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THE FORMER SSI STEELWORKS, REDCAR: PRIORITY AREAS WITHIN SSI LANDHOLDINGS CONTRACT 3

Contract 3: Environmental Risk Assessment Report

South Tees Site Company Limited

REPORT NO. Redcar Steelworks-AUK-XX-XX-RP-GE-0001-01-SSI3_GI_ERA

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The Former SSI Steelworks, Redcar: Priority Areas within SSI Landholdings Contract 3

Contract 3: Environmental Risk Assessment Report

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APPENDICES

1 INTRODUCTION

1.1 Project Background

The former SSI landholdings are made up of eleven discrete, sizeable land parcels situated in the Redcar, Lackenby, Grangetown and South Bank conurbations of the Borough of Redcar & Cleveland, within the industrial area generally known as 'South Tees'.

Desk study work has been ongoing since November 2016, and in two of the SSI areas at Redcar (SSI1 and part of SSI2), this work has already been augmented by an advance programme of ground investigation works, comprising close to 300 trial pit excavations (SSI1) and 67 trial pit excavations (part of SSI2), together with laboratory analysis. The desk studies and advance programme of ground investigation works was undertaken by CH2M. A package of investigations was subsequently designed for the SSI land, namely SSI1, SSI2 and SSI3.

1.2 Contract Details

Arcadis (UK) Limited (Arcadis) were appointed by South Tees Site Company Limited (STSC) to oversee and manage a ground investigation undertaken by Allied Exploration and Geotechnics Limited (AEG) and to provide consultancy advice with respect to redevelopment of the site. The work was carried out in accordance with the "Ground investigation consultancy services former Iron and Steel Works Site, South Tees" contract (Ref: STSC-JN-0007) dated 14 September 2017.

The scope of works was defined by CH2M, on behalf of STSC, and presented in:

- South Tees Site Company Limited, Ground Investigation Consultancy Services, Former Iron and Steel Works Sites, South Tees, Invitation to Tender (STSC Reference Number: STSC-JN-0007, dated July 2017).

The scope of works being undertaken by AEG was developed by CH2M and is presented in:

- STSC - SS - 0030 - Ground Investigation – Contract 3 – Invitation to Tender – The Former SSI Steelworks, Redcar – Ground investigation: Priority Areas within SSI Landholdings Contract 3. CH2M., August 2017.

1.3 Project Aims and Objectives

The overarching aim of the works was to deliver a sustainable ground remediation strategy for the contract sites which is compliant with regulatory needs and has their approval in principle. As technical consultant, the specific objectives of this phase of works were to:

- Manage and technically supervise the site works, undertaken by AEG, on behalf of STSC;
- Direct the site works to ensure compliance by the ground investigation contractors with existing site management protocols and procedures;
- Specify the requirements for laboratory analysis;
- Analyse the results of ground investigations;
- Prepare interpretative technical reports, namely;
    - Site Condition Report
    - Environmental Risk Assessment Report
    - Geotechnical Risk Assessment Report
    - Remediation Options Appraisal Report
- Consult with regulators to ensure compliance with all relevant regulatory requirements;
- Develop cost-effective, value-engineered outline remediation strategies.

1.4 Report Aims

The aim of this environmental risk assessment is to use the available information to assess the significance of source-pathway-receptor (SPR) linkages identified by the Site Condition Report within the conceptual site model (CSM) for the contract area. Where significant, and potentially complete, pollutant linkages are identified, suitable risk management/remediation recommendations are to be made.

1.5 Scope of Work

This environmental risk assessment relates to the physical ground investigation works relating to the SSI3 Landholding (external to buildings), Redcar (Contract 3, Areas A and B).

Figure 1 provides details of the facility location and the site investigation areas.

The scope for the risk assessment comprised:

- Identification of appropriate generic environmental screening criteria for the site based on continued industrial end use;
- Screening of the environmental data collected from the site as presented in the Site Condition Report against the identified generic criteria;
- Where necessary derivation of site specific screening criteria to allow exposure pathway specific screening to be completed;
- Review and update the CSM derived for the site; and,
- Provide recommendations for risk management or remediation.

The legislative context and regulatory guidance for the management of potentially contaminated land is presented as Appendix A.

1.6 Previous Information

The following reports have been prepared by CH2M, AEG, and Arcadis relating to SSI3:

- TS3 Grangetown Prairie – Phase 1 Geo-environmental Desk Study prepared for the Homes and Communities Agency (CH2M Reference Number 678079_TS3_001, dated August 2017), and;
- SSI3 Redcar Works – Phase 1 Geo-environmental Desk Study prepared for the Homes and Communities Agency (CH2M Reference Number 678079_SSI3_001, dated August 2017).
- The Former SSI Steelworks, Redcar – Ground Investigation Contract – Priority Areas Within SSI Landholdings Contract 3, dated June 2018 (AEG, 2018); and
- The Former SSI Steelworks Redcar: Priority Areas Within SSI Landholdings Contract – Contract 3 Site Condition Report, Redcar Steelworks-AUK-XX-XX-RP-GE-0001-02-SSI3_GI_SCR, dated July 2018 (Arcadis, 2018)

This environmental risk assessment should be read in conjunction with the aforementioned reports.

1.7 Reliability / Limitations of Information

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

It should be noted that ground conditions between exploratory holes may vary from those identified during this ground investigation; 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 was carried out and the weather before and during the investigation.

Arcadis have incorporated and utilised data from recent CH2M investigations of SSI1 and SSI2A in this report. Arcadis can provide no reliance as to the accuracy of this data.

2 Summary of Preliminary Conceptual Site Model

2.1 Site Description and Background

The SSI 3 Contract site comprises two areas:

- Area A consists of the former Torpedo Ladle Repair Shop (TLRS), located to the southeast of the Former SSI Steelworks, Redcar facility off Tees Dock Road, Middlesbrough (NGR 454792, 521116).
- Area B consists of the southern part of the larger Former SSI Steelworks Facility (National Grid Reference (NGR) 455375, 521596), located directly northeast of Area A.

2.1.1 Area SSI3A

Area A mainly comprises the large disused TLRS building together with smaller buildings. Disused railway tracks are present to the north and east of the TLRS building, converging in the east of the site. Two gas oil tanks and several piles of waste including brick, concrete and wood are also present. Ground levels range from approximately 9m to 13 m Above Ordnance Datum (AOD). No potentially contaminative land uses have been identified on the site prior to the construction of the steelworks in 1929.

2.1.2 Area SSI3B

Area B comprises the southern 43 hectares of the former steelworks. Buildings and structures on the site were historically used in several processes, including the Basic Oxygen Steelmaking (BOS) and Concast plant, the water treatment works, substations and storage/stockpile areas for slag and other wastes. Disused railway lines are also present. Ground elevations are between 10m and 13m AOD and include hardstanding, grassed and rough surfacing. Small clay pits and Grangetown Power Station were shown on historical maps prior to the steelworks together with evidence for extensive filling and reprofiling.

Due to the age of the structures on the site, it is likely that asbestos containing materials (ACM) are including in the fabric. Further details on the site description and environmental setting are included in the SSI3 Site Condition Report (Arcadis, 2018).

2.2 Environmental Setting

The bedrock geology at the site comprises mudstones and siltstones. From south to north these are shown on the geological map as the Redcar Mudstone Formation, the Penarth Group and the Mercia Mudstone Group. All three units are classified as Secondary Aquifers.

The overlying superficial deposits comprise Glacial Till (sandy gravelly clay), beneath Glaciolacustrine Deposits (laminated silts and clays). An upper layer of Glacial Till is present above the Glaciolacustrine Deposits in places. Neither are classified as an aquifer although groundwater is likely to be present within this stratum in continuity with the Made Ground, potentially perched above more cohesive layers. Extensive Made Ground is present throughout the site, in places comprising a significant amount of slag and other steel-working wastes.

Groundwater levels in the superficial deposits/ Made Ground were recorded in six boreholes between 0.65 to 1.73meters below ground level (m bgl). Groundwater elevations were generally higher in Area A than Area B. An easterly or north-easterly groundwater flow direction was inferred for Area B, although the Site Condition Report notes that is based on limited data and may be affected by foundations and topographical features. The site is not in a groundwater Source Protection Zone (SPZ).

Surface water features near to the site include Knitting Wife Beck, a culverted channel adjacent to the south of Area A, Holme Beck approximately 110m south of Area A (also culverted), a storm drain within Area A which discharges to Knitting Wife Beck, a large pond south of Area B, and two other streams crossing Area B.

2.3 Preliminary Conceptual Site Model

The Site Condition Report developed a geo-environmental CSM for Area A and Area B, these are presented as Figure 2 and 3 below and in Appendix B. Based on the CSMs, several potentially active pollutant linkages have been identified.

Details of the 2017/18 ground investigation that the CSM and this report are based on are given in the Site Condition Report (Arcadis, 2018).

Potential Human Health SPR Linkages
A = Dust inhalation from Made Ground from site and adjacent land
B = Vapour inhalation of indoor or outdoor air from contaminated soil and or groundwater
C = Direct contact and ingestion
D = Accumulation of ground gas in confined spaces
SPR linkages for construction workers during redevelopment not shown

Potential Water Resource SPR Linkages
E = Leaching of contaminants from Made Ground and point sources to groundwater in superficial deposits
F = Migration of contaminated groundwater to (Secondary (Undifferentiated) Aquifer) in bedrock
G = Migration of contaminated groundwater onto site in Made Ground and Superficial Deposits
H = Migration of contaminated groundwater off site in Made Ground and Superficial Deposits
I = Migration of contaminated groundwater into culverted surface water stream (Holme Beck Knitting Wife Beck) either directly or via storm drain.

Other SRP Linkages
J = Attack by contaminants of concern on foundations

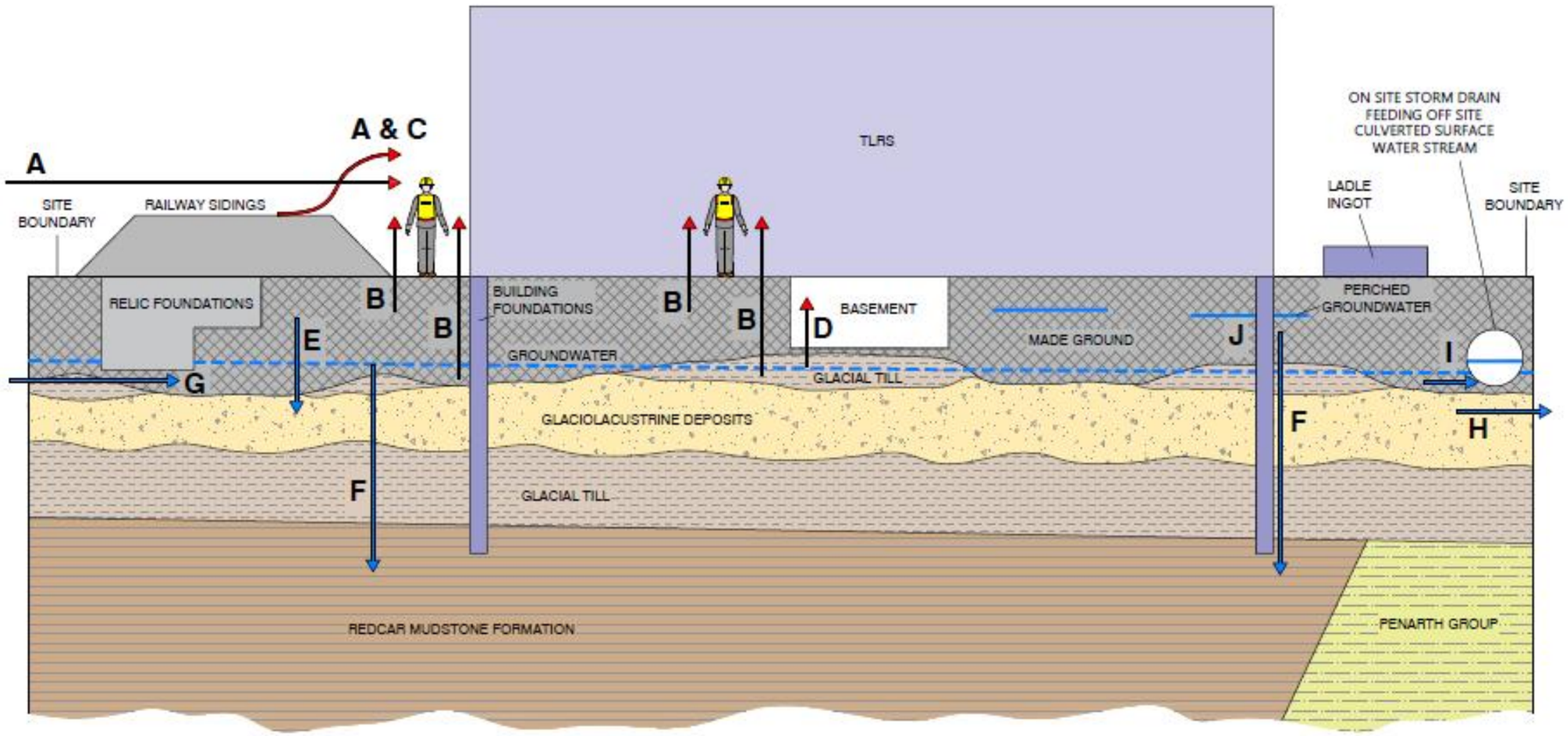

Figure 2: Preliminary Conceptual Site Model Area A

Potential Human Health SPR Linkages
A = Dust inhalation from Made Ground from site and adjacent land
B = Vapour inhalation of indoor or outdoor air from contaminated soil and or groundwater
C = Direct contact and ingestion
D = Accumulation of ground gas in confined spaces
SPR linkages for construction workers during redevelopment not shown

Potential Water Resource SPR Linkages
E = Leaching of contaminants from Made Ground and point sources to groundwater in superficial deposits
F = Migration of contaminated groundwater to Secondary Aquifers in bedrock
G = Migration of contaminated groundwater onto site in Made Ground and Superficial Deposits
H = Migration of contaminated groundwater off site in Made Ground and Superficial Deposits
I = Migration of contaminated groundwater into culverted surface water streams (Kinkerdale Beck, Boundary Beck), and off site pond

Other SRP Linkages
J = Attack by contaminants of concern on foundations

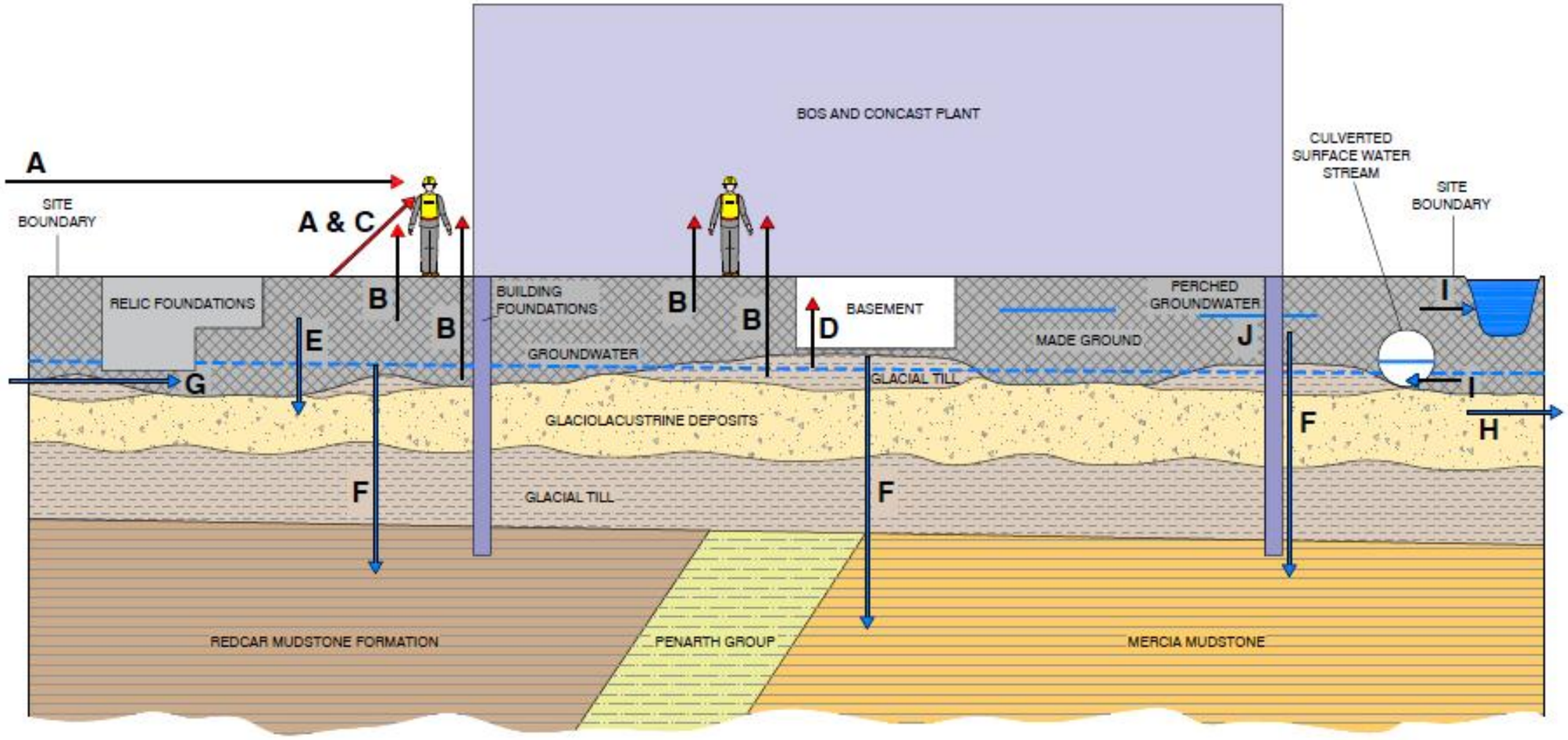

Figure 3: Preliminary Conceptual Site Model Area B

3 Generic Quantitative Risk Assessment

3.1 Tiered Approach

The purpose of this assessment is to quantify potential risks to the human health, controlled waters and built receptors identified in the CSM for a continued commercial/industrial use. An assessment of the geotechnical development constraints is presented in the Geotechnical Risk Assessment Report.

Assessment of risks arising from soil and groundwater contamination are assessed in accordance with the framework presented in Contaminated Land Report 11 (CLR 11) (EA, 2004). This sets out a tiered approach to risk assessment comprising:

- Generic Quantitative Risk Assessment (GQRA) - Comparison of site contaminant levels against generic standards and compliance criteria including an assessment of risk using a source-pathway-receptor model.
- Detailed Quantitative Risk Assessment (DQRA) - Derivation of site-specific risk assessment criteria and calculation of site specific clean-up goals.

In this section, a GQRA has been carried out. The potential identified pollutant linkages identified in the preliminary CSM for human health and controlled water receptors have been assessed by comparison against relevant generic assessment criteria (GAC). These have been derived using conservative assumptions to enable potential pollutant pathways that do not pose unacceptable risks to be identified and discounted. Exceedance of a GAC does not imply that an unacceptable risk is necessarily present, rather that further assessment may be required to verify the potential risk.

It is assumed that the site will be redeveloped as a typical commercial development comprising office buildings, hardstanding and some areas of soft landscaping.

