

Re-use of Dioxin Impacted Sediments

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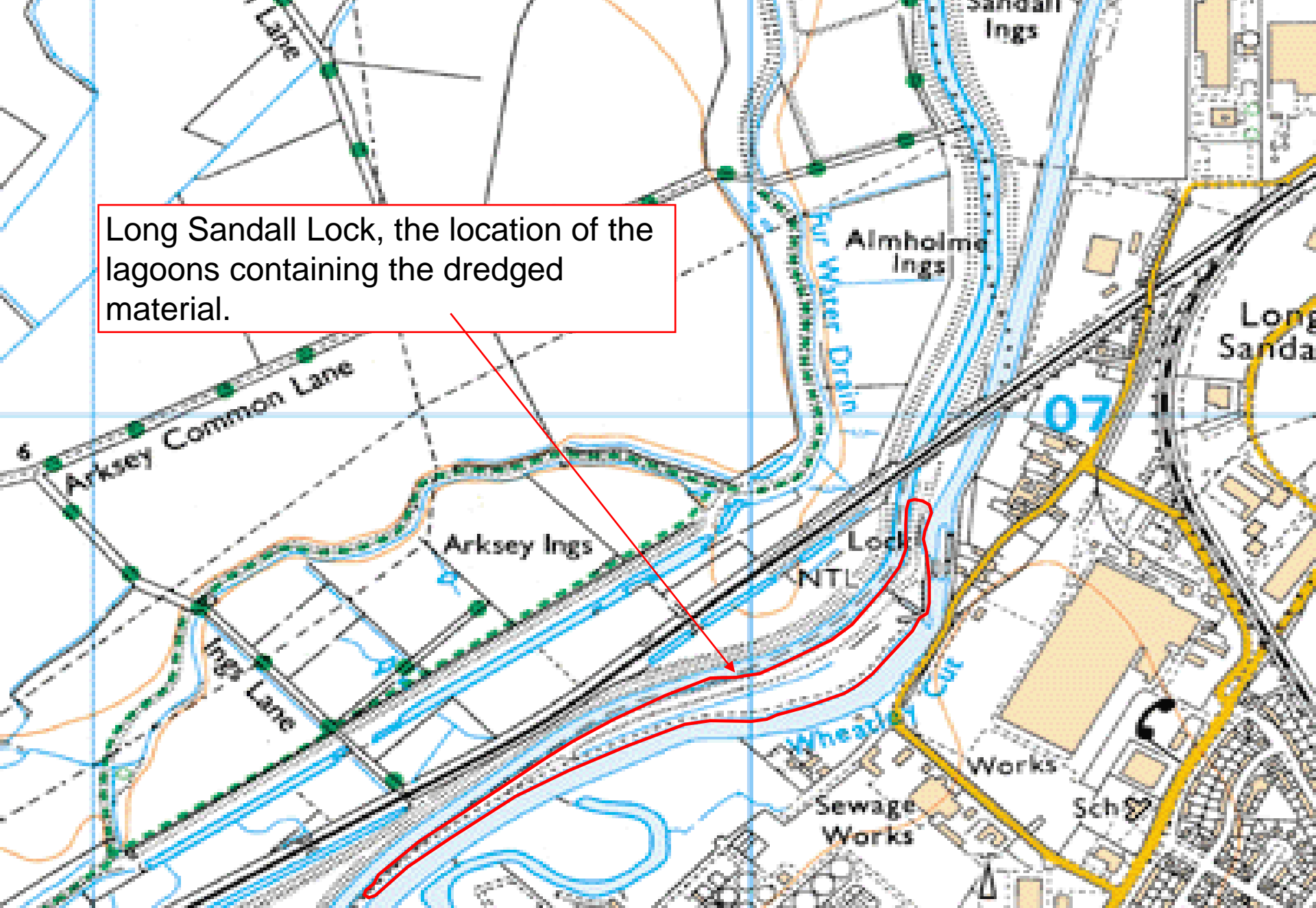
Ramboll Whitbybird



