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SOUTH BANK WESTERN AREA, TEESWORKS, REDCAR

Enabling Earthworks and Remediation Strategy Report

South Tees Development Corporation

REPORT NO. 10035117-AUK-XX-XX-RP-ZZ-0408-02-Rem_Strat_South_Bank_West_Rev01

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South Bank Western Area, Teesworks, Redcar

Enabling Earthworks and Remediation Strategy Report

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VERSION CONTROL

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01 Draft	January 2021	Jonathan Miles	First Draft
01	January 2021	Jonathan Miles	First issue, changes to Figure 1
02	January 2021	Jonathan Miles	Redline change to Figure 1
02.1	January 2021	Jonathan Miles	Minor update to planning details

This report dated 27 January 2022 has been prepared for South Tees Site Company (the "Client") in accordance with the terms and conditions of appointment (the "Appointment") between the Client and **Arcadis (UK) Limited** ("Arcadis") for the purposes specified in the Appointment. For avoidance of doubt, no other person(s) may use or rely upon this report or its contents, and Arcadis accepts no responsibility for any such use or reliance thereon by any other third party.

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1 INTRODUCTION

1.1 Project Aims and Objectives

The South Bank Western (SBW) Area (the site) is a land parcel situated within the wider Teesworks area located across the Redcar, Lackenby, Grangetown and South Bank conurbations of the Borough of Redcar & Cleveland, set in the industrial area generally known as 'South Tees'.

The South Tees Regeneration Masterplan has been developed detailing the industrial-led regeneration of the Former Redcar Steelworks into a world class employment-generating zone and economic growth enabler for the Tees Valley.

The Masterplan has identified the SBW area as being located within the Southern Industrial Zone. The site is a priority development area.

The overarching aim of the works is to deliver a sustainable ground remediation strategy for the contract sites which is compliant with regulatory needs (Local Authority and Environment Agency) and has their approval in principle. As technical consultant, Arcadis' specific objectives of this phase of works is to review the output of the environmental and geotechnical risk assessments and identify an applicable remediation strategy for the site.

This document is intended to support Planning Permission R/2020/0357/OOM, and also support planning matters in the vicinity of the former South Bank Coke Ovens (SBCO) under a future planning application as shown on the drawing provided by STDC presented in the below Figure 1 and included in Appendix A

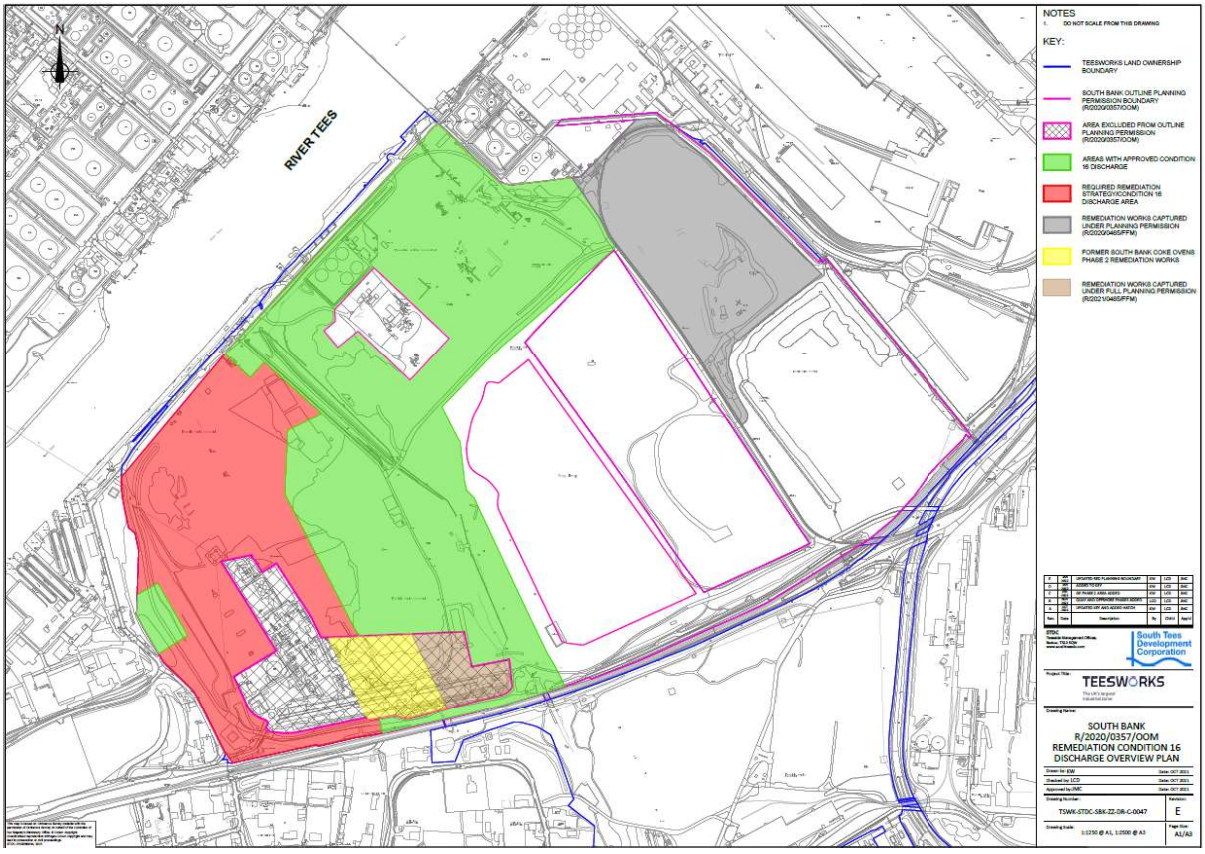


Figure 1- Site Area shown by red shading

1.2 Contract Details

Arcadis (UK) Limited (Arcadis) were appointed by South Tees Development Corporation (STDC) to develop a remediation strategy to address environmental constraints relating to ground conditions identified by the physical ground investigation works conducted at the South Bank Western Area site.

The work was carried out in accordance with the proposal "South Bank Wharf GI – PM and Technical Support" dated 31st July 2020.

1.3 Report Aims

The aim of this remediation strategy document is to use the available information to assess feasible remediation strategies to address the active source-pathway-receptor linkages identified by the site conceptual site model (CSM) for the contract area in order to develop the final remediation technology selection and design.

1.4 Previous Information

The following reports have been prepared for, or include, the South Bank Western Area:

- *Draft - South Bank Area A Teesworks Redcar, Phase 2 Environmental Site Assessment, 10035117-AUK-XX-XX-RP-ZZ-0192-01-SBA_ESA* (version 02 in press), prepared by Arcadis for South Tees Development Corporation, dated March 2021 [Arcadis 2021a].
    - Based on draft data from – South Bank Area A (Final issue *in press*), prepared by Allied Exploration & Geotechnics Ltd (AEG) for South Tees Development Corporation, dated November 2020.
- *South Bank Area C Teesworks Redcar, Phase 2 Environmental Site Assessment, 10035117-AUK-XX-XX-RP-ZZ-0318-02-SBC_ESA*, prepared by Arcadis for South Tees Development Corporation, dated August 2021 [Arcadis 2021b]
    - Based on draft data from - Ground Investigation South Bank Area C, prepared by AEG Ltd. for South Tees Development Corporation*, in press.*
- *Draft South Bank Former Steelworks Redcar, Detailed Quantitative Risk Assessment, 10035117-AUK-XX-XX-RP-ZZ-0331-02-SB_DQRA*, prepared by Arcadis for South Tees Development Corporation, dated September 2021 [Arcadis 2021c].
    - This document supersedes *Detailed Quantitative Risk Assessment South Bank Area A, 10035117-AUK-XX-XX-RP-ZZ-0270-01-SBA_DQRA*.
- *Earthworks Specification South Western Area, 10035117-AUK-XX-XX-RP-ZZ-0419-01-South_Bank_West_Earthworks*, prepared by Arcadis for South Tees Development Corporation, [Arcadis 2021d] in press.
- *South Bank Access Roads - Environmental Assessment Summary 10035117-AUK-XX-XX-CO-ZZ-0357-01-South_Bank_Roads GI*, prepared by Arcadis for South Tees Development Corporation, dated August 2021 {Arcadis 2021e].
- *South Tees Industrial Area- Site C Ground Investigation 12/07/99* prepared by Allied Exploration & Geotechnics Limited,
- *Soil and Groundwater Baseline Characterisation Study, Teesside Works*, prepared by Enviros for Corus UK Ltd [Enviros 2004], Comprising:
    - *Volume 1 – Factual Report, Ref. Rlp250604corusteessidefactual.Doc* dated 25th June 2004 and marked Final;
    - *Volume 2 – Interpretive Report Ref. Mwicorusdraftinterpretivemmdv#2.Doc* dated 25th June 2004 and marked Final; and,
    - *Volume 3 – Summary Report* dated June 2004.
- *South Bank Quay – Ground Investigation and Generic Quantitative Risk Assessment Report, Report Ref: PC1084-RHD-ZZ-XX-RP-Z-0001*, dated 16th April 2021 [Royal Haskoning, 2021],

- *TS4 South Bank – Phase 1 Geo-Environmental Desk Study, report ref. 678079_TS4_002* dated August 2017 and marked Final, prepared by CH2M Hill for the Homes and Communities Agency [CH2M 2017],
- *Former Steelworks Land, South Tees Outline Remedial Strategy, , ref 41825-wood-XX-XX-RP-OC-0001_S0_P01* Prepared for South Tees Development Corporation by Wood dated 25th June 2019 [Wood 2019],

The site is also considered in:

- *Tees South Bank Marine Surveys Overwater Ground Investigation – Work Packages 3 and 4 – Marine Vibrocores and Marine Drilling, ref C2124-R001-WP3_WP4 03*, prepared by Fugro Geoservices Limited for Tees Valley Combined Authority, dated 21 April 2021.
- *South Industrial Zone ES - Vol 2 - Chapter H (Ground Conditions and Remediation)*, prepared by Arcadis for STDC and dated July 2020,
- *South Bank Site Remediation, Ecological Impact Assessment Revision A Final, dated May 2021, Report ID: INCA 2021-29* [INCA].
- *South Bank Site Remediation - Shadow Habitats Regulations Assessment: Stage 1 Screening and Stage 2 Appropriate Assessment Revision A Final, dated May 2021, Report ID: INCA 2021-30* [INCA].

