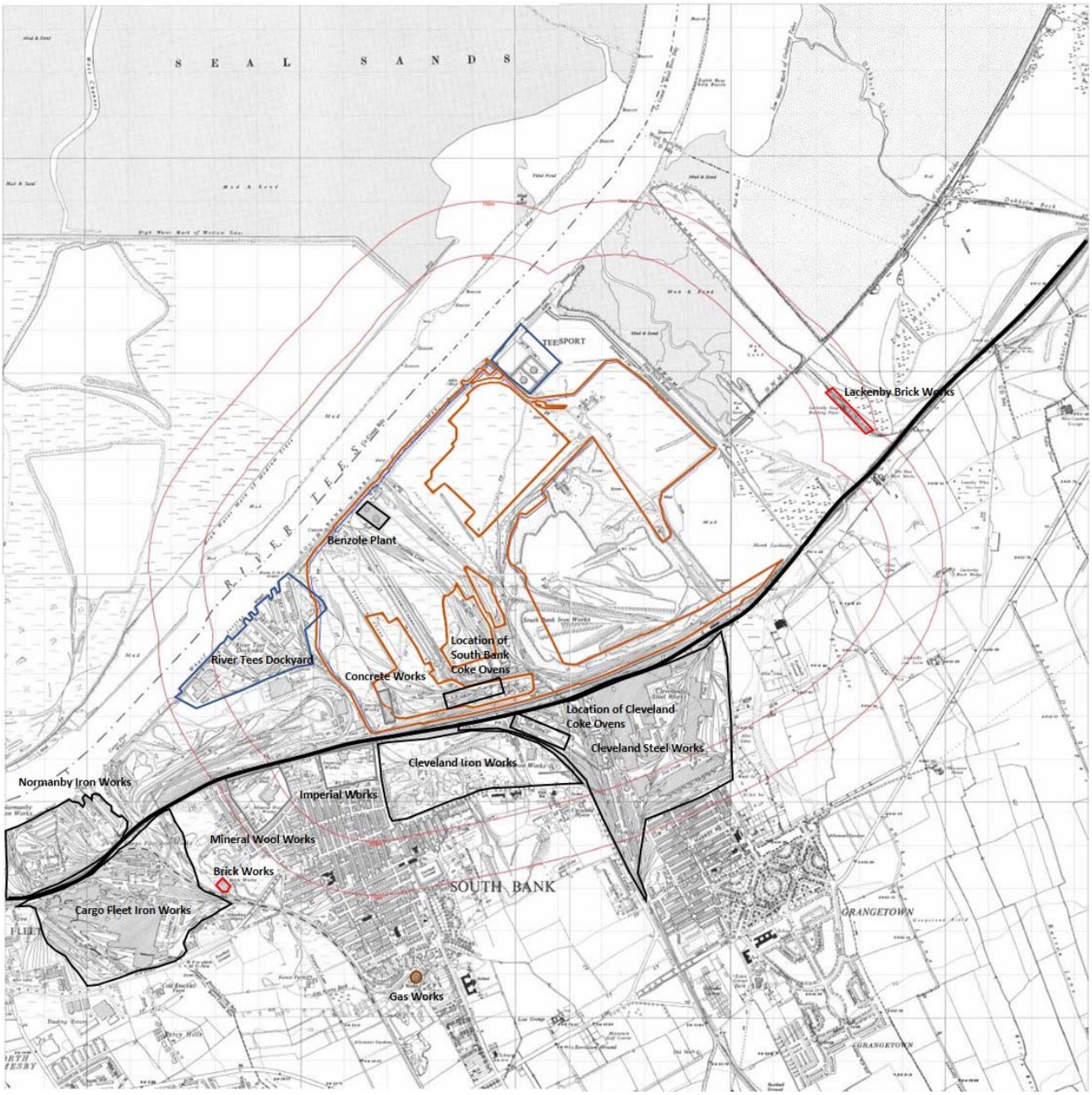


On Site: Significant land reclamation of mud and sand banks in the northern-west area of the area, tracked cranes serving the water front wharf buildings bisect areas formerly occupied by mud and sand. Emergence of two large reservoirs north of the South Bank Works in 1913, reservoirs no longer present by 1927. Construction of Brine wells and tanks north of the South Banks Iron Works. Construction of a number of slag works and concrete works in close proximity to the South Bank Iron Works. Former phosphate manure works repurposed into basic slag works. South Bank Iron Works undergone further development. Additional railway and infrastructure such as tracked travelling cranes constructed during this period. Construction of pumping station on the banks of the Tees. Metal breakers appearing in 1927 on land previously occupied by mud and sand in the centre of the area. By 1915-1929 building in the north west is shown to be a galvanising works.

Off-Site: Construction and growth of Smiths Dock to the south-west, west of the area. Further residential development associated with Grangetown south of the area. Emergence of Slag and Tarmacadam works to the west in 1913, becoming principally orientated around Tarmac manufacturing by 1938. Lackenby Iron and Slag Works constructed to the east of the area.

Further expansion of Cleveland Steel/Iron Works. Development of Clay Lane Iron Works west of South Bank Works. Initial Teesport dock construction identified during this period. Closure of Brickworks south west of the site in 1938 making way for a clay pit. Limited development on and off site between 1927 and 1938.

1938 – 1955

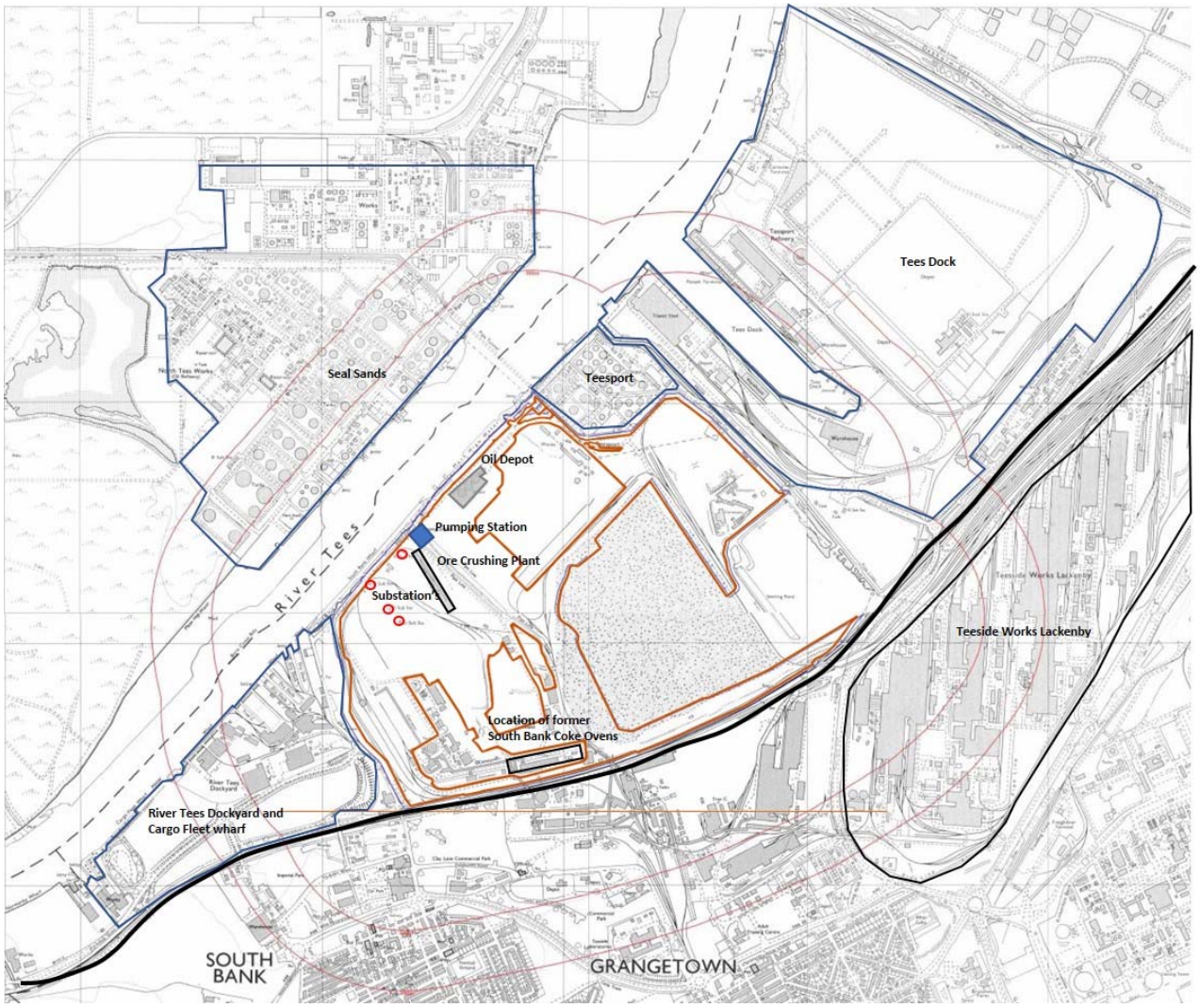


On Site: Significant development of infrastructure serving the South Bank Iron Works, characterised by additional conveyors, travelling cranes and pipelines connecting the works to the South Bank Wharf on the banks of the Tees. A number of tanks and pipes are denoted within the area of the South Bank Iron Works alongside a boiler plant and associated chimneys in the eastern part of the works. During this period brine wells and tanks have been removed with the general area now being used for stockpiling of materials. Eston Sheet and Galvanising Facility on the western boundary no longer present by 1955.

Off-Site: Teesport dry dock expansion to the north-east of the area. Further expansion of Cleveland Steel Works. Mud and sandbanks still occupy much of the area north-east of the area near Teesport development. By 1955 Lackenby Iron Works had been demolished.

Significant expansion of Cleveland Steel Works, Cargo Fleet and Normanby Iron Works by 1955 and residential expansion of Grangetown to the south of the area.

1955-1993



On Site: Removal of travelling cranes from the area used to transport items from the South Bank Iron Works to the docks and wharfs lining the banks of the Tees. Large scale land reclamation both north and south of the Tees can be observed between 1955 and 1988.

Between 1955 and 1959 much of the infrastructure associated with the former South Bank Iron Work has been removed. West of the former South bank Iron Works Site a large undefined rectangular building occupies areas where many of the former coke ovens stood. Located West of the former South Bank Iron Works are the original South Bank Coke Ovens and associated Coke Wharf and Quencher. The buildings occupying the former Cement Works include the Blending Bunkers, Klonne Gas Holder, Repair Shop and Coal Stocking Area. Additional infrastructure associated with a by-product plant is also present inclusive of Booster and Exhaust houses, Condensers and De-Tarrers, Gas Washers, Scrubbers, a Rack Cooler, Acid Storage Tanks, Benzole Storage Tanks and Tar Pump House as well as miscellaneous tanks and sub-stations. Coke Stocking Area is situated to the east, with the two large ore stocking areas to the north.

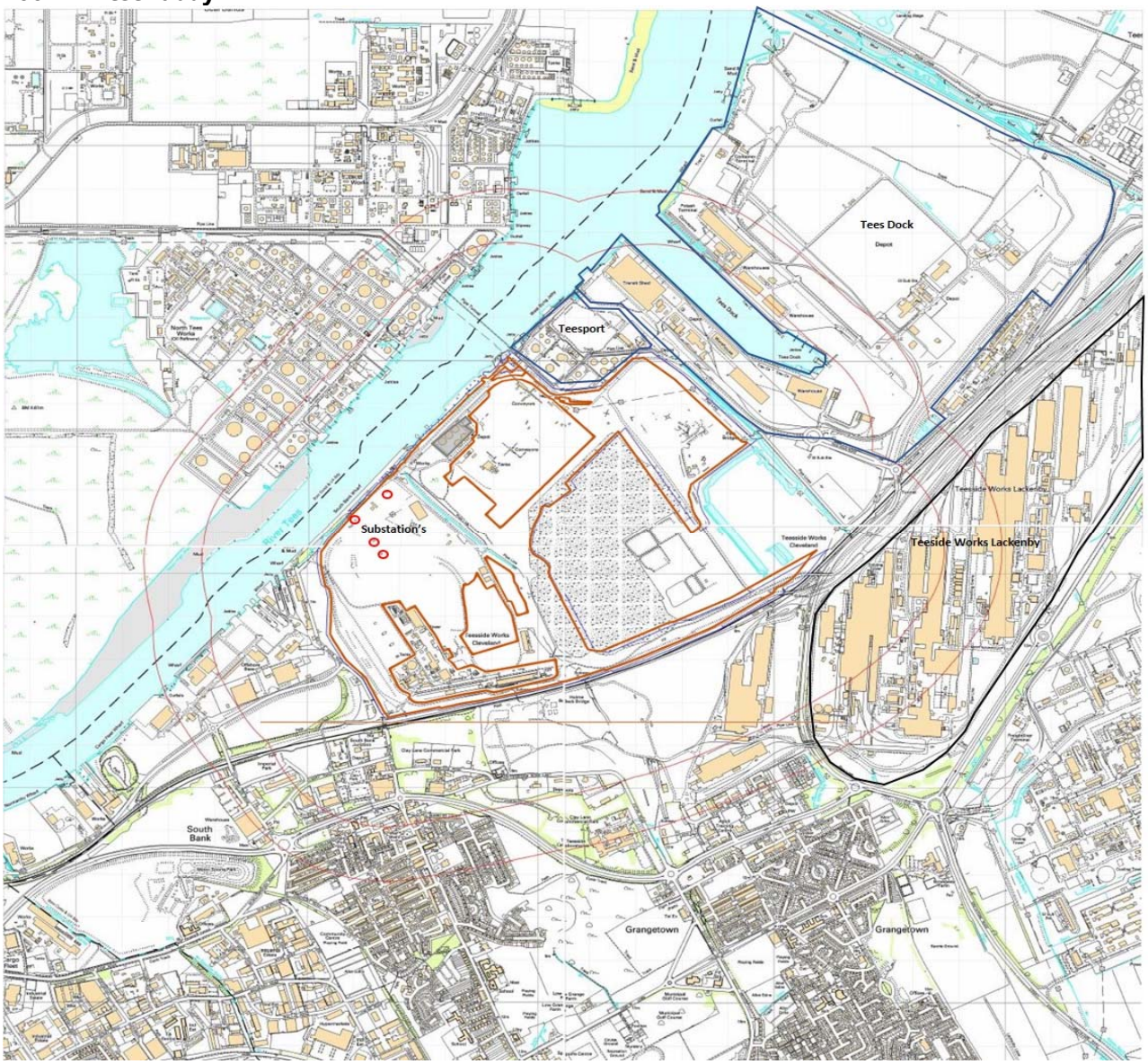
South Bank Iron Works boundary no longer clearly defined due to ongoing redevelopment. Between 1955 and 1992 four substations were constructed in the north east of the area situated southwest of the Riverside Pumping Station. Construction of an Oil depot north east of the riverside pumping station. During Corus's operation[2] the installation comprised a jetty with the facility for discharging fuel oil from ships of up to approximately 30,000 tonnes capacity, five 10,000 tonne capacity oil storage tanks located within a single bund, a pumphouse for oil distribution and loading of tankers, and two package boilers to provide steam for tank heating and pipeline tracing.

By 1968 an Ore Crushing Plant and associated conveyor and railway lines has been constructed 170m south of Riverside Pumping Station. Tanks associated with a disused Benzole plant south east of the South Bank Wharf.

Off-Site: Further expansion around Teesport and Tees Dock to the north east of the area characterised by construction of storage tanks and additional infrastructure between 1992 and 1993. Demolition of infrastructure and facilities associated with River Tees Docks to the West of the area in close proximity to the Tees. Between 1955 and 1992 large areas of the Cargo Fleet as well as Cleveland Iron Works to the south-west and south of the area respectively were demolished. Between 1955 and 1974 Teesside Works Lackenby was constructed on large areas of former farmland south-east of the area. The development was characterised by construction of production and storage facilities, conveyors, travelling cranes, and cooling towers. Further expansion of industrial sites by 1993 in the south-east.

[2] Corus UK LTD. Design of a Site Protection And Monitoring Programme For Cleveland Works, Teesside, October 2004

2002 – Present day



On-Site: Much of the interior of the area is currently undeveloped despite considerable historic land reclamation. Much of the previous infrastructure has been removed with land predominantly used for stockpiling of materials.

Offsite: Further development of the River Tees dockyard to the west of the area in addition to further development of Seal Sands on the north bank of the Tees. Between 2002 and present-day Tees Dock to the north-east of the area has continued to be developed with the construction of additional warehouses, storage facilities and depots associated with the port.

Summary of Area History and Pertinent Features

Since the earliest maps dated 1857, the area and surrounding areas has undergone considerable development. Between 1857 and 1893 significant industrialisation of the south bank began characterised by the construction of the South Bank Iron Works in addition to numerous other iron, slag, brick and gas works with Cleveland Iron Works being constructed offsite between 1897 and 1913. Cargo Fleet Iron Works to the west of the area underwent considerable development from 1893 and 1913.

Much of the north and north east areas of the area situated on land formerly occupied by muds, sands and marsh land. Significant land reclamation of the south bank occurred between 1897 and 1913. It is understood that slag was used to create a high-water embankment. Reclaimed land was subsequently developed characterised by the construction of industrial infrastructure including conveyors, pipelines, travelling cranes, storage tanks and facilities. By 1927 development of Teesport docks began, over time custom houses, wharf buildings and pumping houses were constructed.

Based on historic maps, many of the iron works reached their maximum extent by 1955 prior to being demolished/repurposed by 1992 in addition to much of the supporting infrastructure.

Much of the area is constituted of land formerly associated with the South Bank Iron Works (SBIW).

Notable historic and contemporary features **within the area** which may have implications for land contamination include but are not limited to;

- Antonien Phosphate Works (North) later a Basic Slag Works, suggesting that the phosphate may actually have been being derived from phosphate-rich (basic) slag rather than phosphate rock.
- Land and infrastructure associated with the SBIW inclusive of reservoirs, settlement tanks and ponds chemical and fuel storage tanks, gas holdings, coal and materials stockpiling facilities, waste disposal facilities/refuse heap, material conveyor belts and pipelines (features situated across the site, principally in centre of the area running on a north-south axis).
- Brine works and tanks (South West).
- Sheet metal and Galvanising works (North West).
- Slag works (South and South West).
- Concrete works (South West).
- Benzole plant (North).
- Ore crushing and handling plant (North).
- Electricity Substations (North West).
- Oil depot (North).
- Pumping station (North).

Notable historic and contemporary features **outside of the area boundary** which may have implications for land contamination include but are not limited to;

- Manufacturing infrastructure associated with the SBIW inclusive of coke ovens (South) in addition to land and supporting infrastructure such as coal and materials stockpiling facilities, waste disposal facilities/refuse heap, material conveyor belts and pipelines (features situated across the site, principally in centre of the site running on a north-south axis).
- Slag works (South-West).
- Concrete works (South-West).
- Land and infrastructure associated with the Cleveland Iron and Steel Works (South, South West).
- Normanby, Cargo Fleet Iron Works and associated infrastructure (West).
- Lackenby Iron and Brick Works (East).
- Slag Works (South-West).
- Slag Reduction Works (East).
- Brick Works and associated infrastructure (South West).
- Gas Works and associated infrastructure (South).
- Salt Works and associated infrastructure (West).
- Tarmac Works (to the East & West).
- Mineral Wool Works (South West).
- Imperial Works (South West).
- Seal Sands (North).
- Teesside Works Lackenby (East, South East).
- River Tees Dockyard and associated infrastructure inclusive of docks, wharfs, warehouses (West).
- Teesport inclusive of docks, wharfs, warehouses (North East).
- Tees Dock inclusive of docks, wharfs, warehouses (North East).

Derivatives of the aforementioned features may also be present within and surrounding the area.

Summary of Previous Reports

Previous Report Ref	
Allied Exploration & Geotechnics Limited South Tees Industrial Area- Site C-Ground Investiga1ion **12/07/99** **AEG Contract No. l7JSH**	**Scope of works** The scope of works comprised • Advancement of six boreholes to depths of between 18.70m BGL (BH-C04) and 22.00m BGL (BH-C03) • Thirty-three trial pits were mechanically excavated to depths of between 1.80m BGL (TP-C21) and 8.00m BGL (TP-BHC05) using a 360° tracked excavator. • Analysis of 60 samples for Heavy metals, Pahe, Phenols and Toluene extractable matter • Analysis of 4 grab samples of water from trial pits • Geotechnical testing in the field including California Bearing ratio and standard penetration testing • Geotechnical laboratory testing including Atterburg limits and natural moisture content, particle size distribution, undrained Shear strength, sulphate and pH, **Findings** ***Ground conditions*** With the exception of an initial very shallow layer of variable material (soil, gravels, etc), the made ground deposits are comprised almost entirely of slag, generally assessed as being of a loose to dense nature, with the denser material generally being encountered at depth. The made ground appears to extend down to depths of around 7.0 to 8.5 metres in most parts. However, in borehole BHC6, the made ground was found to extend down to 10.0m below ground. It appears evident that the slag horizon probably prevails across the whole of Site C, substantiating the information acquired at the desk study stage that slag fill was utilised in the original reclamation of the area, which saw it transformed from tidal mudflats into developable land. ***Soil*** *Wood Comment: Lead in soil exceeded the current GAC for commercial end use of 2,300mg/kg. This was in two of the 60 samples with maximum of 2,945.2mg/kg. Concentration of the remaining metals were all below the current GAC for commercial end use.* ***Groundwater*** *The groundwater samples appear to be grab samples from trial pits.*
Enviros **Soil and Groundwater Baseline Characterisation Study Teesside Works** **Summary Report and appendices** **June 2004**	**Scope of works** The report relates to The Cleveland area of the Corus steel works. It includes a summary of the desk study and summary of results. The Cleveland area includes the current site area. Site investigation works were carried out during the April to May 2004. The works comprised • 123 trial pits to up to 3.5m and • 11 boreholes to up to 10m. • Approximately 232soil samples analysed for metals, pH, sulphate cyanide and PAHs, phenol and TPH. Were taken from within the site boundary • One round of groundwater monitoring from 10 groundwater metals, pH, sulphate cyanide and PAHs, phenol and TPH **Findings** ***Ground conditions*** The area is underlain by infilled material (Made Ground). Made Ground comprises fragments of slag, brick, ash and ferrous metal debris with very occasional pockets of clay. Layers of fused 'pelite' (Blast furnace slag) were encountered in some parts of the site. Oily and tarry deposits and strong organic odours were noted at exploration locations located to the northwest of the By Products Plant (particularly near the benzol storage tanks). Soils: Fill materials across the site are typically characterised by alkaline pH and elevated concentrations of sulphide and sulphate. This is due to the widespread occurrence of slag within Made Ground deposits underlying the site. Lead was elevated above thresholds for commercial end use in 4 of the 238 locations and naphthalene was above the thresholds for commercial end use near the off-site coke ovens. Testing for hydrocarbons was carried out using GC. TPH above 1000mg/kg was identified at 14 of the 232 locations and three exceeded a screen for C10-C40 near the coke ovens. These were mostly near the off-site coke ovens and off-site SLEMS landfill. Benzene was detected near the off-site coke ovens. While zinc was below the GAC elevated zinc concentrations were detected which could lead to soil being classified as hazardous in about 5-10% of samples.

Previous Report Ref	
	Groundwater: Groundwater levels across the site ranged from 0.8 to 7.6mbgl (and 1.17 to 6.84mAOD) and did not conform to any consistent flow pattern although there was evidence for a broad flow direction towards the River Tees. Due to the distribution of boreholes across the site it was not possible to draw any specific conclusions from the water levels observed. Local flow conditions were believed to be complex and possibly localized due to local variations in the depth of Made Ground, variations in permeability of the underlying drift deposits and/or the effect of sub-surface drainage systems. *Wood Comment: the range may also be tidally influenced.* Groundwater samples from the By Products Plant and SLEMS areas also indicated concentrations of hydrocarbon compounds in excess of screening criteria (PAH, BTEX Compounds, TPH and GROs). Free product was noted in groundwater monitoring wells in the By Products area, near the benzol storage tanks. Copper, lead mercury, zinc and cyanide were also above EQS for transitional waters in 2 to 3 of the 10 samples.
CORUS UK LTD. **Design of a Site Protection and Monitoring Programme for Cleveland Works, Teesside,** **October 2004**	**Scope of works** This report set outs the requirement for collecting baseline data for areas where the potentially polluting substances were identified to be stored or used at the Cleveland works. The works were divided into 4 areas and descriptions of the area has been used to support this report **Findings** The need to collect further data as set out below • The South Bank Coke Ovens: Reference data did not need to be collected. • South Bank Oil Tank Farm: Reference Data to be collected and reported for the 5 x 100,000 litre capacity heavy fuel oil tanks located at NZ 5370 2250. • The Solid and Liquids Environmental Management System (SLEMS) – outside the current area): reference data to be collected at the Settling Ponds and Drying Bays located at NZ 5490 2248, and the Oil Mop House located at NZ 5525 2218. • The slag handling plant operated by Heckett Multiserv Operations: Reference data did not need to be collected. Baseline investigation was proposed.
CORUS UK LTD. **First Phase Reporting of the Site Protection and Monitoring** **Programme** **31 January 2008**	**Scope of works** This document represented the first phase reporting of reference data for the Teesside Works Site Protection and Monitoring Programme ('SPMP'). Reference Data was collected for Cleveland and Redcar where there is likelihood for potential pollution to land. At Cleveland the sources of potential polluting substances that may cause pollution to land were the Heavy Fuel Oil Storage Tanks, South Bank Oil Farm (Area 2), Cleveland Works. The investigation comprises. 3 Boreholes, BH2B1 to BH2B3, were excavated at south bank oil farm. (this was a variation agreed with the EA to the scope in the 2004 report. The boreholes were to a maximum depth of 13m and excavation comprised excavation to 4m with follow-on rotary which was replaced by sonic drilling for the last hole (which was carried out in December 2006. (this is not reflected in the logs) Nine soil samples were analysed form her made ground and 3 groundwater samples were analysis. **Findings** ***Ground conditions*** Made Ground of slag was encountered in all three locations to between 8.50 metres and 10 metres below ground level (bgl). (the logs show Made ground extending to 13m in BH2B3) Silty sand was encountered underlying the Made Ground. This silty sand was considered to be the natural estuarine alluvial deposits. The logs slightly contradict the report. ***Soil*** TPH and PAHs in all nine samples were low with TPH at a maximum of 100mg/kg and benzo(a)pyrene at a maximum of 1.4mg/kg. ***Groundwater*** The groundwater results showed 30 - 62µg/l of TPH at BH2B2 and BH2B3 in July 2007 and none in 1B1 in January 2007. PAHs and BTEX were all below detection. No groundwater level data was provided.

Previous Report Ref	
Arcadis **The Former SSI Steelworks, Redcar: Replacement Cle3/8 Landfill Boreholes CQA Validation Report** **South Tees Site Company Limited**	The CLE 3/8 Landfill Site is located to the southeast of the area and comprises a large area of worked and built-up ground which extends to the southeast. An area of cleared and levelled ground is located in the southwest which is an area that formerly contained stockpiles of slag material and was owned by TATA Steel Limited. **Scope of works** The works comprised re-drilling previous monitoring wells around the northern and western perimeter of the CLE 3/8 landfill. All three boreholes lie within the current site. **Findings** ***Ground conditions*** Made Ground was encountered in all three exploratory holes progressed and ranged in thickness from 8.5-14.4m bgl. This material generally comprised sandy gravel with cobbles and boulders of slag, concrete and brick. The underlying superficial deposits comprised: Tidal Flat Deposits – encountered in BH4R between 14.4 and 15.5m bgl and comprised silty sand. Glaciolacustrine Deposits – encountered in BH4R and BHD between 8.5 and 15.5m bgl, proved to a maximum depth of 19.4m bgl in BH4R, and comprised soft to firm laminated clays. Glacial Till – encountered in BH4R between 19.4 and 20.0m bgl and comprised firm to stiff, slightly sandy, slightly gravelly clay
Summary of key finding of all investigations	Made Ground is present across the site and typically extends to 6.5 to 8m below ground although it is locally deeper. The made ground typically comprises fragments of slag, brick, ash and ferrous metal debris and blast furnace wastes. The Made ground is very hard and typically boreholes have been advanced by trial pitting through the majority of the made ground prior to drilling. Groundwater levels across the site ranged from 0.8 to 7.6mbgl (and 1.17 to 6.84mAOD) and did not conform to any consistent flow pattern although there was evidence for a broad flow direction towards the River Tees. Analysis of the made ground have indicated that the potential contaminant concentrations are generally below commercial end use criteria. Lead was slightly elevated in a small number of samples. There was evidence of localised hydrocarbon contamination in soil and groundwater within the area near the off-site south bank coke ovens and benzol tanks and near the SLEMS landfill and in lower concentrations at South Bank Oil Tank Farm in the north of the site. The testing on site did not include asbestos analysis. It is noted that elsewhere within the Remediation Strategy site and wider STDC area that asbestos has been detected in similar made ground. For instance, a recent site investigation[3] at the Torpedo Ladle Repair Shop - TLRS in the southern part of the larger Former SSI Steelworks Facility identified asbestos in 38 of the 169 samples analysed.

Data Gaps

Asbestos

Made Ground within the area has not been subject to asbestos analysis. This should be included within any future ground investigations.

[3] Allied Exploration & Geotechnics Limited The Former SSI Steelworks, Redcar – Ground Investigation Contract – Priority Areas Within SSI Landholdings Contract 3 Final Factual Report, June 2018

Landfill Gas

Future development proposals located in close proximity to former landfill sites should be supported by further investigation and an associated Gas Risk Assessment and should incorporate any necessary protection measures appropriate to protect buildings from landfill gas migration.

Future Phase 2 Contaminated Land investigations

It is anticipated that supplementary ground investigation within the site boundary may be required to support specific proposed developments and land parcels as they are brought forward for development.

2.4 Grangetown Prairie

Site Description

The Grangetown Prairie area (the area) is the south western most land parcel and is bound by the Darlington to Saltburn Railway line to the north, by Tees Dock Road to the east and to the west by Eston Road. Immediately to the south of the area within the wider red line site boundary, with vacant former steel works (Torpedo Ladle Repair shop and associated outbuildings), and to the south of this is the Bolckow Industrial Estate. To the east of the area is the South Tees Freight Park.

The area is currently disused and largely derelict, comprising areas of concrete slabs/ hardstanding or unsurfaced ground with sparse emergent scrub vegetation.

The area comprises an area of approximately 55 ha and is generally level with the majority lying between 8 and 9 m AOD. There is a gradual south to north fall, with ground levels ranging from 13m AOD in the extreme south western corner to approximately 7.5m AOD on the north eastern boundary.

Environmental context

Geology & Hydrogeology

Information taken from BGS on-line mapping (http://www.largeimages.bgs.ac.uk/iip/mapsportal.html?id=1001513) and the BGS on-line geoviewer (http://mapapps.bgs.ac.uk/geologyofbritain/home.html), previous reports, the Groundsure Report (Appendix B, which includes extracts of the geological mapping) and the following publicly available exploratory records from the BGS GeoIndex web portal:

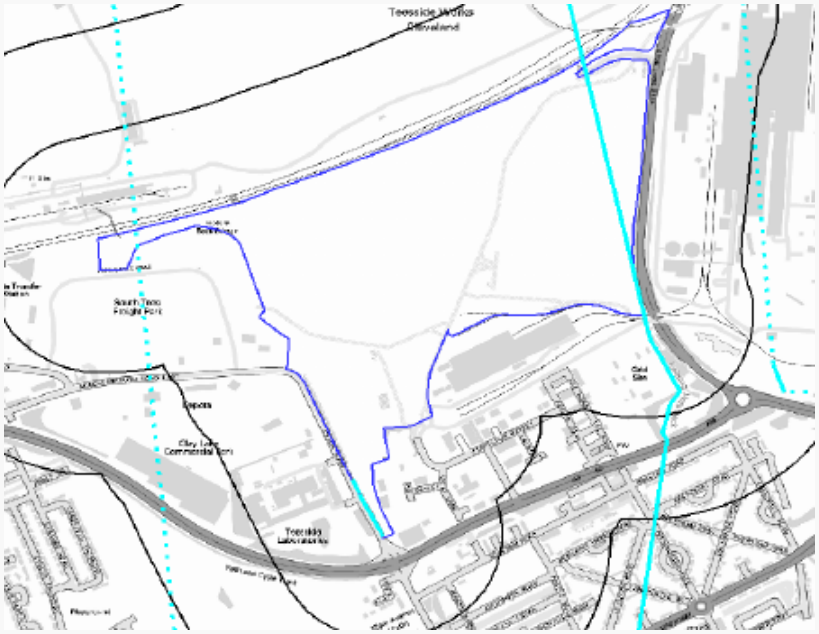
- NZ52SW629 & 631 – North west corner
- NZ52SW131/A-D – Eastern Section
- NZ52SE20/A 1 & 2 – South east corner.

