

South Tees Site High Level View of Risks, Contamination and Development August 2023

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High Level View

- Taking into account size of site, history of contaminating industrial usage and inventory of hazardous chemicals known to be present
- Site known to contain large amount of chemicals highly toxic to marine life
- Ground still contaminated – e.g. high levels of hydrocarbons (what is the source?)
- Therefore assumption has be that any work on the site is likely to cause environmental damage or at least reduce resilience of the local environment to damage
- All operations should be carried out on this assumption – now and going forward
- Development process looks too cheap and too quick

Recommendations

- Revisit environmental risk assessments
 - ~ Based on cumulative not individual risk
- Request DEFRA/EA/CEFAS to carry out an audit of the contamination within and entering the River Tees Estuary
- Request MMO to publish cumulative contamination within sea disposal sites off the River Tees
- Use this data to request funding to protect the environment

The Chemical Risks

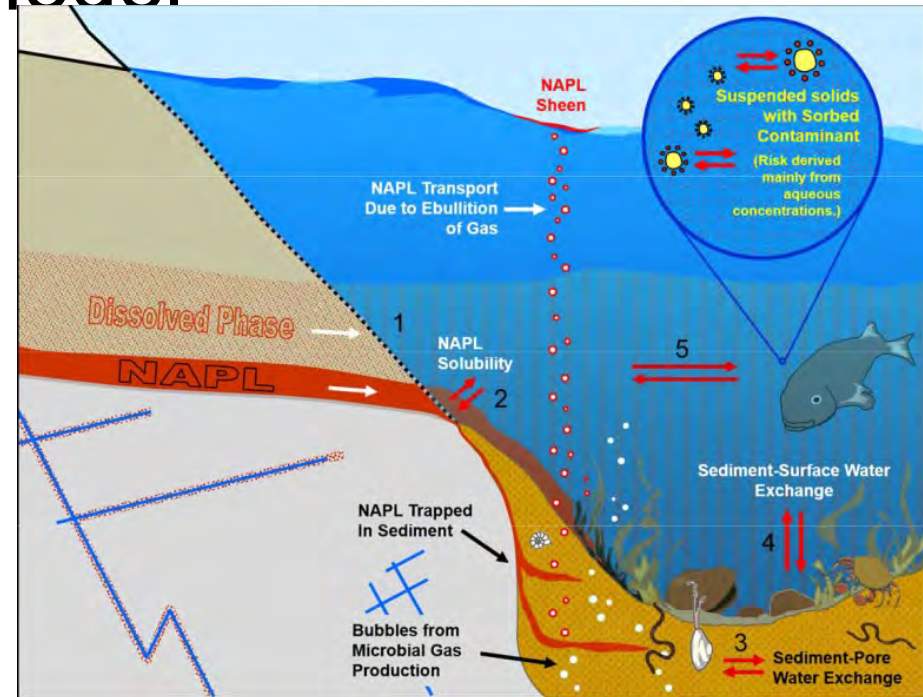
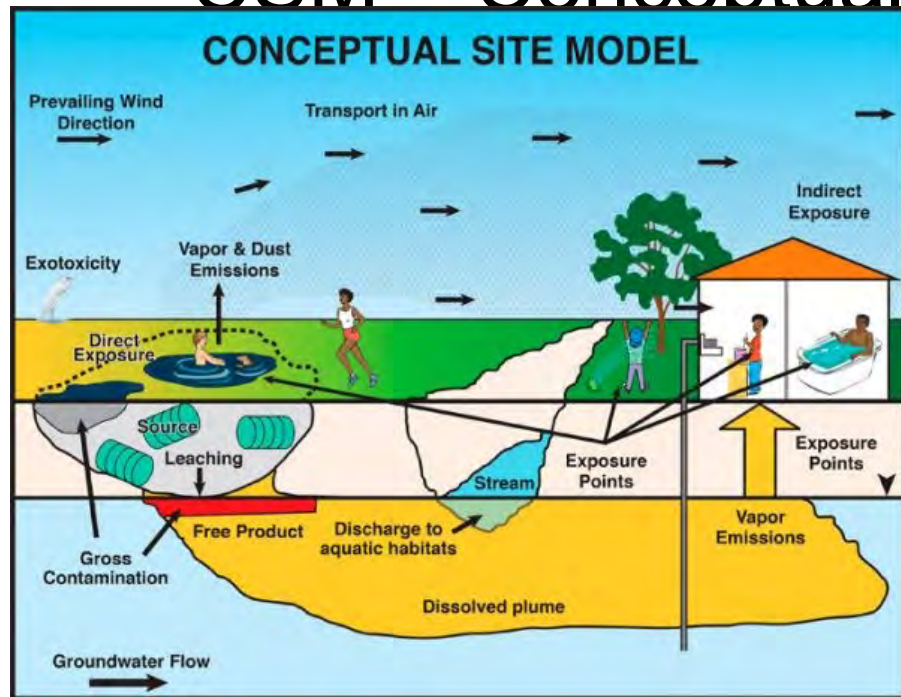
- Above ground
 - ~ Reaction – fire, explosion
 - ~ Presence – protection
 - ~ Mainly removed (COMAH)?
- Below ground
 - ~ Historic - >100 years of coke production
 - ~ Recent – release of above ground chemicals

Risk Assessment

- SPR – Source Pathway Receptor

~ Asbestos on ground – wind – humans: cap with soil

- CSM – Conceptual Site Model



Decontamination then Demolition

- Environment Agency

8th August 2019

~ “These
decontamination
operations should be
completed prior to any
demolition or longer
term restoration of the
site.”

creating a better place



Redcar & Cleveland Borough Council
Redcar & Cleveland House
Kirkleatham Street
Redcar
TS10 1RT

Our ref: NA/2019/114630/01-L01
Your ref: R/2019/0427/FFM
Date: 8 August 2019

Dear

DEMOLITION OF STRUCTURES AND ENGINEERING OPERATIONS ASSOCIATED WITH GROUND PREPARATION AND TEMPORARY STORAGE OF SOILS AND ITS FINAL USE IN THE REMEDIATION AND PREPARATION OF LAND FOR REGENERATION AND DEVELOPMENT LAND AT FORMER SOUTH BANK WORKS; GRANGETOWN PRAIRIE; BRITISH STEEL AND WARRENBY AREA

Thank you for referring this application which we received on 10 July 2019. We have reviewed the documentation and have the following comments to make.

