



Net Zero Teesside – Environmental Statement

Planning Inspectorate Reference: EN010103

Volume III – Appendices

Appendix 10B: Contaminated Land - Conceptual Site Model

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



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10B. Contaminated Land - Conceptual Site Model

10.1 Outline

- 10.1.1 In order to make an assessment of the construction, environmental and human health risks attributed to the Site, a conceptual model needs to be developed. This requires an examination of the 'Source-Pathway-Receptor' linkages associated with existing and future conditions. The first step of the model development is to identify the contaminants of concern, their possible sources and potential receptors on and around the Site.
- 10.1.2 The risk assessment is based on guidance provided in CIRIA C552 - Contamination Land Risk Assessment, A Guide to Good Practice. At this stage, the risk assessment is of a preliminary nature as site specific GI and laboratory test results are not available. The risk assessment is based on information obtained in this geotechnical and geo-environmental study and should be updated as further information becomes available.
- 10.1.3 The risk assessment is performed in accordance with the precautionary principle, in which a pathway is assumed to exist unless there is reasonable contrary evidence. The risk associated with each source-receptor linkage is a product of the probability that a significant pathway exists and the severity of the potential impact. For the purposes of the Preliminary Risk Assessment (PRA), the adopted method for risk evaluation is a qualitative method and involves classification of:
- The magnitude of the potential consequence (severity) of risk (Table 6.3 - CIRIA 552), classified as: Severe, Medium, Mild, Minor; and
 - The magnitude of the probability (likelihood) of risk occurring (Table 6.4 - CIRIA 552), classified as High Likelihood, Likely, Low Likelihood, Unlikely.
- 10.1.4 Assuming that a pathway is present, the consequence of exposure depends on the concentrations of the contaminants as well as the exposure route and the sensitivity of the receptor. This principle drives the Department for Environment, Food & Rural Affairs (Defra) Contaminated Land Exposure Assessment model (CLEA). It is therefore necessary to make the following considerations:
- The potential hazard a chemical may pose;
 - The normal range of chemical concentrations likely to be characteristic of the land use;
 - The efficiency of the delivery of the contaminant by the anticipated pathway (e.g. direct contact, ingestion, dust or vapour inhalation); and
 - The sensitivity of the receptor, be that adult or child.
- 10.1.5 A comparison of consequence against probability is undertaken to indicate the risk presented by each pollutant linkage. The probability indicates the

likelihood that an exposure route may exist. This depends on whether the impacted soils are likely to be present, or indeed exposed, and also the probability that the potential receptor will come in contact with enough of the contamination to be impacted. The principal factors governing probability of exposure are the likely distribution of contaminants and the possible activities that may lead to exposure.

- 10.1.6 Overall risk is calculated in accordance with Table 6.5 – CIRIA 552, reproduced in Table 10B-1.

Table 10B-1: Overall Risk Classification Model

		CONSEQUENCE			
		Severe	Medium	Mild	Minor
PROBABILITY	High Likelihood	Very high risk	High risk	Moderate risk	Moderate / low risk
	Likely	High risk	Moderate risk	Moderate / low risk	Low risk
	Low Likelihood	Moderate risk	Moderate / low risk	Low risk	Very low risk
	Unlikely	Moderate / low risk	Low risk	Very low risk	Very low risk

10.2 Potential Sources of Contamination

- 10.2.1 Table 10B-2 presents the potential sources of contamination associated with historical industrial land use across the Site (these are discussed in further detail in Appendix 10A (ES Volume III, Document Ref. 6.4).