This Strategy document should be read in conjunction with the aforementioned reports.

1.5 Reliability / Limitations of Information

A complete list of Arcadis' Study Limitations is presented in Appendix B.

It should be noted that ground conditions between exploratory holes may vary from those identified during the ground investigations that this report is based upon; any design should take this into consideration. It should also be noted that groundwater levels may be subject to diurnal, tidal, seasonal, climatic variations and those recorded in this report are solely dependent on the time the ground investigation were carried out and the weather before and during the investigation work.

2 Environmental Setting and Development Constraints

This section incorporates a review of the above reports listed in Section 1.4.

2.1 Site Description and Setting

The site is approximately 39 hectares in size and irregular in shape. The site is bound to the north by the River Tees (albeit stepped back from the wharf by approximately 30m). A section of the SBCO are present in the southern section of the site, these assets are undergoing demolition at the time of writing. The remainder of the SBCO and Biproducts Plant are enclosed by the site and are excluded from the area covered by this report. To the south of the site is the Darlington to Saltburn Railway line, which runs along the approximate east-west axis. To the east of the area is the wider South Bank site including the High Tip Landfill, and South Bank Quay and Priority Area landholdings which are covered by separate reports.

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. A small area on the western boundary of the site is the Teesworks Initial Freeport Area and is covered by a separate report.

The site and surrounding areas have a long and layered industrial history and largely comprise mudflat and marshland reclaimed by deposition of iron and steel slag and by-products which form the majority of the site surfacing. At the time of writing the site is being used for materials storage and processing associated with earthworks ongoing within the South Bank Priority and South Bank Quay plots.

Numerous services cross the site including National Grid power lines.

The site setting and layout are shown on Figure 2 and in Appendix A.

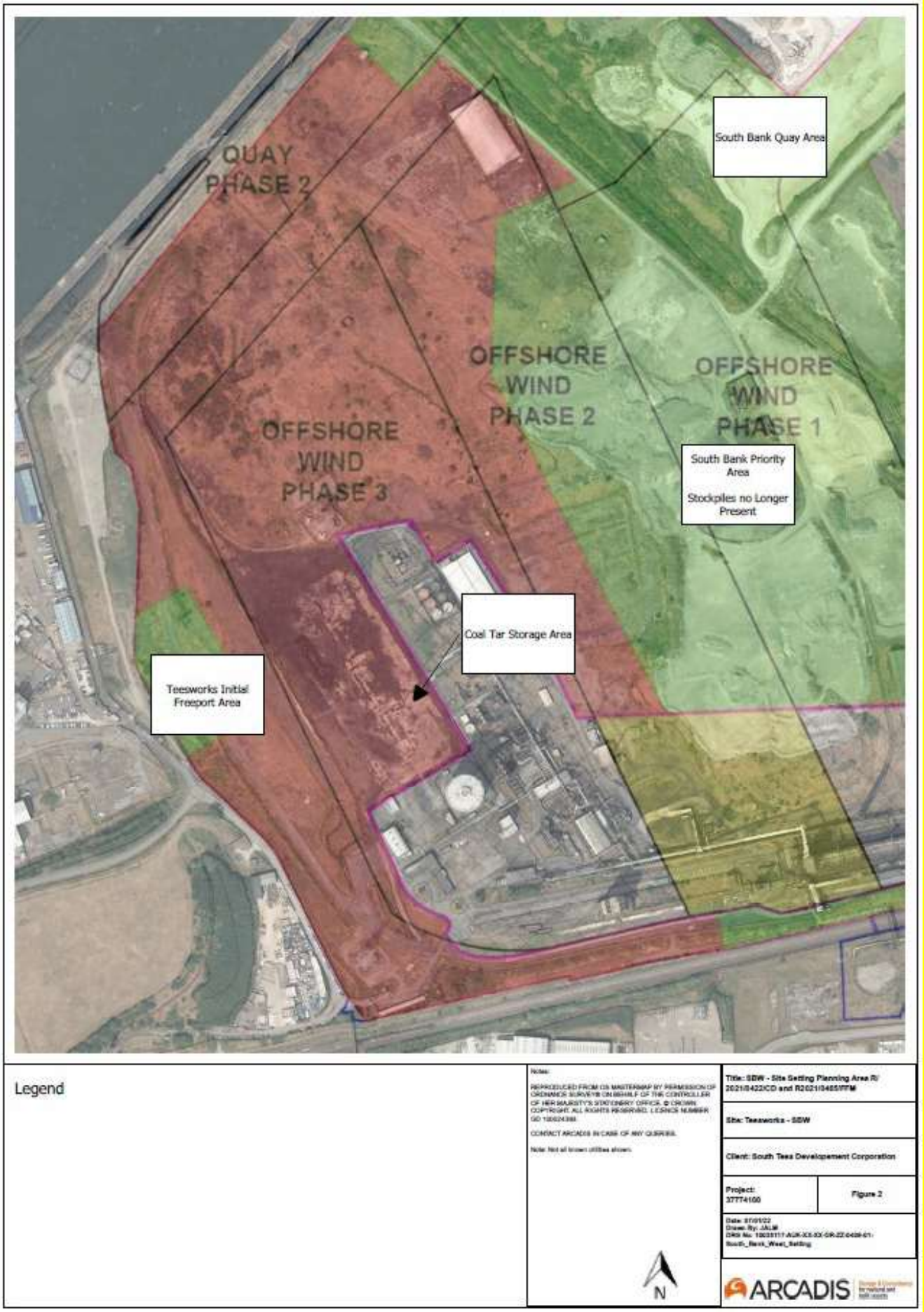


Figure 2 Site Setting

2.2 Geology

The ground investigation data [Arcadis 2021a and 2021b] indicates a substantial thickness of Made Ground underlies the site. Natural deposits comprising Tidal Flat Deposits were identified immediately underlying the Made Ground. Glaciolacustrine deposits were identified below the Tidal Flat Deposits in the majority of locations. The Tidal Flat Deposits and Glaciolacustrine Deposits were underlain by Glacial Till.

The Mercia Mudstone was proven to underlie the superficial deposits and was recovered as an extremely weak to weak red brown mudstone and was noted to become interbedded mudstone, sandstone and siltstone at depth.

The bedrock (assessed including historical data [AEG1999]) was not noted to dip towards the river but to be higher in the centre of the site compared to the northern and southern boundaries.

Unit	General description
Made Ground	Site surfacing comprised either soft standing of gravel, sand or slag. In areas to the southern side of the site hardstanding is present associated with roadways, infrastructure and building structures. The Made Ground encountered during the investigations predominantly comprised granular material with a fine-grained component and medium to high cobble/boulder content which included slag, brick, concrete and occasionally clinker, coke, coal and/or metal. Rare to frequent refractory materials were identified in a number of trial pits across the site. Based on visual assessment slag was found to be the dominant component of Made Ground.
Tidal Flat Deposits (Secondary A Aquifer)	Generally comprised soft sandy silt (often shelly) frequently underlain by a silty sand. Identified to be widely distributed across the site below the Made Ground.
Glaciolacustrine Deposits (unproductive strata)	The deposits were generally described as a soft to firm brown laminated clay often with sand or silt partings along laminations.
Glacial Till (unproductive strata)	Glacial Till was described as a firm to very stiff red brown slightly sandy slightly gravelly clay, with gravel composed of mixed lithologies, including sandstone, mudstone, and limestone Glacial till is distributed widely across the site overlying the bedrock.
Sand and Gravel	The Sand and Gravel was described as a clayey Sand and Gravel with gravel composed of mixed lithologies, including sandstone, limestone, flint and chert. This deposit was not present at all exploratory locations.
Mercia Mudstone (Secondary B Aquifer)	An extremely weak to weak red brown mudstone partially to highly weathered with numerous bands of white gypsum and locally green grey glauconite, The Mercia Mudstone was noted to become interbedded mudstone, sandstone and siltstone in some locations at depth.

Two predominant types of Made Ground were noted:

- **Slag-dominant material (>50% slag):** Identified widely across the site generally ranging from gravel to cobble and occasional boulder size fragments. The slag material was generally vesicular and grey-green-white in colour.
- **Granular Made Ground:** Less frequently identified, of varying composition, most frequently a sandy gravel with varying cobble content. Gravel and cobbles include brick (including refractory), concrete, ash and clinker. Slag was not the dominant constituent although often still present within the soil matrix.

2.3 Hydrogeology

The site was reclaimed from the Tees Estuary on low lying areas immediately above high water by the placement of biproducts from the steel making process. As such, the River Tees is likely in continuity with water within both the Made Ground and the Tidal Flat Deposits, evidenced by tidal influence and brackish water being noted across sections of the site. Recent investigation data indicates that the Mercia Mudstone outcrops in the riverbed [Fugro 2021].

Water was noted to be variably present in Made Ground. The Tidal Flat Deposits are present continuously across the site but in locations are of limited thickness and as such, are not expected to represent a significant resource across the site. Although an Unproductive Strata, the site data indicates the potential for horizontal and vertical migration of groundwater within more permeable horizons of the Glaciolacustrine Deposits. The underlying bedrock is considered the most sensitive aquifer system at the site, with a groundwater flow direction towards the north-east inferred from site data.

