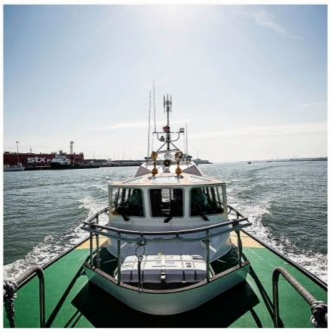
Peel Ports Group

Mersey Maintenance Dredge Protocol (MDP) Baseline Document

Update

July 2022



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Executive Summary

The Mersey Docks and Harbour Company Limited (MDHC), part of the Peel Ports Group, the Statutory Harbour Authority for the Mersey Estuary and approaches, has commissioned ABPmer to compile a Maintenance Dredge Protocol (MDP) Baseline Document. The aim of the MDP is to collate readily available relevant information into a Baseline Document to assist operators and regulators seeking, or giving approval, for maintenance dredging activities that could potentially affect European designated sites. This Baseline Document provides information for the Mersey Estuary and its approaches:

- To provide the relevant information to allow Natural England to consider and endorse an Appropriate Assessment; and
- To provide the information needed to inform the preparation of Water Framework Directive (WFD) compliance assessments in accordance with the Environment Agency's 'Clearing the Waters for All' guidance.

The Mersey Estuary lies on the northwest coast of England and forms one of the largest estuaries in the United Kingdom (UK). The estuary is tidal from the River Mersey at Howley Weir in Warrington to its mouth at Liverpool Bay (forming part of the Irish Sea). The Mersey Estuary has a long and established maritime heritage, with regular transport routes as far back as the Middle Ages. Current port capacity in the Mersey Estuary comprises a suite of enclosed docks, riverside terminals and the entrance to the Manchester Ship Canal.

The Mersey Estuary and its surrounding area are of high nature conservation importance, with large areas of the estuary and the adjacent coastline having been designated as nationally and internationally protected sites. There are currently 11 European/internationally designated sites which overlap or in the vicinity of the maintenance dredge operations and relevant licensed marine disposal sites, including Special Protection Areas (SPAs), Special Areas of Conservation (SACs) and Ramsar sites, namely:

- Ribble and Alt Estuaries SPA;
- Mersey Estuary SPA;
- Mersey Narrows and North Wirral Foreshore SPA;
- Dee Estuary/Aber Dyfrdwy SPA;
- Liverpool Bay/Bae Lerpwl SPA;
- Dee Estuary/Aber Dyfrdwy SAC;
- Sefton Coast SAC;
- Ribble and Alt Estuaries Ramsar;
- Mersey Estuary Ramsar;
- Mersey Narrows and North Wirral Foreshore Ramsar; and
- Dee Estuary Ramsar.

The Mersey Estuary is macro-tidal, experiencing tidal ranges of 3 – 10 m over the extremes of the neap-spring tidal cycle. The largest flow speeds in the Estuary can be observed through The Narrows, with peak flow speeds in excess of 2 m/s for both flood and ebb spring tides. Tidal processes within the estuary play a significant role in sediment transport, with the flood dominant tidal propagation through the Narrows and Inner Estuary along with the prevailing west to east wave direction providing potential for net landward transport of sediment. The sedimentation patterns experienced across the Mersey Estuary over the past century have been significantly affected by both natural changes in the physical environment, such as sea level rise, and anthropogenic activities since the early-mid 1800s associated with dredging and engineering works.

Sediment is constantly entering and departing the estuary, some of which settles in dredged channels, berthing pockets and in the enclosed dock system. Maintaining safe port access for commercial and recreational maritime transport is an important function for the Statutory Harbour Authority (MDHC). This necessitates the maintenance dredging of access channels and berth pockets to remove recently deposited sediment. Dredging to the approaches of the River Mersey began in 1833 to provide access to the Port of Liverpool, while dredging of the Inner Mersey began much later in *circa* 1897. Over the last century, maintenance dredging has been undertaken on a regular basis, with infrequent capital projects to deepen/enlarge existing dredge areas or support new facilities on the Mersey.

Between 2002 to 2020 inclusive, the total annual quantity of maintenance dredging undertaken within the study area, not including Water Injection Dredging (WID), ranged from 350,208 hopper tonnes to 3.1 million hopper tonnes, with a mean dredge quantity of approximately 1.85 million hopper tonnes per year. A relatively large proportion of material was dredged from areas within the Mersey Approach Channel and river berths/entrances compared to the enclosed docks at Liverpool, Birkenhead and Garston.

WID within the Mersey Estuary commenced in 2013 and continued in varying intensities up to 2018. Large-scale WID campaigns in 2015 and 2016 resulted in dredge volumes in excess of 2 million m^3 of material being removed each year. This material would have been redistributed into the estuarine system and, therefore, would have had little influence on the sediment budget of the Estuary. WID techniques were last used in 2018, during which time an extensive, yet small volume of dredging occurred across multiple sites. It is anticipated that WID will continue to support maintenance dredging operations on the Mersey in the future, alongside Trailing Suction Hopper Dredging (TSHD) and other dredging/disposal activities.

This Baseline Document, which addresses the maintenance commitments of the Statutory Harbour Authority (MDHC), has been developed over multiple iterations to present a complete account of the activities undertaken and to provide the most up to date version for use by competent authorities and dredge operators. It should not require substantial revision unless major changes are proposed or significant new information becomes available. In such a case, this document should be updated to reflect these changes. This document must be kept up-dated if it is to be used in assessing maintenance dredging, and it is therefore essential that the most up to date copy is available, and used by, competent authorities and operators.

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1 Introduction

1.1 Background

The Mersey Estuary lies on the northwest coast of England and forms one of the largest estuaries in the United Kingdom (UK). The estuary is tidal from the River Mersey at Howley Weir in Warrington to its mouth at Liverpool Bay (forming part of the Irish Sea; Figure 1.1). The conurbation on both sides of the Mersey is generally referred to as 'Merseyside' and includes the City of Liverpool and Widnes on the north (east) bank, and Wallasey, Birkenhead, Eastham, Ellesmere Port and Runcorn on the south (west) bank.

The Mersey Estuary has a long and established maritime heritage, with regular transport routes as far back as the Middle Ages. Liverpool saw the development of the world's first recorded commercial wet dock, known as the 'Old Dock'. Current port capacity in the Mersey Estuary comprises a suite of enclosed docks, riverside terminals and the Manchester Ship Canal. 'Liverpool Docks' is an interconnected dock system extending over 12 km and remains one of the biggest port estates in the UK; it is complimented by additional riverside berths, including the new Liverpool2 Terminal at Seaforth. Further upstream, at Garston, there are three more enclosed docks. Another sequence of enclosed interconnected docks on the Wirral Peninsula in Birkenhead provides further capacity, with riverside facilities at Twelve Quays (Birkenhead) and the Tranmere Oil Terminal.

The Manchester Ship Canal, which starts in the Mersey Estuary, is capable of taking ocean-going vessels. It provides an important inland transport link, offering access for shipping between the Mersey Estuary and Manchester. Together, the Port of Liverpool and Manchester Ship Canal offer a comprehensive range of port facilities, handling more than 41 million tonnes of cargo in 2019 (Port of Liverpool – 34.31 million tonnes; Manchester Ship Canal – 7.31 million tonnes; Department for Transport, 2019), with over 10,000 ship movements per year.

Sediment is constantly entering and departing the estuary, some of which settles in dredged channels, berthing pockets and in the enclosed dock system. Dredging is therefore required to remove recently deposited sediment. Most of the maintenance dredging occurs in the Outer Estuary in the approach channel and within the Manchester Ship Canal access channel in the Inner Estuary. The remainder of maintenance dredging occurs within the various enclosed dock systems, lock entrances and riverside berths.

This document presents an up-to-date account of maintenance dredging in the Mersey Estuary, in accordance with the Maintenance Dredging Protocol (MDP) (Department for Environment, Food and Rural Affairs (Defra), 2007). It is referred to as a 'Baseline Document' and is intended to summarise relevant and available information to support decision-making in connection with maintenance dredging activities and marine licence applications for dredged material disposal.

The Mersey Docks and Harbour Company Limited (MDHC), part of the Peel Ports Group, is the Statutory Harbour Authority for the Mersey Estuary and Approaches to the Mersey and responsible for maintaining safe port access for both commercial and recreational maritime transport. In this capacity, Peel Ports Group commissioned ABPmer to prepare the original Baseline Document in 2012 (ABPmer, 2012), which was subsequently updated by MarineSpace Limited in partnership with Bright Angel Coastal Consultants Ltd and HR Wallingford in 2017 (MarineSpace Limited *et al.* 2017). This revision has been prepared by ABPmer, updating the Baseline Document with data from late 2016 to 2020 inclusive. It provides information to facilitate Habitats Regulations Assessments (HRAs), Water Framework

Directive (WFD) compliance assessments and Marine Conservation Zone (MCZ) assessments where these are required.

1.2 Study area

This updated Baseline Document covers the Mersey Estuary from the tidal limit at Howley Weir in Warrington, to the Outer Estuary in Liverpool Bay (Figure 1.1). This includes the enclosed docks at Liverpool, Garston and Birkenhead as well as the access channel and lock entrance to the Manchester Ship Canal at Eastham. The study area also includes licensed marine disposal sites in Liverpool Bay, located within the MDHC Statutory Harbour Authority boundary, used to support maintenance dredging operations in the Mersey Estuary. The extent of designated marine protected areas and associated features is presented in Section 7 of this Baseline Document.

1.3 Report objectives

This report has been prepared in order to comply with the requirements of the Conservation Assessment Protocol for maintenance dredging, with respect to The Conservation of Habitats and Species Regulations 2017 (as amended) (the Habitats Regulations). It is the Government's view, as was initially instated by rulings in the European Court of Justice, that maintenance dredging should be considered as a 'plan or project' for the purposes of the Habitats Directive (92/43/EEC) and assessed in accordance with Article 6(3) of that Directive (Defra, 2007). A requirement therefore exists to ensure that maintenance dredging operations with the potential to affect Natura 2000 sites are considered in a wider sediment management context.

The aim of the protocol is to collate relevant information into a Baseline Document to make the process of assessing the effect of maintenance dredging more explicit for all parties. To fulfil this obligation, ABPmer was commissioned by Peel Ports Group to compile an updated MDP Baseline Document for the Mersey Estuary (hereafter referred to as the Baseline Document).

In addition to the requirements of the Habitat Regulations, this document also addresses requirements in respect of maintenance dredging and disposal under the WFD (2000/60EC) and the Priority Substances Directive (2008/105/EC as amended by 2013/39/EU) by way of the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. These Regulations were modified by the Floods and Water (Amendment etc) (EU Exit) Regulations 2019 on 31 January 2020. The lead authority for overseeing the implementation of the WFD within England is the Environment Agency. Furthermore, this document also contains details of nationally designated Sites of Special Scientific Interest (SSSIs) and MCZs, as well as habitats and species identified as being of principal importance in England through the Natural Environment and Rural Communities (NERC) Act 2006.

The Baseline Document therefore provides an agreed basis for the licensing authority to consider maintenance dredge applications. At the outset of the baseline data compilation, it was recognised that maintenance dredging has been an ongoing activity within specific areas of the Mersey Estuary for the safe navigation of vessels and the operational requirements of port facilities. Historically, dredge disposal activities have been licensed by the regulator, and where available, information from the licensing process has been considered and included herein. The presumption, in assessing any potential consequences of dredging activity, is that maintenance dredging will continue in line with established practice. To establish existing maintenance dredge activities, this baseline has drawn on existing and readily available information and presents the current and historical patterns of dredging in relation to the conservation status of the designated sites.

1.4 Report structure

This Baseline Document is structured as follows:

Section 2: **Legislation** – Details the legislative context for the MDP and the marine navigation dredging framework under the WFD;

Section 3: **Coastal and estuarine processes and morphology** – Outlines relevant coastal, estuarine and morphological processes for the Mersey Estuary;

Section 4: **Dredging information** – Details the history of dredging within the Mersey Estuary followed by current dredging and disposal practices;

Section 5: **Sediment quality** – Contains information relating to sediment quality and presents an overall assessment of sediment quality from previous licence applications;

Section 6: **Marine Licence information** – Summarises the Marine Licences held by relevant parties and project-specific licence conditions;

Section 7: **Environmental information** – Outlines the designated sites within the study area and the associated qualifying/interest features and conservation objectives/advice, as well as detailing relevant WFD water bodies and their current status; and

Section 8: **Knowledge gaps** – Describes any knowledge gaps identified during the data collation stages of this Baseline Document.

In addition, the following appendices are provided to support the Baseline Document:

Appendix A: **Sediment quality data** – Collates data from previous sampling schedules to inform conclusions on sediment contamination within the study area;

Appendix B: **SSSI favourable condition status** – Collates SSSI unit status gathered from Natural England's Designated Sites View; and

Appendix C: **Information to inform an Appropriate Assessment** – presents the Habitats Regulations Assessment (HRA) that has been undertaken of the maintenance dredging and the disposal of maintenance dredge arisings from within the Mersey and its approaches; and

Appendix D: **Natural England Comments Log** – presents the comments that were received from Natural England on a draft version of the Updated MDP Baseline Document and WFD Assessment for the Mersey and its approaches.

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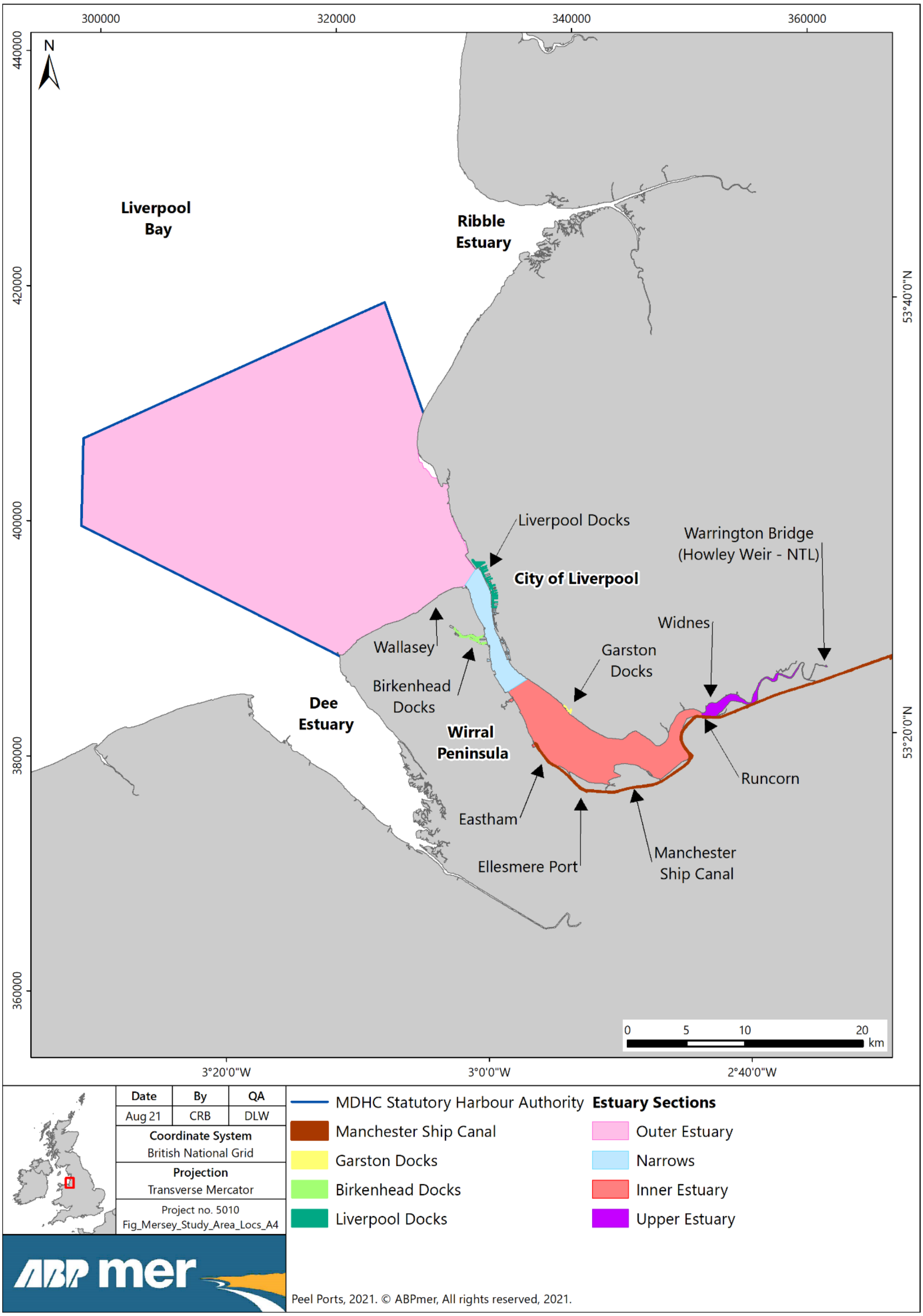

Figure 1.1 **Study area**

2 Legislation

Marine navigation dredging (including capital and maintenance) and disposal at sea are highly regulated activities due to their potential to negatively affect the environment if they are not carefully considered and controlled. The following sections detail the national and international legislative context in which this Baseline Document has been drafted with respect to navigation dredging.

2.1 National legislation

Dredge and disposal operations are regulated in England by the Marine Management Organisation (MMO), an executive non-departmental public body established and given powers under the Marine and Coastal Access Act 2009. The current process of marine licensing under the Marine and Coastal Access Act 2009 came into force on 6 April 2011 and covers the area from Mean High Water Springs (MHWS) out to 12 nautical miles (nm). This process requires anybody wishing to undertake works which are deemed to involve a licensable activity to obtain a marine licence from the MMO, unless the activity qualifies for an exemption from marine licensing.

The Marine and Coastal Access Act 2009 and the Marine Licensing (Exempted Activities) Order 2011 (as amended) set out activities which may be exempt from requiring a marine licence in certain circumstances. This includes certain dredging activities carried out by, or on behalf of, a Harbour Authority, which involves the relocation of sediments inside surface waters, including for the purpose of managing waters and waterways (also see Section 2.5). The activity must be authorised by a local Act or harbour order and the authority must demonstrate to the MMO's satisfaction that the sediments are non-hazardous. Similarly, small-scale navigational dredging (removing under 500 m^3 dredge material per campaign and under 1,500 m^3 per annum; referred to as '*de minimus*' dredging) carried out for navigational purposes in an area that has been dredged at least once in the preceding ten years is exempted from the requirements of a marine licence.

It should be noted that while certain dredging activities are exempted from requiring a marine licence to be issued by the MMO, the activity of disposing dredged material at sea (i.e. conventional disposal of dredge arisings at a licensed marine disposal site) requires a separate marine licence.

2.2 Habitats Regulations

Under Regulation 63 of the Habitats Regulations, competent authorities are required to carry out an Appropriate Assessment if the proposed works are within or adjacent to a designated European Marine Site (EMS) and if they are likely to have a 'significant effect' on the site, either alone or in combination with other 'plans and projects'. The UK Government considers that maintenance dredging proposals, which could potentially affect an EMS, need assessing in accordance with Article 103(7) of the Habitats Regulations. In effect this means that ongoing maintenance dredging should be considered as a relevant 'plan or project' and requires its effects on the EMS to be considered according to a specified procedural framework that may result in a requirement for an Appropriate Assessment prior to any consent being granted.

The MDP is intended to use readily available data to complete a Baseline Document (this document) and, drawing upon existing information, to describe the current and historical patterns of dredging in relation to the conservation status of the EMS. Completion of the protocol is voluntary; however, those estuaries with completed Baseline Documents may use these in support of maintenance dredge and disposal applications. The marine licensing authority (the MMO in England) will use Baseline Documents as a reference point to provide a basis against which maintenance dredging and disposal applications can be assessed. It is anticipated that this strategy will streamline the consenting procedure.

2.3 Marine Conservation Zones

Part 5 of the Marine and Coastal Access Act 2009 provides for the identification, designation and management of nationally important MCZs. Four Regional Projects were established to develop recommendations for MCZs in English waters. Recommendations for waters covered by the study area were made by the Irish Sea Conservation Zones Regional Project in September 2011. The Government issued a public consultation on MCZ recommendations in December 2012 which proposed to formally designate MCZs in a phased manner over succeeding years. In November 2013, Defra announced the designation of 27 MCZs around England's coast. Defra opened the consultation on a second tranche of MCZs in January 2015, with 23 further sites designated in January 2016. As part of tranche 3, 41 new sites (and 12 additional features) were designated. The third phase essentially completed the UK Blue Belt and thus contribution to the ecologically coherent network in the North East Atlantic in terms of the representation of species and habitats[1].

Once designated, public authorities have certain obligations to support the achievement of conservation objectives in delivering their statutory duties (to the extent that this is compatible with the exercise of their statutory functions). In some instances, this may require the implementation of management measures to control levels of human activity in order to achieve the conservation objectives. For licensable activities, the management measures will generally be introduced by means of specific licence conditions. In some circumstances, this may necessitate measures to control maintenance dredging and disposal activities. In relation to maintenance dredging and disposal activities in the Mersey Estuary, this Baseline Document has sought to include information on MCZs to cover any issues relating to objectives for designated features.

2.4 Water Framework Directive

The WFD (2000/60/EC), which came into force on 22 December 2000, establishes a framework approach to the protection, improvement, management and sustainable use of Europe's rivers, lakes, estuaries, coastal waters and groundwater. The Directive applies to all surface waters out to 1 nm seaward of the baseline for territorial waters and to groundwaters. For management purposes, surface and ground waters are divided into a number of discrete units termed 'water bodies'. Water bodies relevant to this study are presented in Figure 2.1. The overall objective of the WFD is to achieve good status in all inland, transitional, coastal and ground waters by 2015, unless alternative objectives are set and there are appropriate reasons for time limited derogation (currently working towards targets for 2021).

The WFD is implemented in England and Wales through the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (commonly termed the Water Framework Regulations)[2]. Under the Water Framework Regulations, the Environment Agency is the competent authority for implementation of the WFD in England. Programmes of measures have been developed through a process of river basin management planning and are set out in regionally based River Basin Management Plans (RBMPs). These were first published in 2009 (Cycle 1), and subsequently updated in early 2016 (Cycle 2). The Mersey Estuary is located within the North West River Basin District which is reported in the North West RBMP (Environment Agency, 2016).

[1] https://www.gov.uk/government/collections/marine-conservation-zone-designations-in-england (Accessed August 2021).

[2] Modified by the Floods and Water (Amendment etc) (EU Exit) Regulations 2019 on 31 January 2020.

Consideration of WFD requirements is necessary for activities and developments which have the potential to cause deterioration in ecological, quantitative and/or chemical status of a water body, or to compromise improvements which might otherwise lead to a water body meeting its WFD objectives. Therefore, it is necessary to consider the potential for maintenance dredging and disposal activities to impact WFD water bodies in and around the Mersey Estuary. In 2016, the Environment Agency published guidance, commonly referred to as 'Clearing the Waters for All', regarding how to assess the impact of activities in transitional and coastal waters[3].

2.5 Local harbour powers

The Mersey Docks and Harbour Board, which was a Public Trust established under the Mersey Docks Consolidation Act 1857, was reconstituted as a Statutory Company under the 'Mersey Docks and Harbour Act 1971' forming the MDHC. The MDHC is the Statutory Harbour Authority for the Port of Liverpool and Birkenhead Docks. It is responsible for the management of navigational safety and protection of the marine environment within its Harbour Area, which includes the Mersey Estuary between Warrington Bridge and the outer port limits (Figure 1.1).

MDHC is also a Competent Harbour Authority for the Port of Liverpool and the docks at Garston within the provisions of the Pilotage Act 1987, providing conservancy, pilotage and vessel traffic services for ships and other craft using the port. Its responsibilities also include the maintenance of navigational channels, moorings, lights and buoys and the provision of hydrographic, tidal and other information. MDHC also owns and operates the Port of Liverpool's enclosed dock systems.

The Mersey Docks Consolidation Act 1857 establishes powers to carry out maintenance dredging for navigational purposes under Part 4, Section 1, Clause C. This allows MDHC:

> "*…at the boards discretion to cleanse, scour, open, deepen, widen, or straighten, dredge, or cut through any banks, shoals, flats, shallows, swatchways or channels within the Port Liverpool, or leading into the same from the sea, for the better maintaining and preserving the navigation thereof.*"

Whilst the Mersey Docks Consolidation 1857 Act establishes the power to dredge, consent is required under the Marine and Coastal Access Act 2009 (in the form of a Marine Licence issued by the MMO) to deposit any dredged material at sea.

Further legislative requirements apply when works are of a sufficient nature or scale or are within a 'sensitive' area for nature conservation. The Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended) provide a requirement to carry out an Environmental Impact Assessment (EIA) prior to granting consent where a plan or project is deemed likely to give rise to significant effects.

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[3] https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters (Accessed August 2021).

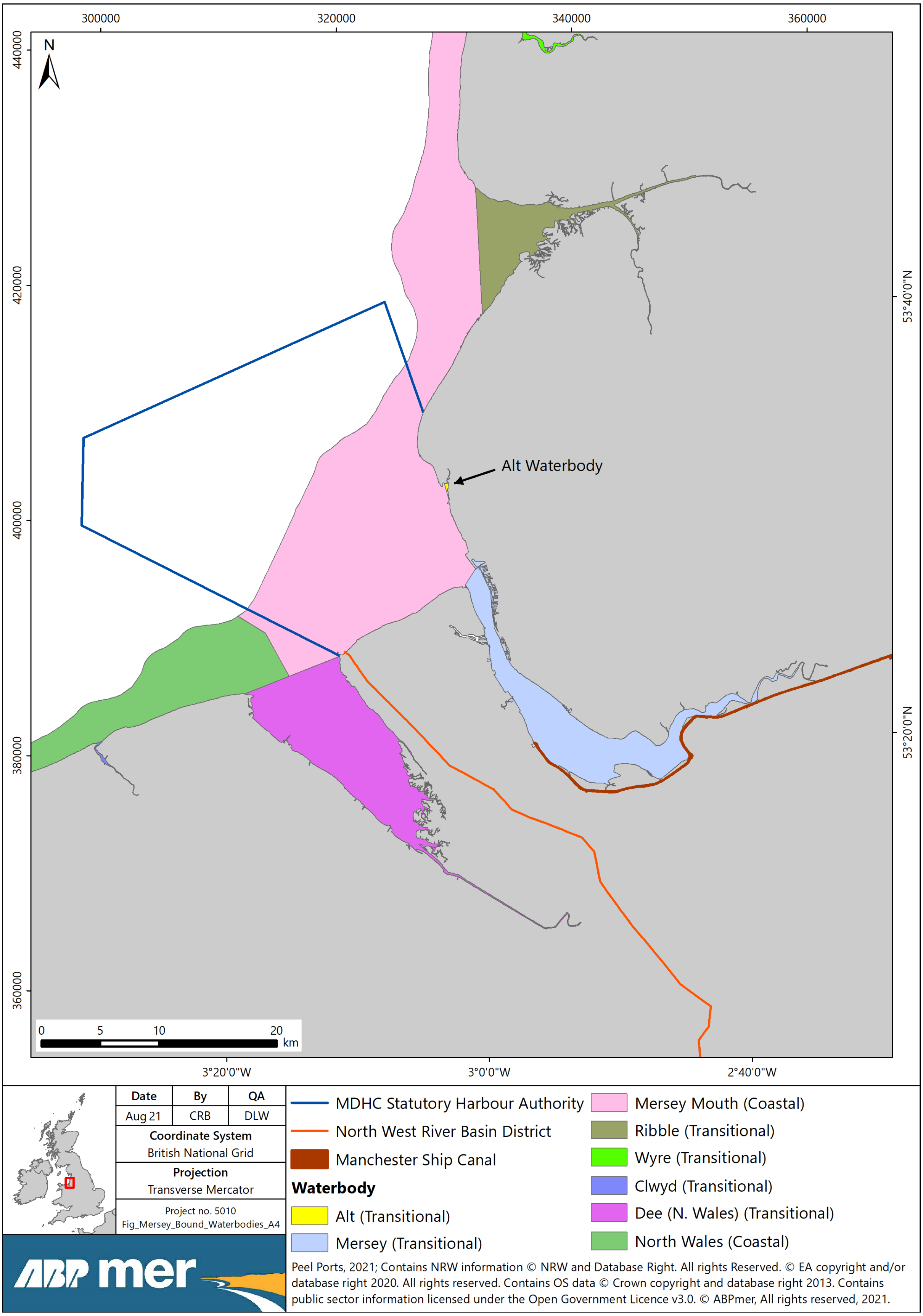


Figure 2.1 Transitional and coastal water bodies in the study area

3 Coastal and Estuarine Processes and Morphology

3.1 General estuary form and geology

The Mersey Estuary is located on the south-eastern boundary of the Irish Sea in northwest England. It is one of the largest estuaries in the UK and has a catchment area of approximately 4,500 km^2, draining a large area west of the Pennines and the Peak District. Freshwater flows are typically 25-200 m^3/s but may exceed 1,200 m^3/s during large floods (CH2MHill, 2013). This fluvial input is small in relation to the tidal prism and the tidal influx into the Narrows of 2,000 m^3/s (on average) during spring tides (McDowell and O'Connor, 1977).

The Mersey Estuary is 'bottle-shaped' and consists of a large tidal basin that is connected to Liverpool Bay by a narrow passage that is composed of resilient substrates. This form is unusual when compared to more conventional funnel-shaped estuaries such as the Thames, Humber, Solway or Severn (Blott *et al.* 2006). As a result, four distinct zones can be described as follows:

- The Outer Estuary: forms part of Liverpool Bay with a 17 km long and 1.5 to 2.0 km wide outer trained approach channel which runs between the coast of Lancashire and the Great Burbo Flats. The area is characterised by large extents of intertidal sand and mud banks;
- The Narrows: a deep incised channel through resilient geology. It is approximately 10 km long and 1.5 km wide, with a mean depth of 15 m;
- The Inner Estuary: identified as a wide inner basin of shifting banks and channels. It is within the Inner Estuary where the Manchester Ship Canal connects to the Mersey Estuary at Eastham; and
- The Upper Estuary: extends eastwards from Runcorn to the limit of tidal influence at Warrington, where Howley Weir separates the tidal estuary from the River Mersey.

Table 3.1 summarises the key parameters for the Mersey Estuary, as taken from the Futurecoast study (Defra, 2002).

Table 3.1 Key estuary parameters for the Mersey Estuary

Parameter	Mersey Estuary
Total area	18,600 hectares
Intertidal area	11,810 hectares
Marsh area	847 hectares
Shoreline	102.9 km
Channel Length	15.6 km
Mean spring tidal range	8.9 m
Mean river flow	67.1 m^3/s
Maximum river flow	717.8 m^3/s
Cross sectional area	35,918 m^2
Mouth width	1,525 m

Source: Defra, 2002

The underlying hard geology of the Mersey Estuary comprises an ice-deepened trough cut into the surrounding and underlying Permo-Triassic sandstones at The Narrows, with solid rock outcrops at intervals upstream, notably at Hale and Runcorn. The margins of the Inner Estuary are formed mainly in Quaternary deposits up to 35 m thick (Blott *et al.* 2006).

The present rivers (Mersey, Birket and Fender) have evolved in response to relative sea level rise during the Flandrian (Holocene) transgression. They re-occupied a sub-Flandrian series of buried channels in the Mersey Wirral (Kenna, 1986). These channels are substantially confined by rising ground and, therefore, any changes in tidally inundated land would not have been extensive (Comber *et al.* 1993). Resulting land surfaces occupied by the Mersey Estuary comprise estuarine sands and silts thinly overlying peats, lagoonal and estuarine silts.

Sea level rise was not uniform and involved a number of transgressive and regressive phases (Comber *et al.* 1993). Radio-carbon dating indicates that there was a rapid rise in relative sea levels around 9,200 – 8,500 years before present that was followed by a period in which sea levels fell, before further rises occurred around 8,500 – 7,000 years before present. Over the last 4,000 years, sea levels have remained fairly stable within 2 m of present, although Comber *et al.* (1993) report that MHWS may have reached 5 m above the current level around 2,000 years before present.

3.2 Hydrodynamic regime

3.2.1 Tides

Liverpool Bay is situated in the Irish Sea, which is a tidally-driven system. Tidal flows associated with the incoming tide approach from both the North (through the North Channel which separates Northern Ireland from south western Scotland) and from the South (through the St Georges Channel separating Ireland and Pembrokeshire). The tidal wave meets around the Isle of Man and subsequently flows into Liverpool Bay.

Upon entering Liverpool Bay, the tidal wave is altered by the shallow bathymetry dominated by a series of sandbanks and channels. The main direction for tidal flow across Liverpool Bay is from west to east, and currents are strongly aligned to the coast (ABPmer, 2001). Typically, these tidal flows are flood dominant, due to the steeper tidal rise on the flood relative to the fall on the ebb. This means that there are higher current velocities on the flood resulting in a greater potential for landward (flood) transport of material. In general, spring tide current speeds within Liverpool Bay reach around 1m/s, with higher velocities experienced in the main navigation channel of the Outer Estuary and in the adjacent Narrows.

The Mersey Estuary itself is a macro-tidal estuary, experiencing tidal ranges of 3 – 10 m over the extremes of the neap-spring tidal cycle, as tabulated in Table 3.2. The largest flow speeds in the Estuary can be observed through The Narrows, with peak flow speeds in excess of 2 m/s for both flood and ebb spring tides.

The shape of the estuary has a significant influence upon the propagation of the tide, with the tidal curve becoming distorted and asymmetrical, up-estuary of The Narrows. This asymmetry is attributed to the friction effect of the estuary bed as the flood tidal wave enters the shallow water of the Inner Estuary. This distortion identifies a flood dominant tidal propagation, with the duration of the flood tide being shorter than the ebb tide, with associated higher velocities, and a greater capacity to transport sediment. Tidal processes within the Estuary play a significant role in sediment transport, with the flood dominant tidal propagation through The Narrows and the Inner Estuary. This tidal regime means that there is potential for net landward transport of sediment.

Table 3.2 Summary of tidal levels for the Mersey Estuary

Tidal Level	Liverpool (Gladstone Dock)	
	m (CD)	m (ODN)
Highest Astronomical Tide	10.40	5.47
Mean High Water Springs	9.40	4.47
Mean High Water Neaps	7.50	2.57
Mean Sea Level	5.26	0.33
Mean Low Water Neaps	3.20	-1.73
Mean Low Water Springs	1.10	-3.83
Lowest Astronomical Tide	0.00	-4.93
CD – Chart Datum; ODN – Ordnance Datum Newlyn		

Source: United Kingdom Hydrographic Office (UKHO), 2015

3.2.2 Waves

A clear division can be made between internal and external wave conditions in the Mersey Estuary due to the restricted mouth of the estuary, creating two distinct wave environments. Both regimes are fetch-limited; external wave conditions are determined by the fetch across the Irish Sea, whereas internal wave conditions are determined by the estuary boundary. The largest waves in the eastern Irish Sea come from a dominant wave approach angle of approximately 280°, with a mean significant wave height of around 2 m. Strong wave activity can promote significant reworking and dispersion of sand and mud deposits in Liverpool Bay.

Although fetch-limited, waves of up to 1.5 m can occur within the Estuary during storms (Comber *et al.* 1993). These waves play an important role in maintaining the form of the Estuary, which lacks substantial areas of saltmarsh but supports extensive mudflats and sandflats. Similar forms can be seen in several smaller estuaries in East Anglia and a conceptual model to explain this phenomenon has been proposed (Morris, 2012). Continual re-working of the shoreline by storm events means that fine sediment does not consolidate and accrete sufficiently to form higher marshes, whilst the tidal energy on spring flood tides is sufficient to re-mobilise eroded sediment that has settled in channels, providing sediment-laden water that returns muds to the foreshore.

3.3 Material type

Liverpool Bay predominantly consists of fine to medium sized sand, formed by tidal current reworking of Pleistocene glacial and fluvial deposits, overlying a partly eroded surface of boulder clay, with outcrops of mud. Additional fluvial input within the Mersey Estuary largely ceased when the Manchester Ship Canal was completed in 1894 (Comber *et al.* 1993).

HR Wallingford (1990) took a number of samples during a survey of dredged pits in Liverpool Bay and indicated a median sand size of 0.29 mm (290 μm), although in places this was mixed with gravel with a diameter of up to 15 mm. The particle size reduces inshore, with material on inshore banks of 0.10 – 0.20 mm (100 – 200 μm); however, the median grain size diameter in the intertidal zone is slightly larger at 0.25 mm (250 μm). There are relatively few deposits of fine sediment on the bed in Liverpool Bay due to the exposure to tidal currents and wave action (Carroll, 2010).

The sediment properties differ considerably between The Narrows and the Inner Estuary, with strong flow speeds through The Narrows leading to substantial scouring of the bed down to rock and gravel. In contrast, the Inner Estuary comprises extensive intertidal banks of mud and sand, between which the tidal flows enter and leave the estuary, drying out almost entirely at low water.

3.4 Sediment transport pathways and budget

HR Wallingford (1990) estimated a net transport of around 3.77 million m^3 of sediment into the estuary each year. Bedform crest orientation and asymmetry indicate that bed load transport pathways in Liverpool Bay are orientated in an easterly direction (ABPmer, 2002). This net easterly movement of bed load is the result of a combination of tidal flood dominance and the prevailing west to east wave direction (ABPmer, 2006). Along the Sefton Coast, a distinct drift divide occurs at Formby Point where the orientation of the coast changes. To the south of Formby Point, drift is directed southeast along the foreshore towards The Narrows, whereas to the north of Formby Point the drift is in a northerly direction. Along the North Wirral foreshore, there is a net drift to the northeast and towards The Narrows.

Suspended sediment transport pathways are controlled by tidal flows, with the net sediment movement dictated by the tidal residual (i.e. the net flow over a tidal cycle). In Liverpool Bay, there is a net easterly drift of suspended sediment due to the flood dominance and the resulting easterly residual flow. This pathway directs suspended sediment from Liverpool Bay towards the Outer Mersey Estuary. Large current speeds within The Narrows provide little opportunity for suspended sediment to settle (with the exception of the dock entrances and deeper riverside berths). Coarser sediments are also unlikely to be deposited within The Narrows and instead move up the estuary to predominantly accumulate in the Inner Estuary (ABPmer, 2006).

The construction of training walls in 1909 had a profound impact on the Estuary and resulted in a period of sedimentation. As a result, extensive new intertidal features were created, and the estuary volume was reduced by almost 9 % (CH2MHill, 2013). Surveys suggest that the Estuary experienced a reduction in water volume of approximately 10 % between 1909 and 1966 as a result of accretion (O'Connor, 1987).

Overall tidal water volumes within the estuary now appear to be increasing. Thomas (2002) and Lane (2004) noted that recent increases may be attributed to a reduction in the supply of marine sediments rather than any changes occurring within the Estuary itself. Spearman *et al.* (2000) suggested that the main driving force behind the observed morphological change is located in Liverpool Bay.

Although the reasons for changes in water volume are as yet unresolved, close attention needs to be paid to the sediment budget for the estuary. A sediment budget considers the combined effects of sediment sinks and mechanisms of sediment export to determine whether the estuary is showing net accumulation or export of sediment. If the sediment budget remains positive (allowing the estuary to continue to evolve towards regime conditions or dynamic equilibrium), then the critical issue is its capacity for sedimentation to keep pace with sea level rise. If there is a reduction in sediment availability, and a shift towards net export of sediment, erosion of tidally exposed sediments will have a negative impact on both wildlife and on coastal defences. O'Connor (1987) concluded that there was a positive sediment budget, whereas CH2MHill (2013) highlighted considerable uncertainty about the sediment budget for the Mersey Estuary and identified this as a matter of medium concern in their advice to Sefton Borough Council. Work to construct a reliable sediment budget remains on the long-list of actions proposed by CH2MHill and is beyond the scope of this Baseline Document.

3.5 Anthropogenic changes

The sedimentation patterns within the Mersey Estuary over the past century have been significantly affected by a combination of natural changes such as sea level rise, and anthropogenic activities. Most of the anthropogenic changes have taken place since the early-mid 1800s and largely involve dredging and engineering works.

Published in 2010, the Shoreline Management Plan (SMP) which covers the Mersey Estuary and environs (Halcrow, 2010) acknowledges the anthropogenic influences on the industrialised, yet heavily designated, estuary, with extensive hold the line (HTL) and managed realignment (MR) plans (Table 3.3). The region can be segmented into five distinct areas, as follows:

- Dee Estuary;
- North Wirral;
- Mersey Estuary;
- Seaforth to River Alt; and
- Formby Dunes.

The majority of the recommended policies within the area (relevant to the Harbour Authority) is HTL (Table 3.3), a preferred option for areas with industrial, commercial or housing importance. However, MR has been recommended for the medium and long-term policy plan for Runcorn Bridge to Arpley Landfall Site and the Sewage Works to Runcorn Bridge (both dependent on further studies) in the Upper Estuary, to create more sustainable, economically and environmentally viable defence alignments in terms of both erosion and flooding.

Understanding the future geomorphological evolution of the Mersey Estuary is linked to the long-term SMP policy, especially where potential anthropogenic changes are extensive and could constrain natural dynamics. The SMP policy provides information to inform future sediment supply and demand, which may in turn influence maintenance dredging requirements.

3.5.1 Channel deepening

There have been several episodes of channel deepening to facilitate transit by vessels larger than the Estuary could naturally carry. Dredging began in 1833, with ongoing activity until 1966 when the approach channels were deepened to -8.5 m (Liverpool Bay Datum; LBD)[4]. A further episode of channel deepening took place in 2014/2015 in association with the new Liverpool2 container terminal. Further details regarding historic dredging are provided in Section 4.

3.5.2 Training wall construction

In 1909, work began on the construction of a training wall 3.6 km in length along the face of Taylor's Bank on the outside of the Crosby Channel bend, to a height of *circa* 2 m Chart Datum (CD). The intention of the wall was to arrest the continued northward movement of the channels, and to prevent a channel from breaking through Taylor's Bank. Between 1910 and 1957, the training wall was extended, and new training walls were built (van der Wal and Pye, 2000). An important objective of the training walls was to concentrate flows along the main navigation channels, and thus reduce the need for dredging. Consequently, this construction led to changes in flow velocities across the adjacent banks, resulting in both sediment migration and accretion (Blott *et al.* 2006). Construction of the training wall was completed in the following stages:

- Taylor's Bank Revetment (1909 – 1910);
- Queens North Training Bank (1933 – 1938 and 1946 – 1957);
- South Training Bank (1935 – 1938, further extended until 1957);
- Askew Spit Training Bank (1933 – 1935);
- Crosby West Training Bank (1923 – 1930); and
- Crosby East Training Bank (1929 – 1930).

[4] Liverpool Bay Datum (LBD) is -4.43 m Ordnance Datum Newlyn (ODN).