Introduction

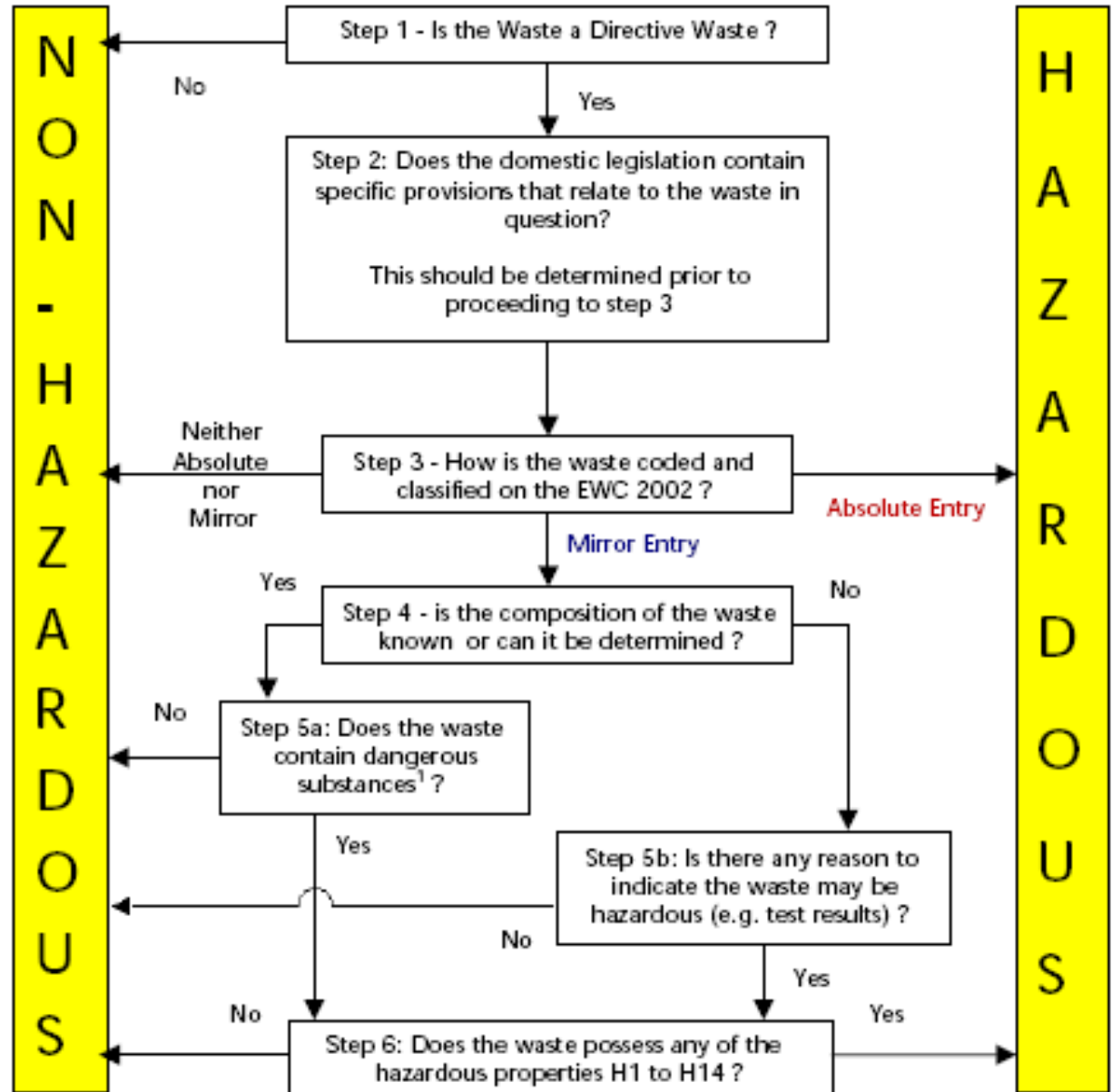
- British Waterways maintain over 3,540km of the inland waterway network across Britain.
- Manage large tonnages of dredged sediment from canals & waterways.
- In the northeast of England, 100,000m³ of sediment dredged from the South Yorkshire region stored in 6No. lagoons
- The lagoons on this site were nearing capacity and could only accept a further limited volume of dredged material.
- British Waterways proposed to use the lagoon material as infill in the canal bank stabilisation works under a Paragraph 19 WML Exemption.
- Waste classification of the material to prove non-hazardous
- Risk assessment - suitable for use

Long Sandall Lock, the location of the lagoons containing the dredged material.