Geology	Aquifer Classification	Groundwater flow
Tidal Flat Deposits	Secondary (A) Aquifer	Not confirmed, aquifer of limited thickness
Glaciolacustrine Deposits	Non-aquifer	Flow dictated by localised preferential pathways
Glacial Till	Non-aquifer	
Mercia Mudstone	Secondary (undifferentiated) Aquifer	North to north-east

2.4 Hydrology

The River Tees is present approximately 20m to the north of the site boundary. The River Tees is a tidal estuary, flowing towards the northeast. The Teesmouth and Cleveland Coast is also a designated Ramsar site, Site of Special Scientific Interest (SSSI) and a Special Protection Area (SPA).

2.5 Data Gap

At the time of issue Arcadis have not undertaken ground investigation of the southern area of the site south of the SBCO. The findings of an historic investigation [Enviros 2004] have been reviewed for this report however it is recognised that these may not represent current conditions. Investigation is not possible below the SBCO structures themselves until demolition works are complete. Arcadis considers any contamination in these areas should be managed as unexpected contamination during the implementation of remedial works.

2.6 Conceptual Site Model

2.6.1 Environmental

The ESAs (Environmental Site Assessment) for South Bank Area A and C [Arcadis 2021a and 2021b] and [Arcadis 2021e] (which form part of the South Bank Western Area) developed conceptual site models (CSM) based on ground investigation findings. The CSMs identified a number of potentially active source-pathway-receptor (SPR) linkages, the significance of which was assessed by comparison to appropriate generic screening criteria. The identified SPR linkages were:

- Human Health - Risk to commercial workers via inhalation of asbestos fibres, originated from shallow Made Ground across the site.
- Human Health - Risk to commercial workers via dust inhalation and direct contact with soils for lead, benzene, naphthalene, dibenzofuran and PAHs (polycyclic aromatic hydrocarbons), originated from shallow soils across the site.
- Water Resources - The findings of the DQRA [Arcadis2021c] concluded that the Made Ground and non-aqueous phase liquid (NAPL) identified does not present a significant level of risk to the identified water resource receptor (River Tees).

The identified SPR linkages for the site are shown within the CSM presented below as Figure 3.

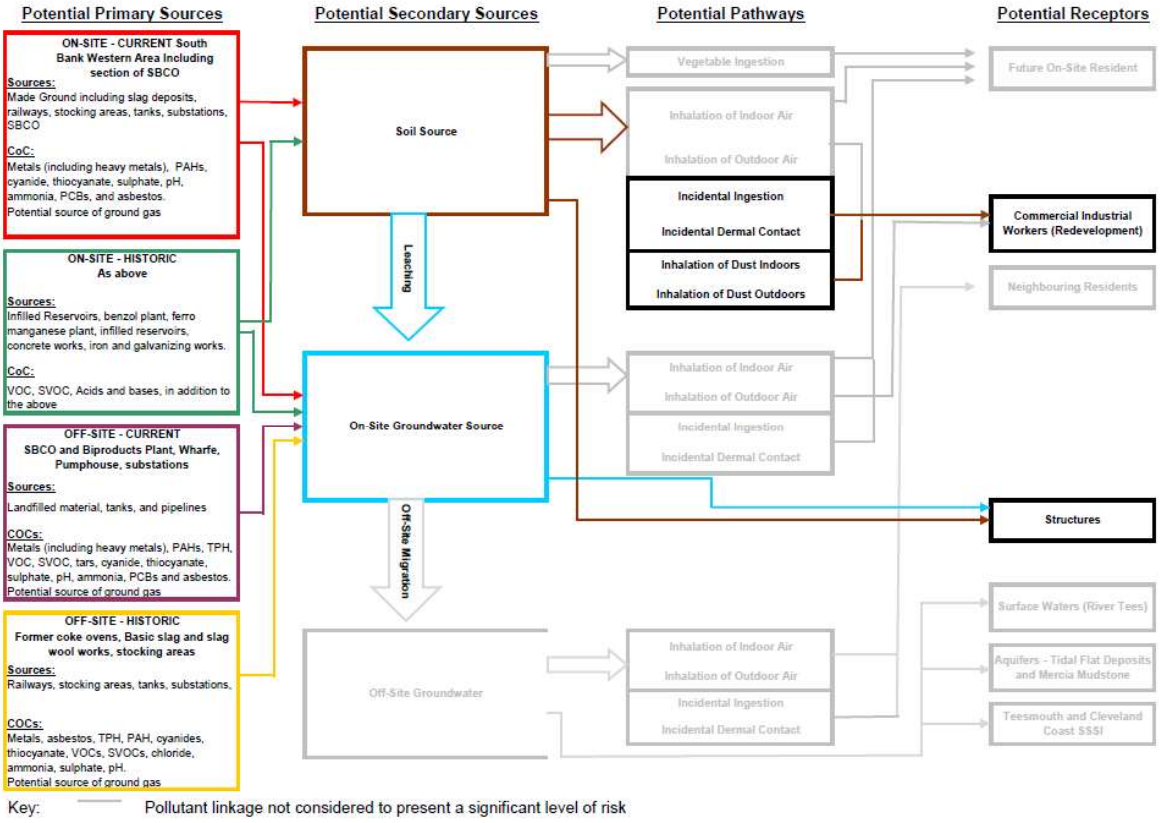


Figure 3 - Conceptual Site Model

2.6.2 Ground Gas

The ESAs for South Bank Area A and C (which form part of the South Bank Priority Area) did not identify an unacceptable risk to human health or built receptors from the accumulation of ground gas. However, as the ground investigation was not designed with a particular redevelopment scenario in mind, the gas data monitoring was limited and may not be representative of the entire extent of the site under a particular redevelopment.

Additional ground gas monitoring at greater density is recommended prior to any specific redevelopment to determine the risk from ground gases at the site, the scope of this investigation and any subsequent remedial requirements would depend on the proposed redevelopment scenario. Arcadis understand from STDC that it is expected this would be the responsibility of the developer.

2.6.3 Geotechnical

It is not the specific intention of this Remediation Strategy to address geotechnical risks however these works have identified the following factors which may present significant development constraints at the site:

- Expansive slag deposits and refractory bricks may lead to disruption and damage of structures, hardstanding etc.;
- Due to long term creep settlement, the Made Ground and underlying Tidal Flat Deposits may possess inadequate bearing capacity to support proposed structures;
- Lateral and vertical changes in ground conditions;
- Anticipated total and differential settlement / heave in excess of the tolerable limits may occur due to changes in loading or groundwater regime;
- Sulphate attack on subsurface concrete; and,
- Obstructions within the made ground (boulder size fragments of slag and buried underground structures).

2.7 Contaminant Distribution

The results of the contamination testing at the site is summarised below.

2.7.1 Human Health

Asbestos in Soils

Arcadis 2021a identified no visible asbestos containing materials during site works, however laboratory testing did identify asbestos fibres in six samples of Made Ground from the SBW site and these were quantified at between <0.001 and 0.014%.

Arcadis 2021b identified no visible asbestos containing materials during site works, however laboratory testing identified asbestos fibres in one sample of Made Ground from the SBW site and this was quantified at <0.001%. Historical investigations did not routinely analysed for asbestos containing materials.

Organic and Inorganic Contaminants

A review of the previously conducted ground investigations identified concentrations of lead, benzene, cyanide, dibenzofuran, and PAHs that were measured in excess of the Generic Assessment Criteria (GAC) in soil, driven by direct contact exposure and dust inhalation. These will need to be considered in the remedial strategy for the site.

Arcadis 2021a and Arcadis 2021b identified the following exceedances of the assessment criteria:

Contaminant	Unit	GAC Exceeded		Sample (Geology)	Concentration (mg/kg)
Dibenzo(a,h)anthracene	mg/kg	S4UL	3.5	SBA_AUK_BH110_SO_0720	47
Lead	mg/kg	C4SL	2,300	SBC_AUK_TP168_SO 2.10mbgl SBA_AUK_TP136_SO_0090 SBA_AUK_TP155_SO_0250	3,900 3,300 2,300
Naphthalene	mg/kg	Wood	1,900	SBA_AUK_BH110_SO_0720	15,000
Benzo(a)anthracene	mg/kg	S4UL	170	SBA_AUK_BH110_SO_0720	770
Chrysene	mg/kg	S4UL	350	SBA_AUK_BH110_SO_0720	590
Benzo(b)fluoranthene	mg/kg	S4UL	44	SBA_AUK_BH110_SO_0720	490
Benzo(a)pyrene	mg/kg	Wood	77	SBA_AUK_BH110_SO_0720	460
Benzene	mg/kg	S4UL	27	SBA_AUK_BH110_SO_0720	580
2-Methylnaphthalene	mg/kg	USEPA	1,000	SBA_AUK_BH110_SO_0720	3,700
Dibenzofuran	mg/kg	USEPA	1,000	SBA_AUK_BH110_SO_0720	2,900

A review of historic data Enviros 2004 identified the following exceedances of the assessment criteria, however it is recognised that these may not represent current conditions

Contaminant	Unit	GAC Exceeded		Sample (Geology)	Concentration (mg/kg)
Cyanide (free)	mg/kg	Arcadis	66	2AT11 0.1m bgl	79
Naphthalene	mg/kg	Wood	1,900	2AB01 6.0m bgl	2,890
Dibenzo(a,h)anthracene	mg/kg	S4UL	3.5	2AT6 0.2m bgl 2AT10 0.15m bgl 2AT11 0.1m bgl	6 4 10
Benzo(b)fluoranthene	mg/kg	S4UL	44	2AT11 0.1m bgl	86
Benzene	mg/kg	S4UL	27	2AB01 6.0m bgl 2AB01 7.0m bgl 2AT11 0.1m bgl	1,040 5,750 4,220

The exposure risk for all contaminants with the exception of cyanide, naphthalene and benzene is driven by direct contact. The exposure risk for naphthalene and benzene is driven by vapour inhalation; however the exceedances for these contaminants in SBA_AUK_BH110_SO_0720 and 2AB01 is within the saturated zone and considered better assessed by groundwater GAC as, for a risk to occur, partitioning into groundwater is required. The concentrations of naphthalene and benzene measured in groundwater from SBA_AUK_BH110 were below the Human Health GAC and as such do not pose a significant risk to the receptor, and therefore remediation for these contaminants of concern is not required. The groundwater concentrations in 2AB01 are not considered appropriate to assess against

current standards due to the time passed since they were measured. Both SBA_AUK_BH110_SO_0720 and 2AB01 are considered to represent the same groundwater source.

