The Bates Partnership
Dredging, Harbour and Offshore Consultants

Belfast Harbour

Maintenance Dredging

Information to Inform a Best Practicable Environmental Option Assessment

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Project Nr
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1 Introduction

1.1 Proposed Maintenance Dredging at Belfast Harbour and Transport and Deposit of Dredged Material at Sea

1.1.1 Belfast Harbour Commissioners (BHC) are the statutory harbour authority responsible for operating and maintaining Belfast Harbour, a role that includes dredging of the harbour to maintain safe navigation and berthing, and the depositing of dredged material at sea.

1.1.2 A bathymetric survey undertaken in May 2025 showed that water depths in various channel areas and berths within Belfast Harbour are being reduced by sediment accretion. Accordingly, BHC are proposing to conduct a new series of maintenance dredging campaigns to remove the accreted sediment from the affected channels and berths and to restore the required water depths for safe navigation and berthing.

1.1.3 As for BHC's previous and ongoing maintenance dredging campaigns, most maintenance dredging will be undertaken using a trailer suction hopper dredger (TSHD) assisted by a plough dredger to move sediment to a location where it can be dredged by the TSHD, while some maintenance dredging will be undertaken using a plough dredger to move sediment over short distances to level an irregular bed or to move sediment from a location where it causes a restriction or obstruction.

1.1.4 As for BHC's previous and ongoing maintenance dredging campaigns, the dredged material removed by the TSHD will be transported to and deposited at the Belfast Dredgings C (Live) disposal site (IS591).

1.1.5 BHC have statutory powers to undertake maintenance dredging under the Belfast Harbour Acts and Orders 1847 to 2002. However, BHC will need a new marine licence from the Department of Agriculture, Environment and Rural Affairs (DAERA) for the deposit of dredged material at sea under the Marine & Coastal Access Act 2009 because their current marine licence (licence number: ML2023020) expires on 26 July 2026. As for BHC's previous and ongoing maintenance dredging campaigns, BHC anticipate that a new marine licence will last for a minimum of 3 years following expiration of the current marine licence (i.e., July 2026 to July 2029), and anticipate the amount of dredged material to be deposited at sea during that period to be approximately 676,000m^3 / 980,000 tonnes (based on a sediment density of 1.45t/m^3), with most of this amount being dredged and deposited in one campaign lasting 8 to 10 weeks.

1.2 Best Practicable Environmental Option Assessment

1.2.1 Regulation 17 of the Waste Regulations (Northern Ireland) 2011 (as amended) places a duty on any person who imports, produces, collects, carries, keeps, treats or disposes of waste, or as a broker or dealer has control of controlled waste, on the transfer of such waste to take all such measures available to that person as are reasonable in the circumstances to apply the waste hierarchy priority order in accordance with Article 4 of the Waste Framework Directive.

1.2.2 The waste hierarchy ranks waste management options according to what is best for the environment, giving top priority to preventing waste in the first place then, when waste is created, it gives priority to preparing it for re-use, then recycling, then recovery, and then disposal as a last resort (Defra, 2011). In relation to dredged material, the waste

hierarchy comprises:

- Prevention: avoiding / reducing the volume of dredged material.
- Preparing for re-use: finding alternative uses for dredged material.
- Recycling: converting dredged material into new products.
- Other recovery: recovering energy from dredged material.
- Disposal at sea: disposing of dredged material as a last resort.

1.2.3 The following chapter provides information to show that the waste hierarchy has been applied. It describes the proposed maintenance dredging and dredged material transport and deposition activities, the dredged material's physical and chemical characteristics, and the options considered for dredged material prevention, re-use, recycling, recovery and disposal.

2 BPEO Assessment Information

2.1 Name of Project or Plan

2.1.1 Belfast Harbour Maintenance Dredging 2026-2029.

2.2 Brief Description of the Project or Plan

2.2.1 Belfast Harbour is situated at the southwest end of Belfast Lough. It is the premier port serving Northern Ireland and is an essential component in the local economy. Maintenance dredging has been undertaken at Belfast Harbour for many years. It is required to facilitate the safe navigation and berthing of vessels in the berth pockets and channels within the confines of the harbour, and in the approach channel to the harbour. The dredged material has been deposited at a designated offshore disposal site located approximately 14 nautical miles from the harbour (location 54° 45.3' North and 5° 26.6' West) for many years.

2.2.2 The proposed maintenance dredging and associated transport and deposit of dredged material continues the previous maintenance dredging activity at Belfast Harbour: it is expected to involve the same or similar dredged material volumes, maintenance dredging areas, dredged material transport route, dredged material deposition location, and dredging, transport and deposition methodologies.

Dredged Material Volumes

2.2.3 Based on bathymetric survey results and previous maintenance dredging campaigns, the volume of dredged material to be removed by maintenance dredging and deposited at sea, between 2026 and 2029, is estimated to be approximately 676,000m^3, which equates to approximately 980,000 tonnes (based on a sediment density of 1.45t/m^3).

Maintenance Dredging Areas

2.2.4 The maintenance dredging areas extend over the channels and berths within Belfast Harbour (Figure A1 in **Appendix A**) and will be focussed on those areas where sediment has accumulated over the required design depths (Figures A2 to A5 in **Appendix A**).

Dredged Material Transport Route

2.2.5 The dredged material will be transported approximately 14 nautical miles from the

maintenance dredging areas within Belfast Harbour to the dredged material deposit location at the disposal site. Based on TSHD vessel tracks during the previous maintenance dredging campaign in 2023, the transport route will pass along the harbour's approach channel and Belfast Lough, and out into the North Channel to the Belfast Dredgings C (Live) disposal site (Figure A6 in **Appendix A**).

Dredged Material Deposit Location

2.2.6 As for the previous maintenance dredging campaigns, the dredged material will be deposited at the Belfast Dredgings C (Live) disposal site (Figure A6 in **Appendix A**). The disposal site is located within the Irish Sea, approximately 28km from Belfast Harbour, approximately 13.4km east of the coastline at Whitehead, approximately 6.3km north-north-east of the nearest of the Copeland Islands, and is defined by a location within a 0.25 nautical mile radius of the following coordinates 54º 45.300' N, 05º 29.600'W. The disposal site has been receiving dredged material since 1998.

Dredging, Transport and Deposition Methods

2.2.7 The dredging, transport and deposition methods described below have been used for many years and were being used prior to and at the time when many of the European sites in and around Belfast Lough were designated and established.

2.2.8 The majority of maintenance dredging activity and all the deposition activity will be undertaken using a Trailer Suction Hopper Dredger (TSHD). The TSHD's dredging activity will be supported by a plough dredger.

2.2.9 A TSHD is a self-propelled vessel that is equipped with hydraulic suction system comprising pumps, pipes and a drag-head, and an in-built hopper. It operates independently of other plant or equipment and can sail over long distances to transport and dispose of dredged material.

2.2.10 To commence the dredging process, the TSHD will sail under its own propulsion to the dredging area within Belfast Harbour. Once in position over the dredging area, the TSHD will lower its trailer arm (with the drag-head and suction pipes) to the bed and sail in a straight line at a very slow speed, typically less than 2 knots. The drag-head will collect a mixture of the bed sediment and surrounding water and pump it through the pipes and into the hopper. As it progresses over the dredging area, the drag-head will pass over produce a trench in the sediment: successive passes will result in the removal of all sediment above the design depth. Dredging will continue until the hopper's capacity is achieved. When the hopper is filled, the TSHD will raise the trailer arm and sail to the Belfast Dredgings C (Live) disposal site where it will deposit the dredged material by releasing it through hatches in its hull. The TSHD will then sail back to the dredging area within Belfast Harbour, lower the trailer arm, and recommence dredging.

2.2.11 A plough dredger – also known as a bed leveller – is not a dredger *per se* but is a bottomless, rectangular box-shaped fabricated steel implement that is towed behind a small workboat or tug using a deck-mounted hoist winch. It is used to move accumulated sediment over a short distance to an accessible location so that it can be removed by the TSHD, or to move sediment to level an irregular bed, and/or to move sediment where it causes a restriction or obstruction.

2.2.12 To commence the dredging process, the workboat will sail under its own propulsion to the dredging area within Belfast Harbour. Once in position over the dredging area, the plough will be lowered and suspended at the required bed level and then towed behind the workboat. The surface sediment will be sliced by the cutting blade at the plough's

leading edge and contained within the rest of the plough's structure until the plough reaches an area where the bed level is lower than the suspended plough level, whereupon the contained sediment will drop through the bottom of the plough. At this point, the plough will be raised above the bed, and the workboat will sail back to the dredging area, lower the plough and recommence dredging.

2.3 Dredged Material Characteristics

Sampling and Analytical Requirements

2.3.1 The dredged material has been characterised in accordance with a sample plan agreed with DAERA. Accordingly, sediment samples were collected from the seabed surface at 36 locations within Belfast Harbour (see Figures A2 to A5 in **Appendix A**) and analysed for the following physical and chemical parameters:

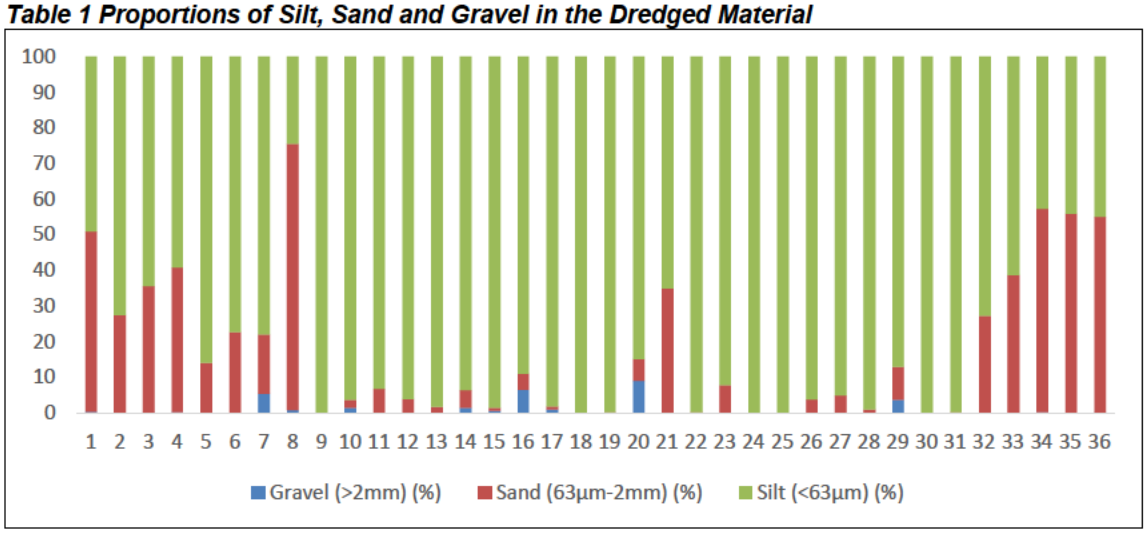
- Physical parameters including particle size distribution across gravel, sand and silt ranges, and total organic carbon (TOC).
- Chemical parameters including metals, organotins, polycyclic aromatic hydrocarbons (PAHs), total hydrocarbons (THC), and polychlorinated biphenyls (PCBs).