Strata	Description	Typical Thickness (m)	Typical Depth to Base (m bgl)	Groundwater	Aquifer Status	Comments
Made Ground	Mixed fill, typically granular Slag, firebricks, coke, ash and brick	0.60 – 5.5	0.60 – 5.5	1.95m bgl in BGS Borehole 127. 2.85m bgl in BGS Borehole 13551/13	Not Classified	
Superficial Deposits						
Glaciolacustrine Deposits	Clay and Silt	0.75	3.60	Not Recorded	Unproductive Strata	Significantly thicker in north west corner
Solid Geology						
Redcar Mudstone	Blue Shale, Grey Mudstone and siltstone, thin beds of limestone	Thickness up to 280m, not proven	Not proved	Not Recorded	Secondary Undifferentiated	Only encountered in Boreholes SE120/A1 and SE20/A2.
Penarth Group	Grey to black Mudstone, subordinate limestone and sandstones	Thickness 0-12m	4.95 – 11.0	2.95m bgl in BGS borehole 796709	Secondary B Aquifer	Present as a narrow band through centre of the area only. Only encountered in Borehole 131/C.
Mercia Mudstone	Red Mudstone, subordinate siltstones, locally Halite and thin gypsum beds and sandstones	Thickness up to >1000m, not proven	Not proved	2.95m bgl in BGS Borehole	Secondary B Aquifer	Only encountered in Borehole 131/B.
Sherwood Sandstone	Red Sandstone	Thickness Approximately 250m			Principal Aquifer	

Hydrogeology	Superficial drift deposits underlying the area are classified as unproductive strata[4]. Penarth Group and Mercia Mudstone underlying the superficial deposits are classified as Secondary B Aquifers, and the Redcar Mudstone is a Secondary (undifferentiated) Aquifer. Secondary A aquifers comprise permeable layers that can support local water supplies and may form an important source of base flow to rivers. Secondary B aquifers are mainly lower permeability layers that may store and yield limited amounts of groundwater. Secondary undifferentiated are aquifers where it is not possible to apply either a Secondary A or B definition because of the variable characteristics of the rock type/ deposits. Made Ground at the site is typically granular and is therefore also water-bearing, although it does not have a formal aquifer classification. Groundwater in the Made Ground is likely to be in continuity with groundwater in the underlying superficial deposits classified as Secondary aquifers. In addition, there is likely to be hydraulic continuity between groundwater in the Made Ground and shallow superficial deposits and surface waters. Previous ground investigations across the area have encountered the presence of a shallow perched water table within superficial deposits at typical depths of less than 2m below ground level (bgl). Given the variable nature of the superficial deposits, it is likely that water bearing horizons within these superficial deposits are not laterally continuous across the study area. There are no licensed groundwater abstractions within 1km of the area. There are no SPZs within the site or within 1km of the site. In general, groundwater flow in shallow deposits is anticipated to be towards the River Tees to the north or northwest. However, groundwater flow direction in shallow soils across the area is likely to be variable and influenced by the presence of surface water features. The main River Tees is also tidally influenced, and there is likely to be some tidal variability of groundwater in hydraulic continuity with surface waters. The presence of man-made features such as excavations, foundations, basements and underground utilities/ services may also influence groundwater flow. The Sherwood Sandstone Principal Aquifer at depth is of limited hydrogeological concern within the area, as it is overlain by a significant thickness of Mercia Mudstone, which are likely to l limit the vertical connectivity with shallow groundwater.
Groundwater Sensitivity	The groundwater sensivity has been based on The Guidance for the Safe Development of Housing on Land Affected by Contamination R&D66: 2008 [5]. The groundwater sensitivity is low. Although the area is underlain by Secondary aquifers, there are no local groundwater abstractions within 2km and the area is not located within an SPZ. Given the widespread former and current heavy industrial use of the site and surrounds, there is likely to be widespread regional degradation of groundwater quality.
Hydrology	The River Tees is located to the approximately 1.2km north of the area, and is classified by the EA as a Main River. The stretch of the River Tees to the north of the area is tidal. There are other minor surface waters courses present within the area. Knitting Wife Beck is present in the east of the area and an unnamed water feature is present in the south west Given the previous development of the area, the surface water drainage is likely to be highly modified, and there are culverted surface waters and below ground drainage present throughout the area.

[4] https://magic.defra.gov.uk/MagicMap.aspx

[5] NHBC/ CIEH / Environment Agency, Guidance for the Safe Development of Housing on Land Affected by Contamination R&D66: 2008



Note:
Surface waters include the culverted Knitting Wife Beck and the River Tees are likely to be in hydraulic continuity with shallow groundwater in Made Ground and potentially the Superficial deposits and therefore receive groundwater baseflow.

Hydrological sensitivity	The surface water sensitivity is low. The area lies in the catchment of the River Tees, which is over 1km away and is tidally influenced.
Ecology	The Teesmouth and Cleveland Coast SSSI is located 745m north of the area, and within 2km north west and south west of the area. The River Tees forms part of the SSSI. The Teesmouth and Cleveland Coast is also designated as a SPA. The SSSI is also a designated Biodiversity interest Area.
Ecological sensitivity	The ecological sensitivity is assessed as Moderate as there is a SSSI approximately 0.75km from the area. The River Tees to the north receives surface water discharge from the area and is designated as a SSSI. However, the influence of discharges from the site are likely to be limited by the tidal exchange and large volume of the water body.

2.5 Other regulatory database information

Only regulatory data within 250m with the potential to impact the area has been detailed below, please refer to Appendix B for the complete regulatory data set.

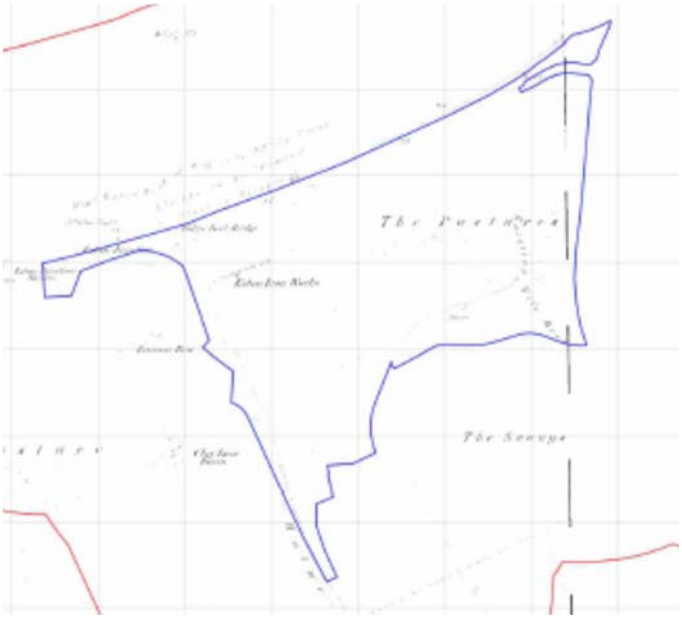
Activity	On-Site	0-250m	Details
Waste management/ transfer/ treatment facilities/disposal	1	1	SSI held a permit for storage of furnace ready scrap for recovery. Issued in December 2014. The permit is listed as issued and revoked. Scot Bros Recycling Limited held a permit for a household, commercial and industrial waste transfer station. Issued in December 1996. Permits for the same location are listed for J W S recycling and Campbell John Waste Management.
Landfill	0	4	The closest landfill is situated approximately 25m to the north of the area and is listed as waste landfilling (excluding inert) and is operated by SSI.
Current Industrial Data	14	99	2 listed as Teesside works, 3 tanks, 6 pylons, 2 pipelines, 1 electricity sub-station.

Activity	On-Site	0-250m	Details
Historical Industrial Data:			
Potentially Contaminative Uses	154	222	Related to the iron and steel works including pits, tanks, heaps, railways, cuttings and gas works.
Tank Database	323	456	Listed as tanks and gas works/holder.
Mineral Extraction and Coal Mining Activities	1	0	Abandoned Brine Wells are listed on site. There is no information listed for coal mines.

2.6 Site history

A summary of the historical development of the area, based on historical OS maps, is presented below. The historical maps can be found within the Groundsure report in Appendix B. Where relevant, interpretation of the maps is supported by knowledge from additional sources:

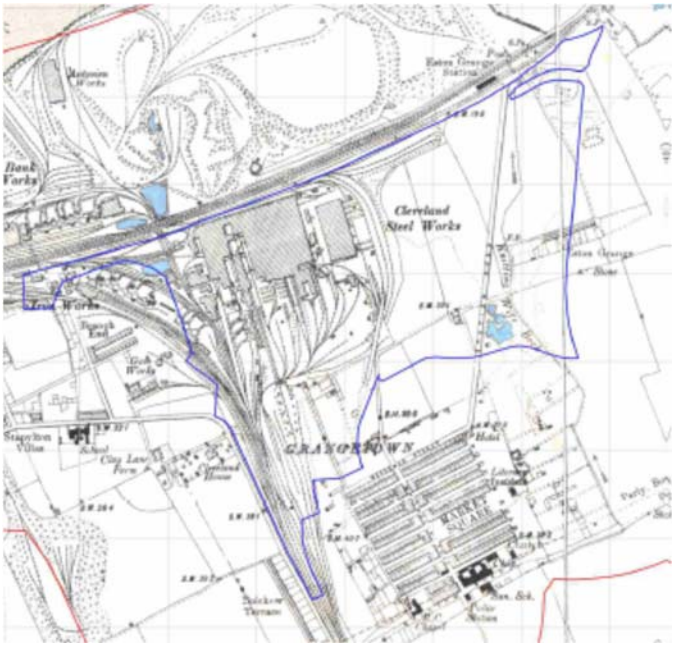
- Drawing 1X1853 Layout of Cleveland South (Sheet 4).



***On-Site:** The majority of the area is shown as agricultural land. Eston Iron Works is shown in the west of the area.

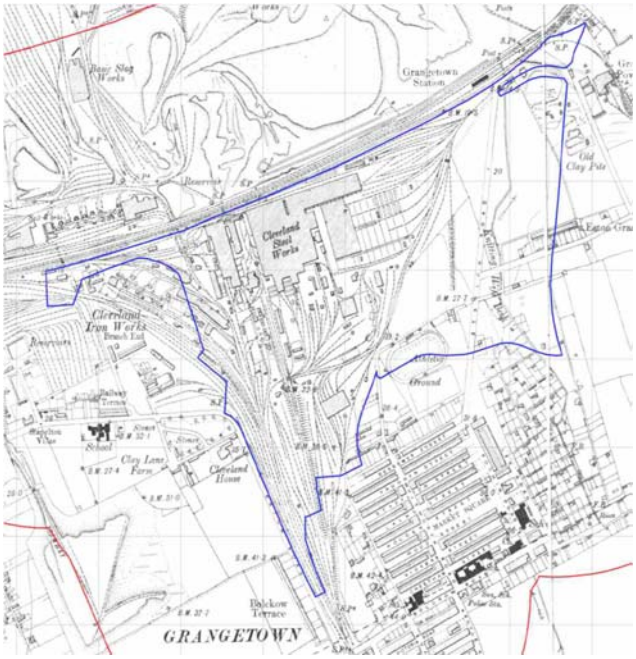
***Off-Site:** Eston Junction Station and Eston Junction are shown in the vicinity of the northern area boundary.

*Detail on the map is unclear, and accurate location and description of area features is therefore difficult to determine.



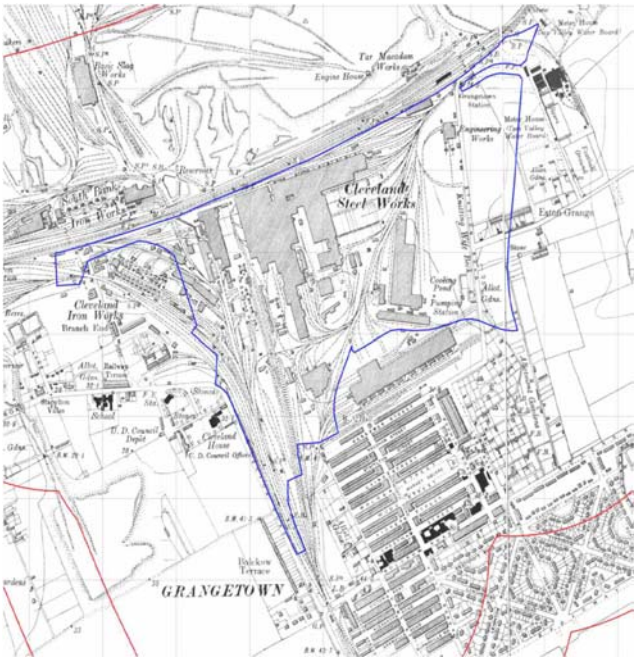
On-Site: Cleveland Steel works is present in the north western part of the area. Railway lines are shown entering the steel works from the south. Cleveland Iron Works is present in the far northwest of the area and extends beyond the boundary. Railway lines run between the iron works and steel works. A water body is located in the far northwest of area between the steel and iron works. Two water bodies are located in the south east of the area and Knitting Wife Beck is located further to the east. Station Road runs north to south to the west of the water bodies. Eston Grange Stone is located on the far east of the area and straddles the boundary.

Off-Site: A gas works is located approximately 50m to the west of the area. A railway line is present adjacent to the north of the area and demarcates the northern boundary. Beyond the railway line is an extensive area of slag heaps. South Bank Iron Works is located beyond the railway line approximately 50m north west of the area along with two surface water bodies. The Antonien Phosphate Works is located approximately 400m north of the area. An iron and slag works are located approximately 400m west of the area. Eston Grange Station is shown adjacent to the area boundary in the north east of the area. An area of terraced housing labelled as Grangetown and Market Square is shown approximately 25m south east of the area at its closest point.



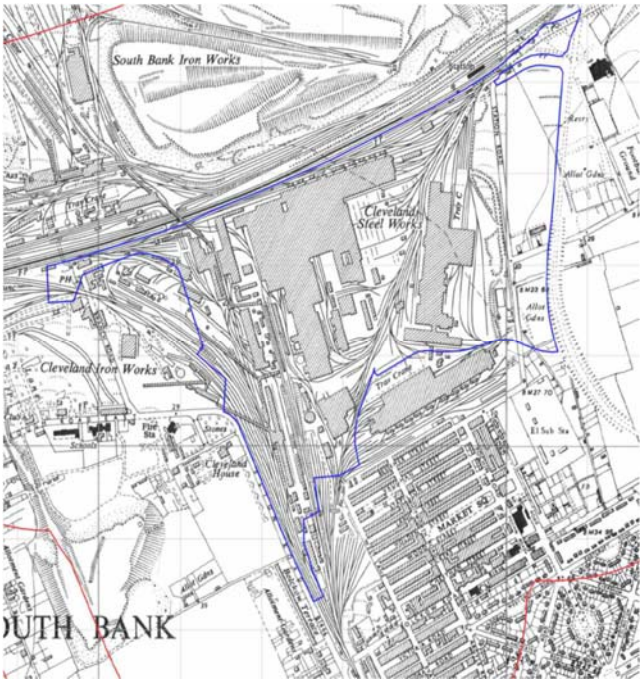
On-Site: Additional railway lines and sidings were constructed to the east and south of the Cleveland Steel Works. Unnamed structures are present to the east and south of the railway lines. The water body in the north west of the area is no longer shown. An athletic ground is shown in the south of the area, the two unnamed water bodies were no longer shown in the south east of the area

Off-Site: A reservoir is shown to the north of the area beyond the railway lines. A salt works is shown within the South Bank Iron Works approximately 100m north. The phosphate works is now shown as a basic slag works. Eston Grange Station has been renamed Grangetown Station.



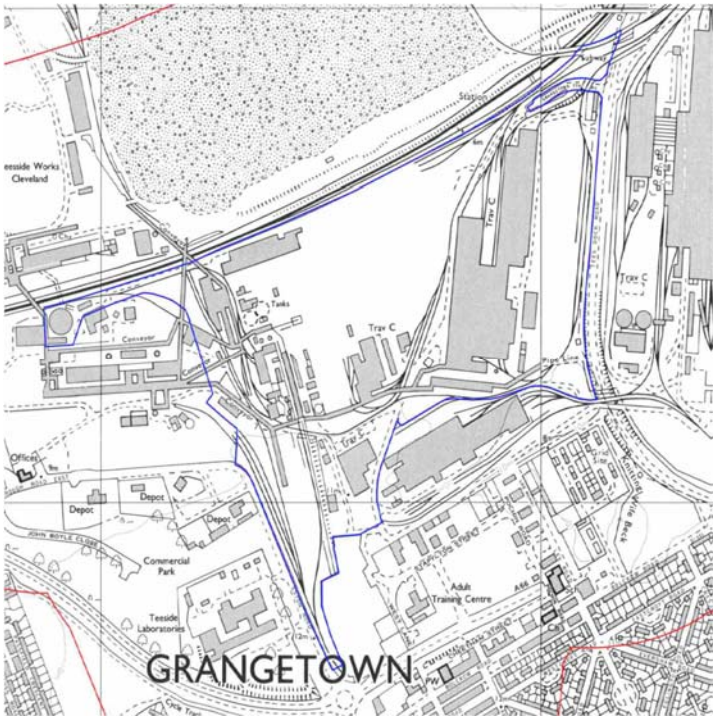
On-Site: The Cleveland Steel Works continued to dominate at this time, with expansion of the main works buildings towards the south. An engineering works is now shown in the north east of the area off Station Road. A cooling pond and pumping station are shown in the south east corner of the area.

Off-Site: The slag heaps continued to be present to the north of the area, along with the basic slag works. The South Bank Iron Works was now shown to the north of the area. A tarmacadam works is shown approximately 50 north of the area. The athletics track has been replaced by a large building adjacent to the south of the area.



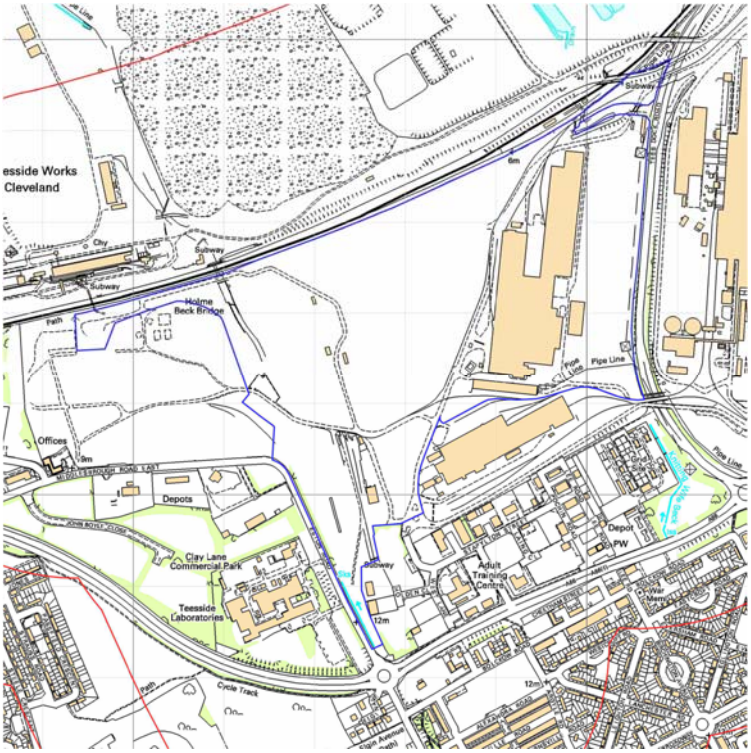
On-Site: The Cleveland Steel Works had expanded, and the building footprint occupied the majority of the central area. The development included boilers, blast furnaces and a cooling tower as shown on site layout plans. A travelling crane is shown in the east of the area. The engineering works in the east of the area was no longer shown.

Off-Site: The South Banks works remained in the area north of the area, comprising works buildings, slag heaps and railway lines. A tarmacadam works is shown approximately 50m north of the area. The athletics track has been replaced by a large works building adjacent to the south of the area. The phosphate works to the north of the area is no longer shown.



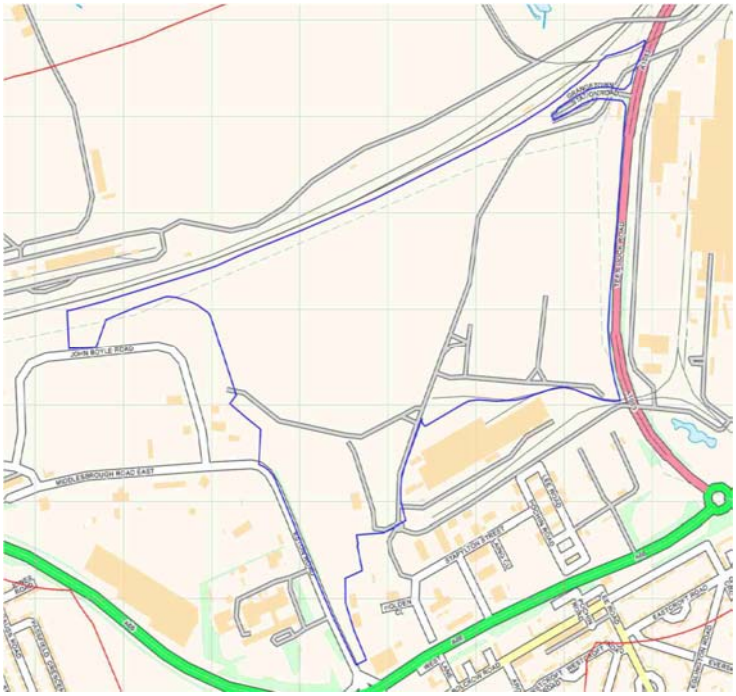
On-Site: The large works buildings in the northern central part of the area are no longer shown. Tanks are shown in the north east of the area which are listed as clarifiers on site layout plans. Conveyor belts are shown on the west of the area linking it with the adjacent works. A circular structure is shown in the far north west of the area which is shown as a gas holder on site layout plans. Many of the railway lines and sidings are no longer present. Travelling cranes are also shown within the area. A pipe line is shown in the far south east.

Off-Site: Multiple buildings, tanks and travelling cranes are shown beyond the Tees Dock Road adjacent to the east of the area. The market hall to the south of the area is now an adult training centre. The layout of buildings to the south of the north west of the area has changed and site layouts indicate this is a blast furnace plant. There remained a large area of slag heaps to the north of the area.



On-Site: Mapping indicates that there had been considerable demolition of site structures in the west and south by this time. Three small unnamed buildings remained in the central part of the area. The large works building in the east of the area is still present, and a pipe line close to the eastern site boundary. Many of the railway lines within the area had been dismantled. Holme Beck Bridge is present on the north western boundary of the area. The south western site boundary was demarcated by a surface water channel.

Off-Site: The works adjacent to the west of the area are no longer present. Land to the west of the area is now occupied as depots, Teesside Laboratories and Clay Lane Commercial Park. Further depots and commercial development had taken place to the south of the area at this time.



On-Site: Further demolition of on-site structures had been carried out. No buildings are present with the exception of one minor building in the south west of the area. Access roads continued to be shown in the southern and eastern parts of the area.

2.7 Summary of Previous Reports

Previous Report Ref	
TS3 Grangetown Prairie – Phase 1 Geoenvironmental Desk Study, CH2M Hill, August 2017.	**Scope of works** This report comprised a data review for the Grangetown Prairie site. The study area extends to approximately 51ha. **Findings** The review findings concluded that the site was formerly part of the Cleveland Iron and Steelworks. The original Cleveland Works was formerly located east of the site but relocated onto the study site prior to 1929. The works comprised the Torpedo Ladle Repair Shop, Bessener Furnace and Mill Buildings along with numerous ancillary works buildings. There was large scale demolition of the works in the 1980s onwards. The site condition at the time of the report comprised hardstanding, grass and scrub vegetation. ***Ground conditions*** ***Soil*** CH2M Hill reviewed the Enviros site investigation carried out in 2004. Site investigation works carried out within the site comprised 3 exploratory holes (2 trial pits, 1 borehole). Investigations revealed Made Ground comprising sand, gravel, cobbles and boulders of slag, clinker, brick concrete and ash, along with relic foundations. Made ground was proven to depths of up to 4m in the north of the site, and in the south of the site, Made Ground exceeded 4.2m in thickness. Made Ground depths on adjacent land indicated Made Ground thicknesses up to 10m. The site was underlain by the Glaciolacustrine deposits comprising clay and silt. Published mapping indicated that Tidal Flat deposits were present adjacent to the north of the site. Enviros investigation (2004) had a limited soils analysis dataset for the Grangetown Prairie site as only 3 exploratory holes were advanced in this area. Exceedances of GAC were encountered as follows: • pH values ranged from 8.6 to 11.1, exceeding the GAC of 10 • Sulphide values ranged from 1712mg/kg to 3450 (GAC 1000mg/kg) • Lead (GAC 750mg/kg)

Previous Report Ref	
	• Zinc (720mg/kg) Enviros investigations (2008) analysed 32 soil samples for heavy metals. One sample exceeded the GAC for lead (SGV of 750mg/kg for commercial use), and the 95% percentile concentration was significantly less than the GAC. Shadbolt Environmental investigations (2011) analysed 35 soil samples, with results compared to GAC for commercial end use at that time. Results indicated that: • pH values exceeded the GAC (pH 9), a maximum value of pH12.4 was recorded. • 2 samples exceeded the GAC of 14mg/kg for benzo(a)pyrene, a maximum value of 42.4mg/kg was recorded. • Lead concentrations were less than GAC of 750mg/kg, a maximum value recorded of 622mg/kg. ***Controlled waters*** Groundwater testing by Enviros (2004) encountered elevated sulphate concentrations. Shadbolt Environmental investigations (2011) analysed groundwater samples, with results reported as 'less than acceptable levels for commercial/ industrial use'. ***Gas*** No results of previous gas monitoring were reported in the CH2M Hill report. **Conceptual Site Model** The report presented a conceptual model, which identified the following potential contamination sources at the site: • Made Ground • Railway Lines • Electrical Substations • Mill Buildings and Plant Equipment • Fuel Tanks • Chimneys • Coke Ovens & Coke Oven Gas Main • Iron & Steel Works **Risk Assessment** Potential pollutant linkages were identified at the site. Risks to selected receptors were assessed as up to moderate or high for all the sources identified.
Summary of Geoenvironmental Information, Cleveland Prairie, Teesside, July 2014.	**Scope of works** The note was a summary of geoenvironmental information held by Tata Steel for the Cleveland Prairie site. The summary included the Torpedo ladle repair shop in the south. The site had been in use for storage of steel stock. **Findings** The potential for land contamination was assessed in April 2005 and documented in the design Site Protection and Monitoring programme (SPMP) submitted to the EA in pursuance of PPC Permit conditions. ***Ground conditions*** The note reported that diesel, lubrication oil, hydraulic oil and greases were identified to be used on site at the boiler yard, stores and steel services areas. The assessment concluded that for the majority of the activities at the installation, there is little likelihood that land pollution or leaks to land would occur during the future life if the installation. The note indicated that Cleveland Prairie site formerly comprised: • Cleveland Steelworks in the east; • Cleveland Coke ovens in the central area; • Cleveland Iron Works in the north; • Clay Lane Iron Works in the west; and • Extensive Rail, Siding area in the west of the site. Cleveland Steelworks was operational site the 1950s, but was closed and decommissioned in the 1980s, with the exception of the South Steel Plant, Medium Section Mill and Drilling Plant

Previous Report Ref	
	Buildings. Cleveland Coke Ovens were demolished in the 1970s, and sub-surface cellars filled with demolition rubble. The note commented that ground investigation was carried out by Enviros (2008) and MD (2011). ***Soil*** The site geology was summarised as follows: • Made Ground, typical thickness up to approximately 2m, greater in cellars, of slag, brick, concrete, sand; • Upper Boulder Clay, thickness range 0.3m to 2.6m, comprising grey sandy silty clay; • Laminated Clay, thickness 1.7-4.5m, clay with varves of yellow brown silty sand; • Lower Boulder Clay, thickness range 2.4m to 5.8m, red-brown clay with gravel. • Bedrock – Lower Lias Shale encountered 0.6mAOD to -0.2m AOD, and Mercia Mudstone in the west encountered at between 0.8m AOD and -11.8m AOD. The note indicated that potential contamination sources include: • Ammoniacal liquor by product of coke oven cleaning; • Coke and coke dust; • Diesel. Oil and greases; • Heavy metals; • Hydrocarbons, coal tar, naphthalene, benzole; • Railway ballast containing metals and PAHs, • Refractory wastes (considered inert) • Steel slag, alkaline pH, metals. Enviros Investigations targeted the Cleveland coke ovens, comprising ten trial pits and analysis of five soil samples. Visual and olfactory evidence of hydrocarbons was encountered, in trial pits, and analysis results detected elevated TPH concentrations. The investigation commented that the contamination was consistent with the former use and was likely to be localised. In 2008, Enviros investigations encountered elevated PAHs and Extractable hydrocarbons in Made Ground (0.4-0.5m depth). Asbestos was identified in a sample recovered from 2m depth. Intrusive investigations by Shadbolt Environmental (2011) were carried out on behalf of MD. MD concluded that materials on site could be processed by crushing and screening to provide suitable backfill for a commercial/ industrial land use. This would be subject to investigation and management of localised contamination 'hotspots'. ***Controlled Waters*** The site is located 750m south east of the Tees dock, and 1.8km south of the River Tees. Surface water drainage from buildings discharged to the storm water system to Knitting Wife Beck Culvert or Holme Beck Culvert and on to the Solid and Liquid Effluent Management System (SLEMS). There were no groundwater abstractions within 1km of the site and no designated SPZs in the area. The Glaciolacustrine deposits are classified as (Unproductive strata), and the underlying bedrock is classified as Secondary B aquifer. The Sherwood Sandstone lies at depth (approximately 400-500m AOD). This is abstracted for industrial use approximately 3km to the south west and abstracted 7km to the north east for potable water supply. Previous ground investigations indicate shallow perched groundwater at 1.5m to 2.5m depth. ***Gas*** No specific review of ground gas information was included in the note. **Site Sensitivity** The review note concluded that the sensitivities of the site were as follows: • Groundwater – Low Sensitivity, no groundwater abstractions, thick low permeability drift deposits • Surface Water – Low Sensitivity, Discharges of surface water to the SLEMS, perched waters in clay deposits of limited connectivity with groundwater in superficial deposits to north which provide baseflow to the Tees. • Ecology – Low Sensitivity, no designated ecology site within 1km • Site Users - Low Sensitivity, health & safety procedures followed by contractors and visitors. Construction workers activities managed via appropriate risk assessment.