2.7.2 Materials Impacted with Non-Aqueous Phase Liquids

Evidence of non-aqueous phase liquids (NAPL) and Tar has been identified primarily within the Made Ground and associated with subsurface or former above ground structures and plant. Further consideration of the NAPL with respect to the risk to human health will be needed as part of the remedial strategy.

Materials impacted with NAPL and tar should not be reinstated due to being a primary source of contamination. The impacted materials will be required to be consigned to a treatment process to remove the NAPL element or disposed of at an appropriate waste facility under duty of care.

Arcadis 2021a, Arcadis 2021c, and Enviros 2004 identified evidence of NAPL **on soils** in the following locations during the ground investigation.

Location	Geology	Description
SBA_AUK_TP116 (1.8 – 4.0m bgl)	Made Ground	Viscous tar noted within soil matrix
SBA_AUK_BH105 (6.6 – 8.3m bgl)	Made Ground / TFD	NAPL, sheen, and odour noted at base of the Made Ground. NAPL later noted at the base of the well during monitoring.
SBA_AUK_BH110	Made Ground / TFD	Strong odour noted during drilling. Black viscous tar noted at the base of the well during monitoring.
SBC_AUK_BH107 (6.5 – 7.2m bgl)	Made Ground / TFD	Oily sheen and hydrocarbon odour
SBC_AUK_BH112 (5.7 – 7.2m bgl)	Made Ground / TFD	Oily sheen and hydrocarbon odour
1AT11 (0.0-0.2m bgl)	Made Ground	Black oily cobbles of slag

2.8 Unexploded Ordnance and Magnetic Anomalies

Desktop Unexploded Ordnance (UXO) assessment has been completed for the STDC boundary. The outcome of the assessment indicates a Medium risk from UXO for borehole and excavation activities.

In addition, magnetic anomalies have been encountered elsewhere on STDC landholdings which may represent potential UXO risk. Should redevelopment require the installation of piled foundations or deep ground improvement, clearance of locations for potential UXO is recommended.

2.9 Archaeology

Archaeological surveys and assessment have not been made available to Arcadis at the time of writing this document. These documents should be reviewed when available to develop an appropriate mitigation and management strategy.

2.10 Ecology

The South Bank Priority Area site is approximately 20m south of the Teesmouth and Cleveland Coast SPA, Ramsar and SSSI site.

A Shadow Habitat Risk Assessment (HRA) completed on the site (reported within *South Bank Site Remediation, Shadow Habitats Regulations Assessment: Stage 1 Screening and Stage 2 Appropriate Assessment Revision A Final* [INCA 2021] and *Ecological Impact Assessment Revision A Final, Report ID: INCA 2021-29*, dated May 2021 [INCA]) concluded that;

“The proposed development will not cause adverse effect to the integrity of the Teesmouth and Cleveland Coast SPA and Ramsar sites, either alone or in combination with other plans or projects.”

Further recommendations and requirements have been highlighted within the document such as;

- *"Removal of vegetation that may support nesting birds should be undertaken outside of nesting season (March to August inclusive), unless the habitats are first checked by a suitably qualified ecologist, who confirms in writing to the LPA that no nesting birds are present, and the work is undertaken within 48 hours. This is a legal requirement of the WCA 1981."*
- *"Measures will be implemented to prevent the spread of invasive non-native plant species, as listed under either Schedule 9 of the WCA 1981 or the Invasive Alien Species (Enforcement and Permitting) Order 2019 (this is a legal requirement)."*
- Compensation is required to offset residual losses after the mitigation through the preparation of an Environment and Biodiversity Strategy, which *"will provide options and opportunities for Teesworks, and those developing within the Teesworks area, to meet any biodiversity value deficit arising from development."*

All recommendations and requirements of the HRA should be incorporated into the working methodology to execute this Remediation Strategy. Where required working practices, restrictions, exclusion zones and the like should be implemented in line with the HRA recommendations.

2.11 Flood Risk

The risk of flooding from rivers and the sea has been assessed by reviewing Environment Agency flood maps for the area which indicate the risk of flooding is "Very Low" with a less than 0.1% chance of flooding in any year.

The Wood "Flood Risk Assessment and Drainage Strategy Flood Risk Assessment and Drainage Strategy" (Ref. 41825-WOOD-XX-XX-RP-OW-0001_A_P01) concluded that the potential import of up to 500mm mudstone onto the site did not increase the surface water flood risk.

The proposed remedial strategy comprises the excavation and crushing of hardstanding (where present) and other impermeable obstructions within the Made Ground and their backfill within the excavation. As such, Arcadis considers that excavation and replacement of the Made Ground combined with removal of hardstanding (where present) is not likely to decrease surface water infiltration rates and therefore the risk of surface water flooding will be no higher than identified by Wood.

2.12 Proposed Redevelopment and Enabling Works

No detailed redevelopment design is currently available for the site.

Arcadis understand STDC are to complete enabling works to create an environmentally suitable development platform for future redevelopment. These works will include turnover of the Made Ground within the subsurface to a depth of up to 2.5 m Below Finished Level (bfl). The finished level for the eastern area is currently set at 10.00m AOD and the turnover of the Made Ground is to be conducted down to 7.5m AOD, including removal and crushing of relic structures and obstructions, removal and treatment of environmental contamination as required and replacement of treated material to formation levels for development.

In some areas of the site large relic structures are anticipated to be present and where these are identified or if environmental contamination is found to extend below 2.5m bfl (7.5mAOD), any requirement for deeper excavation works will be assessed on a case specific basis following consultation with stakeholders.

Anticipated maximum depths of excavation from the existing site levels are shown on the below Figure 4 and in included within Appendix A. It should be noted that these are depths from existing site levels and therefore account for land raises, stockpiles and surface features.

Figure 4 Anticipated depth of excavation from current site levels

It is not STDC's intention to remove piles to depths below 2.5m bfl (7.5m AOD) or address the potential for future slag expansion. If deemed necessary, specific engineering controls will be installed by a future developer.

This strategy has been produced on the assumption that any redevelopment of the site will be for a generic commercial industrial end use. Remediation technologies have been selected based on Arcadis' professional judgement and experience of large-scale redevelopments of brownfield sites. The site is part of a wider STDC landholding and Arcadis recommends the remediation approach is considered holistically with the wider redevelopment of the Teesworks Site.

2.13 Materials Management

Given that remediation measures involve the movement of materials around the South Bank Area of the site and the wider STDC site it is important that they are not classified as a waste (as defined by Waste Framework Directive) on completion of the works.

2.13.1 Achieving Non-Waste Status

There are several different waste regulatory options available, the suitability of which is dependent upon the complexity of the site and the quantity/composition of the material to be reused. Based on the complexity of the site Arcadis recommend the most suitable option is via an application in accordance with CL:AIRE guidance 'Definition of Waste: Development Industry Code of Practice' (DoWCoP).

2.13.2 Definition of Waste: Development Industry Code of Practice

The Environment Agency (EA) has worked with industry through CL:AIRE to prepare the DoWCoP, the purpose of which is to allow industry to regulate itself with respect to determining whether excavated materials have achieved non-waste status. The EA states that 'When a signed Declaration is sent to us (the EA) by a Qualified Person (QP) showing that excavated materials are to be dealt with as set out in the DoWCoP, we (the EA) will take the view that the materials on the site where they are to be used will not be waste'.

If materials are dealt within in accordance with the DoWCoP then the materials are unlikely to be waste. This is either due to the fact that the materials were never discarded in the first place or because they have been submitted to a recovery operation and have been completely recovered so that they have ceased to be waste.

In order to demonstrate that the four factors have been fulfilled will require preparation of various reports including:

- Site investigation report (Site Condition Report / Environmental Site Assessment).
- Quantitative Risk Assessment (QRA);
- Remediation Strategy or Design Statement;
- Materials Management Plan (MMP); and,
- Verification Report (on completion of the works).

In addition to the risk assessment, an MMP will be required detailing where soils will be moved to and how they will be tracked. Approvals will also need to be sought from the Local Authority and the Environment Agency (groundwater team) with respect to this remediation strategy. Planning permission may also be necessary to ensure QP approval of the DoWCoP.

Once this documentation is in place a QP will review the overall strategy and ensure that everything is in place prior to submitting a formal declaration to the Environment Agency (waste team), via CL:AIRE (the scheme administrators). On completion of the work a verification report will need to be completed.

2.13.3 Materials Management Plan

An MMP shall be prepared in accordance with CL:AIRE DoWCoP and authorised by a QP registered with CL:AIRE. Excavated materials will be segregated and sorted into the following categories:

- Materials suitable for re-use on site (without needing additional treatment);
- Materials that require treatment in order to be suitable for re-use on site;

- Soils that require off-site disposal/treatment (not treatable);
- Refractory bricks and potentially expansive slag materials,
- Soils containing asbestos for treatment and reuse or for off-site disposal;
- Excavated hard materials (such as concrete and brick) that may be crushed to produce suitable material for use as infill in the Work; and
- Other materials that require off-site disposal (household waste, electrical goods, vegetation etc).