Physical Characteristics

2.3.2 The results of the physical analyses, of the recent (January 2026) sediment samples, are shown in Table B1 in **Appendix B**.

2.3.3 Physically, the sediment within Belfast Harbour's berths and channels is typically dominated by particles in the silt size fractions of <63µm (24.54% to 100%) with some particles in the sand size fractions of 63µm to 2mm (0% to 74.67%) and occasionally with particles in the gravel size fractions of >2mm (0% to 9.11%), and typically contains low to moderate amounts of organic carbon (0.53% to 22.2%). There is no clear geographical trend to the physical characteristics of the sediment's particle sizes or organic carbon, although the largest proportions of sand size fractions generally occur within the berths and channels at the downstream end of the River Lagan (sample locations 1 to 8 in Figures A2 to A5 in **Appendix A**) and within the Approach Channel (sample locations 32 to 36 in Figures A2 to A5 in **Appendix A**).

Table 1 Proportions of Silt, Sand and Gravel in the Dredged Material



Chemical Characteristics

2.3.4 The results of the chemical analyses, of the recent (January 2026) sediment samples, are shown in Tables B5 to B8 in **Appendix B**.

2.3.5 Chemically, the sediment within Belfast Harbour's berths and channels can be characterised by comparing the analytical data against two sediment quality standards: the UK Action Levels (Mason et al., 2021) and the US Effects Ranges (Long et al., 1995, MacDonald et al., 1996 and Gorham-Test, 1998). The sediment quality standards are shown in Table B3 in **Appendix B**.

2.3.6 The UK action levels are used to inform marine licence applications for dredging and/or disposal at sea activities. They do not represent pass / fail criteria; rather, they are used to determine the contaminant loading of sediment (as dredged material) and its suitability for disposal at sea. Generally, sediment with chemical parameters at concentrations below action level 1 (AL1) is considered suitable for disposal at sea, and sediment with chemical parameters at concentrations above action level 2 (AL2) is considered not suitable for disposal at sea, and sediment with chemical parameters at concentrations between AL1 and AL2 is considered in more detail through a 'weight of evidence' approach.

2.3.7 UK action levels are partially available (AL1 but no AL2) for some PAHs and PCBs. Accordingly, other sediment quality standards can be used to inform marine licence applications - albeit on an advisory basis because the other standards have no legal or policy standing in the UK - by contextualising the contaminant loading of sediment and its suitability for disposal at sea. The US effects ranges are used to contextualise concentrations of PAHs for marine licence applications due to the absence of a AL2. The effect ranges were devised in the US to assess whether sediment has the potential for adverse biological effects. The effects range low (ERL) equates to a contaminant concentration below which adverse biological effects rarely occur, while the effects range median (ERM) equates to a contaminant concentration above which adverse biological effects frequently occur. While the US effects ranges are not formally recognised in the UK, they provide useful criteria for PAHs in the absence of a AL2.

2.3.8 Chemically, the sediment within Belfast Harbour's berths and channels is typically characterised by contaminants present at concentrations that are either below AL1 and the ERL, or slightly above AL1 and the ERL, but with no concentrations approaching or above AL2 or the ERM. On this basis, the dredged material is likely to be considered suitable for re-use and/or disposal within the marine environment because it is unlikely to have a significant contamination effect on the receiving environment.

2.4 Consideration of Prevention Options

2.4.1 BHC have a statutory duty to maintain safe navigation and berthing within Belfast Harbour (Figure A1 in **Appendix A**). Accordingly, BHC routinely undertake maintenance dredging campaigns to remove sediment that has accumulated within the harbour's berths and channels (with major campaigns typically undertaken on a 3-yearly basis) to maintain the harbour's advertised water depths.

2.4.2 As noted above, a bathymetric survey has showed that water depths in various berths and channels are affected by sediment accumulation (Figures A2 to A5 in **Appendix A**). The magnitude of sediment accumulation is similar to that recorded by previous bathymetric surveys and, therefore, is expected to require the removal of approximately 676,000m^3 / 980,000 tonnes of sediment. Sediment accumulation occurs because there are very limited sediment scouring and flushing conditions within the harbour: The

relatively low flow of the River Lagan, into the harbour, limits sediment scouring and flushing in the Victoria Channel, and there is no flow for sediment scouring and flushing in the Musgrove Channel and Herdman Channel.

2.4.3 BHC continuously reviews the opportunities to prevent the generation of waste; notably, the use of water injection dredging (WID) to sustainably relocate accumulated sediment beyond the harbour, thereby retaining it within the local sediment budget. To date, however, WID has not been used because the low current velocities (driven by river and tidal flows), and limited bed gradients, mean the sediment fluidised by the WID process will simply fill the seabed depressions within the harbour's berths and channels rather than flow beyond the harbour and into Belfast Lough.

2.4.4 Given the above, there is no practicable opportunity to achieve prevention (or reduction) in the amount of dredged material arising from maintenance dredging.

2.5 Consideration of Re-use Options

Beach Nourishment / Recharge

2.5.1 Beach nourishment and/or recharge involves restoring and maintaining eroded beaches by replacing lost material with similar material from other sources. Dredged material can be suitable for beach nourishment / recharge, particularly if it comprises sand and/or gravel. Generally, beach nourishment / recharge material should match the characteristics of existing beach material in terms of engineering performance (e.g., beach stability, sediment dynamics, durability) and public acceptability (e.g., recreation, amenity and aesthetics) (Rogers *et al.*, 2010; Harrington and Smith, 2013). There are several examples where dredged material is used for beach nourishment / recharge around the UK coast, particularly at locations where eroded beach material has accumulated in harbour areas and is dredged and returned to the beach from where it originated; notably dredged material from maintenance dredging at Poole Harbour is used to nourish beaches fronting Christchurch, Bournemouth and Poole (Rogers *et al.*, 2010).

2.5.2 The amount of, and physical properties on the dredge material arising from maintenance dredging in Belfast Harbour (as described in Section 2.2 above) is unlikely to be considered suitable for beech recharge due to its silt content and is likely to exceed the amount of dredged material required for beach nourishment / recharge in Belfast Lough, so other re-use, recycling, recovery and/or disposal options are likely to be necessary. The dredging plant for maintenance dredging in Belfast Harbour (as described in Section 2.2 above) is likely to be suitable for facilitating beach nourishment / recharge in Belfast Lough assuming all work can be undertaken at sea, thereby avoiding potentially adverse environmental and financial impacts associated with double / triple handling the dredged material and using land-based plant.

2.5.3 BHC have not been able to identify any beaches within the vicinity of the harbour that require nourishing or recharging. Although there are several beaches within Belfast Lough situated along the north shore (e.g., at Whiteabbey) and the south shore (e.g., at Helen's Bay, Crawfordsburn and Bangor), these beaches predominantly comprise sand material which means the dredged material is unsuitable for beach nourishment / recharge because it predominantly comprises silt material.

2.5.4 Given the above, there is no practicable opportunity to re-use the dredged material arising from maintenance dredging for beach nourishment / recharge.

Coast Protection (other than Beach Nourishment / Recharge)

2.5.5 Coast protection involves reducing coastal erosion risk through the provision of man-made structures such as sea walls, rock armour, groynes and breakwaters, which are typically constructed from rock and/or concrete. Some coast protection structures comprising geotextile containers can be filled with dredged material (e.g., geotubes), and it is these structures that appear to be the primary option for re-use of dredged material in coast protection (Harrington and Smith, 2013).

2.5.6 The amount of dredged material arising from maintenance dredging in Belfast Harbour (as described in Section 2.2 above) is likely to exceed the amount of dredged material required for coast protection using geotubes in Belfast Lough, so other re-use, recycling, recovery and/or disposal options are likely to be necessary. The dredging plant for maintenance dredging in Belfast Harbour (as described in Section 2.2 above) is likely to be suitable for facilitating coast protection using geotubes in Belfast Lough, if assuming all work can be undertaken at sea, thereby avoiding potentially adverse environmental and financial impacts associated with double / triple handling the dredged material and using land-based plant.

2.5.7 BHC have not been able to identify any existing coast protection measures within the vicinity of Belfast Lough that require extending or maintaining, or new coastal protection measures that require installing. Although there are coast protection measures within Belfast Lough, particularly along much of the north shore, these measures predominantly comprise concrete and/or rock armour materials which means the dredged material is unsuitable for extending or maintaining these measures because it predominantly comprises silt material.

2.5.8 Given the above, there is no practicable opportunity to re-use the dredged material arising from maintenance dredging for coast protection.

Habitat Restoration / Creation

2.5.9 Habitat restoration / creation involves restoring, creating, enhancing and maintaining intertidal and subtidal habitats, such as saltmarshes, mudflats and sandflats to reverse the adverse effects of development and sea-level rise. Generally, habitat restoration / creation material should match the characteristics of existing habitat material in terms of ecological performance (e.g., particle sizes and contaminants) (Manning *et al.*, 2021). The principal opportunities for dredged material involve nourishing / recharging sites to raise the elevation of sinking or eroding areas. There are several examples where dredged material is used for habitat restoration / creation around the UK coast, particularly at locations where large-scale capital dredging has affected an estuary's tidal prism to the extent that it has reduced the physical area of intertidal habitat within the tidal prism (e.g., in the estuaries of the Rivers Stour and Orwell, near the ports of Harwich and Felixstowe).

2.5.10 The amount of dredged material arising from maintenance dredging in Belfast Harbour (as described in Section 2.2 above) is likely to exceed the amount of dredged material required for habitat restoration / creation in Belfast Lough, so other re-use, recycling, recovery and/or disposal options are likely to be necessary. The dredging plant for maintenance dredging in Belfast Harbour (as described in Section 2.2 above) is likely to be suitable for facilitating habitat restoration / creation in Belfast Lough, if assuming all work can be undertaken at sea, thereby avoiding potentially adverse environmental and financial impacts associated with double / triple handling the dredged material and using land-based plant.

2.5.11 BHC have not been able to identify any habitat restoration / creation opportunities within the vicinity of the harbour. Belfast Lough's intertidal and subtidal areas provide

supporting habitat to various bird species that are qualifying features for the Belfast Lough Special Protection Area (SPA), Belfast Lough Open Water SPA, East Coast (Northern Ireland) Marine SPA and Outer Ards SPA. BHC understand that these areas are in favourable condition regarding the support they provide to the qualifying features of the SPAs and are not in need of restoration.