The site has not been zoned at this stage and all data has been considered on an individual sample basis. A summary of the ground investigation findings and the chemical data used in this assessment is presented in the Site Condition Report (Arcadis, 2018).

3.2 Human Health Risks

3.2.1 Selection of Soil GAC

Potentially active pollutant linkages and contaminants of concern (CoC) in relation to human health risks have been identified in the initial CSM for both Area A and Area B as:

A. Dust inhalation from Made Ground from site and adjacent land (potential CoC include asbestos and heavy metals),

B. (1) Vapour inhalation of indoor or outdoor air from volatile contaminants in soil (potential CoC include volatile organic compounds (VOC) and semi-volatile organic compounds (SVOC)),

B. (2) Vapour inhalation of indoor or outdoor air from volatile contaminants in groundwater (potential CoC include VOC and SVOC),

C. Direct contact and ingestion of contaminated soil (potential CoC include heavy metals, organic/inorganic compounds), and

D. Accumulation of ground gas in confined spaces.

Source pathway receptor linkages for construction workers during development are not shown in the CSMs in Figure 2 and 3.

For the purposes of this assessment it is assumed that the proposed redevelopment will comprise a commercial or industrial end use, and as such commercial and industrial workers are the primary receptor of concern for any contamination risk. The risk would be influenced by the duration and location of the staff work regimes. For the basis of this assessment, it is assumed that site workers will be on-site for a “standard” 8 hour working day.

Construction workers/contractors could also be exposed to contaminants during any construction processes (i.e. during any ground reprofiling or utility/foundation trenching).

Users of the adjacent buildings (industrial workers) could also be at risk. However, for exposure to occur, active cross-boundary migration pathways would be required. It is considered that assessment or mitigation showing that there is no significant risk to on-site workers will also be suitably protective of off-site human health receptors.

To assess potential linkages A, B(1) and C above, soil generic assessment criteria (GAC) have been chosen, based on an assumed industrial/commercial end use. Criteria published by authoritative industry bodies and commonly accepted by regulators for use under the planning regime for development sites have been used first. For contaminants for which no published values are available, Arcadis-derived criteria (developed following the CLEA framework (v1.07)) or foreign national criteria have been used.

The soil GAC comprise (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) (USEPA, 2018)

A conservative soil organic matter (SOM) content of 1% SOM has been assumed for the assessment. Soil organic matter recorded in 56No. soil samples obtained from Area A and 95No. soil samples obtained from were analysed for SOM, the results are summarised by material type in Table 1 and Table 2.

Table 1 Summary of Soil Organic Matter (SOM) Testing (Area A)

Soil Material	No. samples	Minimum (%)	Mean (%)	Maximum (%)
Cohesive Made Ground (CMG)	3	1.4	2.0	3.2
Granular Made Ground (GMG)	37	0.5	2.0	7.6
Slag-dominated Made Ground	9	0.5	1.9	3.6
Waste Materials	1	0.8	0.8	0.8
Glacial Till	4	1.1	2.7	5.2
Glaciolacustrine Deposits	2	1.3	1.6	1.8
Grand Total	**56**	**0.5**	**2.0**	**7.6**

Table 2 Summary of Soil Organic Matter (SOM) Testing (Area B)

Soil Material	No. samples	Minimum (%)	Mean (%)	Maximum (%)
Cohesive Made Ground (CMG)	12	0.9	2.0	3.4
Granular Made Ground (GMG)	31	0.4	1.8	5
Slag-dominated Made Ground	45	0.3	1.5	7.8
Waste Materials	1	0.8	0.8	0.8
Glacial Till	3	1	1.4	1.7
Glaciolacustrine Deposits	3	1	2.2	3.7
Grand Total	**95**	**0.3**	**1.7**	**7.8**

The mean SOM concentration for both areas was above 1% indicating the selected GAC are suitably protective of receptors on the site. The selected human health GAC for soil are presented in Appendix C with the maximum concentrations recorded on each site.

3.2.2 Soil Screen

Contaminant concentrations in 58 soil samples from Area A and 100No. soil samples from Area B have been compared with the soil GAC.

None of the contaminants for which criteria have been identified exceeded the GAC for a commercial land use. Contaminants that do not exceed the respective GAC are not considered to be CoC and do not require further assessment in relation to the redevelopment of the site unless the above land use assumptions are not valid.

The GAC and the maximum contaminant concentrations in soil from Areas A and B are shown in Appendix C. The distribution of the exploratory hole locations are shown in Figure 4 and Figure 5 below and in Appendix B.

A previous investigation carried out in Area A (comprising two trial pits and one borehole in the west of the site (Enviros, 2004). One exceedance of the criteria then in use for lead (750 mg/kg) and one for zinc (720 mg/kg) were encountered. However, these are based on out-of-date GAC and neither concentration would exceed the S4UL GAC for an industrial/commercial land use used in this report. Soil pH was found to be high (10.5 to 11 in all four soil samples) and sulphate was also flagged as elevated, both are consistent with the findings of the recent ground investigation.

In Area B, 12No. trial pits and 5No. boreholes were completed in 2004. Out of 17No. soil samples, 2 exceeded the GAC for lead, two exceeded for zinc, one for copper, and one sample for boron (Enviros, 2004). With the exception of one lead concentration (5,163 mg/kg), none of the samples exceeded the current GAC in Appendix D.

Figure 2: Location of GAC Exceedances in Soil – Area A

Figure 3: Location of GAC Exceedances in Soil – Area B

3.2.3 Selection of Groundwater Inhalation GAC

To assess the potential risk to human health via pollutant linkage B (2) above (inhalation of volatile contaminants from groundwater), inhalation GAC have been derived by Arcadis for volatile contaminants in groundwater.

These have been derived by Arcadis using the CLEA process and industry standard vapour transport modelling (Johnson & Ettinger model). The same assumptions relating to a commercial end use of the site have been included in the model and an on-site commercial worker has been considered as the receptor.

The inhalation GAC are listed in Appendix E.

3.2.4 Inhalation from Groundwater

Volatile contaminants in groundwater samples were screened against inhalation GAC (where applicable) that are protective of human health via an inhalation from groundwater pathway (potential pollutant linkage B (2) in the preliminary CSM in Section 2.3.

The inhalation GAC and the maximum contaminant concentrations recorded in the 3No. groundwater samples obtained from 3No. boreholes in Area A and 9No. groundwater samples obtained from 5No. boreholes in Area B are listed in Appendix F.

None of the volatile contaminants exceeded the inhalation GAC for on-site commercial workers and therefore the potential pollutant linkage from inhalation of volatile contaminants in groundwater is not considered likely to be active.

3.2.5 Asbestos in Soil

53 No. soil samples from Area A and 95No. soil samples from Area B were analysed by polarised light microscopy in accordance with HSG248 for the presence of asbestos (HSE, 2005). In Area A, asbestos was detected in 16No. samples (30%) as fibres or bundles of fibres. The most common type was chrysotile fibres (14 detections) followed by amosite (3) and crocidolite (1). Made Ground samples confirmed as containing asbestos were from depths ranging from 0.2m to 3.5m bgl. Asbestos quantification by gravimetric methods was carried out on 17No. samples from Area A. Four samples recorded an asbestos mass lower than the limit of quantification (<0.001 % m/m). The remaining 13No. samples recorded concentrations of asbestos fibres between 0.002 and 0.034% m/m.

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

The horizonal distribution of asbestos detections in Area A and Area B is shown in Figure 6 and Figure 7 respectively below and in Appendix B.

Figure 6:Summary of Asbestos Testing – Area A

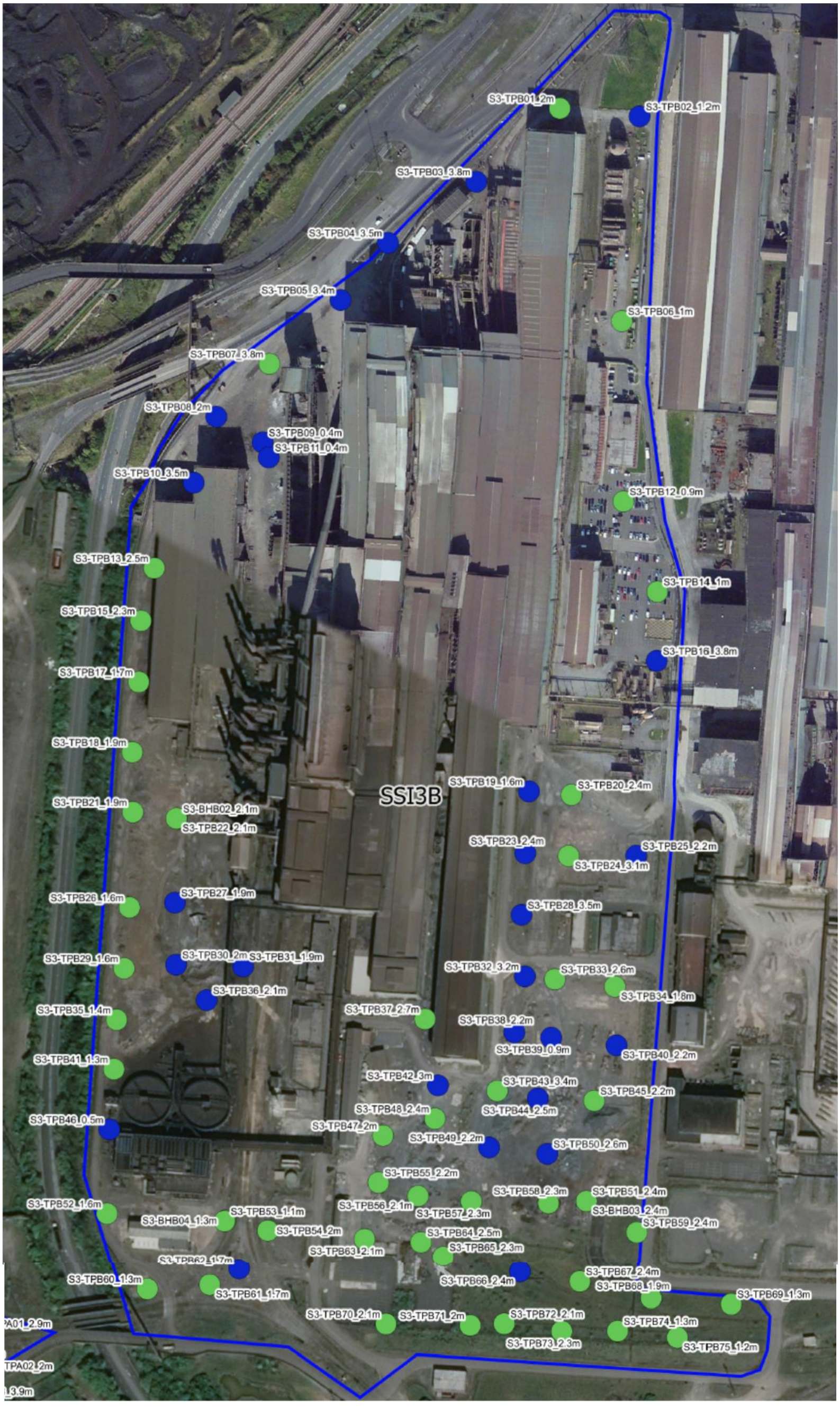

Figure 7: Summary of Asbestos Testing - Area B

3.2.6 Qualitative Risk Assessment for Substances in Soil without GACs

As shown in Appendix D, several contaminants do not have a GAC available, and were recorded at less than the method detection limit (MDL) in all soil samples. These include polychlorinated biphenyls (PCBs), some VOC and SVOC. Based on a review of the MDLs, these are not considered to pose a significant risk, and are likely to indicate an absence of that contaminant group on the site, especially given the relatively low MDLs obtained.

The following contaminants did not have a GAC and were recorded at concentrations in excess of their MDL: aluminium, iron, magnesium, manganese and silicon. These are all elements present naturally in soil and some are biologically required nutrients. They may be elevated above natural levels where slag and other steelmaking wastes are incorporated into soil due to the site's former use, particularly manganese and iron. However, regardless of these elevations, their typically low toxicity is likely to mean these occurrences present a low risk of adverse harm to the development.

Some contaminants, such as thiocyanate, are assessed under other GAC for higher toxicity contaminants, such as the one for total cyanide. Some SVOC including methylphenols, methylnaphthalenes, dibenzofuran and carbazole were detected in minor amounts in some soil samples. These are indicative of incomplete combustion products and therefore consistent with the presence of steelmaking wastes. They were detected in groundwater above MDL, but all below relevant screening criteria for waters (Appendix F). As such, a linkage between soil impacts and groundwater is not significant and a low risk of exposure is anticipated.

The substances without GACs analysed as part of this investigation and not detected are typically considered to be those with low, known toxicity, or incomplete toxicity information. In the absence of suitable toxicity information, the applicable regulators have not defined screening values. As such, further action with regards to these substances is unlikely to be mandated by the local authority, and the below recommendations are likely to adequately manage the risk to human health and the environment.

Other effects, such as phytotoxicity, are not assessed as the Made Ground is likely to be unsuitable as a growing medium and some form of capping with "clean soil" is likely to be incorporated into the development.

3.2.7 Discussion

All of the soil samples tested recorded concentrations of the potential contaminants of concern below the soil GAC. These GAC are considered protective of pollutant linkages B (1) and C and therefore these are considered to be inactive in a commercial land use scenario.

None of the volatile contaminants of concern recorded in groundwater within the Made Ground and Tidal Flat Deposits exceeded GAC for potential inhalation risks. Therefore, pollutant linkage B (2) is also not considered to be active.

Around 30% of the soil samples from Area A and 19% of the soil samples from Area B recorded asbestos fibres or ACM. Asbestos is potentially hazardous when inhaled and therefore pollutant linkage A (inhalation of dust) is considered potentially active as surface soils may become airborne during construction or if incorporated into soft landscaping without any cover.

Acute risks to construction workers arising from short-term contact with contaminated soils during demolition and redevelopment of the site are not assessed by the chronic risk assessment methods in this report. During construction works, site workers should remain vigilant to the possible risk of encountering isolated areas of contaminated material. Should potentially contaminated material be encountered, further testing may be required to assess the risk to health and safety of the site workers and the environment. All persons engaged in site construction works should be made aware of the findings of the intrusive investigation and the hazards associated with handling potentially contaminated materials. It is recommended that all works are conducted in accordance with the Health and Safety Executive publication entitled "Protection of Workers and the General Public during the Development of Contaminated Land" (HSE, 1991).

3.3 Risks to Controlled Waters

3.3.1 Selection of GAC

Potentially active pollutant linkages in relation to Controlled Waters have been identified in the initial CSM for both Areas A and B as:

E. Leaching of CoC from Made Ground to groundwater in superficial deposits

F. Vertical migration of CoC in groundwater to bedrock Secondary Aquifers, directly or via existing foundations

G. Horizontal migration of contaminated groundwater onto site in Made Ground and superficial deposits

H. Migration of CoC off site in Made Ground and superficial deposits groundwater

I. Migration of CoC in groundwater into culverted surface water streams features via Made Ground and superficial deposits.

An assessment of the potential for soluble contaminants in the Made Ground and slag on the Site to impact the Controlled Waters receptors identified in the CSM (Off-site surface water and underlying Secondary Aquifers (superficial deposits and bedrock) has been undertaken.

Concentrations of leachable contaminants from 11No. (Area A) and 10No. (Area B) soil leaching tests and 4No. (Area A) and 9No. (Area B) groundwater samples have been compared to appropriate Water Quality Standards (WQS).

The WQS used are UK Drinking Water Standards (DWS) (U.S. DWS where UK values are not available) protective of aquifer water resources, and Environmental Quality Standards (EQS) considered protective of surface waterbody quality. Where these are not available, USEPA Regional Screening Levels for Tapwater have been used. The WQS are listed in Appendix E and Appendix F.

3.3.2 Soil Leachate

The results of 11No. (Area A) and 10No. (Area B) soil leachate tests were compared to WQS as shown in Appendix D. Contaminant concentrations that exceeded the WQS are shown in Table 3 and Table 4 below.

The majority of the samples subject to leachate testing were of granular Made Ground and slag-dominated Made Ground. Samples were taken across the site from depths ranging from 0.2 m to 3.5m bgl.

Table 3 Summary of Leachate Concentrations Exceeding WQS (Area A)

Contaminant	Unit	No. Samples Exceeding	WQS Exceeded		Sample	Concentration
Cadmium	µg/l	1/10	EQS	0.08	S3-TPA24 1.5m	0.33
Chromium	µg/l	1/10	EQS	4.7	S3-TPA32 1.0m	6.7
Copper	µg/l	7/10	EQS	1	S3-TPA24 1.5m S3-TPA29 0.5m S3-TPA39 0.3m S3-TPA42 0.2m S3-TPA10 1.0m S3-TPA26 0.2m S3-TPA32 1.0m	4.5 3 1.7 1.2 1.1 1.1 1

Contaminant	Unit	No. Samples Exceeding	WQS Exceeded		Sample	Concentration
Lead	µg/l	2/10	EQS	1.2	S3-TPA28 3.5m S3-TPA29 0.5m	2 1.3
Mercury	µg/l	4/10	EQS	0.05	S3-TPA24 1.5m S3-TPA26 0.2m S3-TPA29 0.5m S3-TPA16 0.2m	0.17 0.13 0.11 0.06
Vanadium	µg/l	4/8	EQS	20	S3-TPA24 1.5m S3-TPA10 1.0m S3-TPA14 1.0m S3-TPA32 1.0m	37 36 34 24
Zinc	µg/l	1/10	EQS	12.1	S3-TPA39 0.3m	130
Ammoniacal Nitrogen as N	mg/l	1/8	DWS	0.5	S3-TPA10 1.0m	0.84
Benzo(b)fluoranthene	µg/l	2/3	DWS	0.025	S3-TPA39 0.3m S3-TPA26 0.2	17 0.1
Benzo(k)fluoranthene	µg/l	2/3	DWS	0.025	S3-TPA39 0.3m S3-TPA26 0.2m	7.3 0.04
Benzo(a)pyrene	µg/l	2/3	DWS EQS	0.01 0.00017	S3-TPA39 0.3m S3-TPA26 0.2m	11 0.06
Indeno(1,2,3-c,d)pyrene	µg/l	2/3	DWS	0.025	S3-TPA39 0.3m S3-TPA26 0.2m	9.6 0.08
Benzo(g,h,i)perylene	µg/l	2/3	DWS	0.025	S3-TPA39 0.3m S3-TPA26 0.2m	9.7 0.1

Table 4 Summary of Leachate Concentrations Exceeding WQS (Area B)

Contaminant	Unit	No. Samples Exceeding	WQS Exceeded		Sample	Concentration
Copper	µg/l	4/10	EQS	1	S3-TPB44 1.5m S3-TPB52 1.55m S3-TPB19 1.5m S3-TPB28 1.5m	2.1 1.5 1.2 1.1
Manganese	µg/l	1/10	EQS DWS	30 50	S3-TPB22 1.9m	66

Contaminant	Unit	No. Samples Exceeding	WQS Exceeded		Sample	Concentration
Vanadium	µg/l	2/10	EQS	20	S3-TPB28 1.5m S3-TPB32 0.5m	220 77
Ammoniacal Nitrogen as N	mg/l	1/7	DWS	0.5	S3-TPB33 1.5m	0.6
TPH Ali/Aro Total	µg/l	1/6	EQS	10	S3-TPB22 1.9m	76
Benzo(b)fluoranthene	µg/l	3/6	DWS	0.025	S3-TPB52 1.55m S3-TPB60 0.5m S3-TPB44 1.5m	0.09 0.06 0.03
Benzo(k)fluoranthene	µg/l	2/6	DWS	0.025	S3-TPB60 0.5m S3-TPB52 1.55m	0.03 0.03
Benzo(a)pyrene	µg/l	3/6	DWS EQS	0.01 0.00017	S3-TPB52 1.55m S3-TPB60 0.5m S3-TPB44 1.5m	0.05 0.03 0.02
Indeno(1,2,3-c,d)pyrene	µg/l	2/6	DWS	0.025	S3-TPB52 1.55m S3-TPB60 0.5m	0.06 0.04
Benzo(g,h,i)perylene	µg/l	2/6	DWS	0.025	S3-TPB52 1.55m S3-TPB60 0.5m	0.07 0.04

In Area A, exceedances of EQS for seven heavy metals were recorded in soil leachate samples. The most common exceedance was copper (7 of 10 samples) and the highest exceedance was dissolved zinc from sample S3-TPA39 0.3m (recorded at 10x EQS). Five polyaromatic hydrocarbons (PAH) were recorded above WQS in S3-TPA39 0.3m and S3-TPA26 0.2. Made Ground represented by these the TPA39 sample included slag and clinker and burnt shale.