Table 10B-2: Potential Sources of Contamination

Potential Source	Description
Brine Works	The main contaminants from this industry are assumed to be Sodium Chloride and other common evaporites such as sulphates, other halides and borates from escaped brine, as well as coal combustion products from pump engines and heating plant, e.g. ash and clinker containing metals and PAHs. As well as using Durham coal some salt pans are reported to be heated by gas, which is a product of the iron industry.
Synthetic Ammonia Works (Billingham)	The contaminants of concern associated with the Ammonia Works are wastes from coal reforming and combustion (principally PAHs), ammonia liquors and ammonium salts, , metals, acids, alkalis, naphtha, fuel oils, PCBs, asbestos.
Coking Works (associated with the early chemical industry and iron & steel works)	The contaminants of concern from this industry are coal tar, ammonium sulphate, pure benzene and toluene, naphthalene, nickel, zinc, thiocyanate, phenols and other acids and organic compounds. Ammoniacal liquor and coal tars wastes / products are commonly stored in underground tanks or "wells". Liquors contain free cyanides (easily liberated) and fixed or complex cyanides, thiocyanate, ferrocyanate, as well as other salts of ammonium, chloride, sulphate and thiosulphate. Spent iron oxide generated from gas purification containing complex cyanide "Prussian Blue" may have been exported to a sulphuric acid manufacturer assuming economical quantities of sulphur, or it was commonly disposed of on site. Slaked Lime may also have been used for gas purification resulting in "Foul Lime" with a potential for generation of Hydrogen Sulphide gas. Other potential contaminants according to Department of Environment (DoE) Industry Profiles include acids, alkalis, metals, asbestos, sulphur compounds, Polycyclic Aromatic Hydrocarbons (PAHs) (especially in coal tar), benzene, toluene, ethylbenzene and xylene (BTEX) including the manufactured fuel Benzol, phenols, cresols, xylenols, and numerous other organic chemicals including heterocyclic compounds.
Railways	The Department of Environment (DoE) Industry Profile for Railway Land indicates imported fill was often utilised during construction of the railways where there was a shortfall of natural excavated material. Imported fill often included waste material containing clinker and ash. Given the context of the Site, it is probable that wastes from the iron & steel works will have been utilised in railway construction. Boiler ash generated by steam locomotives was also often used to form ballast along many railway lines. Other potential sources of contaminants that may be encountered on railway land include herbicides, polychlorinated biphenyls (PCBs) utilised in electrical transformers, and general spills of materials used or transported which may include fuels, oils, paraffin, solvents, antifreeze liquids such as ethylene glycol, creosotes and paints. Metal fines, ash and asbestos are also frequently present on railway land. There is limited potential for point sources of contamination to exist associated with leaks or spills from railway traffic, however the impact of these is likely to be localised. Concentrations of contaminants (if present) are likely to be relatively low and acute or chronic health risks are not anticipated for future site users. It is impossible to anticipate the likely distribution of contaminants from accidental release therefore precautionary control measures are likely to be necessary for ground workers. The main contaminants

Potential Source

Description

Potential Source	Description
	associated with railway land are metals (As, Cd, Cr, Cu, Pb, Ni, Zn), sulphate, asbestos, Polycyclic Aromatic Hydrocarbons (PAHs), chlorinated aromatic hydrocarbons and PCBs.
Tar Macadam Slag Works	Coal Tars contains a wide variety of compounds however the main risk drivers are considered to be Polycyclic Aromatic Hydrocarbons (PAHs) including benzo(a)pyrene, which is used as a surrogate marker for coal tar carcinogenicity. Other contaminants of particular concern to water resources include BTEX and other petrol and diesel range petroleum hydrocarbons present in fuels. Phenols, cresols, xylenols and heterocyclic compounds and other contaminants found in coal tars are also likely to be present.
Iron & Steel Works	<p>The wastes from iron making comprise mainly blast furnace slag, dry dust from gas cleaning, wet solids from gas cleaning and refractory waste from ladles and runners. Effluent water from slurry requires treatment prior to recycling or discharge as it may contain high concentrations of lead, zinc and alkalis.</p> <p>Steel making wastes include acid or basic slag, scrap, dust and slurries and refractory material. . Due to the high phosphorus content of some ores, (basic) steel slag may contain more than 15% phosphorous pentoxide.</p> <p>Fines from dust or slurry produced as a result of flume cleaning at steel works contain around 50% iron, lead, zinc and other metals.</p> <p>Fine mill scale from rolling mills that is generally discharged into lagoons and eventually disposed of, may become contaminated with hydrocarbons. Oily waste is often treated using solvent extraction e.g. using halogenated solvents, refined by a specialist contractor or incinerated. Other refractory wastes arising from soaking pits, reheating furnaces and similar equipment in the rolling mill are generally disposed of according to DoE to on-site landfills or tips.</p> <p>Spent sulphuric acid, hydrochloric acid and sodium hydroxide from pickling are generally regenerated at large plants, however at smaller sites they may be neutralised prior to disposal. The wastes from galvanising and tinning processes are produced only in small quantities compared to the other wastes as a whole.</p> <p>Other wastes commonly found in on-site tips that are not directly attributed to the iron & steel processes include; building and demolition rubble, slurries from water treatment plants, insulation material such as asbestos (including roofing and cladding for pipes) and empty chemical containers. Transformers and other electrical equipment may contain PCBs.</p> <p>Metals, metal compounds, the products of coke making and metal finishing are the most significant contaminants at iron and steel works. The distribution of these contaminants will be dependent on the type of process and material storage taking place on the Site. Leakage may have occurred from tanks and pipework carrying products or waste. It is highlighted that in old-established sites, contaminants may be present in on-site landfills, lagoons or soakaways. Storage of oily scrap could have led to ground contamination.</p>

