

H2Teesside Project

Environmental Statement

Volume III – Appendices

Appendix 10C: Contaminated Land Environmental Risk Assessment

Document Reference: 6.4.13

The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (as amended)

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 - Regulation 5(2)(a)



TABLE OF CONTENTS

10C.0	CONTAMINATED LAND ENVIRONMENTAL RISK ASSESSMENT	3
10C.1	Risk Assessment Principles and Framework	3
10C.2	Land Contamination Risk Management Assessment of Risk	5
10C.3	Preliminary Risk Assessment.....	6
10C.4	References.....	27

TABLES

Table 10C-1:	Severity of Risk.....	3
Table 10C-2:	Probability of Risk Occurring	4
Table 10C-3:	Probability of Risk Occurring	5
Table 10C-4:	Probability of Risk Occurring	5
Table 10C-5:	Preliminary Risk Assessment	7

10C.0 CONTAMINATED LAND ENVIRONMENTAL RISK ASSESSMENT

10C.1 Risk Assessment Principles and Framework

10C.1.1 Current best practice recommends that the determination of hazards due to contaminated land is based on the principle of risk assessment, as outlined in the Environment Agency guidance on Land Contamination Risk Management (EA, 2023).

10C.1.2 For a risk to be present, there must be a viable contaminant linkage; i.e. a mechanism whereby a source impacts on a sensitive receptor via a pathway. The potential contaminant linkages that have been identified for the Proposed Development Site are presented in Appendix 10B - Conceptual Site Model (ES Volume III, EN070009/APP/6.4).

10C.1.3 Assessments of risks associated with each of these contaminant linkages, following review of available information for the Proposed Development Site are discussed in the following sections.

10C.1.4 Using criteria broadly based on those presented in Guidance for the Safe Development of Housing on Land Affected by Contamination (National House Building Council (NHBC) et al. 2008) the magnitude of the risk associated with potential contamination at the Proposed Development Site has been assessed. To do this an estimate is made of:

- the potential severity of the risk; and
- the likelihood of the risk occurring.

10C.1.5 The severity of the risk is classified according to the criteria in Table 10C-1.

Table 10C-1: Severity of Risk

SEVERITY	DESCRIPTION
High	<ul style="list-style-type: none"> • Acute risks to human health likely to result in “significant harm” (e.g. very high concentrations of contaminants/ground gases); • Catastrophic damage to buildings/property (e.g. by explosion, sites with high gassing potential, extensive volatile organic compound (VOC) contamination); • Major pollution of controlled waters (e.g. surface watercourses or Principal Aquifers / Source Protection Zones); and • Short term risk to a particular ecosystem.
Medium	<ul style="list-style-type: none"> • Chronic (long-term) risk to human health likely to result in “significant harm” (e.g. elevated concentration of contaminants/ground gases); • Pollution of sensitive controlled waters (e.g. surface watercourses or principal/secondary A aquifers); and • Significant effects on sensitive ecosystems or species.

SEVERITY	DESCRIPTION
Mild	<ul style="list-style-type: none"> • Pollution of non-sensitive waters (e.g. smaller surface watercourses or secondary B aquifers or unproductive strata); and • Significant damage to crops, buildings, structures or services (e.g. by explosion, sites with medium gassing potential, elevated concentrations of contaminants).
Minor	<ul style="list-style-type: none"> • Non-permanent human health effects (requirement for protective equipment during site works to mitigate health effects); • Damage to non-sensitive ecosystems or species; and • Minor (easily repairable) damage to buildings, structures or services (e.g. by explosion, sites with low gassing potential).

10C.1.6 The probability of the risk occurring is classified according to the criteria given in Table 10C-2.

Table 10C-2: Probability of Risk Occurring

PROBABILITY	EXPLANATION
High likelihood	Contaminant linkage may be present that appears very likely in the short term and risk is almost certain to occur in the long term, or there is evidence of harm to the receptor.
Likely	Contaminant linkage may be present, and it is probable that the risk will occur over the long term.
Low Likelihood	Contaminant linkage may be present and there is a possibility of the risk occurring, although there is no certainty that it will do so.
Unlikely	Contaminant linkage may be present but the circumstances under which harm would occur even in the long term are improbable.

10C.1.7 An overall evaluation of the level of risk is gained from a comparison of the severity and probability, as shown in Table 10C-3.