In Area B, exceedances of WQS for three heavy metals, copper, manganese and vanadium, were recorded in leachate samples. Copper was again the most common exceedance and the highest was vanadium in S3-TPB28 1.5m (the concentration was 11x EQS). The same five PAHs were detected above DWS in Area B, these were in samples S3-TPB52 1.55m (tar-like substance noted on log), S3-TPB60 0.5m (silted up drain pipe) and S3-TPB44 1.5m (slag and relict foundations).

Sample S3-TPB22 1.9m was found to have 76 µg/l leachable total petroleum hydrocarbons, comprising primarily aliphatic compounds between carbon chain lengths C12 to C25. This sample was from Made Ground in the former slag pits (potential area of concern PAOC39) in the west of the site. Bitumen and a strong hydrocarbon odour and sheen were noted in the log.

As the WQS are protective of water quality at the point of contact with the receptor (water body for EQS or customer's tap for DWS), direct comparison with soil leachate results is a conservative assessment as it does not take into account dilution and attenuation along the pathway.

The EQS for copper is based on the bioavailable fraction which is likely to be less than the total dissolved concentrations recorded in the results. As not all the copper is likely to be bioavailable the EQS can therefore be regarded as conservative.

3.3.3 Groundwater (Area A)

Four groundwater samples were obtained from Area A from two boreholes over two sampling rounds. Borehole S3-BHA01 screens the Made Ground beneath the small carpark in the northwest of the site. Borehole S3-BHA02 screens the Glaciolacustrine Deposits in rough ground in the southwest of the site.

Dissolved contaminant concentrations were compared to the WQS in Appendix F and exceedances are summarised in Table 5 below. The number of exceedances of all WQS from all samples in each borehole are shown on Figure 8 below and in Appendix B.

Figure 8: Number of WQS Exceedances per Borehole Area A

Table 5 Summary of Groundwater Concentrations Exceeding WQS (Area A)

Contaminant	Unit	WQS Exceeded		No. Samples Exceeding WQS	Sample	Concentration
Copper	ug/l	EQS	1	2 / 4	S3-BHA01 10/01/18 S3-BHA02 22/02/18	3.4 2.1
Manganese	ug/l	EQS DWS	30 50	2 / 4	S3-BHA01 10/01/18 S3-BHA02 10/01/18	170 740
Nickel	ug/l	EQS	4	1 / 4	S3-BHA01 22/02/18	4.2
Total TPH	ug/l	EQS	10	2 / 4	S3-BHA02 10/01/18 S3-BHA02 22/02/18	90 69
Benzo(b)fluoranthene	ug/l	DWS	0.025	2 / 4	S3-BHA01 10/01/18 S3-BHA02 22/02/18	0.21 0.29

Contaminant	Unit	WQS Exceeded		No. Samples Exceeding WQS	Sample	Concentration
Benzo(k)fluoranthene	ug/l	DWS	0.025	2 / 4	S3-BHA01 10/01/18 S3-BHA02 22/02/18	0.1 0.12
Benzo(a)pyrene	ug/l	EQS DWS	0.00017 0.01	2 / 4	S3-BHA01 10/01/18 S3-BHA02 22/02/18	0.13 0.17
Indeno(1,2,3-c,d)pyrene	ug/l	DWS	0.025	2 / 4	S3-BHA01 10/01/18 S3-BHA02 22/02/18	0.14 0.11
Benzo(g,h,i)perylene	ug/l	DWS	0.025	2 / 4	S3-BHA01 10/01/18 S3-BHA02 22/02/18	0.15 0.09

As shown in Table 5 and Appendix E, groundwater samples from the Made Ground and superficial deposits in Area A exceeded WQS screening criteria for copper and manganese, and several PAH compounds. Contaminant concentrations were generally higher in standpipe screening the Made Ground as would be expected and this standpipe also recorded a marginal exceedance of the WQS for nickel. Dissolved aliphatic and aromatic petroleum hydrocarbons were detected in borehole S3-BHA02 screening the superficial deposits in the southwest of the site.

Dissolved metal concentrations were generally higher on the first round which may reflect the effect of sediment suspension as samples were filtered on the second monitoring round. The TPH and PAH concentrations recorded are generally low, inconsistent and comparable to the WQS criteria.

One groundwater sample from Area A was tested during the 2004 investigation for dissolved metals, petroleum hydrocarbons and other contaminants. Only total sulphur as SO_4 exceeded the DWS in use at the time (Enviros, 2004). Dissolved sulphate concentrations in groundwater are above indicator drinking water parameters but are not anticipated to be significant in the context of the site's coastal setting.

3.3.4 Groundwater (Area B)

Nine groundwater samples were obtained from Area B from five standpipes in four boreholes over the same two sampling rounds.

Borehole S3-BHB01 screens the Made Ground and top of the Glacial Till in rough ground between the railway tracks in the far north of the site. Borehole S3-BHB02 screens the Made Ground, upper Glacial Till and Glaciolacustrine Deposits beneath rough ground at the former slag pits in the west of the site.

Borehole S3-BHB03 screens shallow Made Ground beneath the former water treatment plant in the southeast of the site. Borehole S3-BHB04S screens the shallow Made Ground and a separate standpipe in this borehole (S3-BHB04D) screens the Glaciolacustrine Deposits and lower Glacial Till in the southwest of the site, near to the substation and water treatment plant.

Dissolved contaminant concentrations were compared to the WQS in Appendix F and exceedances are summarised in Table 6 below. The number of exceedances of all WQS from all samples in each borehole are shown in Figure 9 below and in Appendix B.

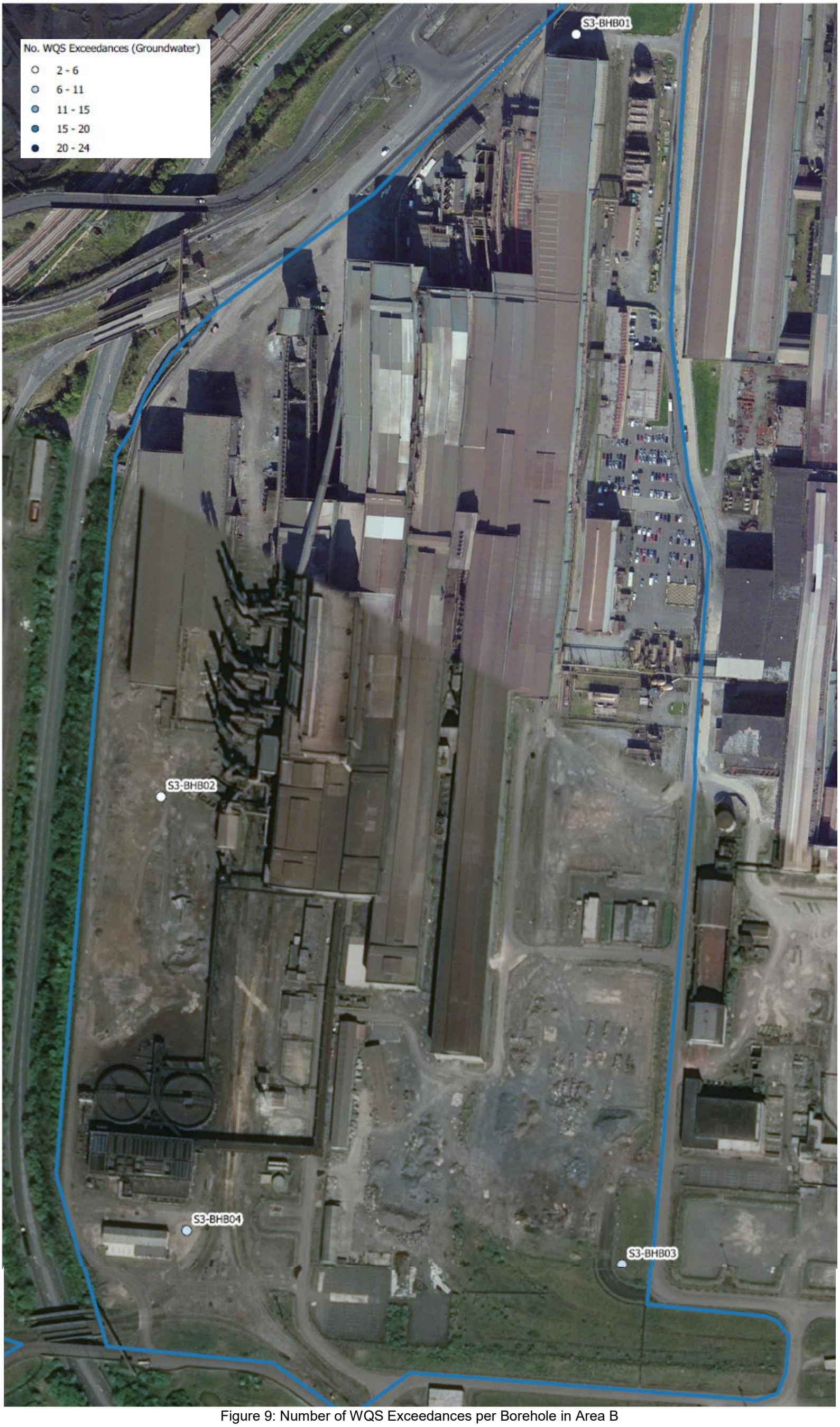

Figure 9: Number of WQS Exceedances per Borehole in Area B

Table 6 Summary of Groundwater Concentrations Exceeding WQS (Area B)

Contaminant	Unit	WQS Exceeded		No. Samples Exceeding WQS	Sample	Concentration
Cadmium	ug/l	EQS	0.08	2 / 9	S3-BHB02 10/01/18 S3-BHB02 22/02/18	0.09 0.12
Copper	ug/l	EQS	1	3 / 9	S3-BHB01 10/01/18 S3-BHB04S (1.5m) 10/01/18 S3-BHB04D 22/02/18	1.2 1.9 1.1
Manganese	ug/l	EQS DWS	30 50	4 / 5	S3-BHB01 10/01/18 S3-BHB03 10/01/18 S3-BHB04S (1.5m) 10/01/18 S3-BHB04 D (5.0m) 10/01/18	130 1500 53 170
Nickel	ug/l	EQS	4	1 / 9	S3-BHB03 10/01/18	4.1
Zinc	ug/l	EQS	12.1	2 / 9	S3-BHB04S (1.5m) 10/01/18 S3-BHB04D (5.0m) 10/01/18	43 36
Ammoniacal Nitrogen	ug/l	DWS	0.5	1 / 5	S3-BHB04S (1.5m) 10/01/18	0.55
Total TPH	ug/l	EQS	10	4 / 9	S3-BHB02 10/01/18 S3-BHB03 10/01/18 S3-BHB03 22/02/18 S3-BHB04D (5.0m) 10/01/18	50 120 300 59
Naphthalene	ug/l	EQS DWS	2 2	1 / 9	S3-BHB04D (5.0m) 10/01/18	9
Benzo(b)-fluoranthene	ug/l	DWS	0.025	6 / 9	S3-BHB01 22/02/18 S3-BHB02 22/02/18 S3-BHB03 10/01/18 S3-BHB04S (1.5m) 10/01/18 S3-BHB04D (5.0m) 10/01/18 S3-BHB04D 22/02/18	0.06 0.1 0.27 11 0.78 0.05

Contaminant	Unit	WQS Exceeded		No. Samples Exceeding WQS	Sample	Concentration
Benzo(k)-fluoranthene	ug/l	DWS	0.025	3 / 9	S3-BHB03 10/01/18 S3-BHB04S (1.5m) 10/01/18 S3-BHB04D (5.0m) 10/01/18	0.09 5.1 0.36
Benzo(a)-pyrene	ug/l	EQS DWS	0.00017 0.01	5 / 9	S3-BHB01 22/02/18 S3-BHB02 22/02/18 S3-BHB03 10/01/18 S3-BHB04S (1.5m) 10/01/18 S3-BHB04D (5.0m) 10/01/18	0.02 0.05 0.21 7.2 0.51
Indeno(1,2,3-c,d)pyrene	ug/l	DWS	0.025	3 / 9	S3-BHB03 10/01/18 S3-BHB04S (1.5m) 10/01/18 S3-BHB04D (5.0m) 10/01/18	0.1 6.9 0.4
Benzo(g,h,i)-perylene	ug/l	DWS	0.025	4 / 9	S3-BHB02 22/02/18 S3-BHB03 10/01/18 S3-BHB04S (1.5m) 10/01/18 S3-BHB04D (5.0m) 10/01/18	0.04 0.16 7.7 0.44

3.3.5 Qualitative Risk Assessment for Substances in Leachate/Groundwater without WQS

Substances not detected in leachate/groundwater

Cyanides were the only substances without WQS that were not detected in groundwater but were detected in soil. This indicates the cyanide is not readily leachable and therefore a low risk to Controlled Water receptors.

Of the VOC and SVOC that were not detected in groundwater and do not have a WQS, none were detected in soil with the exception of minor amounts of 1,1-dichloropropene, 4-nitrophenol and carbazole. However, these were not greatly above the MDL.

PCBs were not detected in either soil or groundwater and which would suggest they are unlikely to be present on the site at concentrations that would pose a significant risk to Controlled Water Receptors.

Substances detected in leachate/groundwater

Substances without WQS that were detected above the MDL in leachate or groundwater included iron, magnesium and vanadium, chloride and sulphate. These are naturally occurring in groundwaters. Considering

the site setting (close to saline coastal environment, no nearby abstractions) these are not considered to pose a significant risk to human health and the environment.

Several PAH compounds do not have WQS, but these will be adequately covered under recommendations for the PAH compounds identified as exceeding their applicable WQS. PAH compounds are generally of low solubility and mobility and the compounds without WQS are non-carcinogenic.

None of the contaminants without WQS are expected to pose a significant risk to Controlled Waters under a commercial redevelopment scenario and therefore do not warrant further assessment.

3.3.6 Discussion

Heavy metals such as arsenic and chromium are common constituents of slag. The leachability of these are dependent on the chemical constituents and type of slag material, the percentage of slag material in the surrounding soil, and the organic content of the soil matrix.

Despite the former use of the site, dissolved metal concentrations in leachate and groundwater samples are not greatly elevated above the conservative WQS (generally <10x WQS), indicating that they are mostly of low leachability under current conditions. The measured pH of soil leachate and groundwater is generally neutral or alkaline which will reduce the leaching of heavy metals.

Low levels of dissolved petroleum hydrocarbons, including PAHs have been detected in shallow groundwater in both areas. These do not correspond spatially with the highest recorded hydrocarbon concentrations in soil samples but are likely to be derived from similar localised hydrocarbon hotspots as the dissolved concentrations are generally low and not consistent over time.

None of the VOC and SVOC exceeded the relevant WQS, however some MDLs were below the USEPA WQS. For carcinogenic compounds, a lower risk threshold is used compared to UK practice and therefore these are not considered significant.

The potential pollutant linkage E (leaching of contaminants from Made Ground into shallow groundwater) is shown to be active based on the available groundwater samples, but does not appear to be having a major impact on the groundwater beneath the site.

The groundwater flow direction within the superficial deposits is likely to be dictated by preferential flow pathways within the more granular parts of the Made Ground and superficial deposits.

The nearest surface water feature to Area A is Holme Beck (110m southeast) and Knitting Wife Beck (adjacent to south, both are culverted. A storm drain runs beneath the site and discharges to the latter. Shallow groundwater, if in continuity with the surface waters, may be a potential contaminant pathway. The watercourses near to Area A are culverted and therefore a significant hydraulic connection is less likely, however potential pollutant linkage I is considered to be active for this site.

Kinkerdale Beck crossing the northern end of the Area B and a pond adjacent to the south may be unlined and therefore potential pollutant linkage I is assumed to be active for Area B.

The contaminants recorded as elevated in groundwater are generally also elevated in soil leachate from the site, and so are consistent with an on-site source. However, concentrations of some contaminants in groundwater such as barium, manganese, nickel, phenol and most petroleum hydrocarbon fractions are higher in groundwater than leachate testing. This could indicate contaminant hotspots not encountered during soil sampling, or it could indicate impact from off-site sources. The SCR notes that potentially contaminative land uses with the potential to impact Areas A and B include nearby landfills, electrical substation, the locomotive repair shop and historical (1900s) furnaces and coke ovens. Therefore, pollutant linkage G (migration of contaminated groundwater onto site) is also assumed to be active.

No information is available on contaminant levels in the underlying bedrock (Redcar Mudstone Formation, Penarth Group and Mercia Mudstone). The Glacial Till (the bulk of which was found to underly the Glaciolacustrine Deposits secondary Aquifer and described as a firm to stiff slightly sandy slightly gravelly clay), has the potential to act as an aquiclude, partially disconnecting groundwater within the bedrock strata from the shallower groundwater in the Glaciolacustrine Deposits and Made Ground. However, the limited thickness and variable lithology of the superficial deposits means that potential pollutant linkage F can be assumed to also be active, although the contaminant flux may be low based on the minor impacts identified in

shallower groundwater. Further assessment of deep groundwater will likely be required depending on the redevelopment scenario.

The current building foundations are understood to be piled through the superficial deposits into the mudstone bedrock and therefore may present a preferential pathway for contaminants. If additional deep foundations are proposed, a foundation assessment should be carried out to ensure that the works do not create a pathway for contaminants to migrate into the secondary aquifer units of the bedrock from shallower strata.

3.4 Built Receptors

Significant contamination can pose a risk to subsurface structures and services, where these are in direct contact with soil and/or groundwater. Substances such as dissolved metals, cations, phenols and hydrocarbons in high concentrations can adversely affect in-ground materials such as concrete, metal and plastics.

The most sensitive built receptor is generally plastic water supply pipes, which can be affected by permeation of hydrocarbons and organic solvents into the pipe. The available chemical data for soil samples has been reviewed against the UK Water Industry Research (UKWIR) criteria to provide an indication of the potential acceptability of polyethylene (PE) pipes in brownfield land (Water UK, 2014), although an exact comparison is not possible due to differences in the determinand suites tested.