Potential Source

Description

Cement Manufacture	Contaminants related to the manufacture of cement include calcium (usually carbonate), silicon, aluminium and iron. The principal contaminants related to this industry are those that are associated with fuel (coal, hydrocarbons) and combustion products (TPH,PAH), alkali (e.g. clinker), sulphate, asbestos and metals.
Anhydrite Process - Sulphuric Acid Manufacture	The principal contaminants are associated with fuel (coal, hydrocarbons) and combustion products (TPH,PAH), alkali (e.g. clinker), acid (e.g. sulphuric acid), sulphate, asbestos and metals.
Anhydrite Mining	Mining is commonly associated with contamination from plant from spilt fuel and combustion products (that may be contaminated with harmful TPH / PAHs), PCBs used as dielectrics in electrical transformers and construction and demolition rubble It is possible that asbestos may be present in the construction and demolition waste. The 7m thick seam of anhydrite is unlikely to have generated much spoil, however anhydrite (calcium sulphate) is likely be present within made ground.

10.3 Potential Receptors

Table 10B-3 provides a summary of the potential receptors at the Site.

Table 10B-3: Potential Receptors

Potential Receptor	Description
Future Site Users	Future site users may be affected by the presence of elevated concentrations of certain determinants in soil, soil leachate and groundwater. Future site users may also be affected by the presence of ground gas.
Construction Workers	Construction workers may be affected by the presence of elevated concentrations of certain determinands in soil, soil leachate and groundwater, particularly during earthworks. Construction workers may also be at risk from ground gas where temporary structures are in place on site during the construction phase.
Maintenance Workers (buried connections)	Maintenance workers may be affected by the presence of elevated concentrations of certain determinands in soil, soil leachate and groundwater. Maintenance workers may also be at risk from ground gas if their work requires them to enter confined spaces or work below ground level.
Maintenance Workers (above ground facilities)	No abnormal risk from exposure to contaminants in soil or groundwater has been assumed for workers maintaining above-ground facilities.
Flora and Fauna	Risk from contamination is minimal for the completed works since the main facilities are to be constructed on industrial land and there are limited pathways for contact with contaminated soil. Protection and reinstatement of existing natural resources is considered under ecology.
Development Infrastructure	Mitigation may be required to protect infrastructure such as concrete, steel, plastic water pipes, barrier membranes and buildings from contamination in soil and groundwater including acids, alkalis, hydrocarbons, sulphates, chlorides, nitrates, hazardous ground gas.
Controlled Waters	<p>The main surface water receptors are the River Tees, Tees Bay and surface water features within the Site.</p> <p>Significant groundwater receptors within the superficial geology at the Site include the following:</p> <ol style="list-style-type: none"> a) Blown Sand: Secondary Aquifer A b) Tidal Flat Deposits (sand and silt): Secondary Aquifer A c) Till (Diamicton): Secondary Aquifer - Undifferentiated d) Glaciofluvial Deposits (sand and gravel): Secondary Aquifer A e) Glaciolacustrine Deposits (sand): Secondary Aquifer A <p>Significant groundwater receptors within the bedrock geology at the Site include the following:</p>

Potential Receptor	Description
	<ul style="list-style-type: none"> f) Redcar Mudstone Formation - Mudstone: Secondary Aquifer - Undifferentiated g) Mercia Mudstone Group - Mudstone: Secondary Aquifer B h) Penarth Group - Mudstone: Secondary Aquifer B i) Sherwood Sandstone Group – Sandstone – Principal Aquifer <p>Due to the distance of travel by ground or by watercourse there is likely to be significant attenuation for most contaminants before drainage reaches the receiving waters, as well as upon entering the Tees estuary or North Sea. Nevertheless, it is considered unsatisfactory for the development to release trapped contamination or to speed up the delivery of latent contamination to controlled waters.</p>
Off-Site Receptors	<p>Off-site receptors may be affected by the presence of elevated concentrations of certain determinants in soil, soil leachate and groundwater. Off-site receptors may also be affected by the presence of migrated ground gas. This includes residents and occupiers of surrounding properties and the ecology of the surrounding area. However, since no exposure to soils or groundwater is envisaged if works are carried out in accordance with environmental regulations, there should be no contaminant linkage.</p>

10.4 Potential Contaminant Linkages

10.4.1 The potential contaminant linkages and associated risks identified for the Site in its proposed use are presented in Table 10B-4.