Table 10C-3: Probability of Risk Occurring

		SEVERITY			
		SEVERE	MEDIUM	MILD	MINOR
PROBABILITY	HIGH LIKELIHOOD	Very High	High	Moderate	Moderate / Low
	LIKELY	High	Moderate	Moderate / Low	Low
	LOW LIKELIHOOD	Moderate	Moderate / Low	Low	Very Low
	UNLIKELY	Moderate / Low	Low	Very Low	Very Low

10C.2 Land Contamination Risk Management Assessment of Risk

10C.2.1 In October 2020 (updated July 2023), the UK government issued guidance on the evaluation and management of contaminated land; Land Contamination Risk Management (LCRM). Current contaminated land guidance LCRM (EA, 2023) categorises risk at Stage 1 Tier 1 as follows:

- acceptable; and
- unacceptable.

10C.2.2 However, no framework for assessing the risk has been published to accompany the guidance, so the CIEH & NHBC R&D Publication 66 assessment framework (2008) constitutes best practice in this regard. To align the risk rankings in Section 10.1 with the LCRM rankings and with the Part 2A definition, the following matrix has been utilised. This conversion is presented in Table 10C-4.

Table 10C-4: Probability of Risk Occurring.

	ACCEPTABLE	UNACCEPTABLE
Very Low		
Low		
Moderate/Low		
Moderate*		
High		
Very High		

*This risk category spans both acceptable and unacceptable. This is intentional as it is this risk band that tends to have the greatest level of uncertainty associated with it. Acceptability will be dependent on site-specific circumstances and level of confidence in the available evidence, determined by professional judgement.

-
- 10C.2.3 For a risk to be unacceptable, the contaminant linkage should be associated with at least a “medium” severity as defined in Table A4.3 in Annex 4 of R&D66 and the probability should (in the majority of cases) be at least “likely” as defined in Table A4.4 of R&D66.
- 10C.2.4 These risk categories represent the level of risk as it is currently understood from the information available at this time.
- 10C.3 Preliminary Risk Assessment
- 10C.3.1 An evaluation of the potential risks associated with the identified sources at the location of the Proposed Development to the various receptors is discussed and presented in Table 10C.5. The level of risk is determined based on the current condition of the Proposed Development Site, i.e. the effects of mitigation measures such as soil or groundwater treatment are not included but the level of risk takes into account the nature of the Proposed Development.
- 10C.3.2 The preliminary risk assessment is based on the information presented in Appendix 10A – Geology, Hydrogeology and Land Contamination Desk Based Summary Report (ES Volume III, EN070009/APP/6.4).
- 10C.3.3 Overall the assessment confirmed that the LCRM risks are deemed acceptable for all pollutant linkages identified given that suitable Proposed Development design and impact avoidance (embedded mitigation) will be implemented.

Table 10C-5: Preliminary Risk Assessment

SOURCE	PATHWAY	RECEPTOR	POTENTIAL SEVERITY	LIKELIHOOD OF OCCURRENCE	POTENTIAL RISK	LCRM RISK	JUSTIFICATION
Main Site							
Contaminants of Potential Concern relating to past and present land use onsite and offsite	Direct contact, dermal absorption or ingestion of soil	Construction Workers	Medium	Likely	Moderate	Acceptable	<p>Previous ground investigation (GI) recorded exceedances of sulphate, metals, polyaromatic hydrocarbons (PAHs) and petroleum hydrocarbons. Asbestos was also encountered in previous GI. Therefore, the potential risk is <i>Moderate</i>. However, it is assumed the EPC Contractor(s) will comply with Construction Design and Management (CDM) 2015 regulations (Health and Safety Executive, 2015) mitigating the risk to Construction Workers.</p> <p>A confirmatory GI will be undertaken which will involve reviewing of data and updating the risk assessment rating. STDC will undertake remediation which will include a temporary surface layer until the construction includes a permanent surface layer.</p>
		Future Site Users – Trespassers and Site Visitors	Medium	Low	Moderate / Low	Acceptable	<p>Previous GI recorded exceedances of sulphate, metals, PAHs and petroleum hydrocarbons. Asbestos was also encountered in previous GI. However, it is expected that the Main Site when redeveloped will consist of mostly hardstanding and any areas of soft</p>