Previous Report Ref	
Prairie Site, Ground Investigation Factual Report, Shadbolt Environmental, July 2011	**Scope of works** The report comprised the factual reporting of ground investigations at the Prairie site in 2011. The scope of ground investigation comprised: • 13 cable percussion boreholes to up to 10.2m depth; • 15 window sample boreholes; • 23 machine-excavated trial pits. **Findings** ***Ground conditions*** Ground conditions comprised Made Ground of slag (sandy gravel with cobbles, boulders and fused slag) overlying superficial glaciolacustrine deposits of cohesive materials, locally granular soils ***Soil*** A total of 35 soil samples were analysed for a suite of potential contaminants including metals, pH sulphate, sulphur, cyanide, phenols, PAHs and TPH. No interpretation of the data was undertaken by Shadbolt. (CH2M compared the results to GACs, as summarised above.) ***Controlled Waters*** Groundwater was encountered locally as perched water upon clay deposits in the base of the holes, and many of the exploratory holes were dry whilst open. Only 3 samples of groundwater were tested for potential contaminants including heavy metals, pH, sulphate, sulphur, cyanide, phenols, PAHs and TPH. (CH2M compared the results to GACs, as summarised above.) Two samples were from trial pits, and results may not be representative of groundwater conditions. ***Gas*** No gas monitoring data was reported.
Former Corus Cleveland prairie Site, Land off Clay Lane – Ground Investigation Report, MD2, July 2011.	**Scope of Works** MD provided interpretation of the previous Phase 2 site investigations carried out at the Prairie site, and additional ground investigation to determine the presence of potential contamination and potential environmental liabilities. The report interprets the data reported in the Shadbolt Environmental Factual Report (2011). **Findings** The findings concurred with other assessment regarding the site history, confirming the historical development of the site to the Cleveland Iron and Steel works by the 1930s. The main structures were demolished in the 1980s, and the site has been largely derelict since this time. ***Ground conditions*** For assessment purposes, the site was considered as the West Side and the East Side. ***West Side*** Made Ground was of variable thickness, typically 1.2-2.0m, up to 4.2m locally. Superficial deposits underlying Made Ground comprised glacial laminated clay (0.8-0.9m bgl), overlying Redcar Mudstone (5.9m – 9.5m bgl). Perched groundwater was encountered at depths of 0.5-2.5m bgl. There was no evidence of heavy metal concentrations above GACs for commercial/ industrial use. Visual/ olfactory evidence of hydrocarbon contamination was encountered previously at the Coke Works area. Visual evidence of hydrocarbons was present in perched groundwater in the Coke Works, by-products plant, blast furnace and Power Station. Elevated sulphate concentrations related to the presence of slag. Ground gas concentrations generally 'low', with hydrocarbon vapours encountered at the Coke Ovens. ***East Side*** This area is underlain by variable thickness of Made Ground. In the east of the area, superficial alluvium deposits, and in the west is Glacial laminated clay. Bedrock is Mercia Mudstone. Knitting Wife Beck is a culverted watercourse below the site. Potential contamination sources include former railway land, steel works, electrical substations, power station, gas works and tar works. A previous investigation (Contamination Consultants, 2007) comprised 8 boreholes and 13 trial pits in a limited area. Made Ground was encountered up to 2.8m deep underlain by laminated clay. The report identified hydrocarbon contamination and evidence of asbestos. Limited waters analysis was undertaken, which identified potassium locally. **Ground Investigations**

Previous Report Ref	
	Ground investigations were carried out by Shadbolt Environmental. The ground investigations encountered Made Ground to depths of between 0.8m and 3.1m bgl, comprising dark gravel and cobbles of slag with fused slag. Underlying superficial deposits of Alluvial clay was encountered in the east between 1.2-3.9m bgl. Glacial Till was encountered to depths of between 1-10m bgl, comprising laminated clay and sands and gravels. Mercia Mudstone bedrock comprised weathered mudstone gravel at 5.6-8.0m bgl. Perched groundwater was encountered at the base of the Made Ground at depths of 2.3-3.0m bgl. No evidence of ground gas was noted. Chemical analysis results of soils were compared with GACs for commercial/ industrial end use. A total of 38 samples were analysed for a suite of contaminants including pH, metals, cyanides, phenols, sulphates, sulphur, PAHs and TPH. The contaminants were generally below the GAC assessment criteria used, with the exception of pH values (indicating alkaline conditions) and benzo(a)pyrene locally in 2 samples. Groundwater results for the 3 samples tested were reported to be 'within acceptable levels for a proposed commercial/industrial end use'. The screening criteria used were the freshwater Environmental Quality Standards (EQS), and standards given in the UK Water Supply Regulations, along with other superseded assessment criteria. **Risk Assessment** The risk assessment based on the data acquired identified low or low-moderate risks to future site users for a commercial/ industrial land use. The risks to controlled waters (groundwater and surface waters) were assessed as low. Risks to ecological receptors were assessed as low. The risk to future development from off-site landfills was assessed as low. Outline Remediation Methodology The report presented an outline remediation methodology which included excavation, and processing (screening, crushing) of site-won materials, along with localised contamination excavation and removal.
Corus Cleveland Prairie Teesside Site, Phase II Geoenvironmental Assessment for Graphite Resources, Enviros 2007	**Scope of works** The study area comprised only the western part of the current study site boundary at Grangetown Prairie. The Scope of work included a ground investigation comprising 41 trial pits, 10 window sample holes, 8 boreholes, sampling of spoils and waters, chemical testing and gas monitoring. The intrusive investigations targeted those sources identified in the Phase 1 review. **Findings** ***Ground conditions*** The investigation encountered the following: • Concrete, from ground level up to between 0.4 and 4.0m bgl • Made Ground – to between 0.3m and 4.2m bgl, mixed materials including slag; • Alluvium – sandy clay encountered between 0.5m and 2.7m depth • Glacial laminated clay – laminated clay over stiff sandy gravelly clay encountered from 0.8m to 4.3m bgl. • Redcar Mudstone – mudstones and sandstones, depth not proven Visual and olfactory evidence of contamination was encountered, including free product and hydrocarbon odours in the southern and central parts of the site, including at the former Coke Works and by-products plant. Perched groundwater was encountered at depths of 0.5-1.5m bgl. Groundwater flow was interpreted as towards the north/ north west. ***Soil*** Soil analysis results were compared with GACs for commercial/industrial land use. Metals determinands were less than the GAC in all samples, with the exception of a single lead result. The 95th percentile for lead was significantly less than the commercial/industrial GAC. For organic contaminants in soils, the results were all below the GAC for commercial/industrial end use. TPH, PAH species and phenol results were all less than the GACs for commercial/ industrial use calculated using the CLEA methodology by Enviros. PCB results were below detection limits. Asbestos fibres were not detected in the 14 samples analysed. Phytotoxic metals exceeded

Previous Report Ref	
	screening criteria above which there may be harm to vegetation. Sulphate results indicated design sulphate class DS-2, indicating that that protection to buried concrete would be required. ***Controlled waters*** Up to 15 samples of groundwater were analysed for a suite of potential contaminants. The results indicated that for the majority of determinands, the results were less than the GAC values (EQS or UK drinking water standards). Elevated sulphate concentrations in groundwater was attributed to the presence of slag at the site. BTEX compounds exceeded assessment criteria at the former By-products plant. PAHs exceeded the GAC in the area of the Coke Oven and By-products plant. Surface water analysis results indicated that the EQS and DWS GACs were not exceeded, with the exception of PAH results. Leachability testing indicated that for the majority of determinands, the results were less than GAC. Selected determinands including vanadium, zinc, cyanide, toluene, PAHs, hydrocarbons and phenol did however indicate potential mobility. ***Gas*** Gas monitoring of boreholes was carried out, and the results of the monitoring indicated that the majority of the site would be classified as 'Characteristic Situation 1', requiring no special precautions with respect to ground gas. Characteristic Situation 2 was encountered locally due to elevated carbon dioxide concentrations, which indicates that it may be prudent to include gas protection measure to new buildings. **Risk Assessment** The risk assessment identified moderate risks to future site users and controlled waters (perched groundwater), with respect to elevated PAHs and hydrocarbons at the former Coke Works and By-products plant. Moderate risks to buildings with respect to sulphate were also assessed. The risks with respect to phytotoxic metals and ground gases were assessed as low. Recommendations The report recommended that additional investigations, risk assessment and/or remediation be carried out with respect to: • Hydrocarbons at the Coke Oven and By-product plant; • Oily groundwater at the Blast Furnace and Power Station; • Potential degraded water quality at the Holme Beck • Potential contamination of the gasholder in the north west of the site; • Unknown materials in former railway embankments.
Corus Cleveland Prairie Teesside Site, Phase 1 Environmental Review for Graphite Resources, Enviros 2007.	**Scope of works** The scope of works comprised an environmental review to support a planning application and to support land acquisition. **Findings** The report confirmed that the site had been used extensively for iron and steel production, with associated coke ovens and by-products plant. Development had included extensive rail sidings, blast furnaces, mill complex, power station, coke ovens and storage tanks. The site was derelict and most infrastructure removed to ground level. ***Ground conditions*** No specific ground investigation was carried out as part of the Phase 1 assessment. The report reviewed the previous site investigation data including the Enviros (2005) investigation of the former Cleveland Coke Oven. Investigations comprised the excavation of 10 trial pits. The potential contamination sources identified on site were listed as follows: • Historic shafts, north east of site • Infilled Reservoir in north of site • Blast Furnace area in Central area; • Coke Ovens and by-products plant in south west of site; • Iron and Steel buildings in north east of site; • Gas holder in north west and south east; • Power station in north of site; • Railway ballast across the site. ***Soil*** Ground conditions were Made Ground comprising of predominantly loose furnace brick fill, with concrete and reinforced steel, and encountered to depths of almost 2m, but may be greater

Previous Report Ref	
	locally. Concentrations of BTEX compounds in soils were less than the GACs used (SGVs) for commercial/ industrial end use. ***Controlled waters*** Enviros trial pits encountered shallow groundwater between 1m and 2m depth on the western side of the Coke Ovens, which were heavily contaminated by free-phase hydrocarbons. ***Gas*** No specific assessment of gas conditions was reported. **Risk Assessment** The risk assessment identified moderate risks associated with the identified on-site sources of potential contamination. Risks to future site users associated with the off-site landfill sources with respect to ground gases were assessed as Low.
Summary of key finding of all investigations	The Grangetown Prairie site was formerly developed to the Cleveland Iron and Steel works from the 1800s, and included blast furnaces, coke ovens, by-products plant, a power station, steel mills and railway sidings complex. The site has been reclaimed by the deposition of Made Ground across the entire site area, and depths of Made Ground in excess of 4m have been encountered previously. The Made Ground comprised predominantly steelworks slag, with concrete, steel and furnace brick. Superficial deposits underlying the Made Ground comprised Alluvium (sandy clay), and Glaciolacustrine deposits (laminated silt and clay). Perched groundwater has been encountered at the site, at typical depths of approximately <1-3m bgl and has been observed to be perched in Made Ground which overlies superficial clay deposits. Previous investigations have encountered localised contamination at the site. Notably, hydrocarbons, PAHs and BTEX compounds were elevated above screening criteria at the former Coke Oven and the former By-products plant in the western part of the site. Analysis of heavy metals indicates that the results were generally less than screening criteria for a commercial/ industrial use. Results for inorganic determinands exceeded the screening criteria locally, most notably elevated pH (alkaline conditions) present in slag at the site. Analysis of groundwater samples indicates elevated sulphate concentrations, consistent with the widespread presence of slag. Visual and olfactory evidence of contamination has been recorded previously, notably free-phase hydrocarbons at the former Coke Oven and By-products plants. Gas monitoring has indicated that the ground gas conditions are generally Characteristic Situation CS-1 (no gas protection measures required) and CS-2 locally (prudent to include protection to new buildings).

2.8 Data Gaps

Future Phase 2 Contaminated Land investigations

It is anticipated that supplementary ground investigation within the Grangetown Prairie area may be required to support specific proposed developments and land parcels as they are brought forward for development. Asbestos analysis to be included.

2.9 Lackenby Coil Plate Mill

Area Description

The Lackenby Coil Plate Mill (the area) is the south eastern most parcel on the Site Location Plan, comprising of approximately 25 ha. The area is part of a wider area occupied by the former SSI BOS and CONCAST steelmaking facilities and Tata Steel's vacant coil plate mill. The south western part of the site is bound by Tees Dock Road and the A1053. More generally, to the south east of the site is the Wilton International site.

To the south west of the site is the residential area of Grangetown, however, this is separated by the A1053 and a distance of over 100m at its closest point, although the majority of the residential area is well over 200m from the edge of the Lackenby area.

Environmental Context

Geology & Hydrogeology

Information taken from British Geological Survey's (BGS) mapping website (http://mapapps.bgs.ac.uk/geologyofbritain/home.html), previous site reports, the Groundsure report (included in appendix C). Geological mapping indicated the following stratigraphic sequence

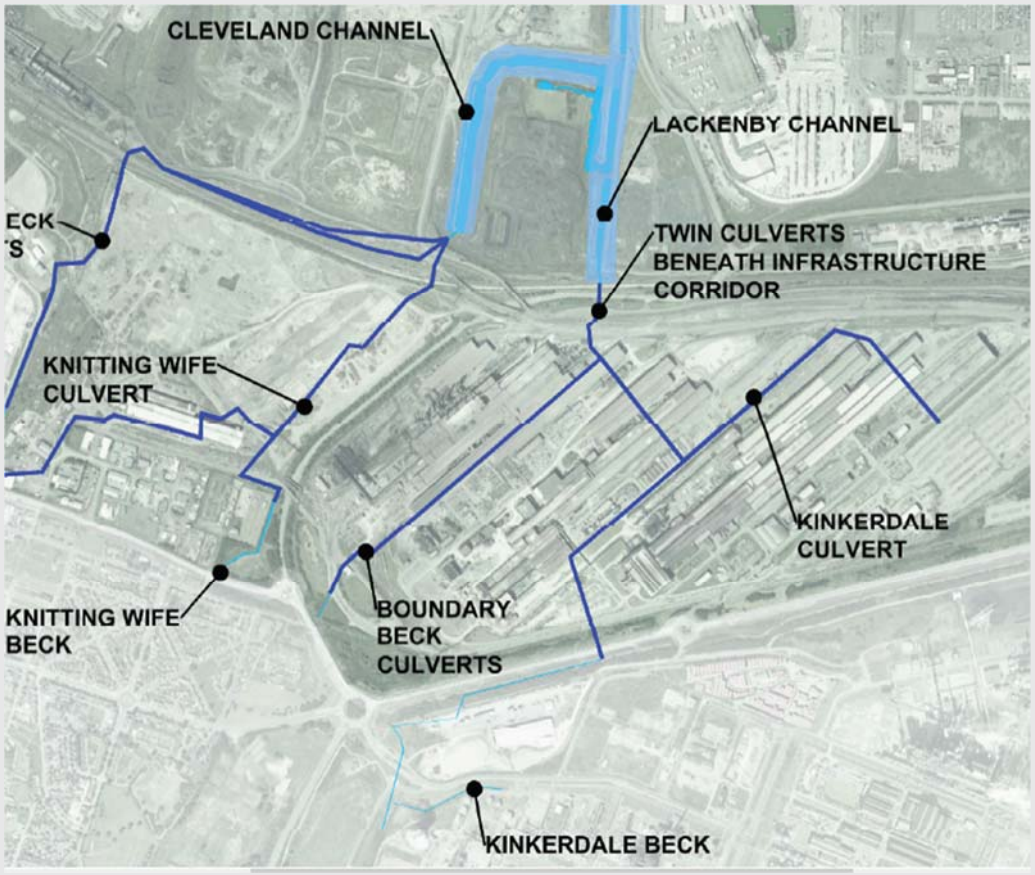
- Artificial / Made Ground in the north
- Alluvium (isolated pockets potentially impinging on site)
- Glacio-lacustrine deposits
- Glacial Till (inferred)
- Redcar Mudstone
- Penarth Mudstone at northern end of site.

A number of borehole records are available on the BGS GeoIndex web portal, which have been reviewed for the purpose of this assessment, these are as follows:

- NZ52SE26/A-C, E-J, L-M, O-P, R-S
- NZ52SE2/A.

The findings of these boreholes generally concur with the published mapping and are summarised below:

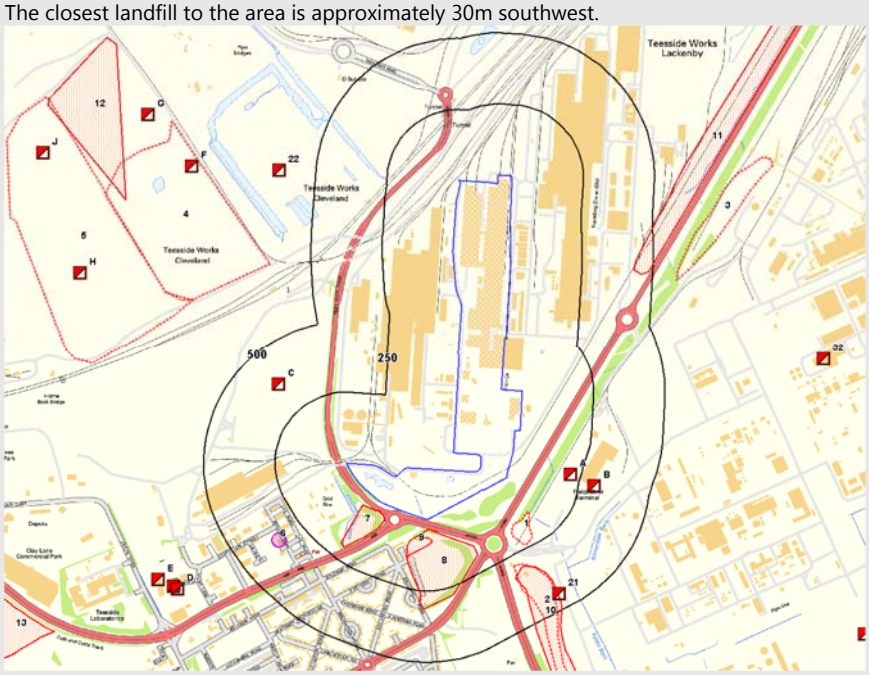
Strata	Description	Typical Thickness (m)	Typical Depth to Base (m bgl)	Groundwater	Aquifer Status	Comments
Topsoil	Soft to firm, locally firm to stiff locally friable brown or grey silty CLAY	0.2 – 0.3	0.2 – 0.3	9.55 – 7.00	Not Classified	Only present in the southern half of the site
Made Ground	Topsoil onto mixed clay with occasional ash	1.4 – 3.15	1.4 – 3.15	8.75 – 6.10	Not Classified	Only present in the northern half of the site. Groundwater 1.30m bgl (8.15m AOD) in Borehole 26/R
Glaciolacustrine Deposits	Predominantly firm to stiff brown silty CLAY with varies or partings of sand. Upper layer of firm to stiff brown mottled grey silty locally gravelly CLAY noted in many boreholes	1.05 – 4.80	1.25 – 5.10	7.00 – 4.00	Unproductive Strata	Logged as Upper Boulder Clay in some boreholes. Thin layer of silty SAND with clay bands in Borehole 26/O.
Glacial Till	Stiff, locally firm, locally hard reddish brown silty sandy gravelly CLAY	0.5 – 5.8	2.55 – 9.65	6.70 to -1.60	Unproductive Strata	
Weathered Redcar Mudstone	Stiff to hard grey CLAY with shale / weak dark grey weathered SHALE	0.45 – 1.5	4.6 – 11.35	4.60 to 2.35	Secondary Undifferentiated	Base not proven in Borehole 26/C
Redcar Mudstone	Weak to moderately strong dark grey SHALE with occasional layers of siltstone	Not Proved	Not Proved	Not Proved	Secondary Undifferentiated	

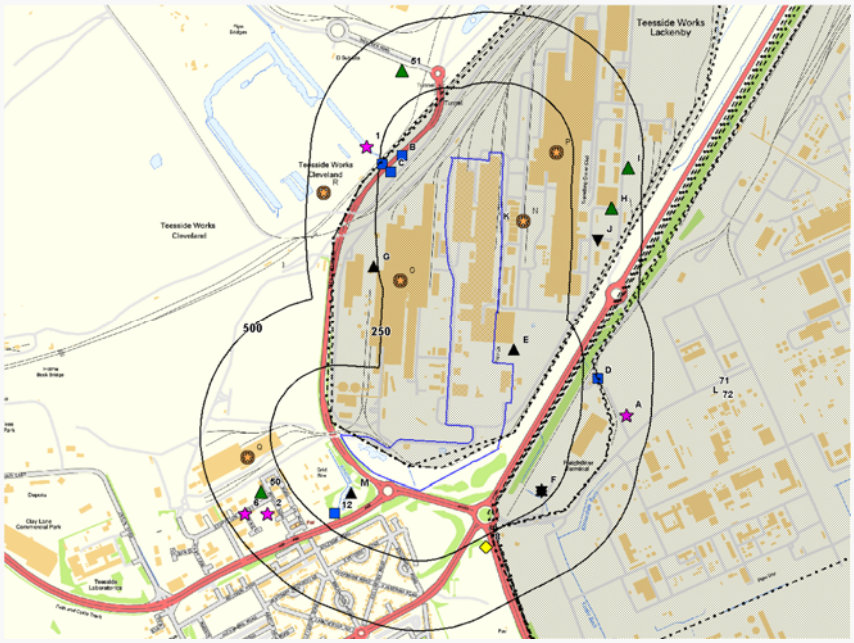
Strata	Description	Typical Thickness (m)	Typical Depth to Base (m bgl)	Groundwater	Aquifer Status	Comments
Hydrogeological sensitivity[6]	The superficial deposits are classified as an undifferentiated secondary aquifer. There are no abstraction or source protection zones (SPZ) within 1km of the area.					
Groundwater Sensitivity	The superficial deposits in the vicinity of the area are classified as an undifferentiated Secondary Aquifer. There are no licensed abstractions within 1km of the site and Groundwater Sensitivity is assessed as being Low.					
Hydrology	 There are several culverts within the wider site entering from the south flowing into the River Tees. The River Tees is classified by the EA as a Main River. The Tees is part of the Teesmouth and Cleveland Coast SSSI.					
Hydrological sensitivity	To the north of the site the principal surface water feature is the Lackenby Channel, which in turn discharges into the River Tees. Kinkerdale Culvert, which originates to the east of the area branches off and flows under the northern end of the plate mill before merging with Boundary Beck, prior to discharging into the Lackenby Channel to the north. Overall surface water sensitivity is assessed as being Moderate/high.					
Ecology	To the north of the area is the Teesmouth and Cleveland Coast SSSI, the Teesmouth and Cleveland Coast SPA and Ramsar site.					
Ecological sensitivity	The area is within a wider area that is still operational, and the ecological sensitivity is assessed as being low/Moderate. An Ecological Assessment has been undertaken by the Industry Nature Conservation Association (INCA) in respect of Remediation Strategy area. Except for nesting birds, no protected species were observed in the surveys carried out as part of the assessment.					

[6] Private water supplies are not included in the database and as such are not considered within the risk assessment, however, there remains the potential for risks to private water supplies however this is considered unlikely in the context of the site and its locality.

Other Regulatory Database Information

Only regulatory data within 250m with the potential to impact the area has been detailed below, please refer to Appendix C for the complete regulatory data set.

Activity	On-Site	0-250m	Details
Potentially Contaminative Land Uses	9	95	Nine potentially contaminative land uses recorded within the area including railway sidings, iron works, electricity substations, unspecified tanks and unspecified ground workings.
Waste management/ transfer/ treatment facilities/disposal	0	1	The closest waste transfer site is 215m east of the area and has been transferred once.
Landfill	0	4	The closest landfill to the area is approximately 30m southwest. 
Sites handling hazardous or explosive substances (inc COMAH or NIHHS) planning hazardous consents	2	7	One current COMAH Upper Tier Operator, South Tees Site Company Limited, that has taken over from the previous COMAH Upper Tier operator, SSI UK Limited. Closest NIHHS is a historical site located 85m southeast of the area.

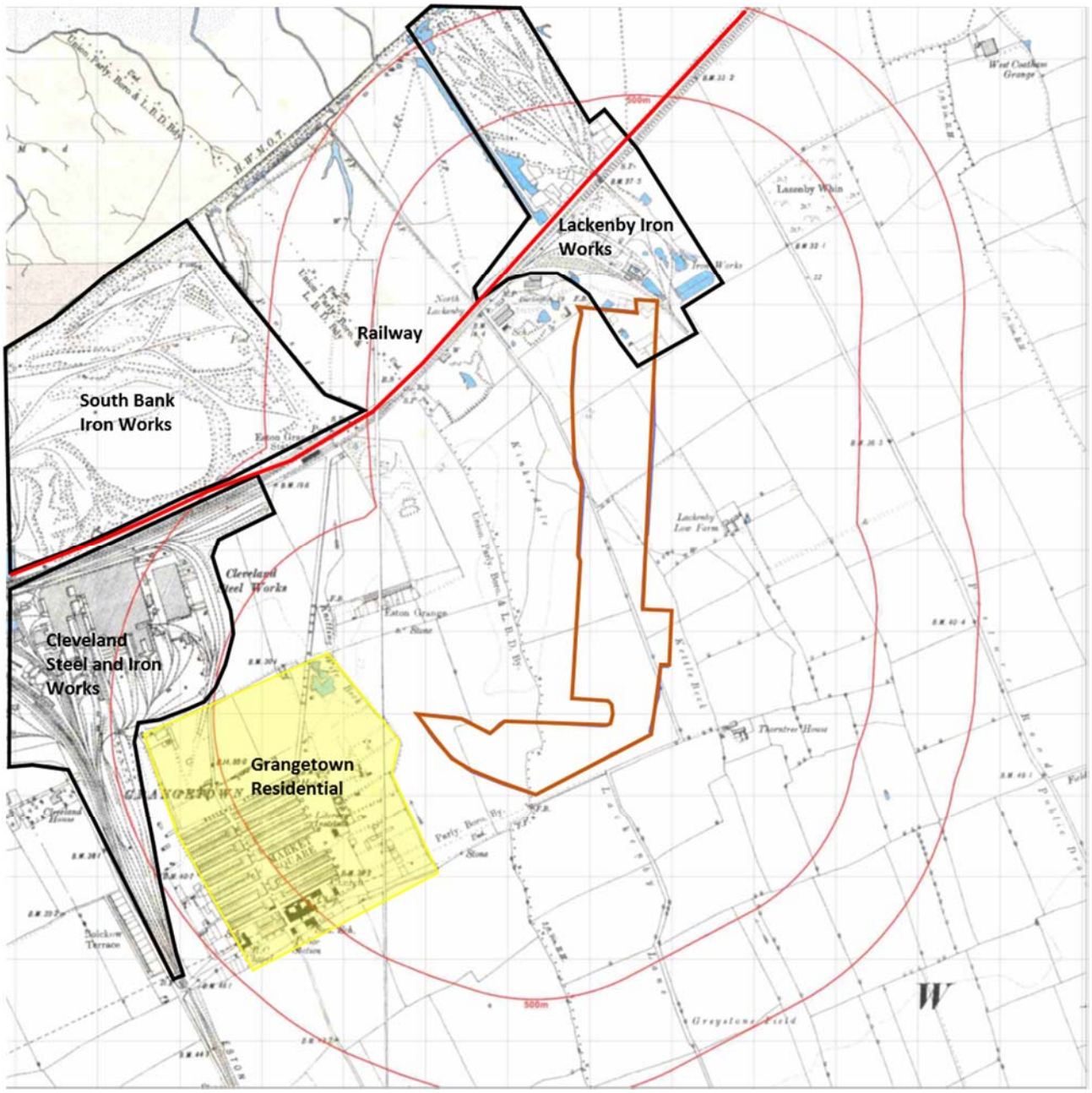
Activity	On-Site	0-250m	Details
			
Mineral Extraction and Coal Mining Activities	0	1	No coal mining within 75m of the area. One instance of Salt – Brine localised small scale mining may have occurred 30m west of the area.
IPC	0	16	One IPC Authorised site 50m from the area that appears to have been transferred three times historically and is now IPPC [7,8]. One IPC Authorised site 215m from area boundary that appears to have been transferred twelve times historically and is now IPPC.
IPPC	0	10	Nearest IPPC permit is 110m southwest and relates to a new medium combustion plant.
Red Discharge Consents	0	0	No consents within 500m of the area.
Petrol and Fuel Sites	0	0	No sites within 500m of the area.
Tank Database	9	141	Tanks within the area listed as 'Unspecified'.

Area history

A summary of the historical development of the area, based on historical OS maps, is presented below. The historical maps can be found within the Groundsure Environinsight report in Appendix C. Where relevant, interpretation of the maps is supported by knowledge from the discussions with the client and other stakeholders and previous reports for the area.

[7] British Steel Teesside Beam Mill – Permit FP3436AT
[8] Teesside Integrated Iron and Steelworks – Permit BK0493

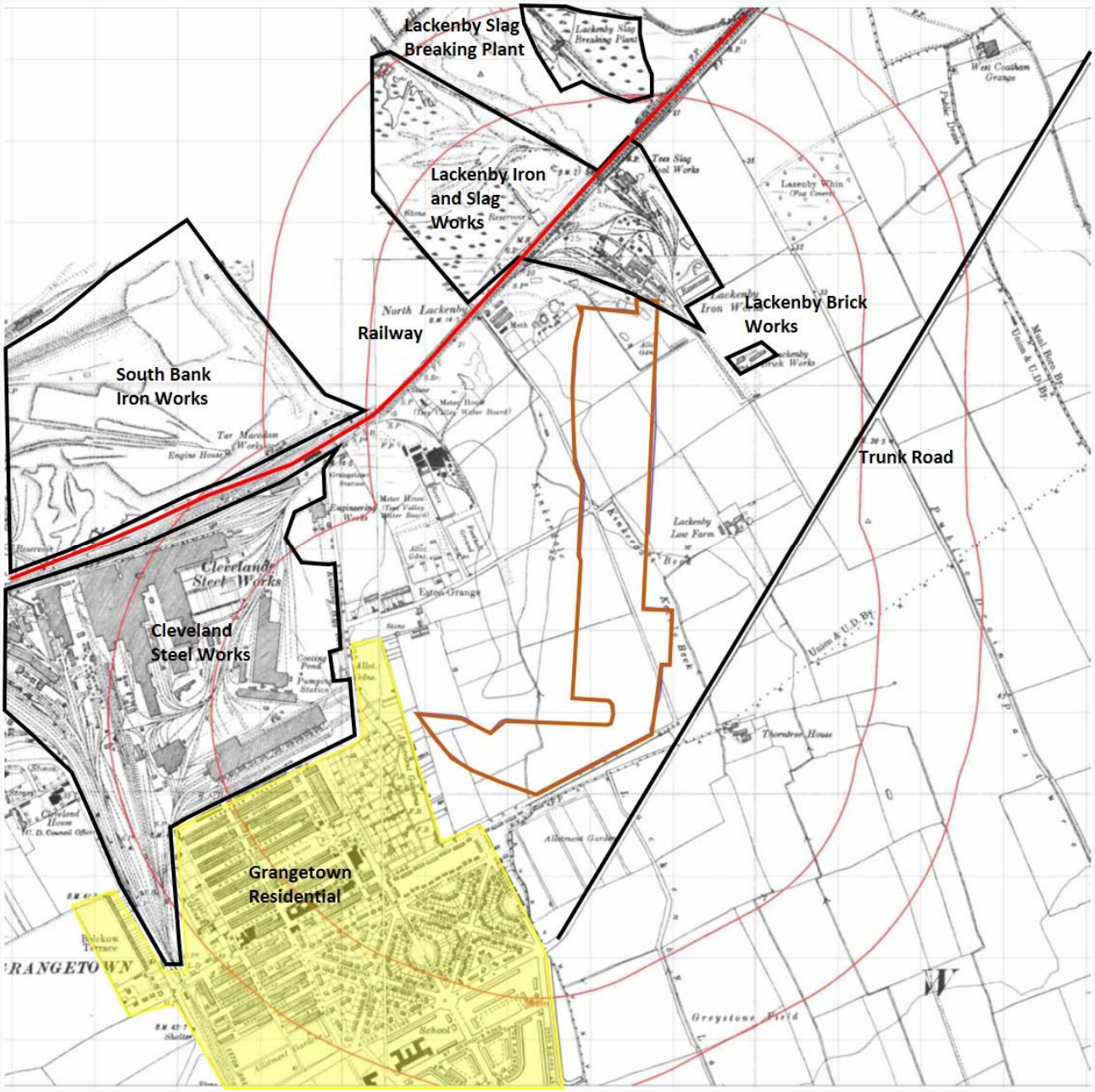
1857 - 1893



On-Site: Earliest historic maps dating to 1857 demonstrate that the area is principally constituted of undeveloped farmland. By 1893 the north of the area occupies land associated with the early phases of Lackenby Iron Works development incorporating two surface water bodies likely associated with the iron production process in addition to a number of tracks and outbuildings. Lackenby Iron Works extends further to the north of the site towards the banks of the Tees.

Off-Site: The South Tees Railway Line runs immediately to the north of the area on an approximate east-west axis. Much of the land to the east of the area is undeveloped, principally constituted of agricultural farmland. By 1893 land to the west of the area underwent significant industrialisation characterised by the emergence of Cleveland Steel Works. Significant development of Grangetown residential housing to the south-west of the area.