Table 10B-4: Potential Contaminant Linkages

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
A. ICI Synthetic Ammonia Works / Anhydrite Process Plant / Anhydrite Mine					
Metals, metalloids	1. Ingestion/ skin contact	Ground Workers (1,2,10)	Mild	Likely	Moderate/Low
	2. Dust Inhalation	Site Users (1,2)	Mild	Low	Low
	3. Vapour Inhalation	General Public (off-site) (1,2)	Mild	n/a	n/a
	4. Explosion / Asphyxiation	Fauna & Flora (5)	Minor	Low	Very low
	5. Plant Uptake / Phytotoxicity	Surface Water (6)	Mild	Low	Low
	6. Leaching to surface water	Groundwater (7)	Mild	Low	Low
	7. Leaching to groundwater	Ground Workers (1,10)	Severe	Low	Moderate
	8. Corrosion/ chemical attack	Site Users (1,9)	Medium	Low	Moderate/Low
pH, acids, alkalis, sulphate, chloride, ammonia, cyanides	9. Permeation of pipes	General Public (off-site) (1)	Medium	n/a	n/a
	10. Exposure to contaminated water	Fauna & Flora (5)	Mild	Low	Low
		Surface Water (6)	Medium	Low	Moderate/Low
		Groundwater (7)	Medium	Low	Moderate/Low
		Infrastructure (8,9)	Medium	Likely	Moderate
		Ground Workers (1)	None	n/a	n/a
		Site Users (1)	None	n/a	n/a
		General Public (off-site) (1)	None	n/a	n/a
Oils, lubricants, greases (TPH - LRO)		Fauna & Flora (5)	None	n/a	n/a
		Infrastructure (8)	None	n/a	n/a
		Ground Workers (1,2,3,4,10)	Minor	Likely	Low
		Site Users (1,2,3,4,9)	Minor	Low	Very low
Petroleum Fuel - (TPH - PRO, DRO)					

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk	
Coal Tars (PAH, TPH), phenols, cresols, xylenols, heterocyclics		General Public (off-site) (1,2,3)	Minor	n/a	n/a	
		Infrastructure (4,8,9)	None	n/a	n/a	
		Fauna & Flora (5)	None	n/a	n/a	
		Surface Water (6)	Minor	Low	Very low	
		Groundwater (7)	Minor	Low	Very low	
		Ground Workers (1,2,3,10)	Medium	Likely	Moderate	
		Site Users (1,2,3,9)	Medium	Low	Moderate/Low	
		General Public (off-site) (1,2,3)	Medium	n/a	n/a	
		Fauna & Flora (5)	Minor	Low	Very low	
		Surface Water (6)	Mild	Low	Low	
POPs: PCBs, dioxins, furans		Groundwater (7)	Mild	Low	Low	
		Infrastructure (8,9)	Minor	Likely	Low	
		Ground Workers (1,2)	None	n/a	n/a	
		Site Users (1,2)	None	n/a	n/a	
		General Public (off-site) (1,2)	None	n/a	n/a	
		Fauna & Flora (5)	None	n/a	n/a	
		Surface Water (6)	Minor	Low	Very low	
		Groundwater (7)	Minor	Low	Very low	
	Asbestos		Ground Workers (2)	Medium	Likely	Moderate
			Site Users (2)	Medium	Unlikely	Low
		General Public (off-site) (2)	Medium	Unlikely	Low	
		Ground Workers (4)	None	n/a	n/a	
Coal Dust						

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
Hazardous Gas		Site Users (4)	None	n/a	n/a
		Infrastructure (4)	None	n/a	n/a
		Ground Workers (4)	Mild	Low	Low
		Site Users (4)	Mild	Low	Low
		Infrastructure (4)	Mild	Low	Low
B. Brine Works					
Metals, metalloids pH, acids, alkalis, sulphate, chloride, ammonia, cyanides	1. Ingestion/ skin contact	Ground Workers (1,2,10)	Mild	Likely	Moderate/Low
	2. Dust Inhalation	Site Users (1,2)	Mild	Low	Low
	3. Vapour Inhalation				
	4. Explosion / Asphyxiation	General Public (off-site) (1,2)	Mild	n/a	n/a
	5. Plant Uptake / Phytotoxicity	Fauna & Flora (5)	Minor	Low	Very low
	6. Leaching to surface water	Surface Water (6)	Mild	Low	Low
	7. Leaching to groundwater	Groundwater (7)	Mild	Low	Low
	8. Corrosion/ chemical attack	Ground Workers (1,10)	Mild	Likely	Moderate/Low
	9. Permeation of pipes	Site Users (1,9)	Mild	Low	Low
	10.Exposure to contaminated water	General Public (off-site) (1)	Mild	n/a	n/a
		Fauna & Flora (5)	Minor	Low	Very low
		Surface Water (6)	Mild	Low	Low
		Groundwater (7)	Mild	Low	Low
		Infrastructure (8,9)	Mild	Likely	Moderate/Low
C. Petroleum Refineries / Tank Farms / Fuel Storage					
Oils, lubricants, greases (TPH - LRO)	1. Ingestion/ skin contact	Ground Workers (1)	Minor	Likely	Low
	2. Dust Inhalation	Site Users (1)	Minor	Low	Very low