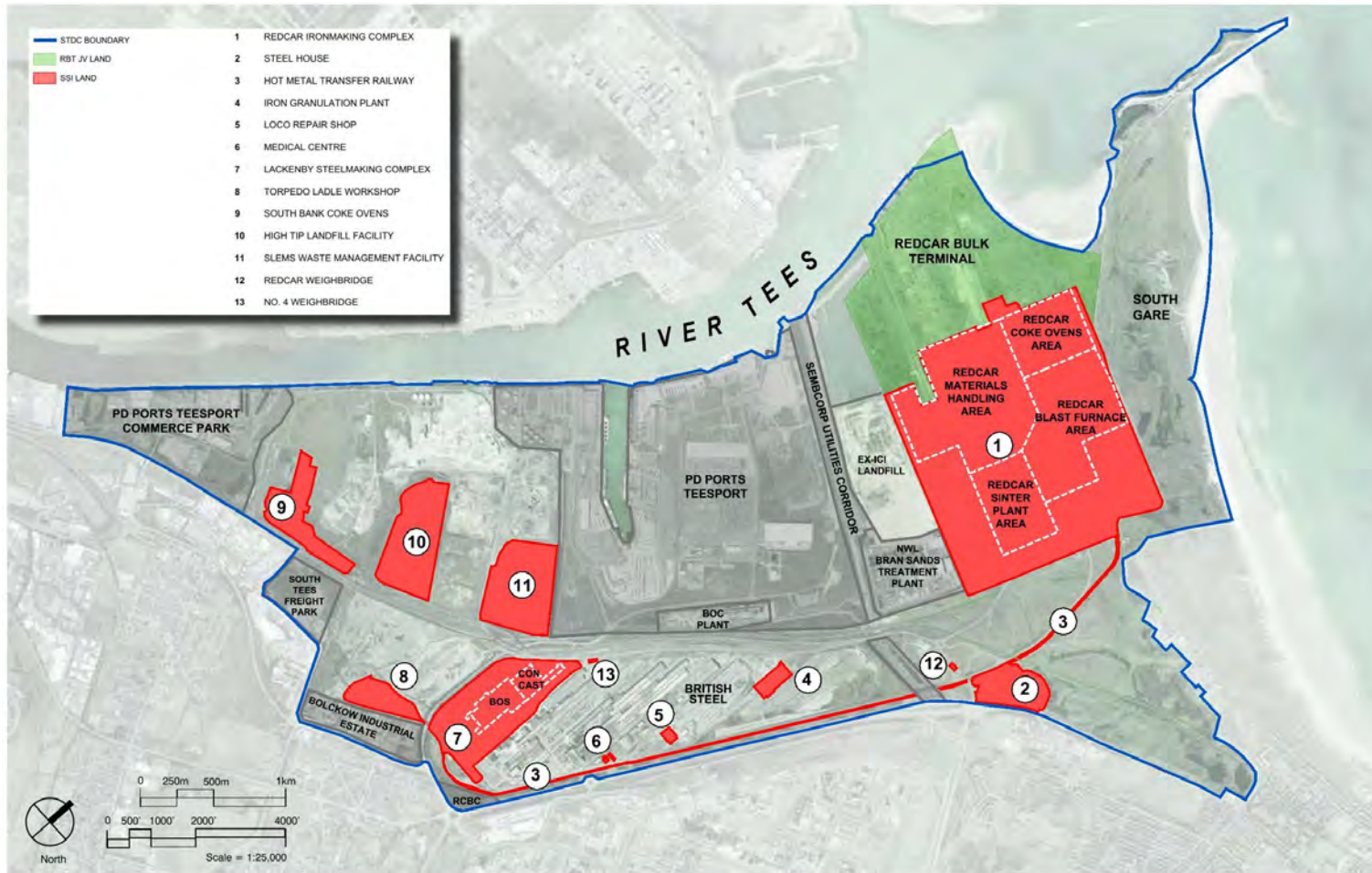
Environment Agency Position

Permanent restoration

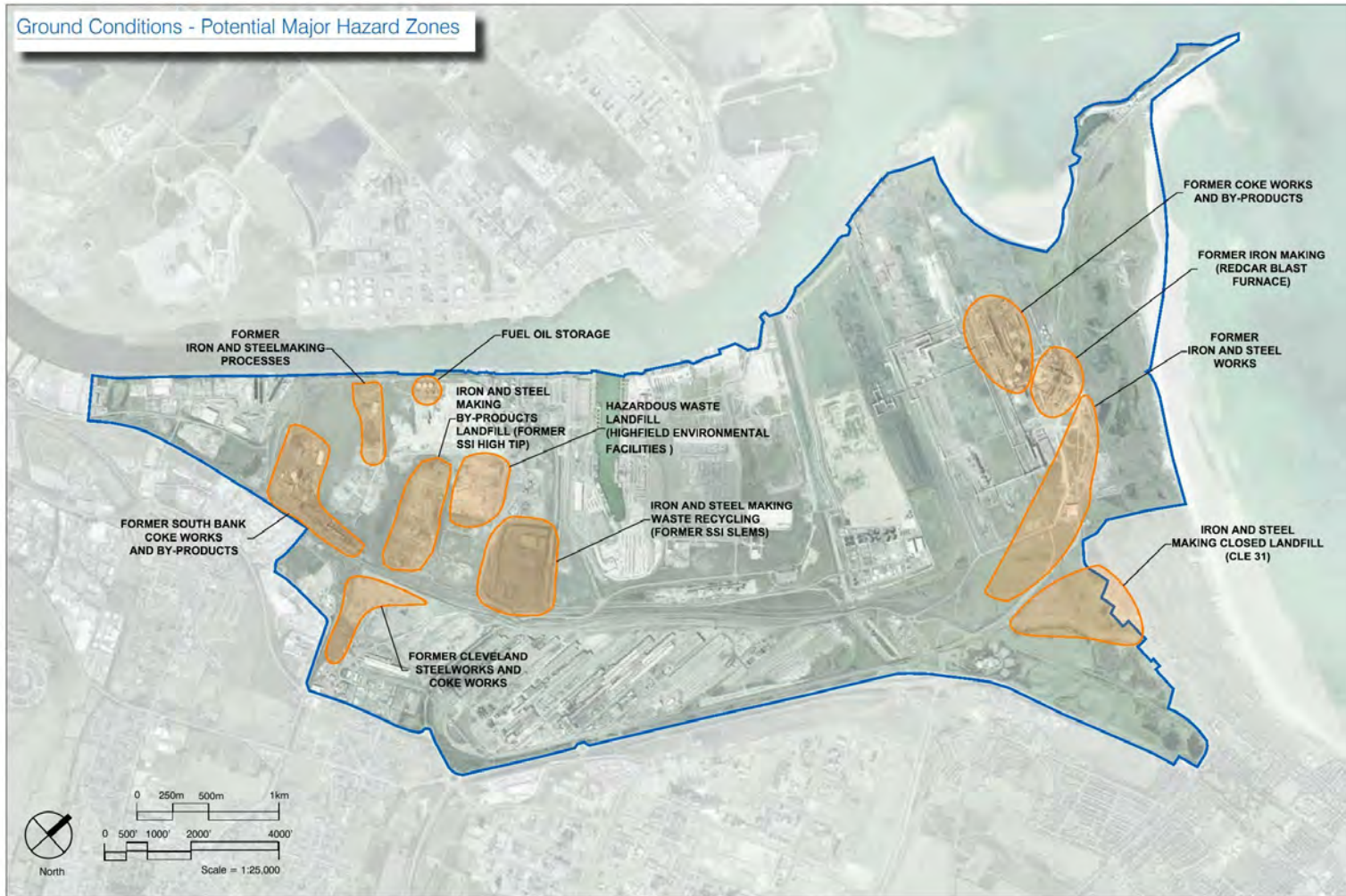
Warrenby and Grangetown Prairie: These are outside of areas with EPR permits regulated by the installations team.

South Bank: Some of this area is within the area covered by EPR permit JP3638HM held by SSI UK Ltd (in liquidation). Parts of this area are also within a COMAH upper tier establishment. The operator of the COMAH establishment is South Tees Site Company Ltd. They are about to begin a phased decontamination project with the aim of removing contaminated residues in pipes, vessels, sumps and other structures with the aim of being able to demonstrate that the site is no longer subject to the COMAH regulations. These decontamination operations should be completed prior to any demolition or longer term restoration of the site.