Table 3.3 Shoreline management policies for the Mersey Estuary

Policy No.	Policy Unit	Policy Plan		
		2030	2060	2110
Dee Estuary				
5.1	Point of Ayr to Mostyn, south of Mostyn Dock	HTL	HTL	HTL
5.2	Mostyn to Flint Marsh	HTL	MR	MR
5.3	Flint Marsh to Chester Weir to Sealand Rifle Range (Inner Dee Estuary, both banks	HTL	HTL	HTL
5.4	Sealand Rifle Range to Burton Point	HTL	MR	MR
5.5	Burton Point to Thurstaston Cliffs	NAI	NAI	NAI
5.6	Thurstaston Cliffs	NAI	NAI	NAI
5.7	Thurstaston Slipway to Croft Drive, Caldy	HTL	HTL	HTL
5.8	Croft Drive Caldy to West Kirby Marine Lake	HTL	HTL	HTL
5.9	West Kirby Marine Lake to Royal Liverpool Golf Club	HTL	HTL	HTL
5.10	Royal Liverpool Golf Club to Hilbre Point (Stanley Road)	NAI	NAI	NAI
5.11	Hilbre Island	HTL	HTL	HTL
North Wirral				
6.1	Hilbre Point (Stanley Road) to Wallesey Embankment (Meols)	HTL	HTL	HTL
6.2	Wallasey Embankment (Meols to Leasowe)	HTL	HTL	HTL
6.3	Wallasey Embankment to (Leasowe) to Harrison Groyne (New Brighton)	HTL	HTL	MR
6.4	Harrison Groyne to Perch rock (New Brighton)	HTL	HTL	HTL
Mersey Estuary				
7.1	Perch Rock to Riverwood Road/ Eastham Park (south/ left bank)	HTL	HTL	HTL
7.2	River Road/Eastham Park to Eastham Ferry	NAI	NAI	NAI
7.3	Eastham Ferry to Runcorn Bridge (south park)	HTL	HTL	HTL
7.4	Runcorn Bridge to Arpley Landfill site (Upper Mersey Estuary south bank)	HTL	MR	MR
7.5	Arpley Landfill site (south bank) to SMP boundary to west of Sewage works (north bank)	HTL	HTL	HTL
7.6	Sewage works to Terrace Road Widnes (Upper Mersey Estuary north bank)	HTL	MR	MR
7.7	Terrace Road Widnes to Pickerings Pasture	HTL	HTL	HTL
7.8	Pickerings Pasture to Garston Industrial Estate	NAI	NAI	NAI
7.9	Garston Industrial Estate to Seaforth (Liverpool)	HTL	HTL	HTL
Seaforth to River Alt				
8.1	Seaforth to Mersey Estuary Pollution Alleviation Scheme (MEPAS) pumping station	HTL	HTL	HTL
8.2	MEPAS pumping station to Hightown	MR	MR	MR
8.3	Hightown to mouth of River Alt	HTL	HTL	HTL
8.4	River Alt mouth (east and west banks) to the Alt pumping station	HTL	HTL	HTL
Formby Dunes				
9.1	Mouth of the River Alt (west bank) to Weld Road, Southport (Formby dune system)	MR	MR	MR
HTL - Hold The Line; MR - Managed Realignment; NAI - No Active Intervention.				

Source: Halcrow, 2010

3.5.3 Land reclamation

The banks of the Mersey Estuary are substantially urbanised and dominated by port infrastructure; however, in many respects, the Estuary has experienced much lower levels of reclamation than many of the larger conventional funnel-shaped estuaries in the UK. Nevertheless, there have been significant modifications, especially within The Narrows as a result of expansion of the Port of Liverpool near Seaforth where land was reclaimed for the construction of Docks (approximately 44 hectares). The other major area of change was around Ince Banks, on the south side of the Inner Estuary, which was affected by the building of the Manchester Ship Canal between 1887 and 1893.

O'Connor (1987) estimated that the direct loss of estuary capacity due to land reclamation since 1861 was about 12 million m^3. Changes to tidal volume can be expected to influence tidal propagation, and Van der Wal and Pye (2000) suggested that it may have affected depths in channels at the Estuary mouth. Since these analyses, the Liverpool2 terminal has been constructed. This project, completed in 2015, involved the removal of approximately 12 hectares of intertidal sediment and is the most recent significant change. It created an 854 m long quay wall with a 62 m wide berthing pocket that is maintained at -16.5 m CD.

3.5.4 Marine aggregate dredging

Historically, marine aggregates (sand) were extracted by Mersey Sand Suppliers from two bedforms associated with the main estuary fairway, namely The New Brighton Shoal and Brazil Elbow (Brazil Bank) under licence to The Crown Estate. The licensees were Norwest Sand and Ballast, United Marine Dredging and CEMEX. For the period 2005 to 2008, The Crown Estate reported that the total amount of aggregates extracted was approximately 271,000 tonnes (Bailey, 2009), which is relatively small in comparison with the yearly sediment volume change between the Mersey Estuary and Liverpool Bay. The Crown Estate confirmed that the licences were surrendered in 2010, with final dredging (44,548 tonnes) occurring during 2009. For the purposes of the updated Baseline Document, these two licence areas for aggregate extraction can effectively be considered historic.

In 2014, a ten-year licence was granted for the extraction of marine aggregates from Hilbre Swash (Area 392/393), valid until January 2029 (noting this site has been dredged for marine aggregates for several decades; HR Wallingford, 2016). The licensed area is within Liverpool Bay, to the western margin of MDHC Statutory Harbour Authority boundary outside of the Dee Estuary.

3.5.5 Flood and coastal defences

Blott *et al.* (2006) reported that there has been relatively little land reclamation in the Mersey Estuary. An estimated total of 0.49 km^2 had been reclaimed by the end of the 19^{th} century and is considered to have had a limited impact on the tidal prism. Nevertheless, the estuary is now substantially constrained by hardened structures, offering limited opportunities to realign its form. Current guidance from the second generation of SMPs for the Mersey Estuary (Halcrow, 2010) identifies the sustainable long-term management policies for the sections of coastline relevant to the Harbour Authority, where changes to the current approach may be recommended. The shoreline management policies considered are those defined by Defra and are identified in Table 3.3 for the relevant policy units.

4 Dredging Information

The Harbour Authority for the Mersey Estuary (MDHC) has a statutory duty to provide and maintain navigable channels within the estuaries and their approaches, and alongside jetties and berths. This is achieved through regular, carefully planned maintenance dredge campaigns and additional capital dredge campaigns when required. The following sections describe historic and current known dredge activities carried out by the Harbour Authority. Details are provided on the dredge quantities, dredge techniques and the status of the dredge disposal sites (i.e. open, closed and disused). In addition to dredging carried out by the Harbour Authority, maintenance dredging is also carried out by ABP Garston within the Mersey Estuary, which has also been captured as part of this review.

4.1 Historic dredging and disposal

Dredging to the approaches of the River Mersey began in 1833 to provide access to the Port of Liverpool. Regular dredging of the channel using two stationary sand pump dredgers commenced after 1890. These dredgers created a narrow channel through 'the Bar' (at the seaward end of the Outer Estuary channel) to a depth of -6.4 m LBD. By 1894, an additional dredger was deployed and, at this point, annual dredging rates of 5 million tonnes of sediment removal were being achieved (ABPmer, 2006). Although the depths of the approach channel could be maintained at around -9 m LBD, the position of the banks could not be stabilised (Blott *et al.* 2006). The increasing frequency and volume of dredging caused shoals to encroach into the navigation channel (McDowell and O'Connor, 1977). By the time construction of the training walls commenced in 1909, significant dredging was needed to maintain the approaches to the Port of Liverpool,

The provision of the training wall was intended to prevent the northwards migration of the channel; in addition, a training wall would also prevent the undesirable formation of a channel through Taylor's Bank. The 1909 training wall provided the initial stabilisation of the approach channel, but continued encroachment of shoals led to the extension of the training walls, which continued up to 1957 (see Section 3.5). This westwards extension to the walls succeeded in reducing the dredging effort, which declined from a peak of *circa* 25 million tonnes in 1924, to less than 10 million tonnes after the Second World War (Blott *et al.* 2006).

In 1966/1967, a channel deepening campaign was undertaken to increase depths in the Outer Estuary to -8.5 m LBD, resulting in a temporary increase in dredging. McDowell and O'Connor (1977) cited the maintenance dredging requirement as having increased to 2.6 million tonnes per quarter following the deepening, but then returning to pre-deepening values of 1.3 million tonnes per quarter.

During the late 1960s and early 1970s, there were significant changes in the management of the Outer Estuary. Established deposit grounds were abandoned and stationary sand pumped dredgers were replaced by Trailer Suction Hopper Dredgers (TSHD). Post 1976, the quantity of material dredged within the Outer Estuary approach channel further reduced to less than 2 million tonnes per annum for maintenance of the channel at -8.5 m LBD. Historically, most of this dredged material was disposed at sites in the Outer Estuary and Liverpool Bay.

In July 2014, further channel deepening commenced in association with the development of the Liverpool2 riverside container terminal. This project was split into two campaigns and was completed in December 2015. Over the course of the project, a total of approximately 8 million m^3 of sediment of various grades were removed. Inevitably over this period, a proportion of the dredged material would have been recently accumulated material (in effect, 'maintenance' dredging'), but the inherent practical difficulties in separating capital and maintenance volumes led to a nil return for Site Z licensed marine disposal site (IS140) during 2014 and 2015. For the purposes of this Baseline Document, however, it has been assumed that of the 8 million m^3 dredged, approximately 2.85 million m^3 could be considered to comprise maintenance dredging and the remaining 5.15 million m^3 assumed to be capital works. Some of the dredged material was disposed at licensed marine disposal sites – Site Y (IS150) and Site Z (IS140) – whilst a further volume was used as fill to construct the Liverpool2 terminal.

Dredging of the Inner Mersey began much later than that of the Outer Estuary, in *circa* 1897. Records indicate that approximately 3 – 6 million tonnes of material were extracted annually between 1897 and 1976, with a brief suspension in dredge activity during the Second World War. Most maintenance dredging focused on the approaches to the Manchester Ship Canal. Post 1976, the amount of dredged material in the Inner Estuary has been reduced as many of the older docks closed and newer docks were constructed further seawards.

4.2 Current dredge and disposal practice

4.2.1 Overview

There are currently a total of four Marine Licences to undertake dredging and disposal activities within the Mersey Estuary and approaches: two held by MDHC, and one held each by Liverpool Marina and ABP Garston (see Section 6). Figure 4.1 to Figure 4.7 show the locations of relevant maintenance dredge areas and licensed marine disposal sites in the study area.

MDHC, as the Statutory Harbour Authority for the Mersey Estuary, is responsible for the greatest volume of maintenance dredging. Most of this maintenance dredging activity concentrates on the Approach Channel together with the enclosed dock systems of Liverpool and Birkenhead, as well as riverside berths on both banks of the Mersey. Until March 2007, the Port's own dredgers (Mersey Venture and the Mersey Mariner) were used to undertake these dredging requirements. The Mersey Venture was a Trailing Suction Hopper Dredger (TSHD) and the Mersey Mariner a Grab Hopper Dredger (GHD), both of which worked a four-day week on average for approximately 46 weeks per year. However, these vessels were decommissioned in May 2007 and March 2009, respectively. Since March 2009, dredging within the Outer Estuary, Inner Estuary and enclosed docks has been carried out by independent contractors, with operational dredging outside of the scheduled campaigns being undertaken in response to business needs.

The Manchester Ship Canal Company (MSCC) maintains depths in the Eastham Channel and approaches to Eastham Lock, where the Manchester Ship Canal enters the Mersey Estuary, along the Manchester Ship Canal and within its respective locks and docks. Over the past 16 years, all dredging by the MSCC has been undertaken using TSHD. This Baseline Document only covers dredged activities which occur within tidal waters. Associated British Ports (ABP) Garston maintain the approaches to the Port of Garston and water depths within the enclosed docks. Generally, there are five or six dredging campaigns per year, with each campaign lasting for approximately 5-11 days. TSHD is employed in the approach channel and docks, supplemented with occasional GHD in the docks and lock approaches. Prior to and following maintenance dredging in the docks, the area may be ploughed to level the dredge area.

4.2.2 Dredging methods

As noted above, dredging across the study area is undertaken by the following principal methods:

- Trailing Suction Hopper Dredging (TSHD);
- Water Injection Dredging (WID);
- Grab Hopper Dredging (GHD); and
- Plough dredging.

Trailer Suction Hopper Dredging (TSHD)

TSHD uses suction to raise loosened material from the seabed through a pipe connected to a centrifugal pump. Suction alone is normally sufficient for naturally loose material, such as recently deposited material within deepened areas. TSHD is most efficient when working with fine substrates, such as mud, silt, sand and loose gravel, as the material can be easily held in suspension. Coarser materials can also be dredged using this method, but with a greater demand on pumping power and with greater wear on pumps and pipes. Material dredged by TSHD then requires depositing either within a licensed marine disposal site or a land-based disposal site, usually by direct bottom dumping (at sea) or through pumped discharge (to a land-based disposal or beneficial use site).

Water Injection Dredging (WID)

WID consists of injecting large amounts of water at low pressure into surface sediments on the seabed. This generates a high-density layer on the seabed, normally being a maximum of 1.0 m deep, with the highest density part of the cloud being 0.5 m above the seabed. The density cloud acts as a fluid layer and flows over the bed through the action of gravity along the contours of the seabed. The aim of this form of dredging is not to suspend sediments within the water column, but rather to move sediments from one area to another, and thus keep the sediment within the system. Some re-suspension of fine sediment fractions often occurs locally to the WID site, or where tidal flows are higher thereby mobilising material. If the density cloud flows over a pronounced incline or gradient, material also has the potential to be re-suspended.

Since the completion of the channel deepening to -8.5 m CD, MDHC has been investigating the most economical method of maintaining the channel to an acceptable depth for navigational safety and future commerce. In February 2016, a trial of large-scale WID operations was undertaken covering the areas within the channel known to be prone to sedimentation. WID was carried out continuously between February and August 2016. It is estimated that sedimentation in the channel during that period was up to 2.15 million m^3 (i.e. equivalent to an estimated rate of deposition of 60,000 – 90,000 m^3 per week). The majority of material removed from local areas of accumulation by WID was retained in deeper adjacent areas of the Approach Channel.

Grab Hopper Dredging (GHD)

Grab Hopper Dredging (GHD) involves a vessel which has one or more dredging cranes mounted around a receiving hopper. The cranes are fitted with grabs that pick-up material from the seabed and discharge the material into the hopper. Vessels are usually held in position while working by anchors and moorings, but some vessels few are fitted with spuds, or piles, which can be dropped onto the seabed whilst the dredger is operating. Once loaded, the vessel moves to a disposal site to discharge material, which is normally achieved through direct placement at the site by direct bottom dumping.

Plough dredging

Plough dredging utilises a tug equipped with a plough unit. The plough is lowered to a predetermined depth and is used to drag sediment along the seabed. Ploughing is typically used in confined areas due to the small size and manoeuvrability of the vessel, moving material from inaccessible areas such as dock entrances, corners or complicated areas of bathymetry to areas accessible by TSHD or GHD, or is used for bed-levelling purposes only. Plough dredging should not typically lead to significant re-suspension of sediment, but if the sediment ploughed is soft it may be sufficiently disturbed to raise smaller sediment fractions into suspension.

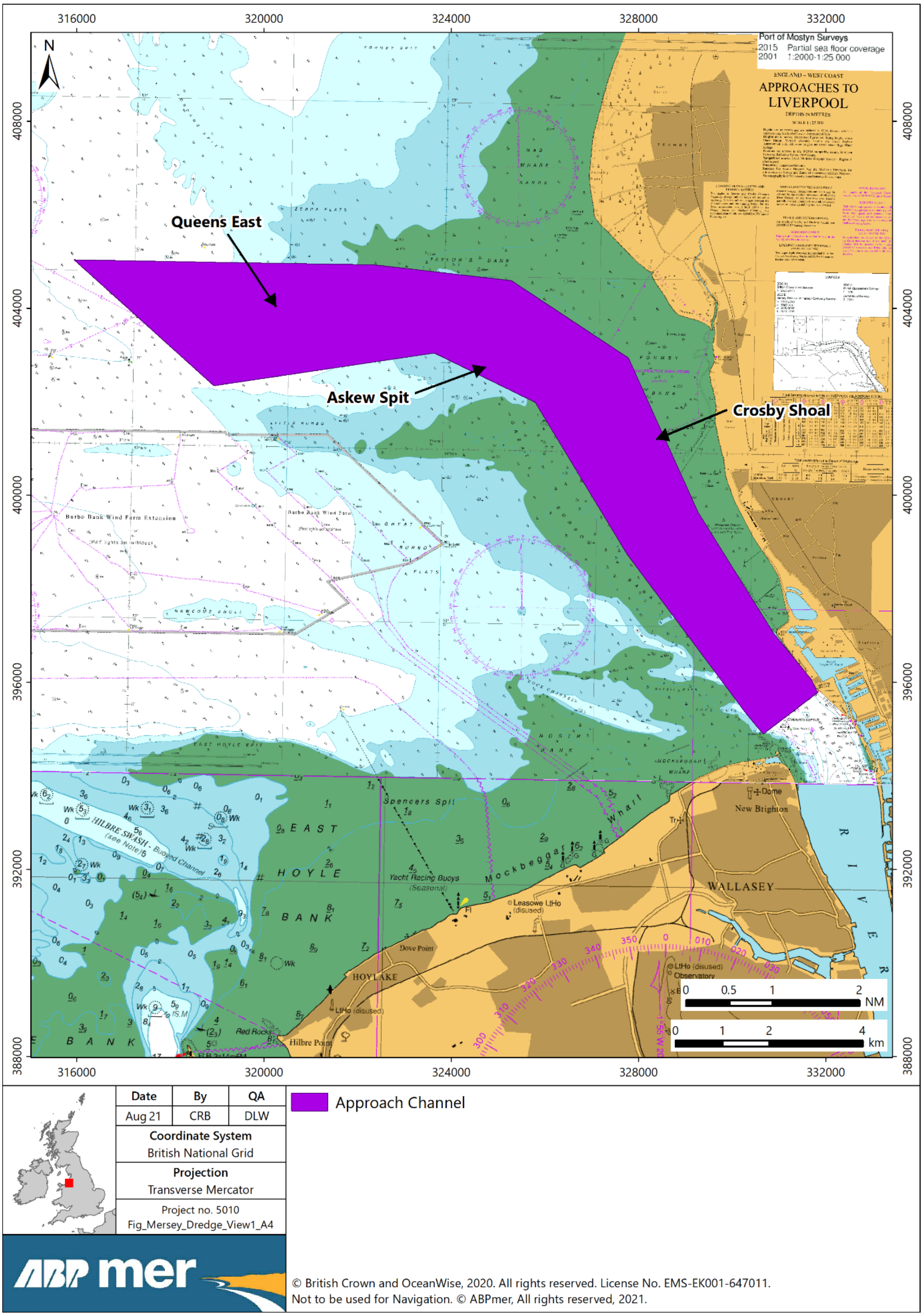


Figure 4.1 Mersey Approach Channel

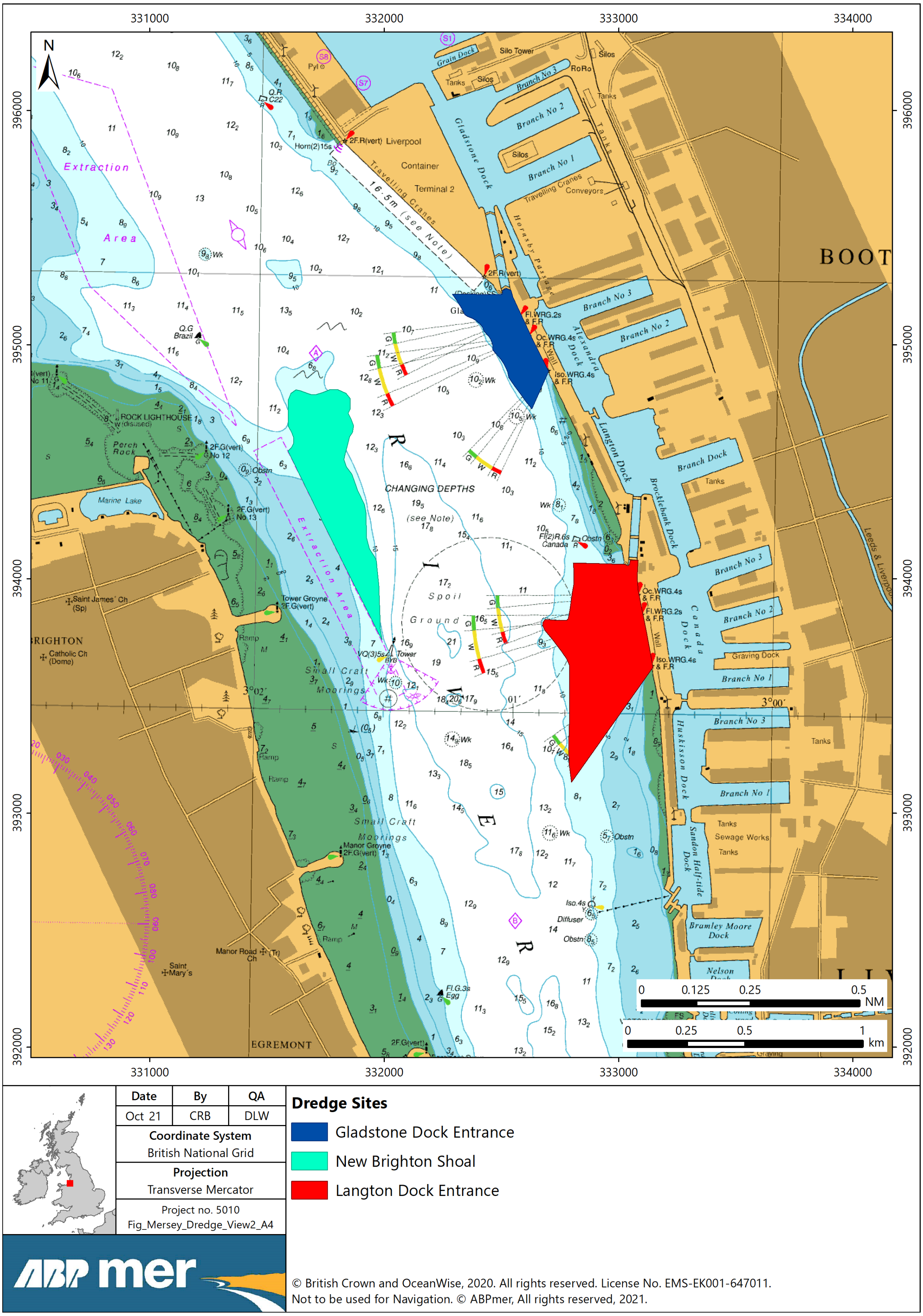


Figure 4.2 Dredge locations in The Narrows (1)

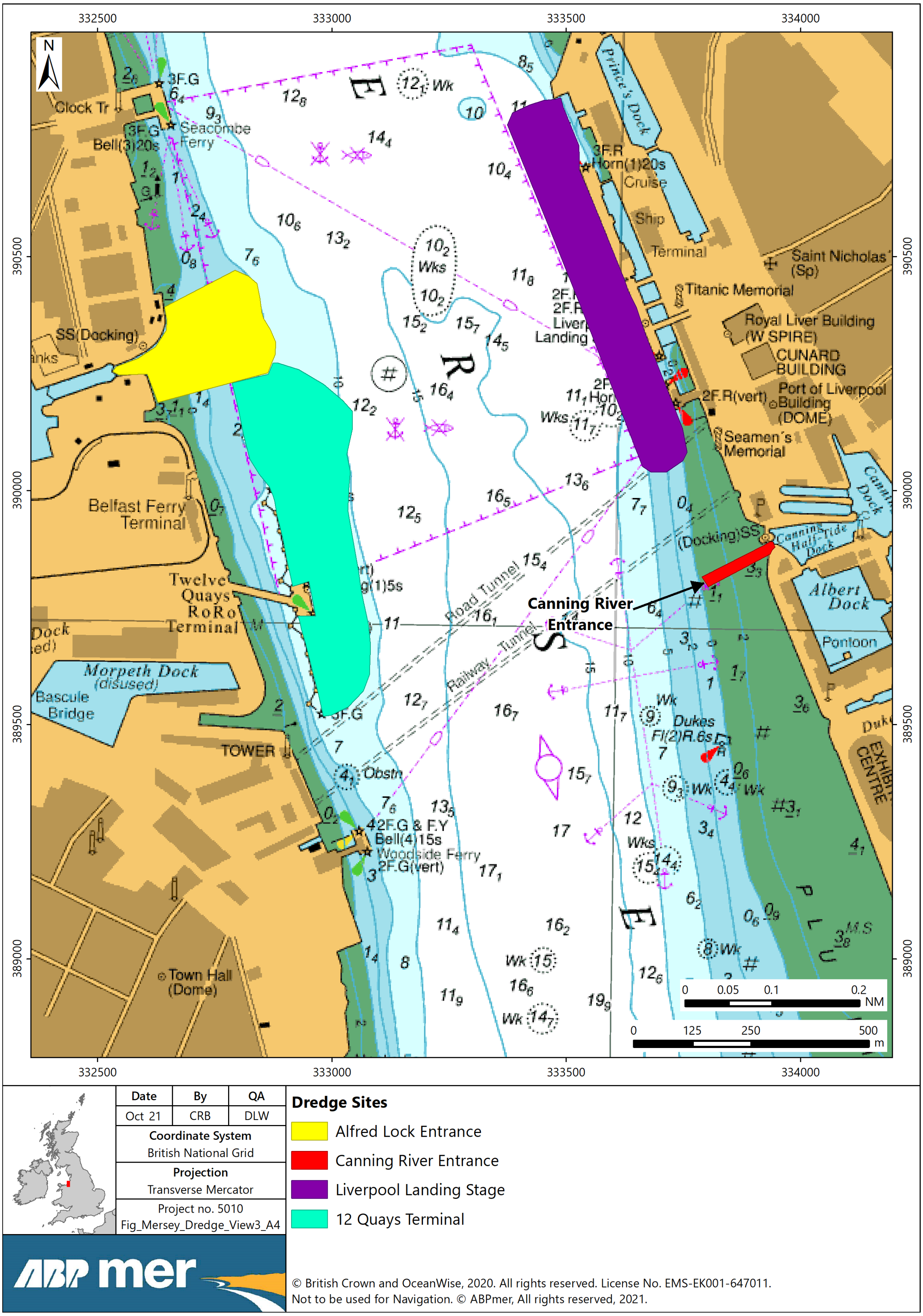
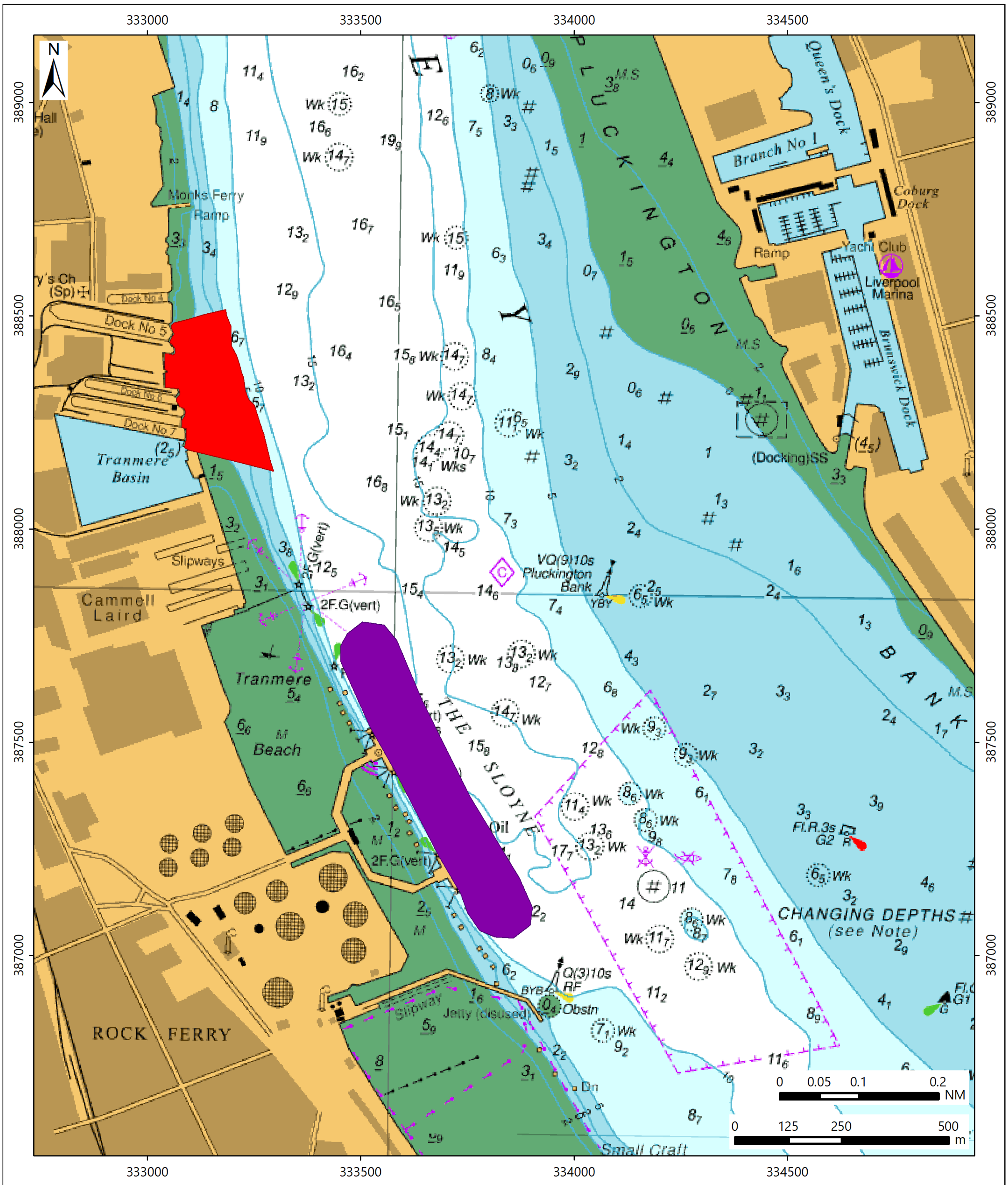
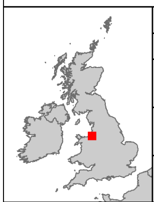


Figure 4.3 Dredge locations in The Narrows (2)





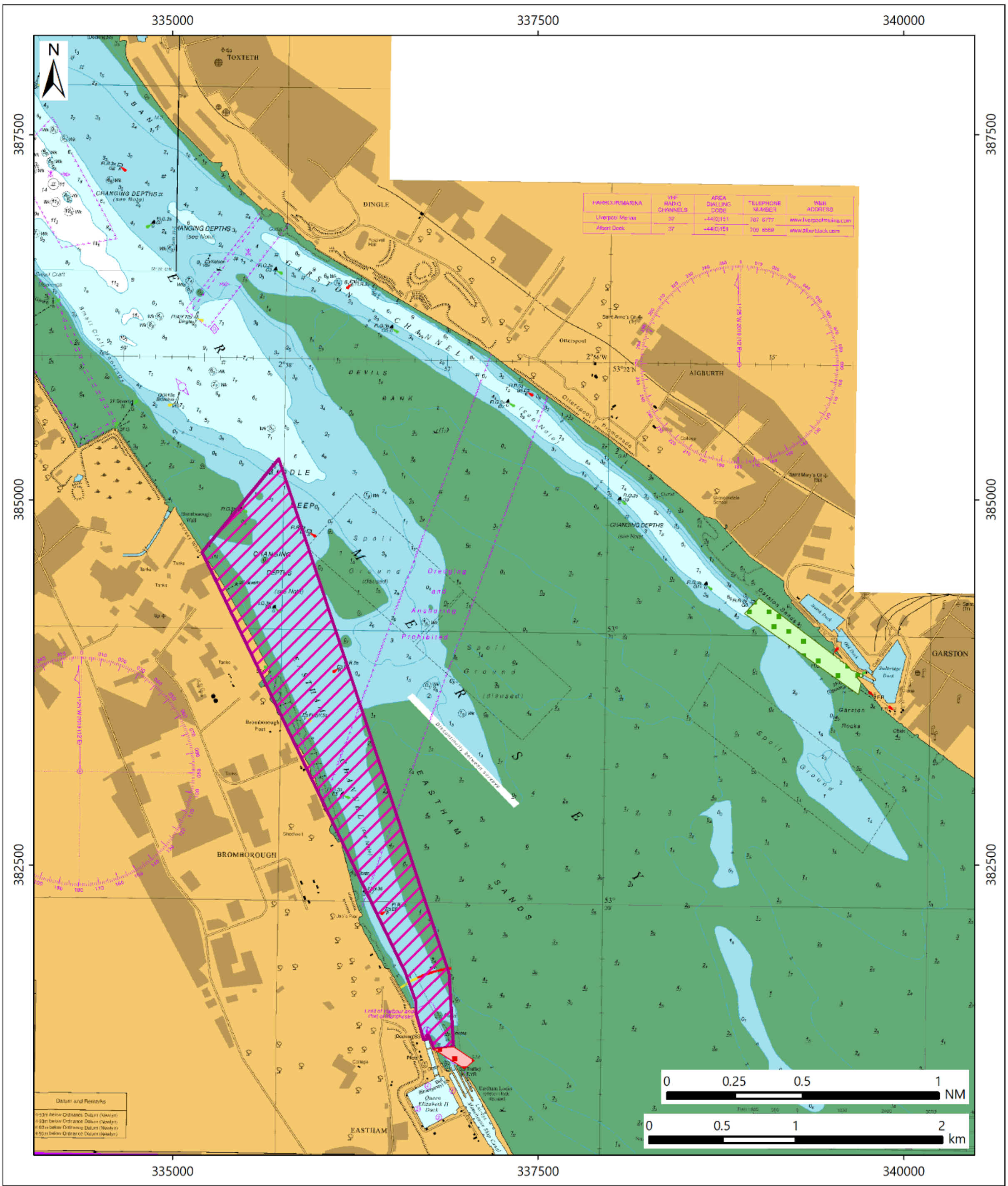
Date	By	QA
Aug 21	CRB	DLW
Coordinate System British National Grid		
Projection Transverse Mercator		
Project no. 5010 Fig_Mersey_Dredge_View4_A4		

Dredge Sites

- Cammell Larids Dry Dock Entrance
- Tranmere Oil Terminal

ABP mer

Figure 4.4 Dredge locations in The Narrows (3)



Date	By	QA
Aug 21	CRB	DLW
Coordinate System British National Grid		
Projection Transverse Mercator		
Project no. 5010 Fig_Mersey_Dredge_View5_A4		

Dredge Areas

- Eastham Lock Approaches
- Eastham Channel
- Garston Approach Channel

Figure 4.5 Inner Estuary dredge areas

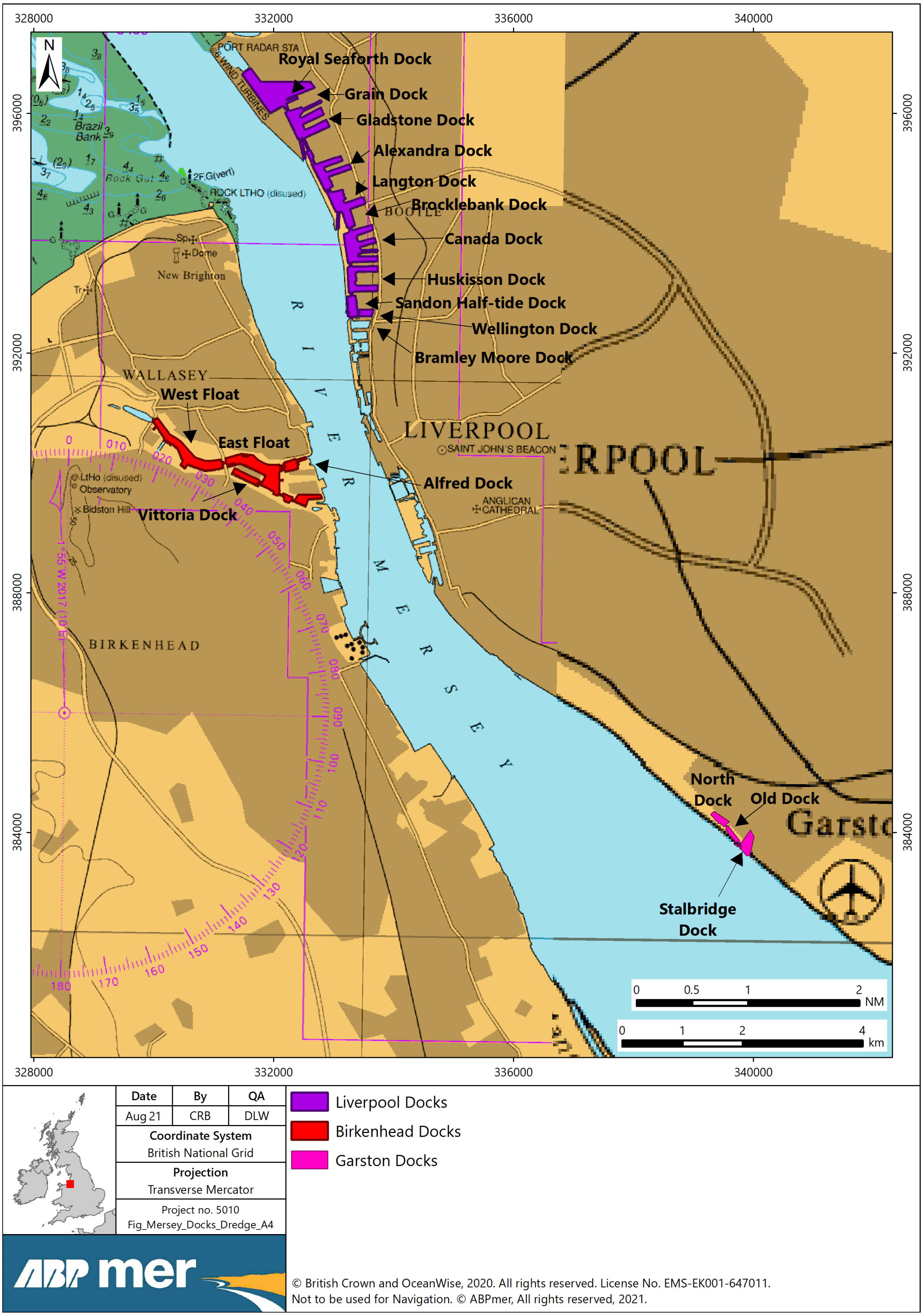


Figure 4.6 Enclosed docks at Liverpool, Birkenhead and Garston

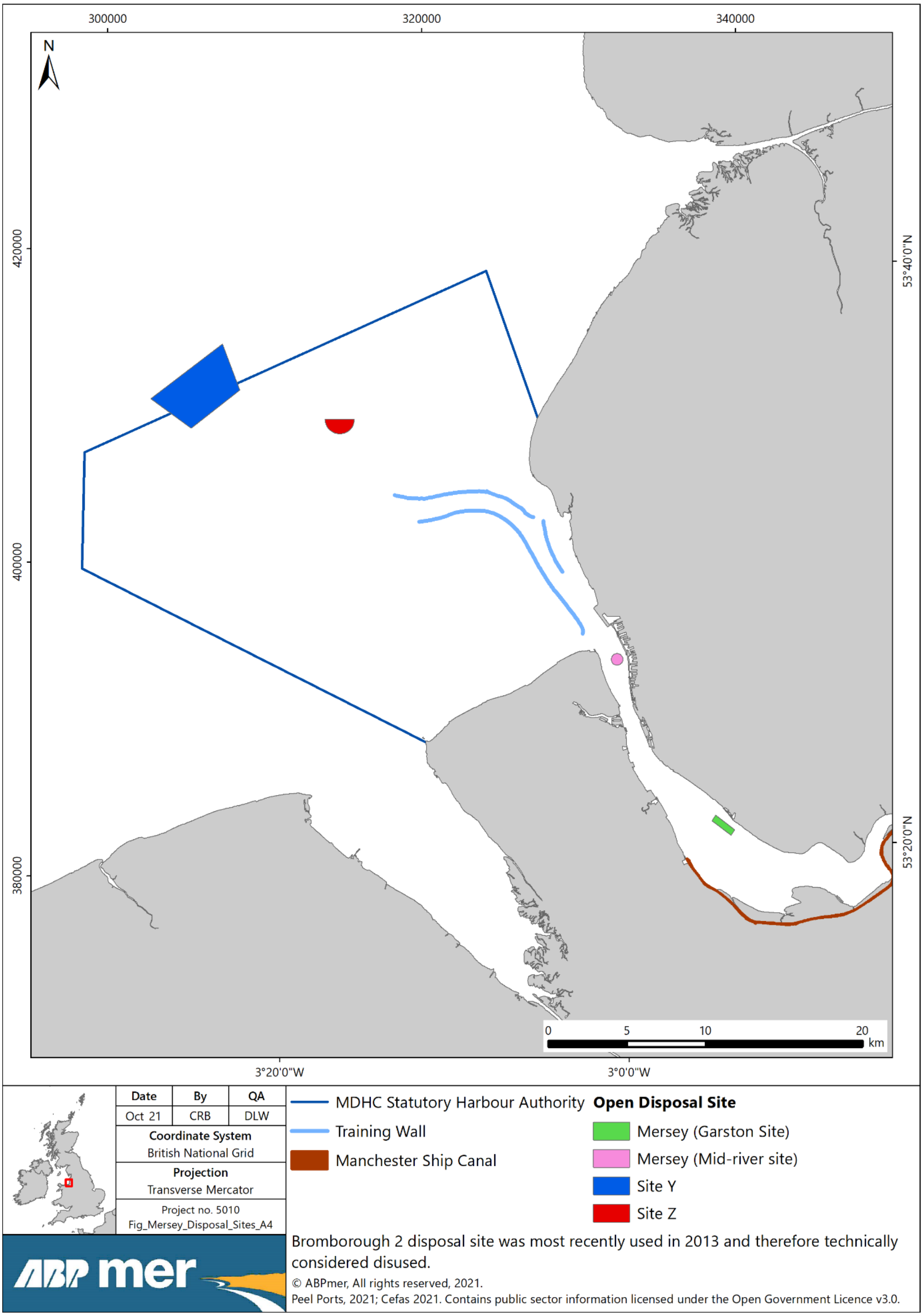


Figure 4.7 Disposal sites in the study area

4.2.3 Dredge quantities

The total annual quantity of maintenance dredging undertaken within the study area between 2002 and 2020 (not including WID) ranged from 350,208 hopper tonnes to 3.1 million hopper tonnes, with a mean dredge quantity of approximately 1.85 million hopper tonnes per year (Table 4.1 and Figure 4.8). A relatively large proportion of material was dredged from areas within the Approach Channel and river berths/entrances compared to the enclosed docks at Liverpool, Birkenhead and Garston.