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
Petroleum Fuel - (TPH - PRO, DRO)	3. Vapour Inhalation	General Public (off-site) (1)	Minor	n/a	n/a
	4. Explosion / Asphyxiation	Fauna & Flora (5)	Minor	Low	Very low
	5. Plant Uptake / Phytotoxicity	Infrastructure (8)	Minor	Likely	Low
	6. Leaching to surface water	Ground Workers (1,2,3,4,10)	Medium	Likely	Moderate
	7. Leaching to groundwater	Site Users (1,2,3,4,9)	Medium	Unlikely	Low
	8. Corrosion/ chemical attack	General Public (off-site) (1,2,3)	Medium	n/a	n/a
	9. Permeation of pipes	Infrastructure (4,8,9)	Mild	Likely	Moderate/Low
	10. Exposure to contaminated water	Fauna & Flora (5)	Mild	Low	Low
		Surface Water (6)	Medium	Low	Moderate/Low
		Groundwater (7)	Medium	Low	Moderate/Low
General Organics (VOC/SVOC including Olefins)		Ground Workers (1,2,3,10)	Minor	Likely	Low
		Site Users (1,2,3,9)	Minor	Low	Very low
		General Public (off-site) (1,2,3)	Minor	n/a	n/a
		Surface Water (6)	None	n/a	n/a
		Groundwater (7)	None	n/a	n/a
		Infrastructure (9)	Minor	Low	Very low
Asbestos		Ground Workers (2)	Medium	Low	Moderate/Low
		Site Users (2)	Medium	Unlikely	Low
		General Public (off-site) (2)	Medium	Unlikely	Low
D. Tar Macadam Slag Works					
Metals, metalloids	1. Ingestion/ skin contact	Ground Workers (1,2,10)	Minor	Likely	Low
	2. Dust Inhalation	Site Users (1,2)	Minor	Low	Very low