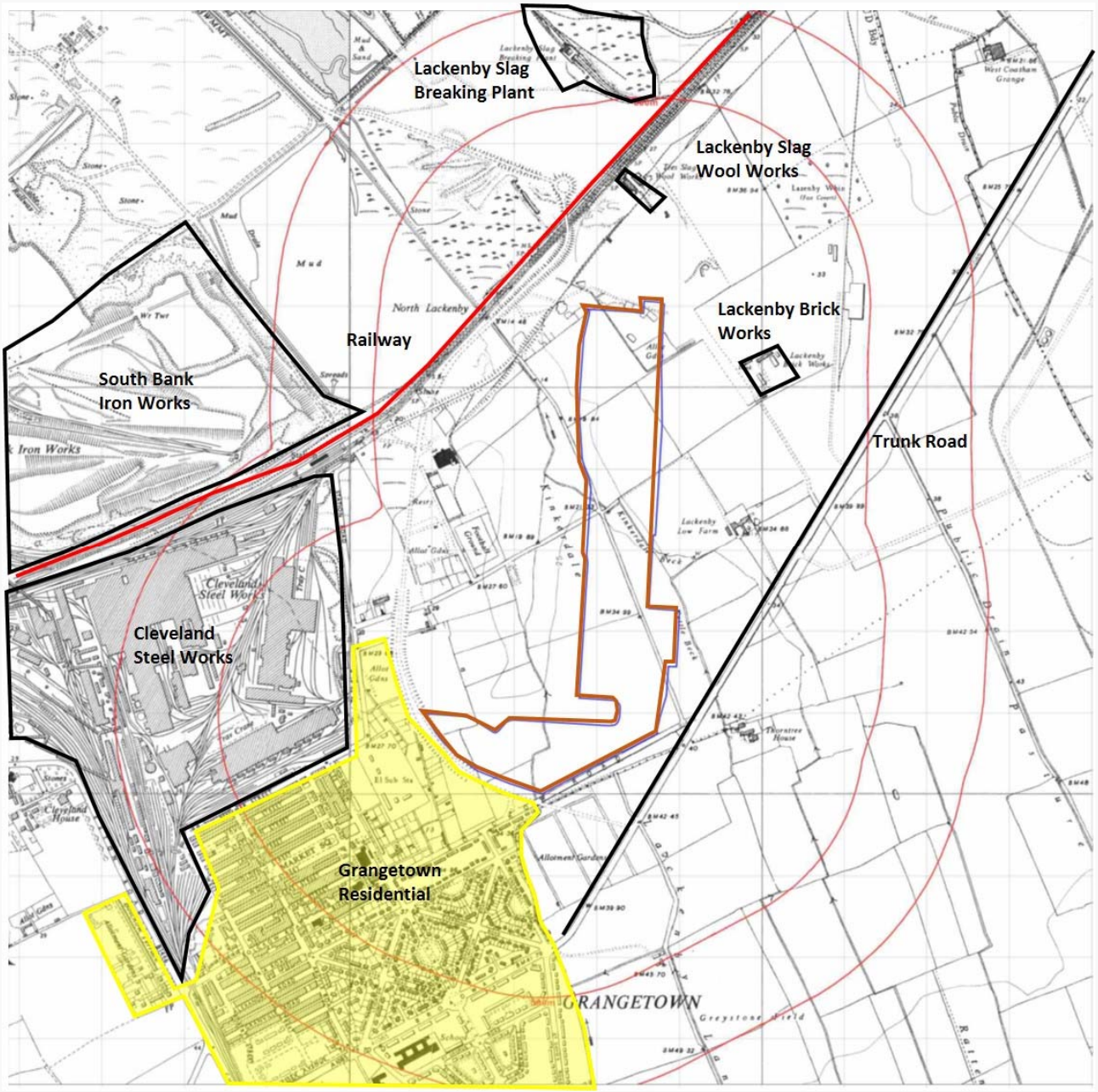
1913 - 1938



On-Site: Similarly to previous mapping much of the area remains undeveloped.

Off-Site: Lackenby Iron Works to the north of the area has undergone further development characterised by the addition of several unspecified structures and supporting infrastructure such as tracks and conveyors. By 1938 To the north-east of the iron works, Tees Slag Wool Works has been constructed in addition to Lackenby Slag Breaking Plant north of the area. Land to the east remains largely undeveloped with the exception of a Lackenby Brickworks. Significant development of residential dwellings and leisure facilities within Grangetown and surrounding areas. Further expansion of Cleveland Steel and Iron Works and supporting infrastructure can be observed during this period. Additional highway infrastructure constructed by 1938 running an an approximate north-east, south-west axis.

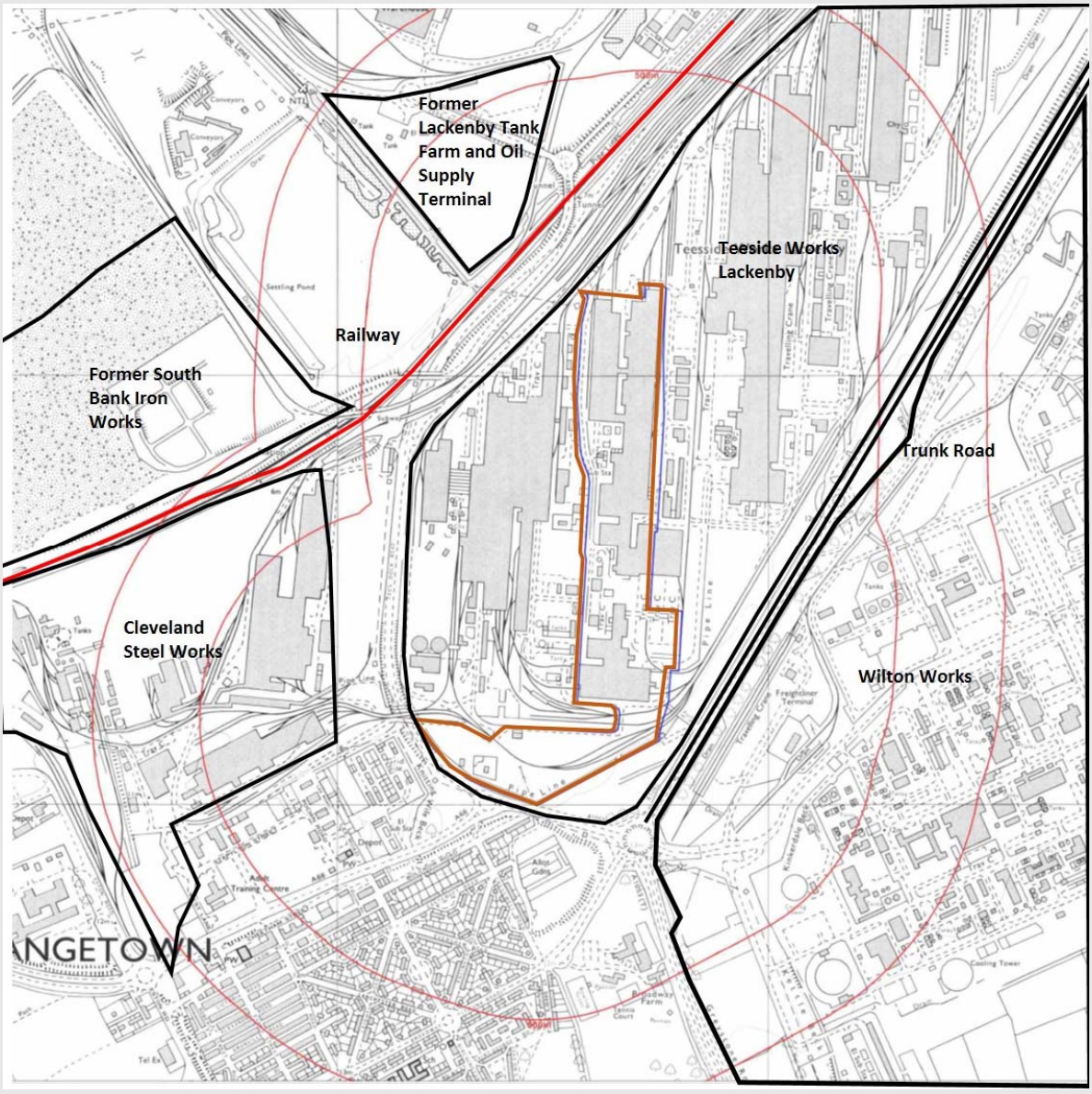
1955



On-Site: Lackenby Iron Works and supporting infrastructure decommissioned and demolished by 1955.

Off-Site: Between 1938 and 1955 Cleveland Steel and Iron Works underwent further expansion reaching its maximum mapped extent by 1955. Lackenby Iron Works and supporting infrastructure decommissioned and demolished by 1955. Land to the east of the area is still largely constituted of greenfield agricultural space. Some minor developments associated with Grangetown residential areas. The South Tees Railway Line continues to run immediately to the north of the site on an approximate east-west axis.

1974 - 1992



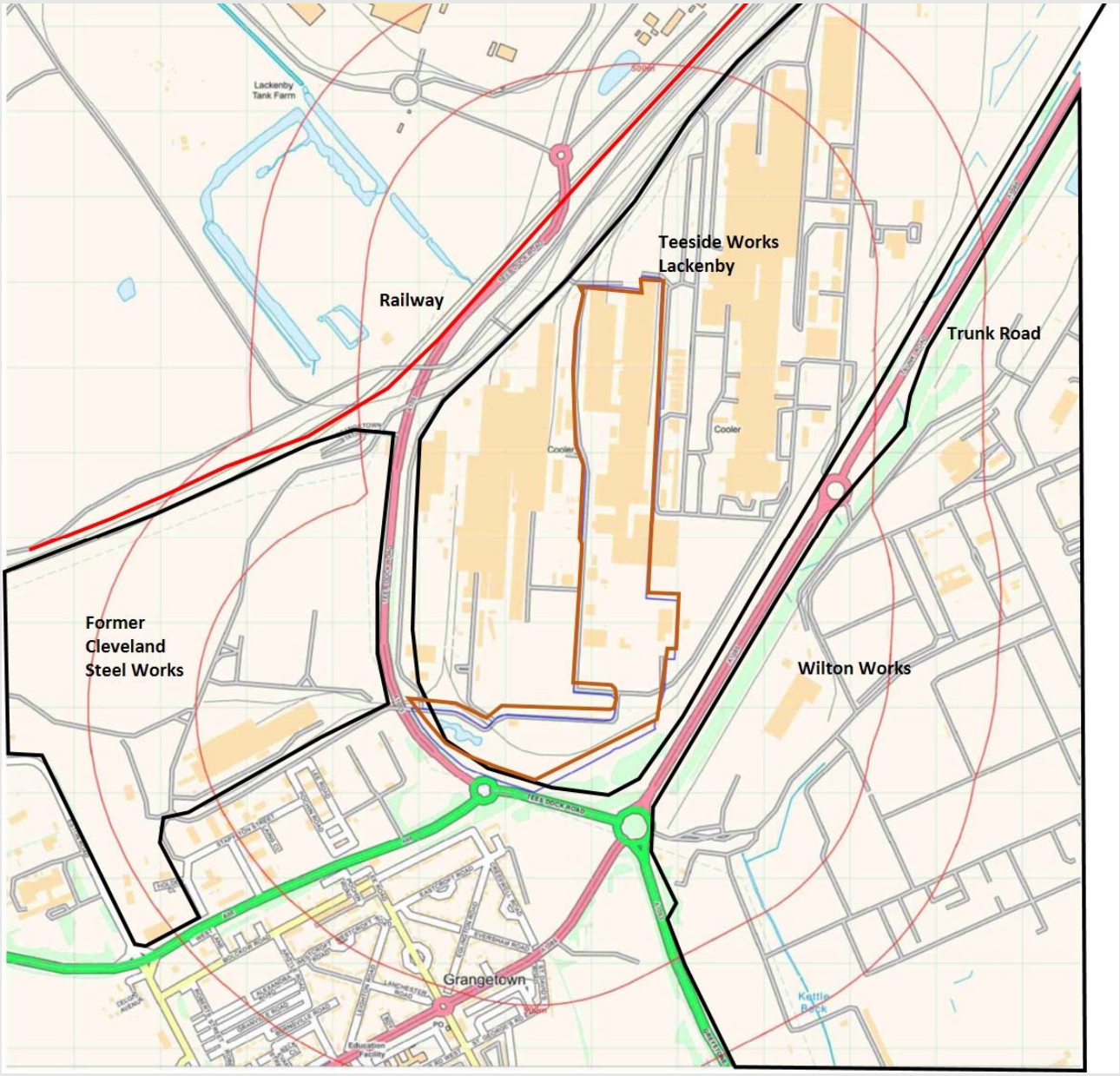
On-site: By 1992 the area and adjacent land to the east has undergone significant industrialisation characterised by the development of Teeside Works Lackenby Plant. Much of the site area is constitued of undefined production and storage facilities with supporting infrastructure inclusive of travelling cranes, pipelines, tanks and a substation situated near the center of the site. The southern extent of the area is largely unoccupied with the exception of a pipeline running on an east-west axis in addition to a number of small undefined buildings.

Off-site: Much of the land occupied by Cleveland Steel and Iron Works to the west of the area has been demolished and subsequently repurposed/redeveloped by 1992. Between 1955 and 1974, land formerly occupied by Lackenby Iron Works to the north of the area was redeveloped into Lackenby Tank Farm and Oil Supply Terminal only to be decommissioned and demolished by 1992.

Teeside Works Lackenby occupies land the north-east, east and west of the area. Much of the land surrounding the area is then constituted of undefined production and storage facilities with supporting infrastructure

inclusive of travelling cranes, pipelines, tanks, chimneys, cooling towers and substations. Significant development of highways infrastructure around Teeside Works and Wilton Works by 1992. Construction and development of Wilton Works by 1992, a multi-occupancy site principally involved in the Petro-chemical refinery and energy production. Wilton Works site contains a considerable number of undefined tanks, cooling towers, conveyors and pipelines in addition to production and storage facilites.

2002 – Present day



On-site: A number of the buildings and supporting infrastructure in the southern region of the area have been demolished.

Off-site: Between 1992 and present day, structures and tanks to the west of the area have been demolished. Further demolition of structures associated with the former Cleveland Steel and Iron Works. Large areas of the Wilton Works and supporting infrastructure to the east, south east have been demolished by 2014.

Summary of site history and pertinent features

Earliest historic maps dating to 1857 show that the area and adjacent land is principally constituted of undeveloped farmland. By 1893 the northern area occupies land associated with the early phases of Lackenby Iron Works which was decommissioned by 1955, land to the west of the area underwent significant industrialisation characterised by the emergence of Cleveland Steel Works and South Bank Iron Works. By 1955 existing industrial sites continue to develop characterised by the construction of additional production, storage facilities as well as supporting infrastructure. A number of slag processing, breaking and repurposing works opened by 1938.

By 1992 the area and adjacent land to the east, formerly farmland, underwent significant industrialisation characterised by the development of Teesside Works Lackenby Plant. Much of the area is constituted of undefined production and storage facilities with supporting infrastructure. Wilton Works a multi-occupancy site principally involved in the Petro-chemical refinery and energy production was developed to the east of Teesside Works Lackenby. Between 1955 and 1974, land formerly occupied by Lackenby Iron Works to the north of the area was redeveloped into Lackenby Tank Farm and Oil Supply Terminal only to be decommissioned and demolished by 1992. Much of the infrastructure associated with Cleveland and South Bank Works has been demolished or repurposed by 1992.

Present day maps show that a number of the buildings and supporting infrastructure in the southern region of the area have been demolished. Further demolition of structures associated with the former Cleveland Steel and Iron Works. Large areas of the Wilton Works to the east, south-east have been demolished by 2014.

Notable historic and contemporary features **within the area** which may have implications for land contamination include but are not limited to;

- Site area and adjacent land is predominantly constituted of farmland until 1897.
- Buildings and ponds associated with Lackenby Iron Works (North).
- Teesside Works and associated infrastructure inclusive of undefined production and storage facilities with supporting infrastructure inclusive of travelling cranes, pipelines, tanks and a substation.

Notable historic and contemporary features **adjacent to the area** which may have implications for land contamination include but are not limited to;

- Supporting infrastructure associated with slag processing, breaking and repurposing works (North).
- Supporting infrastructure associated with Lackenby Iron Works inclusive of production and storage facilities, material stock piles, chimneys, conveyors and tracks (North).
- Cleveland Steel and South Bank Iron Works production and storage facilities and associated infrastructure inclusive of travelling cranes, pipelines, tanks, substations, refuse heaps and material stockpiling facilities (West).
- Lackenby Tank Farm and Oil Supply Terminal and supporting infrastructure inclusive of tanks and distribution pipelines (North).
- Teesside Works Lackenby and supporting infrastructure inclusive of travelling cranes, pipelines, tanks, substations, refuse heaps and material stockpiling facilities (immediately adjacent).
- Wilton Works production and storage facilities and supporting infrastructure in addition to travelling cranes, pipelines, tanks, substations, refuse heaps and material stockpiling facilities (East, south-east).

Summary of Previous Reports

Previous Report Ref	
Enviros **Soil and Groundwater, Baseline Characterisation Study, Teesside Works** **June 2004**	**Scope of works** This included an investigation into Area 8 described as the Primary Mill. 5 trial pits and 1 borehole were advanced within or on the boundary of the current area. 11 soil samples were analysed, and one round of groundwater monitoring was completed. **Findings** ***Ground conditions*** Made Ground comprising sandy angular medium to coarse gravel, cobbles and boulders of slag, brick and ash was encountered in all locations, to depths of up to 4.0m bgl. Made Ground was found to be underlain by Boulder Clay comprising stiff, sandy, occasionally silty clay with fine to coarse angular to rounded gravel between depths of 0.8 and 3.0m bgl. Black oily staining and hydrocarbon odours were observed at two locations (8AT1 and 8AT2) at depths of between 1.1 and 2.0m bgl. No further visual and/or olfactory evidence of possible contamination was observed ***Soil*** Analysis of soil samples did not show concentration for metals, PAHs and TPH above Commercial GACs ***Groundwater*** Groundwater was encountered at two locations in Made Ground at depths of 0.56m, and ~1.8m bgl; Groundwater levels across the site generally form a consistent pattern indicating groundwater flow in a north-westerly direction (towards the Tees). The pH was alkaline. TPH and PAHs were below detection, but copper exceed the Coastal Waters EQS (not adjusted to DOC).
Corus **DESIGN OF A SITE PROTECTION AND MONITORING PROGRAMME FOR LACKENBY WORKS, TEESSIDE,** **CORUS UK LTD.** **That does NOT require reference data to be collected.**	 **Scope of works** This set out the required site protection and monitoring plan Part of Area 6 on the current area included the Export Bay of the disused Coil Processing Mill (CPM), water treatment plants and Primary Mill No.2. The latter was used up until August 2000 for secondary heating and rolling of ingots produced from the BOS Plant. After which operations at the Primary Mill No.2 were reduced to the use of the soaking pits for dehydrogenation. Heckett Mulitserv rand two areas

Previous Report Ref	
	for slag handling under a separate IPPC application. Oils and greases were considered sources from this area.
Summary of key finding of all investigations	Made Ground comprising sandy angular medium to coarse gravel, cobbles and boulders of slag, brick and ash was encountered in all locations, to depths of up to 4.0m bgl. Black oily staining and hydrocarbon odours were observed at two locations. ***Soil*** Analysis of soil samples did not show concentration for metals, PAHs and TPH above Commercial GACs. **Groundwater** Groundwater was encountered at two locations in Made Ground at depths of 0.56m, and ~1.8m bgl. Groundwater levels across the site generally form a consistent pattern indicating groundwater flow in a north-westerly direction (towards the Tees) The pH was alkaline. TPH and PAHs were below detection limits, but copper exceed the Coastal wasters EQS (not adjusted to DOC). The testing on site did not include asbestos analysis. It is noted that on the adjacent to land to the west asbestos has been detected in similar Made Ground. For instance, a recent site investigation[9] at the Torpedo Ladle Repair Shop - TLRS in the southern part of the larger Former SSI Steelworks Facility identified asbestos in 38 of the 169 samples analysed.

Data Gaps

Asbestos

Made Ground within the area has not been subject to asbestos analysis. This should be included within any future ground investigations.

Landfill Gas

Future development proposals located in close proximity to former landfill sites should be supported by further investigation and an associated Gas Risk Assessment and should incorporate any necessary protection measures appropriate to protect buildings from landfill gas migration.

Future Phase 2 Contaminated Land investigations

It is anticipated that supplementary ground investigation within the Lackenby Coil Plate Mill area may be required to support specific proposed developments and land parcels as they are brought forward for development.

[9] Allied Exploration & Geotechnics Limited The Former SSI Steelworks, Redcar – Ground Investigation Contract – Priority Areas Within SSI Landholdings Contract 3 Final Factual Report, June 2018.

2.10 Coatham Marsh (including Warrenby Landfill)

Site details

The Warrenby landfill area is the north eastern most parcel within the redline boundary shown in Figure 2 as Zone 4: Warrenby Landfill & Coatham Marsh (extract below showing area location). The "area" as it will be known throughout this Section, covers approximately 70 ha and comprises an irregularly shaped plot of land to the north of the main A1085 Middlesbrough to Redcar road. The area is centred at approximate NGR NZ 575,245. The area is comprised of three adjacent land parcels separated by the Darlington to Saltburn railway line or internal site road.

- The eastern part of the area is Warrenby Landfill principally utilised for the disposal of slag bi-products and similar waste from iron and steel making. The site is bound to the west by the former Hot Metal Transfer Railway line and to the south by the Darlington to Saltburn Railway line and it is bisected by Fleet Beck watercourse. Immediately to the north and east of the site is undeveloped scrub grassland.
- The north part of the site is also frequently referred to as the 'Teardrop' site.
- The southern part of the site forms part of the 'Steelhouse and surrounding land', although the Steelhouse (Former British Steel Headquarters) is itself outside the current study site boundary.

The site is generally level ground (excluding the Warrenby landfill site) and lies at a ground elevation of between 5 and 10m AOD. The Warrenby Landfill area is raised above the surrounding ground by up to 15m and has an irregular surface profile reflecting the former use for tipping of wastes.

The site is an area of largely disused derelict land, containing former access roads and tracks. The former Hot metal transfer railway cross the site from south to north. The site is partly vegetated by poorly established grass and scrub vegetation, and there are large areas of bare ground Warrenby Landfill. A surface water course (The Fleet) is also present within the south of the site, bisecting the Warrenby landfill to the north from the extension site to the south. Warrenby Landfill is currently not an active waste disposal site. The extension to the landfill south of the Fleet was prepared for the placement of waste steel works materials but not used.

Environmental context

Geology & Hydrogeology	Information taken from BGS on-line mapping (http://www.largeimages.bgs.ac.uk/iip/mapsportal.html?id=1001513) and the BGS on-line geoviewer (http://mapapps.bgs.ac.uk/geologyofbritain/home.html), previous reports and the Groundsure report included in Appendix D. Several borehole records are available on the BGS GeoIndex web portal, which have been reviewed for the purpose of this assessment, these are as follows: - NZ52SE26/A-C, E-J, L-M, O-P, R-S - NZ52SE2/A.

Strata	Description	Typical Thickness (m)	Typical Depth to Base (m bgl)	Groundwater	Aquifer Status	Comments
Made Ground	Mixed fill, typically granular Slag, firebricks, coke, ash and brick	0.60 – 5.55	0.60 – 7.0	1.95m bgl in BGS Borehole 127. 2.85m bgl in BGS Borehole 13551/13	Not Classified	

Superficial Deposits						
Blown Sand	Fine to medium grained sands, silty sand	0.75	3.60	Not Recorded	Secondary A	Present in proximity to coastal margins only to north east
Tidal Flat Deposits	Variable deposits of Silt, peat, clay and sand layers	1.80 – 7.65	5.40 – 10.65	3.15m bgl in BGS borehole 13551/14. 5.70m bgl in BGS borehole BH13551/12B	Secondary A/ Undifferentiated	Present in zone to south east of River Tees
Glacio-lacustrine Deposits	Soft brown clayey SILT/silty CLAY with localised sand traces	>2.25 – 4.50	5.50 – 10.65	4.20m bgl in BGS borehole BH156	Unproductive Strata	
Glacial Till	Stiff brown or red locally silty, gravelly CLAY	>1.35 – 3.75	10.45 > 12.00	Not Recorded	Secondary Undifferentiated	Predominantly present in area of Coatham Marsh and to the south and east
Solid Geology						
Redcar Mudstone	Blue Shale, Grey Mudstone and siltstone, thin beds of limestone	Thickness up to 280m, not proven	Not proved	Not Recorded	Secondary Undifferentiated	
Penarth Group	Grey to black Mudstone, subordinate limestone and sandstones	Thickness 0-12m			Secondary B Aquifer	
Mercia Mudstone	Red Mudstone, subordinate siltstones, locally Halite and thin gypsum beds and sandstones	Thickness up to >1000m, not proven			Secondary B Aquifer	
Sherwood Sandstone	Red Sandstone	Thickness Approximately 250m			Principal Aquifer	

Hydrogeology	Superficial drift deposits of Glacial Till underlying the area are classified as a Secondary (undifferentiated) Aquifer[10]. An area of Secondary A Aquifer is present in the north east extending inland from the coast. This area of Secondary A Aquifer is co-incident with the outcrop of superficial Blown Sands and Tidal Flat deposits. Glaciolacustrine deposits are classified as unproductive strata. The Penarth Group and Mercia Mudstone underlying the superficial deposits are classified as Secondary B Aquifers, and the Redcar Mudstone is a Secondary (undifferentiated) Aquifer. Secondary A aquifers comprise permeable layers that can support local water supplies and may form an important source of base flow to rivers. Secondary B aquifers are mainly lower permeability layers that may store and yield limited amounts of groundwater. Secondary undifferentiated are aquifers where it is not possible to apply either a Secondary A or B definition because of the variable characteristics of the rock type/ deposits. Made Ground is typically granular and is therefore also water-bearing, although it does not have a formal aquifer classification. Groundwater in the Made Ground is likely to be in continuity with groundwater in the underlying superficial deposits classified as Secondary aquifers. In addition, there is likely to be hydraulic continuity between groundwater in the Made Ground and shallow superficial deposits and surface waters. Previous ground investigations across the area have encountered the presence of a shallow perched water table within superficial deposits at typical depths of between 1.5m and 2.5m below ground level (bgl). A previous investigation (Enviros, 2004) interpreted groundwater to have a general flow to the east. Given the variable nature of the superficial deposits, it is likely that water bearing horizons within these superficial deposits are not laterally continuous across the study area. There are no licensed groundwater abstractions within 1km of the area There are no SPZs within the site or within 1km of the area. In general, groundwater flow in shallow deposits is anticipated to be towards the River Tees to the north or northwest. However, groundwater flow direction in shallow soils across the area is likely to be variable and influenced by the presence of surface water features. The main River Tees is also tidally influenced, and there is likely to be some tidal variability of groundwater in hydraulic continuity with surface waters. The Sherwood Sandstone Principal Aquifer at depth is of limited hydrogeological concern at the site, as it is overlain by a significant thickness of Mercia Mudstone, which will limit the vertical connectivity with shallow groundwater.
Groundwater Sensitivity	The groundwater sensitivity is low. Although the area is underlain by Secondary aquifers, there are no local groundwater abstractions and the area is not located within a SPZ. Given the widespread former and current heavy industrial use of the site and surrounds, there is likely to be widespread regional degradation of groundwater quality.
Hydrology	The River Tees is located approximately 2km to the north of the area, and is classified by the EA as a Main River. The stretch of the River Tees to the north of the area is tidal. There are other minor surface waters courses present within the area. To the east the Fleet Beck and Mill Race culvert at Coatham Marshes, which discharge into the Dabholm Gut; this in turn discharges to the River Tees. The Kinnerdale Beck, Knitting Wife Beck and other minor watercourses enter the wider study area from the south in the western area. The Cleveland Channel and the Lackenby Channel are also present. Other surface water features include the Tees dock and the Bran Sands lagoon adjacent to the south bank of the River Tees. The south of the Coatham Marsh and area is crossed by The Fleet. Areas adjacent to The Fleet may be affected by flooding. Surface waters including the River Tees are likely to be in hydraulic continuity with shallow groundwater in Made Ground and Superficial deposits and therefore receive groundwater baseflow.
Hydrological sensitivity	The surface water sensitivity is low. There are minor surface waters which cross the area, and discharge to the River Tees. The River Tees is tidally influenced in the stretch downgradient of the area.

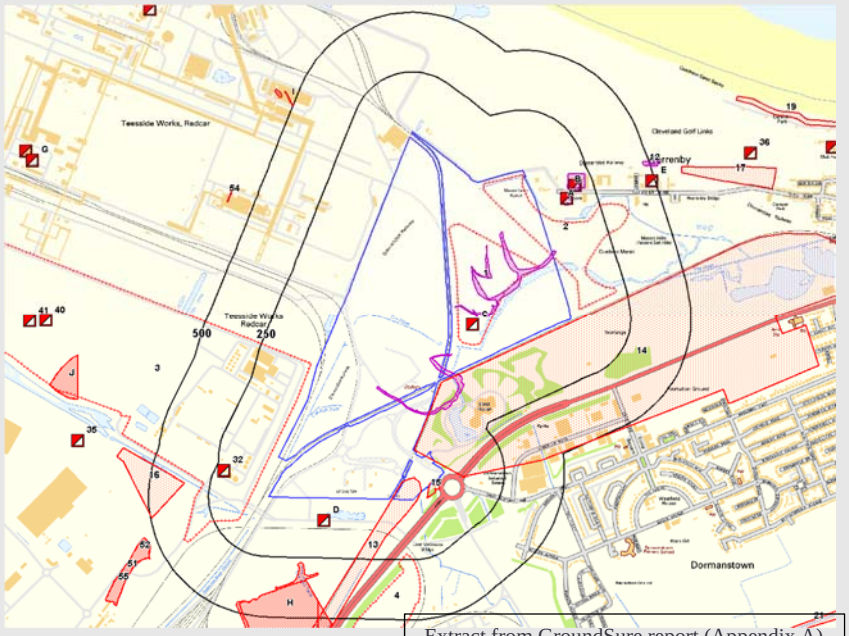
[10] https://magic.defra.gov.uk/MagicMap.aspx

Ecology	The Teesmouth and Cleveland Coast SSSI is located adjacent to the east of Coatham Marshes, and the River Tees to the north forms part of the SSSI. The Teesmouth and Cleveland Coast is also designated as a SPA and a RAMSAR site. An extension to the SPA is proposed which includes areas within the study site at Coatham Marsh.
Ecological sensitivity	The ecological sensitivity is assessed as Moderate as there is a SSSI and SPA less than a 0.2km from the area at Coatham Marshes. The River Tees to the north receives surface water discharge from the area and is designated as a SSSI. However, the influence of discharges from the area are likely to be limited by the tidal exchange and large volume of the River Tees receiving water. The Coatham Marsh Local Wildlife Site also lies to the east of the site.

2.11 Other regulatory database information

Only regulatory data within 250m with the potential to impact the site has been detailed below, please refer to Appendix E for the complete regulatory data set.