Where appropriate, existing concrete, brick and other suitable building materials will be crushed to a 6F2 or other suitable material classification, as specified by the Highways Specification to allow for reuse on-site in accordance with the MMP or other suitable end of waste quality protocol. Materials destined for re-use must meet the criteria proposed within the MMP or other relevant document.

For site-based contaminants the Re-use Criteria and Assessment Criteria should be reviewed and where necessary amended following the current ground investigation works and, if required, Quantitative Risk Assessment.

2.13.3.1 Records to be made

The contractor will be required to maintain records of material excavation and movement in support of the MMP, these shall include but not be limited to

Records whilst excavating	Records whilst backfilling
Date	Date
Grid square of origin	Excavation area or stockpile of origin
Depth of origin	Volume
Type of material (Made Ground, Concrete, slag etc.)	Placement grid square(s)
Volume excavated	Depth placed
Material destination (if direct to processing and backfill the backfill area, stockpile, or treatment area)	Material type
Evidence of contamination	

3 Remediation and Excavation Objectives

The aims of the remediation works at the site are to address the identified development constraints pertaining to environmental ground conditions and to facilitate redevelopment for a generic future commercial / industrial end use.

The remediation works will be undertaken at the same time as enabling earthworks (detailed in Section 2.13) to create a suitable formation level, and therefore should be considered holistically with these works.

3.1 Remediation Objectives

The remediation objectives will be achieved by controlling or breaking the identified SPR linkage in order to mitigate identified risks to the identified environmental receptors. The remediation objectives are to:

- Manage the contamination in excess of screening levels and that is likely to be present following completion of ongoing ground investigation, including NAPL containing soils.
- Manage the identified pollutant linkage between potential asbestos containing materials that are anticipated to be within shallow Made Ground such that the exposure pathway for on-site commercial workers is inactive.
- Maximise the reuse of excavated soils by making them suitable for use under DoWCoP.
- Develop an unexpected contamination strategy in order to manage and mitigate the risks due to encountering additional materials, as is commonplace during the preparation and reclamation of historical brownfield land.

3.2 Excavation Objectives

As the enabling earthworks are to be conducted alongside the environmental remediation it is considered prudent to incorporate the objective of the earthworks into the remediation strategy. The enabling earthworks objectives are to:

- Remove sub-surface obstructions within the Made Ground to a depth of 2.5m bfl (7.5m AOD). Where obstructions extend below this depth their removal will be conducted on a case-by-case basis following consultation with stakeholders;
- Creation of a formation layer (at 10,0 mAOD) suitable for a generic commercial / industrial redevelopment;
- Manage perched and confined groundwater within the Made Ground encountered during excavations;
- Management of risk to external hardstanding, culverted waterways and utilities; and,
- Development of a UXO mitigation strategy.

Arcadis recommends the following excavation objectives are considered as part of the earthworks strategy and therefore require consideration as part of the Earthworks Specification and development plans:

- Consideration of the management and placement of refractory materials excavated as part of the enabling earthworks; and,
- Protection of sub surface structures and utilities from attack due to aggressive ground conditions;

It is not the intention of this Remediation Strategy to fully address geotechnical development constraints at the site as these are the responsibility of the developer and dependent on a specific redevelopment scenario. It is anticipated that appropriate engineering controls will be developed by future site users at detailed design stage.

4 Enabling Earthworks and Remediation Strategy

The strategy for the enabling earthworks and remediation of the South Bank Western Area site should be considered within the wider context of the Teesworks reclamation and remediation. The excavated materials identified as not suitable for direct reuse will be consigned to a remediation process in order to meet the criteria for reuse after treatment. The exact technology is dependent on the volume and availability of the material and the timescale required to complete the remediation. It is currently envisaged that the treatment of materials could be undertaken on the Lackenby Treatment Area as a single location or potentially as part of a hub and cluster arrangement should one be established for the wider Teesworks site.

4.1 Aim

The aim of the works is to:

- Remove underground relic structures and foundations;
- Processing Made Ground materials in order to make them suitable for use as backfill materials,
- Make the site suitable for future commercial / industrial end-use through SPR linkage breaks from materials impacted with lead, asbestos, dibenzofuran, and PAHs; and,
- Reduce the geotechnical risks from slag and refractory materials removed as a consequence of the excavation works.

4.2 Overview of Required Works

In overview the enabling earthworks and remediation will comprise the following activities.

Enabling Earthworks

- Removal and processing of relic underground structures and foundations for reuse, to a depth of 2.5 m bfl (7.5m AOD). The requirement to remove areas of deeper structures or foundations, if encountered, will be assessed on a case-by-case basis.
- Screening and crushing of Made Ground materials in order to make them suitable for reuse.
- Treatment of soils impacted with NAPL in order to make them suitable for reuse.
- Segregation of soils with ACM for treatment and reuse.
- Segregation and processing of refractory materials as far as practicable;
- Dewatering of below ground structures and excavations with management, treatment and disposal of water; and,
- Backfill of excavations to leave the site safe and level, with validated made ground, certified demolition arising, crushed concrete or imported fill.

Remediation

- Remediation of soils impacted with contaminants above target levels through capping of materials to manage SPR linkages.

4.3 Works Approach

4.3.1 Enabling works

Prior to mobilisation and commencing the enabling earthworks and remediation the following documentation, notifications, permits and approvals shall be obtained and in place:

- Approved Schedule;
- Construction Phase Health and Safety Plan;
- Method Statements and Risk Assessments;
- Occupational Health Plan;

- Environmental Permit;
- Trade Effluent Discharge Consent / Water Discharge Activity Environmental Permit;
- Traffic Management Plan;
- Construction Environmental Management Plan;
- Materials Management Plan;
- Emergency Response Plan; and,
- Surface Water Management Plan.

A site compound, including welfare facilities and parking will be required to be established in a suitable area on site. Temporary buildings, structures, equipment and facilities shall be properly maintained for so long as it is in use, and the compound, welfare and parking facilities cleared away on completion. Appropriate site fencing, signage and security shall be implemented to protect the works.

4.3.2 Environmental Permit

An Environmental Permit (EP) Mobile Treatment Licence is likely to be required in order to conduct works comprising the treatment and reuse of site won material identified as requiring remediation and the treatment of any contaminated waters recovered during the works. This is typically held and deployed by the party responsible for designing and managing the execution of the remediation who are responsible and accountable for compliance with regulatory requirements.

An EP deployment form will need to be submitted to and approved by the EA (Environmental Permit Team) detailing the remedial approach and associated engineering controls, prior to treatment being undertaken.

The processing of site won materials which do not require treatment for environmental purposes does not need to be conducted under an EP. If uncontaminated made ground is to be processed and an EP for mobile plant is not in place then an EA Standard Rules Permit for the low risk crushing and screening of materials will also be required.

4.3.3 Discharge Consent / Water Discharge Activity Environmental Permit

All accumulated, perched or ground water encountered within the Made Ground shall be collected in a holding tank or lined lagoon prior to any treatment and subsequent discharge. The incidental water shall either be:

a) discharged to foul sewer under a trade effluent consent agreed with the local sewerage undertaker and/or;

b) discharged to surface water under a Water Discharge Activity Environmental Permit (“WDA-EP”) from the EA.

The Contractor shall make arrangements to identify the most sustainable, compliant and cost-effective discharge method and ensure that relevant permissions and consents are received prior to discharging.

4.3.4 Materials Management

Remediation measures will involve the movement of materials. It is important that they are not classified as a waste (as defined by Waste Framework Directive) on completion of the works.

4.3.4.1 Achieving Non-Waste Status

As discussed in Section 2.13.3, there are several different waste regulatory options available, the suitability of which is dependent upon the complexity of the site and the quantity/composition of the material to be reused. It has been concluded the most suitable option is via an application in accordance with CL:AIRE guidance ‘Definition of Waste: Development Industry Code of Practice’ (DoWCoP). Please refer to section 2.13.3 for further details on this use of the DoWCoP.

4.3.4.2 Use of slag under the DoWCoP

Engagement with the Environment Agency was undertaken on the proposal to re-use iron & steel slag rich made ground under CL:AIRE Definition of Waste: Development Industry Code of Practice (DoW CoP) on the Site of Origin at the Metals Recovery Area, South Bank.

The Environment Agency's position following this engagement is that the steel and iron slag that makes up the made ground located outside of designated former and current landfills is not waste and can be re-used under CL:AIRE DoW CoP based on the following parameters;

- *the developer/operator can demonstrate that the steel and iron slag was used for an intended purpose, i.e. to heighten and extend the marshy low-lying ground for the purpose to use and develop that land.*
- *the developer/operator can demonstrate that the steel and iron slag was deposited pre-Control of Pollution Act (1974). This is in line with our approach not to bring areas of land no longer regulated back into regulation unless not doing so would undermine our existing legislative regime.*
- *Should the re-development area incorporate areas of land that have clearly been designated 'landfill' (both under current permit and historical prior to waste legislation) then if this waste is excavated at any point, current waste regulations will apply for the treatment and/or disposal, recovery and re-deposit of the waste.*

4.3.4.3 Materials Management Plan

An MMP shall be prepared in accordance with CL:AIRE Code of Practice (Definition of Waste) and authorised by a Qualified Person registered with CL:AIRE. Excavated materials will be segregated and sorted into categories as defined in Section 2.13.3.

4.3.5 Soil Sampling

Soil sampling will be undertaken by an STDC appointed representative and at the frequency proposed in Section 4.3.8 and in line with the requirements set out in the Earthworks Specification.

Where samples are required to be taken from the excavation (representative of materials left in-situ or materials reused as backfill) locations shall be machine scraped across the validation sample location and a representative soil sample collected for analysis. Sample locations shall be defined on a predefined grid basis to ensure appropriate coverage and frequency.