Concentrations of heavy end petroleum hydrocarbons in around 10% and 20% of the soil samples in Areas A and B respectively may be above the criteria for unprotected PE water pipes. Therefore, additional testing should be carried along the route of any proposed new water supply pipe, or barrier pipe or similar could be used.

The potential for the ground conditions to generate an aggressive chemical environment for concrete (sulphate attack) is assessed in the Geotechnical Risk Assessment (GRA) report for the site. Other potential constraints such as heave potential due to the composition of the Made Ground and slag are also assessed in the GRA.

Potential pollutant linkage J (attack on subsurface structures) cannot be discounted at this stage for either Area and appropriate mitigation measures may be required, depending on the redevelopment scenario.

4 Ground Gas Assessment

Potential sources of ground gases (principally methane and carbon dioxide) have been identified on the site. The potential gas sources comprise the Made Ground (degradation of organic material and hydrocarbon contamination), and organic layers within the superficial deposits. The main hazards are asphyxiation or explosion due to build-up of hazardous ground gases in confined spaces such as service runs and plant rooms, shown as pollutant linkage D in Figure 2 and 3.

Ground gas monitoring data is included in the factual report for the site (AEG, 2018) and is summarised in Table 7 below. Between three and eight rounds of monitoring were conducted between November 2017 and May 2018 for the two boreholes in Area A and the four boreholes in Area B.

Table 7 Summary of Ground Gas Monitoring Results

Parameter	Range	Location of Maximum Result*
Borehole Flow rate (l/h)	<0.1	-
Methane (% v/v)	<0.1**	-
Carbon Dioxide (% v/v)	<0.1 to 0.9	S3-BHB03 22/12/2017
Oxygen (% v/v)	17.4 to 21.1	S3-BHB03 22/12/2017
Hydrogen Sulphide (ppm)	<1	-
Carbon Monoxide (ppm)	32	S3-BHB02 02/05/2018

*minimum for oxygen
**all seven boreholes recorded 0.2% CH4 on 02/05/18. This has been discounted as a calibration issue.

Concentrations of carbon dioxide and methane recorded in the boreholes across both site areas were below levels that would indicate a significant risk to human health receptors from the accumulation of ground gases. Gas flow from all boreholes was below detection limits, as was concentrations of methane and hydrogen sulphide. Methane recorded in all boreholes on 02/05/18 at 0.2 % may be a calibration issue. The highest concentrations of carbon dioxide are consistent with a low generation potential gas source such as small amounts of organic matter in Made Ground.

Carbon monoxide was recorded on three occasions in three boreholes. These may be associated with blast furnace wastes such as slag and if so are residual and unlikely to be still being generated. The maximum reading of 32 ppm is slightly above the HSE Workplace long-term exposure limit (8-hr TWA reference period) of 30ppm but dilution effects are likely to reduce these concentrations sufficiently if they migrate out of the ground.

Based on the existing monitoring data for the site, there is no evidence of an unacceptable risk to human health or built receptors from the accumulation of ground gas. However, as the recent 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 either Area A or B under a particular redevelopment. In Area A, the response zone of the borehole screening the Made Ground and the borehole screening the superficial deposits were flooded on two and three of three monitoring rounds, as these monitoring wells were primarily designed to assess groundwater conditions in deeper superficial deposits.

Pollutant linkage D is assumed to be potentially active. Additional ground gas monitoring at greater density is recommended prior to redevelopment to determine the risk from ground gases on the site, the scope of this investigation would depend on the proposed redevelopment scenario.

5 Updated Conceptual Site Model

An updated CSM has been developed, using the findings of the above assessments, and is presented as Figure 10 (Area A) and Figure 11 (Area B) below and in Appendix B. Pollutant linkages that have been shown to be inactive or not a significant risk have been removed.

Potential Human Health SPR Linkages

A = Dust inhalation from Made Ground from site and adjacent land
D = Accumulation of ground gas in confined spaces
SPR linkages for construction workers during redevelopment not shown

Potential Water Resource SPR Linkages

E = Leaching of contaminants from Made Ground and point sources to groundwater in superficial deposits
F = Migration of contaminated groundwater to (Secondary (Undifferentiated) Aquifer) in bedrock
G = Migration of contaminated groundwater onto site in Made Ground and Superficial Deposits
H = Migration of contaminated groundwater off site in Made Ground and Superficial Deposits

Other SRP Linkages

J = Attack by contaminants of concern on foundations

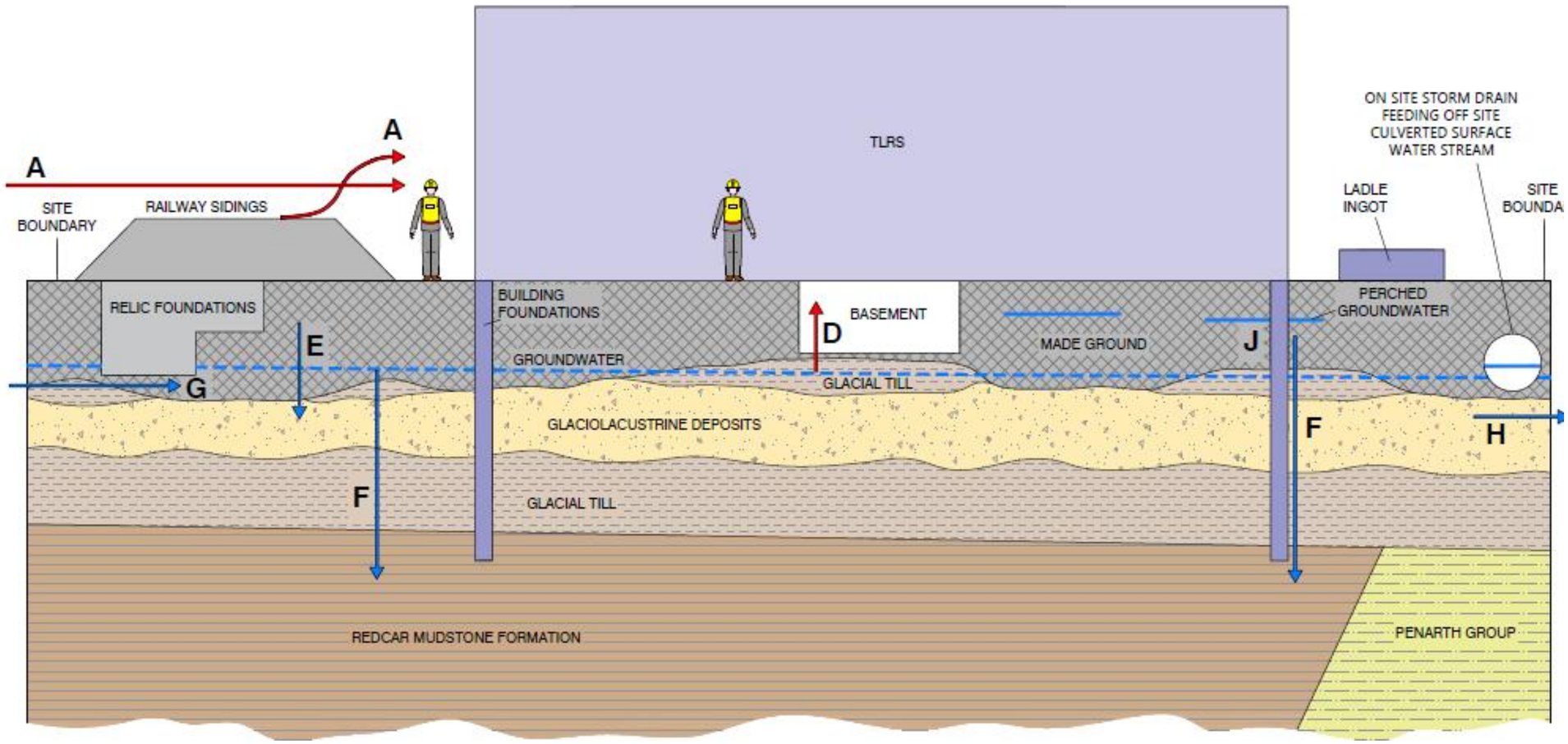

Figure 10: Update Conceptual Site Model foe SSI3 Area A

Potential Human Health SPR Linkages

A = Dust inhalation from Made Ground from site and adjacent land
D = Accumulation of ground gas in confined spaces
SPR linkages for construction workers during redevelopment not shown

Potential Water Resource SPR Linkages

E = Leaching of contaminants from Made Ground and point sources to groundwater in superficial deposits
F = Migration of contaminated groundwater to Secondary Aquifers in bedrock
G = Migration of contaminated groundwater onto site in Made Ground and Superficial Deposits
H = Migration of contaminated groundwater off site in Made Ground and Superficial Deposits
I = Migration of contaminated groundwater into culverted surface water streams (Kinkerdale Beck, Boundary Beck), and off site pond

Other SRP Linkages

J = Attack by contaminants of concern on foundations

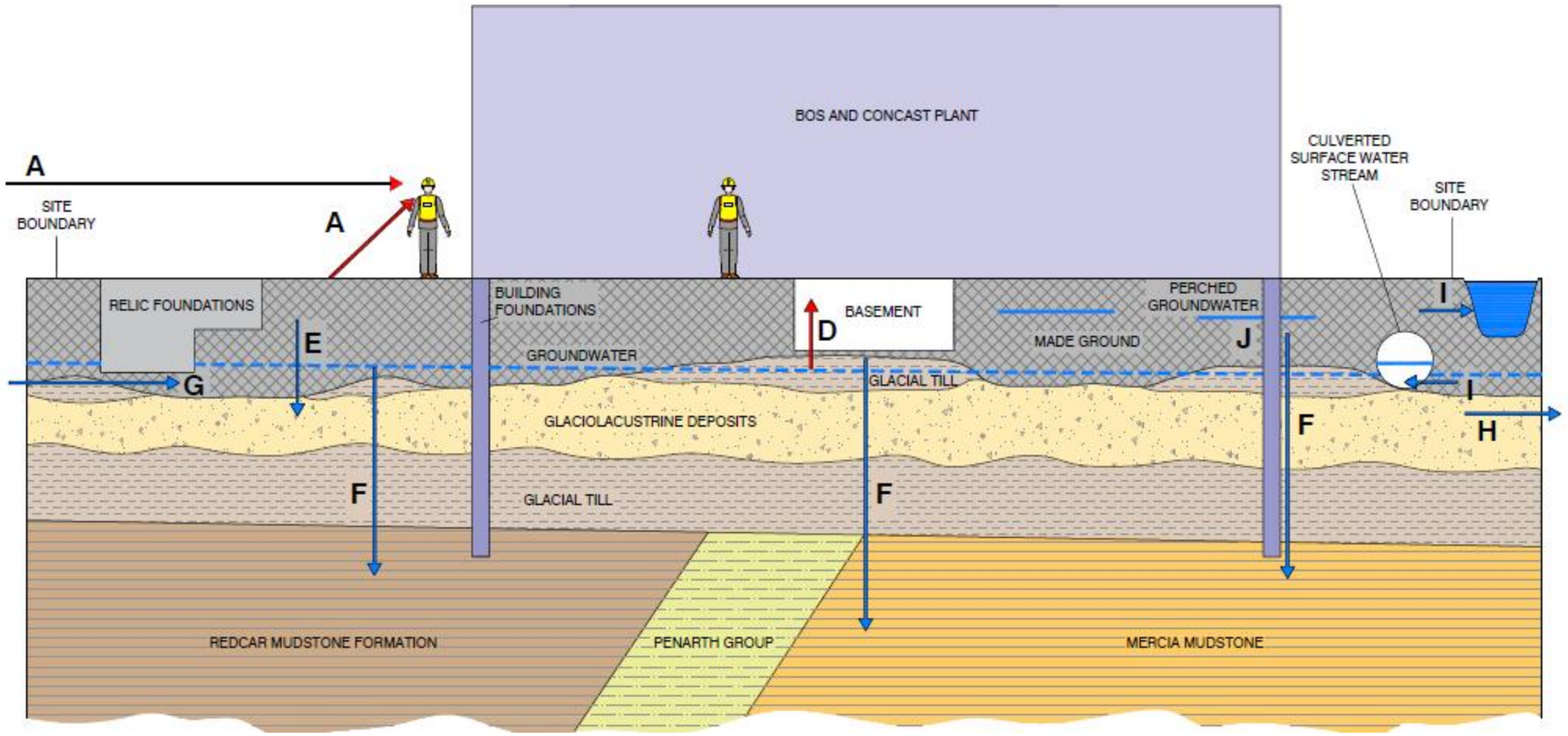

Figure 10: Update Conceptual Site Model foe SSI3 Area B

6 Conclusions and Recommendations

This report has used information obtained from the recent ground investigation (AEG, 2018) to assess the potential contamination risks to human health and Controlled Waters identified in the Site Condition Report (Arcadis, 2018) for the Contract 1 and 2(A) site. It was assumed that the site will be redeveloped for commercial or industrial use.

Heavy metals, hydrocarbons and other contaminants have been recorded in soil and dissolved in soil leachate and groundwater samples across the site. These are likely associated with the slag within the Made Ground, disused railway and TRLS, and releases from the steelworks facilities on and adjacent to the site, as similar contaminants have been identified in other areas investigated within the larger project area.

6.1 Human Health Risk

Potential risks to human health via intake of a range of contaminants from shallow soils (Made Ground including slag materials) were assessed using generic assessment criteria (GAC). All contaminants tested in all samples were recorded below the relevant GAC, indicating that there is unlikely to be an unacceptable risk to human health from ingestion or direct contact with soils, or inhalation of volatiles from soil and groundwater, under a commercial land use. Contaminants without GACs have been qualitatively reviewed and no potentially significant risks have been identified.

However, asbestos was recorded in around 30% of the soil samples from Area A, and 19% of soil samples from Area B. Asbestos was quantified in concentrations up to 0.03% and 0.005% by mass in each area respectively. Asbestos in shallow soils in areas without buildings or hardstanding has the potential to become airborne and available for inhalation, particularly during construction, posing chronic risks to human health.

Additional assessment may be required to further delineate the asbestos impact on the site and determine necessary mitigation measures. It may be that a clean cover system in areas of soft landscaping can be utilised to mitigate the risk to site occupiers and neighbouring land users. During redevelopment, good construction practice such as minimising handling of asbestos-contaminated soils, damping down and appropriate Personal Protective Equipment (PPE) may be sufficient to mitigate the risk to construction workers. An appropriate occupational risk assessment would be required to determine this.

Soil containing more than 0.1% m/m asbestos, if disposed of off-site, may be classified as hazardous waste and attract significantly higher disposal costs. Additional testing would be required to confirm the quantity of asbestos and delineate any areas above the threshold.

6.2 Controlled Waters

Several exceedances of Water Quality Standards (WQS) were recorded in soil leachate samples from Made Ground.

Contaminant concentrations in shallow groundwater within the Made Ground and superficial deposits are above WQS for a range of contaminants. These are generally consistent with contaminants detected in soil and soil leachate analysis indicating that some leaching is occurring from the slag deposits, tar materials, waste deposits and hydrocarbon impacts on the site. A potential pollutant linkage into the deeper bedrock aquifers may also be active.

Nearby surface waters may potentially be impacted by contamination in shallow groundwater. Surface water features near to Area A are culverted and less likely to be in continuity with groundwater.

6.3 Recommendations

1. A remediation options appraisal should be carried out for the loose asbestos fibres identified in the Made Ground on both Area A and B. Additional data collection may be needed to support the associated risk assessment/remediation design.
2. A remediation options appraisal should be carried out to further assess the potential impacts to the groundwater receptors (area A and B) and surface water receptors (Area B) from contaminated soils on the site. This would ideally be carried out as part of a wider Controlled Waters assessment for the

former SSI site due to the possibility of upgradient sources causing regional impacts to groundwaters and surface waters.

3. If deep foundations penetrating the Glacial Till are proposed, a foundation works risk assessment should be carried out to able appropriate mitigation measures to be designed that will prevent contaminant migration into the underlying bedrock aquifers *via* preferential pathways caused by pile installation.
4. To support 2 and 3 above, additional investigation should be carried out to better define the deeper groundwater regime within the bedrock beneath the site, including current groundwater quality.
5. Barrier pipe should be considered for any proposed new water supply pipes laid in Made Ground, or additional data collection completed to verify if soil can be managed sufficiently to avoid the need for such pipe materials.
6. Depending on the redevelopment scenario additional ground gas monitoring at greater density should be undertaken prior to redevelopment to determine the potential ground gas risk to the development. The scope would depend on the proposed redevelopment layout and design.
7. During redevelopment, soil capping measures should be implemented to protect site users from inadvertent contact with contaminated soil.
8. The construction environmental management plan for the site should include precautions to prevent dust creation and the movement of more impacted deep soil closer to the surface.

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APPENDIX A

Legislative Context and Regulatory Guidance

Land contamination is generally dealt with by the following types of regulation:

- Acts of Parliament to investigate and remedy harm caused by land contamination;
- Conditions placed upon Planning Permissions for the redevelopment of land; and,
- Acts of Parliament and Regulations for the control of waste.

In England land contamination is identified and dealt with through Acts / Regulations including:

- The Contaminated Land (England) (Amended) Regulations (2012);
- Part IIA of the Environmental Protection Act (1990);
- The Environment Act 1995;
- The Town and Country Planning Act (1990);
- The Environmental Permitting (England and Wales) (Amended) Regulations (2011);
- The Water Resources Act (1991);
- The Water Act (2003); and
- The Environmental Damage (Prevention and Remediation) Regulations 2009.

Part IIA of the Environmental Protection Act 1990

Part IIA of the Environmental Protection Act 1990 (which was inserted by Section 57 of the Environment Act 1995) created a regime for the identification and remediation of contaminated land. Section 78A (2) of the Environmental Protection Act 1990 defines contaminated land for the purposes of Part IIA as:

'*any land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that;*
(a) Significant harm is being caused or there is a significant possibility of such harm being caused; or
(b) significant pollution of controlled waters is being caused or there is a significant possibility of such pollution being caused.'[1]

Harm is defined under section 78A of the Environmental Protection Act as meaning 'harm to the health of living organisms or other interference with the ecological systems of which they form part and, in the case of man, includes harm to his property'. Types of harm are related to specific receptors in order to determine whether they can be regarded as "significant", as defined in the DEFRA (2012)[2] statutory guidance.

Part IIA sets the definition of contaminated land within the context of the 'suitable for use' approach. The 'suitable for use' approach underlies these objectives, and is based on the principles of risk assessment, including the concept of the 'pollutant linkage'.

In the event that there are unacceptable levels of risk posed by a site, a remediation notice can be served under the contaminated land regime introduced under Part IIA of the Environmental Protection Act 1990.

Regulation of Development on Land Affected by Contamination

Management of risks from contamination in development of land is also regulated in the England under the Town and Country Planning Act 1990. Land contamination is a material planning consideration within this planning regime.

The Local Planning Authority may impose conditions on the development during planning that include preliminary risk assessment, site investigation, risk assessment and remediation. The Environment Agency may use its role as a statutory consultee to provide the Local Planning Authority with advice.

[1] Definition amended by the Water Act 2003, and came into force on 6th April 2012
[2] Contaminated Land Statutory Guidance. DEFRA 2012, which came into force on 6th April 2012

Assessment of risk is again based on the pollutant linkage concept. The aim of risk management in the development should be to render the land suitable for the proposed use and, therefore, to prevent consideration of the site under Part IIA.