2.06 Former SSI Residual Assets



Ground Conditions - Potential Major Hazard Zones



VIEW ACROSS THE STDC AREA TO THE NORTH SEA

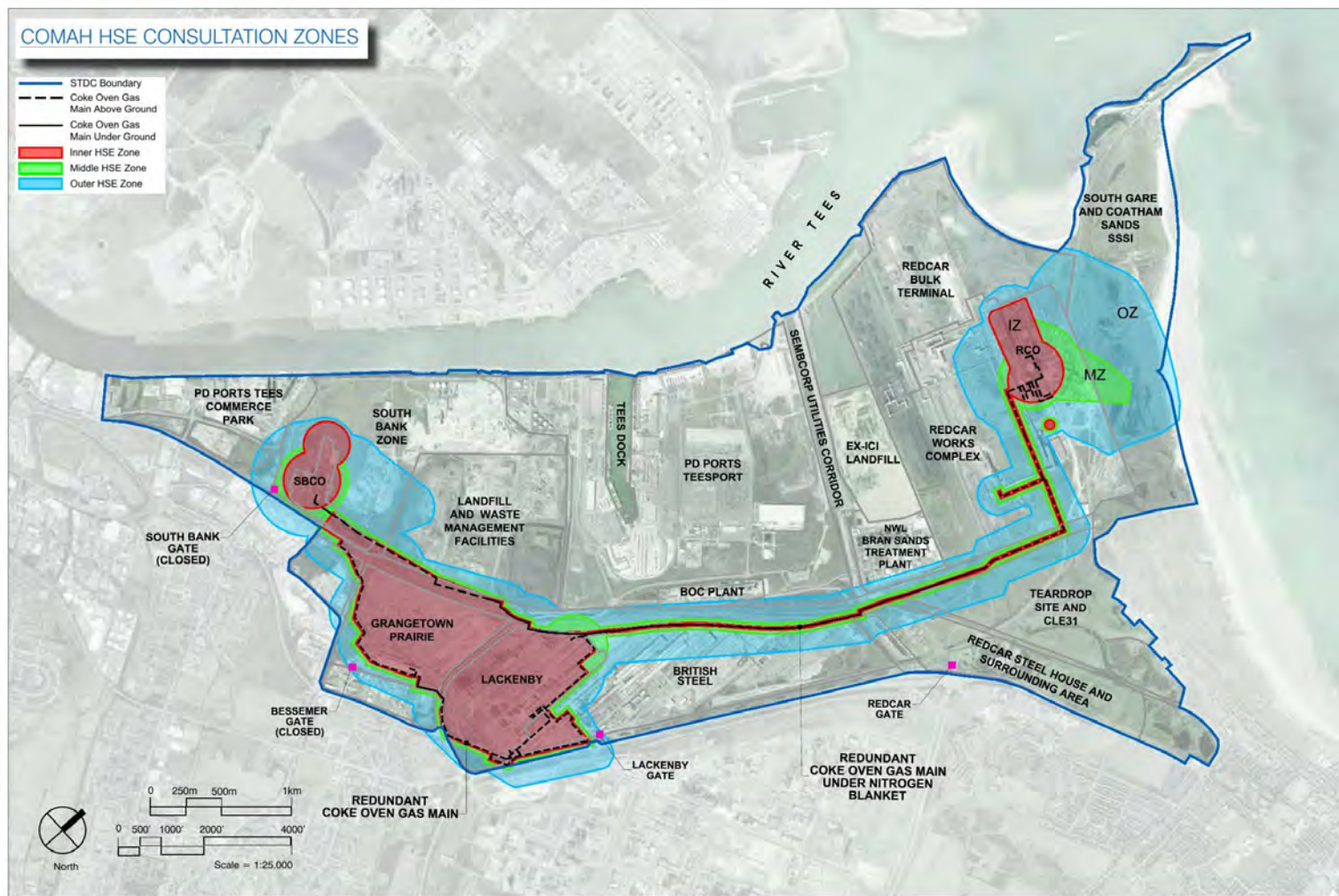




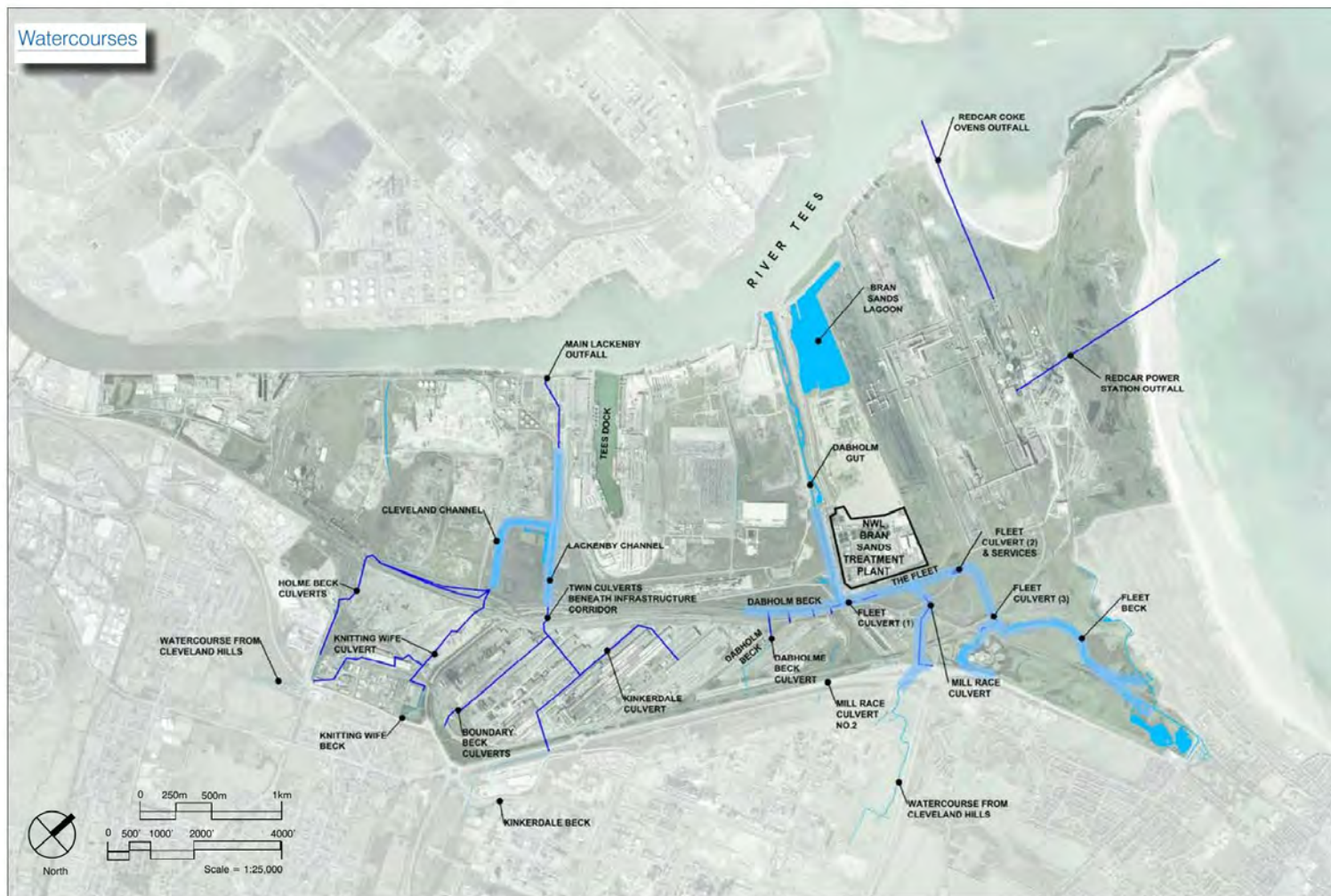
VIEW ACROSS THE REDCAR WORKS COMPLEX TO THE ESTUARY

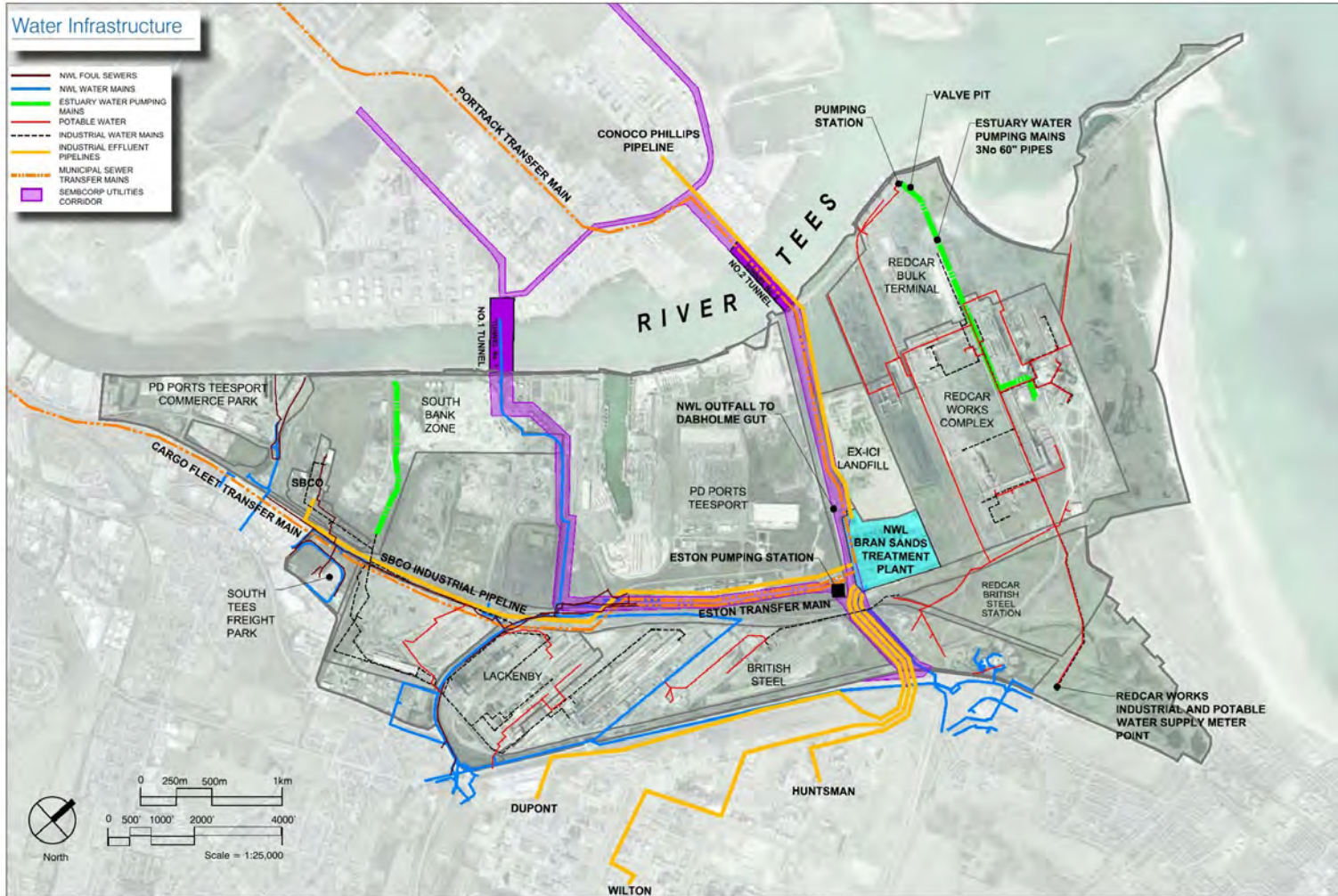
COMAH HSE CONSULTATION ZONES

- STDC Boundary
- Coke Oven Gas Main Above Ground
- Coke Oven Gas Main Under Ground
- Inner HSE Zone
- Middle HSE Zone
- Outer HSE Zone