SOURCE	PATHWAY	RECEPTOR	POTENTIAL SEVERITY	LIKELIHOOD OF OCCURRENCE	POTENTIAL RISK	LCRM RISK	JUSTIFICATION
							landscaping will comprise a clean top layer of backfill, mitigating any potential risk allowing this linkage to be deemed <i>Acceptable</i> . A confirmatory GI will be undertaken which will involve reviewing of data and updating the risk assessment rating. STDC will undertake remediation which will include a temporary surface layer until the construction includes a permanent surface layer.
		Future Site Users – Works / Maintenance	Medium	Low	Moderate / Low	Acceptable	Previous GI recorded exceedances of sulphate, metals, PAHs and petroleum hydrocarbons. Asbestos was also encountered in previous GI. However, it is expected that the Main Site when redeveloped will consist of mostly hardstanding and any areas of soft landscaping will comprise a clean top layer of backfill, mitigating any potential risk allowing this linkage to be deemed acceptable. A confirmatory GI will be undertaken which will involve reviewing of data and updating the risk assessment rating. STDC will undertake remediation which will include a temporary surface layer until the construction includes a permanent surface layer.

SOURCE	PATHWAY	RECEPTOR	POTENTIAL SEVERITY	LIKELIHOOD OF OCCURRENCE	POTENTIAL RISK	LCRM RISK	JUSTIFICATION
	Inhalation of soil particulates derived from soils	Construction Workers	Medium	Likely	Moderate	Acceptable	<p>Previous GI recorded exceedances of sulphate, metals, PAHs and petroleum hydrocarbons. Asbestos was also encountered in previous GI. Therefore, the potential risk is Moderate. However, the EPC Contractor(s) will comply with Construction Design and Management (CDM) 2015 regulations (Health and Safety Executive, 2015) mitigating the risk to Construction Workers.</p> <p>A confirmatory GI will be undertaken which will involve reviewing of data and updating the risk assessment rating. STDC will undertake remediation which will include a temporary surface layer until the construction includes a permanent surface layer.</p>
		Future Site Users – Trespassers and Site Visitors	Medium	Low	Moderate / Low	Acceptable	<p>Previous GI recorded exceedances of sulphate, metals, PAHs and petroleum hydrocarbons. Asbestos was also encountered in previous GI. However, it is expected that the Main Site when redeveloped will consist of mostly hardstanding and any areas of soft landscaping will comprise a clean top layer of backfill, mitigating any potential risk allowing this linkage to be deemed acceptable.</p>
		Future Site Users – Works / Maintenance	Medium	Low	Moderate / Low	Acceptable	

SOURCE	PATHWAY	RECEPTOR	POTENTIAL SEVERITY	LIKELIHOOD OF OCCURRENCE	POTENTIAL RISK	LCRM RISK	JUSTIFICATION
							A confirmatory GI will be undertaken which will involve reviewing of data and updating the risk assessment rating. STDC will undertake remediation which will include a temporary surface layer until the construction includes a permanent surface layer.
	Inhalation of soil vapour derived from soils	Construction Workers	Medium	Likely	Moderate	Acceptable	There is potential for soil vapour generation from the known Made Ground and Tidal Flat Deposits on Site therefore a linkage exists where soils are exposed during excavation. Therefore, the potential risk is Moderate. However, the EPC Contractor(s) will comply with Construction Design and Management (CDM) 2015 regulations (Health and Safety Executive, 2015) mitigating the risk to Construction Workers. Review of confirmatory GI data and update to conceptual site model and risk assessment will be undertaken.
		Future Site Users – Trespassers and Site Visitors	Medium	Low	Moderate / Low	Acceptable	There is potential for soil vapour generation from the known Made Ground and Tidal Flat Deposits on Site therefore a linkage exists where soils are exposed at the surface e.g., in areas of soft landscaping. Risks can be mitigated by the replacement of soils in these areas with clean backfill as part of the redevelopment. In addition, migration of soil
		Future Site Users – Works / Maintenance	Medium	Low	Moderate / Low	Acceptable	