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
Coal Tars (PAH,TPH), phenols, cresols, xylenols, heterocyclics	3. Vapour Inhalation	General Public (off-site) (1,2)	Minor	n/a	n/a
	4. Explosion / Asphyxiation	Fauna & Flora (5)	None	n/a	n/a
	5. Plant Uptake / Phytotoxicity	Surface Water (6)	Minor	Low	Very low
	6. Leaching to surface water	Groundwater (7)	Minor	Low	Very low
	7. Leaching to groundwater	Ground Workers (1,2,3,10)	Severe	Likely	High
	8. Corrosion/ chemical attack	Site Users (1,2,3,9)	Severe	Low	Moderate
	9. Permeation of pipes	General Public (off-site) (1,2,3)	Severe	n/a	n/a
	10.Exposure to contaminated water	Fauna & Flora (5)	Mild	Low	Low
		Surface Water (6)	Medium	Low	Moderate/Low
		Groundwater (7)	Medium	Low	Moderate/Low
General Organics (VOC/SVOC including Olefins)		Infrastructure (8,9)	Mild	Likely	Moderate/Low
		Ground Workers (1,2,3,10)	Mild	Likely	Moderate/Low
		Site Users (1,2,3,9)	Mild	Low	Low
		General Public (off-site) (1,2,3)	Mild	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low
		Infrastructure (9)	Mild	Low	Low
		Ground Workers (1,2)	None	n/a	n/a
		Site Users (1,2)	None	n/a	n/a
		General Public (off-site) (1,2)	None	n/a	n/a
POPs: PCBs, dioxins, furans		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
Asbestos		Groundwater (7)	Minor	Low	Very low
		Ground Workers (2)	Medium	Likely	Moderate
		Site Users (2)	Medium	Unlikely	Low
		General Public (off-site) (2)	Medium	Unlikely	Low
Hazardous Gas		Ground Workers (4)	Minor	Likely	Low
		Site Users (4)	Minor	Low	Very low
		Infrastructure (4)	Minor	Low	Very low
E. Iron / Steel / Coking Works					
Metals, metalloids	1. Ingestion/ skin contact	Ground Workers (1,2,10)	Minor	Likely	Low
	2. Dust Inhalation	Site Users (1,2)	Minor	Low	Very low
	3. Vapour Inhalation	General Public (off-site) (1,2)	Minor	n/a	n/a
	4. Explosion / Asphyxiation	Fauna & Flora (5)	None	n/a	n/a
	5. Plant Uptake / Phytotoxicity	Surface Water (6)	Minor	Low	Very low
	6. Leaching to surface water	Groundwater (7)	Minor	Low	Very low
	7. Leaching to groundwater	Ground Workers (1,10)	Minor	Likely	Low
	8. Corrosion/ chemical attack	Ground Workers (2)	Medium	High	High
	9. Permeation of pipes	Site Users (1,9)	Minor	Low	Very low
	10. Exposure to contaminated water	Site Users (2)	Mild	Likely	Moderate / Low
pH, acids, alkalis, sulphate, chloride, ammonia, cyanides		General Public (off-site) (1)	Minor	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk	
Oils, lubricants, greases (TPH - LRO)		Infrastructure (8,9)	Mild	Likely	Moderate/Low	
		Ground Workers (1)	None	n/a	n/a	
		Site Users (1)	None	n/a	n/a	
		General Public (off-site) (1)	None	n/a	n/a	
		Fauna & Flora (5)	None	n/a	n/a	
Petroleum Fuel - (TPH - PRO, DRO)		Infrastructure (8)	None	n/a	n/a	
		Ground Workers (1,2,3,4,10)	Mild	Likely	Moderate/Low	
		Site Users (1,2,3,4,9)	Mild	Low	Low	
		General Public (off-site) (1,2,3)	Mild	n/a	n/a	
		Infrastructure (4,8,9)	Minor	Likely	Low	
		Fauna & Flora (5)	Minor	Low	Very low	
		Surface Water (6)	Mild	Low	Low	
		Groundwater (7)	Mild	Low	Low	
	Coal Tars (PAH, TPH), phenols, cresols, xylenols, heterocyclics		Ground Workers (1,2,3,10)	Severe	Likely	High
			Site Users (1,2,3,9)	Severe	Low	Moderate
		General Public (off-site) (1,2,3)	Severe	n/a	n/a	
		Fauna & Flora (5)	Mild	Low	Low	
		Surface Water (6)	Medium	Low	Moderate/Low	
		Groundwater (7)	Medium	Low	Moderate/Low	
		Infrastructure (8,9)	Mild	Likely	Moderate/Low	
		Ground Workers (1,2,3,10)	Minor	Likely	Low	
		Site Users (1,2,3,9)	Minor	Low	Very low	

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
General Organics (VOC/SVOC including Olefins)		General Public (off-site) (1,2,3)	Minor	n/a	n/a
		Surface Water (6)	None	n/a	n/a
		Groundwater (7)	None	n/a	n/a
		Infrastructure (9)	Minor	Low	Very low
POPs: PCBs, dioxins, furans		Ground Workers (1,2)	None	n/a	n/a
		Site Users (1,2)	None	n/a	n/a
		General Public (off-site) (1,2)	None	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low
		Infrastructure (9)	Minor	Low	Very low
Asbestos		Ground Workers (2)	Severe	Likely	High
		Site Users (2)	Medium	Likely	Moderate
		General Public (off-site) (2)	Medium	Unlikely	Low
Coal Dust		Ground Workers (4)	Minor	Likely	Low
		Site Users (4)	Minor	Low	Very low
		Infrastructure (4)	Minor	Low	Very low
Hazardous Gas		Ground Workers (4)	Mild	Likely	Moderate/Low
		Site Users (4)	Mild	Low	Low
		Infrastructure (4)	Mild	Low	Low