Table 4.1 Annual maintenance dredge quantities within study area (not including WID)

Origin of Sediment	Dredge Quantity (Hopper Tonnes)			
	2002	2003	2004	2005
Outer Mersey	677,598	811,516	1,065,712	950,871
Inner Mersey	393,195	235,173	210,829	477,832
Liverpool Docks	239,796	235,756	612,753	568,203
Birkenhead Docks	4,065	0	12,886	23,710
Garston Approach Channel, Stalbridge Dock and North/Old Dock	359,778	396,548	412,990	461,037
Total	**1,674,432**	**1,678,993**	**2,315,170**	**2,481,653**
Origin of Sediment	**2006**	**2007**	**2008**	**2009**
Outer Mersey	1,109,535	1,355,302	371,903	1,109,714
Inner Mersey	868,463	757,503	391,465	308,225
Liverpool Docks	625,889	620,007	631,722	827,157
Birkenhead Docks	8,791	6,504	0	6,000
Garston Approach Channel, Stalbridge Dock and North/Old Dock	422,810	395,372	308,489	314,147
Total	**3,035,488**	**3,134,688**	**1,703,579**	**2,565,243**
Origin of Sediment	**2010**	**2011**	**2012**	**2013**
Docks	590,391	549,250	486,198	514,242
River and Channel	1,517,083	1,412,017	1,731,972	1,117,664
Garston Approach Channel, Stalbridge Dock and North/Old Dock	338,630	278,989	278,561	302,609
Total	**2,446,104**	**2,240,256**	**2,496,731**	**1,934,515**
Origin of Sediment	**2014**	**2015**	**2016**	**2017**
Docks	142,659	389,419	372,249	243,610
River and Channel	1,264,625	35,367	0	0
Garston Approach Channel, Stalbridge Dock and North/Old Dock	295,504	185,552	129,249	106,598
Total	**1,702,788**	**610,338**	**501,498**	**350,208**
Origin of Sediment	**2018**	**2019**	**2020**	
Outer Mersey	1,126,981	943,314	1,245,273	
Docks	433,473	158,382	0	
Garston Approach Channel, Stalbridge Dock and North/Old Dock	70,367	50,026	214,257	
Total	**1,630,821**	**1,151,722**	**1,459,530**	

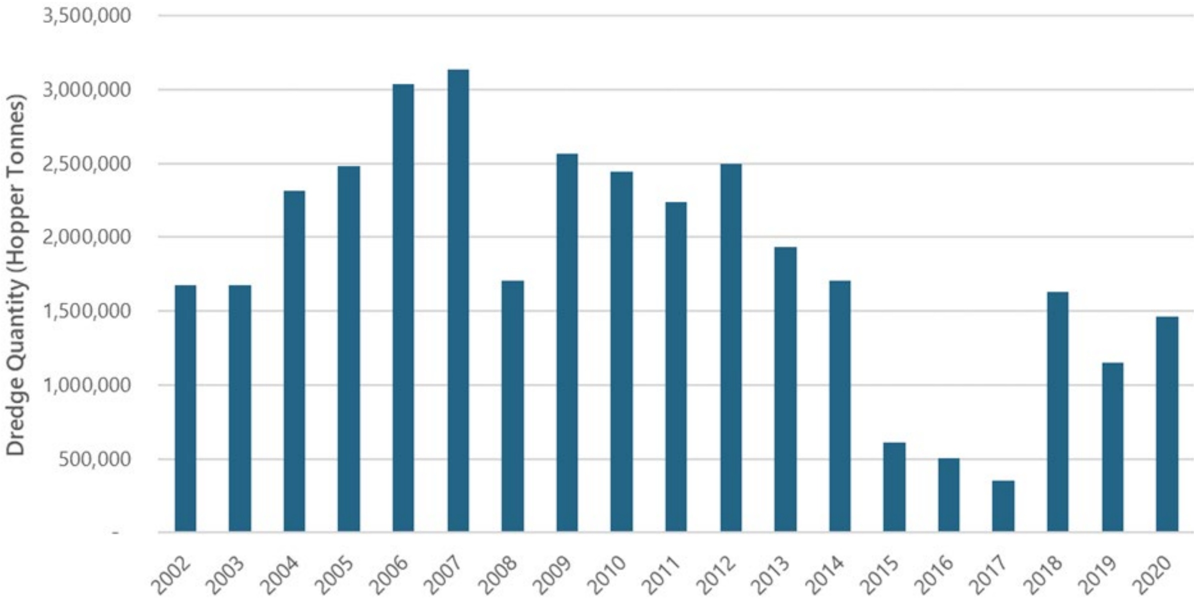


Figure 4.8 Dredge quantities from the Mersey Estuary and approaches (not including WID)

WID within the Mersey Estuary commenced in 2013 and continued in varying intensities up to 2018 (Table 4.2). Large-scale WID campaigns in 2015 and 2016 resulted in dredge volumes in excess of 2 million m^3 of material being removed each year. This material would have been redistributed into the estuarine system and, therefore, would have had little influence on the sediment budget of the Estuary. WID techniques were last used in 2018, during which time an extensive, yet small volume of dredging occurred across multiple sites.

Table 4.2 Water Injection Dredging (WID) volumes within study area

Origin of Sediment	Dredge Volume (m^3)					
	2013	2014	2015	2016	2017	2018
River	181,000	75,000	60,000	30,000	40,000	0
Liverpool Bay	0	0	2,150,000	2,150,000	0	0
Alfred River Entrance	0	0	0	0	0	800
Eastham Approach	0	0	0	0	0	900
Langton	0	0	0	0	0	1,200
Cammell Laird	0	0	0	0	0	2,800
Total	**181,000**	**75,000**	**2,210,000**	**2,180,000**	**40,000**	**5,700**

4.2.4 Disposal sites

There are currently four open, four disused and six closed marine disposal sites within the study area (Table 4.3 and Figure 4.7). Site Z licensed marine disposal site (IS140) is currently the most heavily used location within the study area. The following sections provide a summary of disposal activity (origin and volumes) to the four currently open marine disposal sites, as well as the Off Bromborough 2 (IS128) licensed marine disposal site which was most recently used in 2013 (thus, technically considered disused).

Table 4.3 Marine disposal sites within the study area

Site Code	Site Name	Status
IS110	Garston Site (Rocks)	Open
IS120	Mid River	Open
IS140	Site Z	Open
IS150	Site Y	Open
IS125	Mid River 2	Closed
IS127	Off Bromborough	Closed
IS145	Site Z (Original)	Closed
IS147	BHP Pipeline Route	Closed
IS148	BHP Pipeline Route	Closed
IS149	BHP Pipeline Route	Closed
IS128	Off Bromborough 2	Disused
IS130	Wallasey	Disused
IS115	Bramley Moore Dock	Disused
IS116	Nelson Dock	Disused

Site Z (IS140)

Site Z (IS140) is the only open licensed marine disposal site serving MDHC, MSCC and ABP Garston, receiving dredge arisings from the Approach Channel in the Outer Estuary, Liverpool and Birkenhead enclosed docks and riverside berths in The Narrows. Records between 2002 and 2020 show that annual quantities of maintenance dredge material disposed of at Site Z ranged from 333,892 hopper tonnes (2015) to approximately 2.1 million hopper tonnes (2007 and 2012), except for 2016 and 2017 where no deposits were made to this site (Table 4.4 and Figure 4.9). The total disposal quantity for 2015 is lower due to the channel deepening campaign that effectively combined capital and maintenance dredging (see Section 4.1). The mean annual disposal quantity to Site Z over the period 2002 to 2020 was approximately 1.25 million hopper tonnes.

A large proportion of the dredged material deposited at Site Z are re-distributed into the estuary and the southern part of Liverpool Bay, including the outer navigation channels. Comber *et al.* (1993) stated the following:

> "*…the position of the Site Z (IS140) disposal site has taken little heed of the dominant tidal current regime at the site, with the result that spoil is frequently dumped in flood dominated transport paths. This practice contributes to the health of the sediment budget since what is removed is ultimately returned in a self-sustaining way…*".

Table 4.4 Maintenance dredge disposal quantities for Site Z (IS140)

Origin of Sediment	Dredge Disposal Quantity (Hopper Tonnes)			
	2002	2003	2004	2005
Outer Mersey	670,077	807,044	1,063,883	948,662
Inner Mersey	234,094	149,962	108,567	147,803
Liverpool Docks	202,650	189,743	596,848	545,389
Birkenhead Docks	4,065	0	9,939	21,322
Total	**1,110,886**	**1,146,749**	**1,779,237**	**1,663,176**
Origin of Sediment	**2006**	**2007**	**2008**	**2009**
Outer Mersey	1,109,535	1,291,412	353,068	1,072,514
Inner Mersey	186,207	244,707	63,494	78,686
Liverpool Docks	562,065	519,393	399,152	565,745
Birkenhead Docks	8,791	4,065	0	6,000
Total	**1,866,598**	**2,059,577**	**815,714**	**1,722,945**
Origin of Sediment	**2010**	**2011**	**2012**	**2013**
Channel	1,431,259	1,342,424	1,474,788	1,071,161
River (Mersey berths and river entrances)			174,236	14,559
Docks	365,399	385,494	428,746	462,568
Total	**1,796,658**	**1,727,918**	**2,077,770**	**1,548,288**
Origin of Sediment	**2014**	**2015**	**2016**	**2017**
Channel and River	1,244,920	0	0	0
River (Mersey berths and river entrances)	19,705	35,367	0	0
Docks	125,655	298,525	0	0
Total	**1,390,280**	**333,892**	**0**	**0**
Origin of Sediment	**2018**	**2019**	**2020**	
Outer Mersey	1,126,981	943,314	626,741	
Total	**1,126,981**	**943,314**	**626,741**	

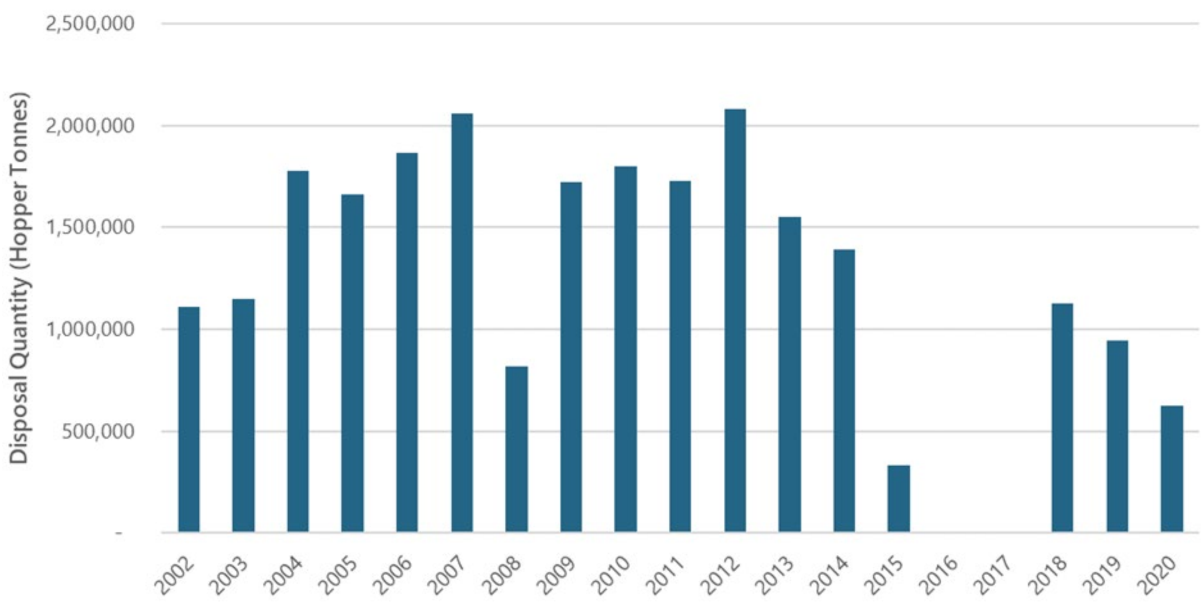


Figure 4.9 Maintenance dredge quantities deposited at Site Z (IS140)

Site Y (IS150)

Since 2002, the Site Y (IS150) licensed marine disposal site has only been used in 2020 to receive maintenance dredge material, with a total of 618,532 hopper tonnes deposited to the site from the Outer Mersey. Historically, this site has received capital dredge material derived from the construction of the Liverpool2 container terminal (1.8 million tonnes in 2013).

Mid River (IS120)

The Mid River (IS120) licensed marine disposal site is currently used by MDHC. Sediment originating from the Outer Estuary, The Narrows, Inner Estuary and from both the Liverpool and Birkenhead enclosed dock systems is placed here. Data for the period 2002 to 2020 are presented in Table 4.5 and Figure 4.10. Annual dredging quantities disposed of at the Mid River site ranged from 17,004 hopper tonnes (2014) to 464,108 hopper tonnes (2009) over this period, except for 2020 where no deposits were made to this site. A marked increase in the disposal quantities at the site between 2002 and 2009 is associated with an increase in dredging within the Inner Estuary and the Liverpool Dock system. This relatively local retention of dredge material followed a rationale discussed with Natural England that it would be beneficial to keep as much sediment in the system as possible.

Reductions in the quantities of dredged sediment disposed at the Mid River site since 2012 coincide with the introduction of WID (see Section 4.2.3) and a general reduction in dredging quantities where practicable, in order to reduce expenditure and budget saving during the economic downturn period. Nevertheless, Mid River has continued to receive notable quantities of dredged material in recent year, with 372,249 and 433,473 hopper tonnes disposed to this site in 2016 and 2018, respectively.

Table 4.5 Maintenance dredge disposal quantities for Mid River (IS120)

<table>
<tr><th rowspan="2">Origin of Sediment</th><th colspan="4">Dredge Disposal Quantity (Hopper Tonnes)</th></tr>
<tr><th>2002</th><th>2003</th><th>2004</th><th>2005</th></tr>
<tr><td>Outer Mersey</td><td>7,512</td><td>4,472</td><td>1,892</td><td>2,209</td></tr>
<tr><td>Inner Mersey</td><td>10,570</td><td>35,443</td><td>97,921</td><td>65,417</td></tr>
<tr><td>Liverpool Docks</td><td>37,146</td><td>46,013</td><td>15,905</td><td>22,814</td></tr>
<tr><td>Birkenhead Docks</td><td>0</td><td>0</td><td>2,947</td><td>2,388</td></tr>
<tr><td>Total</td><td>55,237</td><td>85,928</td><td>118,602</td><td>92,828</td></tr>
<tr><th>Origin of Sediment</th><th>2006</th><th>2007</th><th>2008</th><th>2009</th></tr>
<tr><td>Outer Mersey</td><td>0</td><td>63,890</td><td>18,835</td><td>37,200</td></tr>
<tr><td>Inner Mersey</td><td>191,801</td><td>154,622</td><td>159,780</td><td>165,496</td></tr>
<tr><td>Liverpool Docks</td><td>63,824</td><td>100,614</td><td>232,570</td><td>261,412</td></tr>
<tr><td>Birkenhead Docks</td><td>0</td><td>2,439</td><td>0</td><td>0</td></tr>
<tr><td>Total</td><td>255,625</td><td>321,565</td><td>411,185</td><td>464,108</td></tr>
<tr><th>Origin of Sediment</th><th>2010</th><th>2011</th><th>2012</th><th>2013</th></tr>
<tr><td>Channel</td><td rowspan="2">85,824</td><td rowspan="2">63,743</td><td>0</td><td>0</td></tr>
<tr><td>River (Mersey berths and river entrances)</td><td>9,935</td><td>21,163</td></tr>
<tr><td>Docks</td><td>224,992</td><td>163,756</td><td>57,452</td><td>51,674</td></tr>
<tr><td>Total</td><td>310,816</td><td>227,499</td><td>67,387</td><td>72,837</td></tr>
<tr><th>Origin of Sediment</th><th>2014</th><th>2015</th><th>2016</th><th>2017</th></tr>
<tr><td>Docks</td><td>17,004</td><td>90,894</td><td>372,249</td><td>243,610</td></tr>
<tr><td>Total</td><td>17,004</td><td>90,894</td><td>372,249</td><td>243,610</td></tr>
<tr><th>Origin of Sediment</th><th>2018</th><th>2019</th><th>2020</th><td rowspan="3"></td></tr>
<tr><td>Outer Mersey</td><td>433,473</td><td>158,382</td><td>0</td></tr>
<tr><td>Total</td><td>433,473</td><td>158,382</td><td>0</td></tr>
</table>

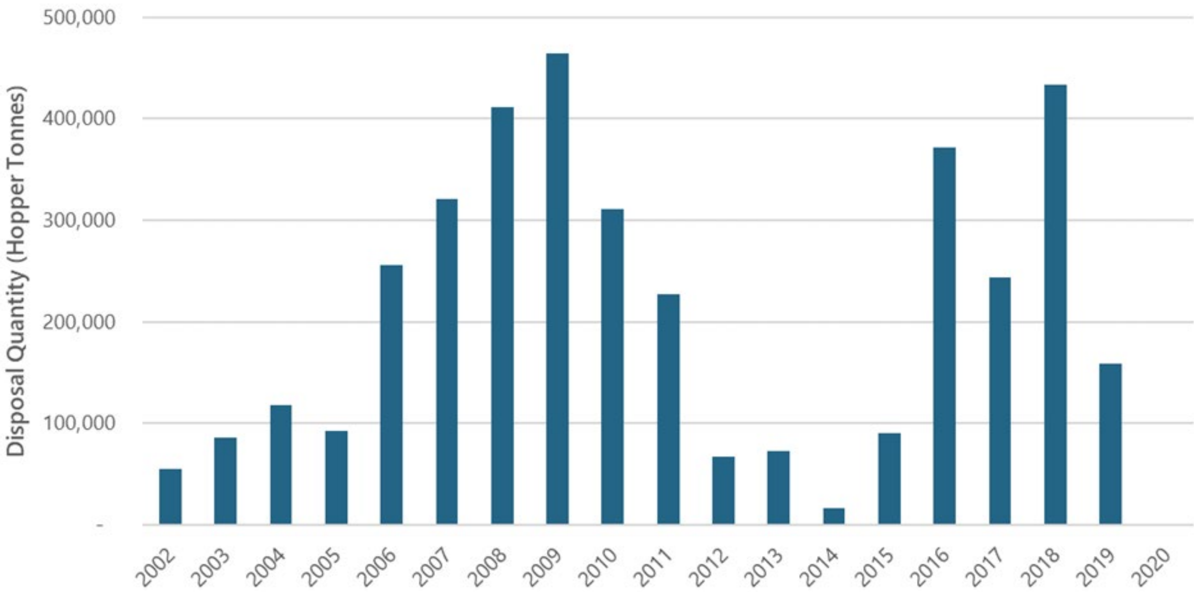


Figure 4.10 **Maintenance dredge quantities deposited at Mid River (IS120)**

Off Bromborough 2 (IS128)

The Off Bromborough 2 (IS128) licensed marine disposal site within the Middle Deep Channel (hence, the disposal site is also known locally as Middle Deep) receives sediment mainly from the north and central sections of Eastham Channel towards the approaches of the Manchester Ship Canal. Between 2002 and 2013, quantities of maintenance dredge material deposited at the Off Bromborough 2 site ranged from less than 6,000 hopper tonnes in 2004 and 2011 (and a nil return in 2010) to 490,455 hopper tonnes in 2006, with a mean annual disposal quantity for this period of 136,480 hopper tonnes (Table 4.6 and Figure 4.11). The site has not been used for the deposit of maintenance dredge material between 2014 and 2020 inclusive (and thus technically referred to as 'disused'). This change reflects the dynamic nature of the sediment regime in the vicinity of Eastham Channel in recent years, with very little requirement to undertake maintenance dredging operations.

Table 4.6 **Maintenance dredge disposal quantities for Off Bromborough 2 (IS128)**

Origin of Sediment	Dredge Disposal Quantity (Hopper Tonnes)			
	2002	2003	2004	2005
Inner Mersey	148,531	49,768	4,341	264,612
Total	**148,531**	**49,768**	**4,341**	**264,612**
Origin of Sediment	2006	2007	2008	2009
Inner Mersey	490,455	358,174	168,191	64,043
Total	**490,455**	**358,174**	**168,191**	**64,043**
Origin of Sediment	2010	2011	2012	2013
Channel and River	0	5,850	73,012	10,781
Total	**0**	**5,850**	**73,012**	**10,781**

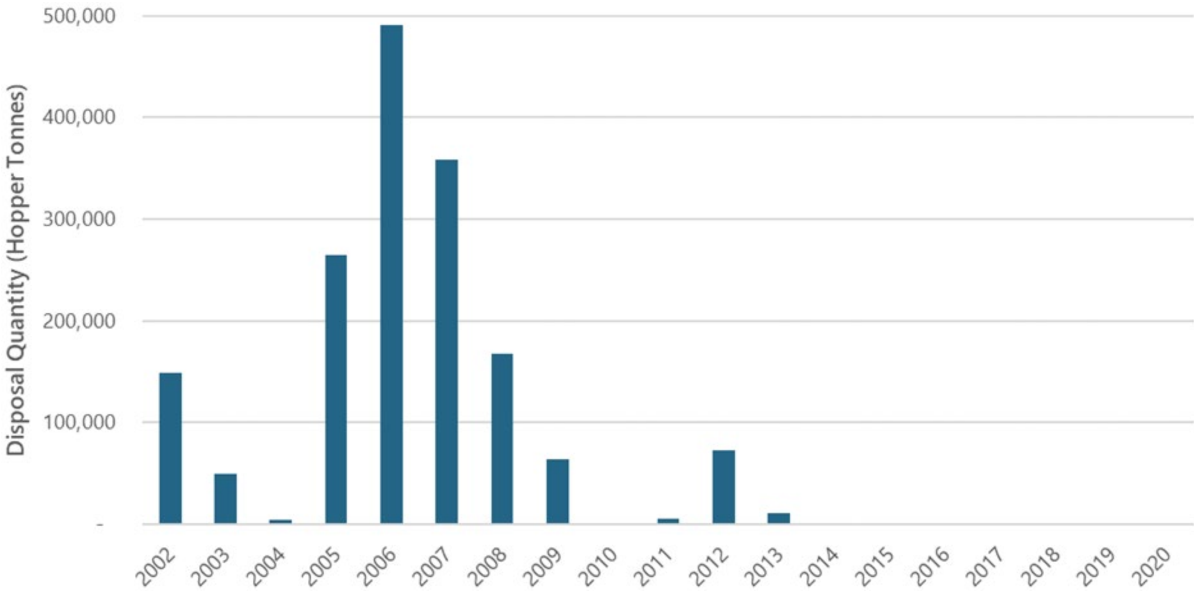


Figure 4.11 Maintenance dredge quantities deposited at Off Bromborough 2 (IS128)

Garston Rocks (IS110)

At present, the Garston Rocks (IS110) licensed marine disposal site is only used by ABP Garston. The site receives the majority of the dredge material from the Garston Approach Channel and within the Stalbridge Dock. Between 2002 and 2020, annual quantities disposed at the Garston Rocks site has ranged from 50,026 hopper tonnes (2019) to 461,037 hopper tonnes (2005), with an average annual for this period of approximately 280,000 hopper tonnes (Table 4.7 and Figure 4.12). There has been a gradual reduction in the use (in terms of quantity) of the Garston Rocks site since 2005.

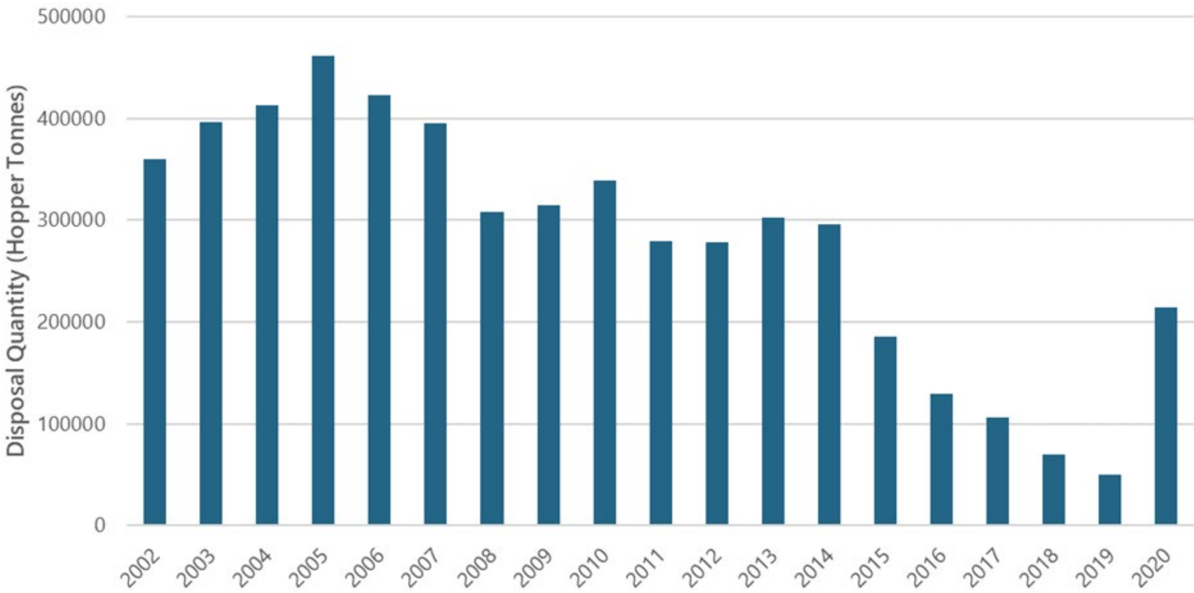


Figure 4.12 Maintenance dredge quantities deposited at Garston Rocks (IS110)

Table 4.7 Maintenance dredge disposal quantities for Garston Rocks (IS110)

Origin of Sediment	Dredge Disposal Quantity (Hopper Tonnes)			
	2002	2003	2004	2005
Garston Approach Channel, Stalbridge Dock and North/Old Dock	359,778	396,548	412,990	461,037
Total	**359,778**	**396,548**	**412,990**	**461,037**
Origin of Sediment	**2006**	**2007**	**2008**	**2009**
Garston Approach Channel, Stalbridge Dock and North/Old Dock	422,810	395,372	308,489	314,147
Total	**422,810**	**395,372**	**308,489**	**314,147**
Origin of Sediment	**2010**	**2011**	**2012**	**2013**
Garston Approach Channel, Stalbridge Dock and North/Old Dock	338,630	278,989	278,561	302,609
Total	**338,630**	**278,989**	**278,561**	**302,609**
Origin of Sediment	**2014**	**2015**	**2016**	**2017**
Garston Approach Channel, Stalbridge Dock and North/Old Dock	295,504	185,552	129,249	106,598
Total	**295,504**	**185,552**	**129,249**	**106,598**
Origin of Sediment	**2018**	**2019**	**2020**	
Garston Approach Channel, Stalbridge Dock and North/Old Dock	70,367	50,026	214,257	
Total	**70,367**	**50,026**	**214,257**	

Summary

Figure 4.13 shows the overall disposal quantities from maintenance dredging activities in the Mersey Estuary and approaches between 2002 and 2020, ranging from approximately 350,000 to over 3 million hopper tonnes per year. Most of the maintenance dredged material was deposited at the Site Z (IS140) licensed marine disposal site, equating to 68% of the total quantity disposed at sea during this period (23.7 million hopper tonnes).

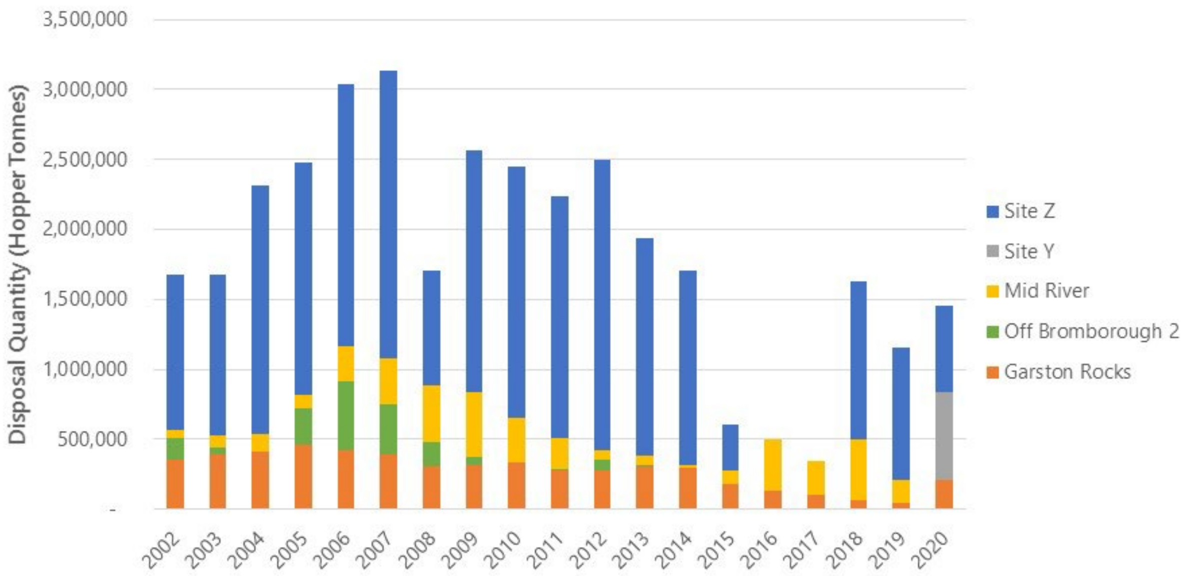


Figure 4.13 Maintenance dredge quantities deposited at licensed marine disposal sites

4.3 Beneficial use

Waste policy and, consequently, the preparation of waste hierarchy assessments, is strongly governed by the waste hierarchy set out in Article 4 of the Waste Framework Directive (2008/98/EC). The waste hierarchy ranks waste management options according to what is best for the environment and comprises the following, in order of most to least favoured (top to bottom):

- Prevention;
- Re-use;
- Recycle;
- Other recovery; and
- Disposal.

The waste hierarchy places emphasis on waste prevention or minimisation of waste, followed where possible by re-use of the material. For any dredging project, the *in situ* characteristics of the material (physical and chemical), as well as the method and frequency of dredging (and any subsequent processing), determines its characteristics for consent through the waste hierarchy. This understanding is central for consideration of management options for dealing with dredged material with respect to the waste hierarchy. Marine licencing guidance states that an applicant must take account of the waste hierarchy and consider alternative means of dredge and disposal before applying for a marine licence.

There is a general acknowledgement that, where practicable, the beneficial use of dredge material is a positive option. This provides a more sustainable approach to sediment management compared to disposal at sea or, the least desirable option, sending dredged material to landfill. Beneficial use can involve a wide range of activities, projects and stakeholders whereby a source of material (i.e. generated via dredging activities) and a use are connected to provide mutual environmental benefits.

The Mersey Sediment Management Stakeholder Group (MSMSG), hosted by Peel Ports Group, is a well-established forum developed to discuss ongoing dredging and disposal requirements on the Mersey. It was set up to investigate potential alternative or beneficial uses of maintenance dredge material in response to several factors (Brooke, 2012):

- Ensure that sediment management options were investigated and to explore opportunities to deliver a benefit (improvement in ecological status) under the WFD;
- Respond to comments made by Natural England during consultation on the first draft MDP Baseline Document (ABPmer, 2012), specifically that it may be beneficial to retain a higher proportion of dredged sediment in the wider estuarine system; and
- Demonstrate environmental good practice, including consideration of adaptive management solutions, climate change adaptation options, and 'Working with Nature'.

In considering potential sediment management options for maintenance dredge material, the MSMSG recognises the following important considerations in terms of viability:

- The beneficial use option should not be (significantly) more expensive than current disposal operations[5];
- The physical and chemical properties of the maintenance dredged material must be suitable for the suggested beneficial use;
- Technical feasibility, including an overriding requirement to ensure no adverse effects on safety of navigation, but also considering any requirement for treatment (among other factors); and

[5] This guiding principle was introduced to differentiate between capital (one-off) and maintenance (ongoing) dredging and disposal activities, and thus help clarify reasonable expenditure to stakeholders in line with the WFD expectation that measures to improve the status of water bodies should not be disproportionately costly.

- Compatibility of quantity and timing requirements with maintenance dredging operational programmes, so as not to cause unreasonable delays to routine works.

The MSMSG includes a range of interested parties, such as (but not limited to) MDHC/Peel Ports Group, Natural England, MMO, Centre for Environment, Fisheries and Aquaculture Science (Cefas), Royal Society for the Protection of Birds (RSPB), Environment Agency, Merseyside Environmental Advisory Service (MEAS), Marlan Maritime Technologies, local councils, non-governmental organisations (NGOs) and environmental consultants.

While the majority of dredge material originating from the Mersey Approach Channel has been deposited at licensed marine disposal sites in recent years, transferring a proportion of the sediment away from the Mersey Estuary (e.g. Site Z and Site Y in the Outer Mersey), apart from in 2020, since 2012, at least 17,000 m^3 has been disposed beneficially to the Mid River licensed disposal site (IS120) site, retaining this sediment in the system (Table 4.5, Figure 4.7). Natural England has indicated a preference to retain fine material dredged from the enclosed docks system within the Estuary, *inter alia* to ensure the supply of sediment to the upstream mudflats and saltmarshes in the face of sea level rise. While technically referred to as a licensed marine disposal site, the Mid River site is recognised as a valuable beneficial use location to support the sediment system within the Mersey Estuary. Marine Licence L/2015/00294/1, issued to MDHC in 2015 by the MMO, permits the disposal of maintenance dredge material originating from within the Liverpool Impounded Dock System to the Mid River (IS120) licensed marine disposal site (also see Section 6).

WID may not be an obvious form of beneficial use, but it can provide an effective way of making best use of the fine and cohesive fractions that are fundamental to ongoing maintenance of local intertidal mudflats. Within estuaries, these sediments are normally mobilised and re-distributed by a combination of wave action and tidal currents, with naturally eroded sediments contributing to significant peaks in suspended sediment concentrations in the water column. This suspended sediment may then be re-deposited in intertidal zones, or in deeper water including dredged navigation channels. Therefore, WID simply re-distributes sediment to areas where it can be re-entrained back into the water column and, potentially, transported to the intertidal zone. Between 2013 and 2018, several WID trials were undertaken by MDHC (Table 4.2). It is anticipated that WID will continue to support maintenance dredging operations on the Mersey in the future, alongside TSHD and other dredging/disposal activities.

In 2014/2015, Natural England developed Site Improvement Plans (SIPs) for each European nature conservation designated site in England (see Section 7 for details of designated sites relevant to this Baseline Document). SIPs provided a high-level overview of the issues (both current and predicted) affecting the condition of the site's qualifying features. They also outlined the priority measures required to improve the condition of these features. There are three SIPs relevant to the dredge areas and disposal site within the study area[6], namely Dee Estuary/Aber Dyfrdwy and Mersey Narrows (SIP056), Liverpool Bay/Bae Lerpwl (SIP123) and Mersey Estuary (SIP 138).

Only Liverpool Bay/Bae Lerpwl (SIP123) included an action relevant to maintenance dredging and disposal activity (Action 5A; Natural England, 2015). It recognised that a proportion of maintenance dredge material from the Mersey is now disposed to the Mid River (IS120) licensed marine disposal site, which may otherwise have been deposited at Site Z (IS140) within the Liverpool Bay/Bae Lerpwl SPA. The action was, therefore, to investigate whether this change has resulted in the improved condition of supporting habitat for bird interest features and whether this could be repeated for other disposal sites within the SPA to provide further benefits. This work has been progressed through collaborations by the MSMSG.

[6] http://publications.naturalengland.org.uk/category/6329101765836800 (Accessed August 2021).

5 Sediment Quality

5.1 Background

This section describes the chemical characteristics of sediments within the study area. As part of the marine licensing process, sediment samples are routinely collected within respective dredge areas, firstly to support the initial marine licence application/renewal and subsequently to provide interim data. The samples are analysed by MMO-approved laboratories and the results are reviewed to determine the ongoing suitability for dredging works and, if required, disposal at sea or beneficial reuse.

The analysis of sediment samples typically includes the following range of chemical parameters (note, the full suite is not always required for each dredge location, depending on historic sampling):

- Trace metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc);
- Organotins (tributyltin (TBT) and dibutyltin (DBT));
- Polycyclic aromatic hydrocarbons (PAHs; USEPA suite of 16, plus other compounds);
- Total hydrocarbon content (THC); and
- Polychlorinated biphenyls (PCBs; sum of 25 congeners and sum of ICES 7 congeners).

In addition, sediment samples are often analysed by MMO-approved laboratories for particle size distribution to determine the physical sediment composition (i.e. proportion of silt, sand and gravel in individual samples). Chemical analysis of sediment samples for organochlorine pesticides (OCPs) and polybrominated diphenyl ethers (PBDEs) may also be undertaken due to known historic contamination events or risk from anthropogenic inputs in the area (e.g. agricultural runoff, industrial setting).

There are no formal quantitative Environmental Quality Standards (EQS) for the concentration of contaminants in sediments, although the WFD has introduced optional standards for a small number of priority (hazardous) substances. Cefas has prepared a series of Guideline Action Levels to assist in the assessment of dredged material (and its suitability for disposal to sea; see Table 5.1). In general, contaminant levels in dredged material below Action Level 1 (AL1) are of no concern and are unlikely to influence the licensing decision. However, dredged material with contaminant levels above Action Level 2 (AL2) is generally considered unsuitable for disposal at sea. Dredged material with contaminant levels between AL1 and AL2 may require further consideration before a decision can be made.

The Cefas Guideline Action Levels should not be viewed as pass/fail thresholds. However, these guidelines provide an appropriate context for consideration of contaminant levels in sediments and are used as part of a 'weight of evidence' approach to assessing dredged material. The Cefas Guideline Action Levels are currently being reviewed by Defra, but no decision has yet been made to amend existing standards or introduce additional standards.

Prior to the collection of sediment samples, it is standard practice for the applicant to request a 'Sample Plan' from the MMO, who will consult Cefas to determine the appropriate suite of chemical analysis.

Table 5.1 Cefas Guideline Action Levels

Contaminant	Units	Cefas Guideline Action Levels	
		Action Level 1 (AL1)	Action Level 2 (AL2)
Metals			
Arsenic (As)	mg/kg	20	100
Cadmium (Cd)	mg/kg	0.4	5
Chromium (Cr)	mg/kg	40	400
Copper (Cu)	mg/kg	40	400
Lead (Pb)	mg/kg	50	500
Mercury (Hg)	mg/kg	0.3	3
Nickel (Ni)	mg/kg	20	200
Zinc (Zn)	mg/kg	130	800
Organotins			
Dibutyltin (DBT)	mg/kg	0.1	1
Tributyltin (TBT)	mg/kg	0.1	1
Polychlorinated Biphenyls (PCBs)			
Sum of ICES 7 congeners	µg/kg	10	-
Sum of 25 congeners	µg/kg	20	200
Polycyclic Aromatic Hydrocarbons (PAHs) and Total Hydrocarbon Content (THC)			
Acenaphthene	mg/kg	0.1	-
Acenaphthylene	mg/kg	0.1	-
Anthracene	mg/kg	0.1	-
Benzo(a)anthracene	mg/kg	0.1	-
Benzo(a)pyrene	mg/kg	0.1	-
Benzo(b)fluoranthene			
Benzo(g,h,i)perylene	mg/kg	0.1	-
Benzo(e)pyrene	mg/kg	0.1	-
Benzo(k)fluoranthene	mg/kg	0.1	-
C1-Napthalene	mg/kg	0.1	-
C1-Phenanthrenes	mg/kg	0.1	-
C2-Naphthalene	mg/kg	0.1	-
C3-Napthalene	mg/kg	0.1	-
Chrysene	mg/kg	0.1	-
Dibenzo(a,h)anthracene	mg/kg	0.1	-
Fluoranthene	mg/kg	0.1	-
Fluorene	mg/kg	0.1	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.1	-
Naphthalene	mg/kg	0.1	-
Perylene	mg/kg	0.1	-
Phenanthrene	mg/kg	0.1	-
Pyrene	mg/kg	0.1	-
THC	mg/kg	100	-
Organochlorine Pesticides (OCPs)			
Dichlorodiphenyltrichloroethane (DDT)	µg/kg	1	-
Dieldrin	µg/kg	5	-

5.2 Sediment quality within the study area

Over the last 20 years, sediment samples have been collected from various locations within the Mersey Estuary, docks and approaches to consider suitability of dredging and disposal activities (Figures 5.1 to 5.4). Table 5.2 provides a summary of sediment sampling undertaken within the study area, including the suite of contaminants analysed. Full sediment quality results are presented in Appendix A. This includes data presented in previous versions of the Baseline Document (ABPmer, 2012; MarineSpace Limited *et al.* 2017), updated with data provided by Peel Ports Group and ABP Garston covering the period from 2016 to 2020 inclusive.

Sediment quality data are summarised for the following areas:

- Mersey Approach Channel and Liverpool Bay (Section 5.2.1);
- Mersey River (Section 5.2.2); and
- Liverpool, Birkenhead and Garston Docks (Section 5.2.3).

5.2.1 Mersey Approach Channel and Liverpool Bay

Sediment samples have been collected and analysed on several occasions from the Mersey Approach Channel, specifically in 2001, 2012, 2013, 2014 and, most recently, 2016 (Figure 5.2). These sediment samples have been collected to inform marine licence applications submitted by MDHC to dispose of dredged material from the Mersey Approach Channel at licensed marine disposal sites (see Section 4), while also providing context to sediment quality in the wider Liverpool Bay area.

Metal and organotin concentrations in the Mersey Approach Channel have typically been below AL1 or marginally exceeding AL1, with only one sample above AL2 for mercury reported in 2012 (3.09 mg/kg; noting several other samples collected were also close to the AL2 threshold at this time). In 2001, PCB concentrations were very high in sediments samples taken from Queens West/East, Askew Split and Crosby Shoal, with the sum of 25 congeners an order of magnitude above AL2. However, PCB concentrations from samples collected in 2016 were all below AL1 for the sum of ICES 7 congeners and sum of 25 congeners (MER1 to MER6; Figure 5.2). PAH concentrations varied from below AL1 to orders of magnitude above AL1 (noting there is currently no AL2 for PAHs).

Overall, contaminant concentrations in sediments within the Mersey Approach Channel and wider Liverpool Bay area have been shown to be relatively low; this is to be expected given the predominantly sandy composition of dredged material in this area, with contaminants largely associated with finer material such as mud/silt. As noted above, there have been a few isolated exceedances of AL2, but these were reported as part of historic sampling (e.g. PCBs in 2001), with more recent analysis indicating a general reduction in contaminant concentrations.

5.2.2 Mersey River

Sediment samples have been collected and analysed on several occasions from the Mersey River, specifically in 1994, 2001, 2002, 2005, 2013 and, most recently, 2016 (Figure 5.3 and Figure 5.4). This has included dredge areas along the central river channel, jetties, berths and dock entrances/ approaches.

Metal and organotin concentrations in the Mersey Approach Channel have typically been below AL1 or marginally exceeding AL1, with only one sample above AL2 for lead reported in 1994 from Cammell Laird (5,624 mg/kg; AL2 = 500 mg/kg). In 2001, PCB concentrations were very high in sediments samples taken from the river entrances to Langton and Alfred Docks, as well as the Tranmere Oil Terminal, with the sum of 25 congeners an order of magnitude above AL2. However, lead and PCB (sum of ICES 7 congeners and sum of 25 congeners) concentrations from samples collected in 2016 were all below AL1 (MER7 to MER7; Figure 5.3 and Figure 5.4). PAH concentrations varied from below AL1 to orders of magnitude above AL1 (noting there is currently no AL2 for PAHs).

Overall, contaminant concentrations in sediments within the River Mersey (The Narrows and Inner Estuary) have been shown to be relatively low, particularly in more recent samples. As noted above, there have been a few isolated exceedances of AL2, but these were reported as part of historic sampling, with more recent analysis indicating a general reduction in contaminant concentrations.

5.2.3 Liverpool, Birkenhead and Garston Docks

Sediment samples have been collected and analysed on a regular basis from the enclosed dock systems of the Mersey, specifically in 2005, 2008, 2010, 2011, 2013, 2014, 2015, 2017, 2018, 2019 and, most recently, 2020 (Figure 5.3 and 5.4). Metal and organotin concentrations in the Liverpool, Birkenhead and Garston Docks have typically been below AL1 or marginally exceeding AL1, although metal concentrations in general appear to be slightly elevated compared to the wider study area. Mercury concentrations exceeded AL2 in samples from Old and North Docks at Garston in 2005, while one sample from Old Dock exceeded AL2 for arsenic, mercury and zinc in 2006. However, metal concentrations from samples collected in 2008 suggested levels were consistently below AL2 within the Garston dock system, although concentrations were still well above AL1.

In 2010, a sample collected from the Port of Liverpool's Sandon Halftide Dock indicated concentrations of mercury and the sum of 25 PCB congeners were above the respective AL2 values, while exceedances of AL2 were also reported at the former Wellington Dock (now infilled to accommodate a sewage treatment plant) in 2012 for lead, mercury, zinc and TBT. More recently, mercury concentrations in two samples from Queen Elizabeth II Dock were reported as being above AL2 (QED1; Figure 5.4), although these were taken from cores at depths of 3.0 and 3.35 m (the sum of 25 PCB congeners also exceeded AL2 in the latter sample). PAH concentrations varied from below AL1 to several orders of magnitude above AL1 (noting there is currently no AL2 for PAHs).

Overall, contaminant concentrations in sediments within the enclosed dock systems of the Mersey (Liverpool, Birkenhead and Garston) have been shown to be of relatively poorer quality compared to the Mersey Approach Channel and Mersey River. This is to be expected given the historic and current industrial usage of these facilities and the restricted flow of water behind dock gates, preventing the natural dispersion of contaminants. It is noted that Marine Licence L/2015/00294/1 includes specific licence conditions which restrict dredging activity within West Float, Wellington Dock or Victoria Dock (condition 5.2.9), Sandon Halftide Dock (condition 5.2.10) and Gladstone Dock (condition 5.2.11). Similarly, condition 5.2.8 of Marine Licence L/2015/00351/1 excludes the disposal at sea of dredge material which originates from North and Old Docks at Garston. See Section 6 for further details regarding current Marine Licences issued by the MMO.