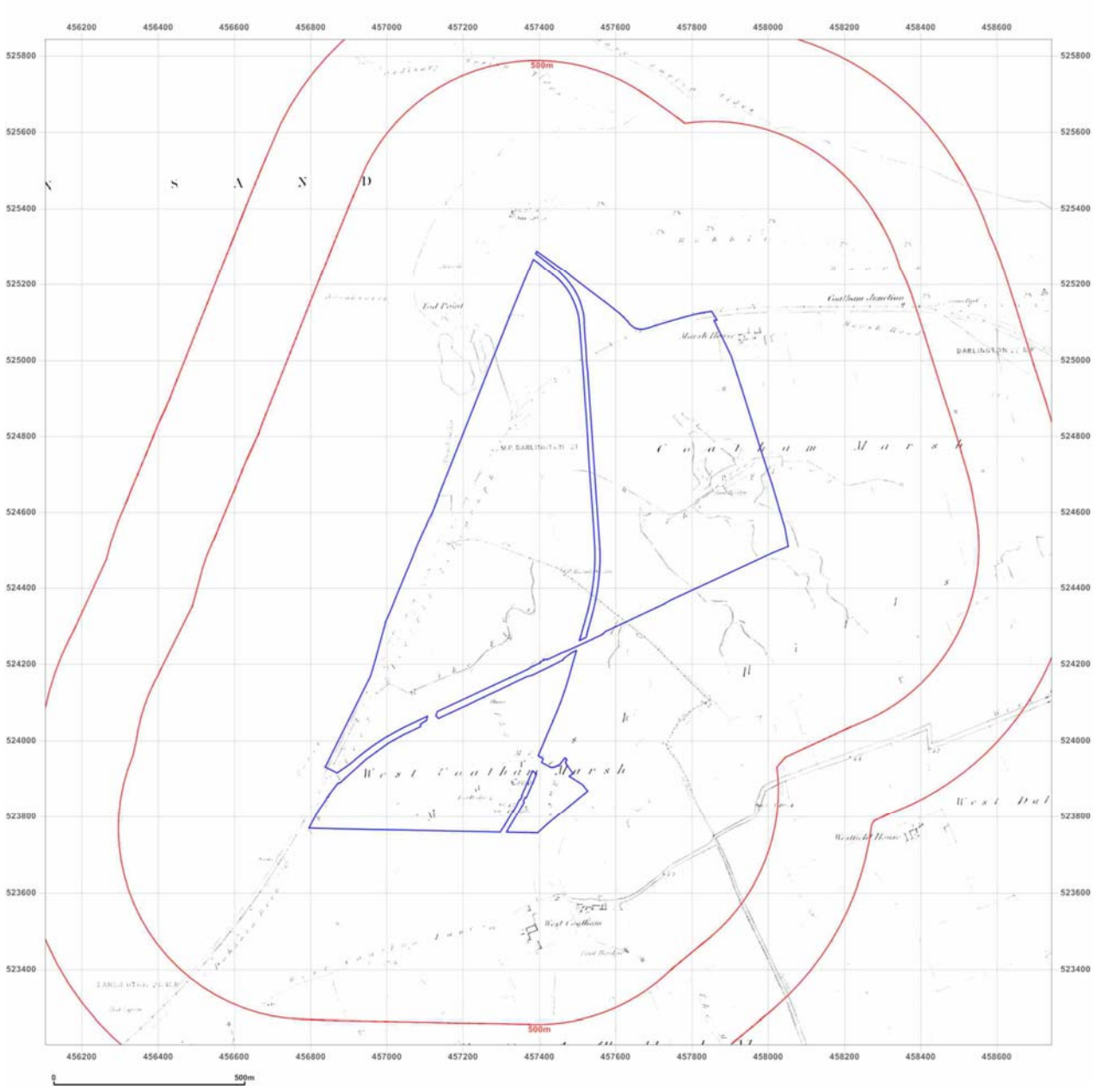
Activity	On-Site	0-250m	Details
Potentially Contaminative Land Uses	96	83	These mainly correspond to unspecified heaps, cuttings and railway infrastructure.
Waste management/ transfer/ treatment facilities/disposal	6	16	There are two sites of Ground Workings and Refuse Heaps located on the area, as well as four waste management sites, two owned by Corus Construction & Industrial and two by Tata Steel UK Limited, accepting Household, Commercial & Industrial Waste Landfill.
Landfill	5	7	The area is designated as a landfill, as summarised below: Operator: TATA Landfill type: A04: Household, Commercial & Industrial Waste Landfill There are two landfills located within 250m: Distance: 30m Operator: York Potash Processing & Ports Limited Landfill Type: A02: Other Landfill Site taking Special Waste Distance: 230m Operator: I C I Chemicals & Polymers Ltd Landfill Type: A07: Industrial Waste Landfill (Factory curtilage)

Activity	On-Site	0-250m	Details
			 Extract from GroundSure report (Appendix A)
Sites handling hazardous or explosive substances (inc COMAH or NIHHS) planning hazardous consents	3	3	Three COMAH & NIHHS sites within the area: Company: British Steel Corporation Ltd Operational Status: Historical NIHHS Site Tier: - Company: Sahaviriya Steel Industries UK Limited Operational Status: Historical COMAH Site Tier: COMAH Upper Tier Operator Company: South Tees Site Company Limited Operational Status: Current COMAH Site Tier: COMAH Upper Tier Operator
Mineral Extraction and Coal Mining Activities	N/A	N/A	No mining coal mining activities within 75m of the area. No non-coal mining activities within 50m of the area.

Area history

A summary of the historical development of the area, based on historical OS maps, is presented below. The historical maps can be found within the Groundsure report in Appendix D. Where relevant, interpretation of the maps is supported by knowledge from the discussions with the client and other stakeholders and previous reports for the area.

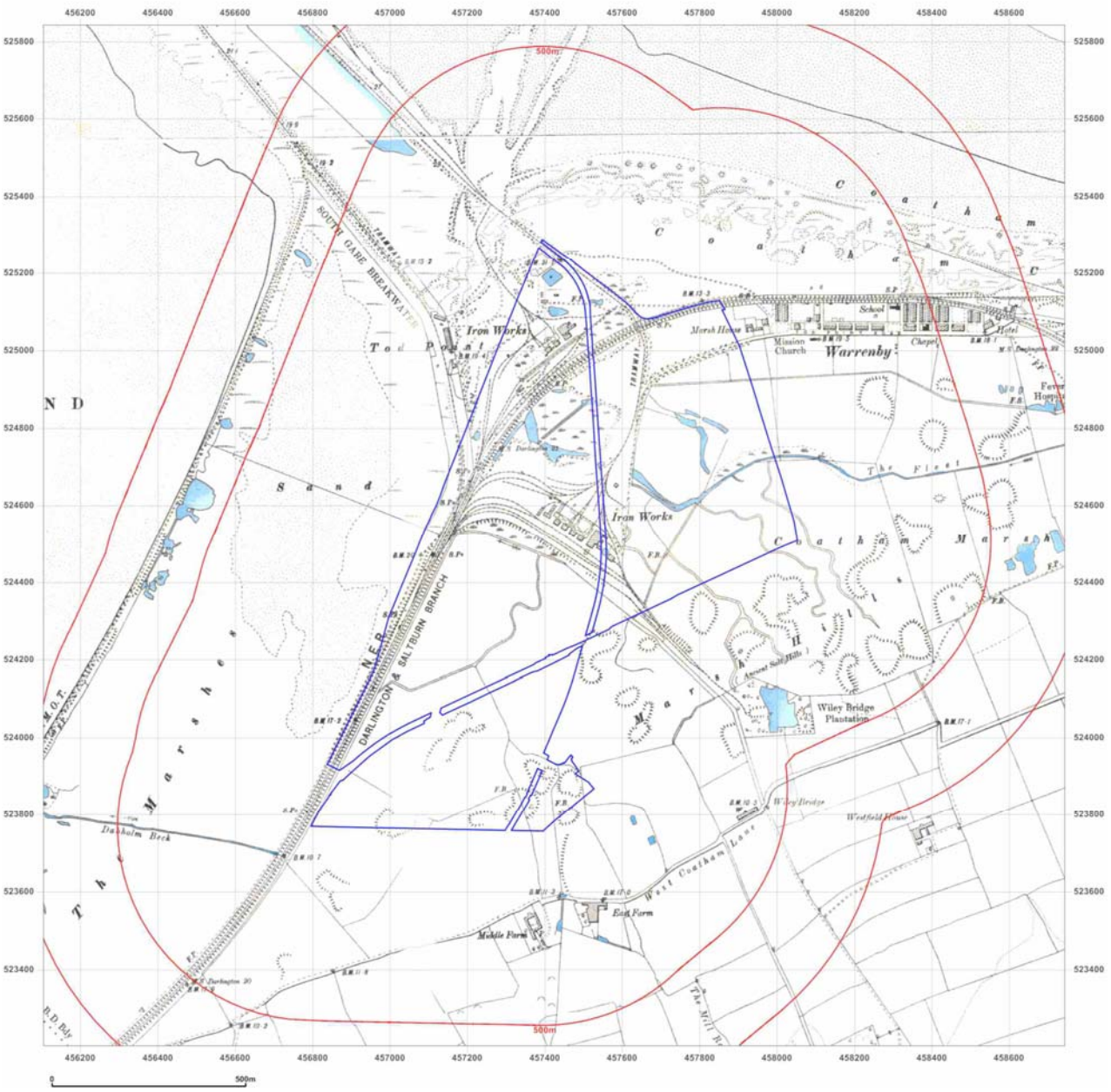
1856-1857



On-site: The area is largely undeveloped agricultural land. M.P. Darlington line runs from the southwest corner of the area, along the west site boundary and through the north of the area.

Off-site: The surrounding land is largely undeveloped agricultural land and sand. A small cluster of buildings can be seen just beyond the northeast corner of the area, labelled 'Marsh House'. Coatham Junction can be seen northeast of the area and is related to the M.P. Darlington trainline. Small structure northwest of the area labelled 'Tod Point' can also be seen. 'Middle Farm' and 'East Farm' can be seen to the southeast of the area.

1893

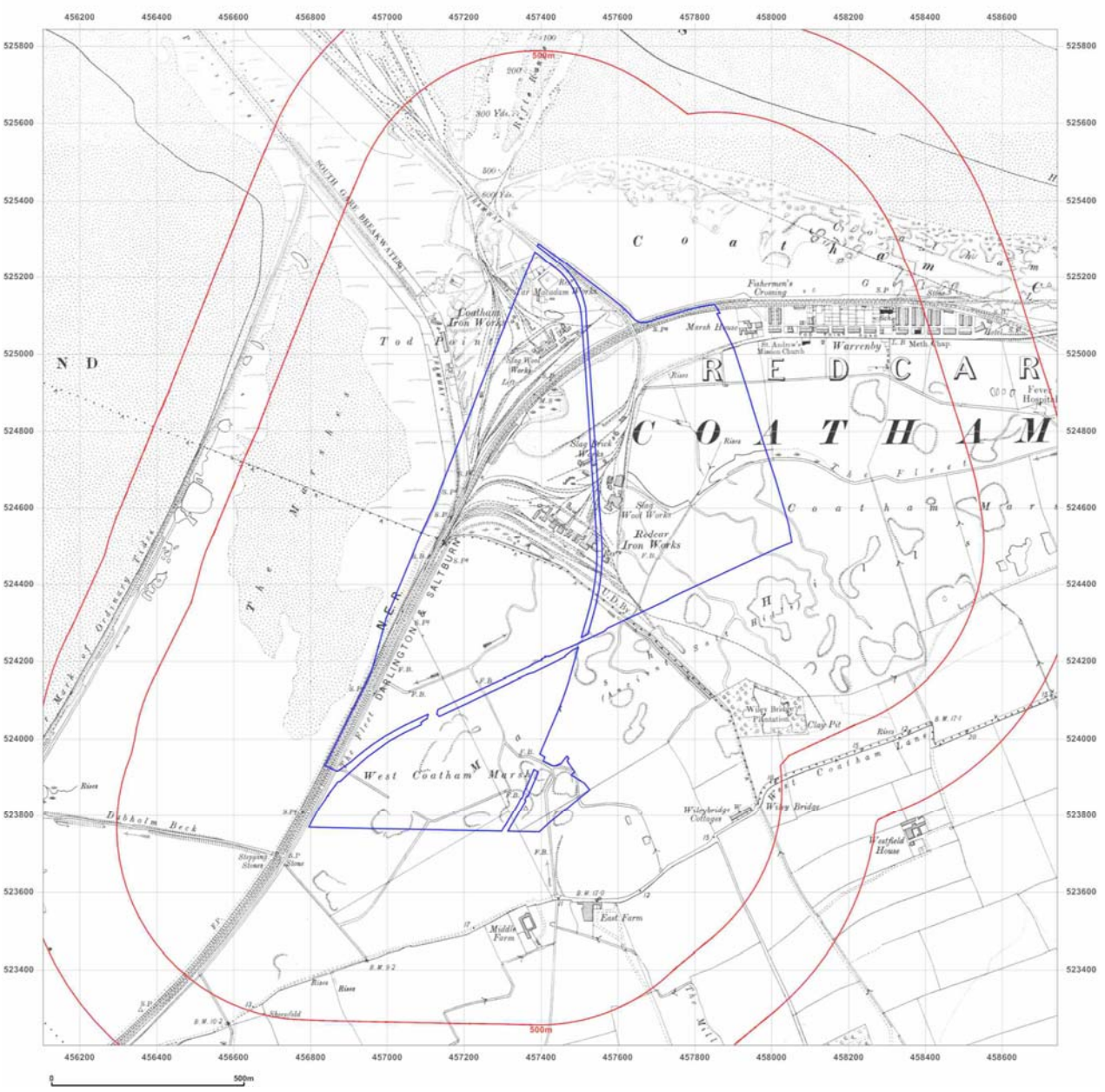


On-site: The central areas had been developed to the Redcar Iron & Steel Works, with four blast furnace chimneys evident. The area was served by a complex of railway sidings. A tramway connected the north of iron works to the docks and the Tees estuary. South of the iron works, the area was undeveloped at this time. The north of the site was subject to earthworks/ tipping activity, for construction of site infrastructure including tramways, and previous drainage was truncated. The Coatham Iron Works was present beyond the Darlington to Saltburn railway line. Majority of the south area is shown as undeveloped, occupying part of West Coatham marsh. A series of mounds are present throughout the area possibly related to the annotated 'Marsh Hills and ancient salt hills'. A series of drainage channels cross the area. The course of these channels suggests they have been significantly altered in the past. A main drain crosses the area in an approximate northwest to southeast orientation within the northeast part of the area, linking to the Wiley Bridge Plantation located just to the south.

Off-site: Much of the surrounding land is still undeveloped and agricultural land and sand. Marsh House can still be seen northwest of the area. Coatham Station can no longer be seen on the map, and a large development is now in its place, labelled 'Warrenby'. Middle Farm and East Farm are still visible at this

point, with a new development labelled 'Wiley Bridge Plantation' approximately half way between the farms and Warrenby. 'Wiley Bridge Cottage' now visible east-southeast of the site. East of the area a series of rail lines is present linking to the adjacent Redcar Iron Works with one line extending to the Wiley Bridge Plantation.

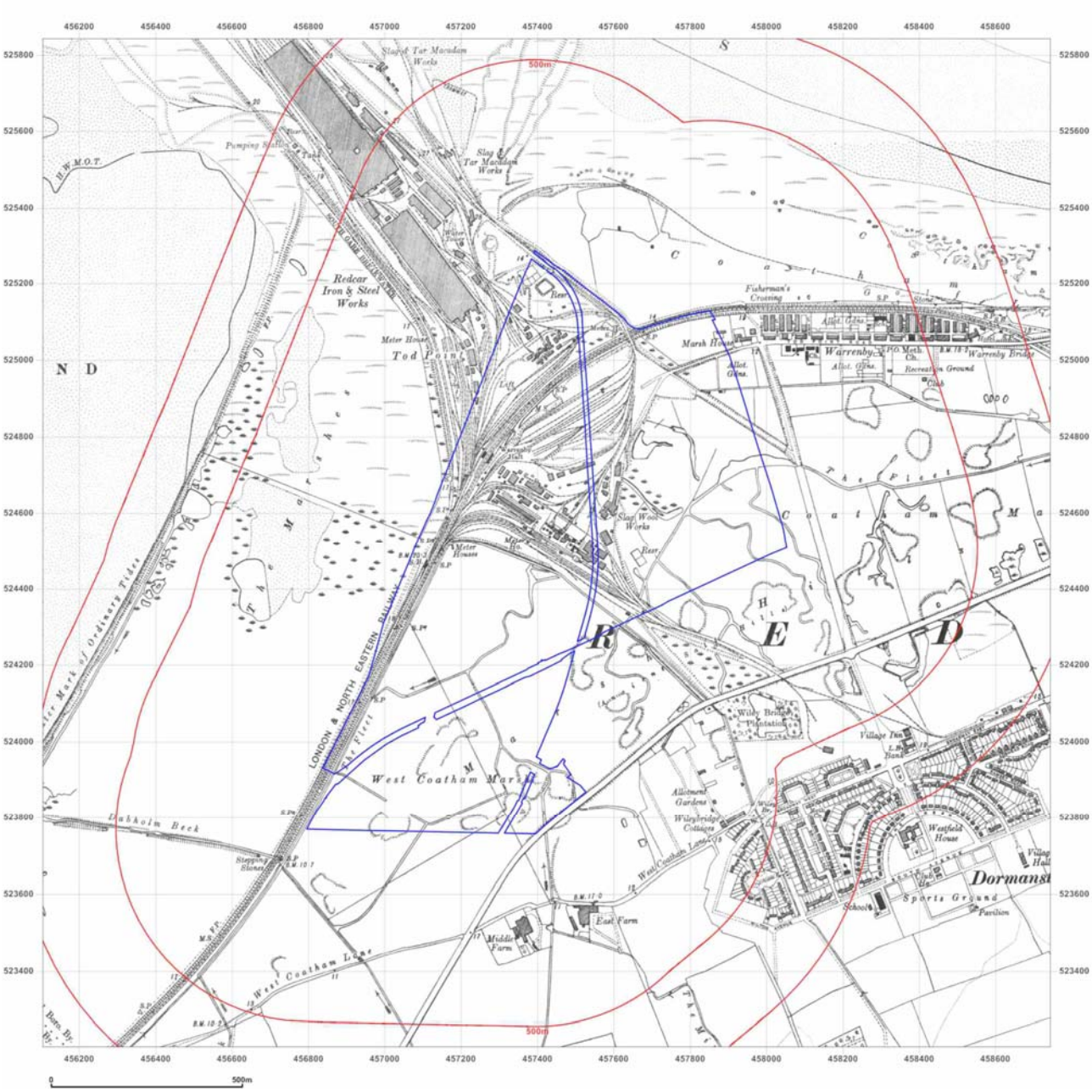
1913



On-site: Expansion of the railway sidings and tramways north of the Iron works, and expansion of the filled area. Reduction in the number of railway lines extending towards Wiley Bridge Plantation. Slag Wools Works shown within the main Iron Works buildings, and one north of the Iron Works buildings. A Slag Brick Works was also present to the north of the Iron Works. No change to the majority of southern area.

Off-site: Majority of land remains unchanged. Land to the west of the area previously labelled 'Sand' is now labelled 'The Marshes'. Reduction in the number of railway lines extending towards Wiley Bridge Plantation.

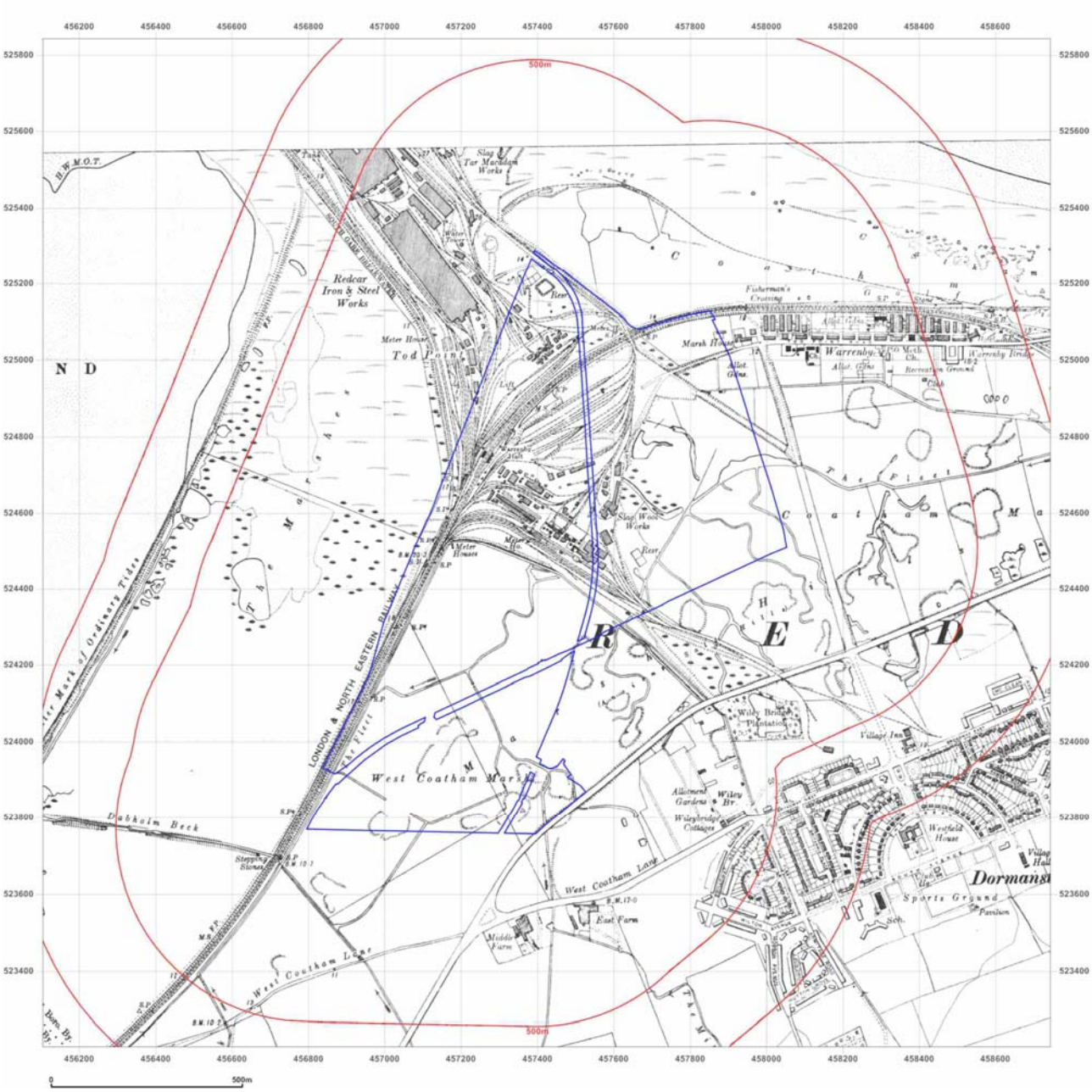
1927



On-site: Significant expansion of developed area to the west of the main Iron Works buildings, new buildings included chimneys, tanks and water coolers. The rail & tramway lines north of the Iron Works underwent significant expansion. The Slag Brickworks and the Slag Wool Works were also expanded at that time. A reservoir was shown to the east of the Iron Works. The majority of the southern area remains unchanged.

Off-site: To the east, northeast of the main drain, new rail lines have been developed that link to a new residential area (Dormanstown) to the south. Between the rail lines and the main drain, the area is recorded as reeds. A road has also been developed along the southern perimeter of the area. Two small circular features, possibly ponds, are located close to the southern perimeter close to the main drain. A large road can now be seen running along the southeast most boundary from south to northeast direction, through the Wiley Bridge Plantation.

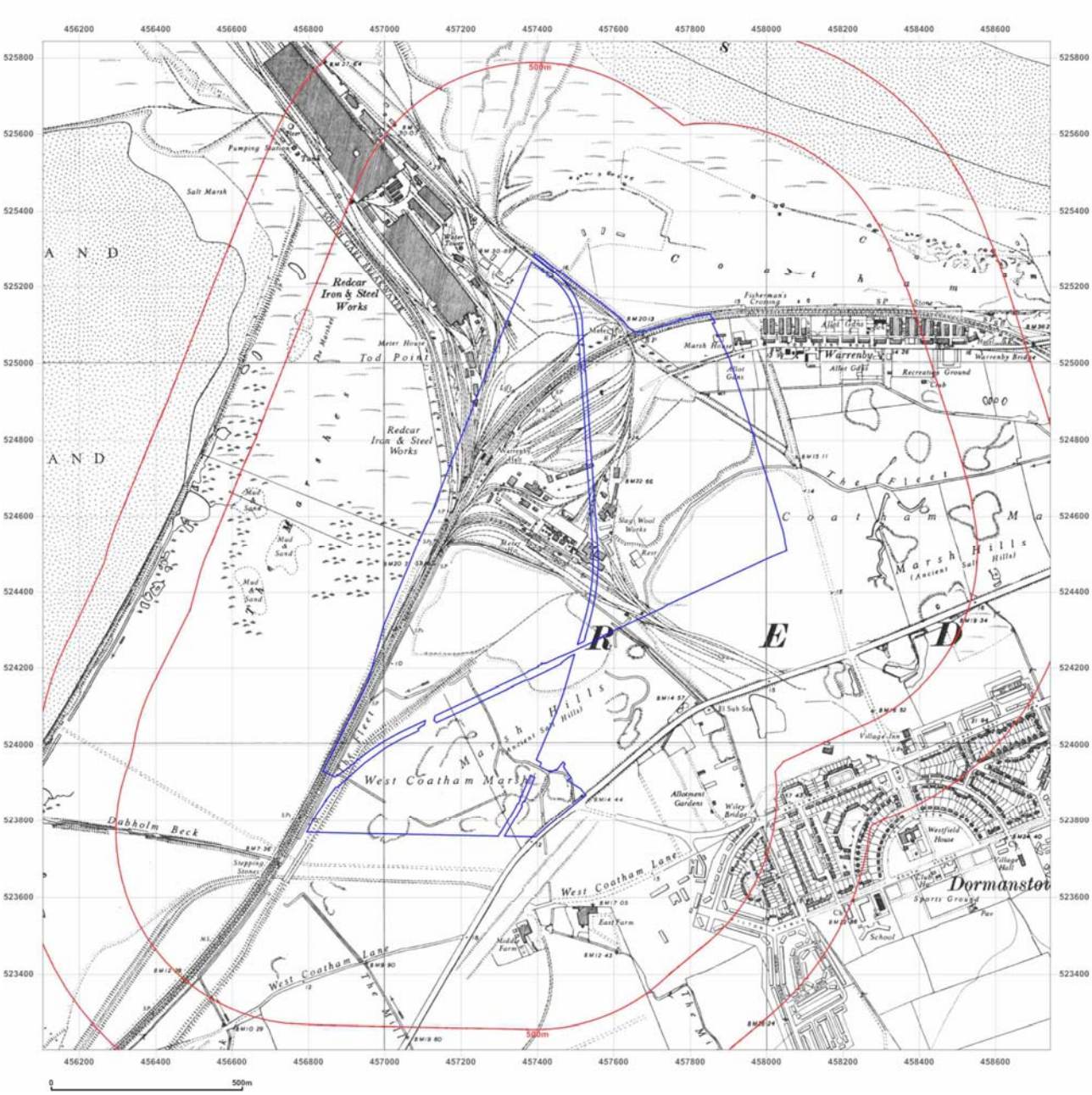
1938



On-site: The area remains unchanged at this time.

Off-site: Surrounding land largely unchanged apart from further development at Dormanstown to the southeast.

1953



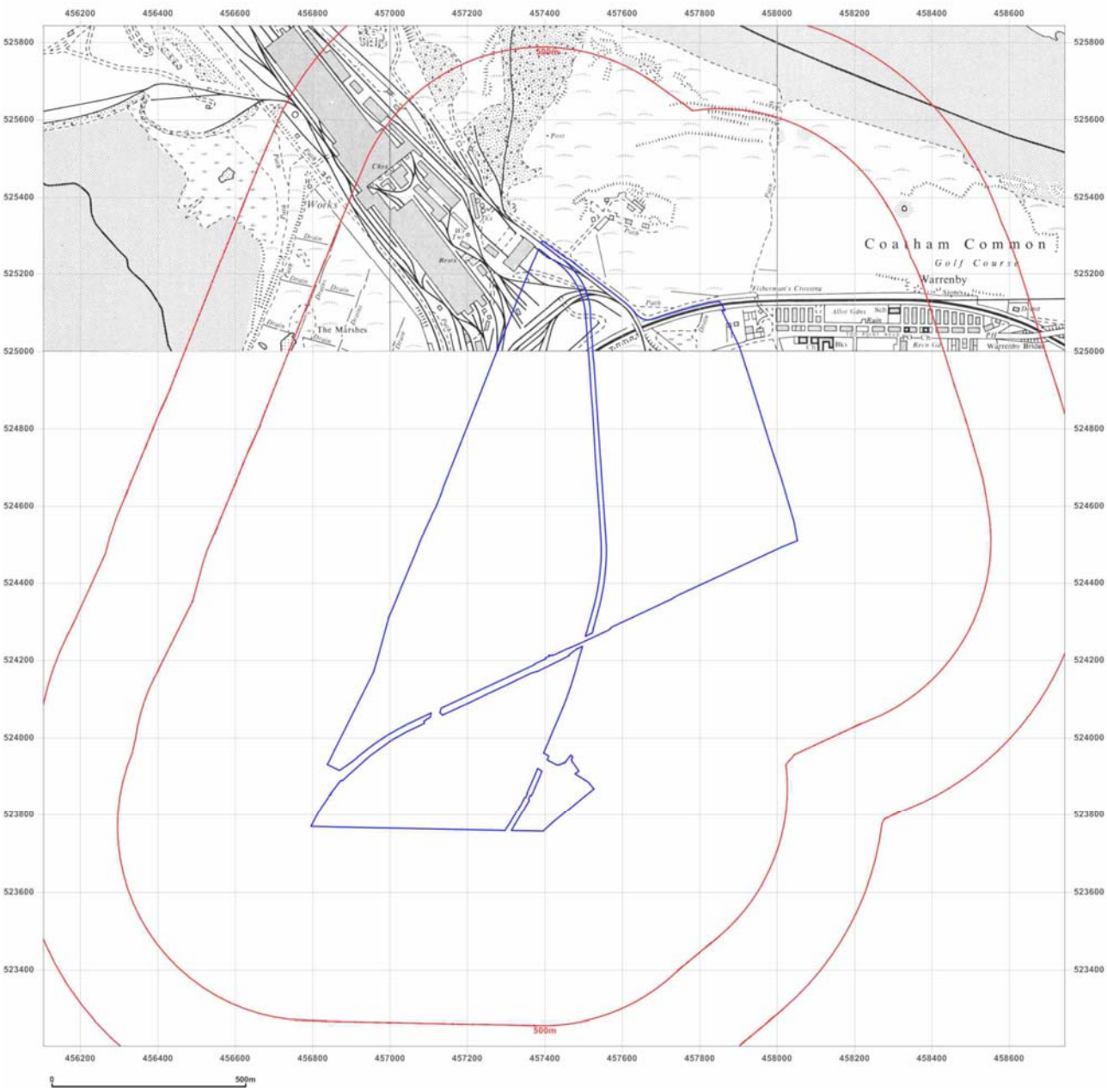
On-site: Main blast furnaces redeveloped into single large building, with associated railway/ tram lines. An extensive area of infilling was shown extending form the site towards the south east, resulting in amendment to the surface water drainage channels. Redevelopment included water coolers and a water tank east of the main steelworks buildings. The Mill Race surface water entered the area in the south.

The majority of the changes are in the eastern sections of the area. Along the northern boundary, a large tip body has been pushed out from Redcar Ironworks/steelworks into the site. The rail development includes some possible building structures, a conveyor and a platform. The circular features noted on the 1929 edition are confirmed as ponds. In addition, on the northern edge of the main drain crossing, the site an electricity substation has been constructed. The drain is now annotated 'The Fleet'. The road to the south of the area has been upgraded and appears as a dual carriageway. The construction of a roundabout is partially completed along the southern section of the site. Within the southern and southwest sector of the area, the drainage pattern has been amended. This includes 'The Mill Race' that flows in a northerly

direction; this enters the area from the south and links to another channel that runs in an east northeast direction. A track is also annotated close to this drain.

Off-site: Further development of the rail lines are shown to the east of the area but it is noted that these have been truncated by the road along the southern boundary.

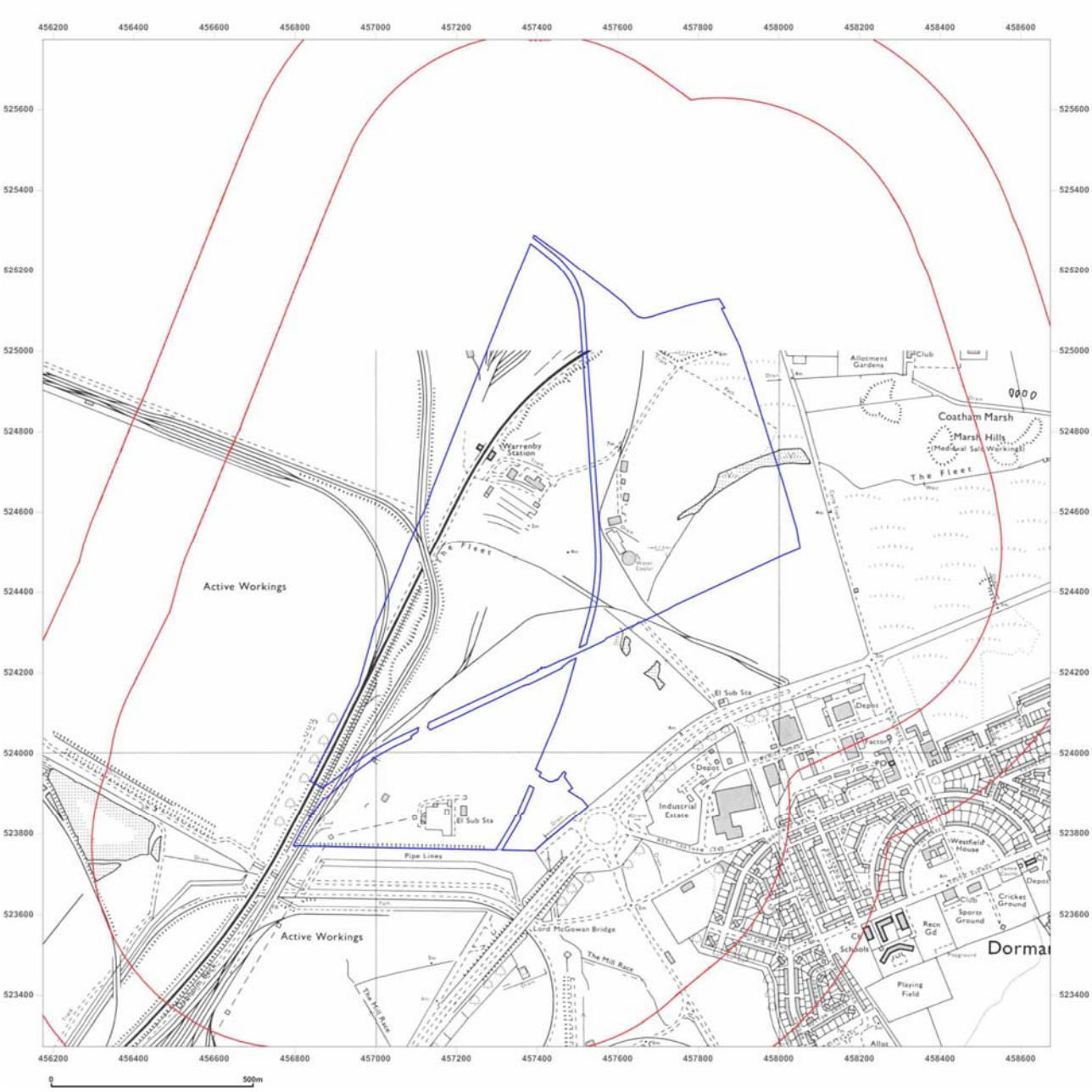
1969



On-site: Only the northmost areas of the area can be seen in this mapping and lacks much of the labelling. The areas visible in mapping at this time are unchanged.