SOURCE	PATHWAY	RECEPTOR	POTENTIAL SEVERITY	LIKELIHOOD OF OCCURRENCE	POTENTIAL RISK	LCRM RISK	JUSTIFICATION
							vapour or ground gases (if present) via permeable strata into buildings may also occur. However, it is anticipated that the Main Site when redeveloped will consist mostly of hardstanding mitigating the risk. Review of confirmatory GI data and update to conceptual site model and risk assessment will be undertaken.
		Adjacent Site Users – during excavation / remediation / earthworks	Medium	Unlikely	Low	Acceptable	The likelihood of inhalation of soils vapour from workers and visitors at adjacent Sites is unlikely due to distance from Main Site and any potential vapours would dissipate. Review of confirmatory GI data and update to conceptual site model and risk assessment will be undertaken.
	Leaching of chemicals and vertical migration via permeable unsaturated strata to shall and / deep groundwater	Secondary A Aquifer (Tidal Flat Deposits)	Medium	Likely	Moderate	Acceptable	Previous GI encountered groundwater between 1.5m and 4.5m AOD. Previous GI identified exceedances of metals, total petroleum hydrocarbons, PAHs and inorganics. Information from Redcar & Cleveland Borough Council (RCBC) detailed data from discharge consents for Redcar Coke Ovens Effluent Treatment Plant situated in the west of Main Site, which reported Environmental
Secondary Undifferentiated (Tidal Flat Deposits)		Medium	Likely	Moderate	Acceptable		
Secondary B (Mercia Mudstone Group and Penarth Group)		Medium	Likely	Moderate	Acceptable		

SOURCE	PATHWAY	RECEPTOR	POTENTIAL SEVERITY	LIKELIHOOD OF OCCURRENCE	POTENTIAL RISK	LCRM RISK	JUSTIFICATION
		Secondary Undifferentiated (Redcar Mudstone Formation)	Medium	Likely	Moderate	Acceptable	Quality Standards (EQS) exceedances most notably for benzo(a)pyrene and fluoranthene. Groundwater in the Glacial Till is not considered to be in hydraulic continuity with groundwater in the overlying Tidal Flat Deposits and the underlying bedrock and is considered to potentially form a confining aquifer between the Tidal Flat Deposits and the underlying bedrock aquifer. Data reviews also found to indicate that groundwater in the bedrock was unlikely to be in hydraulic continuity with the overlying Glacial Till. Review of confirmatory GI data and update to conceptual site model and risk assessment will be undertaken.
	Lateral Migration of impacted shallow groundwater offsite towards surface water features (Ponds, River Tees and North Sea)	Ponds (On Site and 250m North)	Medium	Low	Moderate / Low	Acceptable	It is assumed any current site drainage is expected to seep into underlying fill and within preferential pathways such as relict drains towards the North Sea and River Tees. Due to the appreciable distance (approximately 600 m North and 700 m East) of travel by ground or by watercourse there is likely to be some attenuation for most contaminants before drainage reaches the receiving water, as well as upon entering the River Tees or North Sea. Nevertheless, it is considered unsatisfactory for development to
		River Tees and North Sea	Medium	Low	Moderate / Low	Acceptable	

SOURCE	PATHWAY	RECEPTOR	POTENTIAL SEVERITY	LIKELIHOOD OF OCCURRENCE	POTENTIAL RISK	LCRM RISK	JUSTIFICATION
							release trapped contamination or to speed up the delivery of latent contamination to controlled waters. However, a drainage scheme will be embedded as part of the Proposed Development. An Indicative Surface Water Drainage Plan has been submitted with the DCO Application (EN070009/APP/2.12). Review of confirmatory GI data and update to conceptual site model and risk assessment will be undertaken.
	Vertical migration of impacted shallow groundwater to the deeper Secondary B Aquifer.	Secondary B Aquifer (Mercia Mudstone Group and the Penarth Group)	Medium	Likely	Moderate	Acceptable	<p>Previous GI identified exceedances of metals, total petroleum hydrocarbons, PAHs and inorganics.</p> <p>Groundwater in the Glacial Till is not considered to be in hydraulic continuity with groundwater in the overlying Tidal Flat Deposits and the underlying bedrock and is considered to potentially form a confining aquifer between the Tidal Flat Deposits and the underlying bedrock aquifer. Data reviews also found to indicate that groundwater in the bedrock was unlikely to be in hydraulic continuity with the overlying Glacial Till.</p> <p>Review of confirmatory GI data and update to conceptual site model and risk assessment will be undertaken.</p>