5.3 Summary of sediment quality

Sediment samples collected from across the study area show variable concentrations of chemical contaminants, both spatially and temporally. Many of the samples tested have shown levels in excess of AL1, with occasional samples exceeding AL2 (less frequent in recent years). Despite these changing concentrations, marine licences have been issued for the disposal of dredged material at sea from all of the sampling locations (a few exceptions). In deciding to issue a marine licence for disposal at sea, the licensing authority (currently the MMO in England) will have been satisfied that there was no unacceptable risk to the marine environment, given the concentration of chemicals within sediments at the time. It is concluded that, in the absence of any significant worsening of chemical input, the sediment from the sampling locations remains suitable for disposal at sea (except where restrictions are already in place).

Sample plans issued by the MMO, in consultation with Cefas, are commonly including PBDEs as part of the required analysis to inform marine licence applications; however, other than sampling campaigns in 2010 and 2016, there is currently limited baseline data for these parameters in the study area and thus potential issues are unknown.

Table 5.2 Summary of sediment sampling in the study area

Year	Sample Location	Number of Samples (Figure ID)	Figure(s)	Contaminant				
				Metals	Organotins	PAHs	THC	PCBs
1994	River Mersey	11 (no coordinates)	N/A	✓	✓			
2001	Approach Channel and River Mersey	11 (no coordinates)	N/A	✓	✓	✓	✓	✓
2002	River Mersey	6 (no coordinates)	N/A	✓	✓	✓		
2005	River Mersey	6 (no coordinates)	N/A	✓	✓			
2005	Mersey Docks	8 (no coordinates)	N/A	✓	✓	✓	✓	✓
2005	Garston	13 (no coordinates)	N/A	✓	✓	✓	✓	
2006	Garston	30 (no coordinates)	N/A	✓	✓			
2008	Garston	6 (no coordinates)	N/A	✓	✓	✓	✓	✓
2010	Mersey and Birkenhead Docks*	31 (MBD1–MBD12)	Figure 5.3	✓	✓	✓	✓	✓
2010	Mersey Docks	25 (no coordinates)	N/A	✓	✓	✓	✓	✓
2011	Wellington Dock	53 (no coordinates)	N/A	✓	✓			
2012	Mersey Approach Channel	84 (MAC1–MAC10)	Figure 5.2	✓	✓	✓		✓
2013	Approach Channel, River Mersey, Dock Entrances and Eastham Locks	12 (no coordinates)	N/A	✓	✓	✓	✓	
2013	Mersey Channel (C1 Buoy)	10 (C1B1)	Figure 5.2	✓		✓		✓
2014	Approach Channel	20 (MAC11–MAC30)	Figure 5.2	✓		✓		
2014	Mersey Docks	20 (no coordinates)	N/A	✓		✓	✓	
2015	Garston	5 (GAR1–GAR5)	Figure 5.4	✓	✓	✓		
2016	Mersey Approaches, Cammell Laird and Eastham Channel*	17 (MER1–MER17)	Figure 5.2, Figure 5.3, Figure 5.4	✓	✓		✓	✓
2017	Canning Dock	6 (no coordinates)	N/A	✓	✓	✓		✓
2018	Huskisson, Seaforth, Canada, Gladstone and Langton Docks	20 (DOC1–DOC20)	Figure 5.3	✓		✓	✓	
2019	Garston	12 (GAR6–GAR17)	Figure 5.4	✓			✓	
2020	Gladstone Docks (1)	4 (GLD1)	Figure 5.3	✓	✓	✓	✓	✓
2020	Gladstone Docks (2)	27 (GLD2–GLD28)	Figure 5.3	✓	✓	✓	✓	✓
2020	Queen Elizabeth II Dock	18 (QED1–QED4)	Figure 5.4	✓	✓	✓	✓	✓

PAHs – Polycyclic Aromatic Hydrocarbons; THC – Total Hydrocarbon Content; PCBs – Polychlorinated Biphenyls; N/A – not applicable (no coordinates available).
* Analysis also included Organochlorine Pesticides (OCPs) and Polybrominated Diphenyl Ethers (PBDEs).

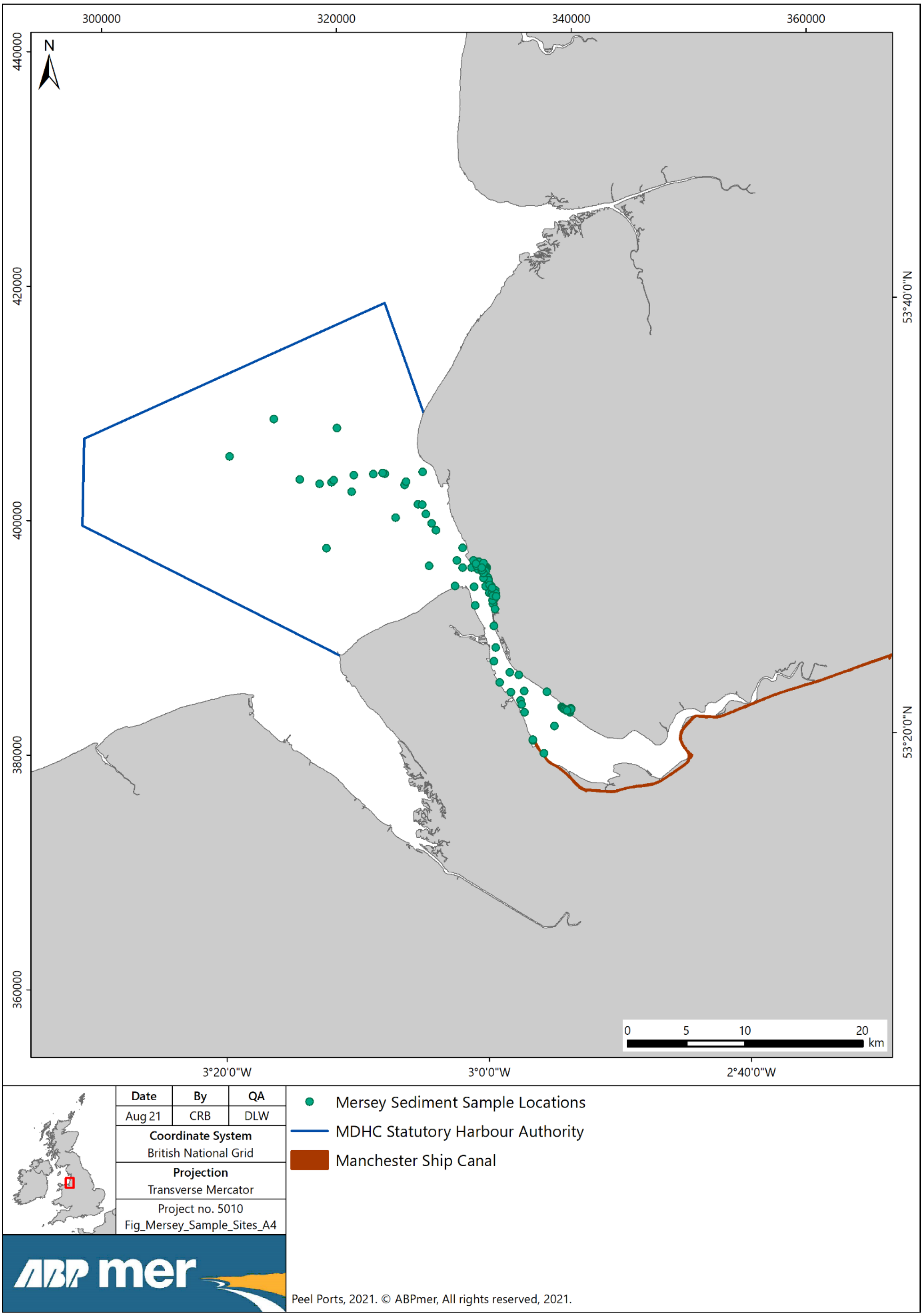


Figure 5.1 Summary of sediment sample locations in the study area

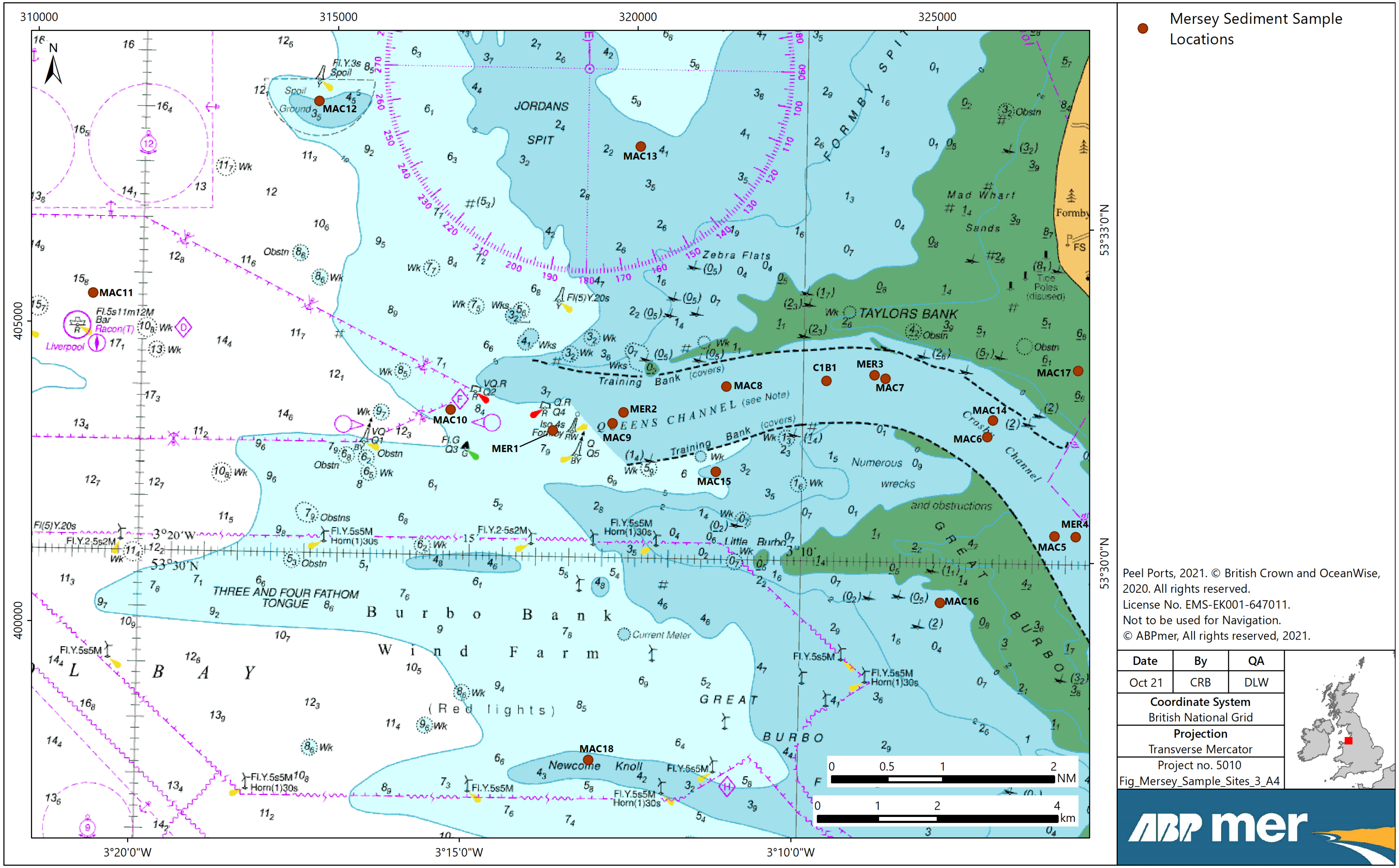
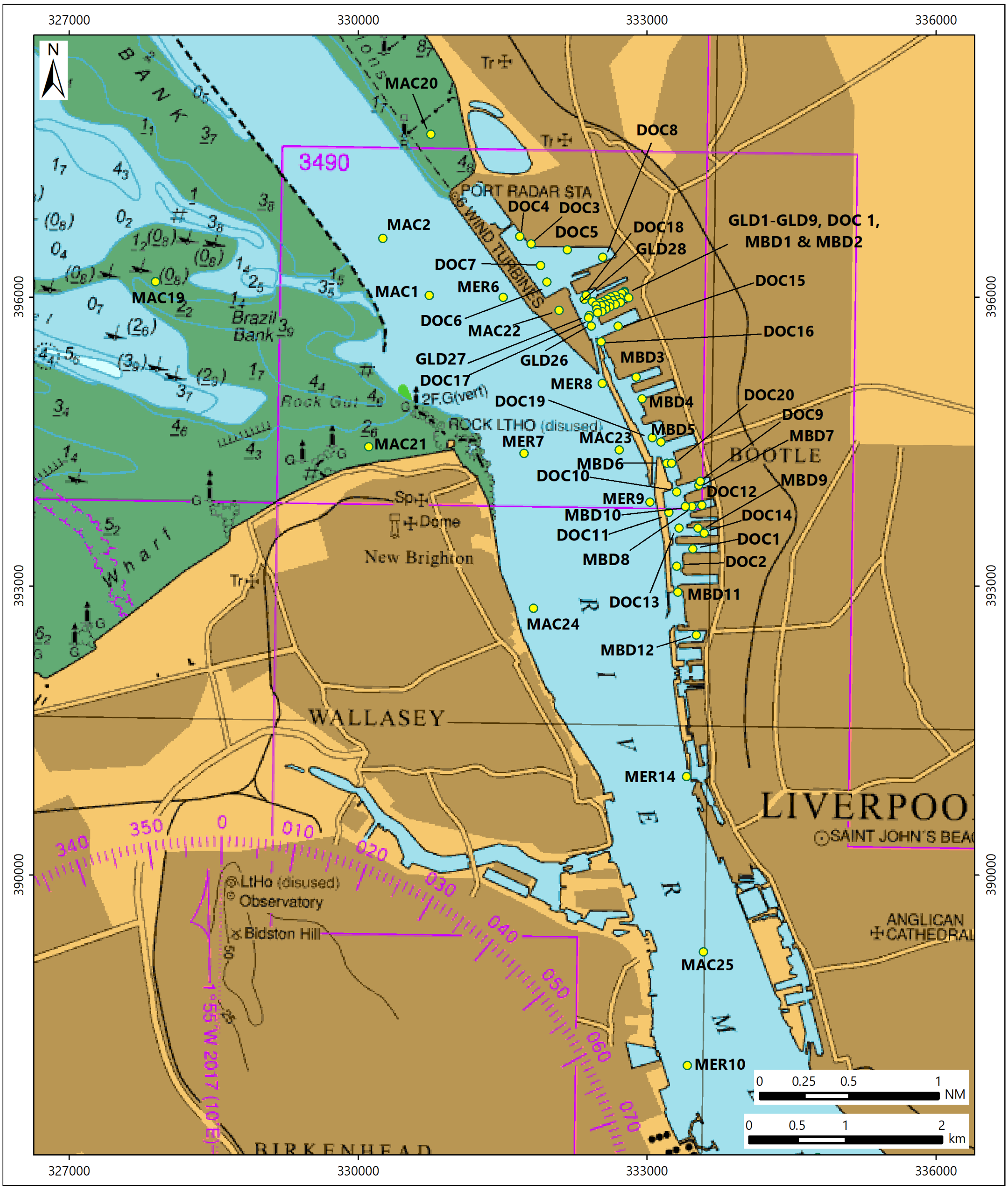
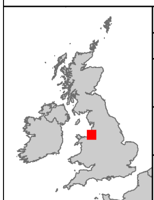


Figure 5.2 Sediment sample locations in the Mersey Approaches





Date	By	QA
Aug 21	CRB	DLW
Coordinate System British National Grid		
Projection Transverse Mercator		
Project no. 5010 Fig_Mersey_Sample_Sites_1_A4		

○ Mersey Sediment Sample Locations

ABPmer

Figure 5.3 Sediment sample locations in The Narrows, Liverpool and Birkenhead Docks

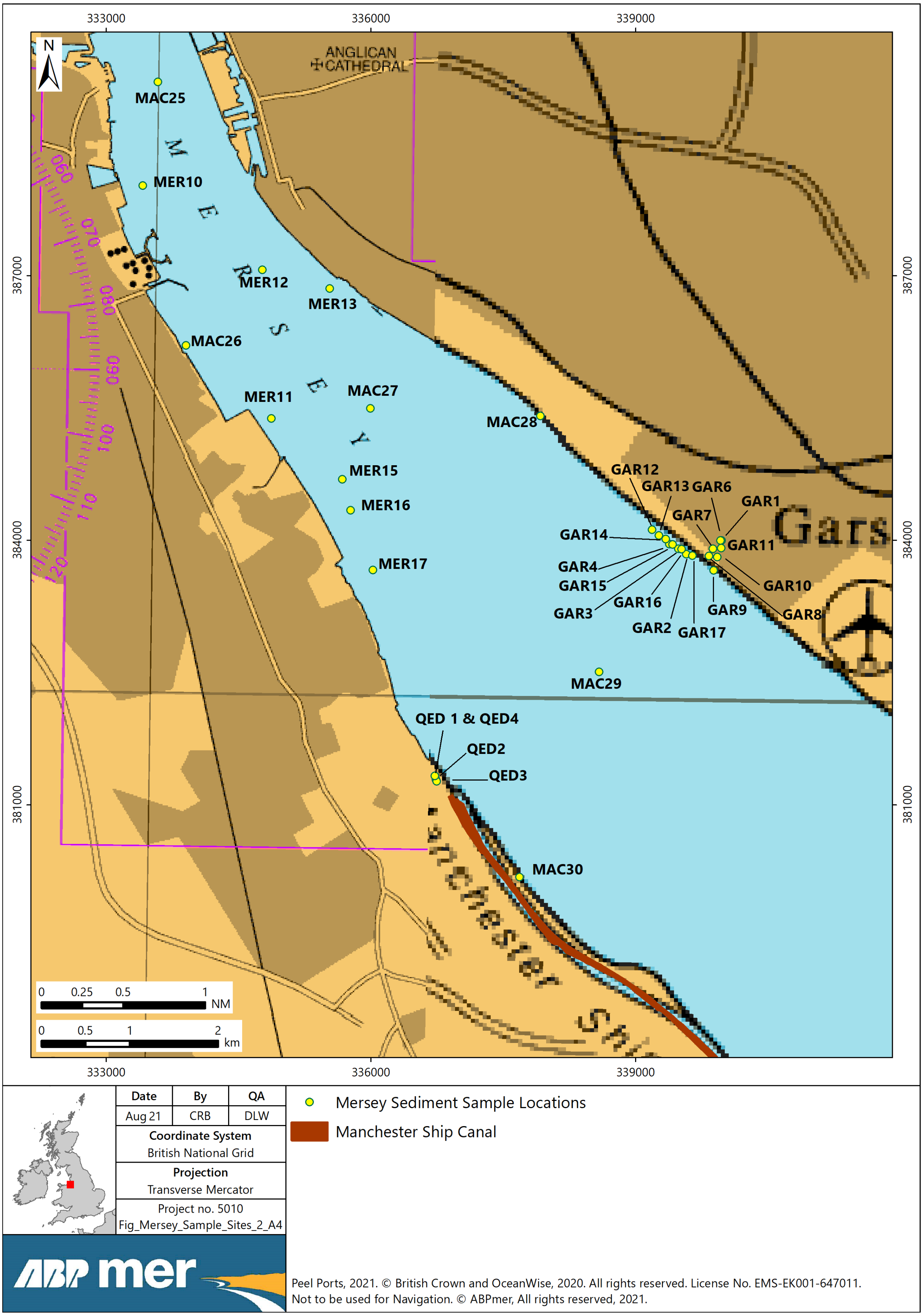


Figure 5.4 Sediment sample locations in the Inner Estuary, Garston and Eastham Channel

6 Marine Licence Information

Three Marine Licences are currently issued (at the time of writing in October 2021) for dredging and/or disposal activities within the Mersey Estuary and Liverpool Bay. It is noted that a Marine Licence obtained by MDHC in relation to dredging and disposal activities for the Mersey Estuary expired in August 2021. It is anticipated that an application to renew this Marine Licence will be submitted to the MMO; therefore, details of this expired Marine Licence have been included to provide context to these activities. This section itemises the current (and recently expired) Marine Licences and selected licence conditions of relevance to the Baseline Document, specifically:

- Mersey River and Approach Channel (Section 6.1);
- Liverpool Impounded Dock System (Section 6.2);
- Liverpool Marina (Section 6.3); and
- ABP Garston (Section 6.4).

6.1 Mersey River and Approach Channel

In August 2018, a three-year Marine Licence (L/2018/00334/1) was issued to MDHC for dredging and subsequent disposal of material originating from within the Mersey Approach Channel, Eastham Channel and River Mersey, Jetties and Cammell Laird. This Marine Licence expired on 13 August 2021. The Marine Licence permitted MDHC to dispose dredge material at three licensed marine disposal sites within the Mersey Estuary and Liverpool Bay area, as outlined in Table 6.1. Table 6.2 presents the project-specific conditions itemised within the Marine Licence issued by the MMO (this is not a full list of conditions; general licence conditions have been omitted). It is noted that licence condition 5.2.6 related to the requirement for the previous version of this MDP Baseline Document (MarineSpace Limited *et al.* 2017) to be approved by the MMO.

Table 6.1 Mersey Estuary (MDHC) total disposal quantities and locations

Disposal Site	Code	Disposal Quantity (Wet Tonnes)	
		Sand (62.5 µm – 2 mm)	Silt (31.25 – 62.5 µm)
Mid River	IS120	-	450,000
Off Bromborough 2	IS128	-	2,400,000
Site Z	IS140	6,300,000	405,000
Total		**6,300,000**	**3,255,000**

Table 6.2 Mersey Estuary (MDHC) project-specific licence conditions

Licence Condition	Description and Reason
5.2.1	Dredged materials must be passed through grid screens no larger than 30 cm. Any man-made material must be separated from the dredged material and disposed of to land.
	Reason: To minimise the amount of man-made materials disposed of at sea.
5.2.2	The licence holder must inform the MMO of the location and quantities of material disposed of each month under this licence. This information must be submitted to the MMO by 15 February each year for the months August to January inclusive, and by 15 August each year for the months February to July inclusive.
	Reason: To allow compliance reporting under the OSPAR Convention agreement as required by Article 4 (3) of Annex II and Article 4(1) of Annex II.

Licence Condition	Description and Reason
5.2.3	The disposal site Mersey Mid-River (IS120) must only be used in the event of bad weather.
	Reason: To ensure material is deposited within the specified disposal sites.
5.2.4	Any oil, fuel or chemical spill within the marine environment must be reported to the MMO Marine Pollution Response Team within 12 hours.
	Reason: To ensure that any spills are appropriately recorded and managed to minimise the risk to sensitive receptors and the marine environment.
5.2.5	The licence holder must notify the local MMO office of the completion of the licensed activities by the licence holder, no later than 10 working days after their completion.
	Reason: To ensure the local MMO officer is aware of the licensed activities at sea occurring within its jurisdiction in order to notify other sea users and to arrange any enforcement visits where appropriate.
5.2.6	Following the completion of the first dredge campaign due to commence August 2018, no further disposal is permitted until The Mersey Maintenance Dredging Protocol Updated Baseline and Assessment Document 2017-2022 is approved by the MMO.
	Reason: To ensure that the Mersey Maintenance Dredging Protocol Updated Baseline and Assessment Document 2017-2022 is sufficient for future disposal activity.

6.2 Liverpool Impounded Dock System

In August 2015, a ten-year Marine Licence (L/2015/00294/1) was issued to MDHC for the dredging and subsequent disposal of material originating from within the Liverpool Impounded Dock System, valid until 25 August 2025. MDHC are permitted to deposit up to 735,000 wet tonnes of silt at both the Mid River (IS120) and Site Z (IS140) licensed marine disposal sites over the duration of the Marine Licence. Table 6.3 presents the project-specific conditions itemised within the Marine Licence issued by the MMO (this is not a full list of conditions; general licence conditions have been omitted). It is noted that licence condition 5.2.12 relates to the provision of the previous version of this MDP Baseline Document (MarineSpace Limited *et al.* 2017).

Table 6.3 Liverpool Impounded Dock System (MDHC) project-specific licence conditions

Licence Condition	Description and Reason
5.2.1	The licence holder must ensure that a notice to mariners is issued 5 days prior to works commencing and a copy sent to the MMO within 7 days of issue.
	Reason: To ensure other vessels in the vicinity can plan and safely conduct their passage.
5.2.2	The licence holder must provide the MMO with the current bathymetry of the areas to be dredged 5 days prior to dredging.
	Reason: To ensure the MMO have the most up to date information.
5.2.3	The licence holder must ensure that no more than 9,500,000 tonnes to be disposed over 10 years to Site Z (IS150) approximately 950,000 per annum, and 2,700,000 tonnes to be disposed over ten years to the Mid River site (IS120). This is a total of 12,200,000 tonnes to both sites (1,220,000 tonnes per annum).
	Reason: To ensure material is deposited within the designated disposal area.
5.2.4	The licence holder must ensure suitable bunding, storage facilities are employed to prevent the release of fuel oils, lubricating fluids associated with the plant and equipment into the marine environment.

Licence Condition	Description and Reason
	Reason: To ensure licence holders are aware of their responsibilities under counter pollution legislation.
5.2.5	The licence holder must ensure that any oil, fuel or chemical spill within the marine environment is reported to the MMO, Marine Pollution Response Team.
	Reason: To ensure that any spills are appropriately recorded and managed to minimise impact to sensitive receptors and general marine environment.
5.2.6	The licence holder must ensure all reasonable precautions are taken to minimise the amount of man-made materials disposed of at sea. Any man-made material must be separated from the dredged material and disposed of to land.
	Reason: To exclude the disposal at sea of man made material such as shopping trolleys, masonry, paint cans etc.
5.2.7	The licence holder must employ best practice to minimise resuspension of sediment during the dredging operations.
	Reason: To prevent the mobilisation of contaminated sediment material.
5.2.8	The licence holder must ensure that the Environment Agency's Pollution Prevention Guidelines for works in or near water (PPG5) are adhered to at all times.
	To ensure that best environmental practice is used at all times.
5.2.9	The licence holder must ensure that no material from West Float, Wellington Dock or Victoria Dock are disposed of at sea, unless further sample analysis is submitted and the material is approved by the MMO as suitable for disposal at sea.
	Reason: To prevent the deposit of contaminated material.
5.2.10	The licence holder must ensure that only material down to 0.5 m within Sandon half-tide dock is disposed of to sea, unless further sample analysis is submitted and the material is approved by the MMO as suitable for disposal at sea
	Reason: To prevent the mobilisation of contaminated material.
5.2.11	The licence holder must ensure that only material down to 1m is disposed of to sea within Gladstone dock (middle branch), unless further sample analysis is submitted and the material is approved by the MMO as suitable for disposal at sea.
	Reason: To prevent the mobilisation of contaminated material.
5.2.12	The licence holder must submit an updated Maintenance Dredge Protocol by 1st August 2016 for approval by the MMO. All dredging and disposal must cease by 1st September 2016 if an agreed updated maintenance dredge protocol is not in place. The updated maintenance dredge protocol must include: justification for changes in dredge quantities; a detailed dredge history over the past ten years for the areas to be dredged; considerations of alternatives to disposal at sea; an updated WFD assessment; a monitoring plan that takes into account quantities to be disposed; and any impact to dredging from the construction of Liverpool II.
	Reason: To ensure the MMO have the most up to date information and that the disposal method is suitable.
5.2.13	The licence holder must ensure that any equipment, temporary structures, waste and/or debris associated with the works are removed upon completion of the works.
	Reason: To prevent the accumulation of unlicensed materials/debris and the potential environmental damage, safety & navigational issues associated with such materials/ debris.

6.3 Liverpool Marina

In February 2021, a nine-year Marine Licence (L/2021/00101/1) was issued to Harbourside Marina Limited for the dredging and subsequent disposal of material originating from within the Liverpool Marina, valid until 31 March 2030. The licence permits the deposit of up to 98,000 wet tonnes of dredge material (silt) back into the River Mersey. This will involve pumping dredge material from a hydraulic dredger in Brunswick Dock along a pipeline into a 'placement area' in the river in front of the form Brunswick Dock (no longer used). Table 6.4 presents the project-specific conditions itemised within the Marine Licence issued by the MMO (this is not a full list of conditions; general licence conditions have been omitted).

Table 6.4 Liverpool Marina project-specific licence conditions

Licence Condition	Description and Reason
5.2.1	Local mariners and fishermen's organisations must be made fully aware of the activity through a local Notice to Mariners. This must be issued at least 5 days before the commencement of the works. The MMO must be sent a copy of the notification within 24 hours of issue.
	Reason: To ensure other vessels in the vicinity can plan and safely conduct their passage.
5.2.2	A notification must be sent to The Source Data Receipt team, UK Hydrographic Office, Taunton of commencement of the licensed activities, at least 5 days before commencement of the works. A copy of the notification must be sent to the MMO within one week of the notification being sent
	Reason: To ensure all necessary amendments to nautical charts and publications are made.
5.2.3	Bunding and/or storage facilities must be installed to contain and prevent the release of fuel, oils, and chemicals associated with plant, refuelling and construction equipment, into the marine environment. Secondary containment must be used with a capacity of no less than 110% of the container's storage capacity.
	Reason: To minimise the risk of marine pollution incidents.
5.2.4	Any oil, fuel or chemical spill within the marine environment must be reported to the MMO Marine Pollution Response Team within 12 hours.
	Reason: To ensure that any spills are appropriately recorded and managed to minimise impact to sensitive receptors and the marine environment.
5.2.5	The disposal of the dredged material into the Mersey should not be carried out over high and low water when there will be no or little tidal current to disperse the sediment.
	Reason: To provide maximum dispersion and minimise sedimentation.
5.2.6	The MMO must be informed of the location and quantities of material disposed of each month under this licence. This information must be submitted to the MMO by 31 January each year for the months August to January inclusive, and by 31 July each year for the months February to July inclusive. When no activity has taken place a null (0) return must be provided.
	Reason: To allow compliance reporting under the OSPAR Convention agreement as required by Article 4 (3) of Annex II and Article 4(1) of Annex II.
5.2.7	A sediment sampling plan request must be submitted to the MMO at least 6 months prior to the end of years 3, 6, 9 (2024, 2027 and 2030). The sediment sampling and analysis must be completed by a laboratory validated by the MMO at least 6 weeks prior to the end of years 3, 6, 9 (2024, 2027 and 2030). The licensed activity must not recommence until written approval is provided by the MMO.
	Reason: To ensure only suitable material is disposed of at sea.

Licence Condition	Description and Reason
5.2.8	A local notification must be sent to the Harbour Authority on completion of the work. Any change data including engineering drawings, hydrographic surveys, details of new or changed aids to navigation must then be sent to the Harbour Authority with the instruction to pass onto the UKHO as per guidance in 'Harbour Master's Guide to Hydrographic and Maritime Information Exchange'. The MMO must be sent a copy of the notification within 24 hours of issue.
	Reason: To ensure accurate navigational information.
5.2.9	A notification must be sent to The Source Data Receipt team, UK Hydrographic Office, Taunton of completion of the licensed activities, no later than 5 days after their completion. A copy of the notification must be sent to the MMO within one week of the notification being sent.
	Reason: To ensure all necessary amendments to nautical charts and publications are made.

6.4 ABP Garston

In October 2015, a ten-year Marine Licence (L/2015/00351/1) was issued to ABP Holdings Limited (ABP Garston) for the dredging and subsequent disposal of material originating from within the Garston Approach Channel and Docks, valid until 06 October 2025. The licence permits the annual deposits of up to 355,000 wet tonnes of sand from the Approach Channel and up to 130,000 wet tonnes of silt from Stalbridge Dock to the Garston Rocks (IS110) licensed marine disposal site. Table 6.5 presents the project-specific conditions itemised within the Marine Licence issued by the MMO (this is not a full list of conditions; general licence conditions have been omitted).

Table 6.5 ABP Garston project-specific licence conditions

Licence Condition	Description and Reason
5.2.1	The licence holder must issue a notice to mariners 5 days prior to works commencing and a copy sent to the MMO within 5 working days of issue.
	Reason: To ensure other vessels in the vicinity can plan and safely conduct their passage.
5.2.2	Water injection dredging must only take place on the flood phase of the tide.
	Reason: To allow dredged material to be carried in to the upper estuary to support habitat extent.
5.2.3	The licence holder must inform the MMO of the location and quantities of material disposed of each month under this licence. This information must be submitted to the MMO by 15 February each year for the months August to January inclusive, and by 15 August each year for the months February to July inclusive.
	Reason: To allow compliance reporting under the OSPAR Convention agreement as required by Article 4 (3) of Annex II and Article 4(1) of Annex II.
5.2.4	The total tonnes of material removed by suction dredger and moved by water injection must not exceed the total tonnes of material removed by suction dredger and bed levelling. To calculate the amount of material moved by water injection dredging compare the pre and post dredge bathymetry survey plot.
	Reason: To ensure that the material disposed of and moved does not exceed the amounts agreed.

Licence Condition	Description and Reason
5.2.5	Any oil, fuel or chemical spill within the marine environment must be reported to the MMO Marine Pollution Response Team within 12 hours.
	Reason: To ensure that any spills are appropriately recorded and managed to minimise the risk to sensitive receptors and the marine environment.
5.2.6	Any man-made material must be separated by the licence holder from the dredged material and disposed of to land.
	Reason: To minimise the amount of man-made materials disposed of at sea.
5.2.7	During the course of disposal, the licence holder must ensure that material is evenly distributed over the disposal site Mersey Garston site IS110.
	Reason: To ensure an even spread of material is achieved over the area of the disposal site in order to avoid shoaling and minimise risk to navigational safety.
5.2.8	The licence holder must not dispose of material from North and Old Docks to sea.
	Reason: To ensure that dredge material with unacceptable levels of contaminants is not disposed of to sea.
5.2.9	The licence holder must not dispose of more than 495,000 tonnes wet weight at Garston site (IS110) per annum.
	Reason: To ensure that acceptable volumes of material can be accommodated within the capacity of the disposal site.
5.2.10	The licence holder must submit a sediment sampling plan request at least 6 months prior to the end of years 4, 7 and 10 from the date of issue.
	Reason: To ensure only suitable material is disposed of at sea.

7 Environmental Information

This section of the Baseline Document introduces national and international designated sites and features in the study area (Section 7.1), and associated conservation advice (Section 7.2), followed by details of relevance to the WFD, including water body status, designated bathing waters and Shellfish Water Protected Areas (Section 7.3).

7.1 Designated sites and features

The Mersey Estuary and its surrounding area are of high nature conservation importance, with large areas of the estuary and the adjacent coastline having been designated as nationally and internationally protected sites. There are currently 11 European/internationally designated sites which overlap or in the vicinity of the maintenance dredge operations and relevant licensed marine disposal sites, including Special Protection Areas (SPAs), Special Areas of Conservation (SACs) and Ramsar Sites, as shown in Figure 7.1. Sites of Special Scientific Interest (SSSIs) largely overlap with the intertidal areas of the European and international designated sites and there are two Marine Conservation Zone (MCZ) within the study area (Figure 7.2).

The MAGIC website (https://magic.defra.gov.uk/) provides maps of marine habitat and species biotope records that contribute to designated Marine Protected Area (MPA) features. This includes Marine Conservation Zone (MCZ) species/habitats of conservation importance and broadscale habitat; Special Protection Area (SPA) supporting habitat; and Special Areas of Conservation (SAC) features/subfeatures. As new evidence of the extent of these features becomes available, these maps are updated.

The key MPA features that are currently mapped in the vicinity of the existing maintenance dredge areas in the Mersey and its approaches and are hydrodynamically linked to these areas are estuaries, intertidal mudflats and sandflats, subtidal sand, intertidal rock and intertidal biogenic reefs. The sensitivity of these features to the pressures from maintenance dredge and disposal activities are assessed in the HRA included in Appendix C.

The following sections discuss European/international and national designated sites, and associated habitat and species features, of relevance to this Baseline Document:

- Special Protection Areas (SPAs) (Section 7.1.1);
- Special Areas of Conservation (SACs) (Section 7.1.2);
- Ramsar sites (Section 7.1.3);
- European Marine Sites (EMS) (Section 7.1.4);
- Sites of Special Scientific Interest (SSSIs) (Section 7.1.5);
- Marine Conservation Zones (MCZs) (Section 7.1.6); and
- Species and habitats of principal importance (Section 7.1.7).

7.1.1 Special Protection Areas

The Birds Directive (79/409/EEC) requires all member states to identify areas to be given special protection for the rare or vulnerable species listed in Annex 1 of the Directive (Article 4.1), for regularly occurring migratory species (Article 4.2) and for the protection of wetlands, especially wetlands of international importance. This legislation has since been transposed into UK legislation by the Habitats Regulations.

These areas are known as SPAs and those relevant to this Baseline Document include (see Figure 7.1)

- Ribble and Alt Estuaries SPA;
- Mersey Estuary SPA;
- Mersey Narrows and North Wirral Foreshore SPA;
- The Dee Estuary/Aber Dyfrdwy SPA; and
- Liverpool Bay/Bae Lerpwl SPA.

Qualifying bird species for each site are provided in Table 7.1. It is noted that since the publication of the previous Baseline Document, the Liverpool Bay/Bae Lerpwl SPA has been extended, adding offshore breeding tern and little gull foraging areas, alongside inshore non-breeding aggregations of common cormorant and red-breasted merganser to the designated feature list. The conservation advice package for Liverpool Bay SPA is currently being updated since the new features were added, and the site was extended in 2017. As this advice has yet to be published, it has not been possible to take account of it in this updated Baseline Document. However, it will be reviewed and considered in the next Baseline Document update.

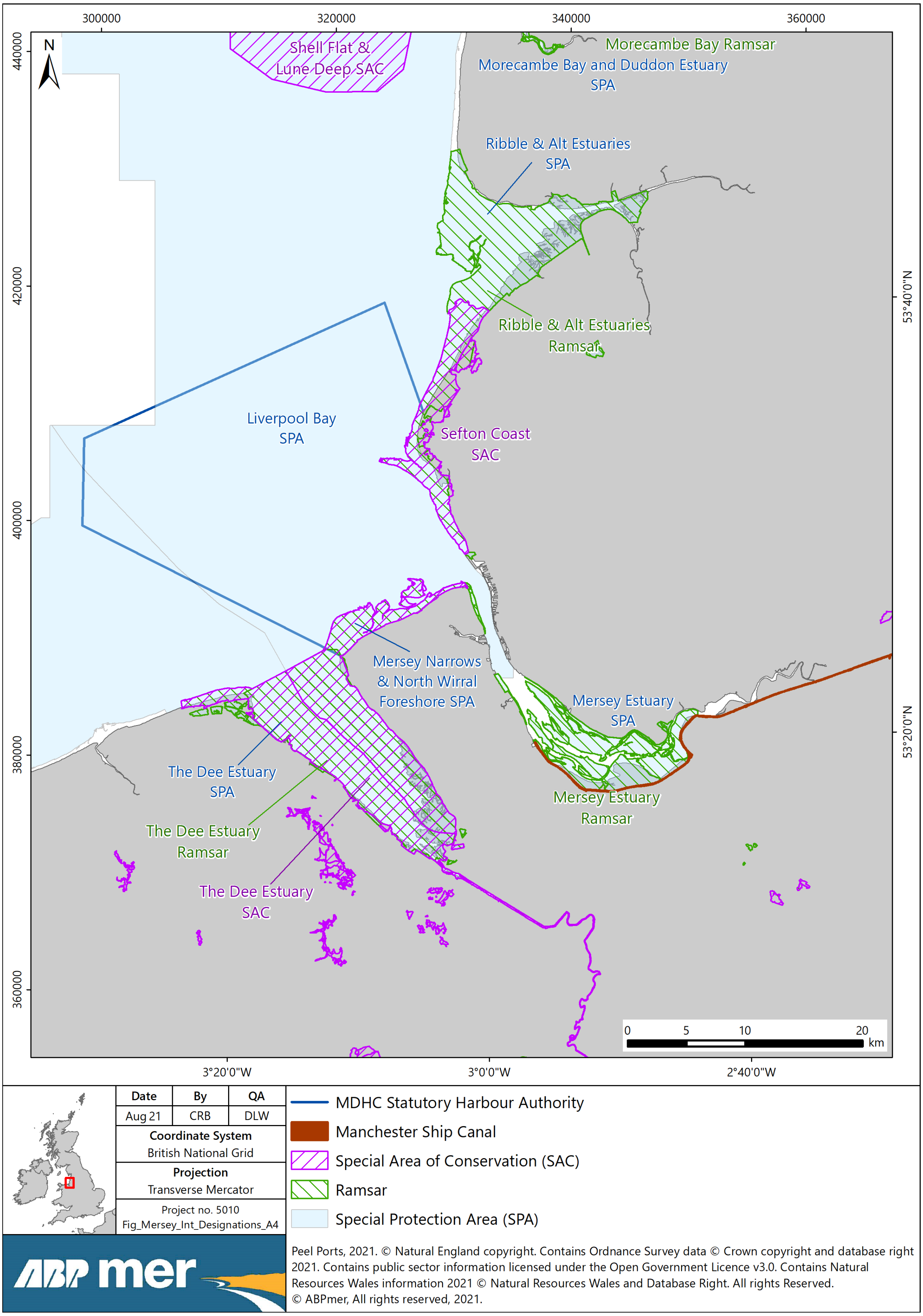


Figure 7.1 European and international nature conservation designated sites in the study area

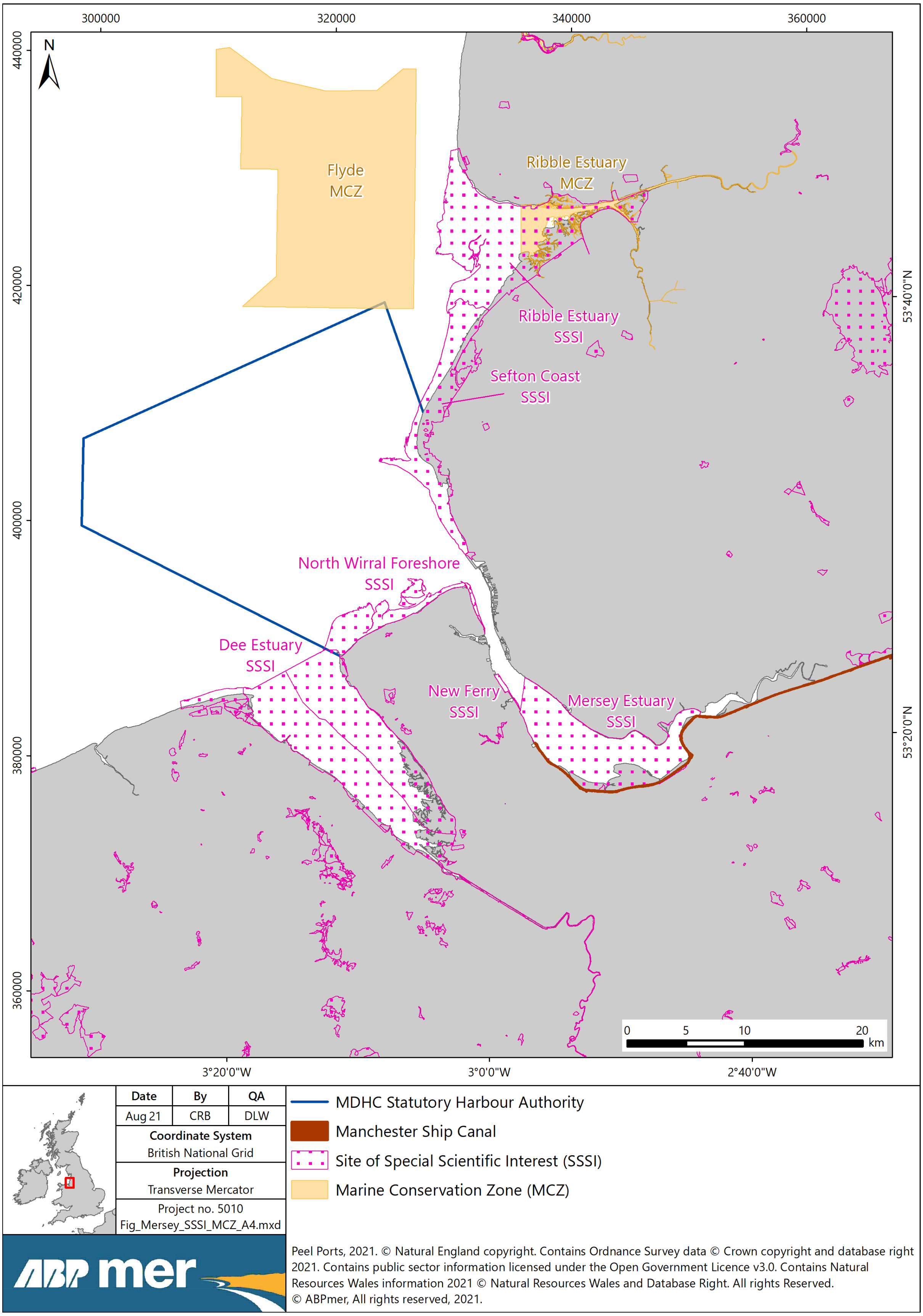


Figure 7.2 SSSIs and MCZs in the study area

Table 7.1 Qualifying bird species of SPAs within the study area

Common Name	Latin Name	Site				
		Ribble and Alt Estuaries SPA	Mersey Estuary SPA	Mersey Narrows and North Wirral Foreshore SPA	The Dee Estuary/ Aber Dyfrdwy SPA	Liverpool Bay/ Bae Lerpwl SPA
Northern pintail	*Anas acuta*	✓ (Wintering)	✓ (Wintering)		✓ (Wintering)	
Eurasian teal	*Anas crecca*	✓ (Wintering)	✓ (Wintering)		✓ (Wintering)	
Eurasian wigeon	*Anas penelope*	✓ (Wintering)	✓ (Wintering)			
Pink-footed goose	*Anser brachyrhynchus*	✓ (Wintering)				
Greater scaup	*Aythya marila*	✓ (Wintering)				
Sanderling	*Calidris alba*	✓ (Wintering/ Concentration)		✓ (Wintering)		
Dunlin	*Calidris alpina alpina*	✓ (Wintering)	✓ (Wintering)	✓ (Wintering)	✓ (Wintering)	
Knot	*Calidris canutus*	✓ (Wintering)		✓ (Wintering)	✓ (Wintering)	
Ringed plover	*Charadrius hiaticula*	✓ (Concentration)	✓ (Concentration)			
Bewick's swan	*Cygnus columbianus bewickii*	✓ (Wintering)				
Whooper swan	*Cygnus cygnus*	✓ (Wintering)				
Red-throated diver	*Gavia stellata*					✓ (Wintering)
Eurasian oystercatcher	*Haematopus ostralegus*	✓ (Wintering)		✓ (Wintering)	✓ (Wintering)	
Little gull	*Larus minutus*			✓ (Concentration)		✓ (Wintering)
Lesser Black-backed gull	*Larus fuscus*	✓ (Breeding)				
Black-headed gull	*Larus ribidundus*	✓ (Breeding)				
Bar-tailed godwit	*Limosa lapponica*	✓(Wintering)		✓ (Wintering)	✓ (Wintering)	
Black-tailed godwit	*Limosa limosa islandica*	✓ (Wintering)	✓ (Wintering)		✓ (Wintering)	
Common scoter	*Melanitta nigra*	✓ (Wintering)				✓ (Wintering)
Curlew	*Numenius arquata*	✓ (Wintering)	✓ (Wintering)		✓ (Wintering)	
Whimbrel	*Numenius phaeopus*	✓ (Concentration)				
Cormorant	*Phalacrocorax carbo*	✓ (Wintering)		✓ (Wintering)		
Ruff	*Philomachus pugnax*	✓ (Breeding)				
Golden plover	*Pluvialis apricaria*	✓ (Wintering)	✓ (Wintering)			

Common Name	Latin Name	Site				
		Ribble and Alt Estuaries SPA	Mersey Estuary SPA	Mersey Narrows and North Wirral Foreshore SPA	The Dee Estuary/ Aber Dyfrdwy SPA	Liverpool Bay/ Bae Lerpwl SPA
Grey plover	*Pluvialis squatarola*	✓ (Wintering)	✓ (Wintering)	✓ (Wintering)	✓ (Wintering)	
Great crested grebe	*Podiceps cristatus*		✓ (Wintering)			
Little tern	*Sterna albifrons*				✓ (Breeding	✓ (Breeding)
Common tern	*Sterna hirundo*	✓ (Breeding)		✓ (Breeding/ Concentration)	✓ (Breeding)	✓ (Breeding)
Sandwich tern	*Sterna sandvicensis*				✓ (Concentration)	
Common shelduck	*Tadorna tadorna*	✓ (Wintering)	✓ (Wintering)		✓ (Wintering)	
Common redshank	*Tringa totanus*	✓ (Wintering/ Concentration)	✓ (Wintering/ Concentration)	✓ (Wintering)	✓ (Wintering/ Concentration)	
Lapwing	*Vanellus Vanellus*	✓ (Wintering)	✓ (Wintering)			

Source: Natural England's Designated Sites View (https://designatedsites.naturalengland.org.uk; Accessed August 2021)

7.1.2 Special Areas of Conservation

The Habitats Directive (92/43/EEC) requires the establishment of a network of important high-quality conservation sites that will make a significant contribution to conserving habitat types and species identified in Annexes I and II of the Directive. There are two SACs within the study area of this Baseline Document, namely (see Figure 7.1);

- Dee Estuary/Aber Dyfrdwy SAC; and
- Sefton Coast SAC.