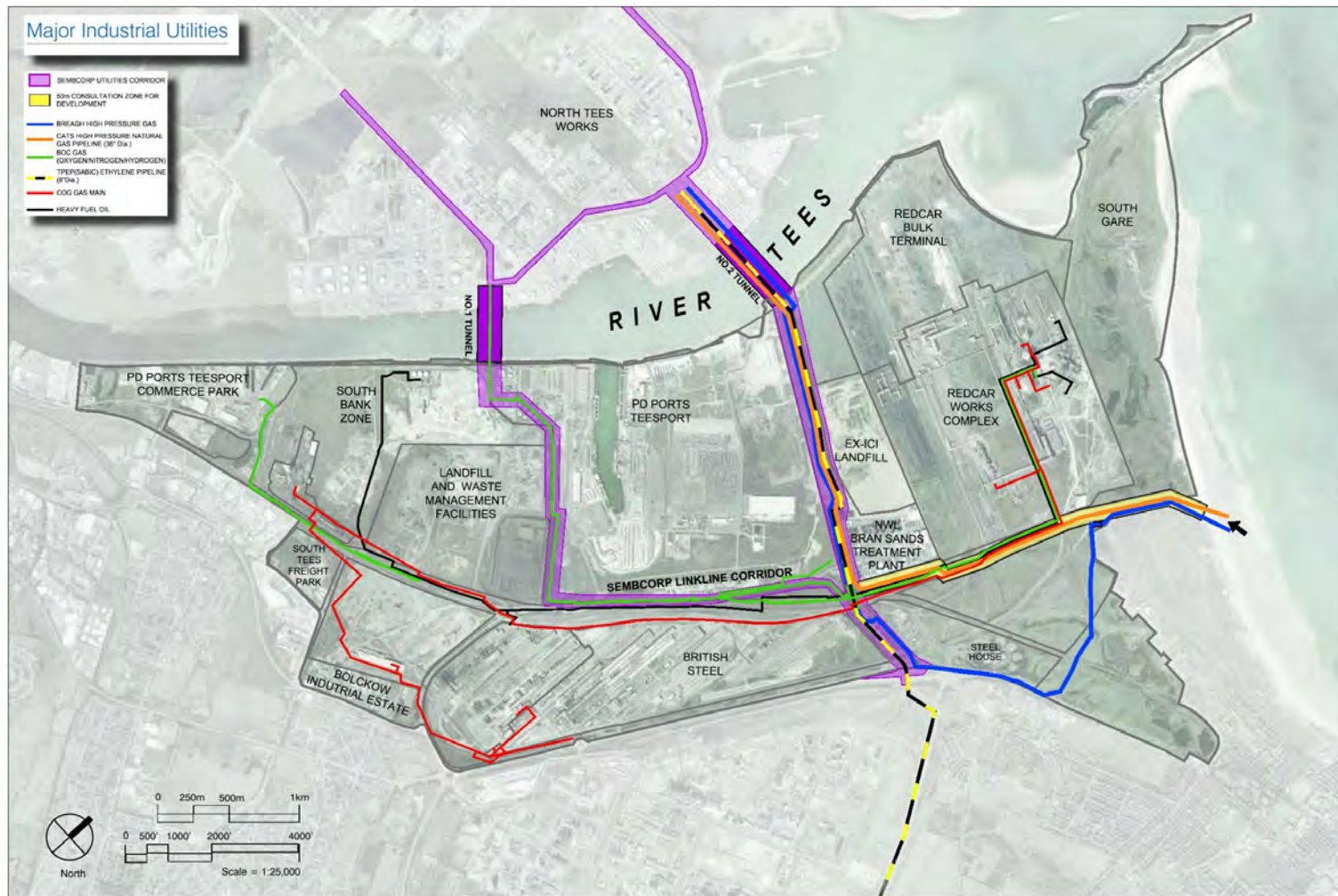
Watercourses

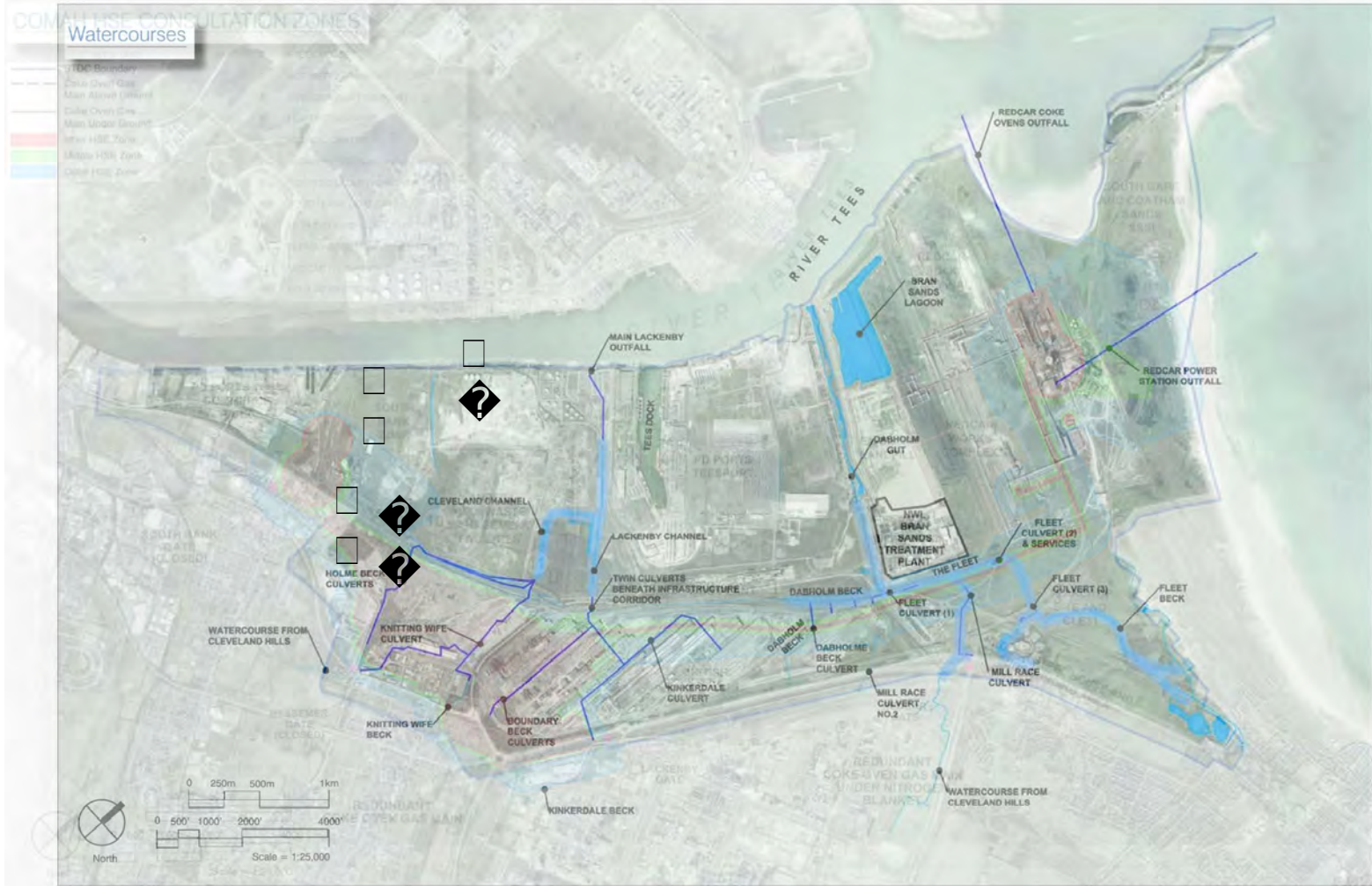




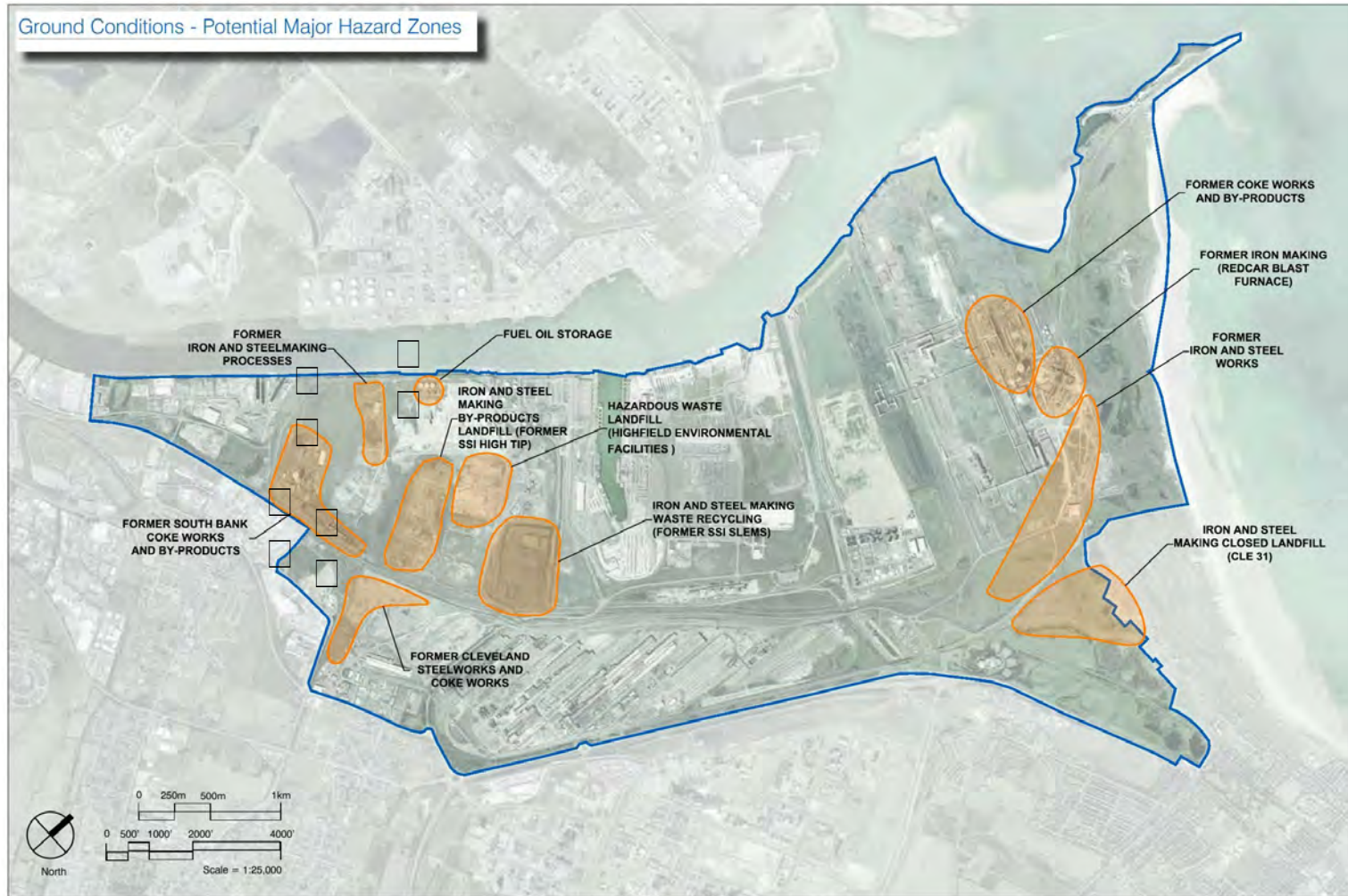
Major Industrial Utilities

- SEMBCORP UTILITIES CORRIDOR
- 80m CONSULTATION ZONE FOR DEVELOPMENT
- BREAUGH HIGH PRESSURE GAS
- CATS HIGH PRESSURE NATURAL GAS PIPELINE (36" DIA.)
- BOC GAS (OXYGEN/NITROGEN/HYDROGEN)
- THERMAGIS ETHYLENE PIPELINE (36" DIA.)
- COG GAS MAIN
- HEAVY FUEL OIL