SOURCE	PATHWAY	RECEPTOR	POTENTIAL SEVERITY	LIKELIHOOD OF OCCURRENCE	POTENTIAL RISK	LCRM RISK	JUSTIFICATION
	Lateral migration of impacted deeper groundwater present in the Secondary B aquifer towards Surface Water Features (Ponds, River Tees and North Sea)	Ponds (>250m)	Medium	Unlikely	Low	Acceptable	Due to the appreciable distance to the Ponds (<250 m) and River Tees (~800 m) and North Sea (~700 m) of travel there is likely to be some attenuation for most contaminants reaching the receiving water, as well as upon entering the River Tees or North Sea. Nevertheless, it is considered unsatisfactory for development to release trapped contamination or to speed up the delivery of latent contamination to controlled waters. However, likelihood of linkage to be present between deeper groundwater and local ponds is considered <i>unlikely</i> . Review of confirmatory GI data to confirm presence or absence of impacted groundwater in deeper aquifer, and update to conceptual site model and risk assessment will be undertaken.
		River Tees and North Sea	Medium	Low	Moderate / Low	Acceptable	
	Direct contact with contaminated soils	Plants, trees, and soft landscaping	Medium	Low	Moderate / Low	Acceptable	

SOURCE	PATHWAY	RECEPTOR	POTENTIAL SEVERITY	LIKELIHOOD OF OCCURRENCE	POTENTIAL RISK	LCRM RISK	JUSTIFICATION
							redevelopment), however risks can be mitigated by the replacement of soils in these areas with clean backfill as part of the redevelopment. Review of confirmatory GI data and update to conceptual site model and risk assessment will be undertaken.
	Leachate/ groundwater entering surface waters	Fish or microbial life in the River Tees and North Sea	Medium	Unlikely	Low	Acceptable	Lateral migration of impacted shallow groundwater to surface water (and therefore to flora and fauna within these waters) may occur. However, given the distance to surface waters, approximately 600 m from the Main Site, any potential contamination will likely attenuate. Review of confirmatory GI data and update to conceptual site model and risk assessment will be undertaken.
	Direct contact of buried concrete with contaminated soils (i.e., hydrocarbons) and aggressive ground conditions (Ph and sulphate)	Potable water supply pipes and other services.	Medium	Unlikely	Low	Acceptable	Given the industrial history of the Main Site, location of the aquifers, and presence of potable water supply pipes within Made Ground; any potential exceedances in soil and/or groundwater are unlikely to result in harm or damage to potable water supply pipes and services.

SOURCE	PATHWAY	RECEPTOR	POTENTIAL SEVERITY	LIKELIHOOD OF OCCURRENCE	POTENTIAL RISK	LCRM RISK	JUSTIFICATION
							Review of confirmatory GI data and update to conceptual site model and risk assessment will be undertaken.
Bulk Gases	Migration of hazardous gases/vapours via permeable strata into confined spaces (asphyxiation/explosion)	Construction and maintenance workers	Medium	Low	Moderate / Low	Acceptable	Ground gas generation is possible from Made Ground and Tidal Flat Deposit known to be present on the Main Site. No identified unacceptable risk to human health or built receptors from the accumulation of ground gas was reported from previous investigations but it was recommended additional monitoring and assessment was undertaken to confirm risks. Not addressed within the existing remediation options appraisal report. Landfills known to be present in close proximity to the Main Site. Review of confirmatory GI data and update to conceptual site model and risk assessment will be undertaken.
		Trespassers and Site Visitors	Medium	Low	Moderate / Low	Acceptable	Based on historical land use and previous GI observations it is indicated that there is the potential for CoPC to be present in the Made Ground and superficial deposits recorded on the Main Site. There is the potential for any soil vapours or gases generated in Made Ground and superficial deposits at the Main Site to accumulate within future above / below ground structures associated with the
		Future Site Users	Medium	Low	Moderate / Low	Acceptable	

SOURCE	PATHWAY	RECEPTOR	POTENTIAL SEVERITY	LIKELIHOOD OF OCCURRENCE	POTENTIAL RISK	LCRM RISK	JUSTIFICATION
							Proposed Development. Soil vapours may also be mobilised during construction activities including excavation of soils. Future buildings as part of Proposed Development, there is the potential for vapours to accumulate in enclosed or confined spaces. Review of confirmatory GI data and update to conceptual site model and risk assessment will be undertaken.
		Adjacent Site users i.e., during excavation/ remediation/ earthworks	Medium	Unlikely	Low	Acceptable	Although there is the potential for vapours and ground gases to migrate beneath neighbouring buildings through granular Made Ground, historical contaminants of potential concern (CoPC) are likely to have attenuated in the distance between site and off-site users and therefore it is unlikely that volumes of soil vapour/ ground gases significant enough to pose a risk to offsite receptors shall be mobilised. Soil vapours may be mobilised during construction activities including excavation of soils. Mobilisation of those soil vapours / ground gases released onsite, if any, is considered more likely to migrate upwards dispersing within the atmosphere. However, further investigation may be required to determine the soil vapour and ground gas risk.