2.5.12 Given the above, there is no practicable opportunity to re-use the dredged material arising from maintenance dredging for habitat restoration / creation.

Land Reclamation

2.5.13 Land reclamation involves creating new land by creating bunds or embankments and filling the submerged area behind them to raise the land elevation. Sand material is most often used as the fill material because of its good drainage and load bearing capacity. Silt material can be used in combination with other fill material, but typically requires extensive, expensive geotechnical treatment to sufficiently improve its engineering properties to improve drainage and reduce settlement risks. Due to its properties, silt material may be suitable for reclaiming land where the load bearing requirement of the land use is low, such as recreational areas (Harrington and Smith, 2013).

2.5.14 The amount of dredged material arising from maintenance dredging in Belfast Harbour (as described in Section 2.2 above) is likely to exceed the amount of dredged material required for land reclamation in Belfast Lough, so other re-use, recycling, recovery and/or disposal options are likely to be necessary. The dredging plant for maintenance dredging in Belfast Harbour (as described in Section 2.2 above) is likely to be suitable for facilitating land reclamation in Belfast Lough, if assuming all work can be undertaken at sea, thereby avoiding potentially adverse environmental and financial impacts associated with double / triple handling the dredged material and using land-based plant.

2.5.15 BHC have not been able to identify any land reclamation opportunities within the vicinity of the harbour, including any land reclamation opportunities within BHC's port estate. In addition, the dredged material is generally unsuitable for use as a fill material, particularly within the port estate, because it predominantly comprises silt material which potentially limits its load bearing capacity.

2.5.16 Given the above, there is no practicable opportunity to re-use the dredged material arising from maintenance dredging for land reclamation.

2.6 Consideration of Recycling Options

Construction Products

2.6.1 Dredged material can replace primary raw materials in the manufacturing of construction products. Sand and gravel materials arising can be used to make concrete, and silt material can be used to make mudcrete and bricks (CEDA-IADC, date unknown). However, the dredged material should have the geochemical characteristics necessary for construction product manufacturing (e.g., particle sizes, silica content, moisture content, chloride content, sulphate content, organic matter content, metal content) and engineering performance (e.g., shear strength, compressive strength). Accordingly, construction product manufacturing using dredged material, particularly silt material, can be subject to extensive physical and chemical characterisation (Harrington and Smith, 2013), and can require the addition of treatment processes (e.g., dewatering to reduce moisture content, washing to reduce the salinity) and/or the addition of other materials

(e.g., binding agents such as cement to stabilise the dredged material).

2.6.2 The amount of dredged material arising from maintenance dredging in Belfast Harbour (as described in Section 2.2 above) is likely to exceed the amount of dredged material required for construction products, so other re-use, recycling, recovery and/or disposal options are likely to be necessary. The dredging plant for maintenance dredging in Belfast Harbour (as described in Section 2.2 above) is unlikely to be suitable for facilitating manufacturing of construction products, if assuming the dredged material has to be brought ashore for treatment and transport, thereby incurring potentially adverse environmental and financial impacts associated with double / triple handling the dredged material and using land-based plant.

2.6.3 BHC have not been able to identify any construction product opportunities within the vicinity of the harbour, including any construction product opportunities within BHC's port estate. In addition, the dredged material is predominantly silt material and is unlikely to be suitable for recycling within construction product manufacturing.

2.6.4 Given the above, there is no practicable opportunity to recycle the dredged material arising from maintenance dredging in the manufacturing of construction products.

2.7 Consideration of Recovery Options

2.7.1 There are no readily viable recovery options for dredged material. While one option involves energy recovery through thermal processes like pyrolysis, the low calorific value of dredged material and the need for treatment processes, such as dewatering of dredged material (to facilitate handling and thermal processes), means that energy recovery is generally not viable because it is expensive and energy intensive and inefficient.

2.7.2 The amount of dredged material arising from maintenance dredging in Belfast Harbour (as described in Section 2.2 above) is likely to exceed the amount of dredged material required for energy recovery, so other re-use, recycling, recovery and/or disposal options are likely to be necessary. The dredging plant for maintenance dredging in Belfast Harbour (as described in Section 2.2 above) is unlikely to be suitable for facilitating energy recovery, if assuming the dredged material has to be brought ashore for treatment and transport, thereby incurring potentially adverse environmental and financial impacts associated with double / triple handling the dredged material and using land-based plant.

2.7.3 BHC have not been able to identify any recovery opportunities within the vicinity of the harbour, including any energy recovery opportunities at energy from waste (EfW) facilities within BHC's port estate which use domestic and commercial refuse as feedstock. In addition, the dredged material is unlikely to be suitable for use in energy recovery elsewhere.

2.7.4 Given the above, there is no practicable opportunity to use the dredged material arising from maintenance dredging for recovery.

2.8 Consideration of Disposal Options

Disposal at Sea

2.8.1 For many years, disposal at sea has been the principal option for dredged material

arising from maintenance dredging of Belfast Harbour.

2.8.2 The physical and chemical characteristics of the dredged material arising from maintenance dredging (as described in Section 2.3 above) appear to be suitable for disposal at sea. The physical characteristics indicate that the particle sizes are predominantly silt and are suitable for deposition at a dispersive disposal site such as the Belfast Dredgings C (Live) disposal site. The chemical characteristics indicate that contaminants are not present in sufficiently elevated concentrations that would preclude disposal at the Belfast Dredgings C (Live) disposal site or, alternatively, would require disposal at a confined disposal site (e.g., as for TBT-contaminated dredged material arising from capital dredging for the D3 terminal development).

2.8.3 The amount of dredged material arising from maintenance dredging in Belfast Harbour (as described in Section 2.2 above) can be accommodated at the Belfast Dredgings C (Live) disposal site, so other re-use, recycling, recovery and/or disposal options are unlikely to be necessary. The dredging plant for maintenance dredging in Belfast Harbour (as described in Section 2.2 above) is suitable for facilitating disposal at sea, thereby avoiding potentially adverse environmental and financial impacts associated with double / triple handling the dredged material and using land-based plant.

2.8.4 BHC are aware that disposal at sea is the primary opportunity available for the dredged material arising from maintenance dredging and have been using this option for many years.

2.8.5 Given the above, disposal at sea is a viable option for the dredged material arising from maintenance dredging.

Disposal to Landfill

2.8.6 There are several landfill sites in Northern Ireland. It is not known whether any sites in Northern Ireland are licensed to receive dredged material. The physical and chemical characteristics of the dredged material arising from maintenance dredging (as described in Section 2.3 above) are not sufficient to classify the dredged material as a hazardous or non-hazardous or inert waste, or to assign it a code corresponding to one of the following European Waste Catalogue (EWC) waste codes:

- 17 05 05 (Hazardous): Dredging spoil containing hazardous substances.
- 17 05 06 (Non-Hazardous): Dredging spoil other than those mentioned in 17 05 05.

2.8.7 Typically, landfill sites cannot receive wet (liquid) waste and/or saline waste, so the dredged material may have to undergo one or more treatment processes (e.g., dewatering, desalination, stabilisation) to make it suitable for transport and disposal at landfill.

2.8.8 The amount of dredged material arising from maintenance dredging in Belfast Harbour (as described in Section 2.2 above) is likely to exceed the amount of dredged material that can be received at Northern Ireland's landfill sites, so other re-use, recycling, recovery and/or disposal options are likely to be necessary. The dredging plant for maintenance dredging in Belfast Harbour (as described in Section 2.2 above) is unlikely to be suitable for facilitating disposal at landfill sites, if assuming the dredged material has to be brought ashore for treatment and transport, thereby incurring potentially adverse environmental and financial impacts associated with double / triple handling the

dredged material and using land-based plant.

2.8.9 BHC have not been able to identify any landfill sites suitable for the disposal of dredged material within the vicinity of the harbour.

2.8.10 Given the above, there is no practicable opportunity to dispose of the dredged material arising from maintenance dredging at landfill sites.

2.9 Conclusion

2.9.1 Given the above findings, disposal at sea is best practicable environmental option for the dredged material arising from maintenance dredging.

3 References

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APPENDIX A
FIGURES

Figure A1 Belfast Harbour Maintenance Dredging Area - Harbour and Approach Channel