The Annex I habitats and Annex II species which form the basis of these designations are summarised in Table 7.2.

Table 7.2 Protected habitats and species of SACs in study area

Site	Annex	Description
Dee Estuary/Aber Dyfrdwy SAC	Annex I Habitats	Estuaries (1130)
		Mudflats and sandflats not covered by seawater at low tide (1140)
		Annual vegetation of drift lines (1210)
		Vegetated sea cliffs of the Atlantic and Baltic Coasts (1230)
		Salicornia and other annuals colonising mud and sand (1310)
		Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) (1330)
		Embryonic shifting dunes (2110)
		Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) (2120)
		Fixed coastal dunes with herbaceous vegetation (grey dunes) (2130; Priority feature)
		Humid dune stacks (2190)
	Annex II Species	Sea Lamprey (*Petromyzon marinus*) (1095)
		River lamprey (*Lampetra fluviatilis*) (1099)
		Petalwort (*Petalophyllum ralfsii*) (1395)
Sefton Coast SAC	Annex I Habitats	Embryonic shifting dunes (2110)
		Shifting dunes along the shoreline with *Ammopilia arenaria* (white dunes) (2120)
		Fixed coastal dunes with herbaceous vegetation (grey dunes) (2130; Priority feature)
		Atlantic decalcified salt meadows (2150; Priority feature)
		Dunes with *Salix repens* ssp. *Argentea* (*Salicon arenariae*) (2170)
		Humid dune stacks (2190)
	Annex II Species	Great crested newt (*Triturus cristatus*) (1166)
		Petalwort (*Petalophyllum ralfsii*) (1395)

Source: Natural England's Designated Sites View (https://designatedsites.naturalengland.org.uk; Accessed August 2021)

7.1.3 Ramsar Sites

Under the 1971 Ramsar Convention on Wetlands of International Importance, it is a requirement of signatory states to protect wetland sites of international importance, including those that are important waterfowl habitats. There are four Ramsar sites relevant to this Baseline Document, including (see Figure 7.1):

- Ribble and Alt Estuaries Ramsar;
- Mersey Estuary Ramsar;
- Mersey Narrows and North Wirral Foreshore Ramsar; and
- The Dee Estuary Ramsar.

An overview of the reasons for designations (Ramsar Criterion) is included in Table 7.3.

Table 7.3 Qualifying criteria of Ramsar sites in study area

Site	Qualifying Criteria
Ribble and Alt Estuaries Ramsar	Ramsar Criterion 2 - This site supports up to 40% of the Great Britain population of Natterjack toads *Bufo calamita*.
	Ramsar Criterion 5 – Assemblages of international importance. Species with peak counts in winter: 222,038 waterfowl (5-year peak mean 1998/99-2002/2003).
	Ramsar Criterion 6 – Species/populations occurring at levels of international importance. Qualifying Species/populations (as identified at designation). Species regularly supported during the breeding season: Lesser black-backed gull (Larus *fuscus graellsii*). Species with peak counts in spring/autumn: Ringed plover (*Charadrius hiaticula*), Grey plover (*Pluvialis squatarola*), Red knot (*Calidris canutus islandica*), Sanderling (*Calidris alba*), Dunlin (*Calidris alpina alpina*), Black-tailed godwit (*Limosa limosa islandica*), Common redshank (*Tringa totanus totanus*) and Lesser black-backed gull (*Larus fuscus graellsii*). Species with peak counts in winter: Tundra swan (*Cygnus columbianus bewickii*), Whooper swan (*Cygnus cygnus*), Pink-footed goose (*Anser brachyrhynchus*), Common shelduck (*Tadorna tadorna*), Eurasian wigeon (*Anas penelope*), Eurasian teal (*Anas crecca*), Northern pintail (*Anas acuta*), Eurasian oystercatcher (*Haematopus ostralegus ostralegus*) and Bar-tailed godwit (*Limosa lapponica lapponica*).
Mersey Estuary Ramsar	Ramsar Criterion 5 – Assemblages of international importance. Species with peak counts in winter: 89,576 waterfowl (5-year peak mean 1998/99-2002/2003).
	Ramsar Criterion 6 – Species/populations occurring at levels of international importance. Qualifying Species/populations (as identified at designation). Species with peak counts in spring/autumn: Common shelduck (*Tadorna tadorna*), Black-tailed godwit (*Limosa limosa islandica*), Common redshank, (*Tringa totanus totanus).* Species with peak counts in winter: Eurasian teal *(Anas crecca),* Northern pintail, *(Anas acuta),* Dunlin *(Calidris alpina alpina).*
Mersey Narrows and North Wirral Foreshore Ramsar	Ramsar Criterion 4 – During 2004/05-2008/09, the site supported important numbers of non-breeding little gulls and common terns.
	Ramsar Criterion 5 – Assemblages of international importance. Species with peak counts in winter: 32,402 waterfowl (5-year peak mean 2004/05-2008/09).
	Ramsar Criterion 6 - Species/populations occurring at levels of international importance. Qualifying Species/populations occurring in any season (as identified at designation): Red knot (*Calidris canutus islandica*) and Bar-tailed godwit (*Limosa lapponica*).

Site	Qualifying Criteria
The Dee Estuary Ramsar	Ramsar Criterion 1 – Extensive intertidal mud and sand flats (20 km by 9 km) with large expanses of saltmarsh towards the head of the estuary. Habitats Directive Annex I features present include: Estuaries (H1130), Mudflats and sandflats not covered by seawater at low tide (H1140), Annual vegetation of drift lines (H1210), Vegetated sea cliffs of the Atlantic and Baltic coasts (H1230), *Salicornia* and other annuals colonising mud and sand (H1310), Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) (H1330), Embryonic shifting dunes (H2110), Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes") (H2120), Fixed dunes with herbaceous vegetation ("grey dunes") (H2130) and Humid dune slacks (H2190).
	Ramsar Criterion 2 – The site supports breeding colonies of the vulnerable Natterjack toad *Epidalea calamita*.
	Ramsar Criterion 5 – Assemblages of international importance: Species with peak counts in winter: Non-breeding season regularly supports 120,726 individual waterbirds (5-year peak mean 1994/5-1998/9).
	Ramsar Criterion 6 – Species/populations occurring at levels of international importance. Qualifying Species/populations (as identified at designation). Species with peak counts in spring/autumn: Redshank (*Tringa totanus*). Species with peak counts in winter: Teal (*Anas cracca*), Shelduck (*Tadorna tadorna*), Oystercatcher (*haematopus ostralegus*), Curlew (*Numenius arquata*), Pintail (*Anas acuta*), Grey plover (*Pluvialis squatarola*), Knot (*Calidris canatus islandica*), Dunlin (*Calidris alpina alpina*), Black-tailed godwit (*Limosa limosa isandica*), Bar-tailed godwit (*Limosa lapponica*) and Redshank (*Tringa totanus*).

Source: Natural England's Designated Sites View (https://designatedsites.naturalengland.org.uk; Accessed August 2021)

7.1.4 European Marine Sites

A European Marine Site (EMS) is the collective term for SACs and SPAs that are covered by tidal water (continuously or intermittently) and protect some of Britain's most special marine and coastal habitats and species of European importance. In accordance with Government advice in both England and Wales, Ramsar sites must be given the same consideration as European sites when considering plans and projects which might affect them.

EMS within the study area include the Ribble and Alt Estuaries, Mersey Estuary, Mersey Narrows and North Wirral Foreshore, Dee Estuary, Sefton Coast and Liverpool Bay, which are all of international significance for the biodiversity they support. EMS often form from a number of constituent sites. For example, the Dee Estuary/Aber Dyfrdwy EMS is formed from the respective SPA and SAC sites.

7.1.5 Sites of Special Scientific Interest

The Wildlife and Countryside Act 1981 provides for the designation and management of SSSIs. These sites are designated to safeguard, for present and future generations, the diversity and geographic range of habitats, species, and geological and physiographical features, including the full range of natural and semi-natural ecosystems and of important geological and physiographical phenomena throughout England and Wales. The Countryside and Rights of Way Act 2000 also provides for public access, on foot, to certain types of land; amends the law for public rights of way; increases protection for SSSIs and strengthens wildlife enforcement legislation; and provides for better management of Areas of Outstanding Natural Beauty (AONB).

SSSIs within the study area include (see Figure 7.2):

- Dee Estuary SSSI;
- Mersey Narrows SSSI;
- Mersey Estuary SSSI;
- New Ferry SSSI;
- North Wirral Foreshore SSSI;
- Red Rocks SSSI;
- Ribble Estuary SSSI; and
- Sefton Coast SSSI.

Most features within these SSSIs are protected through European/international designations. Where the SSSIs uniquely protect intertidal features not covered by the European or International designations, the potential impacts to these SSSI features also need to be considered. There are no interaction pathways between dredging activities and terrestrial features protected by these SSSIs, therefore SSSI features not covered by European and International designations have not been considered further.

7.1.6 Marine Conservation Zones

There are two MCZs present within the wider study area, namely the Flyde MCZ and Ribble Estuary MCZ (see Figure 7.2). Protected features of these two nationally designated sites are provided in Table 7.4. It should be noted that the Sefton Coast recommended MCZ (rMCZ), as reported in the previous version of this MDP Baseline Document (MarineSpace Limited *et al.*, 2017) was not taken forward in the latest tranche of designations.

Table 7.4 MCZs and protected features in the study area

Site	Protected Features	General Management Approach
Flyde MCZ	Subtidal mud	Maintain in favourable condition
	Subtidal sand	
Ribble Estuary MCZ	Smelt (*Osmerus eperlanus*)	Recover to favourable condition

7.1.7 Species and habitats of principal importance

A list of species and habitats of principal importance has been developed under Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006. The Section 41 list contains numerous species and habitats of principal importance which occur in England. Those identified within the vicinity of the Mersey Estuary, with benthic relevance, include:

- Coastal saltmarsh;
- Coastal sand dunes;
- Estuarine rocky habitats;
- Intertidal mudflats;
- Maritime cliff and slopes;
- Peat and clay exposures;
- Subtidal sands and gravels;
- Tide swept channels;
- Petalwort (*Petalophyllum ralfsii*);
- River lampey (*Lampetra fluviatilis*);
- Sea lamprey (*Petromyzon marinus*); and
- Smelt (*Osmerus eperlanus*).

7.2 Conservation advice

Natural England has a statutory responsibility to advise relevant authorities in England as to the conservation objectives for EMS, as well as operations which may cause deterioration or disturbance of natural habitats and species. This advice is provided under Regulation 37 of the Habitats Regulations (formerly Regulation 35). The role of the conservation objectives for an EMS is to define the nature conservation aspirations for the features of interest, thereby representing the aims and requirements of the Habitats and Birds Directives in relation to the site. Natural England has updated conservation advice for most EMS in England, available via the Designated Sites View[7], while advice for transboundary sites which overlap England and Wales has also been informed by Natural Resources Wales (NRW).

The Conservation Objectives for the Dee Estuary/Aber Dyfrdwy SAC and Sefton Coast SAC are as follows (both refer to the same text):

- The objectives are to ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the Favourable Conservation Status of its qualifying features, by maintaining or restoring:
  - The extent and distribution of qualifying natural habitats and habitats of qualifying species;
  - The structure and function (including typical species) of qualifying natural habitats;
  - The structure and function of the habitats of qualifying species;
  - The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely;
  - The populations of qualifying species; and
  - The distribution of qualifying species within the site.

The Conservation Objectives for the Ribble and Alt Estuaries SPA, Mersey Estuary SPA, Mersey Narrows and North Wirral Foreshore SPA, The Dee Estuary/Aber Dyfrdwy SPA and Liverpool Bay/Bae Lerpwl SPA are as follows (each referring to the same text):

- The objectives are to ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:
  - The extent and distribution of the habitats of the qualifying features;
  - The structure and function of the habitats of the qualifying features;
  - The supporting processes on which the habitats of the qualifying features rely;
  - The population of each of the qualifying features; and
  - The distribution of the qualifying features within the site.

Favourable condition status has not yet been defined specifically for all the European/Ramsar sites; however, condition assessments of the respective SSSIs (see Figure 7.2) which cover virtually the same geographic extent as the European/Ramsar sites (Figure 7.1) have been undertaken by Natural England. Advice on Operations has also been prepared by Natural England for SACs, SPAs and MCZs to identify pressures associated with the most commonly occurring marine activities to designated features and subfeatures, including the potential impact of maintenance dredging. It provides a detailed assessment of sensitivity for each feature/subfeature or supporting habitat to these pressures. Conservation objectives, latest condition assessment and the assessment of marine activities, pressures and any supporting evidence can be found on Natural England's Designated Sites Viewer.

7 https://designatedsites.naturalengland.org.uk (Accessed August 2021).

A breakdown of the latest condition assessments for each SSSI within the study area can be found in Appendix B, with a summary of these results being presented in Table 7.5. Of the eight SSSIs within the study area, seven sites see >50% favourable/unfavourable recovering status within their constituent units. The remaining site, North Wirral Foreshore SSSI, reports 0.00% favourable/ unfavourable recovering status as a proportion of land area, with 100% identified as unfavourable declining. An assessment of birds at the site in October 2012 suggested numbers of Turnstone and Bar-tailed godwit were unfavourable. Turnstone numbers appear to have declined due to a loss of feeding habitat at Egremont Foreshore. There is circumstantial evidence that numbers of Bar-tailed godwit have declined due to disturbance and displacement from roosts at North Wirral Foreshore, moving to other sites during the high tide. These deleterious effects are unlikely to be influenced by dredging activity or deposition into the licensed marine disposal sites.

Table 7.5 Favourable condition status of SSSIs in the study area

Favourable Condition Status	Site							
	Dee Estuary SSSI	Mersey Estuary SSSI	Mersey Narrows SSSI	New Ferry SSSI	North Wirral Foreshore SSSI	Red Rocks SSSI	Ribble Estuary SSSI	Sefton Coast SSSI
% Area Favourable	100.00	29.32	22.27	0.00	0.00	0.00	99.11	70.24
% Area Unfavourable Recovering	0.00	26.38	77.73	100.00	0.00	71.62	0.00	21.75
% Area Unfavourable No Change	0.00	44.30	0.00	0.00	0.00	0.00	0.89	4.94
% Area Unfavourable Declining	0.00	0.00	0.00	0.00	100.00	28.38	0.00	3.07
% Area Destroyed/Part Destroyed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: Natural England's Designated Sites View (https://designatedsites.naturalengland.org.uk; Accessed August 2021)

7.3 Water Framework Directive

The WFD (2000/60/EC) came into force in 2000 and establishes a framework for the management and protection of Europe's water resources. It was implemented in England and Wales through the Water Environment (WFD) (England and Wales) Regulations 2003 (the Water Framework Regulations). These Regulations were revoked and replaced in April 2017 by the Water Environment (WFD) (England and Wales) Regulations 2017 (noting, these were modified by the Floods and Water (Amendment etc.) (EU Exit) Regulations 2019 on 31 January 2020). The overall objective of the WFD is to achieve good status (GS) in all inland, transitional, coastal and ground waters by 2021 (original objective was by 2015), unless alternative objectives are set and there are appropriate reasons for time limited derogation.

The WFD divides rivers, lakes, lagoons, estuaries, coastal waters (out to 1 nm from the low water mark), man-made docks and canals into a series of discrete surface water bodies. It sets ecological as well as chemical targets (objectives) for each surface water body. For a surface water body to be at overall GS, the water body must be achieving good ecological status (GES) and good chemical status (GCS). Ecological status is measured on a scale of high, good, moderate, poor or bad, while chemical status is measured as good or fail (i.e. failing to achieve good).

Each surface water body has a hydromorphological designation that describes how modified a water body is from its natural state. Water bodies are either undesignated (i.e. natural, unchanged), designated as a heavily modified water body (HMWB) or designated as an artificial water body (AWB). HMWBs are defined as bodies of water which, as a result of physical alteration by human use activities (such as flood protection and navigation) are substantially changed in character and cannot therefore meet GES. AWBs are artificially created through human activity. The default target for HMWBs and AWBs under the WFD is to achieve good ecological potential (GEP), a status recognising the importance of their human use while ensuring ecology is protected as far as possible.

The ecological status/potential of surface waters is classified using information on the biological (e.g. fish, benthic invertebrates, phytoplankton, angiosperms and macroalgae), physico-chemical (e.g. dissolved oxygen and dissolved inorganic nitrogen) and hydromorphological (e.g. hydrological regime) quality of the water body, as well as several specific pollutants (e.g. copper and zinc). Compliance with chemical status objectives is assessed in relation to environmental quality standards (EQS) for a specified list of 'priority' and 'priority hazardous' substances. These substances were first established by the Priority Substances Directive (PSD) (2008/105/EC) which entered into force in 2009.

The PSD sets objectives, amongst other things, for the reduction of these substances through the cessation of discharges or emissions. As required by the WFD and PSD, a proposal to revise the list of priority (hazardous) substances was submitted in 2012. Subsequently, an updated PSD (2013/39/EU) was published in 2013, identifying new priority substances, setting EQSs for those newly identified substances, revising the EQS for some existing substances in line with scientific progress and setting biota EQSs for some existing and newly identified priority substances. The updated PSD is transposed into UK legislation through the Water Environment Regulations and supported by further detail in the WFD (Standards and Classification) Directions (England and Wales) 2015.

In addition to surface water bodies, the WFD also incorporates groundwater water bodies. Groundwaters are assessed against different criteria compared to surface water bodies since they do not support ecological communities (i.e. it is not appropriate to consider ecological status of a groundwater). Therefore, groundwater water bodies are classified as good or poor quantitative status in terms of their quantity (groundwater levels and flow directions) and quality (pollutant concentrations and conductivity), along with chemical (groundwater) status.

River Basin Management Plans (RBMPs) are a requirement of the WFD, setting out measures for each river basin district to maintain and improve quality in surface and groundwater water bodies where necessary. In 2009, the Environment Agency published the first cycle (2009 to 2015) of RBMPs for England and Wales, reporting the status and objectives of each individual water body. The Environment Agency subsequently published updated RBMPs for England as part of the second cycle (2015 to 2021), as well as providing water body classification results from 2015 and interim classifications via the Catchment Data Explorer[8]. The study area around the Mersey Estuary is located within the North West River Basin District which is reported in the North West RBMP (Environment Agency, 2016). It is noted that the Dee River Basin District, for which the Dee RBMP is led and published by NRW (2015), is located to the west of the study area. The latest water body classifications for the North Wales coast are available via Water Watch Wales[9].

Consideration of WFD requirements is necessary for activities which have the potential to cause deterioration in ecological, quantitative and/or chemical status of a water body or to compromise improvements which might otherwise lead to a water body meeting its WFD objectives. Therefore, it is

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8 https://environment.data.gov.uk/catchment-planning (Accessed August 2021).
9 https://waterwatchwales.naturalresourceswales.gov.uk/en (Accessed August 2021).

necessary to consider the potential for maintenance dredging and disposal activities to impact WFD water bodies, specifically referring to the following environmental objectives of the WFD:

- Prevent deterioration in status of all surface water bodies (Article 4.1 (a)(i));
- Protect, enhance and restore all surface water bodies with the aim of achieving good surface water status by 2015 (now working towards 2021) or later assuming grounds for time limited derogation (Article 4.1 (a)(ii));
- Protect and enhance all HMWBs/AWBs, with the aim of achieving GEP and GCS by 2015 (now working towards 2021) or later assuming grounds for time limited derogation (Article 4.1 (a)(iii));
- Reduce pollution from priority substances and cease or phase out emissions, discharges and losses of priority hazardous substances (Article 4.1 (a)(iv));
- Prevent or limit the input of pollutants into groundwater and prevent deterioration of the status of all groundwater water bodies (Article 4.1 (b)(i));
- Protect, enhance and restore all groundwater water bodies and ensure a balance between abstraction and recharge of groundwater (Article 4.1 (b)(ii));
- Ensure achievement of objectives in other water bodies is not compromised (Article 4.8); and
- Ensure compliance with other community environmental legislation (Article 4.9).

In 2016, the Environment Agency published guidance, referred to as Clearing the Waters for All[10], regarding how to assess the impact of activities in transitional and coastal waters.

7.3.1 Water bodies in the study area

The current status of water bodies in the North West River Basin District is given in the Cycle 2 of the North West RBMP (Environment Agency, 2016) and Dee RBMP (NRW, 2015), with interim classifications provided via the Environment Agency's Catchment Data Explorer[11] and Water Watch Wales[12]. The study area around the Mersey Estuary includes the following transitional and coastal water bodies (see Figure 2.1):

- Alt transitional water body (ID: GB531206908300);
- Dee (N.Wales) transitional water body (ID: GB531106708200);
- Mersey transitional water body (ID: GB531206908100);
- Mersey Mouth coastal water body (ID: GB641211630001);
- North Wales coastal water body (ID: GB641011650000); and
- Ribble transitional water body (ID: GB531207112400).

The Ribble transitional water body (GB531207112400) is within the study area; however, it has been screened out of this Baseline Document due to its boundary location of more than 5 km from dredge areas and licensed marine disposal sites. Numerous riverine (freshwater) water bodies drain into the transitional and coastal water bodies around the Mersey Estuary, while groundwaters underlay the terrestrial margins. These water bodies have also been screened out of this Baseline Document as maintenance dredging and disposal activities are unlikely to result in adverse effects (e.g. riverine water bodies are beyond the normal tidal limit (NTL) or behind a sluice/weir, while works are unlikely to result in saline intrusion for groundwaters).

Table 7.6 provides a summary of water body status (based on interim classifications from 2019 in England and 2018 in Wales) for the transitional and coastal water bodies screened into the Baseline Document. All five water bodies are currently failing to achieve GS, consistently as a result of moderate

10 https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters (Accessed August 2021).

11 https://environment.data.gov.uk/catchment-planning (Accessed June 2021).

12 https://waterwatchwales.naturalresourceswales.gov.uk/en (Accessed August 2021).

ecological potential and failing chemical status. In terms of chemical status, of those water bodies assessed, the priority hazardous substance Mercury and its compounds was reported as 'fail' for all five water bodies, with Polybrominated diphenyl ethers (PBDEs) also failing within four water bodies.

Table 7.6 Summary of water body status in the study area

Water Body Name (Code and Designation)	Current Overall Status	Parameters Currently Failing to Achieve Good
Mersey (GB531206908100, HMWB)	Moderate (moderate ecological potential; failing chemical status)	Mitigation measures assessment (moderate or less); Invertebrates (moderate); Phytoplankton (moderate); Dissolved inorganic nitrogen (moderate); Zinc (moderate); Dichlorvos (fail); Polybrominated diphenyl ethers (PBDE) (fail); Benzo(ghi)perylene (fail); Heptachlor and cis-heptachlor epoxide (fail); Mercury and its compounds (fail).
Mersey Mouth (GB641211630001, HMWB)	Moderate (moderate ecological potential; failing chemical status)	Phytoplankton (moderate); Dissolved inorganic nitrogen (moderate); Mitigation measures assessment (moderate or less); Mercury and its compounds (fail); Polybrominated diphenyl ethers (PBDE) (fail); Benzo(ghi)perylene (fail).
Alt (GB531206908300, HMWB)	Moderate (moderate ecological potential; failing chemical status)	Mitigation measures assessment (moderate or less); Polybrominated diphenyl ethers (PBDE) (fail); Mercury and its compounds (fail).
Dee (N. Wales) (GB531106708200, HMWB)	Moderate (moderate ecological potential; failing chemical status)	Dissolved inorganic nitrogen (moderate); Polybrominated diphenyl ethers (PBDE) (fail); Mercury and its compounds (fail); Trichlorobenzene (fail).
North Wales (GB641011650000, HMWB)	Moderate (moderate ecological potential; failing chemical status)	Phytoplankton (moderate); Mercury and its compounds (fail).

Source: Environment Agency's Catchment Data Explorer (https://environment.data.gov.uk/catchment-planning) and Water Watch Wales (https://waterwatchwales.naturalresourceswales.gov.uk/en)

7.3.2 Water quality - Bathing Waters Directive

The revised Bathing Water Directive (2006/7/EC) was adopted in 2006, updating the microbiological and physico-chemical standards set by the original Bathing Water Directive (76/160/EEC) and the process used to measure/monitor water quality at identified bathing waters. The revised Bathing Water Directive focuses on fewer microbiological indicators, whilst setting higher standards, compared to those of the original Bathing Water Directive. Bathing waters under the revised Bathing Water Directive are classified as excellent, good, sufficient or poor according to the levels of certain types of bacteria (intestinal enterococci and *Escherichia coli*) in samples obtained during the bathing season (May to September).

The original Bathing Water Directive was repealed at the end of 2014 and monitoring of bathing water quality has been reported against revised Bathing Water Directive indicators since 2015. The new classification system considers all samples obtained during the previous four years and, therefore, data has been collected for revised Bathing Water Directive indicators since 2012. The Directive aims to protect the environment and public health, and maintain amenity use of designated bathing waters (fresh and saline) by reducing the risk of pollution. It requires popular bathing waters to be 'designated' and monitored for water quality, particularly for human waste from sewage treatment works or agricultural waste.

During the 2019 bathing season (from 15 May to 30 September each year)[13], there were 420 identified and monitored bathing waters in England, 105 in Wales, 85 in Scotland and 26 in Northern Ireland; thus, a total of 636 bathing waters across the UK. Nearly all bathing waters in England (98.3%) met the new minimum standards required by the revised Bathing Waters Directive and 71.4% met the very highest Excellent standard, compared to 63.6% in 2015.

The closest designated bathing waters to the study area are Wallasey, Moreton, Meols, West Kirby, Formby, Ainsdale, and Southport (Figure 7.3). Water quality classifications for the period 2016 to 2019 are provided in Table 7.7.

Table 7.7 Bathing water quality classifications in study area (2016-2019)

Bathing Water	2016	2017	2018	2019
Wallasey	Excellent	Good	Good	Good
Moreton	Excellent	Excellent	Excellent	Excellent
Meols	Excellent	Excellent	Excellent	Excellent
West Kirby	Excellent	Excellent	Excellent	Excellent
Formby	Excellent	Excellent	Excellent	Excellent
Ainsdale	Good	Good	Good	Good
Southport	Good	Good	Good	Good

Source: Environment Agency's Bathing Water Quality (https://environment.data.gov.uk/bwq/profiles; Accessed August 2021)

7.3.3 Water quality – Shellfish Waters Directive

The Shellfish Waters Directive (2006/113/EC) was repealed in December 2013 and subsumed within the WFD. However, the Shellfish Water Protected Areas (England and Wales) Directions 2016 require the Environment Agency (in England) to endeavour to observe a microbial standard in all 'Shellfish Water Protected Areas'. The microbial standard is 300 or fewer colony forming units of *E. coli* per 100 ml of shellfish flesh and intervalvular liquid. The Directive also requires the Environment Agency to assess compliance against this standard to monitor microbial pollution (75% of samples taken within any period of 12 months below the microbial standard and sampling/analysis in accordance with the Directions).

There are several Shellfish Water Protected Areas within or in the vicinity of maintenance dredging and disposal activities for the Mersey Estuary, namely (Defra, 2016; see Figure 7.3):

- Dee (East);
- North Wirral (West);
- North Wirral (East); and
- Ribble.

Table 7.8 presents details of classification zones located within the Dee, Liverpool Bay and Ribble bivalve mollusc production areas. The classification zones are designated for *Cerastoderma edule* (Common

13 Note, bathing waters were not sampled during the bathing season in 2020 due to the COVID-19 pandemic and safety concerns for Environment Agency officers.

edible cockle) and/or *Mytilus* spp. (*Mytilus edulis* (blue mussel), *Mytilus galloprovincialis* (Mediterranean mussel) and hybrids). These zones were classified as Class B (Long-term; B-LT), Class C, Seasonal A/B or Seasonal B/C for 2020/21, with three zones designated as prohibited areas. The European Union (EU) legislation, retained post-Brexit, determining the classification of shellfish waters within the UK is EC Regulation 2019/627, namely Articles 53 (Class A), 54 (Class B) and 55 (Class C). The classification of shellfish waters determines the level of treatment required before molluscs can be placed on the market.

Table 7.8 Bivalve mollusc classification for 2020/2021

Production Area	Classification Zone	Species	Class
Dee	Caldy Blacks	*C. edule*	Class B (Long-term)
		Mytilus spp.	Class B (Long-term)
	Salisbury	*C. edule*	Seasonal A/B (Class A Season 1 August to 31 May, reverting to Class B at all other times)
		Mytilus spp.	Seasonal A/B (Class A Season 1 August to 31 May, reverting to Class B at all other times)
	Salisbury Middle	*C. edule*	Seasonal A/B (Class A Season 1 August to 31 May, reverting to Class B at all other times)
	Thurstaston	*C. edule*	Class B (Long-term)
		Mytilus spp.	Class B (Long-term)
	Thurstaston East	-	Prohibited
	West Kirby	*C. edule*	Class B (Long-term)
		Mytilus spp.	Class B (Long-term)
Liverpool Bay	Leasowe and New Brighton	*C. edule*	Seasonal B/C (Class B Season 1 October to 31 May, reverting to Class C at all other times)
	Mersey	-	Prohibited
Ribble	Ribble Walls North	*Mytilus spp.*	Class C
	Ribble Channel	-	Prohibited

Source: Food Standards Agency (https://www.food.gov.uk/business-guidance/shellfish-classification; Accessed August 2021)

Category criteria for bivalve mollusc classification zones are summarised as follows:

- Class A: Molluscs must contain 80% of results ≤230 *E.coli* per 100 grams of flesh, no results exceeding 700 *E.coli* per 100g flesh. Molluscs can be harvested for direct human consumption.
- Class B: 90% of sampled molluscs must be ≤4,600 *E.coli* 100 grams of flesh; samples must not exceed 46,000 *E. coli* per 100 grams of flesh. Molluscs can go for human consumption after purification in an approved plant, or after relaying in an approved Class A relaying area, or after an approved heat treatment process. All samples must be less than 46,000 *E.coli*/100g.
- Class C: Molluscs must contain ≤46,000 E. coli per 100 grams of flesh. Molluscs can go for human consumption only after: Relaying for at least two months in an approved Class B relaying area followed by treatment in an approved purification centre, or relaying in an approved Class A relaying area, or an approved heat treatment process.

Sites failing on coliform guideline standards usually do so because mussels accumulate bacteria from water as they filter feed. Human and animal waste is the source input of coliform, and reducing inputs from sewage treatment and farm derived waste is the most effective way to manage the source inputs.

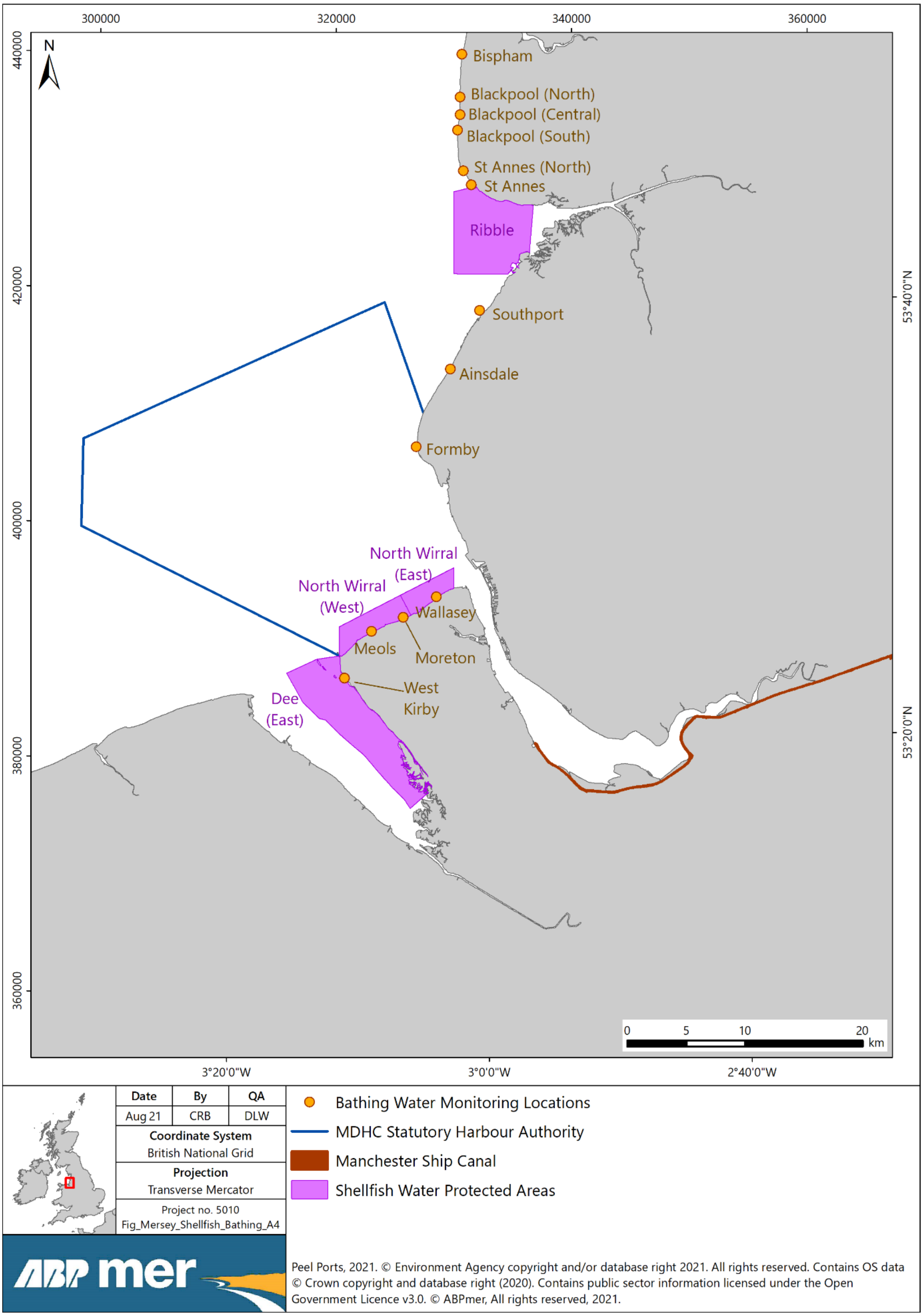

Figure 7.3 Designated bathing waters and Shellfish Water Protected Areas in the study area

7.3.4 Water quality – other directives

There are further EU Directives that impose objectives relevant to the regulation of surface water quality, such as the Urban Waste Water Treatment Directive (91/271/EEC) and the Nitrates Directive (91/676/EEC). The European Union (Withdrawal) Act 2018 ensures incorporation of these EU Directives in UK legislation post-Brexit.

The Urban Waste Water Treatment Directive aims to protect the environment from the adverse effects of the collection, treatment and discharge of urban waste water. It sets treatment levels on the basis of sizes of sewage discharges and the sensitivity of waters receiving the discharges. In general, the Urban Waste Water Treatment Directive requires that collected waste water is treated to at least secondary treatment standards for significant discharges. Secondary treatment is a biological treatment process where bacteria are used to break down the biodegradable matter (already much reduced by primary treatment) in waste water. Sensitive areas under the Urban Waste Water Treatment Directive are water bodies affected by eutrophication due to elevated nitrate concentrations and act as an indication that action is required to prevent further pollution caused by nutrients.

There are two Shellfish water sensitive areas located within the study area, namely Dee (East) and Ribble (111), as well as the Moreton (75), Meols (78), West Kirby (163) and Wallasey (192) Bathing waters sensitive areas[14].

The Nitrates Directive aims to reduce water pollution from agricultural sources and to prevent such pollution occurring in the future (nitrogen is one of the nutrients that can affect plant growth). Under the Nitrates Directive, surface waters are identified if too much nitrogen has caused a change in plant growth which affects existing plants and animals and the use of the water body. Numerous Nitrate Vulnerable Zones (NVZs) surround the Mersey Estuary[15], with the following in the vicinity of dredge areas:

- Alt NVZ (S642);
- Clatter Brook NVZ (S631); and
- Ditton Brook (Halewood to Mersey Estuary) NVZ (S640).

7.3.5 Directive overlap

The WFD makes clear that, in the case of protected areas (i.e. where the presence of a protected area introduces different targets to a particular water body), the more stringent objective applies. There is no indication from the latest North West RBMP (Environment Agency, 2016) or Dee RBMP (NRW, 2015) that any of the WFD objectives would be more stringent than those of the Birds and Habitats Directives. Therefore, it is assumed that any WFD compliance assessment for maintenance dredging and disposal would defer to the outcomes of the MDP with regard to compliance with the objectives of internationally designated sites.

14 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/796751/sensitive-areas-map-manchester.pdf (Accessed August 2021).

15 https://environment.data.gov.uk/farmers (Accessed August 2021).

8 Knowledge Gaps

During the process of compiling this Baseline Document update for the Mersey Estuary, the following knowledge gaps were identified:

- Some updates to environmental information have not been completed for 2020 due to COVID-19 restriction. For example, bathing waters were not monitored by the Environment Agency due to the risk to survey personnel and, therefore, the latest bathing water classification data reported in this Baseline Document is from 2019.
- It is noted that Samples Plans issued by the MMO (prepared in consultation with Cefas) are increasingly including the requirement to analyse sediment samples for PBDEs. However, PBDEs have not been requested in sample plans to date within the Mersey Estuary and, therefore, there is currently a lack of data relating to these contaminants from the dredge areas of the Mersey Estuary. The consistent failing of PBDEs in transitional and coastal water bodies in and around the Mersey Estuary under the WFD (except the North Wales coastal water body) further highlights this baseline data gap.