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
F. Olefins (cracking) - Chemical works					
Oils, lubricants, greases (TPH - LRO)	1. Ingestion/ skin contact	Ground Workers (1)	None	n/a	n/a
	2. Dust Inhalation	Site Users (1)	None	n/a	n/a
	3. Vapour Inhalation	General Public (off-site) (1)	None	n/a	n/a
	4. Explosion / Asphyxiation	Fauna & Flora (5)	None	n/a	n/a
	5. Plant Uptake / Phytotoxicity	Infrastructure (8)	None	n/a	n/a
	6. Leaching to surface water	Ground Workers (1,2,3,4,10)	Minor	Likely	Low
	7. Leaching to groundwater	Site Users (1,2,3,4,9)	Minor	Low	Very low
Petroleum Fuel - (TPH - PRO, DRO)	8. Corrosion/ chemical attack	General Public (off-site) (1,2,3)	Minor	n/a	n/a
	9. Permeation of pipes	Infrastructure (4,8,9)	None	n/a	n/a
	10.Exposure to contaminated water	Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low
		Ground Workers (1,2,3,10)	Medium	Likely	Moderate
		Site Users (1)	Medium	Low	Moderate/Low
		Site Users (2)	Mild	Unlikely	Very low
		Site Users (3)	Minor	Unlikely	Very low
		Site Users (9)	Mild	Low	Low
		General Public (off-site) (1,2,3)	Medium	n/a	n/a
		Fauna & Flora (5)	Minor	Low	Very low
		Surface Water (6)	Mild	Low	Low
	Groundwater (7)	Mild	Low	Low	
Coal Tars (PAH, TPH), phenols, cresols, xylenols, heterocyclics		Ground Workers (1,2,3,10)	Medium	Likely	Moderate
		Site Users (1)	Medium	Low	Moderate/Low
		Site Users (2)	Mild	Unlikely	Very low
		Site Users (3)	Minor	Unlikely	Very low
		Site Users (9)	Mild	Low	Low
		General Public (off-site) (1,2,3)	Medium	n/a	n/a
		Fauna & Flora (5)	Minor	Low	Very low
		Surface Water (6)	Mild	Low	Low
		Groundwater (7)	Mild	Low	Low

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk	
General Organics (VOC/SVOC including Olefins)		Infrastructure (8,9)	Minor	Likely	Low	
		Ground Workers (1,2,3,10)	Mild	Likely	Moderate/Low	
		Site Users (1,2,3,9)	Mild	Low	Low	
		General Public (off-site) (1,2,3)	Mild	n/a	n/a	
		Surface Water (6)	Minor	Low	Very low	
		Groundwater (7)	Minor	Low	Very low	
		Infrastructure (9)	Mild	Low	Low	
POPs: PCBs, dioxins, furans		Ground Workers (1,2)	None	n/a	n/a	
		Site Users (1,2)	None	n/a	n/a	
		General Public (off-site) (1,2)	None	n/a	n/a	
		Fauna & Flora (5)	None	n/a	n/a	
		Surface Water (6)	Minor	Low	Very low	
		Groundwater (7)	Minor	Low	Very low	
		Ground Workers (2)	Severe	Likely	High	
Asbestos		Site Users (2)	Severe	Unlikely	Moderate/Low	
		General Public (off-site) (2)	Medium	Unlikely	Low	
	Hazardous Gas		Ground Workers (4)	Mild	Likely	Moderate/Low
			Site Users (4)	Mild	Likely	Moderate/Low
		Infrastructure (4)	Minor	Low	Very low	
G. Power Generation & Distribution						
Oils, lubricants, greases (TPH - LRO)	1. Ingestion/ skin contact 2. Dust Inhalation	Ground Workers (1)	None	n/a	n/a	
		Site Users (1)	None	n/a	n/a	

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
POPs: PCBs, dioxins, furans	3. Vapour Inhalation	General Public (off-site) (1)	None	n/a	n/a
	4. Explosion / Asphyxiation	Fauna & Flora (5)	None	n/a	n/a
	5. Plant Uptake / Phytotoxicity	Infrastructure (8)	None	n/a	n/a
	6. Leaching to surface water	Ground Workers (1,2)	None	n/a	n/a
	7. Leaching to groundwater	Site Users (1,2)	None	n/a	n/a
	8. Corrosion/ chemical attack	General Public (off-site) (1,2)	None	n/a	n/a
	9. Permeation of pipes	Fauna & Flora (5)	None	n/a	n/a
	10. Exposure to contaminated water	Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low
	H. Infilled Land				
Metals, metalloids	1. Ingestion/ skin contact	Ground Workers (1,2,10)	Minor	Likely	Low
	2. Dust Inhalation	Site Users (1,2)	Minor	Low	Very low
	3. Vapour Inhalation	General Public (off-site) (1,2)	Minor	n/a	n/a
	4. Explosion / Asphyxiation	Fauna & Flora (5)	None	n/a	n/a
	5. Plant Uptake / Phytotoxicity	Surface Water (6)	Minor	Low	Very low
	6. Leaching to surface water	Groundwater (7)	Minor	Low	Very low
	7. Leaching to groundwater	Ground Workers (1,10)	Minor	Likely	Low
	8. Corrosion/ chemical attack	Site Users (1,9)	Minor	Low	Very low
	9. Permeation of pipes	General Public (off-site) (1)	Minor	n/a	n/a
	10. Exposure to contaminated water	Fauna & Flora (5)	None	n/a	n/a
pH, acids, alkalis, sulphate, chloride, ammonia, cyanides		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
Oils, lubricants, greases (TPH - LRO)		Infrastructure (8,9)	Minor	Likely	Low
		Ground Workers (1)	None	n/a	n/a
		Site Users (1)	None	n/a	n/a
		General Public (off-site) (1)	None	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
Coal Tars (PAH,TPH), phenols, cresols, xylenols, heterocyclics		Infrastructure (8)	None	n/a	n/a
		Ground Workers (1,2,3,10)	Mild	Likely	Moderate/Low
		Site Users (1,2,3,9)	Mild	Low	Low
		General Public (off-site) (1,2,3)	Mild	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low
		Infrastructure (8,9)	None	n/a	n/a
		Ground Workers (1,2,3,10)	Minor	Likely	Low
		Site Users (1,2,3,9)	Minor	Low	Very low
General Organics (VOC/SVOC including Olefins)		General Public (off-site) (1,2,3)	Minor	n/a	n/a
		Surface Water (6)	None	n/a	n/a
		Groundwater (7)	None	n/a	n/a
		Infrastructure (9)	Minor	Low	Very low
		Ground Workers (2)	Mild	Likely	Moderate/Low
		Site Users (2)	Mild	Unlikely	Very low
Asbestos		General Public (off-site) (2)	Mild	Unlikely	Very low