Off-site: Only the northmost areas of the area can be seen in this mapping and lacks much of the labelling. Area immediately beyond the northmost site boundary has new development but is unlabelled. Area west-northwest of the area, below Redcar Iron & Steel Works, now has a series of drains. Coatham Common Golf Course can now be seen north of Warrenby.

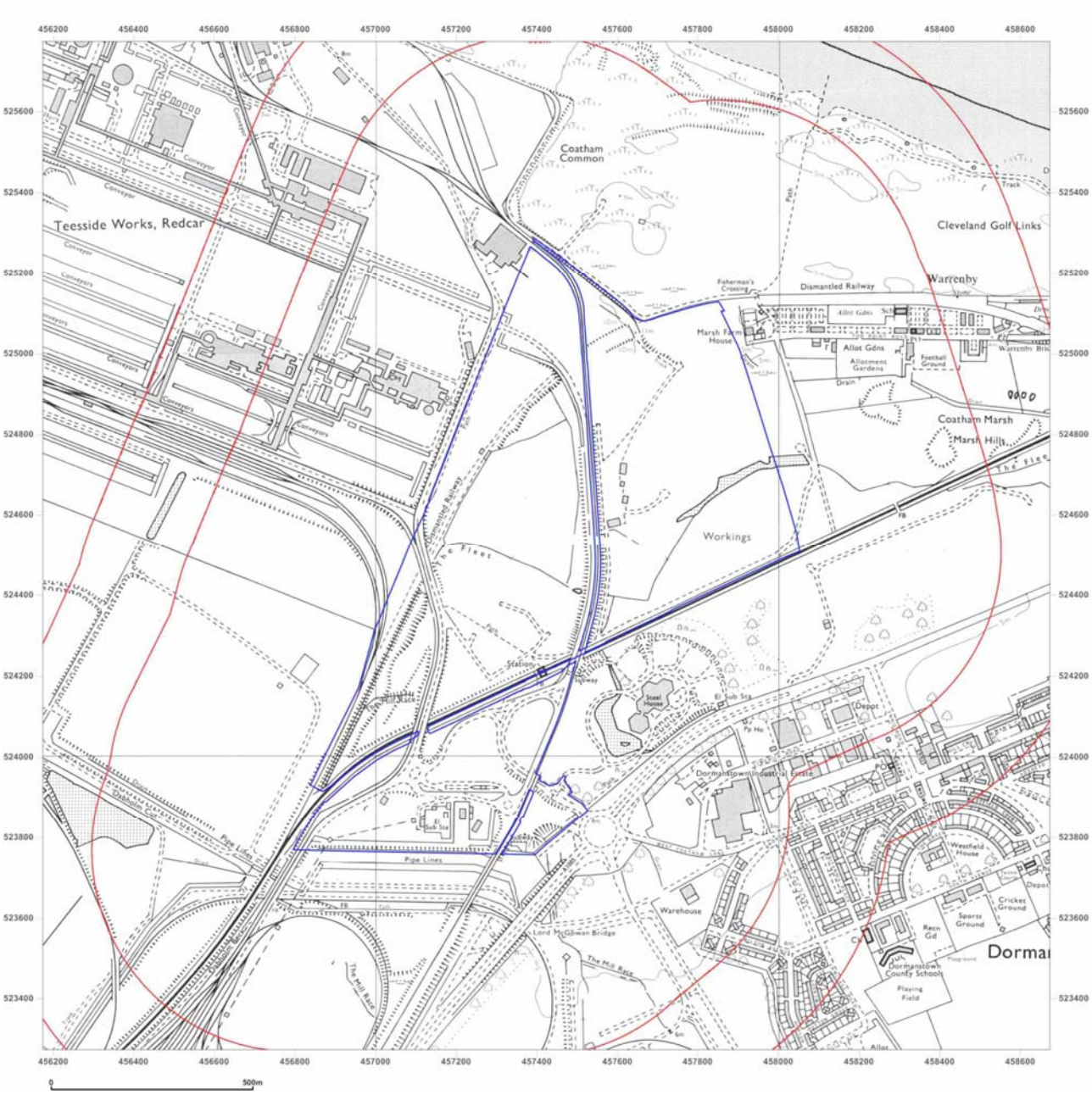
1974



On-site: Much of the development in the centre of the area associated with the historic Coatham Iron Works are now gone, as well as most of the tracks. Additional rail lines shown along the western boundary.

Off-site The surrounding areas remain the same.

1983

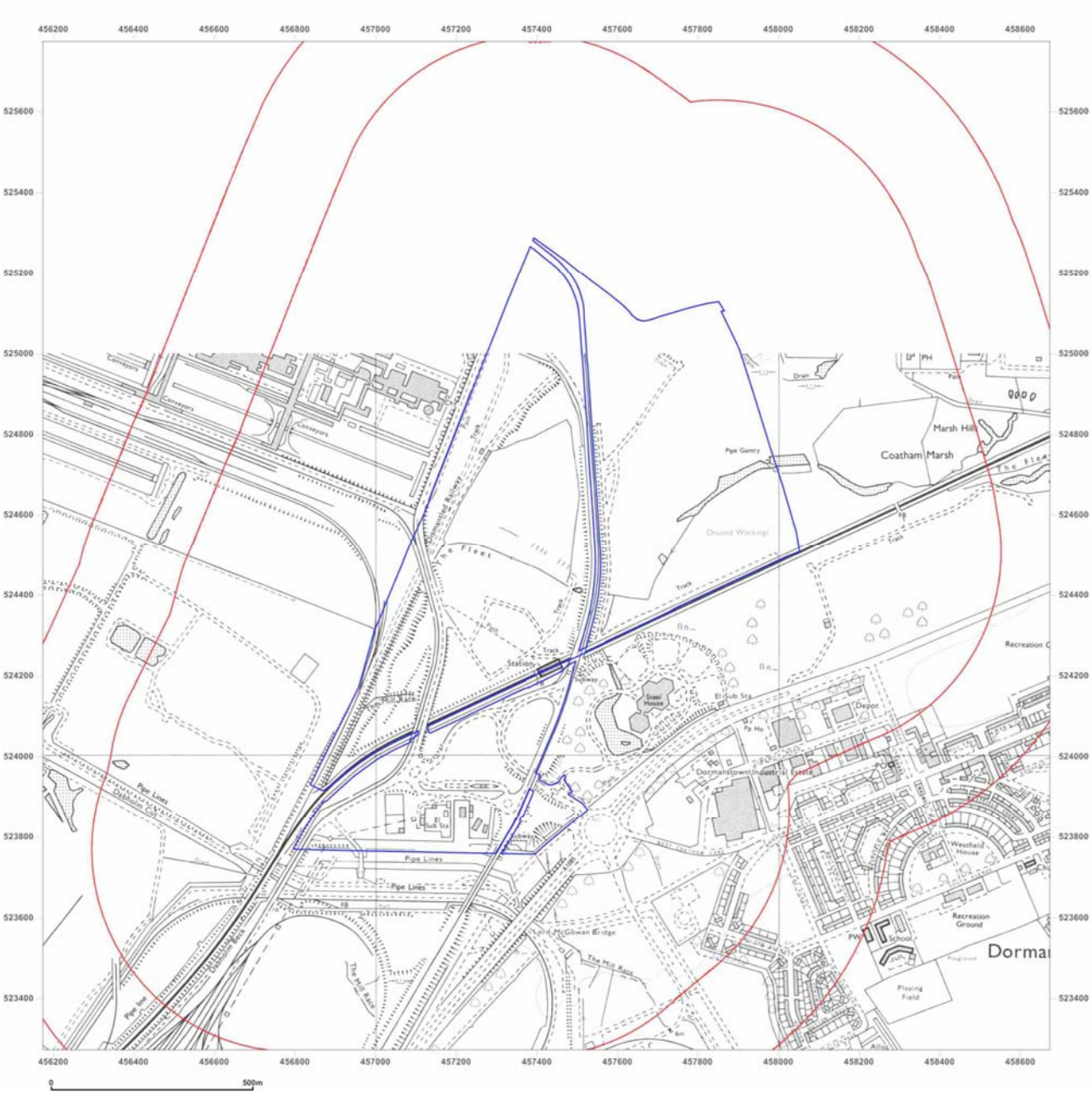


On-site: Further demolition and removal of buildings associated without historical Coatham Iron Works. The Steel House building had been constructed to the adjacent to the southeast of the area, and a station constructed on the Darlington to Saltburn railway line. A new steelworks had been constructed to the south west of the area, which was served by a new road and rail network. This survey period records a major change to the southern area. The Fleet has been incorporated into a large lake feature that is located to the southwest of Steel House. The intake to the lake has been diverted along the southern boundary. A new internal road network and rail line (Hot Metal Route) pass through the area with a separate rail line located along the northern boundary. A rail station (British Steel Redcar) is also present on the northern boundary. The majority of the area appears to have been landscaped. At the south western limit of the area a large electricity substation has been developed with associated pylons linking to the south west. Possibly associated with the substation is an area of hardstanding and buildings (to the east). A weighbridge is recorded adjacent to the northern boundary of the substation. To the south of the

electricity substation a pipe crossing is recorded. Annotations on the plan refer to the South Teesside Works Lackenby and Teesside Works Redcar.

Off-site: This survey period records a major change to the area. Steel House and associated car parking facilities have been developed to the east-southeast. Redcar Iron & Steel Works now labelled 'Teesside Works, Redcar'.

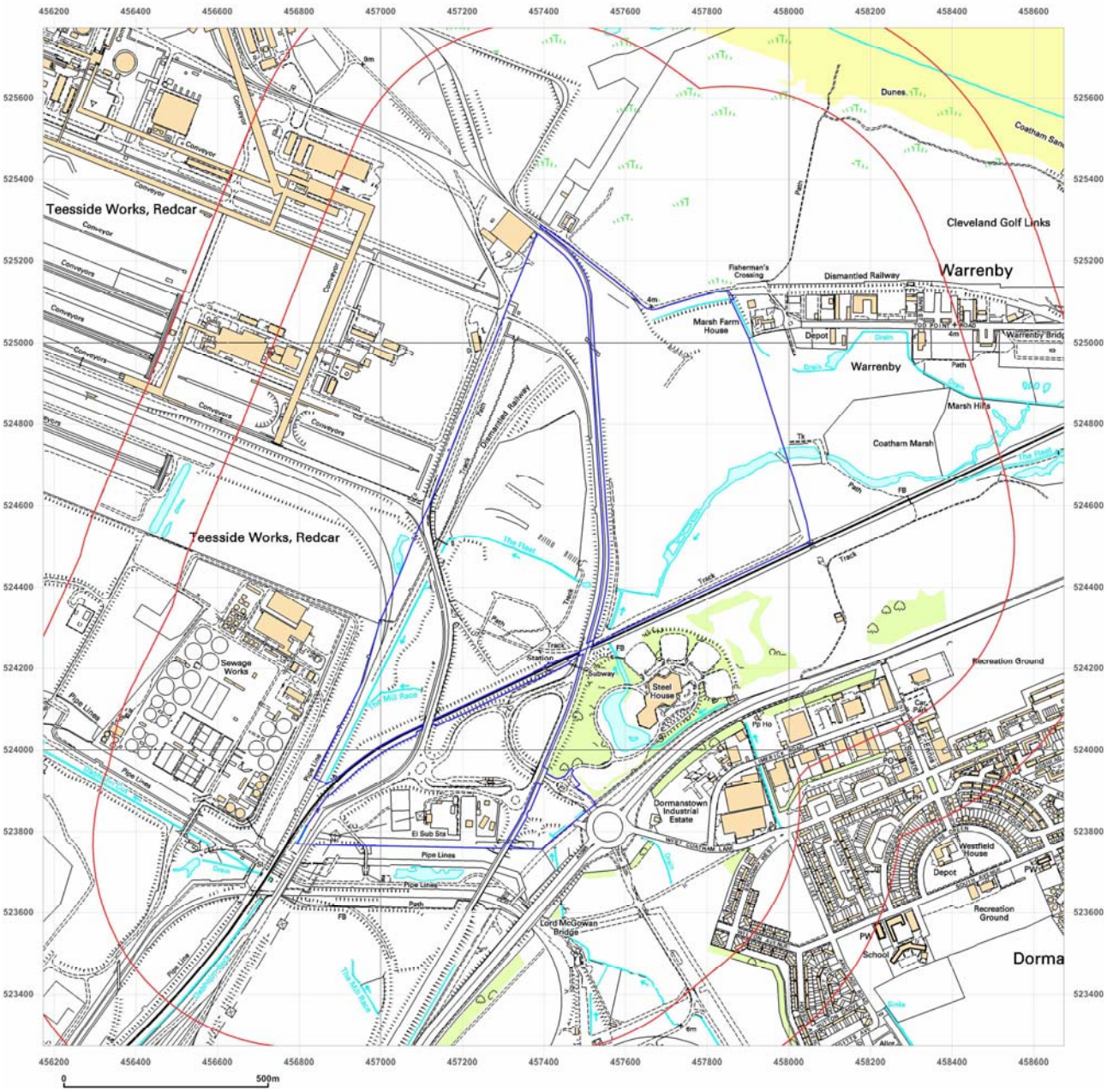
1991



On-site: Majority of the area unchanged, with the exception of a few buildings associated with the substation.

Off-site: Majority of the surrounding area unchanged, with the exception of a new development south of the Teesside Works.

2002



On-site: The area remains unchanged.

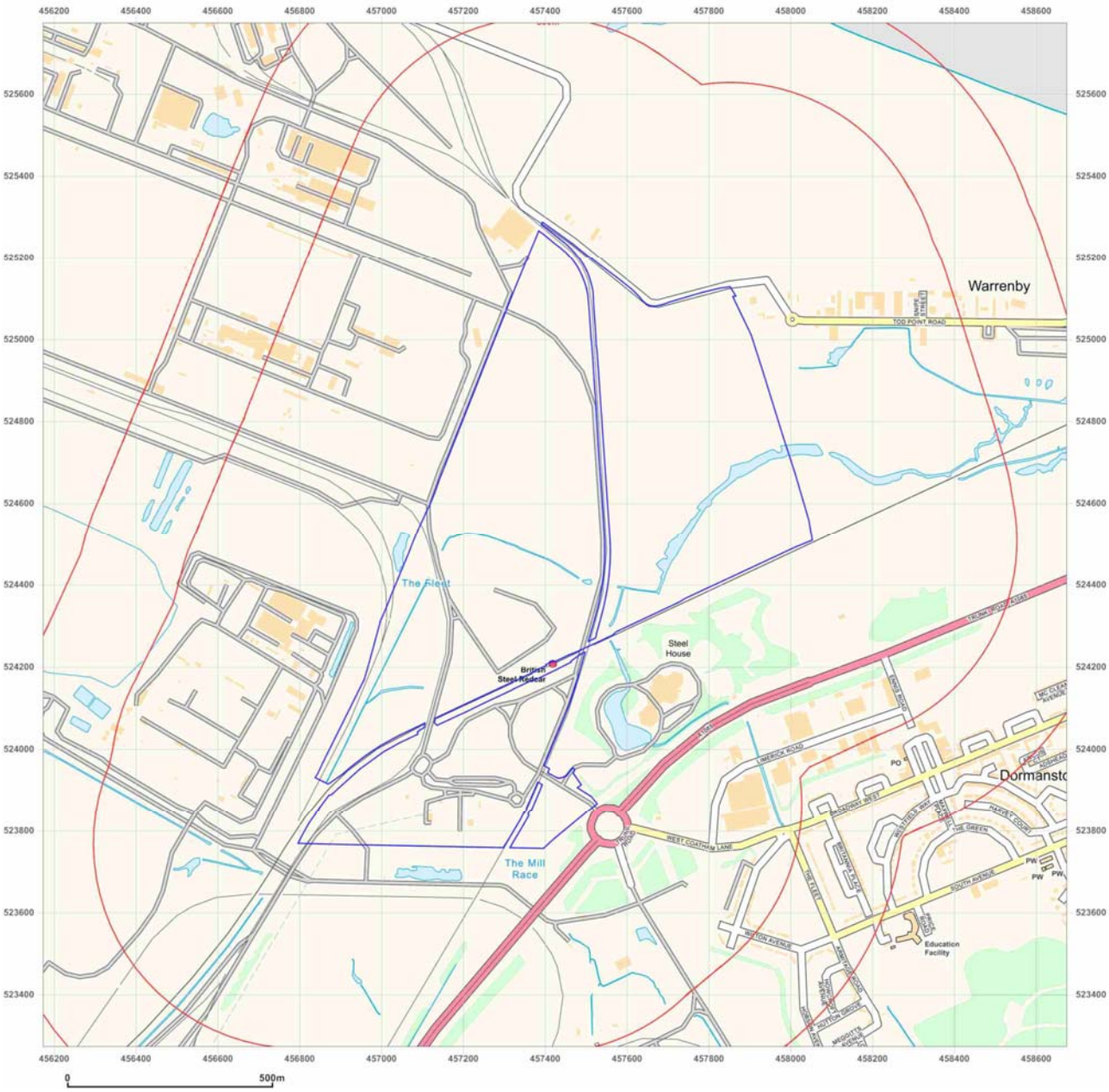
Off-site: This survey records a major development at Teesside Works to the west. The last to the west-southwest of the area that was previously mostly undeveloped is now a large Sewage Works. Pipelines appear to have been rerouted around the sewage works, with new roads and a bridge over the drain to the south now visible.

2010

On-site: Majority of the as area is shown in 2002. In 2006, hard standing area to the west of the substation appears to be covered in waste materials and includes a series of containers and one small building. Some piles of dumped materials are also present adjacent to the western side of the hardstanding. Hardstanding area to the west of the substation gone in 2010 survey.

Off-Site: No changes from previous mapping.

2014



On-site: No changes from previous mapping.

Off-site: No changes from previous mapping.

Summary of site history and pertinent features

Since the earliest maps dated 1856, the area and surrounding areas has undergone considerable development and demolition. Between 1856 and 1893, significant industrialisation began in the northwest and centre of the site with the construction of two separate iron works and sizeable expansion of the Darlington & Saltburn Branch trainline running through the area and connecting the two industrial sites. In the 1913 survey, the iron works located in the northwest and centre of the area are now known as 'Coatham Iron Works' and 'Redcar Iron Works' respectively. Much of the northeast and south of the area remain undeveloped at this time.

In the 1927 surveys, significant expansion of the former Coatham Iron Works to the northwest of the area and is now labelled 'Redcar Iron & Steel Works'. Less significant development at the former Redcar Iron Works located in the centre of the site and is no longer labelled; it is assumed that Coatham Iron Works and Redcar Iron Works are joined at this time. A significant increase in the number of train tracks covering the northwest quadrant of the area.

By 1974, much of the development relating to the original Redcar Iron Works has now gone, and surrounding infrastructure supplying the town of Dormanstown and Warrenby progressed significantly.

In 2002 surveys, development is as appears today. The former Redcar Iron & Steel Works has undergone significant transformation is now known as 'Teesside Works, Redcar' and has gained a large Sewage Works to the south.

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

- Infrastructure associated with historic Redcar Iron Works located at the centre of the site including pump houses, meter houses, pipes, tanks, refuse piles, blast furnaces, water coolers, reservoirs, sluice, overhead pipes, cranes, chimneys, and subways (Central)
- Infrastructure associated with historic Coatham Iron Works located in the northwest corner of the site including reservoirs, tar macadam works, water towers, chimneys
- Slag Brick Works (Central)
- Slag Wool Works (Central, Northwest)
- Land and infrastructure associated with the trainline (Southwest, Northeast)
- Electricity substations (Southwest)

Notable historic and contemporary features in close proximity to the area, outside of the boundary which may have implications for land contamination include but are not limited to;

- Land and infrastructure associated with the Teesside Works, Redcar (Northwest)
- Land and infrastructure associated with the trainline (Southwest, Northeast)
- Slag Works (Northwest)
- Tarmacadam Works (Northwest)
- Storage tanks (Northwest)
- Water coolers (Northwest)

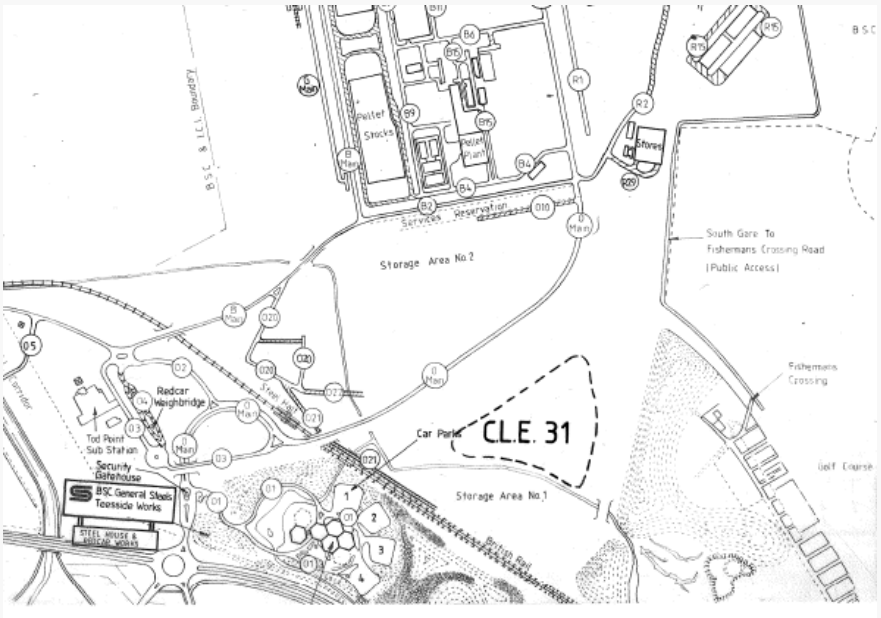
Summary of Previous Reports

Previous Report Ref	
Data Review **TS2 Tear Drop Site – Phase 1 Geoenvironmental Desk Study, CH2M Hill, August 2017**	**Scope of Works** This report was a data review for the northern part of the study area at Coatham Marsh & Warrenby Landfill. The area is approximately 65ha. **Findings** The majority of the site was undeveloped. Warrenby Landfill dominates the site and covers some 7 ha; it holds around one million cubic metres of waste materials, comprising predominantly steelmaking slags, with small amounts of paper and canteen wastes.

Previous Report Ref	
	The review identified that the central area of the site was developed to the Redcar Iron Work by 1874, and the area south of the Work remaining largely undeveloped. Land north of the Iron Work was infilled by 1894, and a Slag Wool and Slag Brick works constructed in that area. The former Coatham Ironworks was present within the north west of the site, to the west of the hot metal route. These were subsequently demolished by the 1950s, and the Redcar Iron Works was demolished by the 1970s. Regrading works in the south of the site had been undertaken as part of present-day road and railways. Review of regional bomb risk maps indicated a Moderate UXB risk. The site held a COMAH upper tier establishment classification associated with PAH in the Coke Oven Gas Main. In addition to Warrenby landfill, an active landfill accepting special wastes was identified at Bran Sands close to the west of the site. **Ground Investigation** Review of previous data indicates the following: **Soil** Made Ground present across the site, variable deposits, up to around 4-5m in thickness (excluding the Warrenby Landfill area), comprising slag, firebricks, bricks, ash, rubble, fused slag. Data reviewed included Enviros 2004 ground investigations, which comprised 2 boreholes and 10 trial pits. Made Ground depth not fully proven in most locations. CH2M Hill reassessed the data acquired by Enviros in 2004 and assessed soil data based on current generic assessment criteria (GAC). Of the 22 samples of Made Ground analysed, results indicated the following exceedances of GAC: • Ph – 6 samples (GAC <5 to >10) • Boron – 2 samples (GAC 3 mg/kg) • PAHs – 1 sample (GAC 40mg/kg) • Lead – 1 sample – GAC 750mg/kg) • Zinc – 2 samples 720 mg/kg • Acid soluble sulphate – 4 samples (GAC 1000mg/kg) • Water soluble sulphate – 3 samples (GAC 12,000mg/kg) CH2M Hill also compared results to the Suitable for Use Levels (S4UL) and for lead, Category 4 Screening Levels (C4SL). None of the screening values were exceeded. Ground investigations at Warrenby Landfill encountered very dense slag to a depth of up to 7m bgl. Underlying superficial Tidal flat deposits of sands and silts, with Blown Sand present in the south locally. Deposits are underlain by Glacial Till, which is in turn underlain by the Redcar Mudstone Formation. The report concluded that contaminants of concern included asbestos, heavy metals, PCBs, hydrocarbons, sulphides, sulphates, carbonates and ground gas from domestic wastes. **Water** CH2M Hill reviewed the Enviros (2004) groundwater monitoring data. One round of testing was conducted, and cyanide and sulphur results exceeded the Tier 1 screening values in groundwater in one borehole location. Superficial deposits were classified as a Secondary A aquifer, with bedrock classified as a Secondary (undifferentiated) aquifer. Surface waters at the site include the Fleet and Mill Race. **Gas** Potential deposition of domestic wastes and other wastes locally in landfill may give rise to ground gases. **Recommendations** The report included the following recommendations:

Previous Report Ref	
	- Further desk based research on the Coke Oven Gas Pipeline decommissioning and implications, confirmation of the Landfill closure application status, and UXO study. - Intrusive investigation comprising 40 trial pits and 9 boreholes in the former Redcar Iron works area, and 40 trial pits and 5 boreholes on the Warrenby Landfill area. A further 5 boreholes were proposed on the remainder of the site.
Data Review TS1 Steel House and Surrounding Area – Phase 1 Geoenvironmental Desk Study, CH2M Hill, August 2017	**Scope of Works** This report was a data review for an area which includes the south of the current Coatham Marshes and Warrenby Landfill study area, south of the Saltburn to Darlington railway. The area is approximately 35ha. The study included assessment of land east of the hot metal route, which lies outside the current study area boundary. **Findings** The site originally comprised agricultural fields, and 1894 mapping indicated that the site was crossed by drainage channels and comprised marsh and ancient salt hills at that time. The former Redcar Iron Works was located adjacent to the north west of the study area. The Redcar Iron Works slag tip encroached onto this site. The site was redeveloped during the 1970s, by the construction of the Steel House and Hot Metal route, which linked the Redcar blast furnace with the Basic Oxygen Steelmaking (BOS) and Concast plant. The Steel House was located outside of the current Coatham marsh & Warrenby landfill study area. Review of regional bomb risk maps indicated a Moderate UXB risk. Potential sources of contamination at the site included the electrical plant at substations, and a fuel dump identified close to the western boundary of the study area, along with general Made Ground. **Ground Investigation** No specific ground investigations undertaken during data review, but review of previous data indicates the following: **Soil** The site was reclaimed from the mudflats and marshland, and Made Ground is expected to be present. The composition of the Made Ground was not established at the time of the report, although the most likely source is slag and other wastes derived from the local steelmaking industry. Underlying superficial Tidal flat deposits comprise of sands and silts, with Glaciolacustrine clay and silt present towards the south and west of the site. Deposits may be laminated, very soft and contains traces of peat. Deposits are underlain by Glacial Till, which is in turn underlain by the Redcar Mudstone Formation. Potential contaminants as per the T2 Tear drop site data review 2017 - asbestos, heavy metals, PCBs, hydrocarbons, sulphides, sulphates, carbonates and ground gas from domestic wastes **Water** Superficial deposits were classified as a Secondary A aquifer, with bedrock classified as a Secondary (undifferentiated) aquifer. The Fleet surface water is predominantly culverted through the site. **Gas** Potential deposition of domestic wastes and other wastes locally may give rise to ground gases. **Recommendations** The report included the following recommendations: - Further desk based research on borehole logs, halite mineral rights, permit review and UXO study. - Intrusive investigation comprising 9 boreholes, 35 trial pits, geophysical survey and specific drum sampling.
Warrenby Landfill HRA Review, Stantec 2018	**Scope of Works** The scope of the report was to undertake a Hydrogeological Risk Assessment of the Warrenby Landfill on behalf of Tata, following an EA request to move the site into definitive closure. The report took into account additional monitoring data.

Previous Report Ref	
	Findings Three phases of landfill were identified at the site, as follows: Phase 1 – Old waste, closed to deposition for decades Phase 2 – Under licence, subject to the HRA review Phase 3 - Planned landfill, never received wastes. Four monitoring boreholes are Phase 2 were subject to additional monitoring. Control levels were reviewed, and the quarterly monitoring frequency for various parameters was recommended to be maintained. **Ground Investigation** **Water** Groundwater quality was found to not have changed significantly. Data indicated the continued presence of brackish water and low-level impact from the site, with no deterioration in groundwater quality. Control levels were proposed for ammoniacal nitrogen, chromium, lead, nickel and sulphate.
Landfill Closure Report for CLE31, Teesside, TATA Steel, 01 June 2015	**Scope of Works** The scope comprised a review of information on the Warrenby Landfill area to support landfill closure. **Findings** The site occupies approximate 7ha of land and contains approximately one million cubic metres of waste material, predominantly steelmaking slag and some paper and canteen wastes. The site was licensed in 1977, and accepted wastes until May 2002. The report estimated the yearly inputs to the landfill as: - General waste - 2000tonnes - Canteen waste – 1000 tonnes - BOS Slag – 59,000 tonnes The majority of the waste is therefore assumed as slag wastes (>95%). **Soil** The landfill (Phase 2) was constructed on slag ballast with a nominal clay layer. The competence of the clay layer was never proven, and the landfill is considered as unlined. **Water** Groundwater is reported as several metres below the base of the landfill. There is no leachate collection infrastructure. The Fleet Beck flows close to the eastern side of the landfill and has been subject to monitoring inspections. **Gas** Previous monitoring indicated no methane production, and minimal carbon dioxide concentrations (<0.2%). Monitoring ceased in 2004. Recent EA surface emission monitoring did not encounter significant surface emissions. There is no landfill gas collection infrastructure at the landfill. **Capping** As part of the Waste Management license, a condition required that on completion a low permeability cap shall be placed over the deposited materials to a depth of not less than 1m, placed to a specified low permeability, and laid to encourage run-off. However, discussion with the EA indicated that a low permeability cap was not required and could be justified by a hydrogeological risk assessment. **Recommendations** Based on the findings of the HRA, TATA proposed that the site be capped with 1m of soils, although a low permeability cap was not proposed. Further quarterly monitoring and survey was proposed following capping, to identify changes or landfill settlement. The report author considered that the information presented provided sufficient information in order that the site could be considered definitively closed.