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10 Abbreviations

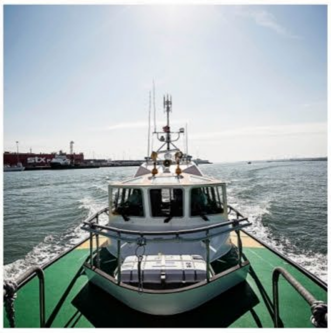
ABP	Associated British Ports
AL1	Cefas Guideline Action Level 1
AL2	Cefas Guideline Action Level 2
AONB	Area of Outstanding Natural Beauty
AWB	Artificial Water Body
BTO	British Trust for Ornithology
CD	Chart Datum
Cefas	Centre for Environment, Fisheries and Aquaculture Science
DBT	Dibutyltin
DDT	Dichlorodiphenyltrichloroethane
Defra	Department for the Environment, Food and Rural Affairs
EIA	Environmental Impact Assessment
EMS	European Marine Site
EQS	Environmental Quality Standard
EU	European Union
GCS	Good Chemical Status
GEP	Good Ecological Potential
GES	Good Ecological Status
GHD	Grab Hopper Dredging
GS	Good Status
HMWB	Heavily Modified Water Body
HRA	Habitats Regulations Assessment
HTL	Hold The Line
LBD	Liverpool Bay Datum
LOD	Limit of Detection
MCZ	Marine Conservation Zone
MDHC	Mersey Docks and Harbour Company
MDP	Maintenance Dredge Protocol
MEAS	Merseyside Environmental Advisory Service
MEPAS	Mersey Estuary Pollution Allevation Scheme
MHWS	Mean High Water Springs
MMO	Marine Management Organisation
MR	Managed Realignment
MSCC	Manchester Ship Canal Company
MSMSG	Mersey Sediment Management Stakeholder Group
NAI	No Active Intervention
NERC	Natural Environment and Rural Communities
nm	Nautical Mile
NRW	Natural Resources Wales
NTL	Normal Tidal Limit
NVZ	Nitrate Vulnerable Zone
OCP	Organochlorine Pesticide
ODN	Ordnance Datum Newlyn
PAH	Polycyclic Aromatic Hydrocarbon
PBDE	Polybrominated Diphenyl Ether
PCB	Polychlorinated Biphenyl
PSD	Priority Substances Directive
RBMP	River Basin Management Plan

rMCZ	recommended Marine Conservation Zone
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SIP	Site Improvement Plan
SMP	Shoreline Management Plan
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
TBT	Tributyltin
THC	Total Hydrocarbon Content
TSHD	Trailer Suction Hopper Dredging
UK	United Kingdom
UKHO	United Kingdom Hydrographic Office
WFD	Water Framework Directive
WID	Water Injection Dredging

Cardinal points/directions are used unless otherwise stated.

SI units are used unless otherwise stated.

Appendices



Innovative Thinking - Sustainable Solutions

A Sediment Quality Data

This appendix presents the current Cefas Guideline Action Levels, as set in 1994 (Section A.1)[16], followed by sediment quality data from the study area. This includes data collected by Peel Ports Group (MDHC) and ABP Garston, presented in chronological order as follows:

- River Mersey (1994) (Section A.2);
- Approach Channel and River Mersey (2001) (Section A.3);
- River Mersey (2002) (Section A.4);
- River Mersey (2005) (Section A.5);
- Mersey Docks (2005) (Section A.6);
- Garston (2005) (Section A.7);
- Garston (2006) (Section A.8);
- Garston (2008) (Section A.9);
- Mersey and Birkenhead Docks (2010) (Section A.10);
- Mersey Docks (2010) (Section A.11);
- Wellington Dock (2011) (Section A.12);
- Mersey Approach Channel (2012) (Section A.13);
- Approach Channel, River Mersey, Dock Entrances and Eastham Locks (2013) (Section A.14);
- Mersey Channel (C1 Buoy) (2013) (Section A.15);
- Approach Channel (2014) (Section A.16);
- Mersey Docks (2014) (Section A.17);
- Garston (2015) (Section A.18);
- Mersey Approaches, Cammell Laird and Eastham Channel (2016) (Section A.19);
- Canning Dock (2017) (Section A.20);
- Huskisson, Seaforth, Canada, Gladstone and Langton Docks (2018) (Section A.21);
- Garston (2019) (Section A.22);
- Gladstone Docks (1) (2020) (Section A.23);
- Gladstone Docks (2) (2020) (Section A.24); and
- Queen Elizabeth II Dock (2020) (Section A.25).

For ease of comparison, the tables have been colour-coded with the current Cefas Guideline Action Levels, where applicable.

16 https://www.gov.uk/guidance/marine-licensing-sediment-analysis-and-sample-plans (Accessed August 2021).

A.1 Cefas Action Levels

Table A.1. Cefas Guideline Action Levels

Contaminant	Units	Cefas Guideline Action Levels	
		Action Level 1 (AL1)	Action Level 2 (AL2)
Arsenic (As)	mg/kg	20	100
Cadmium (Cd)	mg/kg	0.4	5
Chromium (Cr)	mg/kg	40	400
Copper (Cu)	mg/kg	40	400
Lead (Pb)	mg/kg	50	500
Mercury (Hg)	mg/kg	0.3	3
Nickel (Ni)	mg/kg	20	200
Zinc (Zn)	mg/kg	130	800
Dibutyltin (DBT)	mg/kg	0.1	1
Tributyltin (TBT)	mg/kg	0.1	1
Sum of ICES 7 PCB congeners	µg/kg	10	-
Sum of 25 PCB congeners	µg/kg	20	200
Acenaphthene (ACENAPH)	mg/kg	0.1	-
Acenaphthylene(ACENAPT)	mg/kg	0.1	-
Anthracene (ANTHRAC)	mg/kg	0.1	-
Benzo[a]anthracene (BAA)	mg/kg	0.1	-
Benzo[a]pyrene (BAP)	mg/kg	0.1	-
Benzo[b]fluoranthene (BBF)	mg/kg	0.1	-
Benzo[g,h,i]perylene (BENZGHI)	mg/kg	0.1	-
Benzo[e]perylene (BEP)	mg/kg	0.1	-
Benzo[k]fluoranthene (BKF)	mg/kg	0.1	-
C1-Napthalene (C1N)	mg/kg	0.1	-
C1-Phenanthrenes (C1PHEN)	mg/kg	0.1	-
C2-Naphthalene (C2N)	mg/kg	0.1	-
C3-Napthalene (C3N)	mg/kg	0.1	-
Chrysene (CHRYSEN)	mg/kg	0.1	-
Dibenzo[a,h]anthracene (DBENAH)	mg/kg	0.1	-
Fluoranthene (FLUORAN)	mg/kg	0.1	-
Fluorene (FLUOREN)	mg/kg	0.1	-
Indeno[1,2,3-cd]pyrene (INDPYR)	mg/kg	0.1	-
Naphthalene (NAPTH)	mg/kg	0.1	-
Perylene (PERYLEN)	mg/kg	0.1	-
Phenanthrene (PHENANT)	mg/kg	0.1	-
Pyrene (PYRENE)	mg/kg	0.1	-
Total Hydrocarbon Content (THC)	mg/kg	100	-
Dichlorodiphenyltrichloroethane (DDT)	µg/kg	1	-
Dieldrin	µg/kg	5	-

A.2 River Mersey (1994)

Table A.2. Trace metal and organotin concentrations from sediment samples collected from River Mersey (1994)

Laboratory Sample Nº.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
		Cefas Guideline AL1	20	0.4	40	40	0.3	20	50	130	0.1	0.1
		Cefas Guideline AL2	100	5	400	400	3	200	500	800	1	1
Liverpool landing stages (1)	-	52	-	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.02	0.018
Tranmere Oil stages (2)	-	56.9	-	0.49	73.01	44.02	0.9	23.27	353.02	271.46	0.018	0.022
Cammell Laird (3)	-	60	-	0.25	33.75	20.12	0.68	12.22	5624.08	129.42	<0.009	<0.008
Alfred river entrance (4)	-	54.7	-	0.48	71.5	41.66	0.84	23.27	68.39	263.33	0.017	0.017
Brazil elbow (5)	-	74.6	-	<0.04	10.36	3.77	0.08	5.2	10.31	41.38	<0.005	<0.005
Gladstone river entrance (6)	-	66	-	0.32	44.3	25.7	0.68	16.88	45.48	181.24	0.008	0.008
Langdon river entrance (7)	-	69.5	-	0.23	23.88	12.82	0.33	9.86	28.09	123.42	0.009	0.009
Crosby Shoal (11)	-	68	-	0.18	67.21	36.66	0.85	24.15	65.78	230.46	<0.006	<0.006
Cammell Laird (7)	-	55.2	-	0.85	60.18	41.87	1.05	21.79	70.27	256.01	0.028	0.306
Cammell Laird (8)	-	54.8	-	0.97	64.47	41.04	0.99	23.27	74.09	281.88	0.018	0.103
Cammell Laird (9)	-	51.3	-	0.96	76.45	48.54	1.23	26.78	87.54	302.20	<0.009	0.232
Key	Below AL1											
	Above AL1, Below AL2											
	Above AL2											

A.3 Approach Channel and River Mersey (2001)

Table A.3. Trace metal and organotin concentrations from sediment samples collected from River Mersey (2001)

Laboratory Sample Nº.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
		Cefas Guideline AL1	20	0.4	40	40	0.3	20	50	130	0.1	0.1
		Cefas Guideline AL2	100	5	400	400	3	200	500	800	1	1
2001/1540 (Queens West)	-	80.4	8.7	<0.08	2.5	0.91	<0.02	2	9.1	32	0.004	<0.001
2001/1541 (Queens East)	-	73.7	6.4	0.1	10	5.5	0.19	3.6	17	59	0.006	0.003
2001/1542 (Askew Split)	-	82.2	6	<0.04	4.2	1.4	0.02	1.1	7.9	33	<0.001	<0.001
2001/1543 (Crosby Shoal)	-	72.5	9	0.34	12	6.2	0.19	5	41	60	0.241	0.004
2001/1544 (Crosby Channel)	-	80	13	0.65	4.3	1.4	0.04	1.5	14	42	0.156	<0.001
2001/1545 (Brazil Elbow)	-	80.2	<0.22	<0.07	4	2.8	0.06	3.3	<0.09	42	0.085	0
2001/1546 (N Brighton Shoal)	-	81.7	6.1	<0.04	5.4	0.46	<0.01	4.8	5.3	23	<0.039	<0.001
2001/1547 (Gladstone RE)	-	57.3	6.1	0.28	28	15	0.45	12	34	131	0.389	0.008
2001/1548 (Langton RE)	-	49.3	7.5	0.24	29	15	0.49	12	33	124	0.145	0.01
2001/1549 (Alfred RE)	-	64.6	9.8	0.38	29	24	0.62	11	42	148	0.294	0.004
2001/1550 (Tranmere Oil)	-	58.7	13	0.57	42	42	0.91	15	52	241	0.31	0.021
Key	Below AL1											
	Above AL1, Below AL2											
	Above AL2											

Table A.4 Polychlorinated biphenyl (PCB) concentrations from sediment samples collected from the River Mersey (2001)

Laboratory Sample Nº.	Figure ID	PCBs (µg/kg dry weight)												
		#18	#28	#31	#44	#47	#49	#52	#66	#101	#105	#110	#118	#128
Cefas Guideline AL1		-	-	-	-	-	-	-	-	-	-	-	-	-
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-	-
2001/1998 (Queens West)	-	1700	<160	<110	<130	<150	<130	<230	<100	<140	<150	<160	<180	<150
2001/1999 (Queens East)	-	1700	<160	<110	<130	<150	<130	<230	<100	<140	<150	<160	<180	<150
2001/2000 (Askew Split)	-	790	<160	<110	<130	<150	<130	<230	<100	<140	<150	<160	<180	<150
2001/2001 (Crosby Shoal)	-	1100	1100	590	290	<150	<130	500	680	480	340	1300	340	<150
2001/2003 (Crosby Channel)	-	2000	<160	<110	<130	<150	<130	<230	<100	<140	<150	<160	<180	<150
2001/2005 (Brazil Elbow)	-	3900	340	<110	<130	<150	<130	<230	<100	<140	<150	<160	<180	<150
2001/2006 Gladstone RE)	-	<130	<160	<110	<130	<150	<130	<230	<100	<140	<150	<160	<180	<150
2001/2007 (Langton RE)	-	460	1300	700	350	<150	<130	630	360	410	530	1600	450	<150
2001/2010 (Alfred RE)	-	450	1800	1000	520	240	<130	900	710	540	750	2000	540	<150
2001/2011 (Tranmere Oil)	-	320	1400	720	410	<150	<130	630	400	420	490	1700	400	<150

Laboratory Sample Nº.	Figure ID	#138	#141	#149	#151	#153	#156	#158	#170	#180	#183	#187	#194	ΣICES 7 PCBs	Σ25 PCBs
Cefas Guideline AL1		-	-	-	-	-	-	-	-	-	-	-	-	10	20
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-	-	200
2001/1998 (Queens West)	-	<180	<140	<310	<150	<170	<90	<80	<160	<160	<140	<170	<60	-	1700
2001/1999 (Queens East)	-	230	<140	380	<150	<170	<90	<80	<160	<160	<140	<170	<60	-	2310
2001/2000 (Askew Split)	-	<180	<140	<310	<150	<170	<90	<80	<160	<160	<140	<170	<60	-	790
2001/2001 (Crosby Shoal)	-	820	<140	1400	<150	670	<90	<80	<160	530	<140	330	<60	3620	10470
2001/2003 (Crosby Channel)	-	<180	<140	<310	<150	<170	<90	<80	<160	<160	<140	<170	<60	-	2000
2001/2005 (Brazil Elbow)	-	240	<140	390	<150	<170	<90	<80	<160	<160	<140	<170	<60	340	4870
2001/2006 Gladstone RE)	-	<180	<140	<310	<150	<170	<90	<80	<160	<160	<140	<170	<60	-	-
2001/2007 (Langton RE)	-	1000	<140	1600	<150	960	<90	<80	230	670	<140	410	<60	4420	11660
2001/2010 (Alfred RE)	-	1300	<140	2200	<150	1100	<90	<80	460	800	200	470	<60	5680	15980
2001/2011 (Tranmere Oil)	-	1000	<140	1700	<150	880	<90	<80	280	630	<140	380	<60	4360	11760

Key	
	Below AL1
	Above AL1, Below AL2
	Above AL2

Table A.5 Polycyclic aromatic hydrocarbon (PAH) concentrations and total hydrocarbon content (THC) from sediment samples collected from the River Mersey (2001)

Laboratory Sample N°.	Figure ID	PAHs (mg/kg dry weight)										
		ACENAPH	ACENAPT	ANTHRAC	BAA	BAP	BBF	BENZGHI	BEP	BKF	C1N	C1PHEN
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-
2001/1998 (Queens West)	-	<0.0001	0.00029	0.00039	0.00082	0.0016	0.002	0.0013	0.0011	0.0011	0.0019	0.0021
2001/1999 (Queens East)	-	0.00074	0.0074	0.0085	0.027	0.032	0.043	0.025	0.026	0.018	0.036	0.058
2001/2000 (Askew Split)	-	0.00062	0.0036	0.0055	0.019	0.023	0.03	0.018	0.019	0.012	0.021	0.033
2001/2001 (Crosby Shoal)	-	0.0042	0.023	0.054	0.156	0.215	0.286	0.181	0.183	0.145	0.139	0.278
2001/2003 (Crosby South)	-	0.0003	0.0009	0.0012	0.0024	0.0068	0.008	0.0055	0.0048	0.0035	0.0051	0.0082
2001/2005 (Brazil Elbow)	-	0.0011	0.0038	0.0061	0.024	0.034	0.051	0.032	0.03	0.016	0.032	0.042
2001/2006 (N Brighton Shoal)	-	<0.0001	<0.0001	0.0002	0.0003	0.0005	0.00075	0.0006	0.00043	0.00029	0.0004	0.0006
2001/2007 (Gladstone RE)	-	0.0062	0.047	0.106	0.209	0.285	0.392	0.246	0.225	0.145	0.227	0.387
2001/2010 (Langton RE)	-	0.0095	0.046	0.077	0.185	0.251	0.347	0.209	0.229	0.175	0.213	0.373
2001/2011 (Alfred RE)	-	0.003	0.028	0.063	0.169	0.193	0.236	0.14	0.155	0.135	0.158	0.294
2001/2012 (Tranmere Oil)	-	0.01	0.028	0.061	0.158	0.243	0.345	0.187	0.218	0.144	0.176	0.323

Laboratory Sample Nº.	Figure ID	C2N	C3N	CHRYSEN	DBENZAH	FLUORAN	FLUOREN	INDPYR	NAPTH	PERYLEN	PHENANT	PYRENE	THC
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	100
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-
2001/1998 (Queens West)	-	0.00145	0.00318	0.0013	0.00025	0.0017	0.0037	0.0014	0.00093	0.0005	0.0016	0.0023	4.5
2001/1999 (Queens East)	-	0.056	0.089	0.029	0.0086	0.051	0.0085	0.029	0.0088	0.00837	0.041	0.05	69.5
2001/2000 (Askew Split)	-	0.028	0.036	0.024	0.0052	0.036	0.0048	0.02	0.0066	0.00602	0.029	0.034	32.5
2001/2001 (Crosby Shoal)	-	0.215	0.351	0.174	0.07	0.344	0.038	0.218	0.047	0.06	0.198	0.313	251
2001/2003 (Crosby South)	-	0.008	0.012	0.0039	0.00094	0.0081	0.001	0.0073	0.0016	0.0023	0.0048	0.0089	8.7
2001/2005 (Brazil Elbow)	-	0.049	0.083	0.025	0.0057	0.045	0.0052	0.035	0.0096	0.0088	0.023	0.049	43
2001/2006 (N Brighton Shoal)	-	0.00067	0.0011	0.0011	<0.0001	0.0004	0.00013	0.0005	0.0002	0.00017	0.00037	<0.0001	1.3
2001/2007 (Gladstone RE)	-	0.3	0.479	0.22	0.057	0.497	0.065	0.286	0.064	0.075	0.342	0.444	155
2001/2010 (Langton RE)	-	0.418	0.523	0.242	0.044	0.42	0.06	0.22	0.1	0.065	0.348	0.379	414
2001/2011 (Alfred RE)	-	0.362	0.484	0.169	0.039	0.318	0.038	0.136	0.072	0.046	0.236	0.308	360
2001/2012 (Tranmere Oil)	-	0.385	0.462	0.207	0.043	0.358	0.041	0.199	0.081	0.061	0.254	0.348	433
Key	Below AL1												
	Above AL1												

A.4 River Mersey (2002)

Table A.6. Trace metal and organotin concentrations from sediment samples collected from River Mersey (2002)

Laboratory Sample N^o.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
Cefas Guideline AL1			20	0.4	40	40	0.3	20	50	130	0.1	0.1
Cefas Guideline AL2			100	5	400	400	3	200	500	800	1	1
2002/1011 (Eastham Channel)	-	83.1	6.1	0.05	3.4	1.2	0.03	1.3	7.2	44	<0.002	0.004
2002/1012 (Eastham Channel)	-	84.0	5.8	<0.04	2.5	0.66	0.02	1.1	6.2	33	<0.002	0.003
2002/1013 (Eastham Channel)	-	81.3	5.5	0.06	3.7	1.7	0.05	1.4	7.8	41	<0.002	0.005
2002/1014 (Garston Bar)	-	79.1	5.6	0.12	9.6	4.6	0.12	4	12	83	<0.001	0.005
2002/1015 (Garston Bar)	-	79.6	9.4	0.13	11	6	0.18	4	16	63	0.005	0.009
2002/1016 (Garston Bar)	-	83.2	5.3	0.04	4	0.96	0.02	1.4	5.8	30	<0.001	<0.001
Key	Below AL1											
	Above AL1, Below AL2											
	Above AL2											

Table A.7 **Polycyclic aromatic hydrocarbon (PAH) concentrations and total hydrocarbon content (THC) from sediment samples collected from the River Mersey (2002)**

Laboratory Sample N°.	Figure ID	PAHs (mg/kg dry weight)										
		ACENAPH	ACENAPT	ANTHRAC	BAA	BAP	BBF	BENZGHI	BEP	BKF	C1N	C1PHEN
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-
2002/1013 (Eastham Channel)	-	0.00084	0.0071	0.014	0.038	0.043	0.055	0.025	0.038	0.02	0.029	0.058
2002/1016 (Garston Bar)	-	0.00021	0.0006	0.0013	0.0038	0.0077	0.009	0.0047	0.0072	0.0037	0.0099	0.0085

Laboratory Sample N°.	Figure ID	C2N	C3N	CHRYSEN	DBENZAH	FLUORAN	FLUOREN	INDPYR	NAPTH	PERYLEN	PHENANT	PYRENE	THC
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	100
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-
2002/1013 (Eastham Channel)	-	0.03	0.08	0.036	0.0059	0.079	0.0081	0.031	0.011	0.011	0.042	0.079	-
2002/1016 (Garston Bar)	-	0.015	0.023	0.0046	0.001	0.0078	0.00094	0.0058	0.0016	0.0021	0.0044	0.009	-

Key		
	Below AL1	(green)
	Above AL1	(orange)

A.5 River Mersey (2005)

Table A.8. Trace metal and organotin concentrations from sediment samples collected from River Mersey (2005)

Laboratory Sample N^{o.}	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
		Cefas Guideline AL1	20	0.4	40	40	0.3	20	50	130	0.1	0.1
		Cefas Guideline AL2	100	5	400	400	3	200	500	800	1	1
2005/01354	-	78.96	24	0.03	5.2	1.2	0.02	5.2	17	54	<0.001	<0.002
2005/01355	-	76.38	6.8	0.17	7.7	1.9	0.17	4.5	8.3	45	<0.001	<0.001
2005/01356	-	83.71	18	0.04	5.6	1.2	0.02	4.6	14	51	<0.001	<0.001
2005/01357	-	78.12	12	0.04	5.2	1.2	0.02	4.1	10	43	<0.001	<0.001
2005/01358	-	80.21	14	0.11	13	7.6	0.2	7.4	22	78	<0.001	<0.002
2005/01359	-	82.41	6.9	0.04	5.3	1.2	0.02	3.6	7.1	36	<0.001	<0.001
Key	Below AL1											
	Above AL1, Below AL2											
	Above AL2											

A.6 Mersey Docks (2005)

Table A.9. Trace metal and organotin concentrations from sediment samples collected from Mersey Docks (2005)

Laboratory Sample Nº.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
		Cefas Guideline AL1	20	0.4	40	40	0.3	20	50	130	0.1	0.1
		Cefas Guideline AL2	100	5	400	400	3	200	500	800	1	1
2005/04454 (Alexandra Branch)	-	37.72	12.1	0.45	30.2	31.7	0.68	14.7	98.4	264	0.038	0.443
2005/04455 (Alexandra Dock)	-	40.91	13.1	0.29	35.6	27.4	0.61	16.0	61.8	138.7	<0.002	0.078
2005/04456 (Langdon Dock)	-	38.45	10.8	0.21	26.1	22.3	0.50	13.5	50.0	114.2	0.010	0.032
2005/04457 (Canada Dock)	-	39.42	13.4	0.21	32.7	25.6	0.51	16.2	55.2	120.6	0.009	0.038
2005/04458 (Alexandra Branch)	-	78.19	14.9	0.09	19.5	11.7	0.06	18.0	10.9	39.9	<0.001	0.031
2005/04459 (Alexandra Dock)	-	81.66	6.9	0.11	23.7	14.7	0.13	22.9	12.2	44.1	<0.001	0.010
2005/04460 (Langdon Dock)	-	55.28	13.3	0.27	35.4	26.5	0.55	18.8	55.3	129.4	<0.001	0.012
2005/04461 (Canada Dock)	-	68.79	9.6	0.19	28.9	19.3	0.40	17.9	33.7	94.2	<0.001	0.268
Key	Below AL1											
	Above AL1, Below AL2											
	Above AL2											

Table A.10 Polychlorinated biphenyl (PCB) concentrations from sediment samples collected from Mersey Docks (2005)

Laboratory Sample No.	Figure ID	PCBs (µg/kg dry weight) #18	#28	#31	#44	#47	#49	#52	#66	#101	#105	#110	#118	#128
Cefas Guideline AL1		-	-	-	-	-	-	-	-	-	-	-	-	-
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-	-
2005/04454 (Alexandra Branch)	-	11	20	19	9.7	-	8.9	12	13	9.5	4.2	11	9.5	2
2005/04455 (Alexandra Dock)	-	3.1	6.2	4.9	3	-	3	3.9	4.7	3.8	1.8	4.5	3.9	1.3
2005/04456 (Langdon Dock)	-	1.7	3	2.4	1.6	-	1.6	2	2.5	2.2	1.1	4.5	2.5	0.76
2005/04457 (Canada Dock)	-	1.6	2.6	2.2	1.3	-	1.4	1.8	2.2	1.9	1	2.2	2	0.71

Laboratory Sample No.	Figure ID	#138	#141	#149	#151	#153	#156	#158	#170	#180	#183	#187	#194	ΣICES 7 PCBs	Σ25 PCBs
Cefas Guideline AL1		-	-	-	-	-	-	-	-	-	-	-	-	10	20
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-	-	200
2005/04454 (Alexandra Branch)	-	8	1.4	4.8	1.3	7	1.2	1	1.8	2.9	0.8	1.7	0.8	60.9	162.5
2005/04455 (Alexandra Dock)	-	3.8	1	2.7	0.9	3.6	1.2	0.7	1.5	2.1	0.7	1.3	0.7	23.5	64.3
2005/04456 (Langdon Dock)	-	2.3	0.6	1.7	0.6	2.4	0.7	0.4	1.1	1.4	0.4	1	0.5	13.5	38.96
2005/04457 (Canada Dock)	-	2.1	0.6	1.6	0.6	2.3	0.7	0.4	1	1.3	0.4	1	0.5	11.9	33.41

Key		
	Below AL1	
	Above AL1, Below AL2	
	Above AL2	

Table A.11 Polycyclic aromatic hydrocarbon (PAH) concentrations and total hydrocarbon content (THC) from sediment samples collected from Mersey Docks (2005)

Laboratory Sample Nº.	Figure ID	PAHs (mg/kg dry weight)										
		ACENAPH	ACENAPT	ANTHRAC	BAA	BAP	BBF	BENZGHI	BEP	BKF	C1N	C1PHEN
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-
2005/04454 (Alexandra Branch)	-	0.034	0.077	0.273	0.698	0.891	1.56	0.793	0.714	0.564	0.568	1.054
2005/04455 (Alexandra Dock)	-	0.037	0.051	0.205	0.531	0.771	1.221	0.622	0.612	0.466	0.489	0.804
2005/04456 (Langdon Dock)	-	0.033	0.052	0.2	0.433	0.751	1.196	0.515	0.558	0.44	0.451	0.79
2005/04457 (Canada Dock)	-	0.036	0.076	0.21	0.494	0.625	1.057	0.522	0.487	0.377	0.469	0.919

Laboratory Sample Nº.	Figure ID	C2N	C3N	CHRYSEN	DBENZAH	FLUORAN	FLUOREN	INDPYR	NAPTH	PERYLEN	PHENANT	PYRENE	THC
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	100
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-
2005/04454 (Alexandra Branch)	-	0.975	1.433	0.805	0.251	1.458	0.13	0.939	0.274	0.247	0.758	1.356	812
2005/04455 (Alexandra Dock)	-	0.81	1.395	0.591	0.199	1.066	0.083	0.775	0.239	0.209	0.569	1.012	618
2005/04456 (Langdon Dock)	-	0.705	1.069	0.602	0.166	1.01	0.06	0.647	0.206	0.219	0.567	0.946	555
2005/04457 (Canada Dock)	-	0.766	1.333	0.582	0.15	1.115	0.066	0.625	0.205	0.192	0.758	1.028	523

Key		
	Below AL1	(green)
	Above AL1	(orange)

A.7 Garston (2005)

Table A.12. Trace metal and organotin concentrations from sediment samples collected from Garston (2005)

Laboratory Sample Nº·	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
Cefas Guideline AL1			20	0.4	40	40	0.3	20	50	130	0.1	0.1
Cefas Guideline AL2			100	5	400	400	3	200	500	800	1	1
2005/04726 (North Dock)	-	37.95	40	1.7	111	124	2.3	36	156	489	0.052	0.194
2005/04727 (Old Dock)	-	39.56	47	2.3	110	134	3.5	37	192	648	0.046	0.023
2005/04728 (Stalbridge Dock)	-	32.57	23	0.6	69	57	1.4	31	99	314	0.023	0.027
2005/04729 (Approach North)	-	81.23	9	0.1	5	2	0.03	4	9	48	<0.001	<0.001
2005/04730 (Approach Centre)	-	54.67	16	0.7	44	37	1	19	58	253	<0.001	<0.002
2005/04731 (Approach South)	-	40.28	24	0.8	56	46	1	24	73	351	0.017	<0.002
2005/05178 (North Dock West)	-	35.31	43	1.9	128	143	3.2	42	193	516	-	-
2005/05179 (North Dock East)	-	39.72	42	2	106	134	2.9	38	196	520	-	-
2005/05180 (Old Dock West)	-	38.28	65	3.6	141	183	4.3	44	266	667	-	-
2005/05181 (Old Dock East)	-	37.47	25	1	78	71	1.9	32	116	337	-	-
2005/05182 (Stalbridge Dock North)	-	25.55	28	0.7	95	69	1.8	40	131	332	-	-
2005/05183 (Stalbridge Dock Centre)	-	29.87	30	0.7	95	74	1.6	43	132	325	-	-
2005/05453 (Stalbridge Dock South)	-	24.36	31	0.7	93	73	1.6	40	127	331	-	-
Key	Below AL1											
	Above AL1, Below AL2											
	Above AL2											

Table A.13 Polycyclic aromatic hydrocarbon (PAH) concentrations and total hydrocarbon content (THC) from sediment samples collected from Garston (2005)

Laboratory Sample Nº.	Figure ID	PAHs (mg/kg dry weight)										
		ACENAPH	ACENAPT	ANTHRAC	BAA	BAP	BBF	BENZGHI	BEP	BKF	C1N	C1PHEN
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-
2005/04726 (North Dock)	-	0.121	0.572	0.780	1.457	2.192	3.579	1.457	1.678	1.232	0.696	2.147
2005/04728 (Stalbridge Dock)	-	0.047	0.051	0.200	0.448	0.742	1.190	0.536	0.567	0.441	0.508	0.749

Laboratory Sample Nº.	Figure ID	C2N	C3N	CHRYSEN	DBENZAH	FLUORAN	FLUOREN	INDPYR	NAPTH	PERYLEN	PHENANT	PYRENE	THC
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	100
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-
2005/04726 (North Dock)	-	2.355	4.015	1.987	0.493	29.684	0.667	1.772	0.672	0.489	2.902	25.628	1459
2005/04728 (Stalbridge Dock)	-	0.752	1.250	0.536	0.191	0.910	0.050	0.668	0.229	0.203	0.539	0.885	588

Key		
	Below AL1	(green)
	Above AL1	(orange)

A.8 Garston (2006)

Table A.14. Trace metal and organotin concentrations from sediment samples collected from Garston (2006)

Laboratory Sample Nº.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
		Cefas Guideline AL1	20	0.4	40	40	0.3	20	50	130	0.1	0.1
		Cefas Guideline AL2	100	5	400	400	3	200	500	800	1	1
2006/04327 (Old Dock)	-	28.96	27	0.64	70	71	1.8	34	115	392	<0.003	<0.003
2006/04328 (Old Dock)	-	23.49	41	1	121	108	2.7	52	205	585	<0.003	<0.003
2006/04329 (Old Dock)	-	26.81	28	0.68	77	81	1.9	36	122	427	<0.002	<0.003
2006/04330 (Old Dock)	-	30.33	28	0.78	82	77	2	36	120	420	<0.001	<0.002
2006/04331 (Old Dock)	-	38.95	33	1.2	92	90	2.4	37	160	474	<0.002	0.35
2006/04332 (Old Dock)	-	30.64	34	1	87	94	2.6	38	148	492	<0.003	0.19
2006/04333 (North Dock)	-	33.65	32	0.89	83	87	2.4	36	138	442	<0.003	<0.003
2006/04334 (North Dock)	-	29.78	39	1.4	107	118	3.1	40	176	557	<0.003	0.27
2006/04335 (North Dock)	-	31.43	40	1.4	106	125	3.6	39	181	565	<0.003	0.23
2006/04336 (North Dock)	-	29.97	49	1.8	130	151	4.1	51	230	713	<0.002	0.32
2006/04337 (North Dock)	-	36.2	39	1.5	92	113	3.4	34	184	523	0.071	0.32
2006/04338 (North Dock)	-	32.6	46	1.8	113	130	4	42	214	621	<0.003	0.42
2006/04339 (North Dock)	-	32.63	32	1.1	79	97	2.7	32	157	460	<0.003	0.25
2006/04340 (North Dock)	-	28.07	49	1.8	116	149	4.5	48	238	692	<0.003	0.27
2006/04341 (North Dock)	-	37.36	35	1.3	84	107	3.1	33	177	498	<0.002	0.12

Laboratory Sample N°.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
Cefas Guideline AL1			20	0.4	40	40	0.3	20	50	130	0.1	0.1
Cefas Guideline AL2			100	5	400	400	3	200	500	800	1	1
2006/04342 (North Dock)	-	26.79	28	0.89	73	87	2.4	32	144	417	<0.002	0.1
2006/04343 (North Dock)	-	25.91	29	0.76	70	86	2.2	33	146	421	<0.003	0.53
2006/04344 (North Dock)	-	25.82	28	0.74	70	86	2.2	33	143	418	<0.005	<0.005
2006/04396 (North Dock)	-	36.48	44	1.7	115	123	3.3	41	185	630	-	-
2006/04398 (North Dock)	-	53.77	40	1.7	105	115	3.2	38	177	588	-	-
2006/04399 (North Dock)	-	33.99	40	1.5	108	120	3.3	41	174	591	-	-
2006/04400 (North Dock)	-	47.68	53	2.2	116	140	4.2	39	214	709	-	-
2006/04401 (North Dock)	-	32.6	44	1.7	112	152	3.7	40	197	667	-	-
2006/04402 (North Dock)	-	40.54	54	2.5	134	158	5.4	43	229	794	-	-
2006/04403 (Old Dock)	-	34.59	37	1.2	96	99	3.1	38	157	533	-	-
2006/04404 (Old Dock)	-	32.02	100	5.3	213	263	10	69	400	1394	-	-
2006/04405 (Old Dock)	-	44.32	33	1.2	79	82	2.5	29	130	446	-	-
2006/04406 (Old Dock)	-	42.79	36	1.2	98	92	3	37	163	515	-	-
2006/04407 (Old Dock)	-	44.93	27	0.67	76	64	1.9	35	122	389	-	-
2006/04408 (Old Dock)	-	37.59	27	0.61	77	67	2	35	122	410	-	-
Key	Below AL1											
	Above AL1, Below AL2											
	Above AL2											

A.9 Garston (2008)

Table A.15. Trace metal and organotin concentrations from sediment samples collected from Garston (2008)

Laboratory Sample Nº.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
		Cefas Guideline AL1	20	0.4	40	40	0.3	20	50	130	0.1	0.1
		Cefas Guideline AL2	100	5	400	400	3	200	500	800	1	1
2008/04119 (North Dock)	-	31.1	33	1.4	96	107	2.4	38	147	498	0.054	0.183
2008/04120 (Old Dock)	-	40.05	27	1.1	75	83	2.2	28	125	405	0.032	<LOD
2008/04121 (Stalbridge Docks)	-	29.14	21	0.67	66	54	1.5	31	101	323	<LOD	<LOD
2008/04122 (Stalbridge Docks)	-	38.29	18	0.67	57	46	1.2	25	80	276	0.025	<LOD
2008/04124 (Garston Approach)	-	70.6	7.8	0.21	14	8.1	0.2	7.1	18	92	<LOD	<LOD
2008/04125 (Garston Approach)	-	68.63	11	0.43	24	18	0.47	11	32	158	<LOD	<LOD
Key	Below AL1											
	Above AL1, Below AL2											
	Above AL2											

Table A.16 Polychlorinated biphenyl (PCB) concentrations from sediment samples collected from Garston (2008)

Laboratory Sample N^{o.}	Figure ID	PCBs (µg/kg dry weight)												
		#18	#28	#31	#44	#47	#49	#52	#66	#101	#105	#110	#118	#128
Cefas Guideline AL1		-	-	-	-	-	-	-	-	-	-	-	-	-
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-	-
2008/04119 (North Dock)	-	4.4	11.0	7.8	4.6	1.9	-	6.8	7.2	6.4	2.8	7.1	7.0	1.6
2008/04120 (Old Dock)	-	4.2	11.0	8.0	4.4	1.9	-	6.8	7.0	5.7	2.4	6.3	6.2	1.4
2008/04121 (Stalbridge Docks)	-	1.4	3.8	2.9	1.4	0.9	-	2.3	2.5	2.2	1.2	2.7	2.7	0.6
2008/04122 (Stalbridge Docks)	-	0.4	0.8	0.7	0.4	0.0	-	0.6	0.6	0.6	0.4	0.6	0.6	0.0

Laboratory Sample N^{o.}	Figure ID	#138	#141	#149	#151	#153	#156	#158	#170	#180	#183	#187	#194	ΣICES 7 PCBs	Σ25 PCBs
Cefas Guideline AL1		-	-	-	-	-	-	-	-	-	-	-	-	10	20
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-	-	200
2008/04119 (North Dock)	-	7.8	1.5	5.5	1.7	7.9	0.9	0.5	3.0	4.6	1.0	3.4	1.3	43.7	107.7
2008/04120 (Old Dock)	-	6.9	1.4	5.2	1.5	7.3	0.7	0.5	3.0	4.6	1.0	3.2	1.3	41.6	101.9
2008/04121 (Stalbridge Docks)	-	2.9	0.5	2.1	0.6	3.1	0.3	0.0	1.3	1.6	0.3	1.3	0.5	15.7	39.1
2008/04122 (Stalbridge Docks)	-	0.6	0.0	0.4	0.0	0.6	0.0	0.0	0.3	0.3	0.0	0.3	0	3.5	8.2

Key	
Below AL1	(green)
Above AL1, Below AL2	(orange)
Above AL2	(red)

Table A.17 Polycyclic aromatic hydrocarbon (PAH) concentrations and total hydrocarbon content (THC) from sediment samples collected from Garston (2008)

Laboratory Sample Nº.	Figure ID	PAHs (mg/kg dry weight)										
		ACENAPH	ACENAPT	ANTHRAC	BAA	BAP	BBF	BENZGHI	BEP	BKF	C1N	C1PHEN
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-
2008/04119 (North Dock)	-	0.056	0.102	0.441	0.498	0.874	0.983	0.533	0.751	0.512	0.594	1.199
2008/04120 (Old Dock)	-	0.055	0.090	0.241	0.630	0.821	0.934	0.594	0.617	0.412	1.075	1.533
2008/04121 (Stalbridge Docks)	-	0.029	0.048	0.214	0.374	0.452	0.604	0.382	0.443	0.304	0.288	0.670
2008/04122 (Stalbridge Docks)	-	0.031	0.047	0.141	0.419	0.588	0.698	0.389	0.489	0.304	0.301	0.704
2008/04124 (Garston Approach)	-	0.005	0.016	0.041	0.079	0.112	0.167	0.065	0.082	0.059	0.046	0.169
2008/04125 (Garston Approach)	-	0.012	0.039	0.110	0.193	0.290	0.294	0.150	0.191	0.137	0.164	0.369

Laboratory Sample Nº.	Figure ID	C2N	C3N	CHRYSEN	DBENZAH	FLUORAN	FLUOREN	INDPYR	NAPTH	PERYLEN	PHENANT	PYRENE	THC
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	100
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-
2008/04119 (North Dock)	-	1.246	2.055	0.711	0.136	0.843	0.204	0.600	0.426	0.329	0.663	1.054	1817
2008/04120 (Old Dock)	-	2.087	4.710	0.746	0.131	1.002	0.199	0.629	0.409	0.319	0.670	0.982	1814
2008/04121 (Stalbridge Docks)	-	0.567	1.014	0.461	0.085	0.597	0.105	0.416	0.120	0.196	0.460	0.594	1029
2008/04122 (Stalbridge Docks)	-	0.644	1.135	0.516	0.078	0.634	0.085	0.429	0.117	0.222	0.386	0.616	1070
2008/04124 (Garston Approach)	-	0.122	0.240	0.089	0.015	0.132	0.020	0.073	0.022	0.040	0.098	0.133	143
2008/04125 (Garston Approach)	-	0.398	0.705	0.223	0.032	0.355	0.056	0.164	0.061	0.086	0.265	0.329	377
Key	Below AL1												
	Above AL1												

A.10 Mersey and Birkenhead Docks (2010)

Table A.18. Trace metal and organotin concentrations from sediment samples collected from Mersey and Birkenhead Docks (2010)

Laboratory Sample Nº.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
		Cefas Guideline AL1	20	0.4	40	40	0.3	20	50	130	0.1	0.1
		Cefas Guideline AL2	100	5	400	400	3	200	500	800	1	1
2010/01409 (Gladstone Dock)	MBD1	42.02	21	0.62	69	63	1.3	38	139	340	<LOD	<LOD
2010/01410 (Gladstone Dock)	MBD2	36.88	23	0.64	71	65	1.3	38	144	367	<LOD	<LOD
2010/01411 (Gladstone Dock)	MBD2	40.43	23	0.74	69	74	1.3	37	163	353	0.016	0.131
2010/01412 (Alexander Dock)	MBD3	53.23	22	0.74	64	60	1.3	33	121	330	0.018	<LOD
2010/01413 (Alexander Dock)	MBD3	91.41	11	0.10	23	12	0.01	25	8.9	30	<LOD	<LOD
2010/01414 (Alexander Dock)	MBD3	87.83	40	0.11	25	17	0.01	29	6.3	32	<LOD	<LOD
2010/01415 (Alexander Dock)	MBD4	43.98	23	0.88	70	77	1.4	35	162	374	0.031	0.077
2010/01416 (Alexander Dock)	MBD4	77.03	5.8	0.10	23	12	0.03	21	10	39	<LOD	<LOD
2010/01417 (Alexander Dock)	MBD4	71.40	11	0.10	11	4.8	0.0	9.3	3.4	22	<LOD	<LOD
2010/01418 (Langton Dock)	MBD5	47.30	22	0.72	68	59	1.3	34	127	319	0.016	0.027
2010/01419 (Langton Dock)	MBD5	85.86	0.5	0.00	3.7	0.7	0.02	2.4	1.6	3.9	<LOD	<LOD
2010/01420 (Langton Dock)	MBD5	85.63	0.9	0.00	8.9	2.1	0.0	5.0	2.8	7.1	<LOD	<LOD
2010/01421 (Brocklebank Dock)	MBD6	39.47	21	0.75	67	66	1.4	37	124	328	<LOD	<LOD
2010/01422 (Brocklebank Dock)	MBD6	38.51	17	0.51	53	48	1.0	26	88	252	<LOD	<LOD

Laboratory Sample Nº.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
		Cefas Guideline AL1	20	0.4	40	40	0.3	20	50	130	0.1	0.1
		Cefas Guideline AL2	100	5	400	400	3	200	500	800	1	1
2010/01423 (Brocklebank Dock)	MBD6	45.38	22	0.74	68	68	1.3	36	141	335	<LOD	0.024
2010/01424 (Canada Dock)	MBD7	41.78	22	0.54	70	62	1.3	37	131	305	0.019	0.039
2010/01425 (Canada Dock)	MBD7	88.36	1.1	0.0	1.9	1.2	0.02	2.2	0.9	3.8	<LOD	<LOD
2010/01426 (Canada Dock)	MBD7	77.26	1.2	0.0	2.1	2.1	0.03	2.5	2.1	5.3	<LOD	<LOD
2010/01427 (Canada Dock)	MBD8	40.12	18	0.54	53	55	1.2	27	110	261	<LOD	<LOD
2010/01428 (Canada Dock)	MBD8	49.80	19	0.64	60	64	1.4	31	135	292	0.015	0.041
2010/01429 (Canada Dock)	MBD8	54.01	23	0.67	68	68	1.4	35	165	339	0.029	0.047
2010/01430 (Canada Dock)	MBD9	38.94	19	0.62	61	63	1.2	30	135	275	0.022	0.124
2010/01431 (Canada Dock)	MBD9	43.80	22	0.45	75	61	1.3	38	147	367	0.014	0.025
2010/01432 (Canada Dock)	MBD9	44.10	22	0.53	75	73	1.4	35	155	424	0.029	0.084
2010/01433 (Canada Dock)	MBD10	46.20	19	0.48	59	63	1.4	29	121	354	<LOD	<LOD
2010/01434 (Canada Dock)	MBD10	87.80	5.9	0.0	6.5	2.8	0.0	12	2.0	11	<LOD	<LOD
2010/01435 (Canada Dock)	MBD10	80.40	1.7	0.0	3.8	2.1	0.0	4.4	1.3	5.2	<LOD	<LOD
2010/01436 (Sandon Halftide)	MBD11	42.20	21	0.73	72	79	1.4	33	149	406	0.058	0.163
2010/01439 (Bramley Moore)	MBD12	80.40	11	0.0	16	20	0.18	11	27	63	<LOD	0.020
2010/01440 (Bramley Moore)	MBD12	51.90	27	1.0	79	101	1.8	35	176	411	0.073	0.434