Where samples are required to be taken from stockpiles of materials, sampling from stockpiles will be undertaken in order to collect a representative sample.

Further information on the proposed sampling strategy, including sampling frequency and testing schedule will be provided within the Earthworks Specification and the Materials Management Plan.

4.3.6 Excavations

4.3.6.1 General Excavations

The scope of the excavation works is outlined in Section 2.13. Where practicable obstructions will be removed and crushed for re-use on site. Materials which are impacted with contaminants to levels above the defined reuse criteria shall be treated using the remediation strategy or, if treatment is not considered possible, disposed of offsite under full duty of care.

Made Ground materials will require size screening and crushing to enable reuse. Any deleterious materials not suitable for incorporation into the fill material, such as scrap, wood, plastic, putrescible materials etc will be segregated and stored separately on site. Such materials will then be disposed offsite under full duty of care.

4.3.6.2 Slags and Refractory Materials

Ground conditions at the site present a number of potential geotechnical constraints. It is anticipated that the majority of these can be dealt with by adopting appropriate engineering controls at the development phase.

However, Arcadis recommend where potentially expansive refractory materials are excavated as part of the enabling excavations these be managed by Excavation, Separation, and Reuse in low risk areas of the site as defined by STDC. Treatment may also be undertaken if this is identified as feasible for the materials in the given timescale.

The above is intended to reduce rather than eliminate the risks from these materials. Additional management through the use of engineering controls are likely to be required depending on the final redevelopment and these are to be the responsibility of the developer.

4.3.6.3 Segregation and Stockpiling

Excavated materials identified by laboratory analysis as chemically unsuitable for direct reuse will be stockpiled for treatment. Stockpile and treatment areas will be required to be placed on impermeable surfaces with covers and suitable drainage to collect and dispose of waters. Validation testing of these areas will be undertaken to prove the land quality pre- and post-remediation.

4.3.6.4 Surveying

All excavations shall be surveyed by the appointed Remediation Contractor to allow for accurate measurement of excavation extents and to establish remediation verification sample locations.

4.3.6.5 Relic Underground Structures and Services

The following shall be implemented with respect to relic structures:

- Relic structures shall be removed where encountered within 2.5m bfl in the Made Ground. Where relic structures are encountered within 2.5m bfl but continue below 2.5m bfl confirmation on the requirement to remove them below this depth shall be required from STDC. If removal is not required a record of the residual foundation or obstruction shall be made recording the topographical coordinates, size and type.
- Where encountered, piled foundations shall be removed to a maximum extent of 2.5m bfl. A record of the residual foundation shall be made recording the topographical coordinates, size and type.
- Redundant pipework is likely to be encountered within the excavations which may act as preferential pathways for the migration of contamination. Where encountered redundant pipe work will be removed from the excavations. Should complete removal not be possible or feasible then residual pipework will be sealed at the edges of excavations and the location recorded on an as-built survey.

No specific development plans have been made available at the time of writing this remediation strategy and any future development plans may need to account for structures remaining in-*situ* or partially removed following these works depending on the specific redevelopment.

4.3.6.6 Boreholes

There are existing borehole installations across the South Bank Western Area site. Where possible boreholes within defined excavation areas should be protected, however if this is not practicable, they are required to be decommissioned in accordance with the relevant British Standards and EA guidance.

4.3.6.7 UXO

A desktop UXO assessment has been completed for the STDC boundary. The outcome of the assessment indicates a Medium risk from UXO for borehole and excavation activities. Further mitigation activities such as detailed risk assessment or site mitigations are considered essential to reduce the UXO risk on the site to As Low As is Reasonably Practicable (ALARP). These additional mitigating factors should be defined within the Principal Contractors Construction Phase Plan (CPP).

4.3.6.8 Utilities and Services

A review of the available data sources provided to Arcadis has highlighted a number of live services and utilities that cross and bound the site: These services include;

- Overhead and below ground electric,
- Natural Gas Line
- Industrial Water Supply
- Storm Drains. and
- Railway and railway network infrastructure;

There is the potential for other utilities to be crossing the site including redundant gas pipes, water pipes and electrical cables as well as live 3rd party utilities.

Where works are required on or adjacent to the railway infrastructure, consultation with Network Rail's Asset Protection and Optimisation teams (ASPRO) is required to determine permitting requirements, working procedures and requirements for exclusion or standoff zones.

At the time of writing a constraints plan is not available which would identify which site services and 3rd party utilities are required to remain and be protected during the remediation and reclamation works. The constraints plan will be reviewed and accounted for within the CPP.

4.3.7 Groundwater Management

Groundwater and accumulated water are anticipated to be encountered within excavations and subsurface structures, this will require removal to facilitate excavation and backfilling works.

The Contractor shall minimise the quantity of water requiring pumping by backfilling excavations as soon as practicable and avoiding the potential for accumulation of rainwater in open excavations.

The Contractor shall ensure that recovered groundwater is sampled and classified to allow appropriate disposal, either via direct disposal to site foul drainage under discharge consent, *via* on site treatment and discharge to foul drainage under consent, or by tankering and disposal from site.

Any temporary storage of groundwater or accumulated water shall be within storage vessels, which are to bunded and equipped with drain-down and sampling valves.

4.3.7.1 Removal of NAPL on Groundwater

If free phase NAPL is encountered on the groundwater during excavation works, the Contractor shall undertake recovery prior to groundwater discharge. The Contractor shall continue the NAPL recovery process until no visible NAPL is observed or further recovery is not reasonably practicable (evidenced by diminishing recovery quantities i.e. base of asymptotic curve).

Where there is evidence of the presence of NAPL in the unsaturated zone, excavations will be extended to expose the groundwater table and identify if it is impacted by the above material and if groundwater treatment is required.

4.3.8 Remediation Criteria

The following Remediation Criteria have been developed for Human Health receptors at the Site (in order of priority):

- LQM/CIEH Suitable for Use Levels (S4UL) (LQM / CIEH, 2015),
- Department of Environment Food and Rural Affairs (DEFRA) Category 4 Screening Levels (C4SL) (DEFRA, 2012),
- Arcadis derived generic assessment criteria based on CLEA v1.07,
- United States Environmental Protection Agency (U.S. EPA) Regional Screening Levels (RSLs)

Wood derived GAC based on CLEA v1.07 were presented in the Wood 2019 report for benzo(a)pyrene and naphthalene. It is understood that these values and the use of the LQM S4Uls were acceptable to the regulator for this site.

4.3.8.1 Compliance Sampling Frequency

Remediation Criteria Point	Remediation Objective	Compliance Criteria [1]
Excavation Extents in areas without NAPL	Ensure that concentrations of asbestos within soils within the uppermost 0.1m of materials do not exceed the defined risk-based thresholds	Composite soil samples do not exceed the Remediation Criteria. Samples collected at the following frequency • One sample per 50 linear metres of excavation from within the top 0.6m
	Ensure that soils remaining in-situ do not contain contaminant concentrations in excess of the remediation and reclamation criteria	Composite soil samples do not exceed the Remediation Criteria. Samples collected at the following frequency • One sample per 50 linear metres of excavation; and, • One sample per stratum or at 1.0m vertical intervals (whichever is the greater) • One sample per 100x100m extent of excavation base • One sample per 2,000m^3 of stockpiled excavated Made Ground. • One sample per 2,000m^3 of stockpiled crushed site aggregate
Excavation Extents in areas with NAPL	Ensure that concentrations of asbestos within soils within the uppermost 0.1m of materials do not exceed the defined risk-based thresholds	Composite soil samples do not exceed the Remediation Criteria. Samples collected at the following frequency • One sample per 25 linear metres of excavation from within the top 0.6m
	Ensure that soils remaining in-situ do not contain contaminant concentrations in excess of the remediation and reclamation criteria	Composite soil samples do not exceed the Remediation Criteria. Samples collected at the following frequency • One sample per 25 linear metres of excavation; and,

[1] Sampling frequency to be formalised and agreed as part of the Earthworks Specification and MMP

Remediation Criteria Point	Remediation Objective	Compliance Criteria [1]
		• One sample per stratum or at 1.0m vertical intervals (whichever is the greater) • One sample per 50x50m extent of excavation base • One sample per 625m^3 of stockpiled excavated Made Ground. • One sample per 625m^3 of stockpiled crushed site aggregate
Imported Materials	Ensure that materials imported and used at the site do not introduce environmental or human health risks	Soil samples collected at a frequency of one sample per 2,000 m^3 of imported material (with a minimum of three samples per source) do not exceed the Remediation Criteria.
Accumulated NAPL	Ensure that no NAPL is present on groundwater as far as is reasonably practicable	No visible NAPL to be recorded on groundwater or accumulated water as far as reasonably practicable [2]

4.3.8.2 Suitability for Use Criteria

For excavated materials the following reuse criteria will apply:

Reuse Criteria Point	Objective	Compliance Criteria [3]
Reuse below capping layer	To ensure that concentrations of asbestos and presence of NAPL within materials proposed for reuse do not exceed agreed reuse criteria.	Composite soil samples collected at a frequency of one sample per 2,000 m^3 of material proposed for re-use. Human Health - Laboratory analysis confirms concentrations of contaminants are below the criteria set out in Wood 2019 (LQM S4UL and Wood GAC). Water Resources – Reuse criteria to be confirmed by the DQRA. Geotechnical – Backfill in line with Highways Specification. Exact specification to be confirmed in Earthworks Specification. NAPL – Negative NAPL test by field screening kit.
Reuse as capping materials	To ensure that concentrations of contaminants within materials proposed for reuse do not exceed agreed reuse criteria.	

4.3.9 Management of Contaminated Soils

In order to address the identified pollutant linkage in section 2.7.1 it is proposed that remediation should be undertaken to break the pathway between the contaminants and the receptor.