Previous Report Ref	
Waste Disposal Licence, CLE 31/2 Cleveland County Council, 1980	This document was the waste disposal licence, under the CPOA 1974, relating to the deposit of wastes at Warrenby landfill at approximate NGR NZ 580245. The permit allowed deposition of slag, clay, subsoil and topsoil (max 1430 tonnes per day) and paper / canteen wastes (max 20 tonnes per day).
South Teesside Waste Disposal Sites, Currently Licenced Tips, Drawing No. X-108701 (undated)	This drawing showed the extent of the licenced tipping areas at Warrenby Landfill (Referenced CLE 31). The drawing also indicates that in the south of the site is the Tod Point substation, the Redcar weighbridge, and various access routes. Adjacent to the licensed landfill are shown Storage Area No.1, and Storage Area No.2. 
Summary of key finding of all investigations	The area has been used for deposition of Made Ground for land reclamation purposes, and also waste disposal. North and central areas were developed to iron and steel works, with these buildings and structures largely demolished by the 1970s. Warrenby Landfill occupies central and eastern parts of the site and has been used for disposal of wastes derived from the nearby steelworks. There is an off-site enclave within the south of the site used as an electrical substation and associated electrical plant. There is limited ground investigation information available within the area. However, based on the data available and for the surrounding land, Made Ground is likely to be present throughout the area up to approximately 5m in thickness, comprising steelworks derived slag waste. The waste depths in the Warrenby tip have been recorded in excess of 7m. Data review indicates that the potential contaminants of concern at the area include asbestos, heavy metals, PCBs, ammoniacal nitrogen, sulphites, sulphates, carbonates and ground gas. Localised areas of potential higher risk are the former coke works and blast furnaces in the former iron and steel works. The area includes the Warrenby Landfill, which is a permitted landfill site containing around one million cubic metres of predominantly slag wastes, although other wastes including paper and canteen wastes have been disposed in the landfill. Groundwater below the Warrenby Landfill was reported as around 2m below the level of the landfill. A hydrogeological risk assessment of the landfill indicates that groundwater quality is not significantly deteriorating in the vicinity of the landfill. Previous ground gas monitoring also indicates that the landfill is not generating significant volumes of ground gas (methane or carbon dioxide). The gas regime is likely to be characteristic situation CS-1. There are no capping materials present over wastes at Warrenby Landfill. The site permit however requires the construction of 1m of capping materials. The hydrogeological risk assessment concluded that the capping did not necessarily need to be of low permeability material given the limited evidence of groundwater deterioration but should be designed to encourage run off.

Data Gaps

Future Phase 2 Contaminated Land investigations

It is anticipated that supplementary ground investigation within the red line site boundary may be required to support specific proposed developments and land parcels as they are brought forward for development.

3. Conceptual Model & Environmental Risk Assessment

The following section presents the Conceptual Model (CM) and Environmental Risk Assessment established through the appraisal of the site. This is based on assessments made by third parties on behalf of STDC and former land owners. Reference should be made to the reports referenced in Section 1 and summarised in Section 2.

Given the extensive ground characterisation information available no additional intrusive investigations have been undertaken specifically to support the outline remediation strategy. It is anticipated that supplementary ground investigation within the site may be required to support specific proposed developments and allow Generic Quantitative Risk Assessment (GQRA) of contemporary data.

3.1 Conceptual Model

The CM and plausible contaminant linkages are defined below based on the desk study review of publicly available information collated in the previous sections. The CM is carried out in line with CLR11 and is based on the proposed industrial land use. The CM provides an assessment of the site's potential contamination status and identifies the presence of potentially significant contaminant linkages that require further consideration.

3.2 Preliminary risk assessment

In order for land contamination risk to be realised, a '**contaminant linkage**' must exist. A contaminant linkage requires the presence of a:

- source of contamination;
- receptor capable of being harmed; and
- pathway capable of exposing a receptor to the contaminant.

A preliminary risk assessment has been undertaken for potential contaminant linkages to identify potentially unacceptable risks on a qualitative basis. Risk is therefore based on a consideration of both:

- The likelihood of an event (probability – takes into account both the presence of the hazard and receptor and the integrity of the pathway); and
- The severity of the potential consequence (takes into account both the potential severity of the hazard and the sensitivity of the receptor).

The method of dealing with identified risks and the level of significance of those risks will be a function of site use. The risk assessment is based on the future proposed land use and assumes no control measures to manage the risk (e.g. source removal or capping) have been incorporated in the development.

The preliminary risk assessment is presented in Table 3.3.

3.3 Potential contamination (sources)

A review of the site's history and environmental setting has identified potential contaminant sources on the site and the surrounding area, as summarised below in Table 3.1. The list of contaminants has been

established through a review of Annexe 3 in the Guidance for the Safe Development of Housing on Land Affected by Contamination R&D66: 2008 Volume 2.

Table 3.1 Current and historical contaminant sources

No.	Source	Likely Contaminants	Location	Source to be considered further?
1	Made Ground including demolished buildings and structures - slag - ash - demolition rubble - backfilled water features - organic materials	Asbestos, heavy metals, hydrocarbons, elevated pH (alkaline conditions), Sulphate/sulphides, cyanides, carbon dioxide and methane	Whole site	Yes
2	Iron and Steel Works – including Bessemer Works and Pig Casting, Lackenby Iron Works, Cleveland Steel Works, South Bank Iron Works	heavy metals, hydrocarbons, pH, Sulphate/sulphides	On-site	Contamination from process considered as part of general Made Ground assessment
3	Coke Ovens (south Bank & Grangetown Prairie) and the former by-product plants, including historic Benzole	Phenol, hydrocarbons including benzene and naphthalene, heavy metals, sulphate, sulphide, pH, cyanides, ammonia	Indirect northern, western and southern areas	Yes
4	Steel Mills and associated infrastructure / other steel mills	Asbestos, heavy metals, hydrocarbons, Sulphate/sulphides	On-site, Off-site (adjacent)	Contamination from process considered as part of general Made Ground assessment
5	Galvanising works	heavy metals (especially zinc), hydrocarbons, pH, Sulphate/sulphides, cyanide	On-site North west	Contamination from process considered as part of general Made Ground assessment
6	Landfills	heavy metals, hydrocarbons, pH, Sulphate/sulphides Methane and Carbon dioxide	Warrenby Landfill and adjacent to the site (South Bank)	Yes
7	Fuel Oil Depot / tank farms and storage tanks	hydrocarbons	On-site North	Yes
8	Coke Oven Gas Main	Hydrocarbons	On site	Contamination from the pipeline considered as part of Made Ground assessment

No.	Source	Likely Contaminants	Location	Source to be considered further?
9	Slag handling / Slag Works – including Tees Slag Wool Works Lackenby Slag Breaking Plant, Slag Brick Works	heavy metals, hydrocarbons, pH, Sulphate/sulphides, phosphate	On-site	Contamination from process considered as part of general Made Ground assessment
10	Phosphate works and basic slag works	heavy metals, hydrocarbons, pH, Sulphate/sulphides, phosphate		Contamination from process considered as part of general Made Ground assessment
11	Brine Wells and Salt Works	Sodium Chloride		No. Contamination related to sodium chloride. – unlikely to pose a significant impact to health or to water near the estuary
12	Docklands and railway Sidings Coal, raw materials and finished products, waste products	Elevated pH Heavy metals and metalloids Sulphates/sulphides Fuels, oils and grease		Contamination from process considered as part of general Made Ground assessment
13	Substations and oil filled cables	Oils and PCBs		Yes

3.4 Potential receptors and exposure pathways

The potential receptors and associated pathways that have been identified are shown in Table 3.2.

Table 3.2 Pathways and Receptors

Receptors	Potential pathways
Future site users (industrial end use)	Dermal contact, accidental ingestion, inhalation of dusts, vapours, fibres and gases. Direct and following tracking back into buildings. Ingestion includes that of contaminated drinking water subsequent to degradation of water supply pipe construction material as a result of chemical attack.
Buildings and Services	Direct contact, migration through permeable strata and ingress and accumulation of gases. Degradation of water supply pipe construction material or infrastructure and construction materials as a result of chemical attack.
Controlled Waters: (Undifferentiated secondary Aquifer in the Tidal Flats)	Leaching, infiltration and migration via permeable strata
Controlled Waters: Surface water (Tees Estuary SSSI)	Surface water run-off, infiltration and migration via baseflow / permeable strata

With regards to the above human health potential exposure pathways, the critical receptor for the proposed end use, in line with the CLEA model (SC050021/SR3), is identified as a working female adult (aged 16 to 65 years old).

3.5 Exclusion from risk assessment

Current site users

Users of the site in its current configuration are not considered as part of this assessment.

Redevelopment workers

The CM does not consider risks to construction/ site maintenance workers on the basis that risks to workers will be dealt with under the Health and Safety at Work Act (1974) and regulations made under the act. site-specific contamination data obtained from all site investigations should be included in the pre-construction information (requirement of Construction Design and management Regulations 2015) for the proposed works, to enable any contractors to address potential risk from contamination as necessary in their risk assessments and method statements. Moreover, as the exact details of the method adopted are not currently known, it is not considered appropriate to provide a wide ranging and speculative risk assessment for redevelopment workers.

Invasive species

Invasive species (such as Japanese knot weed and giant hogweed) are not considered within the risk assessment for contamination. An ecology survey has been carried out at the site and Giant Hogweed has been identified. However, invasive species are considered to be a constraint to remediation / redevelopment rather than a contaminated land risk issue and would be anticipated to be assessed / addressed further in appropriate documentation relating to the remediation or contractor's method statements for ground preparation.

Unexploded ordnance (UXO)

Assessment of UXO is outside the scope of the current report.

Geotechnical constraints

Geotechnical development constraints are outside the scope of the current report.

Table 3.3 Preliminary Risk Assessment – Risks to future site users and environment from current/historic sources

Potential Source	Potential Pollutant	Potential Receptors	Potential Pathways to Receptors	Associated Hazard [severity]	Likelihood of Occurrence	Risk/ Significance
Made Ground including demolished buildings and structures **- slag** **- ash** **- demolition rubble** **- backfilled water features** **- organic materials**	Asbestos	Future site users (commercial/ industrial end use)	Inhalation fibres: Direct and following tracking back into buildings	Health Hazard (severe)	**Likely** Detected in Made Ground on site. Potential to track back asbestos into buildings if present to surface or in shallow soil. Asbestos analysis was not scheduled for testing in all historic investigations. In addition, it must be noted that the approach to asbestos screening changed and any pre c.2014 'non-detections' should be treated with caution; asbestos may be present that would not have been detected by the previous analysis approach.	**High**
	Heavy metals, hydrocarbons, pH, Sulphate/sulphides, cyanides	Future site users (commercial/ industrial end use)	Dermal contact, accidental ingestion, inhalation of dusts, vapours, fibres and gases. Direct and following tracking back into buildings	Health Hazard (Medium)	**Likely** Made Ground across the site is typically characterised by widespread elevated pH (strong alkaline conditions) and elevated concentrations of sulphide and sulphate. Localised lead, hydrocarbons, PAHs and BTEX compounds elevated above screening criteria. Although previous investigations have reported localised visual and olfactory evidence of contamination, testing of Made Ground has generally reported determinands analysed to be below the commercial/industrial GACs.	**Moderate/High**
		Services	Direct contact with water pipes	Tainting of water supply (Medium)	**Low Likelihood** Slightly elevated TPH in groundwater near fuel oil depot. Potential for migration through plastic pipes	Moderate/low

Potential Source	Potential Pollutant	Potential Receptors	Potential Pathways to Receptors	Associated Hazard [severity]	Likelihood of Occurrence	Risk/ Significance
		Groundwater	Leaching, infiltration and migration via permeable strata	Pollution of undifferentiated secondary Aquifer (Medium)	**Low Likelihood** Elevated heavy metals in a small number of samples and alkaline pH identified in groundwater. Groundwater generally within Made Ground and connectivity of perched water not clear.	Moderate/low
		Surface water (Tees Estuary SSSI)	Surface water run-off, infiltration and migration via baseflow / permeable strata	Pollution of Tees Estuary (Medium)	**Low Likelihood** Elevated heavy metals in a small number of samples and alkaline pH identified in groundwater. Groundwater generally within Made Ground and connectivity of perched water not clear. Potential for migration into the Tees but dilution likely.	Moderate/low
	Carbon dioxide and methane	Future site users (commercial end use) and Buildings	Migration via permeable strata and accumulation in buildings	Explosion and asphyxiation (Severe)	**Low likelihood** Gas regime not known. Limited degradable material identified in Made Ground. Sources likely to have low gas production given the age of the fill.	**Moderate**
Landfills	Carbon dioxide and methane	Future site users (commercial/ industrial end use) and Buildings	Migration via permeable strata and accumulation in buildings	Explosion and asphyxiation (Severe)	**Low likelihood** Gas regime not known. Potential for lateral migration in Made Ground to areas near landfills.	**Moderate**
Fuel oil Depot and storage tanks	Hydrocarbons	Future site users (commercial/ industrial end use)	Dermal contact, accidental ingestion, inhalation of dusts and vapours, direct and following tracking back into buildings	Health Hazard (Medium)	**Likely** Previous SPMP monitoring in 2004 and 2007 for the fuel oil depo reported TPH below the GAC for commercial/industrial end use. Potential for additional spills but fuel oil of relatively low toxicity. There is no evidence of significant leakage from other historic gasoil and smaller fuel storage tanks, some may have been single skin and status of contemporary integrity testing unknown.	**Moderate**

Potential Source	Potential Pollutant	Potential Receptors	Potential Pathways to Receptors	Associated Hazard [severity]	Likelihood of Occurrence	Risk/ Significance
		Services	Direct contact with water pipes	Tainting of water supply (Medium)	**Low Likelihood** Slightly elevated TPH in groundwater near fuel oil depot. Potential for migration through plastic pipes	Moderate/low
		Groundwater	Infiltration and Migration via permeable strata	Pollution of undifferentiated secondary Aquifer (Medium)	**Low Likelihood** Slightly elevated TPH in groundwater near fuel oil depot. Groundwater generally within Made ground and connectivity of perched water not clear. Potential for migration into the Tees	Moderate/low
		Surface water (Tees Estuary SSSI)	Infiltration and Migration via permeable strata	Pollution of Tees Estuary (Medium)	**Low Likelihood** Slightly elevated TPH in groundwater near fuel oil depot. Groundwater generally within Made ground and connectivity of perched water not clear. Potential for migration into the Tees but significant dilution likely.	Moderate/low
Historic Benzole tanks and South Bank Coke Works, Coke Oven Gas Main and By-Products Plant:	Phenol, hydrocarbons including benzene and naphthalene, heavy metals, sulphate, sulphide, pH, cyanides, ammonia	Future site users (commercial/ industrial end use)	Dermal contact, accidental ingestion, inhalation of dusts, vapours. Migration of gases and accumulation in buildings	Health Hazard (Medium)]	**Low likelihood** Naphthalene and TPH identified in soil near the coke ovens and benzol tanks. Potential for migration into building	Moderate/low
		Services	Direct contact with water pipes	Tainting of water supply (Medium)	**Low Likelihood** Naphthalene .and TPH identified in soil near the coke ovens and benzol tanks. Potential for migration into building	Moderate/low
		Groundwater	Infiltration and Migration via permeable strata	Pollution of undifferentiated secondary Aquifer (Medium)	**Low Likelihood** Slightly elevated TPH in groundwater near coke ovens and free product noted near coke ovens and benzol. Groundwater generally within Made ground and connectivity of perched water not clear.	Moderator/low
		Surface water (Tees Estuary SSSI)	Infiltration and Migration via permeable strata	Pollution of Tees Estuary (Medium)	**Low Likelihood** Slightly elevated TPH in groundwater near coke ovens and free product noted near coke ovens and benzol. Groundwater generally within Made ground and connectivity of perched water not clear. Potential for migration into the Tees. Impact likely to be localised	Moderate/low
Substations and oil	Oils and PCBs	Future site	Dermal contact, accidental	Health Hazard	**Low likelihood**	Moderate/low

Potential Source	Potential Pollutant	Potential Receptors	Potential Pathways to Receptors	Associated Hazard [severity]	Likelihood of Occurrence	Risk/ Significance
filled cables		users (commercial/ industrial end use)	ingestion, inhalation of dusts, vapours, fibres and gases. Direct and following tracking back into buildings	(Medium)	PCBs and oil have low mobility. Likely to be near sources.	
		Services	Direct contact with water pipes	Tainting of water supply (Medium)	**Unlikely** PCBs and oil have low mobility.	Low
		Groundwater	Infiltration and Migration via permeable strata	Pollution of undifferentiated secondary Aquifer (Medium)	**Unlikely** PCBs and oil have low mobility. Likely to be near sources.	Low
		Surface water (Tees Estuary SSSI)	Infiltration and Migration via permeable strata	Pollution of Tees Estuary (Medium)	**Unlikely** PCBs and oil have low mobility. Likely to be near sources. Dilution likely	Low

3.6 Risk Evaluation

The preliminary risk assessment for the site, together with previous task specific ground investigations, has identified the presence of contaminants at concentrations which pose potentially significant risks to receptors including future site users.

In order to gain a more detailed understanding of any remediation works necessary to render the site suitable for use, a risk evaluation has been completed. This comprises a detailed review of the potentially significant contaminant linkages, the critical receptors and the key exposure pathways for each contaminant of concern. This information has been used to inform the Remediation Options Appraisal (presented in Section 4), ensuring that options are selected relevant to each of the key contaminant linkages.

It should be noted that the risk associated with the construction of foundation solutions, notably piling, will be dealt with under a separate geotechnical assessment for proposed future developments at the design stage. As such geotechnical/ foundation solutions have not been considered further within the Remediation Strategy.

Despite the long history of industrial activity on site and in the general STDC area, previous investigation work and site assessment, suggest there to be large areas of land previously occupied by operations of a lower contaminative nature, where ground remediation and site preparation requirements will be minimal for future industrial land use. Examples are areas previously given over to steel mills with large ground slabs, used for manufacturing steel products, and those areas used principally for materials storage, in contrast with the front/heavy end process industries within iron and steel making, together with coke production and associated by-products, which are more likely to leave a legacy of localised ground contamination.

3.7 Key Contaminant Linkages

The following key contaminant linkages of concern have been defined with regard development of the site:

- **Iron and Steel Works** – The site and the wider Teesside area has an extensive industrial legacy including almost 170 years of iron and steel making, together with auxiliary works. Previous investigation of the land has confirmed the presence of contaminants including heavy metals, hydrocarbons and abnormal pH. Based on a range of exposure pathways viable pollutant linkages are present to future onsite human health through inhalation, ingestion and direct contact.
- **Made Ground** –The site is known to extensively comprise reclaimed land, made up of slag, together with supplementary Made Ground deposits comprising ash and demolition rubble giving rise to a range of contaminants including heavy metals, abnormal pH and sulphate/sulphides. The ubiquitous nature of such materials across the site and its prevalence at the surface is one of the key pollutant linkages of concern regarding development of the site.
- **Hazardous Ground Gases** – Previous investigation of adjacent land has identified the presence 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. Based on ground gas concentrations and a range of exposure pathways, the presence of ground gases are likely present a 'High to Very High' risk to current and future onsite and offsite human health (e.g. asphyxiation) and 'Moderate to Very High' to onsite and offsite properties (e.g. explosion). Given the nature of contaminants, there is also the potential for risks to human health from exposure to volatile organic compounds (VOCs). The hazardous ground gas risk will need to be assessed separately for specific future developments based on their intended construction form.
- **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. Based on a range of exposure pathways, if the asbestos becomes disturbed and airborne, it will likely present a 'Moderate to High' risk to current and future onsite and offsite human health through inhalation.

- A range of metals, phenols, aliphatic hydrocarbons, PAH's, VOCs, SVOCs and aromatic hydrocarbon contaminants were identified within the soil with the potential to impact groundwater quality. Based on the low sensitivity, productivity aquifer and saline intrusion into groundwater beneath the site and surrounding area from the River Tees estuary, the site presents a 'Low to Moderate' risk to groundwater. Groundwater within the area is recognised by the Environment Agency as being non-viable.
- A range of metals, phenols, aliphatic hydrocarbons, PAH's VOCs, SVOCs and aromatic hydrocarbon contaminants were identified within the soil with the potential to impact surface water quality. Based on the former and current industrial land uses, and the influences of saline intrusions of the River Tees, the sensitivity of the surface water bodies is considered to be low, therefore the site would present a 'Low to Moderate' risk to surface water bodies. Moreover, contaminants potentially entering the surface water bodies would likely be subject to dilution and dispersion during migration. If contaminants did manage to enter the surface water bodies, further dilution and dispersion would likely occur especially when entering the River Tees. Given the industrial land use surrounding the site and the likelihood that the surface water bodies are acting as drainage for a wider industrial area, establishing a true causal relationship between site derived contaminants and the surrounding surface water bodies would prove challenging.

Key contaminant linkages identified as requiring some form of mitigation are summarised in Table 3.4.

Table 3.4 Key Contaminant Linkages

Contaminant Linkage No.	Contaminant Linkage Description
CL1	Future site users and inhalation of asbestos fibres associated with Made Ground.
CL2	Future site users and dermal contact, accidental ingestion, inhalation of dusts, vapours, fibres and gases associated with Made Ground.
CL3	Future site users and gas migration into buildings from landfills.
CL4	Future site users and dermal contact, accidental ingestion, inhalation of vapours associated with fuel storage facilities.

4. Remediation Options Appraisal

The document considers the overall land remediation strategy for the site in relation to the Development Masterplan. As outlined in Section 3, several potentially significant contaminant linkages have been identified. In accordance with CLR11, a Remediation Options Appraisal has been undertaken.

4.1 Remediation Objectives

The proposed redevelopment of available land at South Tees is for industrial end uses.

The objective of the remediation strategy is to take a balanced approach to remediation. As outlined in the Regeneration Masterplan, the objective is to mitigate the level of ground remediation required across the STDC area, minimise conflicts with the many safety restrictions (including various prevailing safety hazard zones) and avoid introducing future end users that would otherwise conflict with the existing industrial and commercial activities within the area.

The objective of the appraisal is to determine which option (or group of options) is most suitable for breaking the identified significant pollutant linkages. Breaking of the contaminant linkages is required to manage the associated risks and to prepare the site for redevelopment.

Remediation Criteria

In addition to ensuring that the site is suitable for its proposed end use, together with the technical feasibility of remediation options, the remediation criteria needs to be reasonable based on practicality, effectiveness, durability, costs and time involved. Any proposed remediation activities also need to take into consideration development requirements, such as the removal of legacy below ground structures as part of remediation, ground preparation or construction phase works.

Compliance with the remediation objectives will be met based on a do minimum / do necessary approach, appropriate to meet development needs while minimising pollution or other adverse effects on the local environment. The site, and wider STDC area, is of such a size that there is flexibility to arrange end user site allocations to minimise conflict with localised, more heavily contaminated areas.

It is acknowledged within the Regeneration Masterplan that not all the STDC area will be redeveloped and it is accepted within the overarching remediation strategy that some of the most contaminated locations may be remediated only to the minimum extent necessary for long-term safekeeping as managed open space. Such areas include the operational landfills, which are to be retained as waste management facilities, together with those considered to be of heritage value.

The outline remediation strategy also needs to consider the potential opportunity presented by the landfills. Although the end solution is anticipated to involve reshaping, capping, installation of leachate and gas management measures, and completion via implementation of a structured landscaping scheme. A large part of the landfill area is licensed to receive wastes from iron and steel making processes. Therefore, the option to utilise this area as a repository for residual, unsuitable materials from ground remediation and site preparation activities could compliment other remediation options through both cost-effective remediation and an environmentally sustainable alternative to off-site disposal.

The outline remediation options appraisal is outlined in Section 4.3.

4.2 Regulatory Requirements

As discussed earlier in Section 1.4 any future development will be controlled via the Planning Regime. Future planning permission may be granted, subject to the discharge of a number of Planning Conditions, including those relating to land contamination guided by the Development Principle STDC9 of the SPD.

The key requirements of the Planning Regime which require consideration at the Remediation Options Appraisal stage is the need to develop a Remediation Strategy to bring the site to a condition suitable for use by removing unacceptable risk to receptors. The outline Remediation Strategy must meet the approval of RCBC and must ensure that the site will not qualify as 'Contaminated Land' under Part 2A. The approved Remediation Strategy shall be implemented within the time frame agreed with RCBC.

As per standard planning conditions any development shall be stopped immediately in the event that contamination not previously identified is found to be present and details of the contamination shall be reported immediately in writing to the Local Planning Authority.

Preserving Heritage Assets

In addition to the technical and pragmatic remediation criteria STDC and RCBC acknowledge the potential opportunity to preserve some of the area's industrial heritage. Policy LS4 of the Local Plan identifies that the Dorman Long Tower at South Bank Coke Ovens is of heritage and cultural importance and it is acknowledged through the SPD that asset retention may well mitigate the burden and cost associated with demolition and remediation, subject to the identification of viable management options.

4.3 Selection of feasible remediation options

There are numerous options available for either source removal or breaking the identified key contaminant linkages (Table 3.4). These can be divided into six principle categories:

- Civil engineering
- Biological
- Chemical
- Physical
- Stabilisation and solidification
- Thermal

Table 4.1 presents a comprehensive matrix of potentially feasible remediation options within each of the categories screen against a range of generic contaminant groups. This has been used for the initial screening of remediation options. For completeness, contaminant groups not previously identified on site as key contaminant linkages have been presented to assist rapid reappraisal of the overarching approach should previously unidentified contaminants be encountered in the future.

Short list of feasible remediation options

The key drivers for remediation activities are to ensure that the site is suitable for the proposed industrial end uses.

As far as possible the options appraisal has looked to build from the known form of developments outlined within the regeneration masterplan, with the flexibility in the redevelopment to arrange end user site allocations to minimise conflict with localised, more heavily contaminated areas wherever possible. This includes taking advantage of hard standing, roadways etc to minimise remediation requirements.

Remediation options associated solely with groundwater have not been taken forward for further appraisal, however hydraulic or permeable reactive barriers together with natural attenuation may be considered in the future at a local scale to compliment other remediation options. Although controlled water risks are not the

principal driver, in line with industry best practice, CLR11 guidance, the ethos of the NPPF and development principle of the SPD, the prevention of pollution and betterment of the existing conditions will be integral to the successful delivery of any remediation scheme.

Thermal remediation methods of incineration and desorption, together with stabilisation and solidification methods of hydraulic binders or vitrification have not been taken forward for evaluation due to energy input requirements and comparatively low treatment volumes. They may be appropriate for local remediation of targeted hotspots but are not considered to be viable for widespread deployment on the site.

Solvent extraction, air sparging, soil vapour extraction (SVE) and dual phase SVE have not been carried forward for evaluation due to the absence of widespread solvent and/or hydrocarbon contamination. Chemical oxidation and dehalogenation are also not applicable to the remediation of heavy metals or asbestos. Soil flushing, surface amendments or soil washing are not appropriate for asbestos contamination.

Biological remediation methods are not applicable for the remediation of asbestos or the ubiquitous heavy metals present within the sites Made Ground deposits. The low nutrient and high pH typical of the Made Ground would also prohibit targeted remediation of hydrocarbons without notable pre-treatment / augmentation or dilution.

Localised in ground barrier solutions may be applicable on a local scale but are not considered, particularly where they may compliment any landfill gas mitigation measures but are not considered to be appreciate for site wide deployment.

4.4 Outline Remediation Options Appraisal

The outline remediation options appraisal is presented in Table 4.2 and considers contaminant linkages CL1, CL2 and CL4 identified in Table 3.4. CL3 has been excluded from the appraisal on the basis that development principle STDC9 of the SPD has already established that '*development proposals located in proximity to former landfill sites should be supported by a Gas Risk Assessment and should incorporate any necessary protection measures, such as those to protect buildings from landfill gas migration*'.

Exposure pathways for commercial/industrial end use include direct soil and indoor dust ingestion, skin contact with soils and dusts, and inhalation of dust and vapours. As it is not pragmatic to remove all potentially impacted materials the overarching remediation strategy needs to consider options to break contaminant linkages is to manage the associated risks and to prepare the site for redevelopment without constraints.

Applicable media **S** = Soils, Made Ground and sediments **W** = Groundwater and surface water		**Organic substances**							**Inorganic substances**				
		Volatile organic compounds (VOCs)	Halogenated hydrocarbons	Non-halogenated hydrocarbons	**Polyaromatic hydrocarbons (PAHs)**	**Polychlorinated biphenyls (PCBs)**	**Dioxins and furans**	Pesticides and herbicides	**Heavy metals**	**Non-metals**	**Asbestos**	**Cyanides**	Explosives
Method	**Remediation options**	Applicable media							Applicable media				
Civil engineering	Containment - cover systems	**S**	S	S	**S**	**S**	**S**	S	**S**	**S**	**S**	**S**	S
	Containment - hydraulic barriers	**W**	W	W	**W**	**W**	**W**	W	**W**	**W**		**W**	W
	Containment - in ground barriers	**S, W**	S, W	S, W	**S, W**	**S, W**	**S, W**	S, W	**S, W**	**S, W**		**S, W**	S, W
	Excavation and disposal	**S**	S	S	**S**	**S**	**S**	S	**S**	**S**	**S**	**S**	S
Biological	Natural attenuation	**W**	W	W	**W**			W	**W**	**W**			W
	Biopiles	**S**		S	**S**			S					S
	Bioventing	**S**	S	S	**S**								
	Biosparging	**S, W**	S, W	S, W	**S, W**			S, W					
	Landfarming	**S**		S	**S**			S					S
	Slurry phase biotreatment	**S**	S	S	**S**		**S**	S				**S**	S
	Windrow turning	**S**		S	**S**			S					S
Chemical	Chemical oxidation	**S, W**	S, W	S, W	**S, W**			S, W		**S, W**			
	Chemical dehalogenation	**S**	S			**S**	**S**						
	Soil flushing	**S**	S	S	**S**				**S**				
	Surface amendments								**S**	**S**			
	Solvent extraction	**S**	S	S	**S**	**S**	**S**	S					S
Physical	Soil vapour extraction (SVE)	**S**	S	S									
	Dual phase SVE	**S, W**	S, W	S, W									
	Air sparging	**W**	W	W									
	Permeable reactive barriers	**W**	W	W	**W**	**W**	**W**	W	**W**	**W**		**W**	W
	Soil washing		S	S	**S**	**S**		S	**S**	**S**		**S**	
Stabilisation and solidification	Hydraulic binders (such as cement)			S	**S**	**S**	**S**	S	**S**	**S**	**S**	**S**	
	Vitrification	**S**	S	S	**S**	**S**	**S**	S	**S**	**S**		**S**	S
Thermal	Incineration	**S**	S	S	**S**	**S**	**S**	S	**S**	**S**		**S**	S
	Thermal desorption	**S**	S	S	**S**	**S**		S	**S**		**S**	**S**	

Table 4.1 Outline Remediation Options Appraisal

Contaminant Linkage	Technique	Summary of Technique	Logistical Requirements	Advantages	Disadvantages	Relative Cost	Conclusion
CL1, CL2 & CL4	Capping of the site with a minimum of 0.3 m of material	Placement of chemically suitable for use materials over contaminated ground. Designed to reduce hazard to human health and enable a clean zone for construction and placement of utilities and associated infrastructure.	Site regrading and in-ground structure removal anticipated to approximately 2.5m bgl. Minimal to no compaction of the underlying material is envisaged prior to placement of suitable cover material. A no dig layer may be considered necessary given the depth of capping. Subject to construction requirements relating to the development, a low permeability break layer may be required. A clean service run area may be required to protect both future land users (maintenance) and utility assets.	Cost effective for use across entirety of site. Significantly reduces hazard to human health. Well established / proven technique. Easily incorporated into the redevelopment of the site and appropriate to phased development of discrete land parcels. The installation of positive drainage and a reduction in surface water percolation through the contaminated made ground to the River Tees.	Will not treat contaminant sources. Contaminant source remains in-situ. Capping material must chemically meet site specific assessment criteria and be geotechnically suitable. Suitable for use materials may need to be imported.	Low to medium	Proven cost-effective technique in the UK, subject to sourcing and transport of capping materials. Environmentally sustainable for the wider development with reuse of materials. Protection of in-ground service/ infrastructure and also future maintenance workers. STDC may be able to utilise materials derived from their wider development works, thereby a sustainable approach.
CL1, CL2 & CL4	Excavation and disposal	Excavation of the contaminated material and off-site disposal to landfill (including those within STDC wider area) or off-site treatment facility.	Vast amounts of groundwork required. Appropriate levels of site investigation to characterise and delineate conditions to reduce the need for movement and/or disposal. Logistical transport arrangements. Dewatering of come materials required and then disposal of potentially contaminated water.	Removes source of contamination. Easily incorporated into the redevelopment of the site. Existing adjacent landfills permitted to accept iron and steel industry wastes. Very low risk of technique failing.	Not a sustainable technique. Waste would require segregation dependent on type and level of contamination. Capacity of adjacent landfills not enough to accept all potentially contaminated Made Ground. Very costly, as material sent off-site for disposal will need to be replaced with imported material. Very unsustainable.	Very high	Standalone remediation option: Relative cost is high to very high. Not considered environmentally sustainable. Environmentally, logistically and economical viable if combined with other techniques for target disposal and utilising existing landfills within the STDC area.
CL1, CL2 & CL4	Hard Surfacing	Use of concrete and or other appropriate hard surfacing to break pathway	Large scale concrete requirement. Protection against aggressive soils will be required. Clean service runs and/or barrier pipes (see below) likely to be required. A clean service run area may be required to protect both future land users (maintenance) and utility assets.	Significantly reduces hazard to human health. Well established / proven technique. Relatively easily incorporated into the redevelopment of the site.	Not very sustainable. Requires a great deal of long-term management and maintenance of the site. Protection of in ground workers and assets required in short and long term	High to very high	Standalone remediation option: Relative cost is high to very high and not viable given the site area. Not considered environmentally sustainable. Cost effective and sustainable when considered as a complimentary option to other techniques and incorporated into development layout design.