The National Planning Policy Framework (NPPF) (2012) provides high level guidance on the relationship between development and the management of risks from land contamination caused by historical use. The interpretation of the NPPF is left to local decision-makers, but with the expectation that good practice developed using the pre-existing Planning Policy Statements will be maintained. The Building Regulations 2000, made under the Building Act 1984, also require measures to be taken to protect new buildings and their occupants from the effects of contamination. Guidance on the requirements is provided in Approved Document C - Site preparation and resistance to contaminants and moisture, published by ODPM in 2004.

Voluntary Remediation Action

Voluntary remediation action on contamination resulting from historical activities can often anticipate future remediation requirements, such as through the Planning regime, and is encouraged, especially where the site is not being assessed under Part IIA.

Environmental Damage

The Environmental Damage (Prevention and Remediation) Regulations 2009 came into force on 1st March 2009 to implement EC Directive 2004/35 on environmental liability with regard to the prevention and remedying of environmental damage.

These Regulations do not apply retrospectively; environmental damage that took place before the Regulations came into force (1st March 2009), or damage that takes place (or is likely to take place) after that date but is caused by an incident, event or emission that occurred before that date are exempt from the requirements of the Regulations.

The Regulation is concerned with preventing environmental damage. It requires that all operators of activities that cause an imminent threat of environmental damage to take all reasonably practical steps to prevent the damage. Where damage has already been caused, the operator must take all reasonably practical steps to prevent further damage from occurring.

Non-Statutory Regulatory Technical Guidance Documents

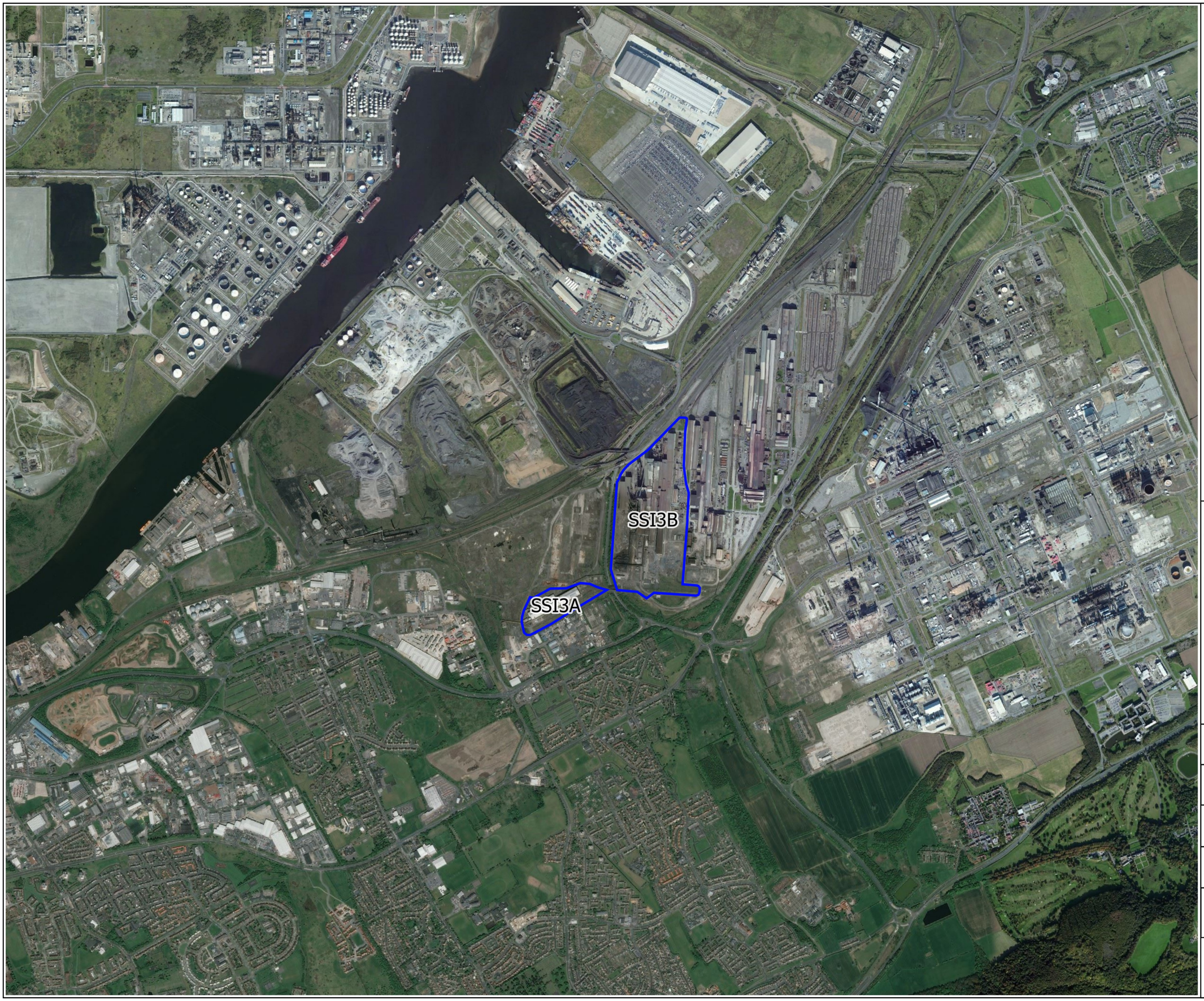
The non-statutory regulatory technical guidance for England on the assessment of land contamination, primarily released as part of the Contaminated Land Exposure Assessment (CLEA) methodology (DEFRA and EA) has recently been updated. The following documents currently present guiding principles in investigating and assessing potentially contaminated land, which are generally adopted in considering sites within any of the legal frameworks discussed above, or when considering voluntary remediation action:

- Investigation of potentially contaminated sites – Code of Practice (British Standard 10175: 2011).
- Contaminated Land Report CLR11 Model Procedures for the Management of Land Contamination. (DEFRA and EA, 2004).
- Human health toxicological assessment of contaminants in soil Environment Agency Science Report SC050021/SR2 (EA, 2009).
- Updated technical background to the CLEA model Environment Agency Science Report SC050021/SR3 (EA, 2009).
- Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values Environment Agency Science Report SC050021/SR7 (EA, 2008).
- An ecological risk assessment framework for contaminants in soil. Environment Agency Science Report SC070009/SR1 and related reports S2a-e.
- Groundwater Protection: Policy and Practice, Environment Agency GP3 Parts 1-4.

- Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination (EA of England and Wales, 2006) developed in consultation with the Scottish Environment Protection Agency (SEPA) and the Northern Ireland Heritage and Environment Service.
- Assessing risks posed by hazardous ground gases to buildings Report C665 (CIRIA, 2007).
- BS 8485:2007 Code of practice for the characterization and remediation from ground gas in affected developments (British Standards Institution, 2007).
- Risk Based Corrective Action (RBCA) Methodology (ASTM designation E1739-95, E2081-00).
- DoE Industry Profiles.

APPENDIX B

Figures



Legend

Contract 3

Notes:

CONTACT ARCADIS IN CASE OF ANY QUERIES.

N

Title:
SSI3 Site Location Plan

Site:
Redcar Steelworks

Client:
South Tees Site Company

Project: 37774100	**Figure 1**

Date: 24/04/2018
Drawn By: JALM
DRG No: 37774100_01_SSI2b_Figure_1

ARCADIS Design & Consultancy for natural and built assets

Potential Human Health SPR Linkages

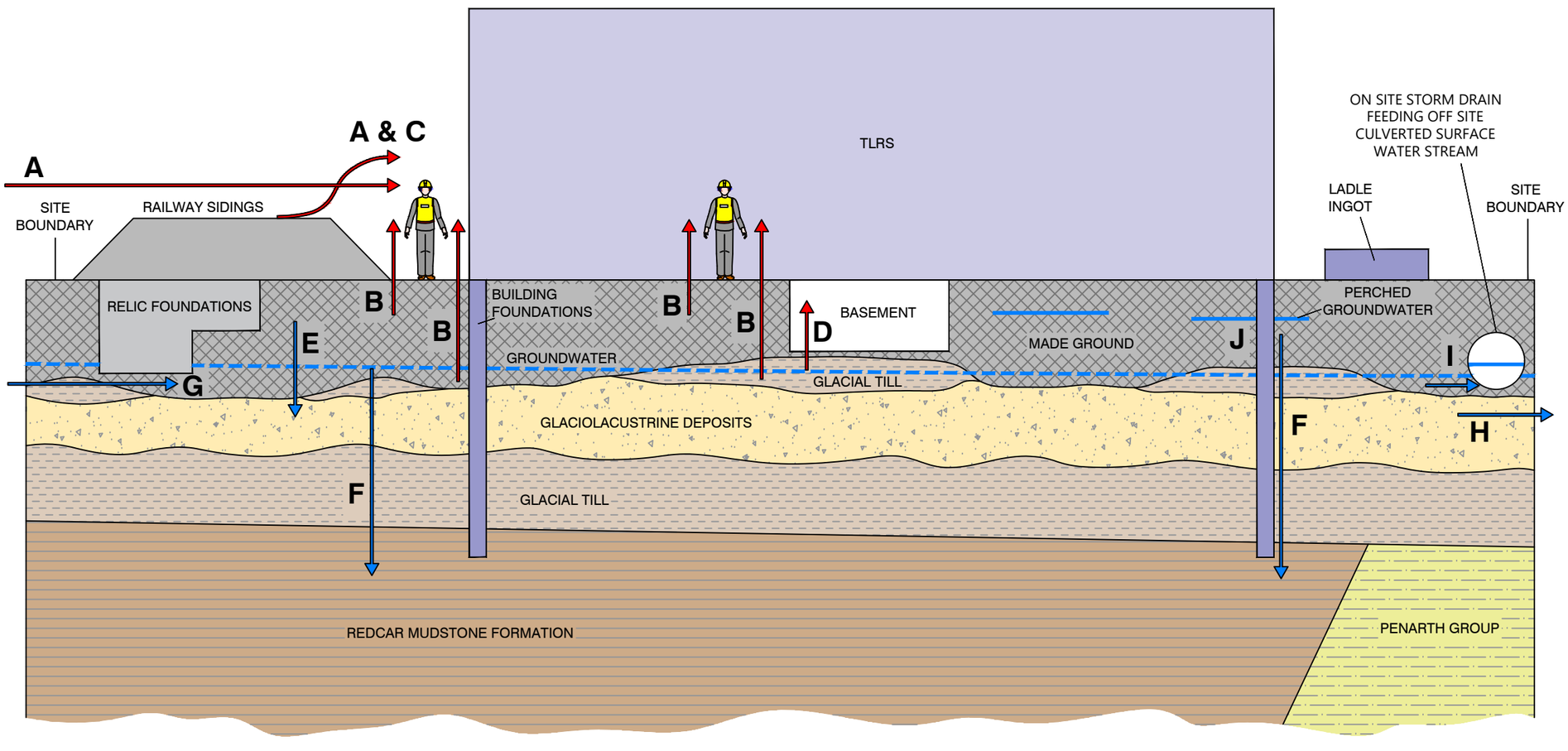
A = Dust inhalation from Made Ground from site and adjacent land
B = Vapour inhalation of indoor or outdoor air from contaminated soil and or groundwater
C = Direct contact and ingestion
D = Accumulation of ground gas in confined spaces
SPR linkages for construction workers during redevelopment not shown

Potential Water Resource SPR Linkages

E = Leaching of contaminants from Made Ground and point sources to groundwater in superficial deposits
F = Migration of contaminated groundwater to (Secondary (Undifferentiated) Aquifer) in bedrock
G = Migration of contaminated groundwater onto site in Made Ground and Superficial Deposits
H = Migration of contaminated groundwater off site in Made Ground and Superficial Deposits
I = Migration of contaminated groundwater into culverted surface water stream (Holme Beck Knitting Wife Beck) either directly or via storm drain.

Other SRP Linkages

J = Attack by contaminants of concern on foundations



KEY

NOTES

SCHEMATIC DRAWING ONLY - NOT TO SCALE

REV	DATE	COMMENT	CAD

TITLE: CONCEPTUAL SITE MODEL - SSI3 AREA A TLRS

SITE: REDCAR

CLIENT: STSC

PROJECT: 10013655 | FIGURE 2

DATE: 19/04/18 | DRAWN: BNB | REV: -

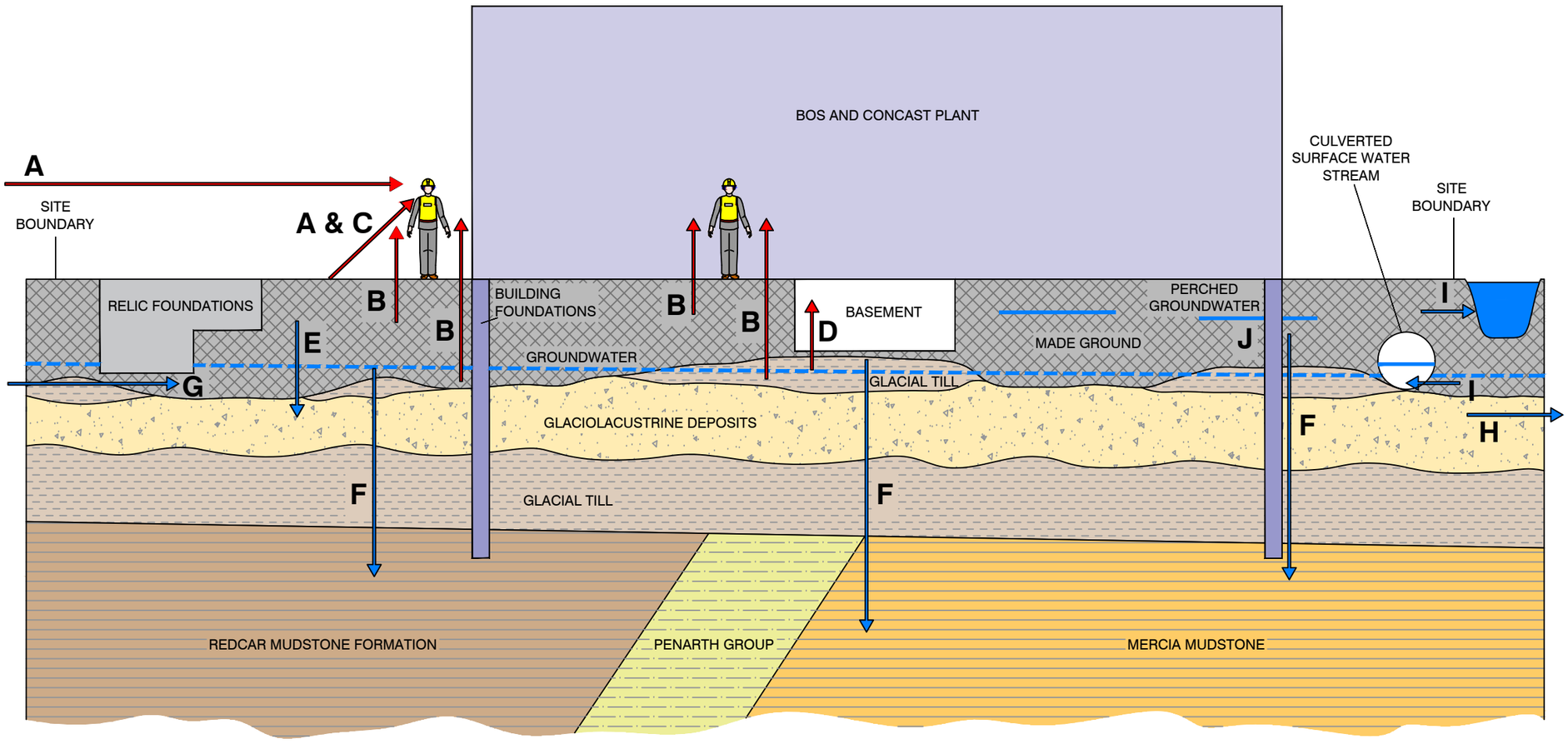
DRG.No.: 10013655_CSM_1 | PRINT: A3

ARCADIS Design & Consultancy for natural and built assets

Potential Human Health SPR Linkages
A = Dust inhalation from Made Ground from site and adjacent land
B = Vapour inhalation of indoor or outdoor air from contaminated soil and or groundwater
C = Direct contact and ingestion
D = Accumulation of ground gas in confined spaces
SPR linkages for construction workers during redevelopment not shown

Potential Water Resource SPR Linkages
E = Leaching of contaminants from Made Ground and point sources to groundwater in superficial deposits
F = Migration of contaminated groundwater to Secondary Aquifers in bedrock
G = Migration of contaminated groundwater onto site in Made Ground and Superficial Deposits
H = Migration of contaminated groundwater off site in Made Ground and Superficial Deposits
I = Migration of contaminated groundwater into culverted surface water streams (Kinkerdale Beck, Boundary Beck), and off site pond

Other SRP Linkages
J = Attack by contaminants of concern on foundations



KEY

NOTES

SCHEMATIC DRAWING ONLY - NOT TO SCALE

REV	DATE	COMMENT	CAD

TITLE: CONCEPTUAL SITE MODEL - SSI3 AREA B BOS AND CONCAST PLANT

SITE: REDCAR

CLIENT: STSC

PROJECT: 10013655 | FIGURE 3

DATE: 19/04/18 | DRAWN: BNB | REV: -

DRG.No.: 10013655_CSM_2 | PRINT: A3

ARCADIS Design & Consultancy for natural and built assets

Legend

Site Areas

Contract 3

Location Exceeds GAC (Soil)

- No
- Yes

Notes:

CONTACT ARCADIS IN CASE OF ANY QUERIES.