SOURCE	PATHWAY	RECEPTOR	POTENTIAL SEVERITY	LIKELIHOOD OF OCCURRENCE	POTENTIAL RISK	LCRM RISK	JUSTIFICATION
							Review of confirmatory GI data and update to conceptual site model and risk assessment will be undertaken.
	Migration of hazardous gases/vapours via permeable strata	Plants, trees, and soft landscaping	Medium	Low	Moderate / Low	Acceptable	South Gare and Coatham Dunes (immediately north of the Main Site) is classified as a Site of Special Scientific Interest. Given the potential Made Ground and fill materials associated with the former activities on Site and the presence of Phytotoxic contaminants cannot be discounted in certain areas of the Main Site. Ground gas generation is possible from Made Ground and Tidal Flat Deposits reported on the Main Site. Previous reports do not detail an unacceptable risk to receptors. Review of confirmatory GI data and update to conceptual site model and risk assessment will be undertaken.
	Migration of hazardous gases/vapours via permeable strata into enclosed spaces and service/utility trenches	Proposed structures may be impacted by accumulations of ground gases.	Medium	Low	Moderate / Low	Acceptable	Previous GIs have detailed substantial thicknesses of Made Ground on Site and reported Tidal Flat Deposits to be present, both have potential for significant ground gas generation. Therefore, there is a risk of build-up within proposed structures and buildings. For future development, appropriate specification materials will be used in

SOURCE	PATHWAY	RECEPTOR	POTENTIAL SEVERITY	LIKELIHOOD OF OCCURRENCE	POTENTIAL RISK	LCRM RISK	JUSTIFICATION
							gas/damp protective membranes to mitigate any risks. Review of confirmatory GI data and update to conceptual site model and risk assessment will be undertaken.
Connection Corridors							
Made Ground (associated with historical land use)	Direct contact, dermal absorption or ingestion of soil	Construction Workers and Maintenance Workers (All Corridors)	Medium	Low	Moderate / Low	Acceptable	Based on historical land use, there is potential for contaminants of potential concern (CoPC) to be present in the Made Ground on site. However, it is assumed the EPC Contractor(s) will comply with Construction Design and Management (CDM) 2015 regulations mitigating the risk to Construction Workers. Review of confirmatory GI data and update to conceptual site model and risk assessment will be undertaken.
Contaminants of Potential Concern relating to past and present land use onsite and offsite		Future Site Users: Trespassers	Medium	Unlikely	Low	Acceptable	It is understood that there are no current site users and likely to be limited access by workers once the pipes are operational.
		Future Site Users: Workers and maintenance	Medium	Unlikely	Low	Acceptable	Review of confirmatory GI data and update to conceptual site model and risk assessment will be undertaken.
		Construction Workers and	Medium	Unlikely	Low	Acceptable	Based on historical onsite and adjacent land use, such as landfill, there is the potential for

SOURCE	PATHWAY	RECEPTOR	POTENTIAL SEVERITY	LIKELIHOOD OF OCCURRENCE	POTENTIAL RISK	LCRM RISK	JUSTIFICATION	
Active or recently closed landfill (under EA regulation) taking special waste, historical landfills and various licensed waste management facilities	Inhalation of soil particulates derived from soils	Maintenance Workers					CoPC, to be present in the Made Ground on site. However, it is assumed the EPC Contractor(s) will comply with Construction Design and Management (CDM) 2015 regulations (Health and Safety Executive, 2015) mitigating the risk to Construction Workers. Furthermore, it is understood that there are no current site users and likely to be limited access by workers once the pipes are operational. The likelihood of exposure by future site users is considered low in outdoor areas given the proposed end use. Possibility of fugitive dust emissions offsite during earthworks but unlikely following construction. Review of confirmatory GI data and update to conceptual site model and risk assessment will be undertaken.	
		Future Site Users: Trespassers	Medium	Unlikely	Low	Acceptable		
		Future Site Users: Workers and maintenance	Medium	Unlikely	Low	Acceptable		
		Adjacent Site Users	Medium	Unlikely	Low	Acceptable		
	Spillage/loss/run off from surface direct to receiving water	Surface Water Features: River Tees and North Sea	Medium	Unlikely	Low	Acceptable		Potential for migration of contaminants during construction especially near to watercourses due to run-off during stockpiling or when excavating materials from below the water table.
		Surface Water Features: Various small water	Medium	Likely	Moderate / Low	Acceptable		