4.5 Selection of final feasible remediation options

The selection of feasible remediation options (Section 4.3) set out the evaluation of options excluded. The SPD acknowledges that areas of the site may be subject to different levels of contamination and the approach of the STDC will be to assess the degree of contamination and to adopt a ground remediation strategy that will deal with the contamination based on site delivery and viability.

Given the size of the site, together with the range and distribution of contaminants, and apparent limited risks to potential future industrial end users the most appropriate **overarching remediation option** comprises the formation of a minimum capping layer across the site to physically break Made Ground contaminant linkages. This is consistent with the Regeneration Masterplan and remediation objective to take a balanced approach to the level of ground remediation required across the STDC area. In areas of the development residual Made Ground contaminant linkages may be broken by the development itself due to the presence of the hardstanding/building slab associated with the development. Clean service runs will be required to protect both future land users (notably maintenance workers) and utility assets.

This overarching approach is compatible with the phased remediation of the site and flexibility of layout design, allowing development hard surfacing to also contribute to remediation solutions. As set out in the remediation criteria, any proposed remediation activities need to take into consideration development requirements, such as the removal of legacy below ground structures as part of remediation, ground preparation or construction phase works. It is anticipated that most areas will require the grubbing out of relic structures resulting in initial enabling works typically involving the reworking of the initial couple of metres below ground level. The option for selective excavation and disposal at the adjacent hazardous waste facility of limited 'hotspots' of contamination complements a capping approach as a balanced approach to remediation and ensures that the site is suitable for its proposed end use. The clean service runs will typically be installed as part of the enabling earthworks to prepare the site for redevelopment.

To enable the protection of the remediation capping layer during both the construction and full site operational phase, it may be necessary to provide an additional layer of engineering fill. This would be provided as part of the building construction phase of works, and the form and nature of any additional layer will be dealt with under a separate application. As such this does not form part of the current Remedial Strategy.

The final form of remediation for each phase will be determined through the engineering design. Future developments will be supported with a simple design statement confirming how the proposed development ties in with the overarching remediation strategy.

5. Proposed Remediation Works

The recommended outline remediation strategy is based on our current understanding of the site.

5.1 Outline of Proposed Remediation

Given the size of the site it is not feasible to remediate the whole site as a single operation. Redevelopment will be phased over numerous years. Consequently, a pragmatic approach will be for remediation works to be undertaken as part of the development platform construction phase for individual land parcels, this will allow remediation tasks to be incorporated into the design of the development.

As stated above, the engineering design for each phase will need to determine the remediation approach based on the intended layout and form of development, to render the site suitable for use. The remediation design statement for each phase will set out how the proposed development conforms with the outline remediation strategy. For future developments regulated under the planning regime a design statement will be submitted to support the specific planning application, specifying the form of development and the manner in which the site will be remediated to render it suitable for use. The design statement as a minimum should include:

- Plan of the proposed development.
- Details of proposed capping, including use of concrete slab, highway, hard standing and capping of open space.
- Any notable variations and associated mitigation from the outline remediation strategy.

Additional ground investigation and/or site specific risk assessment may be required to inform the above.

5.2 Development Platform Remediation – Proposed Works

Initial enabling activities will comprise demolition of legacy structures and ground preparation operations including vegetation clearance and infilling of voids.

The outline remediation strategy does not require the existing site levels to be raised beyond remediation cover system requirements and to enable a level platform for ease of the development.

Site won and imported clean cover soils will be placed under a controlled methodology, mainly driven by geotechnical requirements, to form the development platform. Therefore, the materials are likely to be put down in compacted layers to satisfy these requirements. Clean service runs will need to be incorporated into the development, as appropriate.

Subject to viability and if piling is used in the final design it may be possible to re-use pile and foundation arising's within the confines of the site, beneath the capping layer. This will be subject to chemical analysis of the arising's to ensure they are in keeping with the soil chemistry in the shallow Made Ground and do not lead to leachable contaminants.

To enable the protection of the remediation capping layer during both the construction and full site operational phase, it may be necessary to provide an additional layer of engineering fill, of approximately 0.5 m. This would be provided as part of the building construction phase of works, and the form and nature of any additional layer will be dealt with under a separate application. As such this does not form part of the current Remedial Strategy.

Verification Works

Confirmatory chemical analysis to ensure suitability for use of any capping materials will be required before placement commences and monitored throughout the works. The land parcel specific remediation design statement will set out the testing frequency. All materials will be subject to visual and olfactory assessment during the works, if deemed necessary additional confirmatory analysis will be undertaken. Site specific remediation criteria are not anticipated to be required for the proposed redevelopment of the site. Suggested generic screening criteria, together with determinands to be analysed for those listed in Table 5.1.

Table 5.1 Chemical Suitability Assessment Criteria (Industrial/ Commercial) for Soils

Determinand	Assessment Criteria (mg/kg)	Assessment Criteria Source
Asbestos	Non-detect	-
Arsenic	640	C4SL (Commercial)
Cadmium	410	C4SL (Commercial)
Chromium III	8,600	LQM/CIEH S4UL (Commercial/ Industrial)
Chromium VI	49.00	C4SL (Commercial)
Copper	68,000	LQM/CIEH S4UL (Commercial/ Industrial)
Lead	2,300	C4SL (Commercial)
Nickel	980	LQM/CIEH S4UL (Commercial/ Industrial)
Selenium	12,000	LQM/CIEH S4UL (Commercial/ Industrial)
Zinc	730,000	LQM/CIEH S4UL (Commercial/ Industrial)
Inorganic mercury	1,100	LQM/CIEH S4UL (Commercial/ Industrial)
Benzo(a)pyrene	77	Wood GAC (Commercial/ Industrial)
Naphthalene	1,900	Wood GAC (Commercial/ Industrial)

Additional verification of the placement of the materials will be undertaken based on geotechnical characteristics required to develop the building platform.

It will also be necessary to ensure that a suitable thickness of capping has been placed across the site and this will be demonstrated through surveying of the site before and after remediation works.

Disposable of unsuitable materials

Where materials are chemically and physically suitable they will be retained on site. A site wide MMP will be in operation for re-use of materials. As noted above the existing adjacent landfills, within the wider STDC area, will be utilised wherever appropriate. Responsibility for the correct handling, storage, sampling, analysis and classification of such material will rest with the appointed remediation contractor.

Discovery of Unrecorded Contamination during the Works

Although areas of the site and wider area have been subject to extensive previous ground investigation, there remains the potential for unrecorded contamination which may be encountered during the remediation or site preparation works. The assessment of such material may be based on visual / olfactory evidence of contamination initially, with the material set aside for sampling and analysis to confirm whether the material can be retained or requires off-site disposal. The material will be stored within the site, in a suitable location, pending sampling and analysis. Responsibility for the correct handling, storage, sampling, analysis and classification of such material will rest with the appointed remediation contractor.

5.3 Verification Reporting

The proposed methods of verification are detailed in Section 5.2. Reporting of the verification works is required to provide evidence that the remediation works have been undertaken in accordance with the land parcel remediation design statement (specification) and approved outline remediation strategy, for the benefit of the regulators and future developers. The Verification Report shall also form part of the Health and Safety File.

Verification Reports will be prepared in accordance with CLR11 and include:

- Factual account of all works undertaken, supported with as-built drawings, where appropriate;
- Environmental monitoring records;
- Duty of care information for any wastes removed off-site;
- Confirmation of capping layer thickness;
- Re-appraisal of contaminant linkages post-works; and
- Remediation Statement to confirm works completed or highlight any works which remain outstanding.

5.4 Future Site Maintenance / Redevelopment

Under the requirements of both the Health & Safety at Work Act and the Construction, Design, Management Regulations, 2015 a Health and Safety file is required to be prepared following the completion of the remediation works. The Health and Safety File is to be made available to those intending to undertake any works at the site which involves ground disturbance so that appropriate safe systems of work can be prepared which manage the potential for exposure to contaminants that remain in the ground following redevelopment. The Health and Safety File should also outline requirements for reinstatement of any hardstanding and cover systems on completion of any works to ensure the works have not left any contamination at surface which may pose risk to site users.

6. Control of the Works

6.1 Design Statement

The remediation design statement for each phase will set out how the proposed development conforms with the outline remediation strategy. For future developments regulated under the planning regime a design statement will be submitted to support the specific planning application, specifying the form of development and the manner in which the site will be remediated to render it suitable for use. The design statement as a minimum should include:

- Plan of the proposed development.
- Details of proposed capping, including use of concrete slab, highway, hard standing and capping of open space.
- Any notable variations and associated mitigation from the outline remediation strategy.

6.2 Implementation Plan

In line with CLR11, the works shall be delivered in accordance with a Design Statement. This document shall set out:

- Overview of the remediation objectives, in line with the Remediation Strategy;
- The detailed design of the works, which shall be used to develop the Remediation Works Technical Specification, and which shall be based on the Remediation Strategy;
- Roles and responsibilities with regard to managing and delivering the works;
- Programme for the works;
- Supervision requirements;
- Regulatory permit requirements; and
- Verification requirements.

6.3 Construction (Design and Management) (2015) Regulations

The remediation works will be carried out on behalf of the Client by an appointed remediation contractor, who will be appointed as 'Principal Contractor' under the Construction (Design and Management) Regulations 2015 (CDM 2015).

6.4 Site Supervision

The remediation works will be supervised by both a suitably qualified and experienced geoenvironmental engineer.

6.5 Materials Management Plan

In accordance with the CL:AIRE Definition of Waste Code of Practice, a Materials Management Plan (MMP) will be produced for the works. All recoverable materials will be tracked through this document, with waste materials detailed in the Waste Management Plan (summarised in Section 6.6). The overall approach is to

retain as much material on site as possible, thereby minimising the requirement to export materials off-site for disposal, thus reducing landfill burden and minimising CO_2 emissions from waste transport. The MMP will be subject to review by a Qualified Person (QP).

6.6 Environmental & Waste Management

The remediation works will be undertaken in accordance with the remediation contractor's Environmental Management Plan (EMP) and WMP.

Potential environmental impacts arising from the remediation works, measures to mitigate those impacts and those responsible for their implementation are outlined below.

Waste

The remediation contractor shall prepare a WMP for the works. This document shall identify all anticipated waste streams associated with the works and identify appropriate disposal routes. It shall also include mitigation measures to be implemented to ensure no nuisance arises from waste storage such as odour or littering. The document shall be updated throughout the works to include all waste consignment notes.

Dust

Dust may be generated during excavation, haulage, backfilling and soil stockpiling, particularly during periods of dry weather. It will be the responsibility of the remediation contractor to ensure no nuisance arises. Mitigation measures to be adopted include:

- Maintenance of site traffic routes, and enforcement of speed limits to minimise the potential generation of dust.
- All wagons leaving the site to be sheeted.
- Water sprays to be used during operations as and when required to minimise potential for dust generation.
- Road sweeper to be deployed to clean public highways adjacent to site, where required. Road sweepers are not appropriate for the internal roadways.

Noise & Vibration

Noise and vibration will be associated principally with the breaking out and crushing of any hard materials present in the areas that are to be subject to remediation. The contractor will be required to use the most suitable equipment appropriate to the task, considering noise levels and anticipated duration of the task, to minimise potential for nuisance. In addition, consideration shall be given to restricting works to particular hours, where required.

Odour

Odours may arise during the works, however the potential for generation of significant odours is expected to be relatively low. If significant odours are noted, appropriate mitigation measures will be implemented by the remediation contractor. This may, for example, include covering odorous materials, amending working practices to minimise odours and/or utilising odour suppression and mitigation equipment.

Vapours

Organic vapours were not encountered at significant concentrations during previous site or adjacent site investigation works. Therefore, it is not considered that monitoring of organic vapours is required during the works.

Surface Water

The remediation contractor shall implement appropriate mitigation measures to protect any surface water drains during the works to ensure no pollutants or sediments enter the surface water network. This will include siting soil stockpiles and temporary storage tanks away from surface water drain entry points and where necessary, protecting those entry points with impermeable barriers or covers.

Traffic

Vehicle movements associated with the works are unavoidable. The remediation contractor will be required to implement a Construction Traffic Management Plan (CTMP) which will outline any measures required to minimise disruption and nuisance to adjacent land users.

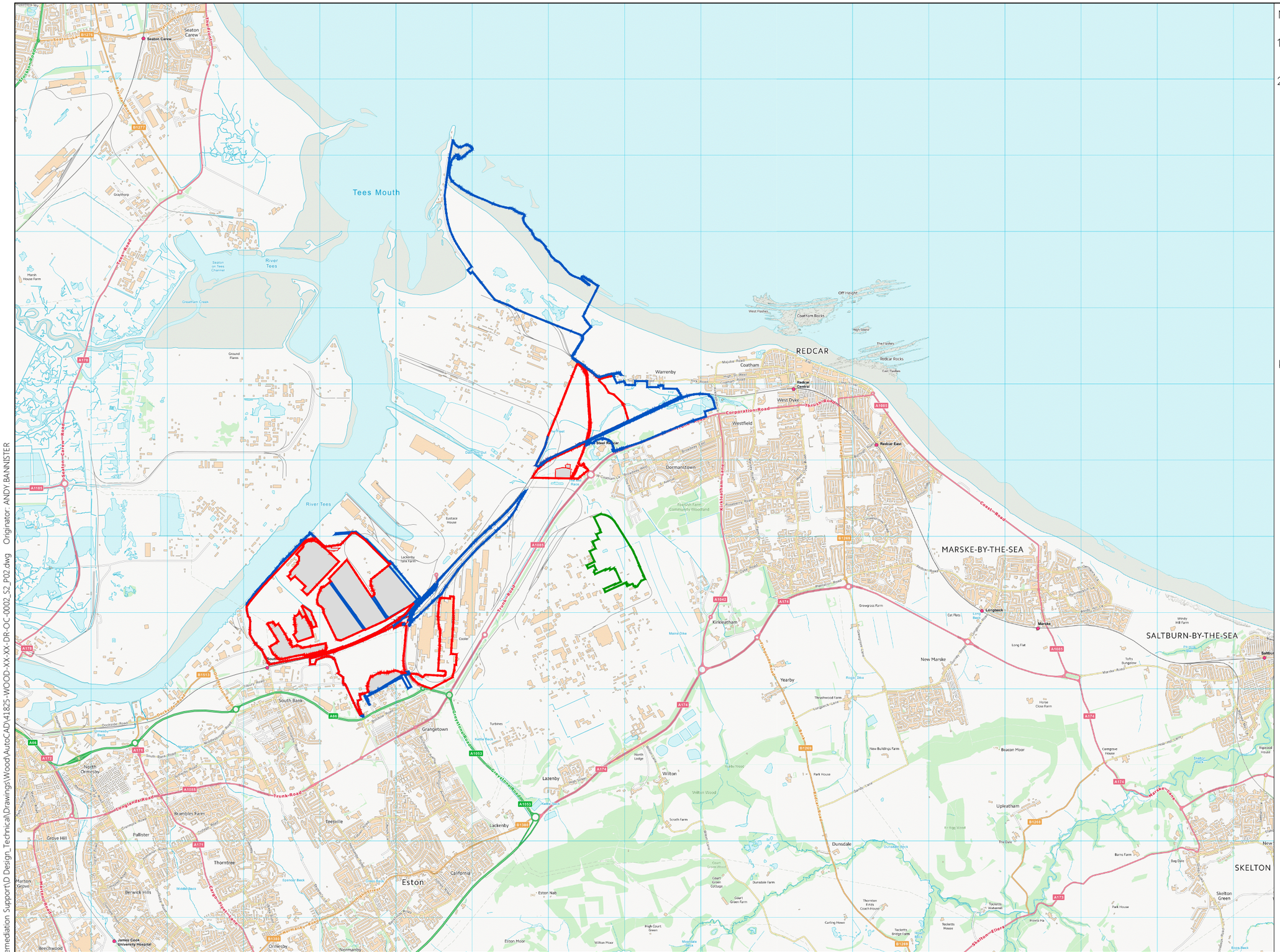
Mud on Roads

There is a potential for mud to be carried out of the site on to local roads during the works. Mitigation measures will be implemented, where necessary, and may include use of a wheel wash and/or deployment of a road sweeper.

Licences / Permits

All relevant environmental permits will be obtained and maintained by the remediation contractor, if required. The remediation contractor will be responsible for adhering to any conditions specific to such permits.

Figures



NOTES:

1. All units are in metres unless otherwise noted.
2. This drawing has been produced using information taken from South Tees Development Corporation drawings STDC–SCW–XX–PLA–0001 dated May 2019 and STDC–SCW–XX–GEN–0003 dated April 2019.

KEY:

- STDC Land ownership boundaries
- Proposed STDC works red line planning boundaries
- Sirius Wilton site boundary
- Areas not included within works

0 km 3 km

Scale 1:50,000 @ A3

REV	DATE		DWN	CHK	APP
P01.1	18/06/19	FIRST ISSUE	AB	MR	MR

REVISIONS

REV	DATE		DWN	CHK	APP
P02	24/06/19	Minor amendments to spot level text	AB	MR	MR

PROJECT TITLE: Former Steel Works South Tees

DRAWING TITLE: Site Location Plan

SCALES : 1:50,000 @ A3 Original Drawing Size – A3

CLIENT: South Tees Development Corporation

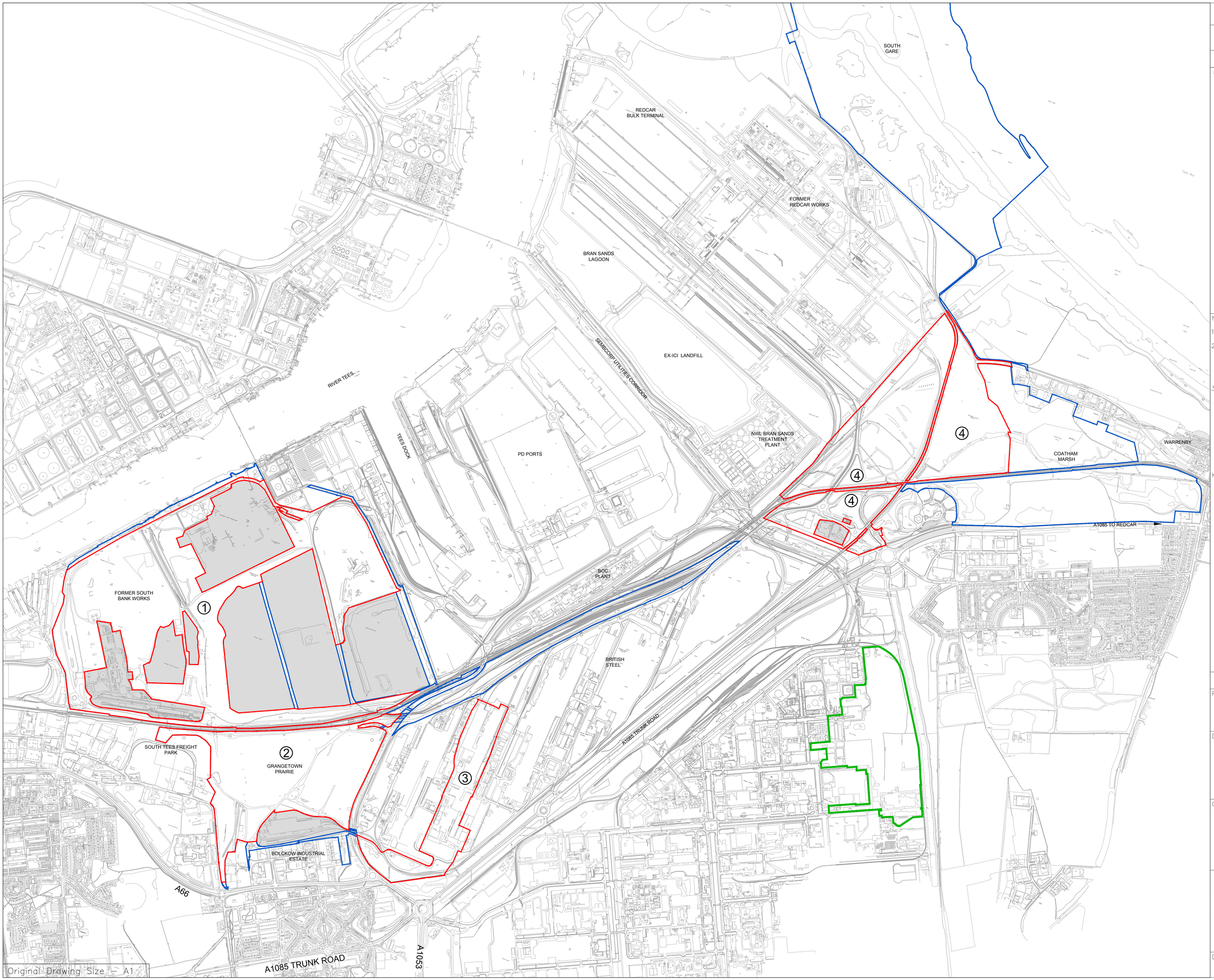
REF:

Canon Court, Abbey Lawn,
Abbey Foregate,
Shrewsbury SY2 5DE.
Tel: (01743) 342000
Fax: (01743) 342010

wood.

DRAWING No.
41825–WOOD–XX–XX–DR–OC–0002_A_P02

H:\Projects\41825 South Tees DC Remediation Support\D Design_Technical\Drawings\Wood\AutoCAD\41825-WOOD-XX-XX-DR-OC-0002_S2_P02.dwg Originator: ANDY.BANNISTER



Original Drawing Size – A1

DESCRIPTION

REV	DATE		DWN	CHK	APP
A	18/06 2019	FIRST ISSUE	AB	MR	MR

REVISIONS

REV	DATE		DWN	CHK	APP
P02	24/06 2019	Amendment to planning boundaries and associated changes to text in key	AB	MR	MR

NOTES:

1. All units are in metres unless otherwise noted.
2. This drawing has been produced using information taken from South Tees Development Corporation drawings STDC-SCW-XX-PLA-0001 dated May 2019 and STDC-SCW-XX-GEN-0003 dated April 2019.
3. Zoned solely for the purpose of historical site review and environmental context appraisal to support overarching remediation Strategy

   Zone 1: Former South Bank Works
   Zone 2: Grangetown Prairie
   Zone 3: Lakenby Coil Plate Mill
   Zone 4: Warrenby Landfill & Coatham Marsh

KEY:

- STDC Land ownership boundaries
- Proposed STDC works red line planning boundaries
- Sirius Wilton site boundary
- Areas not included within works

DRAFT

0m 200m 400m 600m 800m
SCALE 1:10,000

SCALES: 1:10,000 @ A1

PROJECT TITLE:
Former Steel Works
South Tees

DRAWING TITLE:
Site Zones for Environmental Context

CLIENT:
South Tees Development Corporation

REF:

CANON COURT, ABBEY LAWN,
ABBEY FOREGATE,
SHREWSBURY,
SHROPSHIRE
SY2 5DE
TEL: (01743) 342000
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wood.

DRAWING No.
41825-WOOD-XX-XX-DR-OC-0001_A

Rev.
P02

Appendix A
Former South Bank Works

Appendix A1
Enviro Insight Report

Appendix A2
Geo Insight Report

Appendix A3
Maps

Small Scale Grid Index

Small Scale Section 1-1

Small Scale Section 1-2

Small Scale Section 2-1

Small Scale Section 2-2

1:1250 Scale Grid Index

1:1250 Scale Sections 1-1 to 1-3

1:1250 Scale Sections 1-4 to 2-3

1:1250 Scale Sections 2-4 to 3-4

1:1250 Scale Sections 3-5 to 4-2

1:1250 Scale Sections 4-3 to 5-2

1:1250 Scale Sections 5-3 to 5-5

1:1250 Scale Sections 6-2 to 6-4

1:2500 Scale Grid Index

1:2500 Scale Sections 1-1 to 2-1

1:2500 Scale Sections 2-2 to 2-4

1:2500 Scale Sections 3-1 to 3-4

1:2500 Scale Sections 4-1 to 4-3

1:2500 Scale Sections 4-4 to 5-3

Appendix B
Grange Town Prairie

Appendix B1
Enviro Insight Report

Appendix B2
Geo Insight Report

Appendix B3
Maps

Appendix C
Plate Mill

Appendix C1
Enviro Insight Report

Appendix C2
Geo Insight Report

Appendix C3
Maps

1:1250 Scale Sections 1-1 to 1-2

1:1250 Scale Sections 2-1 to 2-3

1:1250 Scale Sections 2-4 to 3-1

1:1250 Scale Sections 3-2 to 3-4

1:2500 Scale Maps

Appendix D
Coatham Marsh & Warrenby Landfill

Appendix D1
Enviro Insight Report

Appendix D2
Geo Insight Report

Appendix D3
Maps

Small Scale Maps

1:1250 Scale Grid Index to Section 1-2

1:1250 Scale Sections 1-3 to 2-2

1:1250 Scale Sections 2-3 to 2-5

1:1250 Scale Sections 3-1 to 3-3

1:1250 Scale Sections 3-4 to 4-5

1:2500 Scale Grid Index to Section 1-4

1:2500 Scale Sections 2-1 to 2-4

1:2500 Scale Sections 3-1 to 3-4

Appendix E
Risk Assessment Methodology

The environmental risk assessment aims to assess the significance of each potential contaminant linkage. The key to the classification is that the designation of risk is based upon the consideration of both:

- **The magnitude of the potential consequence (i.e. severity).** It takes into account both the potential severity of the hazard and the sensitivity of the receptor.
- **The magnitude of probability (i.e. likelihood).** It takes into account both the presence of the hazard and receptor and the integrity of the pathway.

The definitions for the qualitative risk assessment have been taken from "Guidance for the Safe Development of Housing on Land Affected by Contamination" Annex 4 R&D Publication 66: 2008 Volume 2.

The Likelihood Probability Classifications of SPR Linkage being realised is presented in Table E.1

Table E.1 Likelihood Probability Classifications of SPR Linkage being realised

Classification	Definition	Examples
Unlikely	There is pollutant linkage, but circumstances are such that it is improbable that an event would occur even in the very long-term.	a) Elevated concentrations of toxic contaminants are present below hardstanding. b) Light industrial unit <10 yrs. old containing a double skinned UST with annual integrity testing results available.
Low Likelihood	There is pollutant linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a long period such an event would take place and is less likely in the shorter term.	a) Elevated concentrations of toxic contaminants are present in soils at depths >1m in a residential garden, or 0.5-1.0m in public open space. b) Ground/groundwater contamination could be present on a light industrial unit constructed in the 1990s containing a UST in operation over the last 10 years – the tank is double skinned but there is no integrity testing or evidence of leakage.
Likely	There is pollutant linkage and all the elements are present and in the right place which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short-term and likely over the long-term.	a) Elevated concentrations of toxic contaminants are present in soils at depths of 0.5-1.0m in a residential garden, or the top 0.5m in public open space. b) Ground/ groundwater contamination could be present from an industrial site containing a UST present between 1970 and 1990. The tank is known to be single skin. There is no evidence of leakage although there are no records of integrity tests.
High Likelihood	There is pollutant linkage and an event would appear very likely in the short-term and almost inevitable over the long-term, or there is evidence at the receptor of harm or pollution	a) Elevated concentrations of toxic contaminants are present in soils in the top 0.5m in a residential garden. b) Ground/groundwater contamination could be present from chemical works, containing a number of USTs having been in operation on the same site for over 50 years.

"Potential Consequence of Contaminant Linkage" gives an indication of the sensitivity of a given receptor to a particular source or contaminant of concern under consideration. It is based on full exposure via the particular linkage being examined. The classification of consequence is presented in Table E.2.

Table E.2 Outline of Hazard Consequence Classifications for Receptor Types from Contamination Impact:

Classification	Human Health	Controlled Water	Ecology	Property Structures/ Crops and animals	Examples
Severe	Highly elevated concentrations likely to result in "significant harm" to human health as defined by the EPA 1990, Part 2A, if exposure occurs.	Equivalent to EA Category 1 pollution incident including persistent and/or extensive effects on water quality; leading to closure of a potable abstraction point; major impact on amenity value or major damage to agriculture or commerce.	Major damage to aquatic or other ecosystems, which is likely to result in a substantial adverse change in its functioning or harm to a species of special interest that endangers the long-term maintenance of the population.	Catastrophic damage to crops, buildings or property.	Significant harm to humans is defined in circular 01/2006 as death, disease*, serious injury, genetic mutation, birth defects or the impairment of reproductive functions. Major fish kill in surface water from large spillage of contaminants from site. Highly elevated concentrations of Hazardous or priority substances present in groundwater close to small potable abstraction (high sensitivity). Explosion, causing building collapse (can also equate to immediate human health risk if buildings are occupied).
Medium	Elevated concentrations which could result in "significant harm" to human health as defined by the EPA 1990, Part 2A if exposure occurs.	Equivalent to EA Category 2 pollution incident including significant effect on water quality; notification required to abstractors; reduction in amenity value or significant damage to agriculture or commerce.	Significant damage to aquatic or other ecosystems, which may result in a substantial adverse change in its functioning or harm to a species of special interest that may endanger the long-term maintenance of the population.	Significant damage to crops, buildings or property.	Significant harm to humans is defined in circular 01/2006 as death, disease*, serious injury, genetic mutation, birth defects or the impairment of reproductive functions. Damage to building rendering it unsafe to occupy e.g. foundation damage resulting in instability. Ingress of contaminants through plastic potable water pipes.

Classification	Human Health	Controlled Water	Ecology	Property Structures/ Crops and animals	Examples
Mild	Exposure to human health unlikely to lead to "significant harm".	Equivalent to EA Category 3 pollution incident including minimal or short lived effect on water quality; marginal effect on amenity value, agriculture or commerce.	Minor or short lived damage to aquatic or other ecosystems, which is unlikely to result in a substantial adverse change in its functioning or harm to a species of special interest that would endanger the long-term maintenance of the population.	Minor damage to crops, buildings or property.	Exposure could lead to slight short-term effects (e.g. mild skin rash). Surface spalling of concrete.
Minor	No measurable effects on humans	Equivalent to insubstantial pollution incident with no observed effect on water quality or ecosystems.	Equivalent to insubstantial pollution incident with no observed effect on water quality or ecosystems.	Repairable effects of damage to buildings, structures and services.	The loss of plants in a landscaping scheme. Discoloration of concrete.

The risk matrix to link the likelihood and consequence is shown in Table E.*3*

Table E.3 Risk Matrix

Likelihood:	Unlikely	Low Likelihood	Likely	High Likelihood
Potential Consequence:				
Severe	Moderate/low risk	Moderate Risk	High Risk	Very High Risk
Medium	Low	Moderate/low risk	Moderate Risk	High Risk
Mild	Very low risk	Low Risk	Moderate/low risk	Moderate Risk
Minor	Very low risk	Very low risk	Low Risk	Low Risk

The overall risk definitions are summarised in Table E.4

Table E.4 Risk Definitions

Risk	Definition
Very Low	It is a low possibility that harm could arise to a designated receptor, but it is likely at worst, that this harm if realised would normally be mild or minor.
Low	It is possible that harm could arise to a designated receptor from identified hazard, but it is likely at worst, that this harm if realised would normally be mild. It is unlikely that the site owner/or occupier would face substantial liabilities from such a risk. Further investigative work (which is likely to be limited) to clarify the risk may be required. Any subsequent remediation works are likely to be relatively limited.
Moderate	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, and if any harm were to occur it is more likely, that the harm would be relatively mild. Further investigative work is normally required to clarify the risk and to determine the potential liability to site owner/occupier. Some remediation works may be required in the longer term.
High	Harm is likely to arise to a designated receptor from an identified hazard at the site without remediation action. Realisation of the risk is likely to present a substantial liability to the site owner/or occupier. Investigation is required as a matter of urgency to clarify the risk. Remediation works may be necessary in the short-term and are likely over the longer term.
Very High	There is a high probability that severe harm could arise to a designated receptor from an identified hazard at the site without remediation action OR there is evidence that severe harm to a designated receptor is already occurring. Realisation of that risk is likely to present a substantial liability to be site owner/or occupier. Investigation is required as a matter of urgency and remediation works likely to follow in the short-term.