N

Title:
SSI3A Exceedances of GAC in Soil Samples by Exploratory Hole Location

Site:
Redcar Steelworks

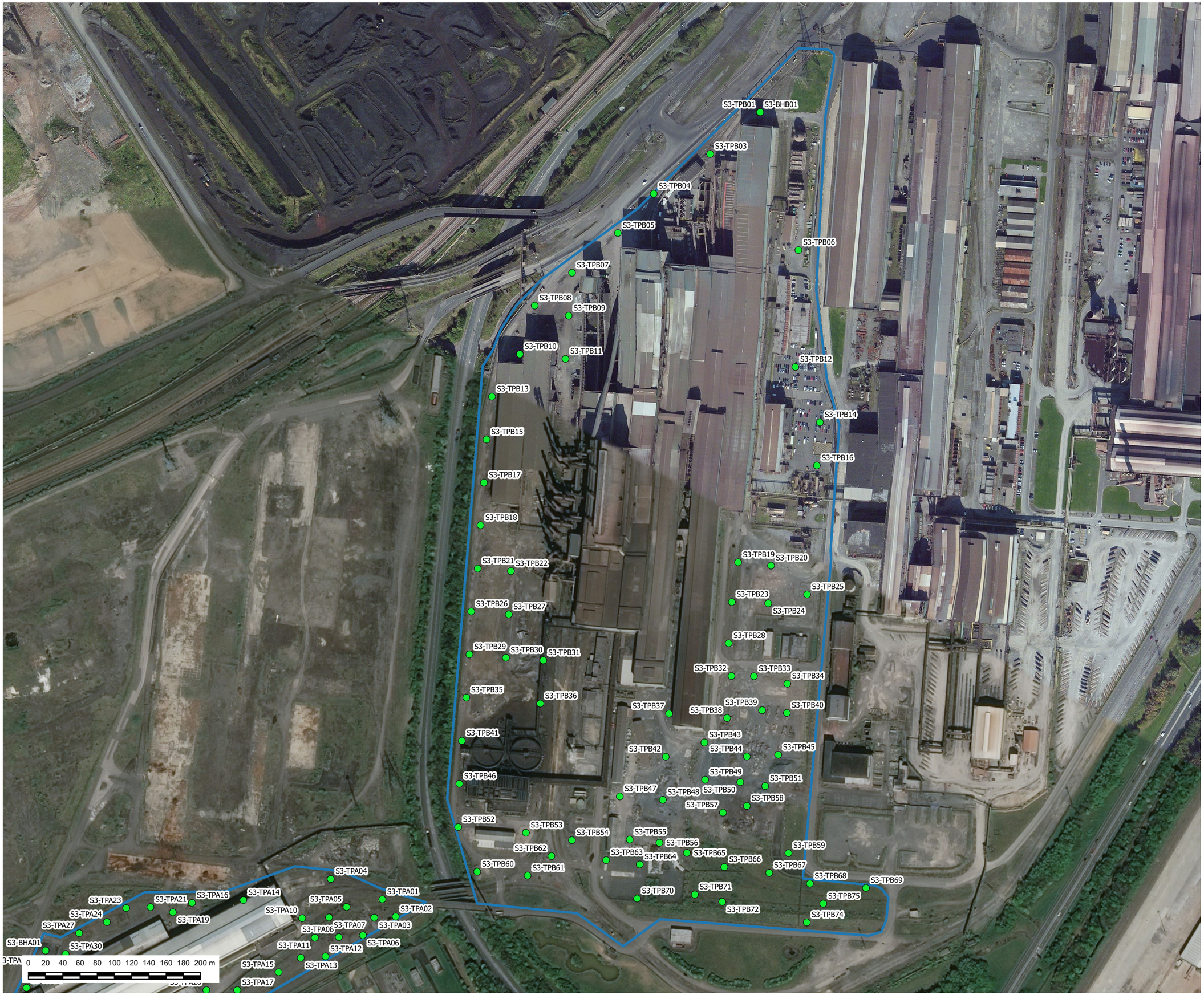
Client:
South Tees Site Company

Project:
37774100

SSI3A Figure 4

Date: 17/07/2018
Drawn By: JAR
DRG No: 37774100_01_SSI3A_ERA_Figure_4

ARCADIS Design & Consultancy for natural and built assets



Legend

Site Areas

Contract 3

Location Exceeds GAC (Soil)

- No
- Yes

Notes:

CONTACT ARCADIS IN CASE OF ANY QUERIES.

N

Title:
SSI3B Exceedances of GAC in Soil Samples by Exploratory Hole Location

Site:
Redcar Steelworks

Client:
South Tees Site Company

Project: 37774100	**SSI3A Figure 5**

Date: 18/07/2018
Drawn By: JAR
DRG No: 37774100_01_SSI3A_ERA_Figure_5

ARCADIS Design & Consultancy for natural and built assets

Legend

Asbestos Plots

- Asbestos Detected (%)
- No Asbestos Detected

Site Areas

- Contract 3

Notes:

CONTACT ARCADIS IN CASE OF ANY QUERIES.

Format: LocationID_Result_% composition

N

Title:
SSI3A Summary of Asbestos Testing

Site:
Redcar Steelworks

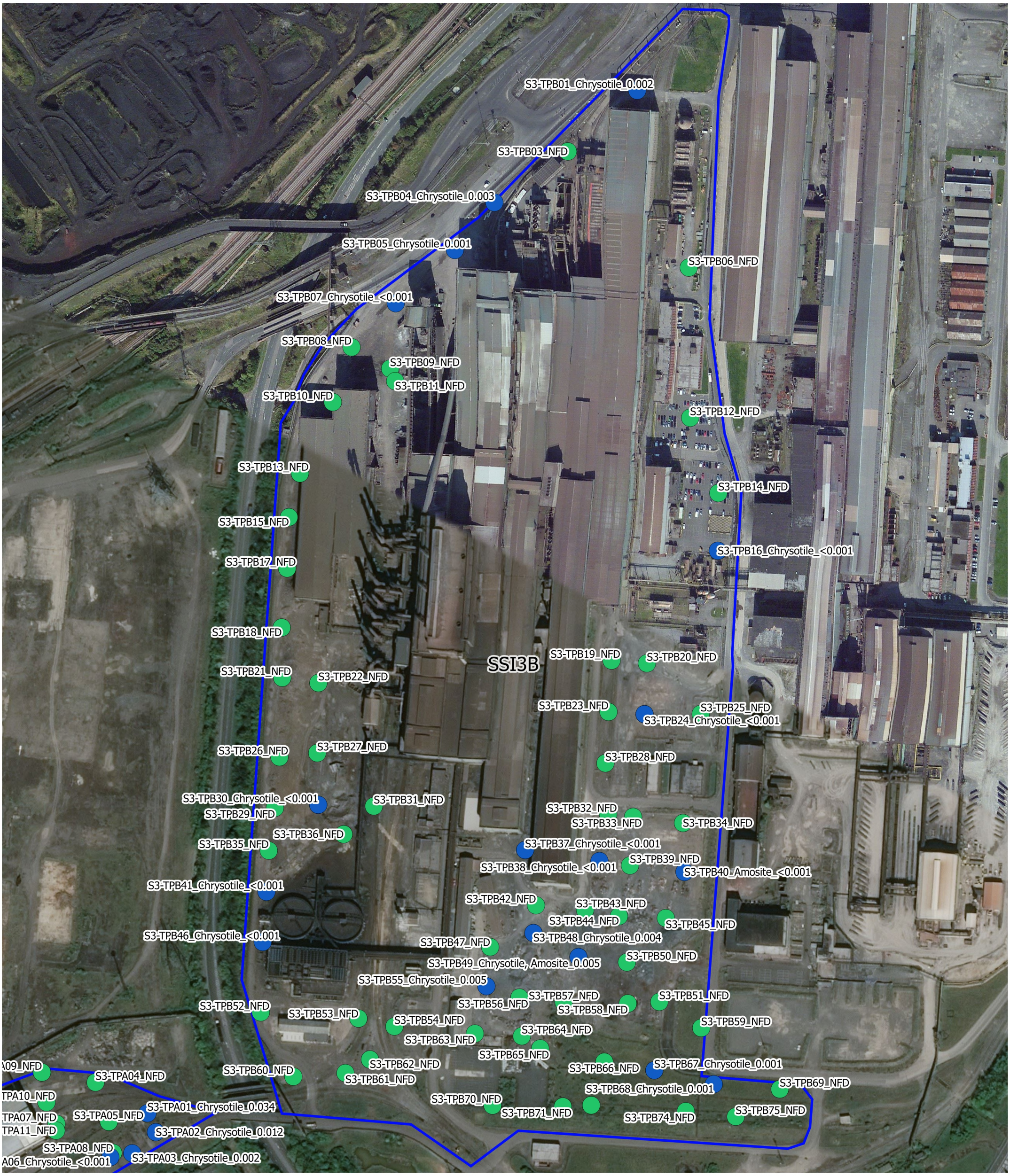
Client:
South Tees Site Company

Project:
37774100

SSI3A Figure 6

Date: 20/04/2018
Drawn By: JALM
DRG No: 37774100_01_SSI3A_Figure_6

ARCADIS Design & Consultancy for natural and built assets



Legend

Asbestos Plots

- Asbestos Detected (%)
- No Asbestos Detected

Site Areas

- Contract 3

Notes:

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CONTACT ARCADIS IN CASE OF ANY QUERIES.

Format: Location ID_Result_% composition

N

Title:
SSI3B Summary of Asbestos Testing

Site:
Redcar Steelworks

Client:
South Tees Site Company

Project:
37774100

SSI3B Figure 7

Date: 20/04/2018
Drawn By: JALM
DRG No: 37774100_01_SSI3B_Figure_6

ARCADIS Design & Consultancy for natural and built assets

Legend

Site Areas

Contract 3

No. WQS Exceedances (Groundwater)

- 2 - 6
- 6 - 11
- 11 - 15
- 15 - 20
- 20 - 24

Notes:

CONTACT ARCADIS IN CASE OF ANY QUERIES.

N

Title:
SSI3A Number of WQS Exceedances in Groundwater by Exploratory Hole Location

Site:
Redcar Steelworks

Client:
South Tees Site Company

Project: 37774100	**SSI3A Figure 8**

Date: 18/07/2018
Drawn By: JAR
DRG No: 37774100_01_SSI3A_ERA_Figure_8

ARCADIS Design & Consultancy for natural and built assets

Legend

Site Areas

Contract 3

No. WQS Exceedances (Groundwater)

- 2 - 6
- 6 - 11
- 11 - 15
- 15 - 20
- 20 - 24

Notes:

CONTACT ARCADIS IN CASE OF ANY QUERIES.

N

Title:
SSI3B Number of WQS Exceedances in Groundwater by Exploratory Hole Location

Site:
Redcar Steelworks

Client:
South Tees Site Company

Project:
37774100

SSI3B Figure 9

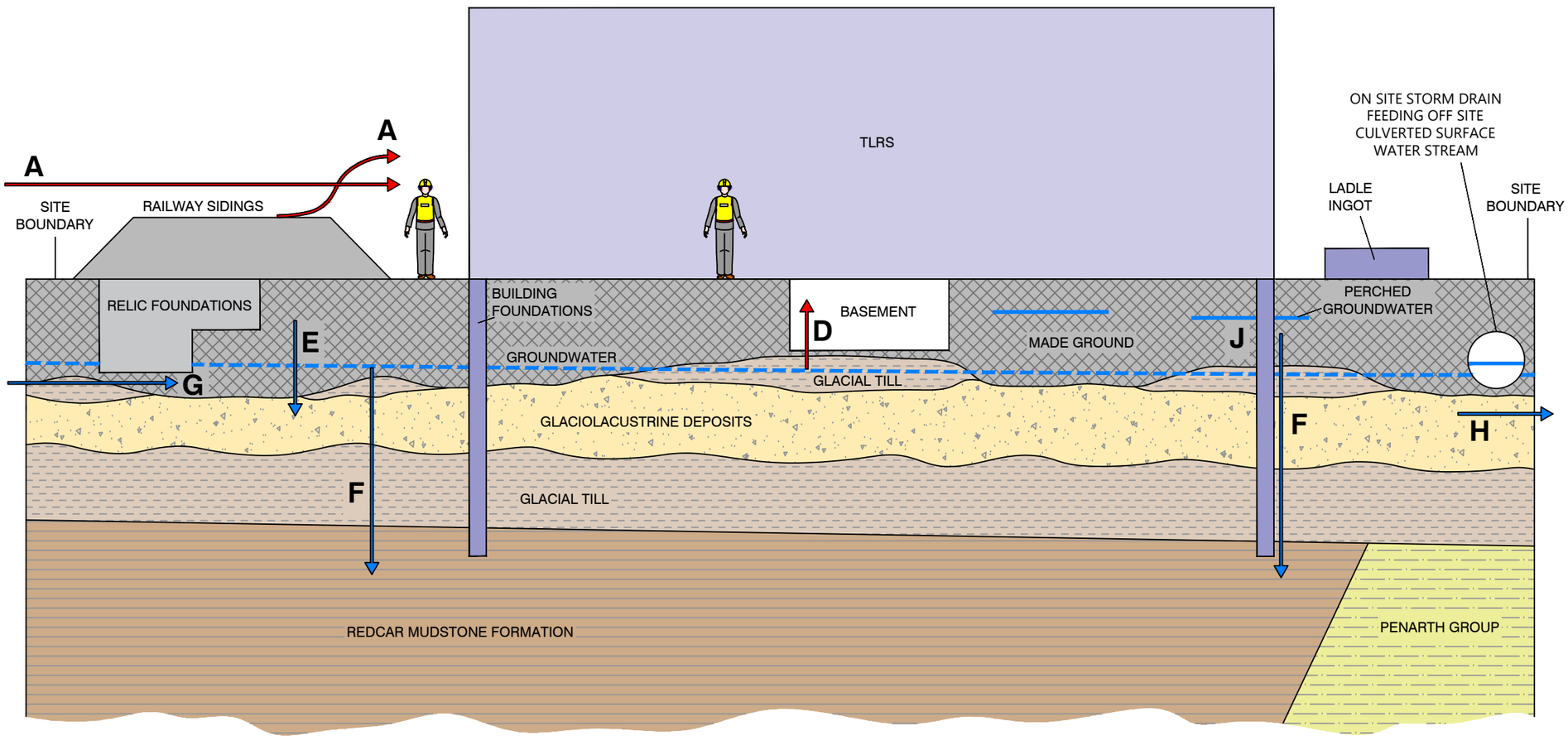
Date: 18/07/2018
Drawn By: JAR
DRG No: 37774100_01_SSI3B_ERA_Figure_9

ARCADIS Design & Consultancy for natural and built assets

Potential Human Health SPR Linkages
A = Dust inhalation from Made Ground from site and adjacent land
D = Accumulation of ground gas in confined spaces
SPR linkages for construction workers during redevelopment not shown

Potential Water Resource SPR Linkages
E = Leaching of contaminants from Made Ground and point sources to groundwater in superficial deposits
F = Migration of contaminated groundwater to (Secondary (Undifferentiated) Aquifer) in bedrock
G = Migration of contaminated groundwater onto site in Made Ground and Superficial Deposits
H = Migration of contaminated groundwater off site in Made Ground and Superficial Deposits

Other SRP Linkages
J = Attack by contaminants of concern on foundations



KEY

NOTES

SCHEMATIC DRAWING ONLY - NOT TO SCALE

REV	DATE	COMMENT	CAD

TITLE: UPDATED CONCEPTUAL SITE MODEL - SSI3 AREA A TLRS

SITE: REDCAR

CLIENT: STSC

PROJECT: 10013655 | FIGURE 10

DATE: 02/07/18 | DRAWN: BNB | REV: -

DRG.No.: 10013655_CSM_1 | PRINT: A3

ARCADIS Design & Consultancy for natural and built assets

Potential Human Health SPR Linkages
A = Dust inhalation from Made Ground from site and adjacent land
D = Accumulation of ground gas in confined spaces
SPR linkages for construction workers during redevelopment not shown

Potential Water Resource SPR Linkages
E = Leaching of contaminants from Made Ground and point sources to groundwater in superficial deposits
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Other SRP Linkages
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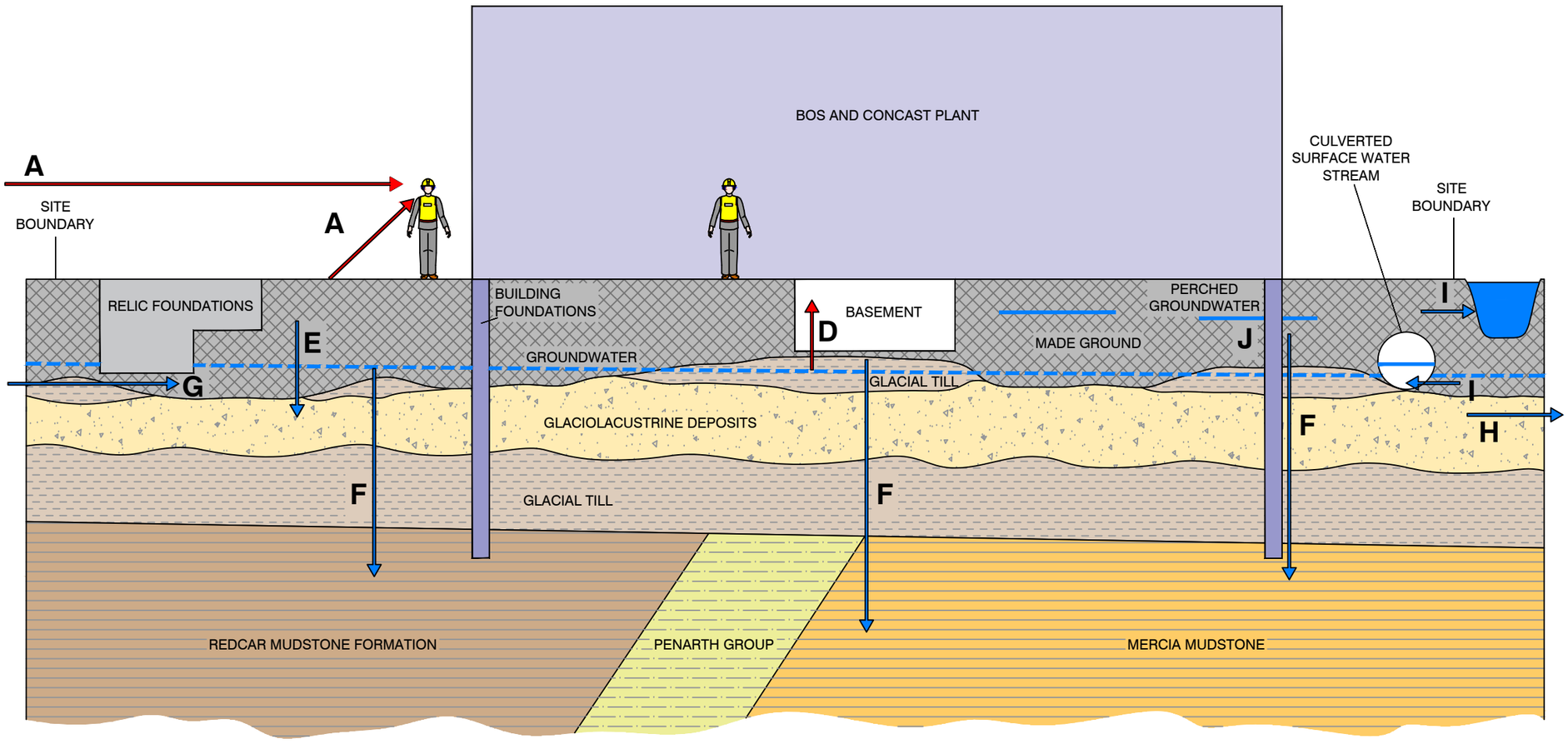

KEY

NOTES

SCHEMATIC DRAWING ONLY - NOT TO SCALE

REV	DATE	COMMENT	CAD

TITLE: UPDATED CONCEPTUAL SITE MODEL - SSI3 AREA B BOS AND CONCAST PLANT

SITE: REDCAR

CLIENT: STSC

PROJECT: 10013655 | FIGURE 11

DATE: 02/07/18 | DRAWN: BNB | REV: -

DRG.No.: 10013655_CSM_2 | PRINT: A3

ARCADIS Design & Consultancy for natural and built assets

APPENDIX C

Study Limitations

IMPORTANT: This section should be read before reliance is placed on any of the information, opinions, advice, recommendations or conclusions contained in this report.

1. This report has been prepared by Arcadis UK Ltd (Arcadis), with all reasonable skill, care and diligence within the terms of the Appointment and with the resources and manpower agreed with **South Tees Site Company** (the 'Client'). Arcadis does not accept responsibility for any matters outside the agreed scope.

2. This report has been prepared for the sole benefit of the Client unless agreed otherwise in writing.

3. Unless stated otherwise, no consultations with authorities or funders or other interested third parties have been carried out. Arcadis are unable to give categorical assurance that the findings will be accepted by these third parties as such bodies may have unpublished, more stringent objectives. Further work may be required by these parties.