Classification Process

- Inorganic
- Dioxin
- Hydrocarbon



Note:

¹ Infectious substances should be considered at this stage of the Hazardous Waste Assessment Methodology

Inorganic Component

- WM2 Hazardous Waste: *Interpretation of the definition and classification of hazardous waste* (2nd Edition v 2.1 2005)
- Inorganic components - worst-case speciation of the elements contained within the sediment
- e.g. chromium, assume that all chromium toxic chromium trioxide (CrO_3) rather than the significantly less toxic di-chromium oxide (Cr_2O_3).
- Inappropriate classification of the soil
- Literature review, XRD, XRF, SedNorm, Siroquant – predict likely speciation and compound form (typically sulphide)
- None of the hazardous properties given in H1 to H14 were triggered
- Metal constituents in the sediment - classified as non-hazardous

Dioxin Component

- Toxicological properties - carcinogenic, immunological, reproductive and human development effects
- Carcinogens - classified as dangerous substances - hazard phrase H7
- H7 (carcinogenic) hazardous threshold value set at 1,000mg/kg.
- Other hazardous properties triggered - H5 and H6 (harmful and toxic respectively) - threshold levels are set at 1,000mg/kg.
- Maximum dioxin concentration recorded at 3,100ng TEQ/kg
- Human health guidance (US EPA) action level set at 1,000ng TEQ/kg
- **6 orders** of magnitude ***less*** than the waste threshold value.

Proposed Dioxin Threshold Concentration

- Described as a Persistent Organic Pollutant (POP)
- European Regulations (EC 1195/2006) - wastes containing dioxins **exceeding the low POP content** must be *"disposed of or recovered.....to ensure that the persistent organic pollutant content is destroyed or irreversibly transformed"* (EC 850/2004).
- Low POP content adopted by the EU and the United Nations Environment Programme (UNEP, 2006) is a threshold of **15,000ng TEQ/kg**.
- Wastes with concentrations of dioxins above the low POP level must be **disposed of** or transformed in an environmentally sound manner; such as permanent storage in a **hazardous** landfill, providing the waste is solidified and the concentration of dioxin does not exceed 5mg/kg (EC 172/2007).

Dioxin Threshold Concentration Accepted by Regulator

- Avoid the inconsistencies with the waste threshold value provided in WM2 (1,000mg/kg) and the human health safe exposure limits (1,000ng TEQ/kg) was proposed that the low POP concentration limit for dioxins of 15,000ng TEQ/kg was used as a trigger value for hazardous waste classification.
- Maximum dioxins concentration was recorded as 3,100ng TEQ/kg less than 15,000ng TEQ/kg threshold value
- Dioxin concentration - sediment classified as non-hazardous.

Hydrocarbon (Oily Waste) component

- “How to find out if waste oil and wastes that contain oil are hazardous” HWR08, June 2007.
- 3 hazard phrases; H5 (Harmful), H7 (Carcinogenic) and H14 (Ecotoxic).
- speciated hydrocarbon analysis - triggered any hazardous properties
- Did not exceed the threshold concentrations to trigger either H5 or H14
- Hazardous property H7, assess the various hydrocarbon bands :
 - PRO (C₆-C₁₀) – 0.1% w/w (1,000mg/kg) - category 1 & 2
 - DRO (C₁₀-C₂₅) – 1% w/w (10,000mg/kg) - category 3
 - Lubricating Oils – 0.1% (1,000mg/kg) - category 1 & 2
- Did not exceed the threshold values for PRO or DRO; but lubricating oil > 1,000mg/kg.

Hydrocarbon (Oily Waste) component

- Guidance states that lubricating/other oil in the waste is "*assumed to be a category 2 carcinogen unless it can be **demonstrated that it does not possess carcinogenic properties.***"
- Lubricating oil fraction (C₂₅-C₄₄) contains category 1, 2 and 3 carcinogens.
- Category 1 and 2 carcinogens (most carcinogenic) are due to the presence of **aromatic hydrocarbons** and specifically PAH compounds e.g. benzo(a)pyrene.
- Category 3 carcinogens (less carcinogenic) are due to the **aliphatic compounds** within the C₂₅-C₄₄ fraction.
- Extremely conservative to assume that the entire C₂₄-C₄₄ fraction contained category 1 and 2 carcinogens