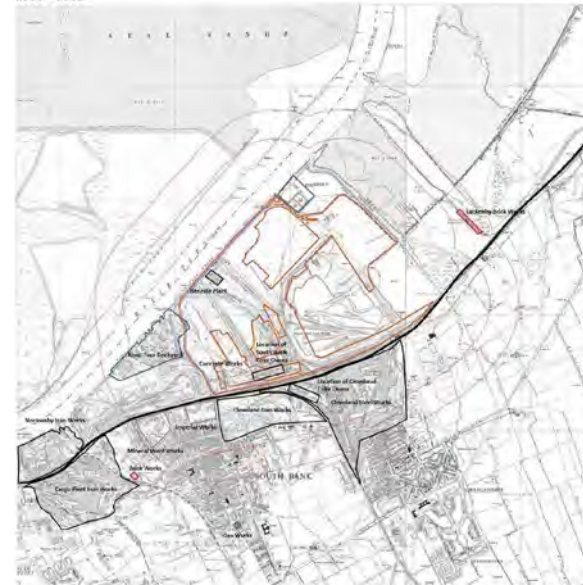
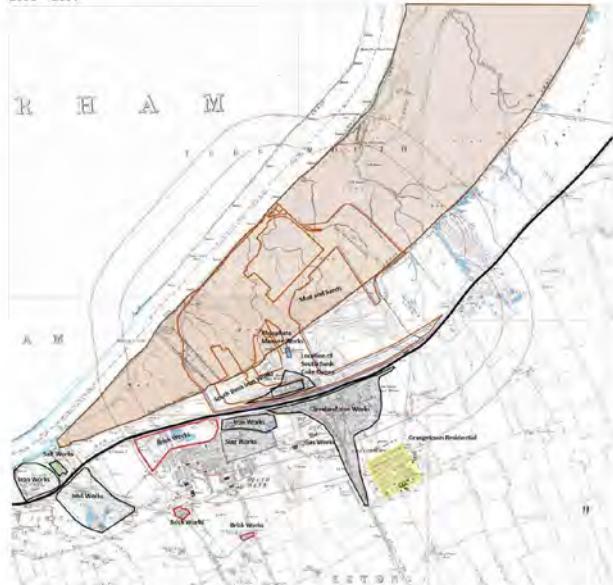




Ground Conditions - Potential Major Hazard Zones



South Bank History



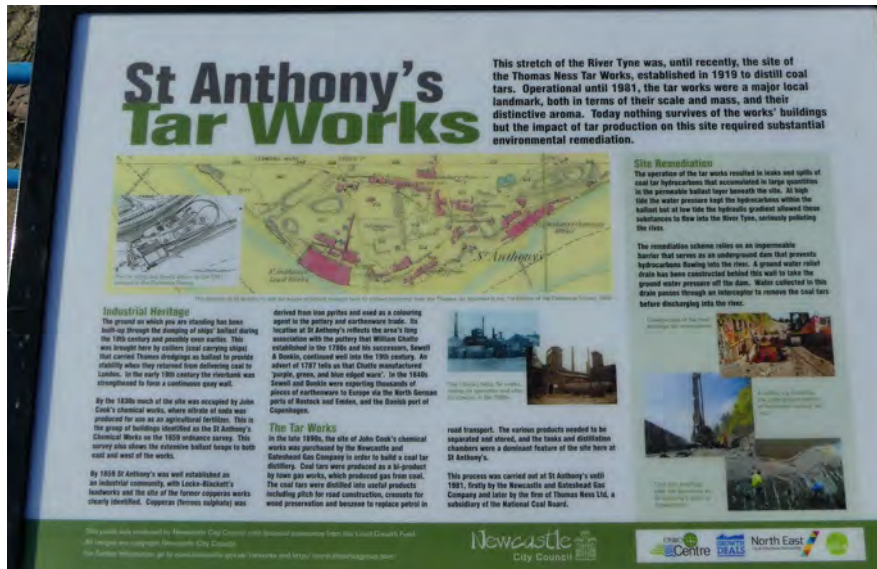
South Tees Site - 2019

- Considerable inventory of hazardous chemicals
- Complex contaminated remaining structures, both above and below ground
- Long history of industrial use – expect hazards
- Multiple known and unknown pathways to contaminate river and sea

Similar Sites

- The Avenue Coke Works, Chesterfield (98Ha)
 - ~ ~£172million (£85million remediation)
 - ~ 10years to remediate (2nd attempt) to housing
 - ~ 2million tonnes of soil decontaminated (“cooked”)
- St Anthony’s Tar Works, Newcastle (4Ha)
 - ~ 1st attempt 2000, 3rd attempt 2016 4 years
 - ~ Impermeable barrier around site to break pathway
- Greenbank Gas Works, Blackburn
 - ~ Bioremediation 10 year project

St Anthony's Tar Works



Site Remediation

The operation of the tar works resulted in leaks and spills of coal tar hydrocarbons that accumulated in large quantities in the permeable ballast layer beneath the site. At high tide the water pressure kept the hydrocarbons within the ballast but at low tide the hydraulic gradient allowed these substances to flow into the River Tyne, seriously polluting the river.

The remediation scheme relies on an impermeable barrier that serves as an underground dam that prevents hydrocarbons flowing into the river. A ground water relief drain has been constructed behind this wall to take the ground water pressure off the dam. Water collected in this drain passes through an interceptor to remove the coal tars before discharging into the river.

Construction of the land drainage tar interceptors.



A drilling rig installing the underground barrier of bentonite/cement soil mix.

Coal tars leaching onto the foreshore at St Anthony's prior to remediation.



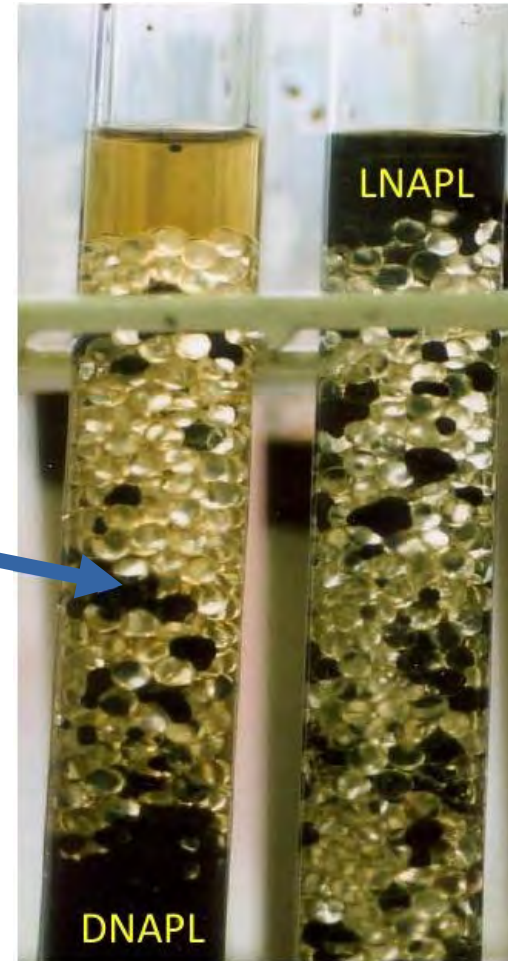
Non-aqueous Phase Liquid (NAPL)

- NAPL = Non-Aqueous Phase Liquid
 - ~ Does not mix with water and remains as a separate phase
 - ~ Coal tar / petroleum hydrocarbons *and chlorinated solvents*
- Hydrocarbon NAPL
 - ~ Composed of different hydrocarbons
 - ~ Hydrocarbons have different solubilities
- Transport
 - ~ Directly – driven by density difference (sinks in ground) and direction of water flow
 - ~ Individual components solubilised in groundwater

Dense NAPL (DNAPL)

- DNAPL = NAPL that is more dense than water
 - ~ Coal Tar, *Chlorinated solvents* – PCE, TCE, TCA
 - ~ *Single-component products*
- South Bank Quay Historic Uses
 - ~ Coking ovens – dense coal tar
 - ~ Heavy fuel oil storage – heavy fuel oil

Capillary
held
residuals of
NAPL



DNAPLs are Complex – 1

- DNAPLs can be trapped
 - ~ Depends on aperture sizes
- Increasing the aperture
 - ~ May release DNAPL to move
 - ~ Explosions may rearrange ground
 - ~ Freeing DNAPL to move again