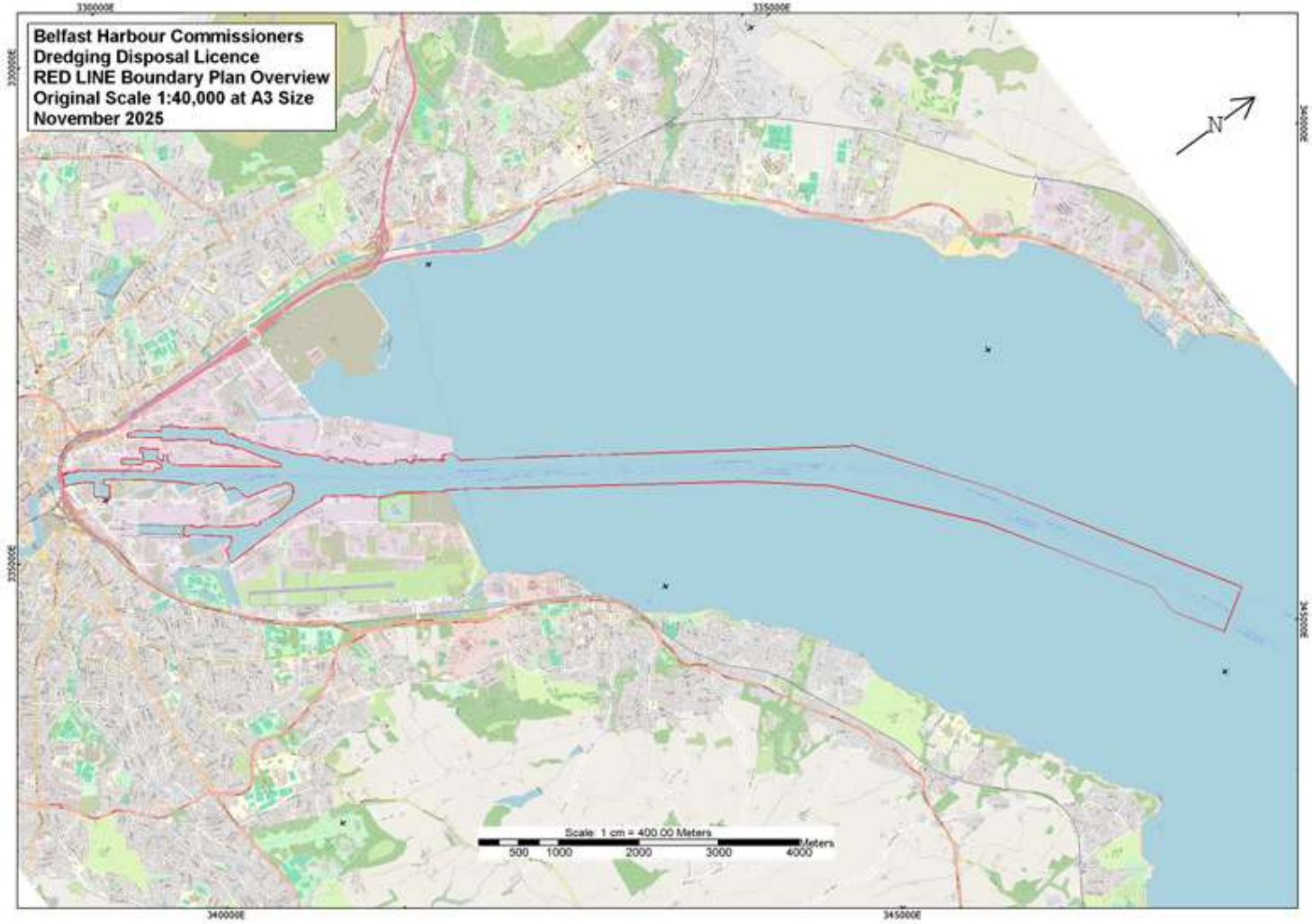

Figure A2 Belfast Harbour Sediment Accumulation – Harbour

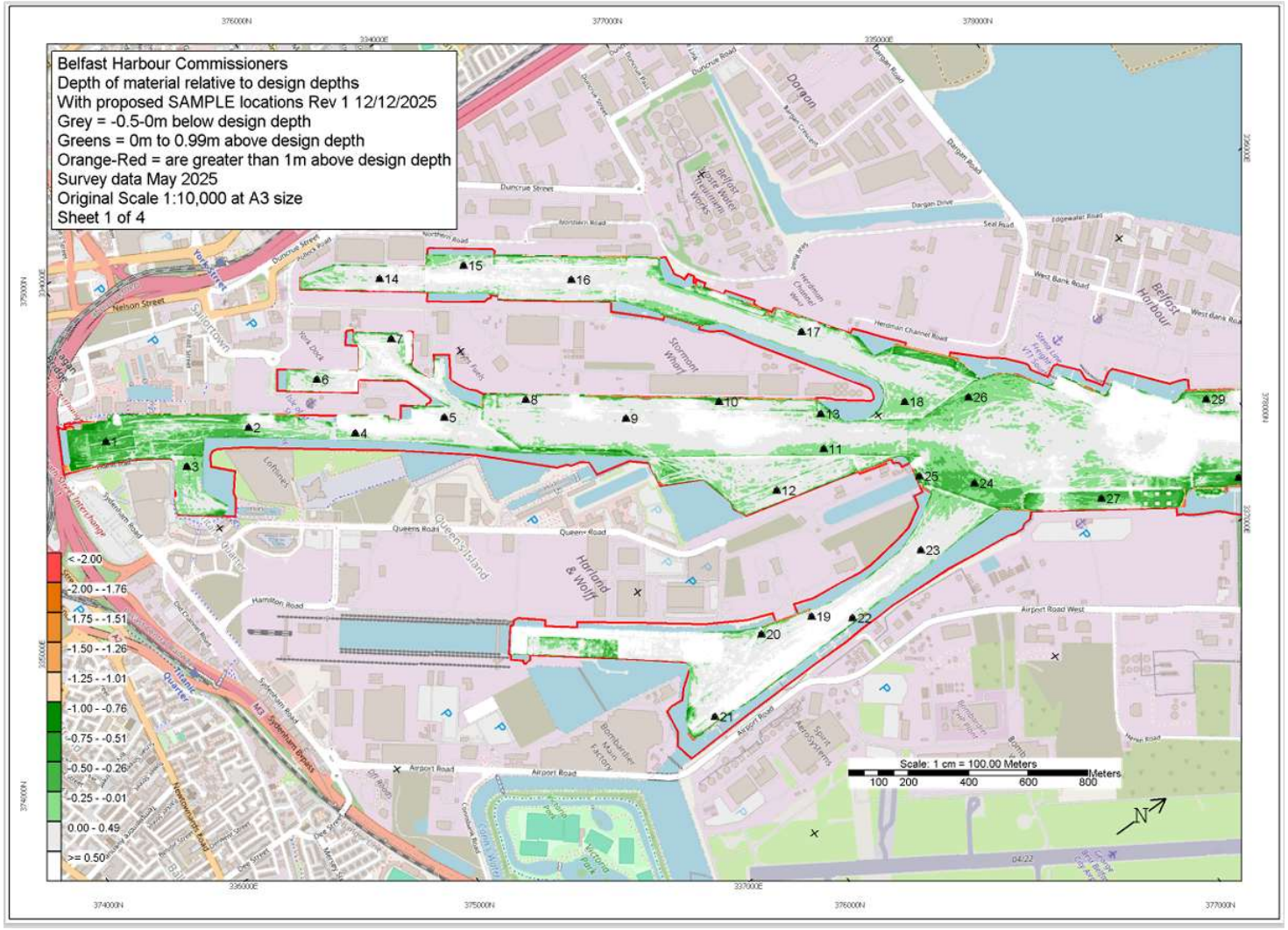

Figure A3 Belfast Harbour Sediment Accumulation – Inner Approach Channel

Figure A4 Belfast Harbour Sediment Accumulation – Middle Approach Channel

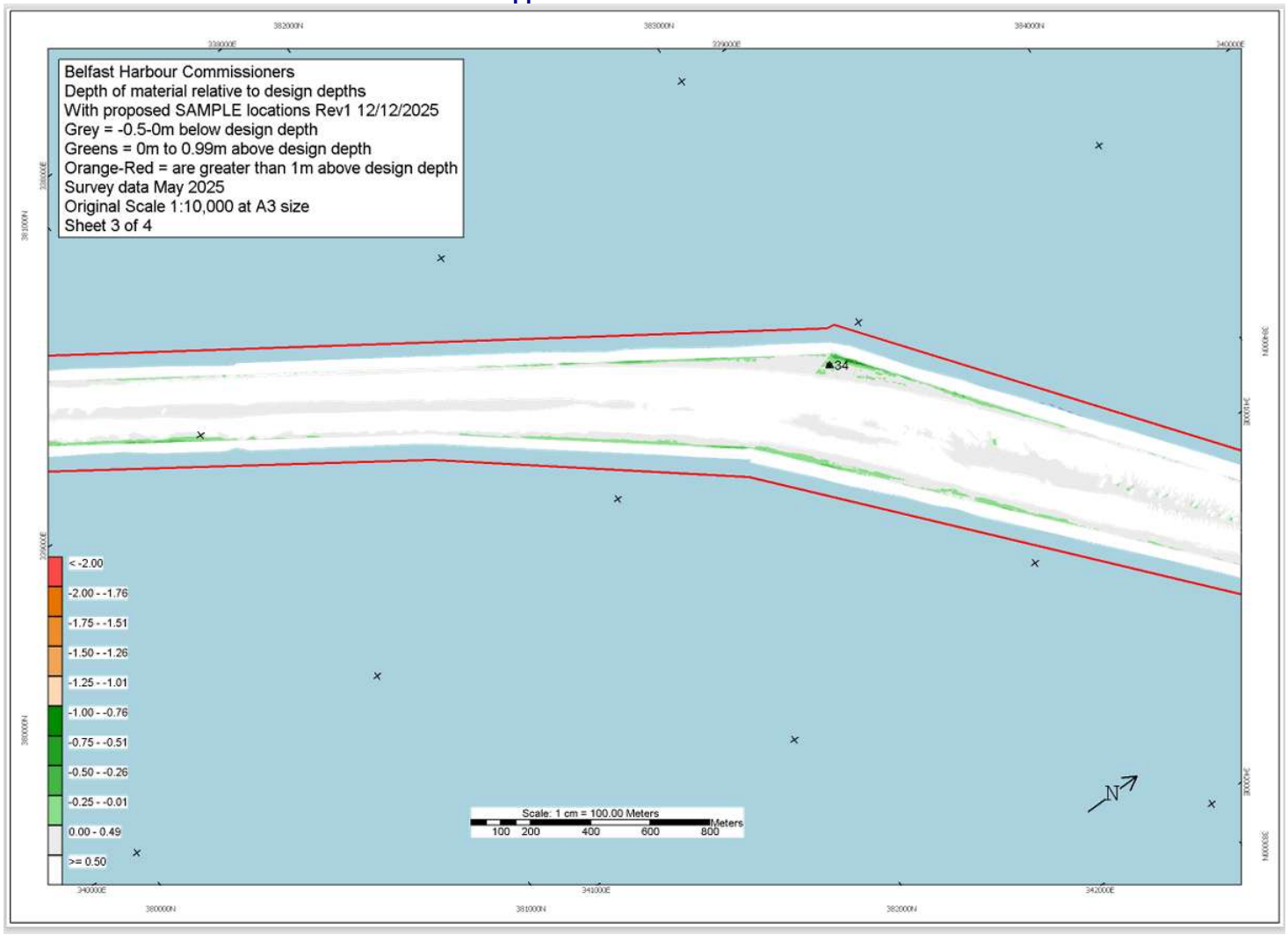

Figure A5 Belfast Harbour Sediment Accumulation – Outer Approach Channel

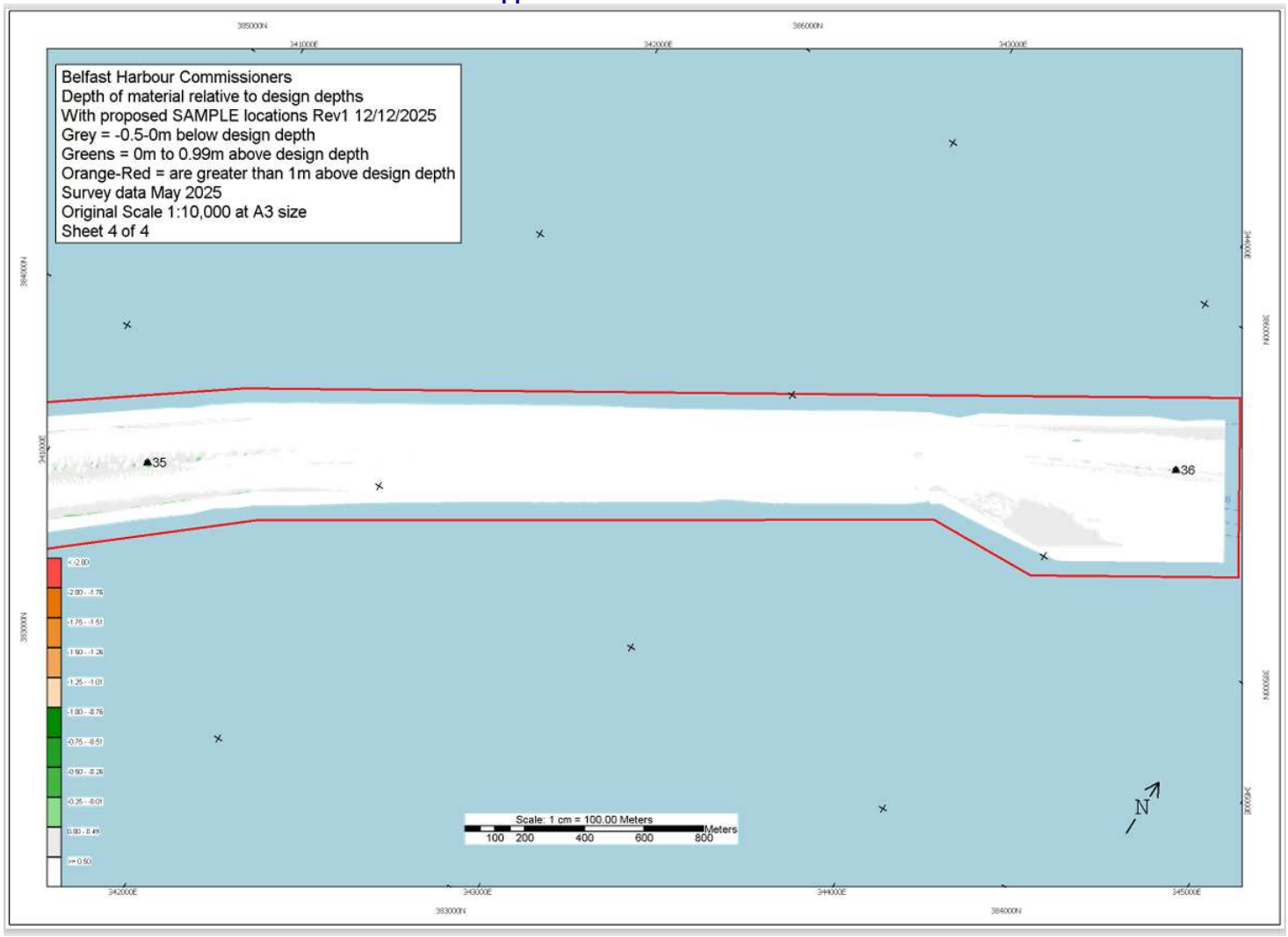

Figure A6 Belfast Dredgings C (Live) Disposal Site with TSHD tracks in 2023, transport to and return from licenced disposal site.

APPENDIX B
SEDIMENT CHARACTERISATION DATA AND COMPARISON TO SEDIMENT QUALITY STANDARDS

Table B1 Sediment Sample Composition

Sample ID	Moisture Content (%)	Total Solids (%)	Gravel (>2mm) (%)	Sand (63µm-2mm) (%)	Silt (<63µm) (%)	Total Organic Carbon (%)
1	75.7	24.3	0.43	50.51	49.05	6.93
2	76.5	23.5	0.00	27.50	72.50	5.87
3	76.0	24.0	0.23	35.36	64.40	5.71
4	59.6	40.4	0.29	40.61	59.10	2.77
5	72.3	27.7	0.00	14.16	85.84	4.87
6	70.5	29.5	0.00	22.73	77.27	4.03
7	73.2	26.8	5.47	16.55	77.98	4.28
8	83.4	16.6	0.78	74.67	24.54	>22.2
9	61.7	38.3	0.00	0.00	100.00	4.72
10	65.9	34.1	1.51	2.14	96.35	5.63
11	68.2	31.8	0.00	6.92	93.08	1.85
12	67.9	32.1	0.07	3.80	96.14	2.08
13	66.3	33.7	0.00	1.71	98.29	2.25
14	66.6	33.4	1.46	4.95	93.59	3.56
15	62.3	37.7	0.69	0.83	98.49	3.51
16	55.4	44.6	6.44	4.51	89.05	4.09
17	63.3	36.7	0.96	0.87	98.16	2.20
18	64.3	35.7	0.00	0.00	100.00	2.00
19	60.2	39.8	0.00	0.28	99.72	3.63
20	61.6	38.4	9.11	5.93	84.97	9.26
21	68.7	31.3	0.16	34.74	65.10	6.21
22	62.7	37.3	0.00	0.32	99.68	2.68
23	59.9	40.1	0.00	7.85	92.15	2.02
24	68.1	31.9	0.00	0.10	99.90	2.20
25	66.4	33.6	0.00	0.10	99.90	2.27
26	66.8	33.2	0.00	3.76	96.24	2.50
27	66.5	33.5	0.00	4.96	95.04	2.33
28	67.1	32.9	0.00	0.97	99.03	2.31
29	56.2	43.8	3.65	9.30	87.05	1.56
30	61.0	39.0	0.00	0.00	100.00	2.01

Sample ID	Moisture Content (%)	Total Solids (%)	Gravel (>2mm) (%)	Sand (63µm-2mm) (%)	Silt (<63µm) (%)	Total Organic Carbon (%)
31	64.9	35.1	0.00	0.28	99.72	2.26
32	55.8	44.2	0.26	27.02	72.72	1.27
33	50.5	49.5	0.00	38.71	61.29	1.23
34	51.4	48.6	0.33	56.92	42.75	0.53
35	39.6	60.4	0.09	55.77	44.15	0.62
36	51.1	48.9	0.24	54.83	44.93	0.77

Table B2 Analyte Abbreviations

Abbreviations have been used in the headings of the following tables, as defined in the table below.

Analyte Groups	Abbreviations
Organotins	TBT (tributyltin) DBT (dibutyltin) MBT (monobutyltin)