4. All work carried out in preparing this report has used, and is based on, Arcadis' professional knowledge and understanding of current relevant legislation. Changes in legislation or regulatory guidance may cause the opinion or advice contained in this report to become inappropriate or incorrect. In giving opinions and advice, pending changes in legislation, of which Arcadis is aware, have been considered. Following delivery of the report, Arcadis have no obligation to advise the Client or any other party of such changes or their repercussions.

5. This report is only valid when used in its entirety. Any information or advice included in the report should not be relied upon until considered in the context of the whole report.

6. Whilst this report and the opinions made are correct to the best of Arcadis' belief, Arcadis cannot guarantee the accuracy or completeness of any information provided by third parties.

7. This report has been prepared based on the information reasonably available during the project programme. All information relevant to the scope may not have been received.

8. This report refers, within the limitations stated, to the condition of the Site at the time of the inspections. No warranty is given as to the possibility of changes in the condition of the Site since the time of the investigation.

9. The content of this report represents the professional opinion of experienced environmental consultants. Arcadis does not provide specialist legal or other professional advice. The advice of other professionals may be required.

10. Where intrusive investigation techniques have been employed they have been designed to provide a reasonable level of assurance on the conditions. Given the discrete nature of sampling, no investigation technique is capable of identifying all conditions present in all areas. In some cases the investigation is further limited by site operations, underground obstructions and above ground structures. Unless otherwise stated, areas beyond the boundary of the site have not been investigated.

11. If below ground intrusive investigations have been conducted as part of the scope, service tracing for safe location of exploratory holes has been carried out. The location of underground services shown on any drawing in this report has been determined by visual observations and electromagnetic techniques. No guarantee can be given that all services have been identified. Additional services, structures or other below ground obstructions, not indicated on the drawing, may be present on Site.

12. Unless otherwise stated the report provides no comment on the nature of building materials,

operational integrity of the facility or on any regulatory compliance issue

APPENDIX D

GQRA – Soil Screen Summary

Table D1: Soil GAC protective of Human Health

Contaminant	MDL	Units	GAC	GAC Source	Maximum soil concentration (Area A)	Maximum soil concentration (Area B)
Metals						
Aluminium	1	mg/kg	None		46000	62000
Antimony	1	mg/kg	470	USEPA	18	10
Arsenic	0.2	mg/kg	640	S4UL	96	33
Barium	1.5	mg/kg	19000	Arcadis	1100	1300
Beryllium	0.2	mg/kg	12	S4UL	4.9	6
Boron, Water Soluble	0.2	mg/kg	240000	S4UL	35	13
Cadmium	0.1	mg/kg	190	S4UL	8.4	5.9
Chromium	0.15	mg/kg	8600	S4UL	1300	710
Chromium, Hexavalent	1	mg/kg	33	S4UL	<1.0	<1.0
Copper	0.2	mg/kg	68000	S4UL	3200	190
Iron	25	mg/kg	None		160000	190000
Lead	0.3	mg/kg	2300	C4SL	1200	1200
Magnesium	1	mg/kg	None		27000	44000
Manganese	20	mg/kg	None		30000	86000
Mercury	0.05	mg/kg	58	S4UL	5.6	2.6
Molybdenum	0.4	mg/kg	5540	Arcadis	18	36
Nickel	1	mg/kg	980	S4UL	100	220
Silicon	10	mg/kg	None		200000	190000
Vanadium	0.8	mg/kg	9000	S4UL	3000	2000
Zinc	1	mg/kg	730000	S4UL	5000	2900
Inorganics						
pH	0.1		None		12.5	12.7
Cyanide, Total	0.1	mg/kg	150	USEPA	43	21
Cyanide, Free	0.1	mg/kg	None		1.1	0.5
Cyanide, Complex	0.2	mg/kg	None		35	20
Thiocyanate	0.6	mg/kg	None		8.7	2.7
Organic matter	0.1	%	None		7.6	7.8
Sulphate Aqueous Extract as SO4	10	mg/l	None		1600	1900
Sulphur as S, Total	0.01	%	None		44	370
Petroleum Hydrocarbons						
Aliphatic C5-C6	0.01	mg/kg	3200	S4UL	< 0.01	< 0.01
Aliphatic C6-C8	0.01	mg/kg	7800	S4UL	< 0.01	< 0.01
Aliphatic C8-C10	0.01	mg/kg	2000	S4UL	6.3	0.02
Aliphatic C10-C12	1.5	mg/kg	9700	S4UL	120	65
Aliphatic C12-C16	1.2	mg/kg	59000	S4UL	430	330
Aliphatic C16-C21	1.5	mg/kg	1600000	S4UL	370	340
Aliphatic C21-C35	3.4	mg/kg	1600000	S4UL	280	2100

Contaminant	MDL	Units	GAC	GAC Source	Maximum soil concentration (Area A)	Maximum soil concentration (Area B)
Aliphatic C5-C35	10	mg/kg	None		1100	2400
Aromatic C5-C7	0.01	mg/kg	26000	S4UL	0	0.01
Aromatic C7-C8	0.01	mg/kg	56000	S4UL	0	0.01
Aromatic C8-C10	0.01	mg/kg	3500	S4UL	4.8	0.09
Aromatic C10-C12	0.9	mg/kg	16000	S4UL	34	11
Aromatic C12-C16	0.5	mg/kg	36000	S4UL	210	150
Aromatic C16-C21	0.6	mg/kg	28000	S4UL	310	280
Aromatic C21-C35	1.4	mg/kg	28000	S4UL	460	1600
Aromatic C5-C35	10	mg/kg	None		750	1900
TPH Ali/Aro Total	10	mg/kg	None		1800	3400
PAHs						
Naphthalene	0.03	mg/kg	190	S4UL	0.67	1.1
Acenaphthylene	0.03	mg/kg	83000	S4UL	1.1	0.27
Acenaphthene	0.03	mg/kg	84000	S4UL	0.84	3.9
Fluorene	0.03	mg/kg	63000	S4UL	1.9	3.8
Phenanthrene	0.03	mg/kg	22000	S4UL	13	19
Anthracene	0.03	mg/kg	520000	S4UL	6.5	4
Fluoranthene	0.03	mg/kg	23000	S4UL	77	15
Pyrene	0.03	mg/kg	54000	S4UL	56	12
Benzo(a)anthracene	0.03	mg/kg	170	S4UL	30	5.3
Chrysene	0.03	mg/kg	350	S4UL	23	5.2
Benzo(b)fluoranthene	0.03	mg/kg	44	S4UL	40	7.6
Benzo(k)fluoranthene	0.03	mg/kg	1200	S4UL	18	3.1
Benzo(a)pyrene	0.03	mg/kg	35	S4UL	25	4.5
Indeno(1,2,3-c,d)pyrene	0.03	mg/kg	500	S4UL	17	2.6
Dibenzo(a,h)anthracene	0.03	mg/kg	3.5	S4UL	3.1	0.92
Benzo(g,h,i)perylene	0.03	mg/kg	3900	S4UL	18	3.2
PAH - USEPA 16, Total	0.1	mg/kg	None		330	71
Phenols						
Phenol - Monohydric	0.3	mg/kg	760	S4UL	0.6	0.9
PCBs						
PCB 28 + PCB 31	0.01	mg/kg	None		< 0.01	< 0.01
PCB 52	0.01	mg/kg	None		< 0.01	< 0.01
PCB 101	0.01	mg/kg	None		< 0.01	< 0.01
PCB 118	0.01	mg/kg	None		< 0.01	< 0.01
PCB 153	0.01	mg/kg	None		< 0.01	< 0.01
PCB 138	0.01	mg/kg	None		< 0.01	< 0.01
PCB 180	0.01	mg/kg	None		< 0.01	< 0.01
PCB 7 Total	0.01	mg/kg	None		< 0.01	< 0.01

Contaminant	MDL	Units	GAC	GAC Source	Maximum soil concentration (Area A)	Maximum soil concentration (Area B)
VOC						
Vinyl Chloride mg/kg	0.01	mg/kg	0.059	S4UL	<0.01	<0.01
1,1 Dichloroethylene mg/kg	0.01	mg/kg	1,000	USEPA	<0.01	<0.01
Trans-1,2-dichloroethylene mg/kg	0.01	mg/kg	23,000	USEPA	<0.01	<0.01
1,1-dichloroethane mg/kg	0.01	mg/kg	16	USEPA	<0.01	<0.01
Cis-1,2-dichloroethylene mg/kg	0.01	mg/kg	2,300	USEPA	<0.01	<0.01
2,2-dichloropropane mg/kg	0.01	mg/kg	None		<0.01	<0.01
Bromochloromethane mg/kg	0.01	mg/kg	630	USEPA	<0.01	<0.01
Chloroform mg/kg	0.01	mg/kg	99	S4UL	<0.01	<0.01
1,1,1-trichloroethane mg/kg	0.01	mg/kg	660	S4UL	<0.01	<0.01
1,1-dichloropropene mg/kg	0.01	mg/kg	None		0.01	0.01
Carbon tetrachloride mg/kg	0.01	mg/kg	2.9	S4UL	<0.01	<0.01
Benzene mg/kg	0.01	mg/kg	27	S4UL	<0.01	<0.01
1,2-dichloroethane mg/kg	0.01	mg/kg	0.67	S4UL	<0.01	<0.01
Trichloroethylene mg/kg	0.01	mg/kg	1.2	S4UL	0.22	<0.01
1,2-dichloropropane mg/kg	0.01	mg/kg	11.0	USEPA	<0.01	<0.01
Dibromomethane mg/kg	0.01	mg/kg	99.0	USEPA	<0.01	<0.01
Bromodichloromethane mg/kg	0.01	mg/kg	1.3	USEPA	<0.01	<0.01
cis-1,3-dichloropropene mg/kg	0.01	mg/kg	8.2	USEPA	<0.01	<0.01
Toluene mg/kg	0.01	mg/kg	56,000	S4UL	<0.01	<0.01
trans-1,3-dichloropropene mg/kg	0.01	mg/kg	8.2	USEPA	<0.01	<0.01
1,1,2-trichloroethane mg/kg	0.01	mg/kg	5	USEPA	<0.01	<0.01
Tetrachloroethylene mg/kg	0.01	mg/kg	19	S4UL	<0.01	<0.01
1,3-dichloropropane mg/kg	0.01	mg/kg	23,000	USEPA	<0.01	<0.01
Dibromochloromethane mg/kg	0.01	mg/kg	39	USEPA	<0.01	<0.01
1,2-dibromoethane mg/kg	0.01	mg/kg	0.16	USEPA	<0.01	<0.01
Chlorobenzene mg/kg	0.01	mg/kg	56	S4UL	<0.01	<0.01
1,1,1,2-tetrachloroethane mg/kg	0.01	mg/kg	110	S4UL	<0.01	<0.01
Ethylbenzene mg/kg	0.01	mg/kg	5,700	S4UL	<0.01	<0.01
m+p-Xylene mg/kg	0.01	mg/kg	5,900	S4UL	<0.01	<0.01
o-Xylene mg/kg	0.01	mg/kg	6,600	S4UL	<0.01	<0.01
Styrene mg/kg	0.01	mg/kg	35,000	USEPA	<0.01	<0.01
Bromoform mg/kg	0.01	mg/kg	86	USEPA	<0.01	<0.01
Isopropylbenzene mg/kg	0.01	mg/kg	None		<0.01	<0.01
Bromobenzene mg/kg	0.01	mg/kg	1,800	USEPA	<0.01	<0.01
1,2,3-trichloropropane mg/kg	0.01	mg/kg	0.11	USEPA	<0.01	<0.01
n-propylbenzene mg/kg	0.01	mg/kg	None		<0.01	<0.01
2-chlorotoluene mg/kg	0.01	mg/kg	23,000	USEPA	<0.01	<0.01
1,3,5-trimethylbenzene mg/kg	0.01	mg/kg	1,500	USEPA	<0.01	<0.01

Contaminant	MDL	Units	GAC	GAC Source	Maximum soil concentration (Area A)	Maximum soil concentration (Area B)
4-chlorotoluene mg/kg	0.01	mg/kg	23,000	USEPA	<0.01	<0.01
Tert-butylbenzene mg/kg	0.01	mg/kg	120,000	USEPA	<0.01	<0.01
1,2,4-trimethylbenzene mg/kg	0.01	mg/kg	1,800	USEPA	<0.01	<0.01
sec-butylbenzene mg/kg	0.01	mg/kg	120,000	USEPA	<0.01	<0.01
p-isopropyltoluene mg/kg	0.01	mg/kg	None		<0.01	<0.01
1,3-dichlorobenzene mg/kg	0.01	mg/kg	30	S4UL	<0.01	<0.01
1,4-dichlorobenzene mg/kg	0.01	mg/kg	4,400	S4UL	<0.01	<0.01
n-butylbenzene mg/kg	0.01	mg/kg	58,000	USEPA	<0.01	<0.01
1,2-dichlorobenzene mg/kg	0.01	mg/kg	2,000	S4UL	<0.01	<0.01
1,2-dibromo-3-chloropropane mg/kg	0.01	mg/kg	0.06	USEPA	<0.01	<0.01
1,2,4-trichlorobenzene mg/kg	0.01	mg/kg	220	S4UL	<0.01	<0.01
Hexachlorobutadiene mg/kg	0.01	mg/kg	31	S4UL	<0.01	<0.01
1,2,3-trichlorobenzene mg/kg	0.01	mg/kg	102	S4UL	<0.01	<0.01
MTBE mg/kg	0.01	mg/kg	210	USEPA	<0.01	<0.01
SVOC						
Phenol	0.1	mg/kg	760	S4UL	0.2	<0.1
Aniline	0.1	mg/kg	400	USEPA	<0.1	<0.1
2-Chlorophenol	0.1	mg/kg	5,800	USEPA	<0.1	<0.1
Benzyl Alcohol	0.1	mg/kg	82,000	USEPA	<0.1	<0.1
2-Methylphenol	0.1	mg/kg	41,000	USEPA	<0.1	<0.1
Bis(2-chloroisopropyl)ether	0.1	mg/kg	None		<0.1	<0.1
3&4-Methylphenol	0.1	mg/kg	82,000	USEPA	0.2	<0.1
2,4-Dimethylphenol	0.1	mg/kg	16,000	USEPA	<0.1	<0.1
Bis-(dichloroethoxy)methane	0.1	mg/kg	None		<0.1	<0.1
2,4-Dichlorophenol	0.1	mg/kg	2,500	USEPA	<0.1	<0.1
1,2,4-Trichlorobenzene	0.1	mg/kg	110	USEPA	<0.1	<0.1
4-Chloro-3-methylphenol	0.1	mg/kg	82,000	USEPA	<0.1	<0.1
2-Methylnaphthalene	0.1	mg/kg	3,000	USEPA	0.7	0.5
Hexachlorocyclopentadiene	0.1	mg/kg	8	USEPA	<0.1	<0.1
2,4,6-Trichlorophenol	0.1	mg/kg	210	USEPA	<0.1	<0.1
2,4,5-Trichlorophenol	0.1	mg/kg	82,000	USEPA	<0.1	<0.1
2-Chloronaphthalene	0.1	mg/kg	60,000	USEPA	<0.1	<0.1
2-Nitroaniline	0.1	mg/kg	8,000	USEPA	<0.1	<0.1
2,4-Dinitrotoluene	0.1	mg/kg	7.4	USEPA	<0.1	4.4
3-Nitroaniline	0.1	mg/kg	None		<0.1	<0.1
4-Nitrophenol	0.1	mg/kg	None		1.8	3
Dibenzofuran	0.1	mg/kg	1,000	USEPA	2.5	0.8
2,6-Dinitrotoluene	0.1	mg/kg	1.50	USEPA	<0.1	<0.1
2,3,4,6-Tetrachlorophenol	0.1	mg/kg	25,000	USEPA	<0.1	<0.1

Contaminant	MDL	Units	GAC	GAC Source	Maximum soil concentration (Area A)	Maximum soil concentration (Area B)
Diethylphthalate	0.1	mg/kg	660,000	USEPA	<0.1	<0.1
4-Chlorophenylphenylether	0.1	mg/kg	None		<0.1	<0.1
4-Nitroaniline	0.1	mg/kg	110	USEPA	<0.1	<0.1
2-Methyl-4,6-Dinitrophenol	0.1	mg/kg	None		<0.1	<0.1
Diphenylamine	0.1	mg/kg	82,000	USEPA	<0.1	<0.1
4-Bromophenylphenylether	0.1	mg/kg	None		<0.1	<0.1
Hexachlorobenzene	0.1	mg/kg	110	S4UL	<0.1	<0.1
Pentachlorophenol	0.1	mg/kg	400	S4UL	<0.1	<0.1
Di-n-butylphthalate	0.1	mg/kg	None		<0.1	<0.1
Butylbenzylphthalate	0.1	mg/kg	1,200	USEPA	<0.1	<0.1
Bis(2-ethylhexyl)phthalate	0.1	mg/kg	160	USEPA	<0.1	0.4
Di-n-octylphthalate	0.1	mg/kg	8,200	USEPA	<0.1	0.1
1,4-Dinitrobenzene	0.1	mg/kg	82	USEPA	<0.1	<0.1
Dimethylphthalate	0.1	mg/kg	None		<0.1	<0.1
1,3-Dinitrobenzene	0.1	mg/kg	82	USEPA	<0.1	<0.1
1,2-Dinitrobenzene	0.1	mg/kg	82	USEPA	<0.1	<0.1
2,3,5,6-Tetrachlorophenol	0.1	mg/kg	None		<0.1	<0.1
Azobenzene	0.1	mg/kg	26	USEPA	<0.1	<0.1
Carbazole	0.1	mg/kg	None		4.2	0.1

APPENDIX E

GQRA – Soil Leachate Screen Summary

Table E1: WQS protective of Controlled Waters

Contaminant	MDL	Units	EQS	DWS	Maximum Leachate Concentration (Area A)	Maximum Leachate Concentration (Area B)
Metals						
Antimony			-	5	2.3	0.88
Arsenic, Dissolved	0.16	ug/l	50	10	8.9	2.6
Barium, Dissolved	0.26	ug/l	700	700	180	29
Beryllium, Dissolved	0.1	ug/l	-	-	0.05	<0.1
Boron	100	ug/l	2000	1000	230	420
Cadmium, Dissolved	0.03	ug/l	0.08	5	**0.33**	<0.03
Chromium, Dissolved	0.25	ug/l	4.7	50	**6.7**	1.5
Copper, Dissolved	0.4	ug/l	1	2000	**4.5**	**2.1**
Iron	5.5	ug/l	-	-	130	170
Lead, Dissolved	0.09	ug/l	1.2	10	**2**	0.94
Manganese, Dissolved	0.22	ug/l	30	50	21	**66**
Mercury, Dissolved	0.01	ug/l	0.05	1	**0.17**	0.01
Nickel, Dissolved	0.5	ug/l	4	20	0.6	0
Selenium, Dissolved	0.25	ug/l	10	10	6.8	1.6
Vanadium, Dissolved	0.6	ug/l	20		**37**	**220**
Zinc, Dissolved	1.3	ug/l	12.1	3000	**130**	8.5
Inorganics						
pH					11.7	10.6
Cyanide, Total	40	ug/l		50	<40	40
Phenol - Monohydric	0.5	ug/l	7.7		<0.5	<0.5
Ammoniacal Nitrogen as N	0.015	mg/l		0.5	**0.84**	**0.6**
Sulphate as SO4	0.1	mg/l			47	86
Petroleum Hydrocarbons						
Aliphatic C5-C6	0.1	ug/l			< 0.1	<0.1
Aliphatic C6-C8	0.1	ug/l			< 0.1	< 0.1
Aliphatic C8-C10	0.1	ug/l			< 0.1	< 0.1
Aliphatic C10-C12	1	ug/l			< 1.0	2.3
Aliphatic C12-C16	1	ug/l			< 1.0	5.6
Aliphatic C16-C21	1	ug/l			< 1.0	15
Aliphatic C21-C35	1	ug/l			< 1.0	31
Aliphatic C5-C35	10	ug/l			< 10	54
Aromatic C5-C7	0.1	ug/l			< 0.1	< 0.1
Aromatic C7-C8	0.1	ug/l	10	1	< 0.1	< 0.1
Aromatic C8-C10	0.1	ug/l	74	700	< 0.1	< 0.1
Aromatic C10-C12	1	ug/l			< 1.0	< 1.0
Aromatic C12-C16	1	ug/l			< 1.0	5
Aromatic C16-C21	1	ug/l			7.2	8.4
Aromatic C21-C35	1	ug/l			50	8.7