SOURCE	PATHWAY	RECEPTOR	POTENTIAL SEVERITY	LIKELIHOOD OF OCCURRENCE	POTENTIAL RISK	LCRM RISK	JUSTIFICATION
		courses/bodies (e.g. Ponds, streams, reservoirs)					<p>However, it is assumed that mitigation will be implemented during construction and operation.</p> <p>The proximity of the River Tees and North Sea makes the likelihood of spillage/loss/run off unlikely. However, the various small water courses/bodies (e.g. Ponds, streams, reservoirs) on Site are deemed more likely to be impacted by potential spillage/loss/run-off but due to the isolated nature of the various small water courses/bodies, the severity is considered to be medium</p> <p>Review of confirmatory GI data and update to conceptual site model and risk assessment will be undertaken.</p>
	Leaching of chemical and vertical migration via permeable unsaturated strata to shallow and/ or deep groundwater	Superficial Aquifers: Secondary Unproductive Aquifer (Glaciolacustrine Deposits) (All Corridors)	Mild	Low	Low	Acceptable	<p>Leaching of contaminants from unsaturated soils may occur in areas of soft landscaping into shallow groundwater.</p> <p>Areas of the Connection Corridors are underlain at shallow depth by Unproductive and Secondary Undifferentiated strata with low permeability that have negligible significance for water supply and/or river base flow.</p>
		Superficial Aquifers:	Medium	Low	Moderate / Low	Acceptable	

SOURCE	PATHWAY	RECEPTOR	POTENTIAL SEVERITY	LIKELIHOOD OF OCCURRENCE	POTENTIAL RISK	LCRM RISK	JUSTIFICATION
		Secondary A Aquifer (Blown Sand) (Possibly all Corridors)					<p>The Secondary A Aquifer (Alluvium) only underlies a very small section of the Hydrogen Pipeline Corridor. The Secondary A Aquifer (Blown Sand & Tidal Flat deposits) are present in all corridors.</p> <p>With regards the underlying bedrock it is considered unlikely due to the significant thickness of cohesive strata separating the bedrock from the potential contaminant. The Principal Aquifer of the Sherwood Sandstone is anticipated to have lesser thicknesses of overbearing strata to the north of the River Tees and is therefore has a higher potential risk (<i>Moderate/Low</i>).</p> <p>Review of confirmatory GI data and update to conceptual site model and risk assessment will be undertaken.</p>
		Superficial Aquifers: Secondary A (Alluvium) (Hydrogen Pipeline Corridor Only)	Mild	Low	Low	Acceptable	
		Superficial Aquifers: Secondary Undifferentiated (Devensian Till) (All Corridors except Other Gases)	Mild	Low	Low	Acceptable	
		Superficial Aquifers: Secondary A (Tidal Flat Deposits) (All Corridors)	Mild	Low	Low	Acceptable	

SOURCE	PATHWAY	RECEPTOR	POTENTIAL SEVERITY	LIKELIHOOD OF OCCURRENCE	POTENTIAL RISK	LCRM RISK	JUSTIFICATION
		Bedrock Aquifers: Principal Aquifer (Sherwood Sandstone) (All Corridors)	Medium	Low	Moderate / Low	Acceptable	
		Bedrock Aquifers: Secondary B (Mercia Mudstone Group) (All Corridors)	Mild	Low	Low	Acceptable	
		Bedrock Aquifers: Secondary B Aquifer (Penarth Group) (All Corridors)	Mild	Low	Low	Acceptable	
		Bedrock Aquifers: Secondary Undifferentiated (Redcar Mudstone Formation) (All Corridors)	Mild	Low	Low	Acceptable	
	Vertical migration of impacted shallow groundwater to	Bedrock Aquifers: Principal Aquifer (Sherwood Sandstone) (All Corridors, directly	Medium	Low	Moderate / Low	Acceptable	