PAHs	PAHs (polycyclic aromatic hydrocarbons) BAA (benzo[a]anthracene) BAP (benzo[a]pyrene) BBF (benzo[b]fluoranthene) BENZGHIP (benzo[ghi]perylene) BKF (benzo[k]fluoranthene) DBENZAH (dibenzo[ah]anthracene) INDPYR (indeno[1,2,3-cd]pyrene)
THC	THC (total hydrocarbons content)
PCBs	PCBs (polychlorinated biphenyls) ∑ICES7 (sum of the International Council for the Exploration of the Sea (ICES) 7 PCB congeners 28, 52, 101, 118, 138, 153 and 180) ∑25 PCBs (sum of all 25 PCB congeners)

Table B3 Sediment Quality Standards

Sediment quality has been determined by comparing the data identifying the contaminant concentrations within the sediment samples to sediment quality standards.

Contaminant	Units	UK Action Levels*		US Effects Ranges**	
		Action Level 1 (AL1)	Action Level 2 (AL2)	Effect Range Low (ERL)	Effect Range Median (ERM)
Metals: arsenic	$mg.kg^{-1}$ dry weight	20	100		
Metals: cadmium	$mg.kg^{-1}$ dry weight	0.4	5		
Metals: chromium	$mg.kg^{-1}$ dry weight	40	400		
Metals: copper	$mg.kg^{-1}$ dry weight	40	400		
Metals: mercury	$mg.kg^{-1}$ dry weight	0.3	3		
Metals: nickel	$mg.kg^{-1}$ dry weight	20	200		
Metals: lead	$mg.kg^{-1}$ dry weight	50	500		
Metals: zinc	$mg.kg^{-1}$ dry weight	130	800		
Organo-tins: TBT	$mg.kg^{-1}$ dry weight	0.1	1		
Organo-tins: DBT	$mg.kg^{-1}$ dry weight	0.1	1		
PCBs: sum of ICES 7 congeners	$mg.kg^{-1}$ dry weight	10			
PCBs: sum of 25 congeners	$mg.kg^{-1}$ dry weight	0.02	0.2		
PAHs: individual	$mg.kg^{-1}$ dry weight	0.1			
PAHs: acenaphthene	$mg.kg^{-1}$ dry weight			0.044	0.64
PAHs: acenaphthylene	$mg.kg^{-1}$ dry weight			0.016	0.5
PAHs: anthracene	$mg.kg^{-1}$ dry weight			0.085	1.1
PAHs: benz[a]anthracene	$mg.kg^{-1}$ dry weight			0.261	1.6
PAHs: chrysene	$mg.kg^{-1}$ dry weight			0.384	2.8
PAHs: dibenz[a,h]anthracene	$mg.kg^{-1}$ dry weight			0.063	0.26
PAHs: fluoranthene	$mg.kg^{-1}$ dry weight			0.6	5.1
PAHs: fluorene	$mg.kg^{-1}$ dry weight			0.019	0.54
PAHs: naphthalene	$mg.kg^{-1}$ dry weight			0.16	2.1
PAHs: phenanthrene	$mg.kg^{-1}$ dry weight			0.24	1.5
PAHs: pyrene	$mg.kg^{-1}$ dry weight			0.665	2.6

Table B4 Key to Sediment Contaminant Data Comparison

Indicator	Data Comparison to Cefas Action Levels and US Effects Ranges
	Data is below UK Action Level 1 / US Effects Range Low
	Data is above UK Action level 1 and below UK Action Level 2 / above US Effects Range Low and below US Effects Range Median
	Data is above UK Action Level 2 / above US Effects Range Median
	Not applicable as there is no UK Action Level / US Effects Range

Table B5 Metals (mg/kg dry weight) and Organo-tins (mg/kg dry weight) compared to UK Action Levels