Aromatic C5-C35	10	ug/l			58	22
TPH Ali/Aro Total	10	ug/l	10		<10	**76**
PAHs						
Naphthalene	0.01	ug/l	2	2	0.06	0.03
Acenaphthylene	0.01	ug/l			0.24	<0.01
Acenaphthene	0.01	ug/l			0.1	0.12
Fluorene	0.01	ug/l			0.06	0.02
Phenanthrene	0.01	ug/l			0.28	0.08
Anthracene	0.01	ug/l			0.28	<0.01
Fluoranthene	0.01	ug/l			6.7	0.07
Pyrene	0.01	ug/l			7.7	0.07
Benzo(a)anthracene	0.01	ug/l			6.5	0.04
Chrysene	0.01	ug/l			6.3	0.05
Benzo(b)fluoranthene	0.01	ug/l		0.025	**17**	**0.09**
Benzo(k)fluoranthene	0.01	ug/l		0.025	**7.3**	**0.03**
Benzo(a)pyrene	0.01	ug/l	0.00017	0.01	**11**	**0.05**
Indeno(1,2,3-c,d)pyrene	0.01	ug/l		0.025	**9.6**	**0.06**
Dibenzo(a,h)anthracene	0.01	ug/l			2	<0.01
Benzo(g,h,i)perylene	0.01	ug/l		0.025	**9.7**	**0.07**
PAH Total	0.04	ug/l			85	0.61

APPENDIX F

GQRA – Groundwater Screen Summary

Table F1: Inhalation GAC protective of Human Health

Determinand	Human Health Inhalation GAC (On-site Commercial Worker) (µg/l)
Antimony, Dissolved	NVP
Arsenic, Dissolved	NVP
Boron	NVP
Barium, Dissolved	NVP
Beryllium, Dissolved	NVP
Cadmium, Dissolved	NVP
Chromium, Dissolved	NVP
Copper, Dissolved	NVP
Iron, Dissolved	NVP
Lead, Dissolved	NVP
Magnesium, Dissolved	NVP
Manganese, Dissolved	NVP
Mercury, Dissolved	NVP
Nickel, Dissolved	NVP
Selenium, Dissolved	NVP
Vanadium, Dissolved	NVP
Zinc, Dissolved	NVP
Phenol - Monohydric	>SOL
Aliphatic C5-C6	>SOL
Aliphatic C6-C8	>SOL
Aliphatic C8-C10	>SOL
Aliphatic C10-C12	>SOL
Aliphatic C12-C16	>SOL
Aliphatic C16-C21	NR
Aliphatic C21-C35	NR
Aliphatic C5-C35	na
Aromatic C5-C7	57000
Aromatic C7-C8	>SOL
Aromatic C8-C10	>SOL
Aromatic C10-C12	>SOL
Aromatic C12-C16	>SOL
Aromatic C16-C21	NR
Aromatic C21-C35	NR
Aromatic C5-C35	na
TPH Ali/Aro Total	na
Naphthalene	>SOL
Acenaphthylene	>SOL
Acenaphthene	>SOL
Fluorene	>SOL
Phenanthrene	>SOL

Determinand	Human Health Inhalation GAC (On-site Commercial Worker) (µg/l)
Anthracene	>SOL
Fluoranthene	>SOL
Pyrene	>SOL
Benzo(a)anthracene	>SOL
Chrysene	>SOL
Benzo(b)fluoranthene	>SOL
Benzo(k)fluoranthene	>SOL
Benzo(a)pyrene	>SOL
Indeno(1,2,3-c,d)pyrene	>SOL
Dibenzo(a,h)anthracene	>SOL
Benzo(g,h,i)perylene	>SOL
PAH Total	na
Phenol - Monohydric	>SOL
Vinyl Chloride	5000
1,1-dichloroethylene	740000
Trans-1,2-dichloroethylene	430000
1,1-dichloroethane	1600000
Cis-1,2-dichloroethylene	120000
Chloroform	820000
1,1,1-trichloroethane	>SOL
Benzene	57000
1,2-dichloroethane	3600
Trichloroethylene	13000
Toluene	>SOL
Tetrachloroethylene	140000
Chlorobenzene	130000
Ethylbenzene	>SOL
m+p-Xylene	>SOL
o-Xylene	>SOL
MTBE	24000000

Notes:
>SOL Target acceptable risk not exceeded at theoretical solubility concentration
NR No appropriate inhalation reference dose identified during review of toxicological data
na Comprises multiple contaminants - no GAC derived
- No water quality standard identified as suitable for deriving generic assessment criteria
NVP Contaminant has low vapour pressure in groundwater

Table F2: WQS protective of Controlled Waters

Contaminant	MDL	Unit	EQS	DWS	USEPA RSL	Maximum Groundwater Concentration (Area A)	Maximum Groundwater Concentration (Area B)
	Metals						
Antimony, Dissolved	0.17	ug/l		5		0.86	0.75

Contaminant	MDL	Unit	EQS	DWS	USEPA RSL	Maximum Groundwater Concentration (Area A)	Maximum Groundwater Concentration (Area B)
Arsenic, Dissolved	0.16	ug/l	50	10		2.6	4.5
Barium, Dissolved	0.26	ug/l	2000	1000		76	180
Beryllium, Dissolved	0.1	ug/l	700	700		<0.1	<0.1
Boron	100	ug/l	2000	1000		280	930
Cadmium, Dissolved	0.03	ug/l	0.08	5		0.07	**0.12**
Chromium, Dissolved	0.25	ug/l	4.7	50		<0.25	3.7
Copper, Dissolved	0.4	ug/l	1	2000		**3.4**	**1.9**
Iron, Dissolved	5.5	ug/l				54	170
Lead, Dissolved	0.09	ug/l	1.2	10		0.31	0.15
Magnesium, Dissolved	0.02	mg/l				83	77
Manganese, Dissolved	0.22	ug/l	30	50		**740**	**1500**
Mercury, Dissolved	0.01	ug/l	0.05	1		<0.01	0.02
Nickel, Dissolved	0.5	ug/l	4	20		**4.2**	**4.1**
Selenium, Dissolved	0.25	ug/l	10	10		5.8	7.2
Vanadium, Dissolved	0.6	ug/l				6	73
Zinc, Dissolved	1.3	ug/l	12.1	3000		4.3	**43**
Inorganics							
pH						8.6	9.5
Alkalinity as CaCO3 (Automated)	10	mg/l				240	170
Cyanide, Total	40	ug/l				<40	<40
Cyanide, Free	20	ug/l				<20	<20
Cyanide, Complex	40	ug/l				<40	<40
Phenol - Monohydric	0.5	ug/l	7.7	7.7		<0.5	5.2
Thiocyanate	40	ug/l				<40	<40
Total Dissolved Solids	5	mg/l				1500	2700
Ammoniacal Nitrogen as N	0.015	mg/l		0.5		0.039	**0.55**
Chloride	0.1	mg/l				120	100
Sulphate as SO4	0.1	mg/l				770	1600
Petroleum Hydrocarbons							
Aliphatic C5-C6	0.1	ug/l				0	0
Aliphatic C6-C8	0.1	ug/l				0	0
Aliphatic C8-C10	0.1	ug/l				0	0
Aliphatic C10-C12	1	ug/l				6.1	3.5
Aliphatic C12-C16	1	ug/l				24	4.2
Aliphatic C16-C21	1	ug/l				26	25
Aliphatic C21-C35	1	ug/l				13	150
Aliphatic C5-C35	10	ug/l				69	170
Aromatic C5-C7	0.1	ug/l				0	0
Aromatic C7-C8	0.1	ug/l	10	1		0	0

Contaminant	MDL	Unit	EQS	DWS	USEPA RSL	Maximum Groundwater Concentration (Area A)	Maximum Groundwater Concentration (Area B)
Aromatic C8-C10	0.1	ug/l	74	700		0	0
Aromatic C10-C12	1	ug/l				4.7	5.2
Aromatic C12-C16	1	ug/l				7.3	8.3
Aromatic C16-C21	1	ug/l				5.6	16
Aromatic C21-C35	1	ug/l				20	110
Aromatic C5-C35	10	ug/l				38	130
TPH Ali/Aro Total	10	ug/l	10			**90**	**300**
Benzene	1	ug/l	10	1	0.46	<1	<1
Toluene	1	ug/l	74	700	1100	<1	<1
Ethylbenzene	1	ug/l	20	300	1.5	<1	<1
Xylene	1	ug/l	30	500		<1	<1
PAHs							
Naphthalene	0.01	ug/l	2	2		0.04	**9**
Acenaphthylene	0.01	ug/l				0.02	0.26
Acenaphthene	0.01	ug/l				0.19	10
Fluorene	0.01	ug/l				0.15	3.7
Phenanthrene	0.01	ug/l				0.42	20
Anthracene	0.01	ug/l				0.1	32
Fluoranthene	0.01	ug/l				1	20
Pyrene	0.01	ug/l				1.2	16
Benzo(a)anthracene	0.01	ug/l				0.27	6.7
Chrysene	0.01	ug/l				0.32	9.2
Benzo(b)fluoranthene	0.01	ug/l		0.025		**0.29**	**11**
Benzo(k)fluoranthene	0.01	ug/l		0.025		**0.12**	**5.1**
Benzo(a)pyrene	0.01	ug/l	0.00017	0.01		**0.17**	**7.2**
Indeno(1,2,3-c,d)pyrene	0.01	ug/l		0.025		**0.14**	**6.9**
Dibenzo(a,h)anthracene	0.01	ug/l				0	1.4
Benzo(g,h,i)perylene	0.01	ug/l		0.025		**0.15**	**7.7**
PAH Total	0.04	ug/l				4.5	100
VOC							
Dichlorodifluoromethane	1	ug/l			200	< 1	< 1
Chloromethane	1	ug/l			190	< 1	< 1
Vinyl Chloride	1	ug/l	0.5	0.5	0.019	< 1	< 1
Bromomethane	1	ug/l			7.5	< 1	< 1
Chloroethane	1	ug/l			21000	< 1	< 1
Trichlorofluoromethane	1	ug/l			5200	< 1	< 1
1,1-dichloroethylene	1	ug/l	140	7	280	< 1	< 1
Methylene Chloride	27	ug/l			11	< 27	< 27
Trans-1,2-dichloroethylene	1	ug/l	25	25	360	< 1	< 1
1,1-dichloroethane	1	ug/l	2.7	2.7	2.8	< 1	< 1

Contaminant	MDL	Unit	EQS	DWS	USEPA RSL	Maximum Groundwater Concentration (Area A)	Maximum Groundwater Concentration (Area B)
Cis-1,2-dichloroethylene	1	ug/l	25	25	36	< 1	< 1
2,2-dichloropropane	2	ug/l				< 2	< 2
Bromochloromethane	4	ug/l			83	< 4	< 4
Chloroform	1	ug/l	2.5	300	0.22	< 1	< 1
1,1,1-trichloroethane	1	ug/l	100	2000	8000	< 1	< 1
1,1-dichloropropene	1	ug/l				< 1	< 1
Carbon tetrachloride	1	ug/l			0.46	< 1	< 1
Benzene	1	ug/l	10	1	0.46	< 1	< 1
1,2-dichloroethane	1	ug/l	10	3	0.17	< 1	< 1
Trichloroethylene	1	ug/l	10	10	0.49	< 1	< 1
1,2-dichloropropane	1	ug/l			0.85	< 1	< 1
Dibromomethane	1	ug/l			8.3	< 1	< 1
Bromodichloromethane	4	ug/l			0.13	< 4	< 4
cis-1,3-dichloropropene	1	ug/l			0.47	< 1	< 1
Toluene	1	ug/l	74	700	1100	< 1	< 1
trans-1,3-dichloropropene	1	ug/l			0.47	< 1	< 1
1,1,2-trichloroethane	1	ug/l			0.28	< 1	< 1
Tetrachloroethylene	1	ug/l	10	10	11	< 1	< 1
1,3-dichloropropane	1	ug/l			370	< 1	< 1
Dibromochloromethane	1	ug/l			0.87	< 1	< 1
1,2-dibromoethane	1	ug/l			0.0075	< 1	< 1
Chlorobenzene	1	ug/l	100	100	78	< 1	< 1
1,1,1,2-tetrachloroethane	1	ug/l			0.57	< 1	< 1
Ethylbenzene	1	ug/l	20	300	1.5	< 1	< 1
m+p-Xylene	2	ug/l	30	500	190	< 2	< 2
o-Xylene	1	ug/l	30	500	190	< 1	< 1
Styrene	1	ug/l			1200	< 1	< 1
Bromoform	1	ug/l			3.3	< 1	< 1
Isopropylbenzene	1	ug/l			450	< 1	< 1
1,1,2,2-tetrachloroethane	1	ug/l			0.076	< 1	< 1
Bromobenzene	1	ug/l			62	< 1	< 1
1,2,3-trichloropropane	1	ug/l			0.00075	< 1	< 1
n-propylbenzene	1	ug/l			660	< 1	< 1
2-chlorotoluene	1	ug/l			240	< 1	< 1
1,3,5-trimethylbenzene	1	ug/l			60	< 1	< 1
4-chlorotoluene	1	ug/l			250	< 1	< 1
Tert-butylbenzene	1	ug/l			690	< 1	< 1
1,2,4-trimethylbenzene	1	ug/l			56	< 1	< 1
sec-butylbenzene	1	ug/l			2000	< 1	< 1
p-isopropyltoluene	1	ug/l				< 1	< 1

Contaminant	MDL	Unit	EQS	DWS	USEPA RSL	Maximum Groundwater Concentration (Area A)	Maximum Groundwater Concentration (Area B)
1,3-dichlorobenzene	2	ug/l				< 2	< 2
1,4-dichlorobenzene	1	ug/l			0.48	< 1	< 1
n-butylbenzene	1	ug/l				< 1	< 1
1,2-dichlorobenzene	1	ug/l			300	< 1	< 1
1,2-dibromo-3-chloropropane	1	ug/l			0.00033	< 1	< 1
1,2,4-trichlorobenzene	1	ug/l			1.2	< 1	< 1
Hexachlorobutadiene	1	ug/l			0.14	< 1	< 1
1,2,3-trichlorobenzene	1	ug/l			7	< 1	< 1
MTBE	1	ug/l	15	15	14	< 1	< 1
SVOC							
Phenol	1	ug/l			5800	<1.0	<1.0
Aniline	1	ug/l			13	<1.0	<1.0
2-Chlorophenol	1	ug/l			91	<1.0	<1.0
Benzyl Alcohol	1	ug/l			2000	<1.0	1.5
2-Methylphenol	1	ug/l			930	<1.0	<1.0
Bis(2-chloroisopropyl)ether	1	ug/l				<1.0	<1.0
3&4-Methylphenol	1	ug/l			1900	<1.0	<1.0
Bis(2-chloroethoxy)methane	1	ug/l			59	<1.0	<1.0
2,4-Dimethylphenol	1	ug/l			360	<1.0	<1.0
2,4-Dichlorophenol	1	ug/l			46	<1.0	<1.0
1,2,4-Trichlorobenzene	1	ug/l			1.2	<1.0	<1.0
4-Chloro-3-methylphenol	1	ug/l			1400	<1.0	<1.0
2-Methylnaphthalene	1	ug/l			36	<1.0	<1.0
Hexachlorocyclopentadiene	1	ug/l			0.41	<1.0	<1.0
2,4,6-Trichlorophenol	1	ug/l			4.1	<1.0	<1.0
2,4,5-Trichlorophenol	1	ug/l			1200	<1.0	<1.0
2-Chloronaphthalene	1	ug/l			750	<1.0	<1.0
2-Nitroaniline	1	ug/l			190	<1.0	<1.0
2,4-Dinitrotoluene	1	ug/l			0.24	<1.0	<1.0
3-Nitroaniline	1	ug/l				<1.0	<1.0
4-Nitrophenol	1	ug/l				<1.0	<1.0
Dibenzofuran	1	ug/l			7.9	<1.0	<1.0
2,6-Dinitrotoluene	1	ug/l			0.049	<1.0	<1.0
2,3,4,6-Tetrachlorophenol	1	ug/l			240	<1.0	<1.0
Diethylphthalate	1	ug/l			15000	<1.0	<1.0
4-Chlorophenylphenylether	1	ug/l				<1.0	<1.0
4-Nitroaniline	1	ug/l			3.8	<1.0	<1.0
Diphenylamine	1	ug/l			1300	<1.0	<1.0
4-Bromophenylphenylether	1	ug/l				<1.0	<1.0

Contaminant	MDL	Unit	EQS	DWS	USEPA RSL	Maximum Groundwater Concentration (Area A)	Maximum Groundwater Concentration (Area B)
Hexachlorobenzene	1	ug/l			0.0098	<1.0	<1.0
Bis(2-ethylhexyl)ester	1	ug/l				<1.0	<1.0
Pentachlorophenol	1	ug/l			0.041	<1.0	<1.0
Di-n-butylphthalate	1	ug/l			900	<1.0	3.7
Butylbenzylphthalate	1	ug/l			16	<1.0	<1.0
Bis(2-ethylhexyl)phthalate	1	ug/l		5.6	5.6	<1.0	2.4
Di-n-octylphthalate	1	ug/l			200	<1.0	<1.0
1,4-Dinitrobenzene	1	ug/l			2	<1.0	<1.0
Dimethylphthalate	1	ug/l				<1.0	<1.0
1,3-Dinitrobenzene	1	ug/l			2	<1.0	<1.0
2,3,5,6-Tetrachlorophenol	1	ug/l				<1.0	<1.0
Azobenzene	1	ug/l			0.12	<1.0	<1.0
Carbazole	1	ug/l				<1.0	<1.0
1-Methylnaphthalene	1	ug/l		1.1	1.1	<1.0	<1.0
PCBs							
PCB 28 + PCB 31	0.3	ug/l				< 0.3	-
PCB 52	0.2	ug/l				< 0.2	-
PCB 101	0.3	ug/l				< 0.3	-
PCB 118 + PCB 123	0.6	ug/l			0.004	< 0.6	-
PCB 138	0.2	ug/l				< 0.2	-
PCB 153	0.2	ug/l				< 0.2	-
PCB 180	0.2	ug/l				< 0.2	-
PCB 7 Total	1	ug/l				< 1.0	-

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