SOURCE	PATHWAY	RECEPTOR	POTENTIAL SEVERITY	LIKELIHOOD OF OCCURRENCE	POTENTIAL RISK	LCRM RISK	JUSTIFICATION
	the deeper Principal aquifer	beneath Superficial at Hydrogen Pipeline Corridor)					works do not introduce new preferential pathways for contaminant migration. Review of confirmatory GI data and update to conceptual site model and risk assessment will be undertaken.
	Lateral migration of impacted shallow groundwater off site towards surface water features	Surface Water Features: River Tees and North Sea (Offsite all Corridors)	Medium	Unlikely	Low	Acceptable	Due to the proximity of the site to surface water receptors it is likely that contaminants in shallow groundwater could migrate into surface water. It will be necessary to ensure the construction works do not introduce new preferential pathways for contaminant migration. The Hydrogen Pipeline Corridor is within a SSSI, Ramsar Site and SPA and there is a potential for migration of contaminants in groundwater and / or surface water towards this area. Review of confirmatory GI data and update to conceptual site model and risk assessment will be undertaken.
		Surface Water Features: Various small water courses/bodies (e.g. Ponds, streams, reservoirs) (Onsite / Offsite all Corridors)	Medium	Low	Moderate / Low	Acceptable	
		Sensitive Land Uses: SSSI & SPA (Offsite all Corridors, Onsite Hydrogen Pipeline Corridor)	Medium	Low	Moderate / Low	Acceptable	

SOURCE	PATHWAY	RECEPTOR	POTENTIAL SEVERITY	LIKELIHOOD OF OCCURRENCE	POTENTIAL RISK	LCRM RISK	JUSTIFICATION
	Direct contact with contaminated soils Uptake via root system	Flora: Plants, trees, and soft landscaping	Minor	Likely	Low	Acceptable	Potential for direct contact by plants with soil contaminants although no specific signs of vegetative distress were observed during the site walkover. Landscaping following development to consider potential risks from contaminant. Review of confirmatory GI data and update to conceptual site model and risk assessment will be undertaken.
	Migration of hazardous gases/vapours via permeable strata	Future proposed services at the Site may be impacted by contamination in the ground	Mild	Likely	Very Low	Acceptable	Ground gas could be present associated with Made Ground and historical landfill or migration of contaminants. Ground gas could also be generated from the Tidal Flat Deposits. Potential for services to act as preferential pathways for gas or vapour migration.
		Potable water supply pipes and other services.	Mild	Likely	Very Low	Acceptable	Review of confirmatory GI data and update to conceptual site model and risk assessment will be undertaken.
	Direct contact of buried concrete with contaminated soils (i.e. hydrocarbons) and aggressive	Future proposed services at the Site may be impacted by contamination in the ground	Mild	Unlikely	Very Low	Acceptable	The presence of sulphates can damage structural and load bearing concrete causing significant structural instability and damage. Suitable classification of the strata in which the future developments shall be found, will be undertaken to inform design options.

SOURCE	PATHWAY	RECEPTOR	POTENTIAL SEVERITY	LIKELIHOOD OF OCCURRENCE	POTENTIAL RISK	LCRM RISK	JUSTIFICATION
	ground conditions (pH and sulphate).						Currently, there is no known plan for structures for the Connection Corridors. Review of confirmatory GI data and update to conceptual site model and risk assessment will be undertaken.
	Direct contact of services and supply pipes with contaminated soils.	Potable water supply pipes and other services	Medium	Unlikely	Low	Acceptable	Given the industrial history of the Main Site, location of the aquifers, and presence of potable water supply pipes within Made Ground; any potential exceedances in soil and/or groundwater are unlikely to result in harm or damage to potable water supply pipes and services. Review of confirmatory GI data and update to conceptual site model and risk assessment will be undertaken to confirm aggressive ground conditions.

10C.4 References

- National House Building Council (NHBC), Environment Agency, Chartered Institute of Environmental Health (2008). *Guidance for the Safe Development of Housing on Land Affected by Contamination. The Construction Industry Research and Information Association publication Research & Development (R&D) Publication 66.*
- Environment Agency (EA) (2023). *Land Contamination Risk Management (LCRM).*
- Health and Safety Executive (2015). *The Construction (Design and Management) Regulations 2015.*