Laboratory Sample No.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
Cefas Guideline AL1			20	0.4	40	40	0.3	20	50	130	0.1	0.1
Cefas Guideline AL2			100	5	400	400	3	200	500	800	1	1
2010/01450 (Bramley Moore)	MBD12	49.50	31	1.0	76	119	1.5	35	180	446	0.149	0.575
Key	Below AL1											
	Above AL1, Below AL2											
	Above AL2											

Table A.19 Polychlorinated biphenyl (PCB) concentrations from sediment samples collected from Mersey and Birkenhead Docks (2010)

Laboratory Sample No.	Figure ID	PCBs (µg/kg dry weight)												
		#18	#28	#31	#44	#47	#49	#52	#66	#101	#105	#110	#118	#128
Cefas Guideline AL1		-	-	-	-	-	-	-	-	-	-	-	-	-
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-	-
2010/01411 (Gladstone Dock)	MBD2	4.3	7.5	5.8	3.3	1.3	3.0	4.4	4.4	3.8	1.9	4.6	4.3	1.4
2010/01414 (Alexander Dock)	MBD3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
2010/01417 (Alexander Dock)	MBD4	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
2010/01420 (Langton Dock)	MBD5	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
2010/01423 (Brocklebank Dock)	MBD6	2.0	3.9	2.9	1.6	0.8	1.7	2.5	2.5	2.4	1.3	2.8	2.8	1.0
2010/01426 (Canada Dock)	MBD7	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
2010/01429 (Canada Dock)	MBD8	2.5	4.7	3.5	2.0	1.0	2.1	3.1	3.1	2.9	1.6	3.4	3.6	1.2
2010/01432 (Canada Dock)	MBD9	3.6	6.7	5.5	2.7	0.99	2.7	4.0	4.2	3.1	1.2	3.5	3.7	0.87
2010/01435 (Canada Dock)	MBD10	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
2010/01436 (Sandon Halftide)	MBD11	6.1	9.9	8.0	3.6	1.4	3.4	4.9	4.8	3.8	1.5	4.2	3.9	0.99
2010/01440 (Bramley Moore)	MBD12	6.2	9.0	7.4	4.9	1.1	4.3	7.9	6.8	7.3	2.8	8.0	6.8	1.6

Laboratory Sample Nº.	Figure ID	#138	#141	#149	#151	#153	#156	#158	#170	#180	#183	#187	#194	ΣICES 7 PCBs	Σ25 PCBs
Cefas Guideline AL1		-	-	-	-	-	-	-	-	-	-	-	-	10	20
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-	-	200
2010/01411 (Gladstone Dock)	MBD2	4.3	0.8	3.3	0.87	4.2	0.96	0.41	1.1	2.4	0.53	1.5	0.77	26.6	71.14
2010/01414 (Alexander Dock)	MBD3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-
2010/01417 (Alexander Dock)	MBD4	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-
2010/01420 (Langton Dock)	MBD5	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-
2010/01423 (Brocklebank Dock)	MBD6	2.9	0.61	2.4	0.49	2.9	0.86	0.24	0.84	1.7	0.37	1.1	0.68	16.2	43.29
2010/01426 (Canada Dock)	MBD7	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-
2010/01429 (Canada Dock)	MBD8	3.7	0.65	2.7	0.58	3.4	0.89	0.29	1.0	2.1	0.43	1.3	0.73	19.8	52.47
2010/01432 (Canada Dock)	MBD9	3.2	0.53	2.6	0.66	3.2	0.49	0.27	1.1	1.7	0.38	1.2	0.57	22.4	58.66
2010/01435 (Canada Dock)	MBD10	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-
2010/01436 (Sandon Halftide)	MBD11	3.8	0.67	3.2	1.0	3.9	0.53	0.29	1.3	2.2	0.48	1.5	0.67	28.6	76.03
2010/01440 (Bramley Moore)	MBD12	7.4	1.6	6.3	1.8	7.2	1.0	0.74	2.7	4.9	1.0	2.6	1.3	43.1	112.6
Key	Below AL1														
	Above AL1, Below AL2														
	Above AL2														

Table A.20 Polycyclic aromatic hydrocarbon (PAH) concentrations and total hydrocarbon content (THC) from sediment samples collected from Mersey and Birkenhead Docks (2010)

Laboratory Sample Nº·	Figure ID	PAHs (mg/kg dry weight)										
		ACENAPH	ACENAPT	ANTHRAC	BAA	BAP	BBF	BENZGHI	BEP	BKF	C1N	C1PHEN
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-
2010/01409 (Gladstone Dock)	MBD1	0.02745	0.03759	0.10403	0.34264	0.53988	0.82298	0.36365	0.49959	0.2724	0.39598	0.44986
2010/01410 (Gladstone Dock)	MBD2	0.0285	0.03875	0.11818	0.32108	0.54136	0.81955	0.33146	0.48396	0.26028	0.42873	0.49126
2010/01411 (Gladstone Dock)	MBD2	0.02382	0.03903	0.11537	0.31923	0.62161	0.93143	0.38564	0.5375	0.27147	0.52512	0.56038
2010/01412 (Alexander Dock)	MBD3	0.0294	0.04796	0.11628	0.34616	0.62523	0.79846	0.36695	0.49789	0.23895	0.35965	0.47079
2010/01413 (Alexander Dock)	MBD3	-	-	0.00156	-	-	-	-	0.001	-	-	-
2010/01414 (Alexander Dock)	MBD3	-	-	0.00164	-	-	-	-	-	-	0.00785	-
2010/01415 (Alexander Dock)	MBD4	0.02618	0.04146	0.10769	0.42864	0.55036	0.85854	0.44661	0.49753	0.34576	0.31004	0.53275
2010/01416 (Alexander Dock)	MBD4	-	-	0.00255	-	-	0.01784	0.01682	0.02034	0.00244	0.04608	0.06446
2010/01417 (Alexander Dock)	MBD4	-	-	-	-	0.00274	0.00402	0.00291	0.00444	0.00151	0.00786	0.01643
2010/01418 (Langton Dock)	MBD5	0.02354	0.05385	0.11581	0.34872	0.54887	0.77492	0.40828	0.44274	0.25042	0.30244	0.48589
2010/01419 (Langton Dock)	MBD5	-	-	-	-	-	-	-	-	-	-	-
2010/01420 (Langton Dock)	MBD5	-	-	0.00305	-	0.00435	0.00456	0.00233	0.00296	0.00152	0.00206	-
2010/01421 (Brocklebank Dock)	MBD6	-	0.03605	0.10396	0.32941	0.56667	0.78418	0.38249	0.44477	0.26706	0.32007	0.50386

2010/01422 (Brocklebank Dock)	MBD6	0.03128	0.03821	0.1065	0.36793	0.49433	0.66394	0.30735	0.40871	0.26511	0.28956	0.50591
2010/01423 (Brocklebank Dock)	MBD6	0.0255	0.03248	0.10313	0.33578	0.48639	0.72345	0.34233	0.43571	0.27367	0.28272	0.46819
2010/01424 (Canada Dock)	MBD7	0.02346	0.02919	0.09019	0.29285	0.47722	0.74437	0.32303	0.4313	0.24981	0.2684	0.44221
2010/01425 (Canada Dock)	MBD7	-	0.00151	0.00111	0.00712	0.00435	0.00483	0.0015	0.00261	0.00167	0.00539	0.0136
2010/01426 (Canada Dock)	MBD7	-	0.00345	0.01321	-	0.00848	0.01113	0.00544	0.00626	0.00508	0.01282	-
2010/01427 (Canada Dock)	MBD8	0.02289	0.03249	0.11113	0.19747	0.45041	0.67763	0.39166	0.38476	0.25566	0.32207	0.5016
2010/01428 (Canada Dock)	MBD8	0.02572	0.044	0.12409	0.25681	0.48103	0.6571	0.44737	0.40898	0.25246	0.36043	0.49681
2010/01429 (Canada Dock)	MBD8	0.02347	0.03929	0.09951	0.22487	0.46615	0.67022	0.43011	0.38041	0.23963	0.34252	0.48376
2010/01430 (Canada Dock)	MBD9	0.02704	0.03791	0.11389	0.24535	0.368423	0.59552	0.30276	0.33279	0.17776	0.33876	0.53027
2010/01431 (Canada Dock)	MBD9	0.02457	0.04088	0.104	0.22374	0.45013	0.65427	0.39157	0.36965	0.2201	0.35481	0.47659
2010/01432 (Canada Dock)	MBD9	0.02675	0.04084	0.10846	0.21491	0.46227	0.65908	0.40023	0.39905	0.22431	0.34575	0.56276
2010/01433 (Canada Dock)	MBD10	0.03582	0.04812	0.11492	0.23011	0.43451	0.60314	0.39201	0.37238	0.20615	0.40997	0.52874
2010/01434 (Canada Dock)	MBD10	-	-	-	-	-	0.00158	0.00103	-	-	-	-
2010/01435 (Canada Dock)	MBD10	-	-	-	-	-	-	-	-	-	-	-
2010/01436 (Sandon Halftide)	MBD11	0.03063	0.05788	0.15708	0.30892	0.60948	0.72612	0.4624	0.49722	0.30171	0.39901	0.60311
2010/01439 (Bramley Moore)	MBD12	-	0.01876	0.04503	0.05996	0.08738	0.1013	0.05989	0.06119	0.04267	0.07678	0.12332
2010/01440 (Bramley Moore)	MBD12	-	0.08557	0.30603	0.53285	1.32916	1.57243	0.8926	0.99259	0.64013	0.68853	1.0147
2010/01450 (Bramley Moore)	MBD12	0.03242	0.10232	0.14009	0.36482	0.69359	0.83711	0.57476	0.56315	0.25857	0.40606	0.62817

Laboratory Sample N°.	Figure ID	C2N	C3N	CHRYSEN	DBENZAH	FLUORAN	FLUOREN	INDPYR	NAPTH	PERYLEN	PHENANT	PYRENE	THC
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	100
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-
2010/01409 (Gladstone Dock)	MBD1	0.63115	1.00425	0.31672	0.07598	0.52967	0.07638	0.4211	0.15793	0.19922	0.29225	0.61166	833
2010/01410 (Gladstone Dock)	MBD2	0.70693	1.10722	0.25643	0.06959	0.54846	0.07762	0.41498	0.16091	0.21176	0.30427	0.61998	937
2010/01411 (Gladstone Dock)	MBD2	0.74383	1.15325	0.28361	0.08981	1.93415	0.07721	0.42768	0.18263	0.21489	0.33445	2.10834	955
2010/01412 (Alexander Dock)	MBD3	0.63811	0.96594	0.31992	0.08387	0.68434	0.06807	0.40809	0.12171	0.22993	0.31774	0.75961	829
2010/01413 (Alexander Dock)	MBD3	0.00769	0.01577	-	-	0.00253	-	-	0.01647	-	0.00262	0.00100	6.6
2010/01414 (Alexander Dock)	MBD3	0.00795	0.01712	-	-	0.00284	-	-	0.01742	-	0.00276	0.01165	8.1
2010/01415 (Alexander Dock)	MBD4	0.68122	1.14868	0.32374	0.08678	0.63931	0.0689	0.4817	0.13045	0.24167	0.30548	0.77987	915
2010/01416 (Alexander Dock)	MBD4	0.08891	0.1551	-	0.02189	0.01197	0.00538	0.00473	0.0088	0.12118	0.02686	0.01402	65
2010/01417 (Alexander Dock)	MBD4	0.2247	0.04285	-	-	0.00426	-	-	0.00162	0.14474	0.00587	0.00403	17
2010/01418 (Langton Dock)	MBD5	0.63611	0.98356	0.24657	0.09308	0.55837	0.09732	0.45686	0.14047	0.21243	0.30878	0.61929	889
2010/01419 (Langton Dock)	MBD5	-	-	-	-	-	-	-	-	-	-	-	2.3
2010/01420 (Langton Dock)	MBD5	0.01	0.02038	-	-	0.00783	-	0.00212	0.00186	0.00117	0.00548	0.00763	13
2010/01421 (Brocklebank Dock)	MBD6	0.63686	1.03471	0.26307	0.07493	0.54639	0.07992	0.43894	0.12695	0.20895	0.28648	0.6128	927
2010/01422 (Brocklebank Dock)	MBD6	0.56332	0.96036	0.28464	0.05468	0.5681	0.06801	0.34879	0.12907	0.15942	0.29706	0.64452	829
2010/01423 (Brocklebank Dock)	MBD6	0.55713	0.95319	0.24329	0.06371	0.54217	0.05869	0.38703	0.12128	0.19522	0.26919	0.64053	850

2010/01424 (Canada Dock)	MBD7	0.50072	0.7976	0.21843	0.05909	0.47334	0.05359	0.36857	0.11109	0.1813	0.2509	0.54995	800
2010/01425 (Canada Dock)	MBD7	0.00966	0.02033	0.0039	-	0.04827	0.0024	0.00186	0.00581	0.00109	0.00599	0.04995	11
2010/01426 (Canada Dock)	MBD7	0.01945	0.03461	0.00892	0.00107	0.07244	0.00421	0.00495	0.01006	0.00259	0.01403	0.05902	25
2010/01427 (Canada Dock)	MBD8	0.61523	1.03958	0.15958	0.09348	0.47721	0.06621	0.45068	0.13515	0.19373	0.29956	0.49149	854
2010/01428 (Canada Dock)	MBD8	0.62484	1.05791	0.15757	0.09484	0.46844	0.07173	0.48379	0.13365	0.17671	0.30758	0.49558	777
2010/01429 (Canada Dock)	MBD8	0.64204	0.99465	0.19432	0.07649	0.44825	0.06235	0.47641	0.12628	0.19861	0.27171	0.48057	779
2010/01430 (Canada Dock)	MBD9	0.70024	1.47462	0.19216	0.06272	0.49462	0.07556	0.32319	0.13672	0.14832	0.33487	0.53157	779
2010/01431 (Canada Dock)	MBD9	0.66149	0.98961	0.19203	0.06824	0.43293	0.08004	0.39479	0.13955	0.17911	0.30547	0.49035	812
2010/01432 (Canada Dock)	MBD9	0.73796	1.21957	0.19449	0.08826	0.4741	0.08213	0.43125	0.14197	0.18644	0.32038	0.53434	838
2010/01433 (Canada Dock)	MBD10	0.73394	1.09848	0.23042	0.09141	0.48713	0.08164	0.35848	0.17106	0.14186	0.33819	0.53425	854
2010/01434 (Canada Dock)	MBD10	-	0.01729	-	-	0.00277	-	-	-	-	0.0036	0.00199	6.1
2010/01435 (Canada Dock)	MBD10	-	-	-	-	0.00144	-	-	-	-	-	0.00119	4.3
2010/01436 (Sandon Halftide)	MBD11	0.6834	1.13097	0.27661	0.08185	0.68994	0.0807	0.49027	0.16426	0.20983	0.44395	0.79952	1039
2010/01439 (Bramley Moore)	MBD12	0.13012	0.22833	0.04662	0.01243	0.13839	0.02202	0.06326	0.03461	0.02822	0.11658	0.15392	208
2010/01440 (Bramley Moore)	MBD12	1.08445	1.80957	0.54366	0.19417	0.9978	0.1458	0.88831	0.33506	0.37997	0.70829	2.15435	3543
2010/01450 (Bramley Moore)	MBD12	0.77321	1.59724	0.31255	0.0527	0.61726	0.13284	0.48177	0.21714	0.26276	0.45585	1.15258	2032
Key	Below AL1												
	Above AL1												

Table A.21. Polybrominated diphenyl ether (PBDE) concentrations from sediment samples collected from Mersey and Birkenhead Docks (2010)

Laboratory Sample N°.	Figure ID	Polybrominated Diphenyl Ethers (PBDEs) (mg/kg dry weight)										
		BDE17	BDE28	BDE47	BDE66	BDE85	BDE99	BDE100	BDE138	BDE153	BDE154	BDE183
Cefas Guideline AL1		-	-	-	-	-	-	-	-	-	-	-
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-
2010/01411 (Gladstone Dock)	MBD2	0.00042	0.00031	0.00118	0.00019	0.00009	0.00157	0.00013	0.00070	0.00033	0.00007	0.00047
2010/01414 (Alexander Dock)	MBD3	<0.0002	<0.0002	0.00002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
2010/01417 (Alexander Dock)	MBD4	<0.0002	<0.0002	0.00004	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
2010/01420 (Langton Dock)	MBD5	<0.0002	<0.0002	0.00003	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
2010/01423 (Brocklebank Dock)	MBD6	0.00030	0.00022	0.00084	0.00011	0.00006	0.00098	0.00006	0.00052	0.00012	0.00004	0.00033
2010/01426 (Canada Dock)	MBD7	<0.0002	<0.0002	0.00002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
2010/01429 (Canada Dock)	MBD8	0.00021	0.00022	0.00130	0.00009	0.00008	0.00176	0.00021	0.00025	0.00033	0.00014	0.00088
2010/01432 (Canada Dock)	MBD9	0.00011	0.00008	0.00028	0.00004	0.00002	0.00046	0.00005	0.00019	0.00006	<0.0002	0.00009
2010/01435 (Canada Dock)	MBD10	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
2010/01436 (Sandon Halftide)	MBD11	0.00014	0.00008	0.00033	0.00003	0.00003	0.00039	0.00005	0.00022	0.00006	<0.0002	0.0001
2010/01440 (Bramley Moore)	MBD12	0.00007	0.00005	0.00008	<0.0002	<0.0002	0.00010	<0.0002	0.00008	0.00002	<0.0002	0.00004

Table A.22. Organochlorine pesticide (OCP) concentrations from sediment samples collected from Mersey and Birkenhead Docks (2010)

Laboratory Sample N°.	Figure ID	Organochlorine Pesticides (OCP) (µg/kg dry weight)	
		Dieldrin	DDT
Cefas Guideline AL1		5.0	1.0
Cefas Guideline AL2		-	-
2010/01411 (Gladstone Dock)	MBD2	1.01	0.6
2010/01414 (Alexander Dock)	MBD3	0.32	<0.2
2010/01417 (Alexander Dock)	MBD4	0.35	0.31
2010/01420 (Langton Dock)	MBD5	0.36	<0.2
2010/01423 (Brocklebank Dock)	MBD6	0.94	0.7
2010/01426 (Canada Dock)	MBD7	0.32	<0.2
2010/01429 (Canada Dock)	MBD8	0.99	0.76
2010/01432 (Canada Dock)	MBD9	0.9	13.5
2010/01435 (Canada Dock)	MBD10	0.3	0.4
2010/01436 (Sandon Halftide)	MBD11	1.2	13.9
2010/01440 (Bramley Moore)	MBD12	4.4	18.3
Key	Below AL1		
	Above AL1		

A.11 Mersey Docks (2010)

Table A.23. Trace metal and organotin concentrations from sediment samples collected from Mersey Docks (2010)

Laboratory Sample No.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
		Cefas Guideline AL1	20	0.4	40	40	0.3	20	50	130	0.1	0.1
		Cefas Guideline AL2	100	5	400	400	3	200	500	800	1	1
2010/00123 (Seaforth Dock)	-	39.21	20	0.24	58	38	1.1	27	80	215	<LOD	<LOD
2010/00124 (Seaforth Dock)	-	48.06	21	0.47	68	51	1.3	32	113	292	<LOD	<LOD
2010/00125 (Seaforth Dock)	-	40.67	20	0.55	62	66	1.3	37	113	351	<LOD	0.053
2010/00126 (Gladstone Dock)	-	41.27	18	0.32	59	46	0.91	28	90	275	<LOD	<LOD
2010/00127 (Gladstone Dock)	-	43.49	26	0.69	80	65	1.4	35	120	369	0.038	0.082
2010/00128 (Gladstone Dock)	-	32.69	28	0.62	90	71	1.4	41	135	432	<LOD	<LOD
2010/00129 (Gladstone Dock)	-	53.20	18	0.96	70	73	1.6	30	186	366	0.071	0.971
2010/00130 (Gladstone Dock)	-	43.10	27	0.48	76	50	1.3	30	154	333	0.036	0.401
2010/00131 (Gladstone Dock)	-	85.58	1.4	0.02	4.7	1.0	0.01	5.6	1.1	5.3	<LOD	<LOD
2010/00132 (Gladstone Dock)	-	42.58	20	0.37	58	48	1.0	28	97	312	<LOD	0.024
2010/00133 (Gladstone Dock)	-	57.37	25	0.50	76	54	1.1	33	129	347	0.015	0.036
2010/00134 (Huskisson Dock)	-	36.46	27	0.94	95	105	1.7	37	146	441	0.057	0.566
2010/00135 (Huskisson Dock)	-	89.09	3.9	0.06	23	9.1	0.01	20	4.7	27	<LOD	<LOD
2010/00136 (Huskisson Dock)	-	32.72	23	0.16	78	66	1.1	34	115	326	<LOD	0.041

Laboratory Sample Nº.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
Cefas Guideline AL1			20	0.4	40	40	0.3	20	50	130	0.1	0.1
Cefas Guideline AL2			100	5	400	400	3	200	500	800	1	1
2010/00137 (Huskisson Dock)	-	86.12	22	0.02	10	4.8	0.01	9.6	4.8	18	<LOD	<LOD
2010/00138 (Huskisson Dock)	-	31.20	25	0.10	78	75	1.3	34	112	346	<LOD	0.038
2010/00139 (Huskisson Dock)	-	42.17	30	0.94	98	82	1.9	33	145	416	0.062	0.284
2010/00140 (Sandon H/T Dock)	-	37.66	25	0.29	73	56	1.1	28	101	305	0.030	0.084
2010/00141 (Sandon H/T Dock)	-	54.71	45	2.10	104	116	3.2	31	180	610	0.050	0.047
2010/00142 (East Float)	-	41.34	24	0.74	72	60	1.3	34	106	305	0.046	0.095
2010/00143 (East Float)	-	83.42	6.4	0.03	31	18	0.02	36	9.7	53	<LOD	<LOD
2010/00144 (East Float)	-	39.81	18	0.31	58	45	1.1	26	78	262	<LOD	<LOD
2010/00145 (East Float)	-	45.90	17	0.55	58	46	1.1	27	92	301	0.026	0.028
2010/00146 (Alfred Dock)	-	50.37	22	0.44	65	42	0.95	27	80	272	0.017	0.032
2010/00147 (Alfred Dock)	-	56.78	19	0.34	63	41	0.82	26	79	260	0.027	0.089
Key	Below AL1											
	Above AL1, Below AL2											
	Above AL2											

Table A.24 Polychlorinated biphenyl (PCB) concentrations from sediment samples collected from Mersey Docks (2010)

Laboratory Sample N^{o.}	Figure ID	PCBs (µg/kg dry weight)												
		#18	#28	#31	#44	#47	#49	#52	#66	#101	#105	#110	#118	#128
Cefas Guideline AL1		-	-	-	-	-	-	-	-	-	-	-	-	-
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-	-
2010/00124 (Seaforth Dock)	-	1.6	3.5	2.3	1.4	0.77	1.7	2.3	2.7	2.5	0.83	2.8	2.8	0.82
2010/00127 (Gladstone Dock)	-	3.7	7.5	5.8	2.8	1.3	3.3	4.4	4.8	4.4	1.4	4.7	4.6	1.1
2010/00129 (Gladstone Dock)	-	3.3	6.6	5	3	1.2	2.9	4.8	4.3	4.8	1.8	5.7	5	1.3
2010/00131 (Gladstone Dock)	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
2010/00133 (Gladstone Dock)	-	0.82	5.9	4.6	2.4	1	2.5	3.6	3.4	3	1.1	3.2	3.2	0.86
2010/00135 (Huskisson Dock)	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
2010/00137 (Huskisson Dock)	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
2010/00139 (Huskisson Dock)	-	3.3	7.5	5	3.3	1.4	3.3	5.3	4.6	5.2	1.7	5.7	5.1	1.5
2010/00141 (Sandon H/T Dock)	-	11	28.5	14	11	4	10	16	14	13	5.3	14	12	3.3
2010/00143 (East Float)	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
2010/00145 (East Float)	-	1.4	3.5	2.3	1.5	0.81	1.7	2.6	2.4	2.4	0.9	2.6	2.7	1
2010/00147 (Alfred Dock)	-	0.95	2.2	1.5	0.96	0.54	1.1	1.7	1.5	1.6	0.59	1.7	1.8	0.7

Laboratory Sample N°.	Figure ID	#138	#141	#149	#151	#153	#156	#158	#170	#180	#183	#187	#194	ΣICES 7 PCBs	Σ25 PCBs
Cefas Guideline AL1		-	-	-	-	-	-	-	-	-	-	-	-	10	20
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-	-	200
2010/00124 (Seaforth Dock)	-	2.6	0.44	2.4	0.63	3	0.68	<0.2	0.9	1.5	0.36	1.4	0.61	15.6	40.54
2010/00127 (Gladstone Dock)	-	4.2	0.61	3.2	0.87	3.9	0.61	0.33	1	1.9	0.47	1.5	0.61	26.7	69
2010/00129 (Gladstone Dock)	-	5.2	0.83	4.3	1.1	4.9	0.58	0.41	1.4	2.6	0.58	1.8	0.78	28.7	74.18
2010/00131 (Gladstone Dock)	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-
2010/00133 (Gladstone Dock)	-	2.9	0.51	2.4	0.63	3	0.59	0.25	0.82	1.4	0.34	1.1	0.59	20.1	50.11
2010/00135 (Huskisson Dock)	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-
2010/00137 (Huskisson Dock)	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-
2010/00139 (Huskisson Dock)	-	5.9	1	5.1	1.4	5.8	0.95	0.45	2	4.1	0.83	2.7	1.3	33	84.43
2010/00141 (Sandon H/T Dock)	-	15	3.6	13	3.9	15	1.5	1.4	6.5	13	2.5	7.2	3.6	97.5	242.3
2010/00143 (East Float)	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-
2010/00145 (East Float)	-	2.7	0.54	2.4	0.71	2.9	0.98	0.2	1	1.7	0.39	1.4	0.71	15.8	41.44
2010/00147 (Alfred Dock)	-	1.8	0.33	1.5	0.43	2	0.73	<0.2	0.64	1.1	0.22	0.9	0.5	10.4	26.99
Key	Below AL1														
	Above AL1, Below AL2														
	Above AL2														

Table A.25 Polycyclic aromatic hydrocarbon (PAH) concentrations and total hydrocarbon content (THC) from sediment samples collected from Mersey Docks (2010)

Laboratory Sample N°.	Figure ID	PAHs (mg/kg dry weight)										
		ACENAPH	ACENAPT	ANTHRAC	BAA	BAP	BBF	BENZGHI	BEP	BKF	C1N	C1PHEN
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-
2010/00124 (Seaforth Dock)	-	0.0306	0.0449	0.1108	0.2944	0.4769	0.6824	0.4514	0.4338	0.2667	0.3571	0.5726
2010/00127 (Gladstone Dock)	-	0.0234	0.0453	0.1508	0.3211	0.6005	0.8538	0.4168	0.5021	0.3107	0.4411	0.6039
2010/00129 (Gladstone Dock)	-	0.1785	0.2568	0.3165	0.7139	1.0858	1.4523	0.8582	1.0336	0.4851	8.5993	6.9581
2010/00131 (Gladstone Dock)	-	-	-	0.0004	-	-	-	-	-	-	0.0024	-
2010/00133 (Gladstone Dock)	-	0.0155	0.0439	0.1053	0.2565	0.4540	0.6340	0.3574	0.3946	0.2274	0.3788	0.5474
2010/00135 (Huskisson Dock)	-	-	-	0.0015	-	-	-	-	-	-	0.0012	-
2010/00137 (Huskisson Dock)	-	0.0026	0.0181	0.0817	0.0375	0.2615	0.0448	0.0224	0.0278	0.0131	0.1319	0.2103
2010/00139 (Huskisson Dock)	-	0.0223	0.0528	0.1664	0.2596	1.0243	1.749	0.5641	0.9159	0.5412	0.4731	0.7101
2010/00141 (Sandon H/T Dock)	-	0.0505	0.1322	0.4724	0.8460	1.4087	2.1790	1.0389	1.1909	0.7760	0.7219	1.2435
2010/00143 (East Float)	-	0.0002	0.0012	0.0004	0.0095	0.0031	0.0290	0.0126	0.0228	0.0037	0.0211	0.0321
2010/00145 (East Float)	-	0.0228	0.0726	0.1247	0.3027	0.9037	1.6129	0.4727	0.7732	0.4735	0.4429	0.6574
2010/00147 (Alfred Dock)	-	0.0136	0.0445	0.0972	0.2586	0.4840	0.8926	0.3537	0.4235	0.2604	0.3223	0.4712

Laboratory Sample Nº.	Figure ID	C2N	C3N	CHRYSEN	DBENZAH	FLUORAN	FLUOREN	INDPYR	NAPTH	PERYLEN	PHENANT	PYRENE	THC
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	100
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-
2010/00124 (Seaforth Dock)	-	0.8269	1.2646	0.3651	0.0745	0.5664	0.0819	0.5024	0.1468	0.1609	0.3578	0.5612	690
2010/00127 (Gladstone Dock)	-	0.7922	1.1903	0.3812	0.1023	0.6657	0.0832	0.5086	0.1875	0.2303	0.3827	0.6200	945
2010/00129 (Gladstone Dock)	-	15.8576	26.0200	0.7469	0.1443	1.2720	0.5395	0.5782	2.0420	0.3447	2.1373	1.2654	4596
2010/00131 (Gladstone Dock)	-	0.0049	0.0074	-	-	0.0014	-	-	0.0022	-	0.0017	0.0006	2
2010/00133 (Gladstone Dock)	-	0.7135	1.0485	0.2902	0.0739	0.56	0.0708	0.4098	0.1390	0.2104	0.3515	0.5261	819
2010/00135 (Huskisson Dock)	-	0.0030	0.0081	-	-	0.0052	-	-	0.0020	0.0443	0.0018	0.0039	3
2010/00137 (Huskisson Dock)	-	0.1637	0.3372	0.0389	0.0047	0.2203	0.0288	0.0177	0.0390	0.0129	0.1133	0.1662	69
2010/00139 (Huskisson Dock)	-	0.7452	1.4582	0.3870	0.1339	0.7548	0.1106	0.9063	0.1814	0.3017	0.3856	0.6974	1209
2010/00141 (Sandon H/T Dock)	-	1.2878	3.2684	0.9020	0.2819	1.6287	0.2073	1.3098	0.3796	0.4929	0.8893	1.2175	2511
2010/00143 (East Float)	-	0.0306	0.0507	0.0114	0.0030	0.0064	0.0008	0.0057	0.0047	0.0073	0.0143	0.0056	30
2010/00145 (East Float)	-	0.7253	1.4927	0.4129	0.1244	0.8054	0.1221	0.5788	0.1643	0.3457	0.3827	0.6230	941
2010/00147 (Alfred Dock)	-	0.5070	1.0137	0.2852	0.0771	0.5027	0.0770	0.4414	0.1152	0.1951	0.2875	0.5037	724
Key	Below AL1												
	Above AL1												

A.12 Wellington Dock (2011)

Table A.26. Trace metal and organotin concentrations from sediment samples collected from Wellington Dock (2011)

Laboratory Sample Nº.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
		Cefas Guideline AL1	20	0.4	40	40	0.3	20	50	130	0.1	0.1
		Cefas Guideline AL2	100	5	400	400	3	200	500	800	1	1
B	-	-	44.1	2.2	82	197	3.4	3.4	539	1610	<0.1	<0.1
D	-	-	14.3	0.4	55.7	68	0.9	0.9	101	305	-	-
E	-	-	22.3	1.3	64.7	119	1.7	1.7	187	544	<0.1	<0.1
F	-	-	27	1.8	71.4	138	2.4	2.4	206	637	<0.1	<0.1
L	-	-	14	0.3	27.8	48	0.7	0.7	92	201	<0.1	<0.1
N	-	-	16.9	0.4	62.8	58	1.1	1.1	95	314	<0.1	<0.1
P	-	-	33.2	1.9	78.9	153	2.5	2.5	216	704	-	-
R	-	-	38.3	2.3	88.1	158	3.1	3.1	247	807	<0.1	<0.1
S	-	-	21.5	0.8	54.3	121	1.3	1.3	130	385	<0.1	<0.1
T	-	-	22.5	1.1	51.5	104	1.5	1.5	199	417	<0.1	<0.1
B	-	-	24.6	1.3	51.2	102	1.9	1.9	431	467	<0.1	<0.1
D	-	-	28.3	1.7	73	145	2.2	2.2	193	645	-	-
E	-	-	23.6	1.7	68.1	129	2.2	2.2	180	613	<0.1	<0.1
F	-	-	30.1	1.8	77.9	141	2.6	2.6	195	614	<0.1	<0.1
H	-	-	39.1	2.3	89.1	175	2.9	2.9	245	782	<0.1	<0.1
J	-	-	16.8	0.4	67.4	98	1.3	1.3	120	376	<0.1	<0.1
L	-	-	10.8	0.2	26.7	43	0.5	0.5	56	172	<0.1	<0.1
P	-	-	25.2	1.4	63.4	115	1.9	1.9	162	526	-	-
R	-	-	16.4	0.4	55.5	71	0.9	0.9	101	303	<0.1	<0.1
S	-	-	25.1	1.5	64.4	127	2	2	182	576	<0.1	<0.1
T	-	-	22.3	0.8	54.9	93	1.4	1.4	150	428	<0.1	<0.1
A Batch 2	-	-	36	1.6	90	142	2.9	2.9	290	700	0.045	0.17
A Batch 1	-	-	41	1.9	188	188	2.9	2.9	230	632	0.027	0.09
C Batch 2	-	-	39	2.4	171	171	3.3	3.3	323	788	0.051	0.261
C Batch 1	-	-	39	1.6	95	143	2.6	2.6	211	597	0.03	0.071
G Batch 2	-	-	37	2.3	177	177	3.2	3.2	306	809	0.067	0.236
G Batch 1	-	-	36	3.2	87	145	2	2	499	3113	0.091	0.442

Laboratory Sample No.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
		Cefas Guideline AL1	20	0.4	40	40	0.3	20	50	130	0.1	0.1
		Cefas Guideline AL2	100	5	400	400	3	200	500	800	1	1
I Batch 2	-	-	38	1.9	169	169	2.8	2.8	270	701	0.069	0.272
K Batch 2	-	-	26	1.1	73	106	1.8	1.8	154	461	0.038	0.097
K Batch 1	-	-	32	1.5	97	145	2.4	2.4	197	622	0.075	0.282
M Batch 2	-	-	10	0.035	39	45	0.66	0.66	56	181	0.015	0.02
M Batch 1	-	-	32	1.5	101	138	2.5	44	199	605	0.054	0.224
O Batch 2	-	-	21	0.66	85	115	1.4	36	148	353	0.143	0.418
O Batch 1	-	-	25	0.24	108	113	1.5	49	142	373	0.042	0.063
Q Batch 2	-	-	38	1.6	116	162	2.6	50	262	640	0.074	0.269
A	-	-	32	1.4	94	135	2.1	40	200	549	0.073	0.177
C	-	-	39	2	107	165	4.2	45	263	674	0.08	0.324
D	-	-	36	2.1	106	144	2.6	42	234	670	0.074	0.219
E	-	-	38	2.1	111	156	2.6	47	248	701	0.087	0.263
G	-	-	31	1.5	95	160	2.3	41	195	586	0.068	0.138
I	-	-	31	1.5	96	136	2.2	42	200	621	0.088	0.286
K	-	-	35	2	101	141	2.5	41	224	651	0.089	0.314
M	-	-	20	0.52	83	80	1.4	40	124	372	0.025	0.03
O	-	-	20	0.62	91	96	1.5	41	146	420	0.096	2.496
P	-	-	27	1.4	86	141	2.1	36	185	548	0.084	0.387
Q	-	-	27	1.5	96	112	2.1	36	183	560	0.079	0.235
R	-	-	30	1.9	94	123	2.3	39	215	634	0.097	0.379
S	-	-	29.1	0.8	40.2	51	1.3	21.4	237	387	-	-
BH3	-	-	0.6	0.5	-	11	-	-	-	-	-	-
BH4	-	-	0.2	0.1	-	2	-	-	-	-	-	-
BH5	-	-	0.7	0.3	-	7	-	-	-	-	-	-
BH9	-	-	42.8	1.9	82.5	135	2.8	34.6	182	601	-	-
BH21	-	-	0.7	0.1	-	4	-	-	-	-	-	-
Key	Below AL1											
	Above AL1, Below AL2											
	Above AL2											

A.13 Mersey Approach Channel (2012)

Table A.27. Trace metal and organotin concentrations from sediment samples collected from Mersey Approach Channel (2012)

Laboratory Sample Nº.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
Cefas Guideline AL1			20	0.4	40	40	0.3	20	50	130	0.1	0.1
Cefas Guideline AL2			100	5	400	400	3	200	500	800	1	1
V-A1 (0.00-0.10)	MAC1	-	3.24	0.02	8.11	4	0.005	8.42	4.21	17.4	<0.0004	<0.0004
V-A1 (1.00-1.10)	MAC1	-	3.29	0.029	28.7	7.34	0.002	22.2	6.54	32.3	<0.0004	<0.0004
V-A1 (2.00-2.10)	MAC1	-	2.38	0.034	17.4	15.9	<0.002	17.8	3.34	22.4	<0.0004	<0.0004
V-A1 (3.00-3.10)	MAC1	-	4.73	0.054	38.7	13.5	0.005	31.8	7.37	44.3	<0.0004	<0.0004
V-A4 (0.00-0.10)	MAC2	-	13.1	0.126	15.3	8.55	0.179	7.66	27	88	0.0021	<0.0004
V-A4 (1.00-1.10)	MAC2	-	3.98	0.046	40.9	14.6	0.005	30.4	6.93	43.6	<0.0004	<0.0004
V-A4 (2.10-2.20)	MAC2	-	4.74	0.065	37.9	19.5	0.006	33.9	7.35	48.5	<0.0004	<0.0004
V-C3 (0.00-0.10)	MAC3	-	9.17	0.088	13.7	25	0.0559	18.2	9.43	64.7	0.0006	<0.0004
V-C3 (1.00-1.10)	MAC3	-	5.26	0.054	45.2	15.2	0.006	34.1	7.88	47.1	<0.0004	<0.0004
V-C3 (1.90-1.96)	MAC3	-	4.58	0.059	36.5	13.6	0.006	30.3	7.01	45.9	<0.0004	<0.0004
V-D4 (0.00-0.10)	MAC4	-	5.61	0.162	18.1	7.44	0.17	7.48	19.9	83.6	0.0007	<0.0004
V-D4 (1.00-1.10)	MAC4	-	13.3	0.57	38.5	26	0.775	16	57.5	227	0.0051	0.0083
V-D4 (2.00-2.10)	MAC4	-	8.18	0.224	17.3	12.7	0.322	7.21	31.2	102	<0.0004	<0.0004
V-D4 (3.00-3.10)	MAC4	-	29.2	0.714	68.6	62.3	0.709	28.3	131	326	<0.0004	<0.0004
V-D4 (4.10-4.20)	MAC4	-	8.08	0.128	42.8	17.7	0.008	34.9	11.4	58.7	<0.0004	<0.0004
V-D7 (0.00-0.10)	MAC5	-	9.4	0.227	33	20.4	0.485	15.1	43.1	144	0.0022	0.002
V-D7 (1.00-1.10)	MAC5	-	4.91	0.111	9.55	4.03	0.0817	4.45	12.1	64.3	<0.0004	<0.0004
V-D7 (2.00-2.10)	MAC5	-	22.4	0.286	31	23.7	0.441	16.6	54.8	159	<0.0004	<0.0004
V-D7 (3.00-3.10)	MAC5	-	4.75	0.033	6.52	2.25	0.014	3.82	7.79	33.2	<0.0004	<0.0004
V-D7 (4.00-4.10)	MAC5	-	5.5	<0.02	6.34	1.32	0.003	3.47	7.48	28.9	<0.0004	<0.0004
V-E6 (0.00-0.10)	MAC6	-	10.2	0.292	28.2	19.7	0.531	14.5	42.5	151	0.0016	<0.0004
V-E6 (1.00-1.10)	MAC6	-	6.67	0.077	12.2	4.44	0.064	6.2	14.9	55.1	<0.0004	<0.0004
V-E6 (2.00-2.10)	MAC6	-	10.3	0.282	28.6	18.8	0.459	12.5	46	148	0.0066	<0.0004
V-E6 (3.00-3.10)	MAC6	-	8.81	0.244	17	10.3	0.247	6.89	24.8	104	0.0069	<0.0004
V-E6 (4.00-4.10)	MAC6	-	15.4	0.406	39	29.4	0.954	14.8	66.7	198	0.0045	<0.0004
V-F2 (0.00-0.10)	MAC7	-	8.21	0.144	14	10.2	0.058	7.37	21.7	81.8	<0.0004	<0.0004
V-F2 (1.00-1.10)	MAC7	-	5.36	0.035	7.16	1.53	0.01	3.64	7.94	33.2	<0.0004	<0.0004

Laboratory Sample Nº.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
		Cefas Guideline AL1	20	0.4	40	40	0.3	20	50	130	0.1	0.1
		Cefas Guideline AL2	100	5	400	400	3	200	500	800	1	1
V-F2 (2.00-2.10)	MAC7	-	5.1	0.117	9.45	2.96	0.05	4.24	11.2	60.9	<0.0004	<0.0004
V-F2 (3.00-3.10)	MAC7	-	4.83	0.064	10.4	2.34	0.021	4.19	10.1	48.1	<0.0004	<0.0004
V-F2 (4.00-4.10)	MAC7	-	7.86	0.051	6.93	2.19	0.023	3.64	10.9	46.3	<0.0004	<0.0004
VH1 (0.00-0.10)	MAC8	-	9.98	<0.02	5.68	1.4	0.008	3.43	10.5	33.9	<0.0004	<0.0004
VH1 (1.00-1.10)	MAC8	-	16.3	0.524	39.5	32.5	1.18	16	74.9	257	0.004	<0.0004
VH1 (2.00-2.10)	MAC8	-	6.32	<0.02	6.85	1.34	0.006	3.38	5.64	20.4	<0.0004	<0.0004
VH1 (3.00-3.10)	MAC8	-	5.97	0.021	6.54	1.6	0.008	3.36	6	22.7	<0.0004	<0.0004
VH1 (4.00-4.10)	MAC8	-	4.9	0.021	8.64	1.55	0.004	4.29	5.71	22	<0.0004	<0.0004
V-J1 (0.00-0.10)	MAC9	-	13.8	0.512	45.5	30.4	0.818	20.4	63.6	240	<0.0004	0.0014
V-J1 (1.00-1.10)	MAC9	-	15.5	0.748	47.1	39.8	1.44	18.4	84.5	314	0.008	<0.0004
V-J1 (2.00-2.10)	MAC9	-	6.25	0.078	13	6.36	0.093	6.39	17	55.6	<0.0004	<0.0004
V-J1 (3.00-3.10)	MAC9	-	7.68	0.079	13.6	6.23	0.095	6.15	18.2	57	<0.0004	<0.0004
V-J1 (4.00-4.10)	MAC9	-	10.4	0.1	19.1	8.94	0.11	11	22.9	66.9	<0.0004	<0.0004
V-K2A (0.00-0.10)	MAC10	-	6.42	0.239	19.7	11.8	0.258	10.1	30.6	106	0.0025	<0.0004
V-K2A (1.00-1.10)	MAC10	-	31.5	0.312	34.2	35	0.531	16.9	81.2	176	<0.0004	<0.0004
V-K2A (2.00-2.10)	MAC10	-	4.74	0.031	17	6.15	0.016	10.5	17.5	35	<0.0004	<0.0004
V-K2A (3.00-3.10)	MAC10	-	4.57	0.021	7.89	1.71	<0.002	4.74	3.22	14.5	<0.0004	<0.0004
V-K2A (4.00-4.10)	MAC10	-	2.74	0.021	6.9	1.56	<0.002	4.1	2.16	12.1	<0.0004	<0.0004
V-R01 (0.00-0.10)	-	-	8.77	0.326	27.4	16.1	0.382	12.2	39.1	143	0.006	0.0037
V-R01 (1.00-1.10)	-	-	17.1	0.978	44.5	41.2	1.37	18.7	90.3	331	0.0299	0.0023
V-R01 (2.00-2.10)	-	-	30	1.73	78.9	74.4	3.09	26.4	152	481	0.0245	0.0009
V-R01 (3.00-3.10)	-	-	53.2	2.72	88.2	91.6	2.56	32.2	211	599	0.0514	0.0312
V-R01 (4.00-4.10)	-	-	16.1	0.779	21.5	32.4	0.571	9.13	55.4	177	0.0174	0.0013
V-R08 (0.00-0.10)	-	-	8.16	0.0591	32.8	20.1	0.009	40.1	15	51.3	<0.0004	<0.0004
V-R08 (1.00-1.10)	-	-	5.19	0.0629	34.3	16.8	0.006	35.1	8.07	48.3	<0.0004	<0.0004
V-R08 (2.00-2.10)	-	-	3.31	0.0387	23.1	8.93	0.004	19.9	4.66	32.9	<0.0004	<0.0004
V-R08 (2.92-2.97)	-	-	5.05	0.0219	7.72	9.32	<0.002	8.99	2.69	14.5	<0.0004	<0.0004
V-R03 (0.00-0.10)	-	-	18.3	0.504	54.9	39.4	1.11	27.2	96.9	291	<0.0004	0.0063
V-R03 (1.00-1.10)	-	-	18.6	0.923	42.2	40.6	1.07	15.7	88	304	0.0066	0.0011
V-R03 (2.00-2.10)	-	-	24.9	1.43	70.4	64.5	2.07	25.3	136	483	0.0201	0.0012
V-R03 (3.00-3.10)	-	-	33.3	1.58	119	80.4	2.83	29	194	520	0.053	0.0107
V-R03 (4.00-4.10)	-	-	20.6	1.26	28.1	28.9	0.804	10.7	59.9	256	0.0156	0.0011