[2] To consider that further free phase recovery is not reasonably practicable, it should be demonstrated that free phase recovery rates have diminished to asymptotic conditions.
[3] Sampling frequency to be formalised and agreed as part of the Earthworks Specification and MMP

This should comprise placement of protective cover layers in areas where contaminants in soils are identified above the reuse criteria. A temporary cap is to be installed to provide risk reduction prior to redevelopment when the final capping solution shall be required to be engineered into the design requirements.

4.3.9.1 Temporary Cover System

In order to facilitate development a temporary cover system should be installed across the footprint of the site; this temporary cover system should comprise 200mm of site won or certified imported materials (which may include the Mudstone being brought onto site from an off-site source) which meet the reuse criteria defined in Section 4.3.8.2. The presence of the cover system should be considered when the final construction phase planning and design are finalised

4.3.9.2 Developer Led Remediation Requirements

As part of the future developer led re-development works, a permanent cover system should be incorporated into the design and construction works. Areas of hardstanding will act as a suitable cover system however in areas of soft standing and landscaping the following permanent cover system should be incorporated into the design and installed:

- Geotextile marker layer over soils containing exceedance of the reuse criteria; and
- 450-600 mm thickness of suitable imported materials.
- Suitable Engineering controls in structures as required (e.g. ground gas and vapour, concrete design).

4.3.9.3 NAPL Impacted Materials

Materials impacted with NAPL are likely to be excavated as part of the enabling earthworks. The most sustainable use of these materials is to facilitate their reuse on site and, as such, treatment is required to make them suitable for use such that they do not represent a potential ongoing source of contamination. The volumes of materials for treatment have been estimated at between 5-10% of the predicted soil arisings, however due to the discrete nature of these impacts, materials will potentially be generated throughout the works and in variable amounts.

The exact approach to treatment of materials impacted with NAPL will be influenced by a number of variables including volume of material, contaminant loading, contaminant properties and timescales. A number of remediation technologies are available that could technically, operationally and commercially be employed to meet the remediation objectives and make the NAPL impacted soils suitable for re use at the site, these include;

- Ex situ bioremediation;
- Stabilisation
- Soil Washing;
- Ex situ thermal remediation (smouldering combustion or thermopile); and,
- Excavation and disposal

Where soils are visibly impacted with NAPL or onsite screening / testing indicates the presence of NAPL they shall be consigned for treatment either on site or within a wider project treatment hub

4.3.9.4 Management of Asbestos Containing Materials

It is anticipated that there is a potential for asbestos fibres to be identified within materials excavated from the South Bank Western Area, however only a limited number of the historical ground investigation works have scheduled asbestos analysis and therefore it cannot be determined at this point how frequently materials are expected to contain asbestos containing materials.

During excavation works to remove underground structures there is the potential for ACM to be encountered. In the event that suspected ACM materials are observed associated with excavations, sampling will be undertaken to confirm the asbestos type and quantification. Where ACM has to be

removed to facilitate removal of structures it shall be separately stockpiled and covered to control potential dust generation.

Soils containing asbestos in excess of the reuse criteria will not be subject to mechanical screening where free fibres have been detected or are suspected. All soils containing asbestos will be managed by maintaining mist sprays to keep the soils wet whilst handled and covered when stockpiled.

Soils which have been identified as containing asbestos (or suspected to) will be stockpiled separately from all other excavated materials. These materials will be characterised by sampling and laboratory analysis.

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

Where soils containing CoC in excess of the reuse criteria and, due to the presence of asbestos cannot be safely handled or successfully treated, they will be disposed of offsite.

4.3.9.5 Management of Potentially Expansive Refractory Materials

If these materials are excavated as part of the enabling earthworks and are not comingled with other materials, they should be separated from other materials as far as practicable and stockpiled. Material should be crushed to 6f2 or similar suitable material class and reused in areas identified by STDC as low risk from the effects of expansive properties.

The above is intended to reduce rather than eliminate the risks from these materials. Additional management through the use of engineering controls are likely to be required depending on the final redevelopment, these are to be the responsibility of the developer.

4.3.9.6 Invasive Species

Treatment of Japanese Knotweed can be achieved through:

- Herbicide treatment,
- Burying plants under an Environmental Permit or Remediation Position Statement, or
- Disposing of plants off site as controlled waste.

Materials contaminated by Japanese Knotweed, its crown and rhizome shall be remediated using one or a combination of the above treatments. The specific treatment shall be defined as part of an invasive species treatment plan.

4.3.10 Unexpected Contamination

At present, data gaps exist in the south of the site in the vicinity of the potential source area and no detailed characterisation has been undertaken in this area of the site.

Additionally, changes to the remediation strategy may be required during the remediation works, as a result of encountering unexpected contamination [4]. Should unexpected contamination be encountered, then further characterisation and risk assessment will be undertaken as required. In this situation an addendum to the strategy will be prepared detailing how this contamination will be dealt with. Written agreement with the regulators will be required prior to implementation of any amendments to the agreed strategy. Any such amendments shall be required to be fully documented within the Verification Report.

4.3.11 Anticipated Enabling Earthworks and Remediation Extents Quantities

The extent of the enabling earthworks and remediation have been estimated based on current site information and will be refined following the completion of ground investigation and site assessment works. Anticipated excavation extents are presented on Figure 4 in Section 2.13 and in Appendix A. It should be noted that these are depths from existing site levels and therefore account for land raises, stockpiles and surface features.

[4] This is defined as any contamination source which is distinct in its chemical or physical composition from the type of source material considered within the conceptual site model.

4.3.12 Verification of Excavations and Materials for Reuse

Materials identified for reuse will be required to be tested prior to placement to demonstrate compliance with the reuse criteria. Testing will be undertaken on a proposed frequency identified in Section 4.3.8.

4.3.13 Backfill

All Made Ground will be excavated and screened to remove oversize or deleterious material. Oversize material will be crushed for reuse, while deleterious material will be removed from site. All remaining material will be placed into stockpiles and subjected to testing and grading to ensure suitability as defined in series 600 of the Specification for Highways. Where the material does not meet the suitability criteria, it will be subjected to physical treatment, modification or stabilisation as required to achieve the necessary degree of compaction. Imported fill such as mudstone may be used if sufficient suitable site-won materials cannot be identified to meet development timescales.

No detailed redevelopment design is currently available for the site and therefore no groundworks model with cut and fill levels is available. In addition, the geotechnical specification for backfilling is not provided as a development ready platform but to provide a level access to and around the site.

The Earthworks Specification should be consulted for further details 10035117-AUK-XX-XX-RP-ZZ-0419-01-South_Bank_West_Earthworks [in press]

Where required, imported materials from off site or the wider Teesworks shall be used to fulfil any materials deficit. Imported material must be certified free of asbestos (or contain only trace levels no higher than those pre-existing on site as demonstrated by Arcadis 2021) and other deleterious material. For each source of imported material for backfill, a material statement shall be provided detailing the chemical testing results, geotechnical testing material classification, destination of material deposition on site and proposed method of compaction. Site won materials that are re-used on site must be demonstrated as suitable for use in accordance with the MMP. Prior to backfill, excavations will be dewatered. Excavations will be backfilled in layers in accordance with the Highway Specifications.

4.3.14 Environmental Controls and Management

The Contractor shall prepare and submit a Construction Phase Environmental Management Plan (CEMP) for the Works and shall consider the following environmental aspects.

4.3.14.1 Surface Water Management

The Contractor shall develop and implement a surface water management plan as a component of the CEMP to provide temporary drainage facilities and protection measures (such as silt fences) as necessary to ensure the site, the Remediation Works, the adjacent land and existing facilities are adequately drained and run-off managed during the course of the Work.

The Contractor shall ensure that surface water and other water generated as part of the Works shall be monitored and treated via an appropriate water treatment system in order to meet the requirements of the Environmental Permit or Trade Effluent Discharge Consent.

This may include;

- Settlement tanks, lamella filters, sand filters or similar, to remove solids and fines from water.
- Granular Activated Carbon filtration.
- pH adjustment.
- Any further treatment necessary to effect compliance with the consent limits.

4.3.14.2 Dust, Noise and Vibration

Air Quality and Dust Management Plan

An Air Quality and Dust Management Plan (AQDMP) will be prepared as a component of the CEMP. Baseline data will be collected as part of this plan to allow the impact of the works on the surrounding environment to be determined and allow the success of control measures undertaken to protect the site workforce and neighbouring receptors to be assessed. Trigger levels for remedial action will be defined within this plan.

Dust control measures will be implemented through the works including the use of damping down, sealing of stockpiles and vehicle wash facilities to prevent the transport of mud and debris from the site onto public roads.

Asbestos

A reassurance monitoring plan and program shall be developed and implemented for asbestos air monitoring will be prepared as a component of the CEMP. Baseline data will be collected as part of this plan to allow the impact of the works on the surrounding environment to be determined and allow the success of control measures undertaken to protect the site workforce and neighbouring receptors to be assessed.

Noise

Prior to commencement on site noise data will be taken to establish baseline conditions. Trigger levels to prevent unacceptable impacts to receptors shall be identified within the CEMP and agreed with the Regulators. Noise monitoring stations will be implemented to monitor the impact of the Works against background levels and allow measures to be implemented to ensure noise levels remain below these limits.

Vibration

Prior to commencement on site vibration levels will be taken to establish baseline conditions. Trigger levels to prevent unacceptable impacts to receptors shall be identified within the CEMP and agreed with the regulators. The Contractor shall implement vibration monitoring stations to monitor the impact of the Works against background level and these limits.

4.3.14.3 Ecology

As discussed in Section 2.1 following the completion of the ecological surveys and review of the findings of the HRA, any control and mitigation measures identified within it shall be adopted in relations to the remediation and restoration works and future development.