Sample ID	Metals									Organotins		
	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Aluminium	TBT	DBT	MBT
1	8.4	0.51	135	69.8	55.3	0.26	60.9	269	62200	<0.005	<0.005	0.045
2	12.5	0.60	125	71.1	52.4	0.23	59.1	259	80400	<0.005	<0.005	0.032
3	10.6	0.58	116	67.2	48.3	0.17	54.6	246	80700	<0.005	<0.005	0.032
4	9.4	0.37	94.5	40.7	33.7	0.12	43.7	140	63500	<0.005	0.013	0.016
5	12.1	0.40	97.6	48.0	41.4	0.14	45.9	168	79200	<0.005	<0.005	0.023
6	14.2	0.81	101	73.2	80.6	0.32	44.5	239	71600	<0.005	0.045	0.020
7	11.9	0.56	104	58.0	47.4	0.19	50.9	196	74500	<0.005	0.031	<0.005
8	3.9	0.12	19.8	14.8	10.1	0.22	12.5	80.3	14900	<0.005	<0.005	<0.005
9	14.1	0.40	113	49.2	49.5	0.20	51.4	299	70700	<0.005	<0.005	0.027
10	10.2	0.45	110	55.2	39.4	0.15	47.4	194	60400	0.022	0.079	0.015
11	11.1	0.28	98.2	31.3	29.9	0.10	41.2	125	63100	<0.005	<0.005	0.044
12	23.7	0.66	200	71.4	62.2	0.23	79.9	268	66400	<0.005	<0.005	0.037
13	13.0	0.30	95.3	34.4	35.9	0.11	44.5	142	68500	<0.005	<0.005	0.033
14	13.5	1.14	121	66.4	58.9	0.18	48.1	279	72500	0.033	0.095	0.763
15	11.6	0.88	99.2	54.2	51.6	0.19	47.7	273	61600	0.022	0.058	0.027
16	11.1	0.58	108	47.7	38.9	0.17	51.9	178	62300	0.014	0.031	0.024
17	13.1	0.57	116	42.4	43.6	0.24	47.5	172	68900	<0.005	0.017	0.060
18	14.4	0.33	116	36.6	40.5	0.13	50.0	158	66800	<0.005	<0.005	0.054
19	14.8	0.78	133	65.4	77.0	0.28	53.4	319	61400	0.048	0.034	0.088
20	14.6	0.65	106	78.0	77.5	0.23	51.6	286	76600	0.045	0.056	0.102
21	12.9	0.88	131	81.1	83.7	0.36	58.8	352	75800	0.148	0.032	0.119
22	14.4	0.46	110	51.6	56.5	0.24	48.0	219	73200	0.032	0.023	0.087
23	14.2	0.34	114	38.0	44.1	0.15	47.6	157	90400	0.006	0.013	0.014
24	14.6	0.25	102	29.7	43.8	0.12	44.0	147	79500	<0.005	<0.005	0.021
25	15.2	0.26	108	33.5	44.3	0.14	47.7	158	81400	<0.005	<0.005	0.023
26	14.0	0.24	102	30.0	39.5	0.15	44.2	145	74700	<0.005	<0.005	0.020
27	16.1	0.26	116	33.6	45.7	0.15	50.8	163	90900	<0.005	<0.005	0.017
28	13.4	0.22	92.3	27.8	37.7	0.11	41.6	139	93800	<0.005	<0.005	0.020
29	11.7	0.22	110	26.5	29.6	0.08	45.4	116	71600	<0.005	<0.005	0.021
30	13.1	0.22	97.8	27.4	37.0	0.10	42.0	137	73100	<0.005	<0.005	0.020

Sample ID	Metals									Organotins		
	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Aluminium	TBT	DBT	MBT
31	15.4	0.25	106	31.0	43.7	0.12	47.3	156	94500	<0.005	<0.005	0.018
32	10.5	0.21	98.0	22.0	29.0	0.09	36.9	104	70500	<0.005	<0.005	0.017
33	11.1	0.23	101	21.6	30.5	0.08	36.6	106	82300	<0.005	<0.005	0.017
34	7.6	0.11	97.5	11.0	18.0	0.03	25.9	57.6	48600	<0.001	<0.001	<0.001
35	8.5	0.09	90.3	11.0	17.3	0.02	24.7	55.2	46700	<0.001	<0.001	<0.001
36	7.8	0.10	89.3	11.7	21.8	0.03	27.7	66.1	49500	<0.001	<0.001	<0.001
AL1	20	0.4	40	40	50	0.3	20	130	-	0.1	0.1	-
AL2	100	5	400	400	500	3	200	800	-	1	1	-

Table B6 Polyaromatic Hydrocarbons (PAHs) and Total Hydrocarbon Content (THC) (mg/kg dry weight) compared to UK Action Levels

Sample ID	PAHs							
	Acenaphthene	Acenaphthylene	Anthracene	BAA	BAP	BBF	BGHIP	BKF
1	0.024	0.101	0.116	0.306	0.409	0.320	0.304	0.335
2	0.036	0.043	0.101	0.274	0.359	0.339	0.307	0.278
3	0.030	0.062	0.093	0.283	0.362	0.352	0.309	0.308
4	0.028	0.050	0.081	0.162	0.208	0.166	0.181	0.162
5	0.033	0.041	0.088	0.190	0.259	0.198	0.251	0.196
6	0.063	0.077	0.156	0.402	0.518	0.475	0.399	0.385
7	0.056	0.037	0.098	0.220	0.287	0.256	0.298	0.189
8	0.277	0.204	0.381	1.030	1.310	0.955	1.000	0.930
9	0.035	0.025	0.075	0.179	0.190	0.183	0.215	0.152
10	0.029	0.019	0.067	0.158	0.239	0.172	0.256	0.133
11	<0.005	<0.005	0.020	0.068	0.047	0.130	0.113	0.099
12	0.023	<0.005	0.028	0.073	0.100	0.103	0.096	0.094
13	<0.005	<0.005	0.026	0.076	0.113	0.128	0.123	0.120
14	0.035	0.023	0.083	0.122	0.101	0.092	0.100	0.046
15	0.050	0.048	0.120	0.303	0.422	0.337	0.391	0.234
16	0.043	0.032	0.102	0.288	0.402	0.259	0.389	0.169
17	0.021	0.021	0.043	0.183	0.260	0.250	0.244	0.156
18	<0.005	<0.005	0.025	0.077	0.106	0.109	0.114	0.079
19	0.026	0.026	0.073	0.156	0.226	0.265	0.246	0.204

Sample ID	PAHs							
	Acenaphthene	Acenaphthylene	Anthracene	BAA	BAP	BBF	BGHIP	BKF
20	0.112	0.045	0.233	0.389	0.431	0.427	0.450	0.347
21	0.045	0.055	0.134	0.367	0.470	0.464	0.440	0.481
22	0.017	0.022	0.042	0.109	0.159	0.180	0.164	0.138
23	<0.005	0.013	0.020	0.075	0.110	0.116	0.123	0.092
24	<0.005	<0.005	0.024	0.065	0.100	0.129	0.107	0.095
25	<0.005	<0.005	0.022	0.062	0.103	0.108	0.114	0.108
26	<0.005	<0.005	0.016	0.055	0.088	0.097	0.107	0.087
27	<0.005	<0.005	0.017	0.064	0.086	0.093	0.106	0.087
28	<0.005	<0.005	<0.005	0.060	0.040	0.096	0.105	0.105
29	<0.005	<0.005	0.014	0.040	0.062	0.072	0.073	0.062
30	<0.005	<0.005	0.015	0.046	0.067	0.077	0.074	0.074
31	<0.005	<0.005	0.015	0.047	0.077	0.082	0.087	0.095
32	<0.005	<0.005	0.015	0.050	0.061	0.071	0.058	0.062
33	<0.005	<0.005	<0.005	0.028	0.040	0.043	0.045	0.045
34	<0.001	0.003	0.004	0.015	0.020	0.027	0.021	0.024
35	0.009	0.004	0.011	0.033	0.045	0.051	0.042	0.044
36	0.003	0.005	0.005	0.026	0.040	0.051	0.041	0.044
AL1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
AL2	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Table B6 (cont) Polyaromatic Hydrocarbons (PAHs) and Total Hydrocarbon Content (THC) (mg/kg dry weight) compared to UK Action Levels

Sample ID	PAHs								THC
	Chrysene	DBENZAH	Fluoranthene	Fluorene	INDPYR	Naphthalene	Phenanthrene	Pyrene	
1	0.385	0.067	0.460	0.058	0.279	0.082	0.203	0.519	1140
2	0.352	0.065	0.462	0.065	0.269	0.129	0.309	0.535	1140
3	0.338	0.058	0.487	0.059	0.295	0.095	0.239	0.528	834
4	0.220	0.048	0.235	0.055	0.145	0.107	0.188	0.295	497
5	0.251	0.069	0.256	0.064	0.203	0.175	0.298	0.327	795
6	0.487	0.116	0.514	0.108	0.351	0.267	0.396	0.670	867
7	0.286	0.078	0.298	0.104	0.185	0.222	0.364	0.391	821
8	1.160	0.284	1.450	0.274	0.833	0.463	0.728	1.730	2000

Sample ID	PAHs								THC
	Chrysene	DBENZAH	Fluoranthene	Fluorene	INDPYR	Naphthalene	Phenanthrene	Pyrene	
9	0.216	0.053	0.251	0.074	0.161	0.224	0.353	0.330	708
10	0.211	0.080	0.169	0.056	0.141	0.189	0.263	0.239	529
11	0.102	0.030	0.104	0.023	0.108	0.047	0.088	0.115	243
12	0.115	0.030	0.112	0.028	0.090	0.062	0.123	0.131	244
13	0.122	0.033	0.109	0.029	0.113	0.075	0.113	0.127	298
14	0.141	0.023	0.195	0.058	0.041	0.240	0.320	0.263	1040
15	0.419	0.118	0.303	0.091	0.237	0.214	0.307	0.473	761
16	0.426	0.133	0.242	0.082	0.185	0.207	0.344	0.417	631
17	0.329	0.088	0.153	0.040	0.175	0.114	0.184	0.257	460
18	0.146	0.031	0.084	0.020	0.085	0.051	0.093	0.117	272
19	0.186	0.045	0.233	0.051	0.208	0.091	0.197	0.344	786
20	0.490	0.087	0.639	0.165	0.303	0.353	0.653	0.780	1100
21	0.470	0.094	0.812	0.069	0.400	0.097	0.393	0.785	1640
22	0.158	0.037	0.164	0.029	0.151	0.065	0.113	0.219	604
23	0.149	0.031	0.087	0.022	0.103	0.046	0.079	0.111	313
24	0.096	0.026	0.104	0.021	0.099	0.039	0.085	0.123	258
25	0.092	0.032	0.088	0.020	0.111	0.043	0.083	0.100	296
26	0.092	0.025	0.076	0.019	0.097	0.043	0.076	0.091	199
27	0.094	0.023	0.089	0.018	0.092	0.040	0.075	0.099	258
28	0.088	0.025	0.088	0.018	0.106	0.040	0.069	0.098	257
29	0.060	0.016	0.065	0.015	0.064	0.030	0.053	0.072	189
30	0.065	0.015	0.086	0.015	0.071	0.029	0.061	0.091	207
31	0.075	0.021	0.078	0.017	0.092	0.036	0.067	0.089	228
32	0.067	0.015	0.086	0.015	0.057	0.026	0.075	0.089	162
33	0.039	<0.005	0.048	<0.005	0.040	0.021	0.041	0.052	125
34	0.019	0.004	0.031	0.004	0.021	0.009	0.023	0.029	21.4
35	0.042	0.008	0.062	0.010	0.039	0.015	0.053	0.067	38.3
36	0.034	0.008	0.035	0.007	0.040	0.019	0.028	0.037	35.6
AL1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	n/a
AL2	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Table B7 Polyaromatic Hydrocarbons (PAHs) and Total Hydrocarbon Content (THC) (mg/kg dry weight) compared to US Effects Ranges