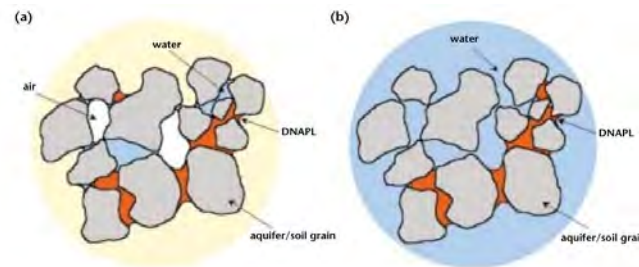


Figure 3 Residual DNAPL in (a) unsaturated and (b) saturated porous media

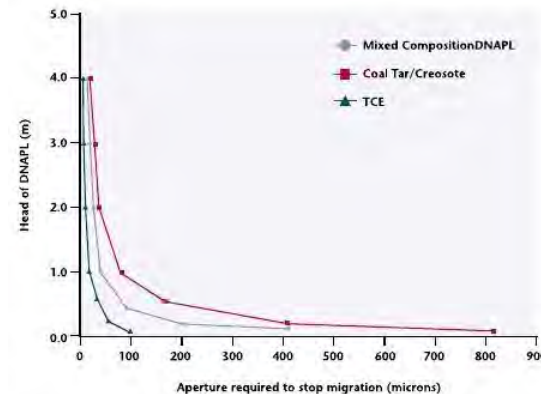
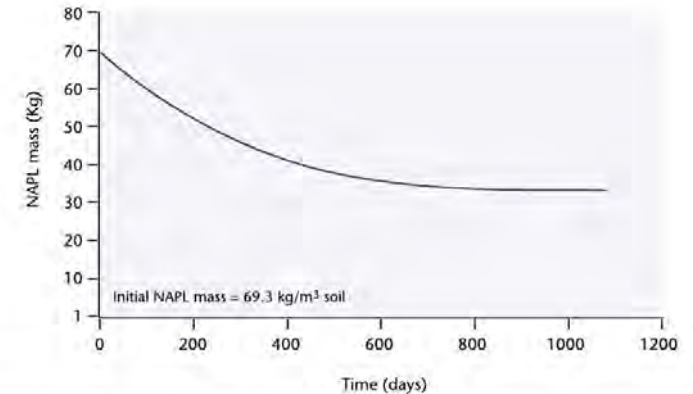
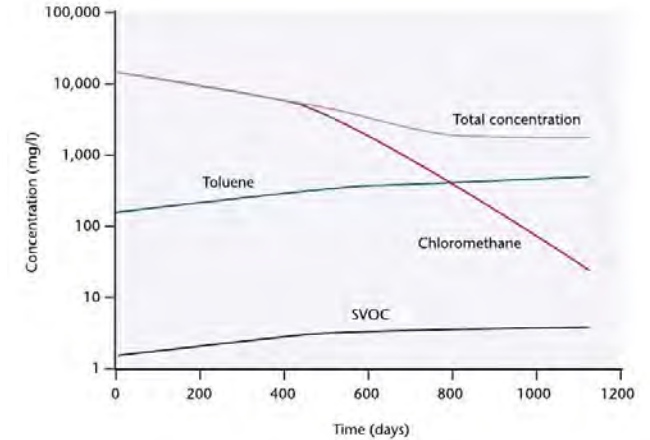


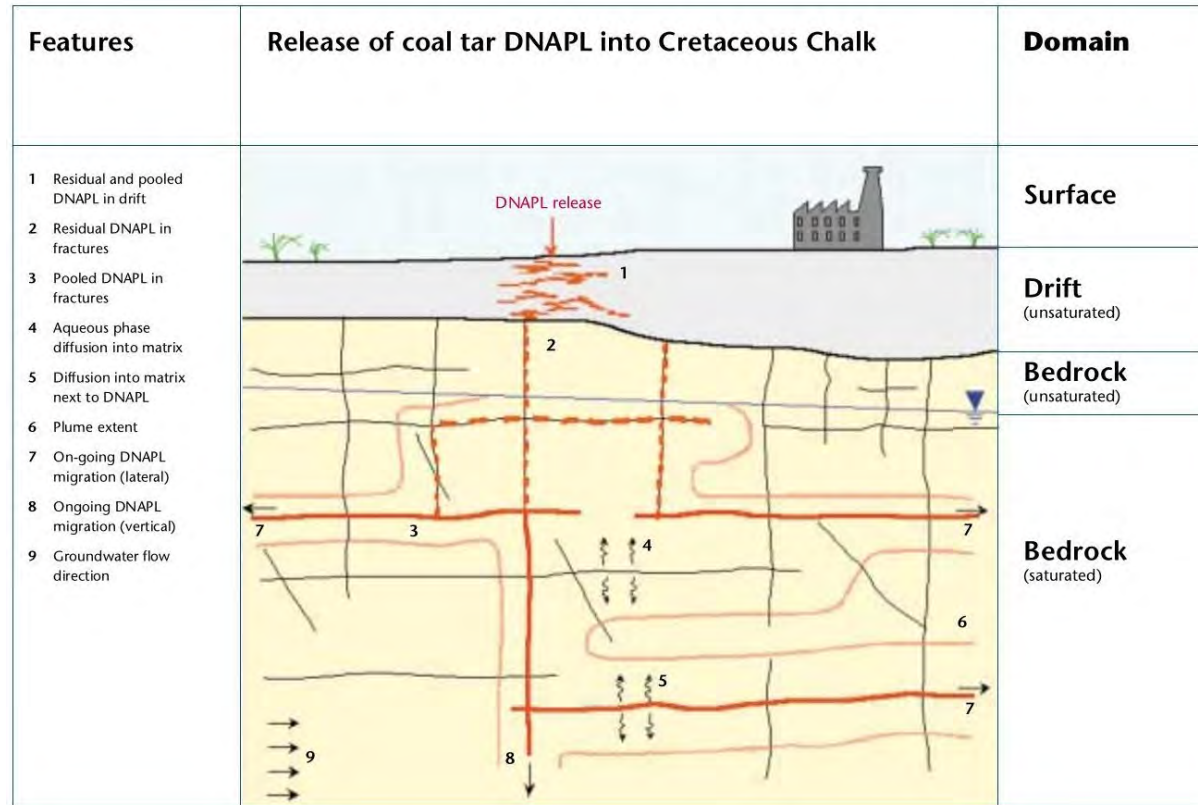
Figure 11 Fracture aperture required to stop migration versus height of accumulated DNAPL

DNAPLs are Complex – 2

- DNAPLs are mixtures
 - ~ Measured concentrations of most toxic components can/do increase over time
 - ~ Release depends on solubility of other component and mass fraction
- DNAPLs can remain contaminating for decades
 - ~ Due to low solubility (non-aqueous)



EA Handbook – DNAPLs Sink – Coal Tar 1



EA Handbook – DNAPLs Sink – Coal Tar 2

Features	Release of coal tar DNAPL into Triassic Sandstone	Domain
<ol style="list-style-type: none"> 1 DNAPL pool slowly entering fractures 2 Aqueous phase plume formation 3 DNAPL discharge to surface water 4 Pooled DNAPL 5 Matrix diffusion 6 Residual DNAPL 7 Plume in fracture 8 Groundwater flow direction 9 On-going DNAPL migration to depth 		Surface
		Drift (unsaturated)
		Drift (saturated)
		Bedrock (saturated)

NAPLs in Water Courses



- In the Tees any DNAPL will be hidden by turbidity or sediment
- On a small clear water course coal tar can be seen:
 - ~ Hydrocarbon staining on far bank
 - ~ DNAPL Coal tar on bed of river (+ house bricks for scale) – in flood event this DNAPL will get dispersed downstream (perhaps several Km)
 - ~ Emergence of DNAPL at discrete points in river bed, that then runs down topography of riverbed to collect in pools

NAPL Remediation

- Either

~

Remove all coal tar

- Quickly pyrolysis (heat soil to high temperature)
- Slowly either bioremediation or water circulation

- Or

~

Entomb all coal tar plus clean / monitor any water present

- Cap surface and make an underground wall between coal tar source and clean ground / water

South Bank Source of Coal Tar



Teesworks Demolition Project

Inventory of COMAH substances within South Bank Coke Ovens By-products DEMOLITION AREA SBBP/01

Plant Item	Dwg No	Dimensions (m)	Substance	Estimated Residue (t)
Effluent storage tank No 1	CO 11830	11 dia x 12 H	Tar/Naphtha/NH3 Liquor	105 [liq] + 27 [Tar]
Effluent storage tank No 2	CO 11733	11 dia x 12 H	Tar/Naphtha/NH3 Liquor	105 [liq] + 29 [Tar]
Effluent storage tank No 3	CO 11830	11 dia x 12 H	Tar/Naphtha/NH3 Liquor	105 [liq] + 62 [Tar]
Effluent storage tank No 4	CO 11830	11 dia x 12 H	Tar/Naphtha/NH3 Liquor	114 [liq] + 105 [Tar]
Effluent surge tank	N/A	1 x 2	Tar/Naphtha/NH3 Liquor	0.25
"L" Tar tank	N/A	15 dia x 11 H	Tar/Naphtha/NH3 Liquor	248 Coal tar residue
"M" Tar tank	N/A	15 dia x 11 H	Tar/Naphtha/NH3 Liquor	251 Coal tar residue
"N" Tar tank				
North Tar tank				
South Tar tank				
To be continued				