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
Organic Matter		Ground Workers (4)	Minor	Likely	Low
		Site Users (4)	Minor	Low	Very low
		Infrastructure (4)	Minor	Low	Very low
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	None	n/a	n/a
Hazardous Gas		Ground Workers (4)	Minor	Likely	Low
		Site Users (4)	Minor	Low	Very low
		Infrastructure (4)	Minor	Low	Very low

I. Railways

Metals, metalloids	1. Ingestion/ skin contact	Ground Workers (1,2,10)	Minor	Likely	Low
	2. Dust Inhalation	Site Users (1,2)	Minor	Low	Very low
	3. Vapour Inhalation	General Public (off-site) (1,2)	Minor	n/a	n/a
	4. Explosion / Asphyxiation	Fauna & Flora (5)	None	n/a	n/a
	5. Plant Uptake / Phytotoxicity	Surface Water (6)	Minor	Low	Very low
	6. Leaching to surface water	Groundwater (7)	Minor	Low	Very low
	7. Leaching to groundwater	Ground Workers (1,10)	Minor	Likely	Low
	8. Corrosion/ chemical attack	Site Users (1,9)	Minor	Low	Very low
	9. Permeation of pipes	General Public (off-site) (1)	Minor	n/a	n/a
	10. Exposure to contaminated water	Fauna & Flora (5)	None	n/a	n/a
pH, acids, alkalis, sulphate, chloride, ammonia, cyanides		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
Oils, lubricants, greases (TPH - LRO)		Infrastructure (8,9)	Minor	Likely	Low
		Ground Workers (1)	None	n/a	n/a
		Site Users (1)	None	n/a	n/a
		General Public (off-site) (1)	None	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
Petroleum Fuel - (TPH - PRO, DRO)		Infrastructure (8)	None	n/a	n/a
		Ground Workers (1,2,3,4,10)	Minor	Likely	Low
		Site Users (1,2,3,4,9)	Minor	Low	Very low
		General Public (off-site) (1,2,3)	Minor	n/a	n/a
		Infrastructure (4,8,9)	None	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low
		Ground Workers (1,2,3,10)	Mild	Likely	Moderate/Low
		Site Users (1,2,3,9)	Mild	Low	Low
Coal Tars (PAH, TPH), phenols, cresols, xylenols, heterocyclics		General Public (off-site) (1,2,3)	Mild	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low
		Infrastructure (8,9)	None	n/a	n/a
		Ground Workers (1,2)	None	n/a	n/a
		Site Users (1,2)	None	n/a	n/a

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
		General Public (off-site) (1,2)	None	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low
Asbestos		Ground Workers (2)	Mild	Likely	Moderate/Low
		Site Users (2)	Mild	Unlikely	Very low
		General Public (off-site) (2)	Mild	Unlikely	Very low

*Magnitude of the potential **Consequence** (severity) of risk, Table 6.3, CIRIA C552.*

*Magnitude of the **Probability** (likelihood) of risk occurring, Table 6.4 - CIRIA C552.*

***Risk** presented by each pollutant linkage, Table 6.5 – CIRIA C552.*

- 10.4.2 Actions corresponding with the risk classification are calculated based on the requirements of Table 6.6 – CIRIA 552. The table indicates that any risk classified as moderate or higher will require further investigation or mitigation measures.