Sample ID	PAHs							
	Acenaphthene	Acenaphthylene	Anthracene	BAA	BAP	BBF	BGHIP	BKF
1	0.024	0.101	0.116	0.306	0.409	0.320	0.304	0.335
2	0.036	0.043	0.101	0.274	0.359	0.339	0.307	0.278
3	0.030	0.062	0.093	0.283	0.362	0.352	0.309	0.308
4	0.028	0.050	0.081	0.162	0.208	0.166	0.181	0.162
5	0.033	0.041	0.088	0.190	0.259	0.198	0.251	0.196
6	0.063	0.077	0.156	0.402	0.518	0.475	0.399	0.385
7	0.056	0.037	0.098	0.220	0.287	0.256	0.298	0.189
8	0.277	0.204	0.381	1.030	1.310	0.955	1.000	0.930
9	0.035	0.025	0.075	0.179	0.190	0.183	0.215	0.152
10	0.029	0.019	0.067	0.158	0.239	0.172	0.256	0.133
11	<0.005	<0.005	0.020	0.068	0.047	0.130	0.113	0.099
12	0.023	<0.005	0.028	0.073	0.100	0.103	0.096	0.094
13	<0.005	<0.005	0.026	0.076	0.113	0.128	0.123	0.120
14	0.035	0.023	0.083	0.122	0.101	0.092	0.100	0.046
15	0.050	0.048	0.120	0.303	0.422	0.337	0.391	0.234
16	0.043	0.032	0.102	0.288	0.402	0.259	0.389	0.169
17	0.021	0.021	0.043	0.183	0.260	0.250	0.244	0.156
18	<0.005	<0.005	0.025	0.077	0.106	0.109	0.114	0.079
19	0.026	0.026	0.073	0.156	0.226	0.265	0.246	0.204
20	0.112	0.045	0.233	0.389	0.431	0.427	0.450	0.347
21	0.045	0.055	0.134	0.367	0.470	0.464	0.440	0.481
22	0.017	0.022	0.042	0.109	0.159	0.180	0.164	0.138
23	<0.005	0.013	0.020	0.075	0.110	0.116	0.123	0.092
24	<0.005	<0.005	0.024	0.065	0.100	0.129	0.107	0.095
25	<0.005	<0.005	0.022	0.062	0.103	0.108	0.114	0.108
26	<0.005	<0.005	0.016	0.055	0.088	0.097	0.107	0.087
27	<0.005	<0.005	0.017	0.064	0.086	0.093	0.106	0.087
28	<0.005	<0.005	<0.005	0.060	0.040	0.096	0.105	0.105
29	<0.005	<0.005	0.014	0.040	0.062	0.072	0.073	0.062
30	<0.005	<0.005	0.015	0.046	0.067	0.077	0.074	0.074

Sample ID	PAHs							
	Acenaphthene	Acenaphthylene	Anthracene	BAA	BAP	BBF	BGHIP	BKF
31	<0.005	<0.005	0.015	0.047	0.077	0.082	0.087	0.095
32	<0.005	<0.005	0.015	0.050	0.061	0.071	0.058	0.062
33	<0.005	<0.005	<0.005	0.028	0.040	0.043	0.045	0.045
34	<0.001	0.003	0.004	0.015	0.020	0.027	0.021	0.024
35	0.009	0.004	0.011	0.033	0.045	0.051	0.042	0.044
36	0.003	0.005	0.005	0.026	0.040	0.051	0.041	0.044
ERL	0.044	0.016	0.085	0.261	0.43	n/a	n/a	n/a
ERM	0.64	0.5	1.1	1.6	1.6	n/a	n/a	n/a

Table B7 (cont) Polyaromatic Hydrocarbons (PAHs) and Total Hydrocarbon Content (THC) (mg/kg dry weight) compared to US Effects Ranges

Sample ID	PAHs								THC
	Chrysene	DBENZAH	Fluoranthene	Fluorene	INDPYR	Naphthalene	Phenanthrene	Pyrene	
1	0.385	0.067	0.460	0.058	0.279	0.082	0.203	0.519	1140
2	0.352	0.065	0.462	0.065	0.269	0.129	0.309	0.535	1140
3	0.338	0.058	0.487	0.059	0.295	0.095	0.239	0.528	834
4	0.220	0.048	0.235	0.055	0.145	0.107	0.188	0.295	497
5	0.251	0.069	0.256	0.064	0.203	0.175	0.298	0.327	795
6	0.487	0.116	0.514	0.108	0.351	0.267	0.396	0.670	867
7	0.286	0.078	0.298	0.104	0.185	0.222	0.364	0.391	821
8	1.160	0.284	1.450	0.274	0.833	0.463	0.728	1.730	2000
9	0.216	0.053	0.251	0.074	0.161	0.224	0.353	0.330	708
10	0.211	0.080	0.169	0.056	0.141	0.189	0.263	0.239	529
11	0.102	0.030	0.104	0.023	0.108	0.047	0.088	0.115	243
12	0.115	0.030	0.112	0.028	0.090	0.062	0.123	0.131	244
13	0.122	0.033	0.109	0.029	0.113	0.075	0.113	0.127	298
14	0.141	0.023	0.195	0.058	0.041	0.240	0.320	0.263	1040
15	0.419	0.118	0.303	0.091	0.237	0.214	0.307	0.473	761
16	0.426	0.133	0.242	0.082	0.185	0.207	0.344	0.417	631
17	0.329	0.088	0.153	0.040	0.175	0.114	0.184	0.257	460
18	0.146	0.031	0.084	0.020	0.085	0.051	0.093	0.117	272
19	0.186	0.045	0.233	0.051	0.208	0.091	0.197	0.344	786

Sample ID	PAHs								THC
	Chrysene	DBENZAH	Fluoranthene	Fluorene	INDPYR	Naphthalene	Phenanthrene	Pyrene	
20	0.490	0.087	0.639	0.165	0.303	0.353	0.653	0.780	1100
21	0.470	0.094	0.812	0.069	0.400	0.097	0.393	0.785	1640
22	0.158	0.037	0.164	0.029	0.151	0.065	0.113	0.219	604
23	0.149	0.031	0.087	0.022	0.103	0.046	0.079	0.111	313
24	0.096	0.026	0.104	0.021	0.099	0.039	0.085	0.123	258
25	0.092	0.032	0.088	0.020	0.111	0.043	0.083	0.100	296
26	0.092	0.025	0.076	0.019	0.097	0.043	0.076	0.091	199
27	0.094	0.023	0.089	0.018	0.092	0.040	0.075	0.099	258
28	0.088	0.025	0.088	0.018	0.106	0.040	0.069	0.098	257
29	0.060	0.016	0.065	0.015	0.064	0.030	0.053	0.072	189
30	0.065	0.015	0.086	0.015	0.071	0.029	0.061	0.091	207
31	0.075	0.021	0.078	0.017	0.092	0.036	0.067	0.089	228
32	0.067	0.015	0.086	0.015	0.057	0.026	0.075	0.089	162
33	0.039	<0.005	0.048	<0.005	0.040	0.021	0.041	0.052	125
34	0.019	0.004	0.031	0.004	0.021	0.009	0.023	0.029	21.4
35	0.042	0.008	0.062	0.010	0.039	0.015	0.053	0.067	38.3
36	0.034	0.008	0.035	0.007	0.040	0.019	0.028	0.037	35.6
ERM	0.384	0.063	0.600	0.019	n/a	0.16	0.24	0.665	n/a
ERL	2.8	0.260	5.1	0.54	n/a	2.1	1.5	2.6	n/a

Table B8 Polychlorinated Biphenyls (PCBs) (mg/kg dry weight) compared to UK Action Levels

Sample ID	PCB Congener													
	PCB28	PCB52	PCB101	PCB118	PCB138	PCB153	PCB18	PCB105	PCB110	PCB128	PCB141	PCB149	PCB151	PCB156
1	0.00112	0.00044	0.00138	0.00121	0.00023	0.00144	0.00033	0.00129	0.00040	0.00156	0.00019	0.00021	0.00051	0.00043
2	0.00115	0.00051	0.00120	0.00152	0.00037	0.00160	0.00047	0.00129	0.00043	0.00179	0.00035	0.00042	0.00066	0.00030
3	0.00098	0.00038	0.00100	0.00106	0.00025	0.00154	0.00026	0.00122	0.00038	0.00155	0.00017	0.00029	0.00048	0.00023
4	0.00067	0.00033	0.00074	0.00079	0.00021	0.00119	0.00019	0.00092	0.00026	0.00126	0.00015	0.00018	0.00041	0.00019
5	0.00055	0.00026	0.00050	0.00075	0.00016	0.00082	0.00012	0.00069	0.00019	0.00118	0.00009	0.00019	0.00035	0.00012
6	0.00211	0.00074	0.00203	0.00224	0.00056	0.00335	0.00056	0.00291	0.00089	0.00385	0.00039	0.00040	0.00143	0.00052
7	0.00115	0.00040	0.00099	0.00116	0.00026	0.00172	0.00020	0.00136	0.00048	0.00200	0.00022	0.00022	0.00055	0.00031