2021

200t Coal tar

400t Tar/naphtha/ammoniacal
liquid

500t Coal tar residue



Non-aqueous / insoluble material present in water across South Bank Site

Multiple sources:
DNAPL on site
DNAPL SBCO
Fuel tanks

VIEW FROM SOUTH BANK LOOKING DOWNRIVER



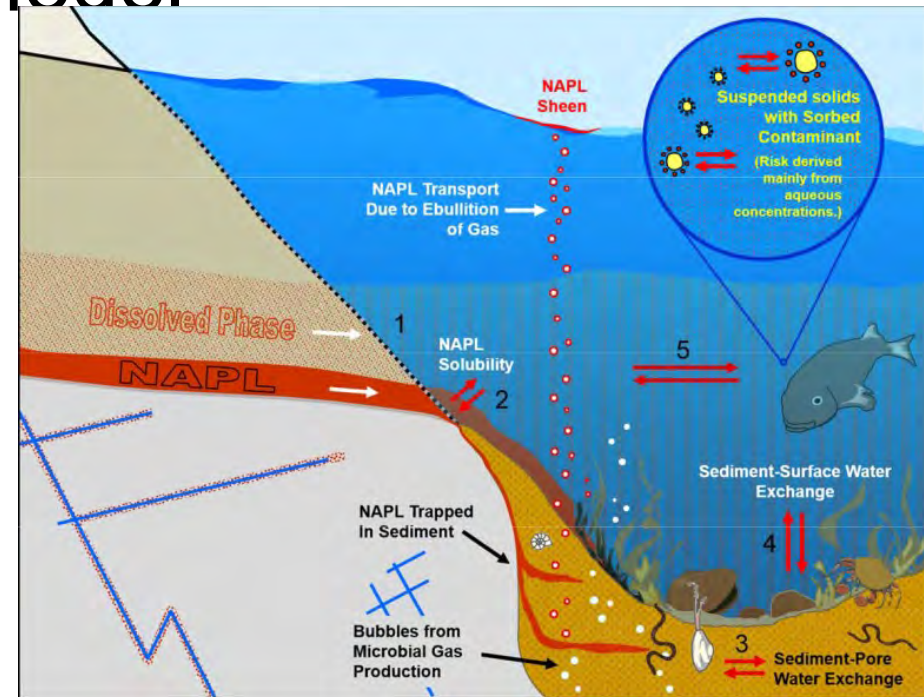
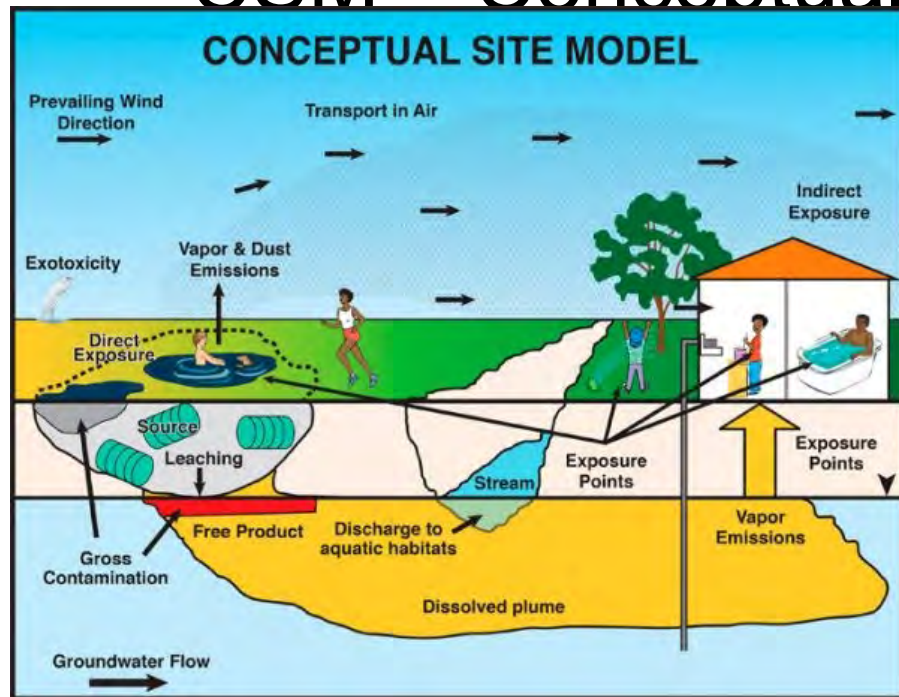


Risk Assessment

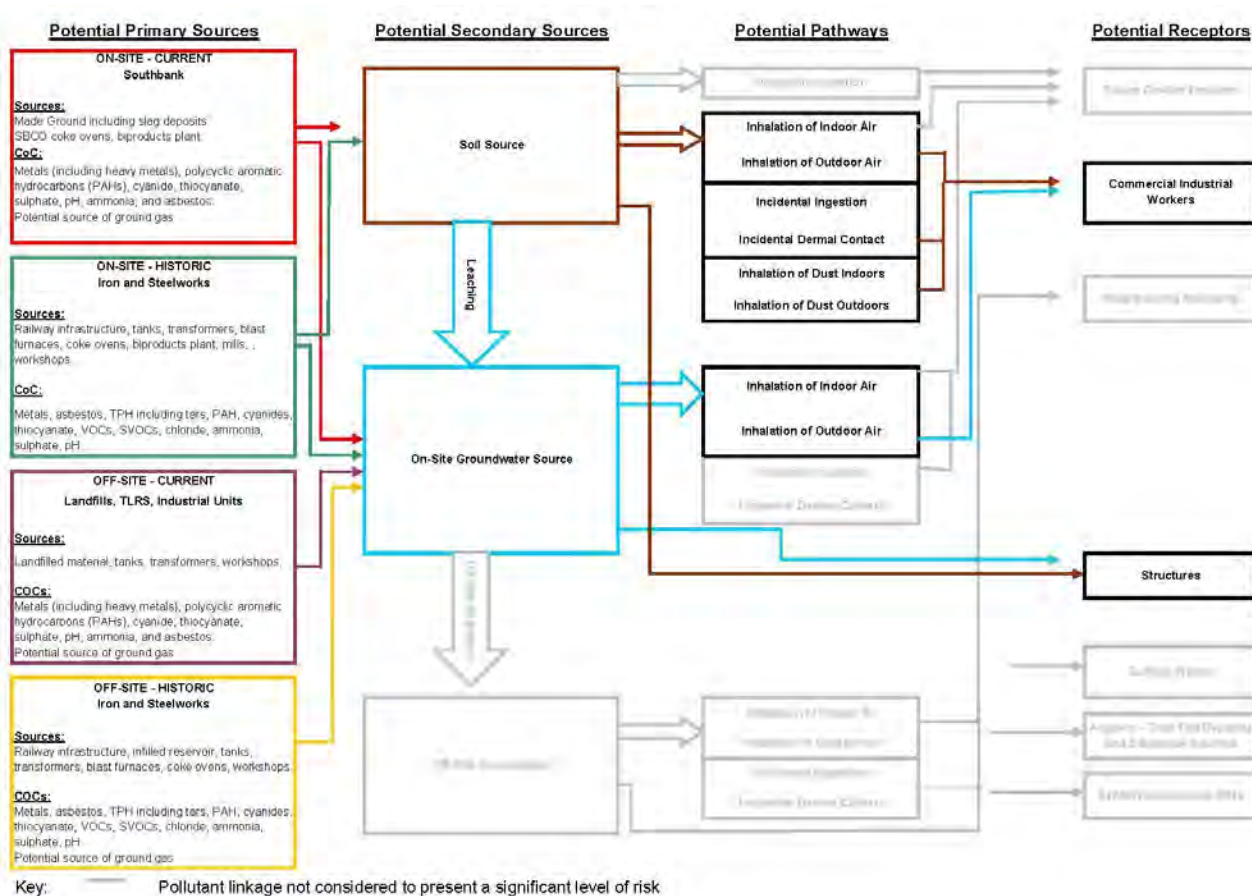
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~ Asbestos on ground – wind – humans: cap with soil

- CSM – Conceptual Site Model



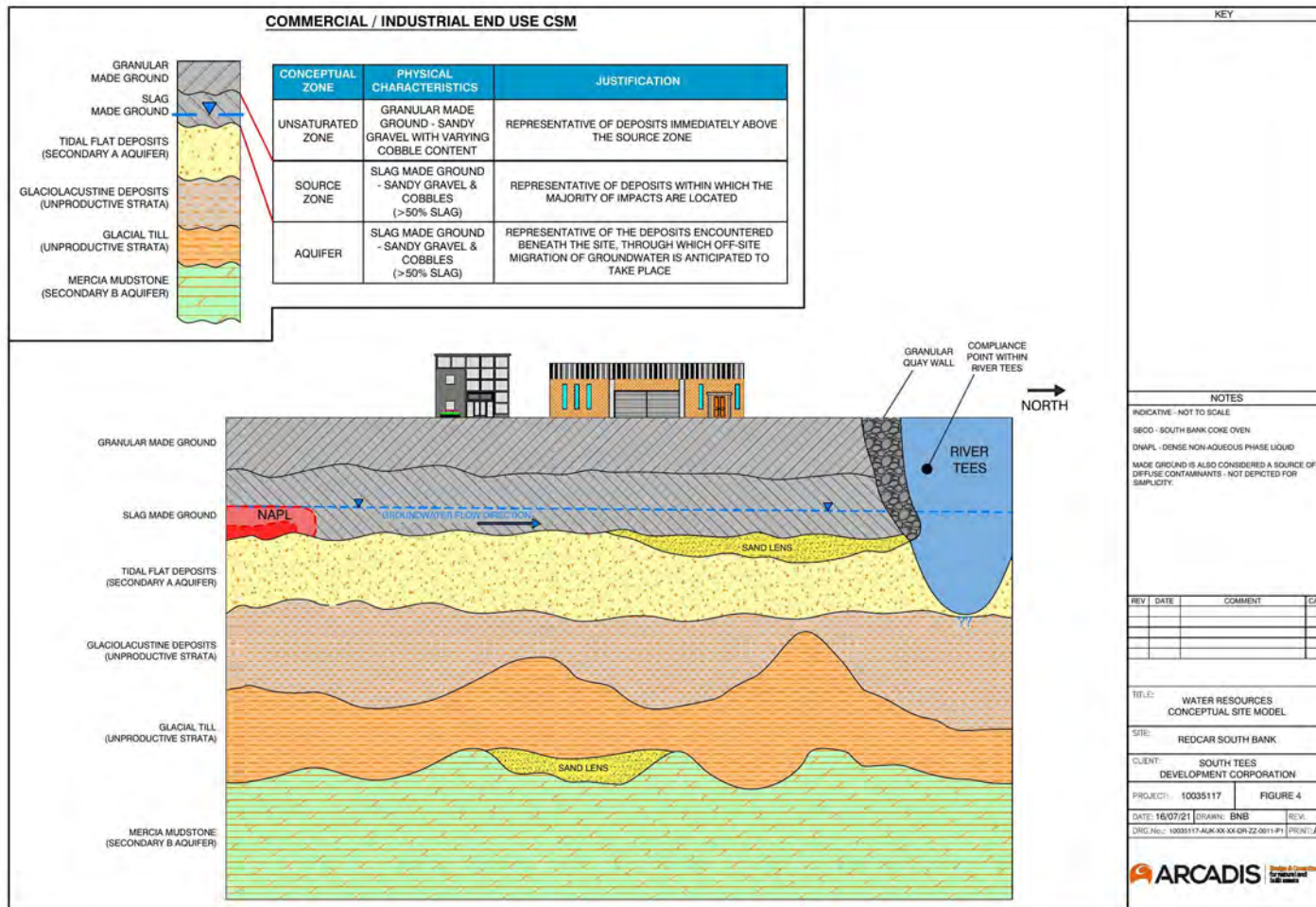
Outline Conceptual Site Model



Removes risk to water based on:

Dilution & Water brackish

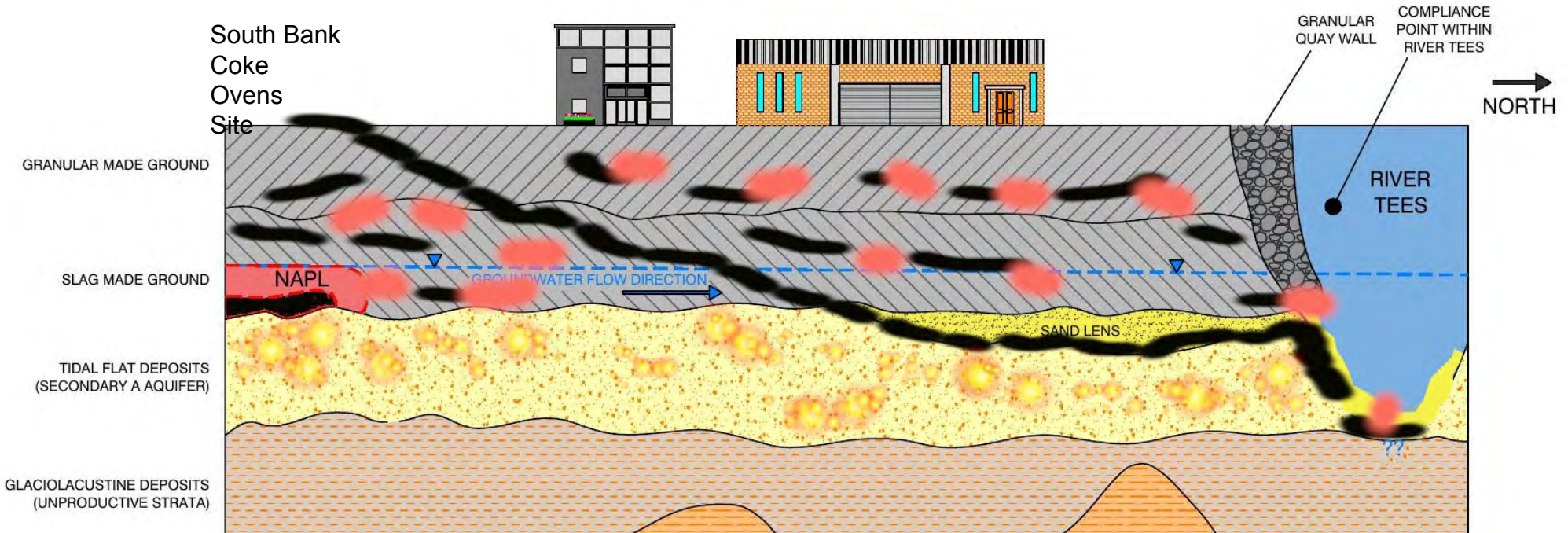
- Approach not appropriate for DNAPLs (*require specialist removal or remediation*)
- Hasn't considered risks to sensitive local receptors e.g. SSSI, RAMSAR River Tees *as they are removed from CSM!*
- Or risks from creating additional pathways to sensitive receptors (e.g. piling, explosives or dredging activities)
- Tidal Flats groundwater **source and pathway**– hydraulic continuity with the river/sea



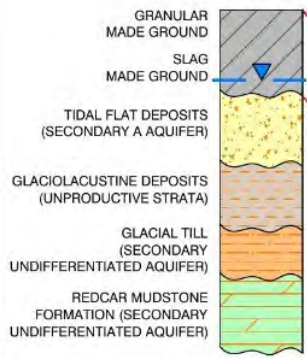
Hasn't taken account of additional pathways – e.g. through piling.

- DNAPLs also closer to River Tees
- End state – risks to humans
- Not construction – highest risk to environment
- Incorrect isolation of NAPLs

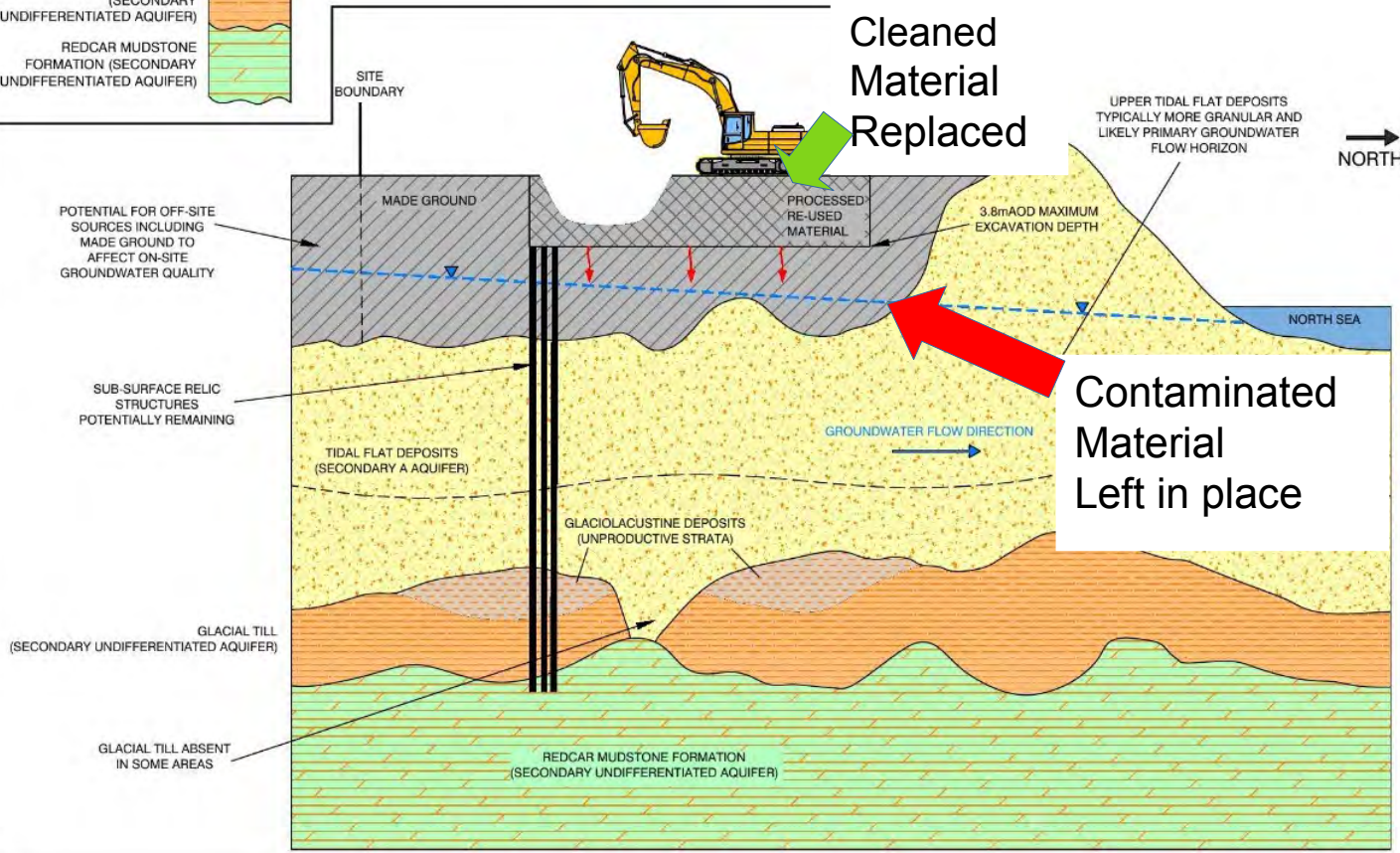
Revised Conceptual Model showing risks to river/marine receptors *(EA DNAPL + Arcadis South Bank)*



COMMERCIAL / INDUSTRIAL END USE CSM



CONCEPTUAL ZONE	PHYSICAL CHARACTERISTICS	JUSTIFICATION
SOURCE ZONE	MADE GROUND	REPRESENTATIVE OF DEPOSITS WITHIN WHICH THE MAJORITY OF IMPACTS ARE LOCATED
AQUIFER	SLIGHTLY SILTY SLIGHTLY GRAVELLY CLAY	REPRESENTATIVE OF THE DEPOSITS ENCOUNTERED BENEATH THE SITE, THROUGH WHICH OFF-SITE MIGRATION OF GROUNDWATER IS ANTICIPATED TO TAKE PLACE



KEY

GROUNDWATER ELEVATION

VERTICAL MIGRATION OF LEACHATE

NOTES

INDICATIVE - NOT TO SCALE

REV	DATE	COMMENT	CAD

TITLE: CONCEPTUAL SITE MODEL CROSS SECTION

SITE: REDCAR SOUTH BANK

CLIENT: SOUTH TEES DEVELOPMENT CORPORATION

PROJECT: 10035117 FIGURE 9

DATE: 28/02/23 DRAWN: AP REV: -

DRG.No.: 10035117-AUK-XX-XX-OR-ZZ-0049-P1 PRINT: A3

Summary

- South Tees Site was a contaminated site
- Teesworks will be a contaminated site
- Has/Is enough been/being done to protect the environment?
- Measurement / monitoring should be based on known historical industry
- Measurement / monitoring should not be stopped just because current measurements do not find a known historical contaminant

Recommendations

- Revisit environmental risk assessments
 - ~ Based on cumulative not individual risk
- Request DEFRA/EA/CEFAS to carry out an audit of the contamination within and entering the River Tees Estuary
- Request MMO to publish cumulative contamination within sea disposal sites off the River Tees
- Use this data to request funding to protect the environment