5 Reporting

5.1 Pre-commencement

5.1.1 Materials Management Plans

An MMP, as detailed in Section 2.14 shall be prepared by the appointed Contractor in accordance with CL:AIRE DoWCoP and authorised by a Qualified Person registered with CL:AIRE.

5.1.2 Construction Phase Environmental Management Plan

The appointed Contractor will prepare a construction phase environmental management plan (CEMP) for the works. This will consider the potential impacts that the works will have on the environment and include any monitoring and control measures required.

The plan will set out the monitoring and recording process for the management and minimisation of waste, including the storage and transport of waste on-site. This will include a recording mechanism for required waste documentation such as Waste Transfer or Consignment Notes (dependent on the waste stream) in order to confirm the assessment of the waste impact and to implement embedded mitigation measures.

The CEMP will include their methodologies for controlling and monitoring the following aspects of the works:

- Waste Management Procedures
- Noise and vibration
- Air quality and dust management
- Any ecological mitigations required
- Surface water drainage
- Spills and environmental releases
- Monitoring and measuring procedures
- Relevant policies, legal requirements and key stakeholders

5.2 Implementation

During remediation implementation, regular meetings will be held and minuted by the remediation contractor to provide robust control of the work. Meetings are proposed to include:

- Pre-start Meeting
- Daily Site Briefings
- Weekly Site Progress Meetings
- Fortnightly Contract Review meetings
- Risk Reduction/Change Management Meetings
- Project Close Out Meeting

Data types to be collected and reviewed during the remediation implementation period are described in Section 5.3 below. Records will be produced to detail progress of the works. Should site conditions vary from those currently known, resulting in a change to the proposed remediation strategy, this will be communicated to relevant stakeholders at the earliest opportunity to allow for an amended approach to be developed and approved.

5.3 Remediation Works Verification Report

Verification of remediation will be based on a number of lines of evidence collected during the works and tracked through the implementation phase. These will be documented within the final Verification Report as follows:

5.3.1 Field records

Field records will be collected by the remediation contractor to verify the works may include the following;

- Excavation extents and depths supported by topographic survey data;
- Volumetric measures of materials excavated and removed from site;
- Field screening / onsite analysis of soil samples;
- Records of required backfilling and compaction processes;
- In situ geotechnical testing of reinstated material to ensure compliance with Earthworks Specification;
- Volumetric records of water and free phase hydrocarbons recovered from excavations; and,
- Photographic records.

5.3.2 Laboratory Results

Soil and water sampling and accredited laboratory analysis data will be provided to confirm that:

- On completion of excavations, contaminant concentrations within remaining in situ soil meets the reuse criteria, as far as is reasonably practicable (laboratory results).
- Contaminant concentrations within excavated soil that may be re-used onsite as infill to excavations meet the reuse criteria.
- Recovered groundwater / treated groundwater is suitable for off-site disposal, re-infiltration or disposal under consent to foul drainage network.
- Material imported onto site as backfill meets the reuse criteria.
- Reinstated material complies geotechnically with the Earthworks Specification. Laboratory analysis will be undertaken by a UKAS accredited laboratory.

5.3.3 Topographic Survey Records and Drawings

Site drawings and topographic plans will be developed by the remediation contractor to demonstrate that:

- Source areas have been removed (if identified) and provide records of excavation extents during the Works;
- Records of below ground obstructions left in-situ following the works;
- Site levels have been restored to the agreed formation levels;
- Thickness and extent of capping layer placed on the site; and,
- Re-used materials have been located in the correct place through as-built drawings showing locations of remedial works and records of residual hazards

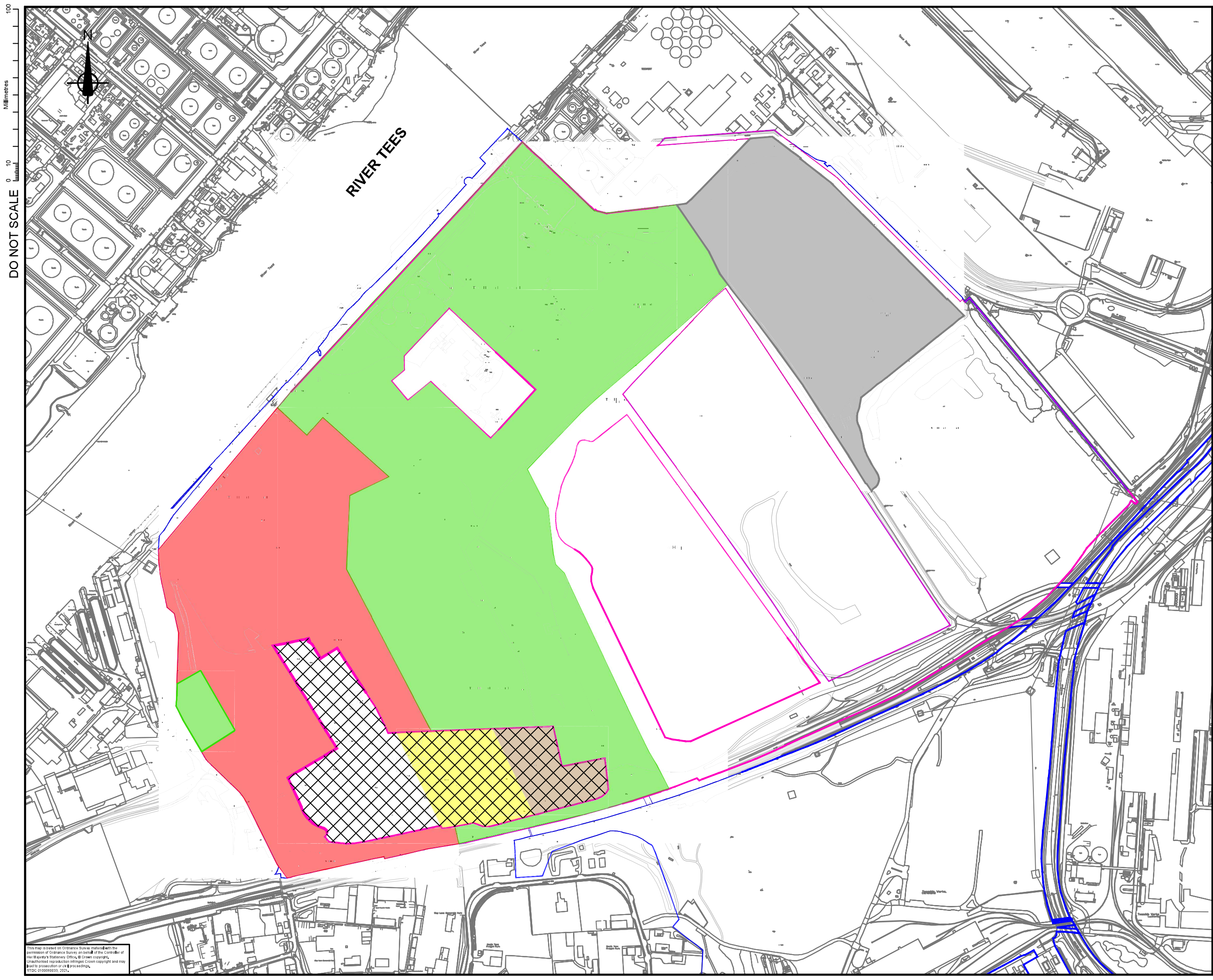
5.3.4 Materials Audit Trail Records & Environmental Monitoring

The results of the monitoring and testing set out in the CEMP, including details of any spills or emergency response measures employed, will be included together with evidence to demonstrate that:

- Re-used material has been deposited in the correct location in compliance with the MMP;
- Waste materials have been properly quantified and have been accepted by an appropriately licenced facility include completed waste transfer documentation; and
- Imported materials are of correct quality and volume for use on site and free of asbestos.

APPENDIX A

Figures



NOTES

1. DO NOT SCALE FROM THIS DRAWING

KEY:

- TEESWORKS LAND OWNERSHIP BOUNDARY
- SOUTH BANK OUTLINE PLANNING PERMISSION BOUNDARY (R/2020/0357/OOM)
- AREA EXCLUDED FROM OUTLINE PLANNING PERMISSION (R/2020/0357/OOM)
- AREAS WITH APPROVED CONDITION 16 DISCHARGE
- REQUIRED REMEDIATION STRATEGY/CONDITION 16 DISCHARGE AREA
- REMEDIATION WORKS CAPTURED UNDER PLANNING PERMISSION (R/2020/0465/FFM)
- FORMER SOUTH BANK COKE OVENS PHASE 2 REMEDIATION WORKS
- REMEDIATION WORKS CAPTURED UNDER FULL PLANNING PERMISSION (R/2021/0465/FFM)

Rev.	Date	Description	By	Chk'd	App'd
E	JAN 2022	UPDATED RED PLANNING BOUNDARY	KW	LCD	JMC
D	JAN 2022	ADDED TO KEY	KW	LCD	JMC
C	DEC 2021	GE PHASE 2 AREA ADDED	KW	LCD	JMC
B	NOV 2021	QUAY AND OFFSHORE PHASES ADDED	LCD	LCD	JMC
A	OCT 2021	UPDATED KEY AND ADDED HATCH	KW	LCD	JMC

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South Tees Development Corporation

Project Title: TEESWORKS
The UK's largest industrial zone

Drawing Name:

SOUTH BANK R/2020/0357/OOM REMEDIATION CONDITION 16 DISCHARGE OVERVIEW PLAN

Drawn by: KW Date: OCT 2021
Checked by: LCD Date: OCT 2021
Approved by: JMC Date: OCT 2021

Drawing Number: TSWK-STDC-SBK-ZZ-DR-C-0047
Revision: E

Drawing Scale: 1:1250 @ A1, 1:2500 @ A3
Page Size: A1/A3