Hydrocarbon (Oily Waste) component

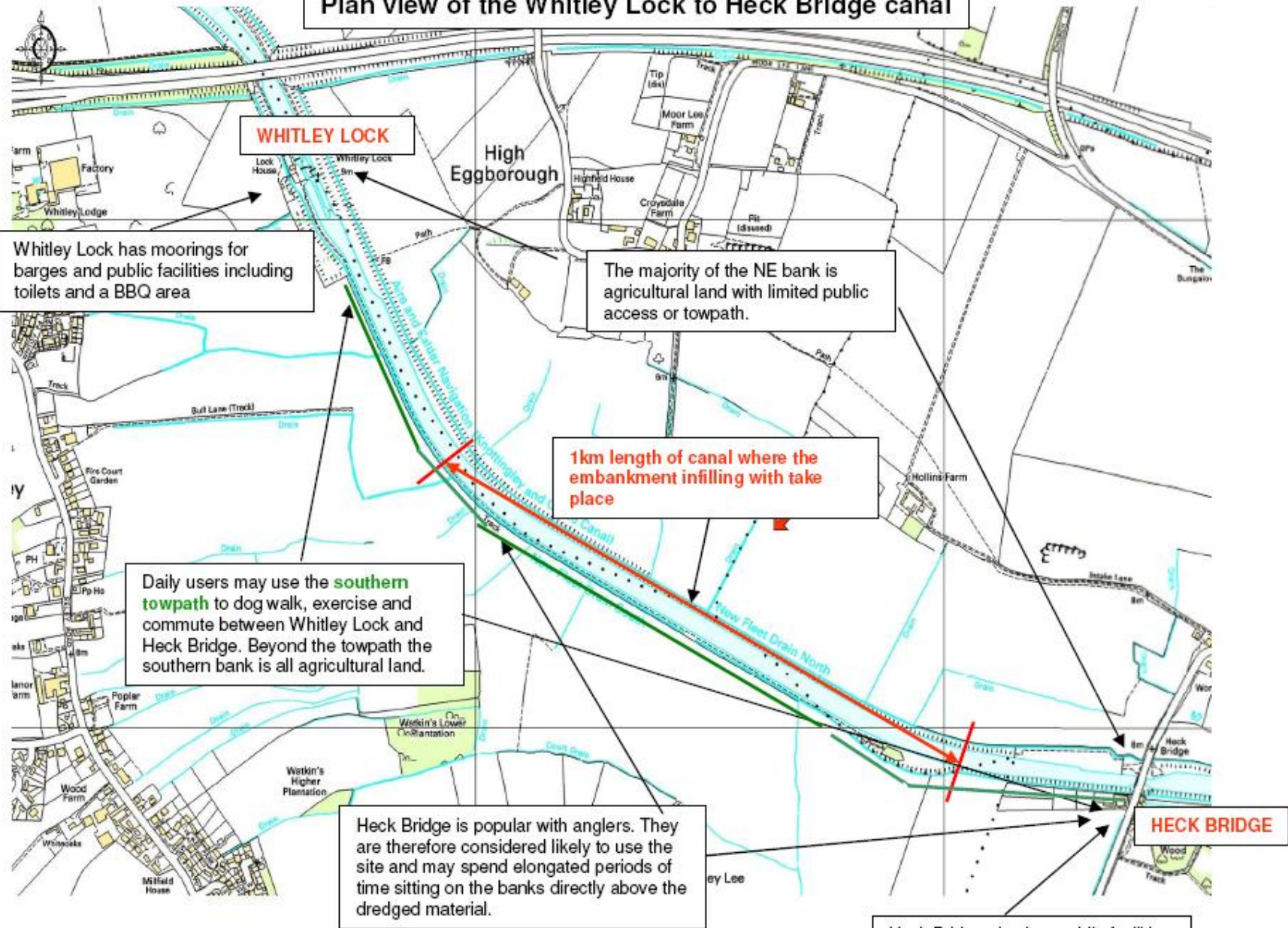
- Analysed sediment for carcinogenic compounds in terms of A) category 1 and 2 carcinogens and B) category 3 carcinogens:
 - A) Category 1 and 2 carcinogens
 - including **petrol range organics**
 - **TPH aromatic fraction** of lubricating/other oils (C₂₄-C₄₄)

summed and compared to the waste threshold of **0.1% w/w 1,000mg/kg**
 - B) Category 3 carcinogens
 - including **diesel range organics**
 - **TPH aliphatic fraction** of lubricating/other oils (C₂₄-C₄₄)