Sample ID	PCB Congener													
	PCB28	PCB52	PCB101	PCB118	PCB138	PCB153	PCB18	PCB105	PCB110	PCB128	PCB141	PCB149	PCB151	PCB156
8	0.00015	0.00009	0.00029	0.00032	<0.00008	0.00022	<0.00008	0.00035	0.00012	0.00028	<0.00008	0.00009	<0.00008	0.00011
9	0.00049	0.00021	0.00039	0.00075	0.00010	0.00068	<0.00008	0.00064	0.00015	0.00088	<0.00008	0.00010	0.00024	0.00009
10	0.00047	0.00019	0.00050	0.00063	0.00013	0.00064	<0.00008	0.00062	0.00016	0.00090	0.00009	0.00010	0.00028	0.00012
11	0.00028	0.00018	0.00026	0.00047	0.00012	0.00062	<0.00008	0.00041	0.00012	0.00061	<0.00008	0.00009	0.00016	<0.00008
12	0.00040	0.00018	0.00036	0.00053	0.00008	0.00059	0.00009	0.00046	0.00013	0.00070	0.00008	<0.00008	0.00018	<0.00008
13	0.00041	0.00017	0.00035	0.00052	0.00017	0.00061	<0.00008	0.00051	0.00013	0.00077	<0.00008	0.00011	0.00021	0.00008
14	0.00213	0.00072	0.00201	0.00224	0.00051	0.00315	0.00072	0.00351	0.00113	0.00452	0.00035	0.00046	0.00154	0.00081
15	0.00212	0.00059	0.00200	0.00211	0.00044	0.00295	0.00064	0.00301	0.00074	0.00376	0.00034	0.00044	0.00130	0.00044
16	0.00091	0.00042	0.00089	0.00100	0.00021	0.00124	0.00022	0.00124	0.00035	0.00144	0.00013	0.00022	0.00050	0.00022
17	0.00079	0.00030	0.00074	0.00103	0.00019	0.00118	0.00020	0.00102	0.00027	0.00123	0.00012	0.00018	0.00037	0.00017
18	0.00037	0.00017	0.00037	0.00056	0.00010	0.00055	<0.00008	0.00044	0.00011	0.00071	<0.00008	0.00010	0.00017	<0.00008
19	0.00223	0.00081	0.00216	0.00226	0.00051	0.00290	0.00070	0.00323	0.00094	0.00381	0.00040	0.00041	0.00180	0.00288
20	0.00296	0.00112	0.00333	0.00332	0.00061	0.00320	0.00060	0.00293	0.00098	0.00413	0.00046	0.00056	0.00104	0.00283
21	0.00144	0.00061	0.00185	0.00205	0.00045	0.00213	0.00045	0.00195	0.00048	0.00252	0.00027	0.00044	0.00075	0.00036
22	0.00106	0.00047	0.00116	0.00134	0.00028	0.00136	0.00021	0.00124	0.00027	0.00178	0.00020	0.00030	0.00043	0.00025
23	0.00059	0.00029	0.00063	0.00093	0.00014	0.00078	0.00009	0.00063	0.00017	0.00088	0.00012	0.00015	0.00024	0.00009
24	0.00037	0.00015	0.00028	0.00055	0.00017	0.00058	<0.00008	0.00044	0.00014	0.00069	<0.00008	0.00009	0.00020	<0.00008
25	0.00034	0.00018	0.00035	0.00056	0.00016	0.00057	<0.00008	0.00047	0.00013	0.00072	<0.00008	0.00011	0.00017	<0.00008
26	0.00034	0.00016	0.00026	0.00052	0.00009	0.00059	<0.00008	0.00044	0.00010	0.00071	0.00008	0.00008	0.00014	<0.00008
27	0.00033	0.00018	0.00028	0.00047	0.00015	0.00058	<0.00008	0.00040	0.00013	0.00068	<0.00008	0.00010	0.00018	<0.00008
28	0.00033	0.00017	0.00024	0.00054	0.00011	0.00054	0.00008	0.00042	0.00011	0.00069	<0.00008	0.00011	0.00020	<0.00008
29	0.00029	0.00018	0.00029	0.00046	0.00008	0.00053	<0.00008	0.00039	0.00011	0.00063	<0.00008	<0.00008	0.00017	<0.00008
30	0.00026	0.00013	0.00024	0.00046	0.00010	0.00046	<0.00008	0.00033	0.00011	0.00060	<0.00008	<0.00008	0.00015	<0.00008
31	0.00031	0.00015	0.00023	0.00045	0.00011	0.00054	<0.00008	0.00038	0.00012	0.00058	<0.00008	<0.00008	0.00016	<0.00008
32	0.00018	0.00011	0.00015	0.00035	0.00009	0.00035	<0.00008	0.00029	0.00010	0.00042	<0.00008	<0.00008	0.00012	<0.00008
33	0.00022	0.00011	0.00018	0.00026	<0.00008	0.00033	<0.00008	0.00023	<0.00008	0.00037	<0.00008	<0.00008	0.00009	<0.00008
34	<0.00008	<0.00008	<0.00008	0.00013	<0.00008	0.00011	<0.00008	0.00012	<0.00008	0.00014	<0.00008	<0.00008	<0.00008	<0.00008
35	<0.00008	<0.00008	<0.00008	0.00010	<0.00008	0.00011	<0.00008	0.00008	<0.00008	0.00013	<0.00008	<0.00008	<0.00008	<0.00008
36	0.00009	<0.00008	<0.00008	0.00016	<0.00008	0.00013	<0.00008	0.00011	<0.00008	0.00017	<0.00008	<0.00008	<0.00008	<0.00008
AL1	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Sample ID	PCB Congener													
	PCB28	PCB52	PCB101	PCB118	PCB138	PCB153	PCB18	PCB105	PCB110	PCB128	PCB141	PCB149	PCB151	PCB156
AL2	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Table B8 (cont) Polychlorinated Biphenyls (PCBs) (mg/kg dry weight) compared to UK Action Levels

Sample ID	PCB Congener											Sum of 7 PCBs	Sum of 25 PCBs
	PCB158	PCB170	PCB180	PCB183	PCB187	PCB194	PCB31	PCB44	PCB47	PCB49	PCB66		
1	0.00132	0.00025	0.00061	0.00032	0.00067	0.00059	0.00075	0.00025	0.00076	0.00110	0.00086	0.00843	0.01822
2	0.00131	0.00043	0.00078	0.00041	0.00068	0.00046	0.00057	0.00027	0.00053	0.00079	0.00090	0.00883	0.01919
3	0.00138	0.00031	0.00070	0.00031	0.00058	0.00039	0.00042	0.00017	0.00044	0.00065	0.00069	0.00774	0.01583
4	0.00093	0.00025	0.00046	0.00026	0.00042	0.00034	0.00037	0.00013	0.00030	0.00045	0.00049	0.00572	0.01189
5	0.00077	0.00014	0.00044	0.00016	0.00035	0.00025	0.00021	0.00009	0.00021	0.00032	0.00042	0.00474	0.00933
6	0.00324	0.00074	0.00170	0.00075	0.00107	0.00088	0.00080	0.00028	0.00081	0.00132	0.00135	0.01717	0.03492
7	0.00139	0.00036	0.00079	0.00037	0.00062	0.00051	0.00040	0.00018	0.00042	0.00067	0.00077	0.00869	0.0175
8	0.00021	<0.00008	0.00012	<0.00008	0.00020	0.00010	<0.00008	<0.00008	<0.00008	0.00011	0.00012	0.00149	0.0036
9	0.00055	0.00013	0.00036	0.00018	0.00030	0.00020	0.00014	0.00008	0.00018	0.00026	0.00037	0.00391	0.00763
10	0.00057	0.00016	0.00030	0.00016	0.00031	0.00022	0.00020	0.00009	0.00018	0.00027	0.00037	0.00379	0.00774
11	0.00042	0.00013	0.00025	0.00013	0.00020	0.00014	0.00011	<0.00008	0.00012	0.00016	0.00027	0.00276	0.00557
12	0.00047	0.00013	0.00028	0.00014	0.00024	0.00014	0.00014	<0.00008	0.00012	0.00019	0.00027	0.00313	0.00614
13	0.00044	0.00011	0.00028	0.00012	0.00024	0.00017	0.00015	<0.00008	0.00013	0.00020	0.00032	0.00319	0.00644
14	0.00402	0.00096	0.00212	0.00104	0.00133	0.00128	0.00119	0.00042	0.00128	0.00182	0.00169	0.01922	0.04095
15	0.00318	0.00067	0.00161	0.00084	0.00086	0.00074	0.00085	0.00030	0.00088	0.00136	0.00125	0.01634	0.03342
16	0.00132	0.00031	0.00065	0.00032	0.00055	0.00045	0.00041	0.00016	0.00039	0.00062	0.00069	0.00708	0.01486
17	0.00089	0.00024	0.00057	0.00026	0.00041	0.00031	0.00026	0.00012	0.00031	0.00048	0.00053	0.00602	0.01217
18	0.00049	0.00013	0.00027	0.00014	0.00022	0.00016	0.00012	<0.00008	0.00015	0.00021	0.00031	0.00312	0.00617
19	0.00683	0.00126	0.00349	0.00480	0.00372	0.00368	0.00188	0.00061	0.00187	0.00211	0.00260	0.02385	0.05789
20	0.00240	0.00063	0.00152	0.00081	0.00395	0.00369	0.00194	0.00064	0.00187	0.00254	0.00264	0.02249	0.0507
21	0.00182	0.00038	0.00093	0.00043	0.00069	0.00069	0.00060	0.00023	0.00057	0.00087	0.00086	0.01151	0.02382
22	0.00115	0.00026	0.00060	0.00035	0.00061	0.00048	0.00044	0.00018	0.00040	0.00058	0.00076	0.00789	0.01616
23	0.00059	0.00016	0.00038	0.00022	0.00025	0.00018	0.00018	<0.00008	0.00017	0.00030	0.00036	0.00431	0.0086
24	0.00044	0.00011	0.00027	0.00013	0.00022	0.00013	0.00011	<0.00008	0.00011	0.00016	0.00026	0.00301	0.00592
25	0.00042	0.00014	0.00030	0.00013	0.00022	0.00014	0.00011	<0.00008	0.00013	0.00019	0.00031	0.00302	0.00617
26	0.00040	0.00011	0.00029	0.00015	0.00022	0.00012	0.00013	<0.00008	0.00012	0.00016	0.00029	0.00294	0.00574

Sample ID	PCB Congener											Sum of 7 PCBs	Sum of 25 PCBs
	PCB158	PCB170	PCB180	PCB183	PCB187	PCB194	PCB31	PCB44	PCB47	PCB49	PCB66		
27	0.00040	0.00011	0.00027	0.00012	0.00020	0.00012	0.00013	<0.00008	0.00012	0.00016	0.00028	0.00282	0.00571
28	0.00041	0.00012	0.00026	0.00015	0.00018	0.00011	0.00013	<0.00008	0.00010	0.00014	0.00026	0.00283	0.00564
29	0.00040	0.00010	0.00021	0.00013	0.00019	0.00012	0.00012	<0.00008	0.00011	0.00015	0.00025	0.00266	0.00531
30	0.00040	0.00009	0.00023	0.00012	0.00017	0.00010	0.00010	<0.00008	0.00009	0.00012	0.00022	0.00247	0.00488
31	0.00037	0.00010	0.00024	0.00012	0.00019	0.00012	0.00010	<0.00008	0.00010	0.00014	0.00024	0.00258	0.00515
32	0.00028	<0.00008	0.00017	<0.00008	0.00013	0.00009	<0.00008	<0.00008	<0.00008	0.00010	0.00017	0.00181	0.00382
33	0.00016	<0.00008	0.00012	<0.00008	0.00012	<0.00008	<0.00008	<0.00008	<0.00008	0.00009	0.00016	0.00155	0.0034
34	0.00010	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	0.00067	0.0022
35	0.00009	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	0.00058	0.00211
36	0.00009	<0.00008	0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	0.00009	0.00075	0.00228
AL1	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.01	0.02
AL2	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.2