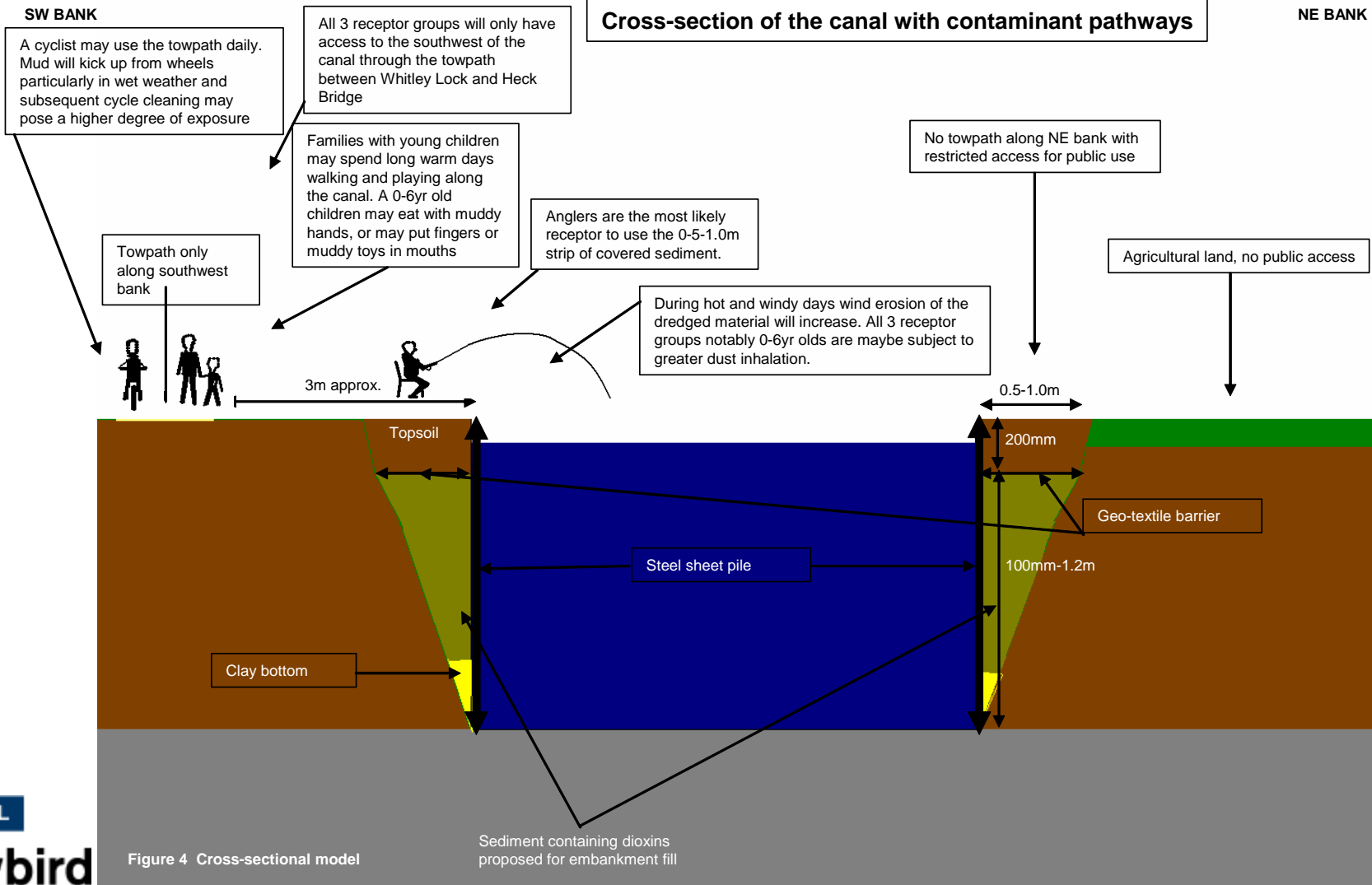
summed and compared to the waste threshold of **1% w/w 10,000mg/kg**
- When assessed in this way the sediments are classified as non-hazardous



Plan view of the Whitley Lock to Heck Bridge canal



Conceptual Model



Human Health and Controlled Waters Risk Assessment

Chemical analysis of sediments identified impacts by:

- Arsenic
- Nickel
- Naphthalene
- Benzo(a)pyrene
- Aromatic TPH (C₁₆-C₃₅)
- Aliphatic TPH (C₁₂-C₁₆)
- Dioxins

Further assessed using Detailed Quantitative Risk Assessment

Human Health and Controlled Waters Risk Assessment continued....

- Human Health - RISC Workbench software (Spence and BP Oil, 2003) - generate Site Specific Assessment Criteria (SSAC) for the contaminants of concern.
 - 0-6year old child – most susceptible but not the most frequent site user or likely to come in contact with the dredged sediments
 - Angler – potentially frequent user of the site and likely for a significant duration per visit and most likely to come in contact with dredged sediments.
 - Adult commuter – most frequent user but for a limited duration and less likely to come into contact with dredged sediments
- Controlled Waters - Environment Agency Remedial Targets Spreadsheet (P20) – fate and transport model

Cost Savings and Conclusions

- Sediments being classified as “hazardous”
- Challenged this assessment Regulator accepted non-hazardous classification
- Reducing the cost of disposal by 4-5 fold.
- Space in a hazardous waste landfill was being not used inappropriately by materials that do not need such disposal.
- Could transport the dredgings using the waterway network - saving 10,000 vehicle movements on a 24 mile journey on largely congested roads.
- Using the 100,000m³ dredged material avoided requirement for virgin materials saving £500,000
- Avoiding landfill disposal – saving £1,000,000