Laboratory Sample Nº.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
		Cefas Guideline AL1	20	0.4	40	40	0.3	20	50	130	0.1	0.1
		Cefas Guideline AL2	100	5	400	400	3	200	500	800	1	1
V-R07 (0.00-0.10)	-	-	10.5	0.552	32.5	23	0.811	11.7	46.8	195	0.0054	0.0011
V-R07 (0.85-0.95)	-	-	64.4	3.21	76.1	153	2.28	28.5	255	561	0.0111	0.0014
V-R07 (1.95-2.05)	-	-	6.32	0.0534	30.2	14.2	0.007	27.3	8.61	42.6	<0.0004	<0.0004
V-R10A (0.00-0.10)	-	-	11.1	0.321	21.9	13.7	0.22	12.4	72.4	88.7	0.0009	<0.0004
V-R10A (1.00-1.10)	-	-	6.65	0.0526	31.9	13.2	0.007	30.7	8.47	44.2	<0.0004	<0.0004
V-R10A (1.97-2.10)	-	-	5.34	0.0516	31.6	12.8	0.008	27.5	8.16	43.1	<0.0004	<0.0004
V-R11A (0.00-0.10)	-	-	3.99	0.0395	21.4	9.04	0.013	20	8.51	35	<0.0004	<0.0004
V-R11A (1.00-1.10)	-	-	5.69	<0.02	7.78	1.17	<0.002	7.7	1.86	8.6	<0.0004	<0.0004
V-R06 (0.00-0.10)	-	-	10.5	0.258	33.5	17.1	0.513	14.4	37.3	138	0.0032	0.0016
V-R06 (1.00-1.10)	-	-	31.9	1.65	89.9	93.1	1.04	30.8	175	534	0.0329	0.0015
V-R06 (2.00-2.10)	-	-	26.2	1.4	71.6	65.7	2.32	22.5	130	424	0.0127	0.0007
V-R06 (3.00-3.10)	-	-	36.4	1.82	97.6	83.1	2.52	28.4	170	2	0.0627	0.0026
V-R06 (4.00-4.10)	-	-	28.6	1.78	46.4	53.6	1.4	17.1	98.5	438	0.0181	0.0009
V-R05 (0.00-0.10)	-	-	17.3	0.937	46.2	44	1.44	18.7	84.8	306	0.0049	0.0009
V-R05 (1.00-1.10)	-	-	20.9	0.629	47.6	45.6	1.17	20.9	121	239	0.0005	<0.0004
V-R04 (0.00-0.10)	-	-	6.21	0.0741	15.3	8.44	0.058	11.3	11.2	48.1	0.0004	<0.0004
V-R04 (1.00-1.10)	-	-	0.874	<0.02	6.18	5.92	0.003	4.98	1.54	7.56	<0.0004	<0.0004
V-R02 (0.00-0.10)	-	-	5.48	0.0826	29.3	14.4	0.052	26.9	11.7	55	<0.0004	<0.0004
V-R02 (1.00-1.10)	-	-	4.03	<0.02	2.97	2.23	<0.002	3.84	1.82	10.7	<0.0004	<0.0004
V-R02 (2.00-2.10)	-	-	1.27	<0.02	4.3	1.55	<0.002	4.04	1.74	7.47	<0.0004	<0.0004
V-R02 (2.85-2.95)	-	-	8.77	<0.02	7.97	3.49	<0.002	8.52	3.14	20.6	<0.0004	<0.0004
V-R09A (0.00-0.10)	-	-	19.4	0.752	68.9	47.8	1.56	25.6	93.8	308	0.0093	0.0029
V-R09A (1.00-1.10)	-	-	14.3	0.0526	36.6	12	0.013	28.1	8.54	44.6	<0.0004	<0.0004
V-R09A (2.00-2.10)	-	-	6.34	0.0647	41	18.4	0.009	31.3	8.66	49	<0.0004	<0.0004
V-R09A (2.98-3.08)	-	-	5.78	0.105	36.4	16.1	0.009	33.1	10	52.3	<0.0004	<0.0004

Key	
	Below AL1
	Above AL1, Below AL2
	Above AL2

Table A.28 Polychlorinated biphenyl (PCB) concentrations from sediment samples collected from Mersey Approach Channel (2012)

Laboratory Sample N^{o.}	Figure ID	PCBs (µg/kg dry weight)												
		#18	#28	#31	#44	#47	#49	#52	#66	#101	#105	#110	#118	#128
Cefas Guideline AL1		-	-	-	-	-	-	-	-	-	-	-	-	-
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-	-
V-A1 (0.00-0.10)	MAC1	-	0.11	-	-	-	-	0.05	-	0.02	-	-	<0.01	-
V-A1 (1.00-1.10)	MAC1	-	0.02	-	-	-	-	0.02	-	<0.01	-	-	<0.01	-
V-A1 (2.00-2.10)	MAC1	-	0.01	-	-	-	-	0.05	-	<0.01	-	-	<0.01	-
V-A1 (3.00-3.10)	MAC1	-	0.84	-	-	-	-	1.04	-	0.59	-	-	0.23	-
V-A4 (0.00-0.10)	MAC2	-	0.33	-	-	-	-	0.31	-	0.1	-	-	0.1	-
V-A4 (1.00-1.10)	MAC2	-	0.01	-	-	-	-	<0.01	-	<0.01	-	-	<0.01	-
V-A4 (2.10-2.20)	MAC2	-	<0.01	-	-	-	-	<0.01	-	<0.01	-	-	<0.01	-
V-C3 (0.00-0.10)	MAC3	-	0.17	-	-	-	-	0.19	-	0.14	-	-	0.11	-
V-C3 (1.00-1.10)	MAC3	-	0.01	-	-	-	-	0.02	-	<0.01	-	-	<0.01	-
V-C3 (1.90-1.96)	MAC3	-	0.01	-	-	-	-	0.05	-	<0.01	-	-	<0.01	-
V-D4 (0.00-0.10)	MAC4	-	0.48	-	-	-	-	0.06	-	0.08	-	-	0.12	-
V-D4 (1.00-1.10)	MAC4	-	0.04	-	-	-	-	0.03	-	0.01	-	-	<0.01	-
V-D4 (2.00-2.10)	MAC4	-	0.12	-	-	-	-	0.44	-	0.17	-	-	0.05	-
V-D4 (3.00-3.10)	MAC4	-	0.03	-	-	-	-	0.08	-	0.02	-	-	0.02	-
V-D4 (4.10-4.20)	MAC4	-	<0.01	-	-	-	-	<0.01	-	<0.01	-	-	<0.01	-
V-D7 (0.00-0.10)	MAC5	-	0.91	-	-	-	-	0.9	-	0.46	-	-	0.3	-
V-D7 (1.00-1.10)	MAC5	-	0.33	-	-	-	-	0.3	-	0.15	-	-	0.1	-
V-D7 (2.00-2.10)	MAC5	-	0.09	-	-	-	-	0.08	-	0.01	-	-	0.05	-
V-D7 (3.00-3.10)	MAC5	-	0.01	-	-	-	-	<0.01	-	<0.01	-	-	<0.01	-
V-D7 (4.00-4.10)	MAC5	-	<0.01	-	-	-	-	<0.01	-	<0.01	-	-	<0.01	-
V-E6 (0.00-0.10)	MAC6	-	0.78	-	-	-	-	0.81	-	0.2	-	-	0.13	-
V-E6 (1.00-1.10)	MAC6	-	0.23	-	-	-	-	0.24	-	0.18	-	-	0.14	-
V-E6 (2.00-2.10)	MAC6	-	1.21	-	-	-	-	1.04	-	0.55	-	-	0.38	-
V-E6 (3.00-3.10)	MAC6	-	1.02	-	-	-	-	1.02	-	0.44	-	-	0.36	-
V-E6 (4.00-4.10)	MAC6	-	1.77	-	-	-	-	1.52	-	1.22	-	-	0.67	-
V-F2 (0.00-0.10)	MAC7	-	0.44	-	-	-	-	0.6	-	0.12	-	-	0.16	-
V-F2 (1.00-1.10)	MAC7	-	0.04	-	-	-	-	0.05	-	0.02	-	-	0.02	-
V-F2 (2.00-2.10)	MAC7	-	0.15	-	-	-	-	0.16	-	0.1	-	-	0.05	-
V-F2 (3.00-3.10)	MAC7	-	0.08	-	-	-	-	0.09	-	0.05	-	-	0.04	-
V-F2 (4.00-4.10)	MAC7	-	0.13	-	-	-	-	0.11	-	0.12	-	-	0.1	-
VH1 (0.00-0.10)	MAC8	-	0.02	-	-	-	-	0.02	-	<0.01	-	-	0.01	-

VH1 (1.00-1.10)	MAC8	-	3.01	-	-	-	-	2.01	-	1.18	-	-	0.88	-
VH1 (2.00-2.10)	MAC8	-	<0.01	-	-	-	-	<0.01	-	<0.01	-	-	<0.01	-
VH1 (3.00-3.10)	MAC8	-	<0.01	-	-	-	-	<0.01	-	<0.01	-	-	<0.01	-
VH1 (4.00-4.10)	MAC8	-	<0.01	-	-	-	-	<0.01	-	<0.01	-	-	<0.01	-
V-J1 (0.00-0.10)	MAC9	-	1.07	-	-	-	-	0.72	-	0.78	-	-	0.13	-
V-J1 (1.00-1.10)	MAC9	-	1.57	-	-	-	-	1.09	-	0.86	-	-	0.53	-
V-J1 (2.00-2.10)	MAC9	-	0.02	-	-	-	-	0.03	-	0.01	-	-	<0.01	-
V-J1 (3.00-3.10)	MAC9	-	0.02	-	-	-	-	0.03	-	<0.01	-	-	0.03	-
V-J1 (4.00-4.10)	MAC9	-	0.02	-	-	-	-	0.02	-	<0.01	-	-	<0.01	-
V-K2A (0.00-0.10)	MAC10	-	0.14	-	-	-	-	0.14	-	0.05	-	-	0.03	-
V-K2A (1.00-1.10)	MAC10	-	0.02	-	-	-	-	<0.01	-	<0.01	-	-	<0.01	-
V-K2A (2.00-2.10)	MAC10	-	<0.01	-	-	-	-	<0.01	-	<0.01	-	-	<0.01	-
V-K2A (3.00-3.10)	MAC10	-	0.01	-	-	-	-	<0.01	-	<0.01	-	-	<0.01	-
V-K2A (4.00-4.10)	MAC10	-	<0.01	-	-	-	-	<0.01	-	<0.01	-	-	<0.01	-
V-R01 (0.00-0.10)	-	-	0.31	-	-	-	-	0.28	-	0.11	-	-	0.07	-
V-R01 (1.00-1.10)	-	-	8.37	-	-	-	-	3.86	-	2.23	-	-	1.47	-
V-R01 (2.00-2.10)	-	-	12	-	-	-	-	6.09	-	2.8	-	-	0.95	-
V-R01 (3.00-3.10)	-	-	8.36	-	-	-	-	5.85	-	3.09	-	-	1.57	-
V-R01 (4.00-4.10)	-	-	4.74	-	-	-	-	8.42	-	6.85	-	-	4.7	-
V-R08 (0.00-0.10)	-	-	0.02	-	-	-	-	0.03	-	0.01	-	-	<0.01	-
V-R08 (1.00-1.10)	-	-	0.01	-	-	-	-	<0.01	-	<0.01	-	-	<0.01	-
V-R08 (2.00-2.10)	-	-	<0.01	-	-	-	-	<0.01	-	0.01	-	-	<0.01	-
V-R08 (2.92-2.97)	-	-	<0.01	-	-	-	-	<0.01	-	<0.01	-	-	<0.01	-
V-R03 (0.00-0.10)	-	-	0.62	-	-	-	-	0.46	-	0.17	-	-	0.11	-
V-R03 (1.00-1.10)	-	-	1.65	-	-	-	-	1.46	-	0.87	-	-	0.3	-
V-R03 (2.00-2.10)	-	-	4.53	-	-	-	-	3.13	-	1.56	-	-	0.65	-
V-R03 (3.00-3.10)	-	-	6.99	-	-	-	-	4.2	-	2.39	-	-	1.43	-
V-R03 (4.00-4.10)	-	-	6.43	-	-	-	-	3.79	-	1.59	-	-	0.96	-
V-R07 (0.00-0.10)	-	-	1.82	-	-	-	-	1.45	-	0.58	-	-	0.39	-
V-R07 (0.85-0.95)	-	-	4.47	-	-	-	-	3.15	-	1.59	-	-	1.11	-
V-R07 (1.95-2.05)	-	-	0.02	-	-	-	-	<0.01	-	<0.01	-	-	<0.01	-
V-R10A (0.00-0.10)	-	-	0.16	-	-	-	-	0.26	-	0.12	-	-	0.09	-
V-R10A (1.00-1.10)	-	-	<0.01	-	-	-	-	<0.01	-	<0.01	-	-	<0.01	-
V-R10A (1.97-2.10)	-	-	0.02	-	-	-	-	<0.01	-	<0.01	-	-	<0.01	-
V-R11A (0.00-0.10)	-	-	0.07	-	-	-	-	0.2	-	0.29	-	-	0.23	-
V-R11A (1.00-1.10)	-	-	0.01	-	-	-	-	<0.01	-	<0.01	-	-	<0.01	-

V-R06 (0.00-0.10)	-	-	1.36	-	-	-	-	1.11	-	0.44	-	-	0.36	-
V-R06 (1.00-1.10)	-	-	4.38	-	-	-	-	2.69	-	1.56	-	-	0.68	-
V-R06 (2.00-2.10)	-	-	8.12	-	-	-	-	4.73	-	2.32	-	-	1.57	-
V-R06 (3.00-3.10)	-	-	12.8	-	-	-	-	7.4	-	3.94	-	-	2.69	-
V-R06 (4.00-4.10)	-	-	11.1	-	-	-	-	6.03	-	2.67	-	-	1.15	-
V-R05 (0.00-0.10)	-	-	0.49	-	-	-	-	2.34	-	0.81	-	-	0.81	-
V-R05 (1.00-1.10)	-	-	0.24	-	-	-	-	0.46	-	0.24	-	-	0.13	-
V-R04 (0.00-0.10)	-	-	0.11	-	-	-	-	0.11	-	0.05	-	-	0.07	-
V-R04 (1.00-1.10)	-	-	0.01	-	-	-	-	<0.01	-	<0.01	-	-	<0.01	-
V-R02 (0.00-0.10)	-	-	0.02	-	-	-	-	0.05	-	0.02	-	-	0.02	-
V-R02 (1.00-1.10)	-	-	<0.01	-	-	-	-	<0.01	-	<0.01	-	-	<0.01	-
V-R02 (2.00-2.10)	-	-	<0.01	-	-	-	-	<0.01	-	<0.01	-	-	<0.01	-
V-R02 (2.85-2.95)	-	-	0.01	-	-	-	-	<0.01	-	<0.01	-	-	<0.01	-
V-R09A (0.00-0.10)	-	-	3.13	-	-	-	-	2.34	-	1.03	-	-	0.51	-
V-R09A (1.00-1.10)	-	-	0.03	-	-	-	-	0.02	-	0.01	-	-	<0.01	-
V-R09A (2.00-2.10)	-	-	<0.01	-	-	-	-	<0.01	-	<0.01	-	-	<0.01	-
V-R09A (2.98-3.08)	-	-	0.01	-	-	-	-	<0.01	-	<0.01	-	-	<0.01	-

Laboratory Sample N^{o.}	Figure ID	#138	#141	#149	#151	#153	#156	#158	#170	#180	#183	#187	#194	ΣICES 7 PCBs	Σ25 PCBs
Cefas Guideline AL1		-	-	-	-	-	-	-	-	-	-	-	-	10	20
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-	-	200
V-A1 (0.00-0.10)	MAC1	0.03	-	-	-	0.01	-	-	-	<0.01	-	-	-	0.22	-
V-A1 (1.00-1.10)	MAC1	<0.01	-	-	-	<0.01	-	-	-	0.02	-	-	-	0.06	-
V-A1 (2.00-2.10)	MAC1	<0.01	-	-	-	<0.01	-	-	-	<0.01	-	-	-	0.06	-
V-A1 (3.00-3.10)	MAC1	0.6	-	-	-	0.32	-	-	-	0.14	-	-	-	3.76	-
V-A4 (0.00-0.10)	MAC2	0.15	-	-	-	0.19	-	-	-	0.09	-	-	-	1.27	-
V-A4 (1.00-1.10)	MAC2	<0.01	-	-	-	<0.01	-	-	-	<0.01	-	-	-	0.01	-
V-A4 (2.10-2.20)	MAC2	<0.01	-	-	-	<0.01	-	-	-	<0.01	-	-	-	-	-
V-C3 (0.00-0.10)	MAC3	0.12	-	-	-	0.14	-	-	-	0.05	-	-	-	0.92	-
V-C3 (1.00-1.10)	MAC3	<0.01	-	-	-	<0.01	-	-	-	<0.01	-	-	-	0.03	-
V-C3 (1.90-1.96)	MAC3	<0.01	-	-	-	<0.01	-	-	-	<0.01	-	-	-	0.06	-
V-D4 (0.00-0.10)	MAC4	0.19	-	-	-	0.14	-	-	-	0.1	-	-	-	1.17	-
V-D4 (1.00-1.10)	MAC4	0.01	-	-	-	0.01	-	-	-	<0.01	-	-	-	0.1	-
V-D4 (2.00-2.10)	MAC4	0.12	-	-	-	0.12	-	-	-	0.04	-	-	-	1.06	-
V-D4 (3.00-3.10)	MAC4	0.09	-	-	-	0.05	-	-	-	0.02	-	-	-	0.31	-
V-D4 (4.10-4.20)	MAC4	<0.01	-	-	-	<0.01	-	-	-	<0.01	-	-	-	-	-

V-D7 (0.00-0.10)	MAC5	0.39	-	-	-	0.52	-	-	-	0.21	-	-	-	3.69	-
V-D7 (1.00-1.10)	MAC5	0.13	-	-	-	0.16	-	-	-	0.09	-	-	-	1.26	-
V-D7 (2.00-2.10)	MAC5	0.04	-	-	-	0.01	-	-	-	0.02	-	-	-	0.3	-
V-D7 (3.00-3.10)	MAC5	<0.01	-	-	-	<0.01	-	-	-	0.01	-	-	-	0.02	-
V-D7 (4.00-4.10)	MAC5	<0.01	-	-	-	<0.01	-	-	-	<0.01	-	-	-	-	-
V-E6 (0.00-0.10)	MAC6	0.28	-	-	-	0.31	-	-	-	0.13	-	-	-	2.64	-
V-E6 (1.00-1.10)	MAC6	0.14	-	-	-	0.17	-	-	-	0.08	-	-	-	1.18	-
V-E6 (2.00-2.10)	MAC6	0.5	-	-	-	0.56	-	-	-	0.35	-	-	-	4.59	-
V-E6 (3.00-3.10)	MAC6	0.37	-	-	-	0.36	-	-	-	0.26	-	-	-	3.83	-
V-E6 (4.00-4.10)	MAC6	0.88	-	-	-	0.89	-	-	-	0.57	-	-	-	7.52	-
V-F2 (0.00-0.10)	MAC7	0.18	-	-	-	0.18	-	-	-	0.09	-	-	-	1.77	-
V-F2 (1.00-1.10)	MAC7	0.02	-	-	-	0.02	-	-	-	0.01	-	-	-	0.18	-
V-F2 (2.00-2.10)	MAC7	0.09	-	-	-	0.12	-	-	-	0.06	-	-	-	0.73	-
V-F2 (3.00-3.10)	MAC7	0.05	-	-	-	0.05	-	-	-	0.02	-	-	-	0.38	-
V-F2 (4.00-4.10)	MAC7	0.14	-	-	-	0.14	-	-	-	0.04	-	-	-	0.78	-
VH1 (0.00-0.10)	MAC8	0.02	-	-	-	0.02	-	-	-	<0.01	-	-	-	0.09	-
VH1 (1.00-1.10)	MAC8	1.15	-	-	-	1.25	-	-	-	0.99	-	-	-	10.47	-
VH1 (2.00-2.10)	MAC8	<0.01	-	-	-	<0.01	-	-	-	<0.01	-	-	-	-	-
VH1 (3.00-3.10)	MAC8	<0.01	-	-	-	<0.01	-	-	-	<0.01	-	-	-	-	-
VH1 (4.00-4.10)	MAC8	<0.01	-	-	-	<0.01	-	-	-	<0.01	-	-	-	-	-
V-J1 (0.00-0.10)	MAC9	0.48	-	-	-	0.81	-	-	-	0.14	-	-	-	4.13	-
V-J1 (1.00-1.10)	MAC9	0.21	-	-	-	0.55	-	-	-	0.41	-	-	-	5.22	-
V-J1 (2.00-2.10)	MAC9	0.02	-	-	-	0.01	-	-	-	0.02	-	-	-	0.11	-
V-J1 (3.00-3.10)	MAC9	<0.01	-	-	-	0.01	-	-	-	0.02	-	-	-	0.11	-
V-J1 (4.00-4.10)	MAC9	<0.01	-	-	-	<0.01	-	-	-	0.02	-	-	-	0.06	-
V-K2A (0.00-0.10)	MAC10	0.05	-	-	-	0.1	-	-	-	0.04	-	-	-	0.55	-
V-K2A (1.00-1.10)	MAC10	<0.01	-	-	-	<0.01	-	-	-	0.01	-	-	-	0.03	-
V-K2A (2.00-2.10)	MAC10	<0.01	-	-	-	<0.01	-	-	-	<0.01	-	-	-	-	-
V-K2A (3.00-3.10)	MAC10	<0.01	-	-	-	<0.01	-	-	-	0.01	-	-	-	0.02	-
V-K2A (4.00-4.10)	MAC10	<0.01	-	-	-	<0.01	-	-	-	<0.01	-	-	-	-	-
V-R01 (0.00-0.10)	-	0.29	-	-	-	0.11	-	-	-	0.06	-	-	-	1.23	-
V-R01 (1.00-1.10)	-	2.02	-	-	-	1.62	-	-	-	1.07	-	-	-	20.64	-
V-R01 (2.00-2.10)	-	1.87	-	-	-	1.21	-	-	-	0.98	-	-	-	25.9	-
V-R01 (3.00-3.10)	-	1.89	-	-	-	1.8	-	-	-	1.11	-	-	-	23.67	-
V-R01 (4.00-4.10)	-	2.27	-	-	-	6.52	-	-	-	1.42	-	-	-	34.92	-
V-R08 (0.00-0.10)	-	<0.01	-	-	-	<0.01	-	-	-	<0.01	-	-	-	0.06	-

V-R08 (1.00-1.10)	-	<0.01	-	-	-	<0.01	-	-	-	0.01	-	-	-	0.02	-
V-R08 (2.00-2.10)	-	<0.01	-	-	-	<0.01	-	-	-	0.02	-	-	-	0.03	-
V-R08 (2.92-2.97)	-	<0.01	-	-	-	<0.01	-	-	-	0.01	-	-	-	0.01	-
V-R03 (0.00-0.10)	-	0.15	-	-	-	0.14	-	-	-	0.08	-	-	-	1.73	-
V-R03 (1.00-1.10)	-	0.51	-	-	-	0.44	-	-	-	0.35	-	-	-	5.58	-
V-R03 (2.00-2.10)	-	0.91	-	-	-	0.82	-	-	-	0.68	-	-	-	12.28	-
V-R03 (3.00-3.10)	-	2.12	-	-	-	2.33	-	-	-	1.62	-	-	-	21.08	-
V-R03 (4.00-4.10)	-	0.98	-	-	-	1.19	-	-	-	0.76	-	-	-	15.7	-
V-R07 (0.00-0.10)	-	0.17	-	-	-	0.26	-	-	-	0.41	-	-	-	5.08	-
V-R07 (0.85-0.95)	-	1.2	-	-	-	1.57	-	-	-	1.04	-	-	-	14.13	-
V-R07 (1.95-2.05)	-	<0.01	-	-	-	<0.01	-	-	-	<0.01	-	-	-	0.02	-
V-R10A (0.00-0.10)	-	0.15	-	-	-	0.13	-	-	-	0.1	-	-	-	1.01	-
V-R10A (1.00-1.10)	-	<0.01	-	-	-	<0.01	-	-	-	<0.01	-	-	-	-	-
V-R10A (1.97-2.10)	-	<0.01	-	-	-	<0.01	-	-	-	<0.01	-	-	-	0.02	-
V-R11A (0.00-0.10)	-	0.28	-	-	-	0.16	-	-	-	0.05	-	-	-	1.28	-
V-R11A (1.00-1.10)	-	<0.01	-	-	-	<0.01	-	-	-	<0.01	-	-	-	0.01	-
V-R06 (0.00-0.10)	-	0.42	-	-	-	0.49	-	-	-	0.26	-	-	-	4.44	-
V-R06 (1.00-1.10)	-	1.27	-	-	-	1.42	-	-	-	0.95	-	-	-	12.95	-
V-R06 (2.00-2.10)	-	1.71	-	-	-	1.95	-	-	-	1.39	-	-	-	21.79	-
V-R06 (3.00-3.10)	-	2.87	-	-	-	3.06	-	-	-	2.06	-	-	-	34.82	-
V-R06 (4.00-4.10)	-	1.6	-	-	-	1.98	-	-	-	1.31	-	-	-	25.84	-
V-R05 (0.00-0.10)	-	0.76	-	-	-	0.73	-	-	-	0.53	-	-	-	6.47	-
V-R05 (1.00-1.10)	-	0.2	-	-	-	0.06	-	-	-	0.11	-	-	-	1.44	-
V-R04 (0.00-0.10)	-	0.09	-	-	-	0.09	-	-	-	0.04	-	-	-	0.56	-
V-R04 (1.00-1.10)	-	<0.01	-	-	-	<0.01	-	-	-	<0.01	-	-	-	0.01	-
V-R02 (0.00-0.10)	-	0.02	-	-	-	0.02	-	-	-	0.01	-	-	-	0.16	-
V-R02 (1.00-1.10)	-	<0.01	-	-	-	<0.01	-	-	-	<0.01	-	-	-	-	-
V-R02 (2.00-2.10)	-	<0.01	-	-	-	<0.01	-	-	-	<0.01	-	-	-	-	-
V-R02 (2.85-2.95)	-	<0.01	-	-	-	<0.01	-	-	-	<0.01	-	-	-	0.01	-
V-R09A (0.00-0.10)	-	0.71	-	-	-	0.59	-	-	-	0.49	-	-	-	8.8	-
V-R09A (1.00-1.10)	-	0.01	-	-	-	0.01	-	-	-	<0.01	-	-	-	0.08	-
V-R09A (2.00-2.10)	-	<0.01	-	-	-	<0.01	-	-	-	<0.01	-	-	-	-	-
V-R09A (2.98-3.08)	-	<0.01	-	-	-	<0.01	-	-	-	<0.01	-	-	-	0.01	-
Key	Below AL1														
	Above AL1, Below AL2														
	Above AL2														

Table A.29 Polycyclic aromatic hydrocarbon (PAH) concentrations and total hydrocarbon content (THC) from sediment samples collected from Mersey Approach Channel (2012)

Laboratory Sample Nº.	Figure ID	PAHs (mg/kg dry weight)										
		ACENAPH	ACENAPT	ANTHRAC	BAA	BAP	BBF	BENZGHI	BEP	BKF	C1N	C1PHEN
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-
V-A1 (0.00-0.10)	MAC1	0.0002	0.0005	0.0009	0.0025	0.003	0.0027	0.0028	-	0.0013	-	-
V-A1 (1.00-1.10)	MAC1	0.0002	0.0002	0.0001	0.0004	0.0003	0.0004	0.0004	-	0.0001	-	-
V-A1 (2.00-2.10)	MAC1	<0.0001	0.0001	<0.0001	0.0003	0.0003	0.0009	0.0007	-	0.0001	-	-
V-A1 (3.00-3.10)	MAC1	0.0002	0.0002	0.0003	0.0015	0.0013	0.0037	0.0039	-	0.0005	-	-
V-A4 (0.00-0.10)	MAC2	0.0111	0.0095	0.0223	0.0427	0.0373	0.0303	0.0301	-	0.0162	-	-
V-A4 (1.00-1.10)	MAC2	0.0384	0.024	0.0727	0.1711	0.1166	0.0879	0.0757	-	0.0468	-	-
V-A4 (2.10-2.20)	MAC2	0.0002	0.0002	0.0003	0.0015	0.0012	0.0036	0.0038	-	0.0005	-	-
V-C3 (0.00-0.10)	MAC3	0.0014	0.0038	0.0054	0.0094	0.0171	0.0148	0.0141	-	0.0075	-	-
V-C3 (1.00-1.10)	MAC3	0.0003	0.0002	0.0003	0.0019	0.0019	0.005	0.0053	-	0.0007	-	-
V-C3 (1.90-1.96)	MAC3	0.0003	0.0002	0.0003	0.0018	0.0016	0.0044	0.0052	-	0.0006	-	-
V-D4 (0.00-0.10)	MAC4	0.0056	0.0076	0.0121	0.0274	0.0321	0.0289	0.03	-	0.0143	-	-
V-D4 (1.00-1.10)	MAC4	0.0007	0.0007	0.0013	0.0038	0.004	0.0069	0.0076	-	0.0015	-	-
V-D4 (2.00-2.10)	MAC4	0.0114	0.037	0.0693	0.168	0.142	0.0981	0.093	-	0.0538	-	-
V-D4 (3.00-3.10)	MAC4	0.0295	0.0572	0.113	0.218	0.214	0.16	0.167	-	0.0839	-	-
V-D4 (4.10-4.20)	MAC4	0.0006	0.0003	0.0007	0.0031	0.0028	0.0064	0.0075	-	0.001	-	-
V-D7 (0.00-0.10)	MAC5	0.0163	0.0243	0.0391	0.0886	0.0894	0.0795	0.0793	-	0.0398	-	-
V-D7 (1.00-1.10)	MAC5	0.0044	0.0043	0.0098	0.0175	0.0177	0.0147	0.0123	-	0.0079	-	-
V-D7 (2.00-2.10)	MAC5	0.035	0.0828	0.15	0.387	0.342	0.249	0.251	-	0.138	-	-
V-D7 (3.00-3.10)	MAC5	0.0056	0.0026	0.0126	0.0271	0.0247	0.0178	0.0177	-	0.0098	-	-
V-D7 (4.00-4.10)	MAC5	0.0001	0.0002	0.0005	0.0008	0.0013	0.0012	0.0012	-	0.0006	-	-
V-E6 (0.00-0.10)	MAC6	0.0116	0.0213	0.0317	0.0763	0.0783	0.065	0.0676	-	0.0336	-	-
V-E6 (1.00-1.10)	MAC6	0.0048	0.0057	0.0104	0.0252	0.0269	0.0258	0.0203	-	0.0128	-	-
V-E6 (2.00-2.10)	MAC6	0.0253	0.0295	0.0648	0.1469	0.1257	0.1084	0.0947	-	0.0549	-	-
V-E6 (3.00-3.10)	MAC6	0.0126	0.0158	0.027	0.045	0.0526	0.0444	0.036	-	0.0226	-	-
V-E6 (4.00-4.10)	MAC6	0.0201	0.0257	0.0501	0.1041	0.1235	0.1073	0.0989	-	0.0508	-	-
V-F2 (0.00-0.10)	MAC7	0.0067	0.0053	0.0156	0.0468	0.0517	0.0451	0.0384	-	0.0218	-	-

V-F2 (1.00-1.10)	MAC7	0.0003	0.0006	0.0012	0.0031	0.0043	0.0038	0.0036	-	0.0019	-	-
V-F2 (2.00-2.10)	MAC7	0.0519	0.0023	0.062	0.1719	0.129	0.1069	0.0746	-	0.0554	-	-
V-F2 (3.00-3.10)	MAC7	0.0008	0.0013	0.0021	0.0061	0.01	0.0092	0.0086	-	0.0046	-	-
V-F2 (4.00-4.10)	MAC7	0.0008	0.001	0.0036	0.0071	0.011	0.0096	0.0086	-	0.0047	-	-
VH1 (0.00-0.10)	MAC8	0.0001	0.0001	0.0002	0.0006	0.0013	0.0015	0.0014	-	0.0007	-	-
VH1 (1.00-1.10)	MAC8	0.0257	0.0541	0.117	0.1781	0.1936	0.1683	0.1444	-	0.0791	-	-
VH1 (2.00-2.10)	MAC8	0.0012	0.0026	0.0032	0.0068	0.0084	0.0065	0.0068	-	0.0033	-	-
VH1 (3.00-3.10)	MAC8	0.0001	0.0002	0.0005	0.0019	0.0036	0.0031	0.0031	-	0.0016	-	-
VH1 (4.00-4.10)	MAC8	0.0004	0.0003	0.001	0.004	0.0044	0.0042	0.0019	-	0.0022	-	-
V-J1 (0.00-0.10)	MAC9	0.0291	0.0281	0.0636	0.1512	0.1154	0.0918	0.097	-	0.0478	-	-
V-J1 (1.00-1.10)	MAC9	0.022	0.0212	0.0682	0.1379	0.1408	0.1044	0.1119	-	0.0532	-	-
V-J1 (2.00-2.10)	MAC9	0.0018	0.005	0.0069	0.0135	0.0245	0.0196	0.0192	-	0.0097	-	-
V-J1 (3.00-3.10)	MAC9	0.0066	0.0149	0.0214	0.0565	0.0674	0.0545	0.0476	-	0.028	-	-
V-J1 (4.00-4.10)	MAC9	0.0278	0.0243	0.0545	0.1172	0.1214	0.0919	0.0897	-	0.0496	-	-
V-K2A (0.00-0.10)	MAC10	0.0063	0.0044	0.0177	0.0461	0.0395	0.0308	0.032	-	0.0163	-	-
V-K2A (1.00-1.10)	MAC10	0.0132	0.0048	0.0222	0.0572	0.0401	0.0337	0.0314	-	0.0169	-	-
V-K2A (2.00-2.10)	MAC10	0.0009	0.0006	0.002	0.0071	0.0043	0.0052	0.0027	-	0.0023	-	-
V-K2A (3.00-3.10)	MAC10	0.0002	0.0001	0.0003	0.0007	0.0007	0.0011	0.0016	-	0.0003	-	-
V-K2A (4.00-4.10)	MAC10	<0.0001	0.0001	0.0002	0.0002	0.0003	0.0005	0.0004	-	0.0002	-	-
V-R01 (0.00-0.10)	-	0.006	0.0111	0.0197	0.0422	0.0447	0.0386	0.0457	-	0.0195	-	-
V-R01 (1.00-1.10)	-	0.0798	0.0591	0.14	0.224	0.193	0.16	0.143	-	0.0834	-	-
V-R01 (2.00-2.10)	-	0.082	0.0432	0.122	0.143	0.141	0.109	0.105	-	0.0588	-	-
V-R01 (3.00-3.10)	-	0.258	0.0524	0.194	0.194	0.176	0.152	0.129	-	0.0776	-	-
V-R01 (4.00-4.10)	-	0.15	0.0253	0.227	0.383	0.237	0.163	0.144	-	0.0943	-	-
V-R08 (0.00-0.10)	-	0.0018	0.0017	0.0034	0.0073	0.0062	0.0073	0.0025	-	0.0032	-	-
V-R08 (1.00-1.10)	-	0.0004	0.0001	0.0003	0.0009	0.0009	0.0026	0.0013	-	0.0005	-	-
V-R08 (2.00-2.10)	-	0.0002	0.0001	0.0001	0.0006	0.0007	0.0028	0.0016	-	0.0006	-	-
V-R08 (2.92-2.97)	-	0.0001	0.0001	0.0001	0.0004	0.0006	0.0017	0.0013	-	0.0006	-	-
V-R03 (0.00-0.10)	-	0.0029	0.0026	0.0076	0.0183	0.0237	0.0237	0.0127	-	0.0115	-	-
V-R03 (1.00-1.10)	-	0.0322	0.0291	0.1703	0.177	0.1668	0.1363	0.1056	-	0.0685	-	-
V-R03 (2.00-2.10)	-	0.0638	0.0346	0.1038	0.1517	0.1447	0.1277	0.0986	-	0.0583	-	-
V-R03 (3.00-3.10)	-	0.7833	0.1852	1.17	0.6924	0.4426	0.3777	0.3186	-	0.1969	-	-
V-R03 (4.00-4.10)	-	0.0833	0.0501	0.1491	0.2096	0.1953	0.1514	0.1553	-	0.0771	-	-
V-R07 (0.00-0.10)	-	0.0583	0.0248	0.065	0.1186	0.1236	0.099	0.1078	-	0.0508	-	-
V-R07 (0.85-0.95)	-	3.34	0.1466	1.43	0.4951	0.3686	0.2835	0.2509	-	0.1535	-	-
V-R07 (1.95-2.05)	-	0.0039	0.0008	0.0036	0.0043	0.0033	0.0073	0.0088	-	0.0013	-	-

V-R10A (0.00-0.10)	-	0.0163	0.0231	0.046	0.1235	0.1222	0.0834	0.0819	-	0.0475	-	-
V-R10A (1.00-1.10)	-	0.0003	0.0002	0.0003	0.002	0.002	0.0057	0.0044	-	0.0008	-	-
V-R10A (1.97-2.10)	-	0.0004	0.0006	0.0007	0.0029	0.0029	0.0069	0.0074	-	0.0011	-	-
V-R11A (0.00-0.10)	-	0.1352	0.0045	0.0201	0.1007	0.0709	0.0758	0.0525	-	0.0386	-	-
V-R11A (1.00-1.10)	-	0.0001	<0.0001	<0.0001	0.0002	0.0002	0.0003	0.0001	-	0.0001	-	-
V-R06 (0.00-0.10)	-	0.0074	0.0139	0.0246	0.0583	0.0723	0.0662	0.0746	-	0.0329	-	-
V-R06 (1.00-1.10)	-	0.5933	0.0715	0.3927	0.2457	0.2313	0.2119	0.1893	-	0.0994	-	-
V-R06 (2.00-2.10)	-	0.2814	0.0663	0.2229	0.1967	0.1718	0.1503	0.1372	-	0.0746	-	-
V-R06 (3.00-3.10)	-	0.1457	0.0773	0.2513	0.2417	0.2005	0.1944	0.1388	-	0.0909	-	-
V-R06 (4.00-4.10)	-	0.0543	0.046	0.1085	0.1863	0.1687	0.1421	0.1221	-	0.0732	-	-
V-R05 (0.00-0.10)	-	0.0259	0.0633	0.125	0.2585	0.2522	0.2289	0.1377	-	0.1103	-	-
V-R05 (1.00-1.10)	-	0.0471	0.096	0.1984	0.5929	0.3865	0.3263	0.2037	-	0.1693	-	-
V-R04 (0.00-0.10)	-	0.0017	0.0044	0.0068	0.0164	0.0285	0.0248	0.02	-	0.0131	-	-
V-R04 (1.00-1.10)	-	0.0001	0.0001	0.0001	0.0002	0.0003	0.0009	0.0007	-	0.0002	-	-
V-R02 (0.00-0.10)	-	0.0084	0.0243	0.0307	0.0677	0.0686	0.0541	0.0529	-	0.0274	-	-
V-R02 (1.00-1.10)	-	<0.0001	0.0001	0.0001	0.0002	0.0004	0.0011	0.0008	-	0.0004	-	-
V-R02 (2.00-2.10)	-	0.0001	<0.0001	<0.0001	0.0002	0.0003	0.0015	0.001	-	0.0004	-	-
V-R02 (2.85-2.95)	-	0.0001	0.0001	0.0001	0.0002	0.0003	0.0015	0.0011	-	0.0005	-	-
V-R09A (0.00-0.10)	-	0.0122	0.0201	0.0468	0.0733	0.0845	0.0781	0.063	-	0.0382	-	-
V-R09A (1.00-1.10)	-	0.0005	0.0006	0.0008	0.0024	0.0026	0.0047	0.0037	-	0.0011	-	-
V-R09A (2.00-2.10)	-	0.003	0.0009	0.0051	0.012	0.0074	0.0129	0.0153	-	0.0025	-	-
V-R09A (2.98-3.08)	-	0.0014	0.0008	0.0018	0.007	0.0057	0.013	0.0158	-	0.002	-	-

Laboratory Sample No.	Figure ID	C2N	C3N	CHRYSEN	DBENZAH	FLUORAN	FLUOREN	INDPYR	NAPTH	PERYLEN	PHENANT	PYRENE	THC
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	100
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-
V-A1 (0.00-0.10)	MAC1	-	-	0.0029	0.0006	0.003	0.0005	0.0026	0.0012	-	0.0025	0.0042	-
V-A1 (1.00-1.10)	MAC1	-	-	0.0007	0.0001	0.0005	0.0002	0.0001	0.0005	-	0.0022	0.0005	-
V-A1 (2.00-2.10)	MAC1	-	-	0.0011	0.0001	0.0005	0.0002	0.0003	0.0009	-	0.0009	0.0005	-
V-A1 (3.00-3.10)	MAC1	-	-	0.0053	0.0004	0.003	0.0008	0.0012	0.0009	-	0.0046	0.0033	-
V-A4 (0.00-0.10)	MAC2	-	-	0.0449	0.0061	0.0825	0.011	0.0344	0.0152	-	0.0571	0.0728	-
V-A4 (1.00-1.10)	MAC2	-	-	0.184	0.018	0.275	0.0398	0.0939	0.0383	-	0.1857	0.2565	-
V-A4 (2.10-2.20)	MAC2	-	-	0.005	0.0004	0.0032	0.0008	0.0012	0.001	-	0.0047	0.0031	-
V-C3 (0.00-0.10)	MAC3	-	-	0.0108	0.003	0.0155	0.0022	0.0172	0.0045	-	0.0095	0.0221	-

V-C3 (1.00-1.10)	MAC3	-	-	0.0068	0.0006	0.0038	0.0011	0.0017	0.0011	-	0.0062	0.0047	-
V-C3 (1.90-1.96)	MAC3	-	-	0.0065	0.0006	0.0042	0.0012	0.0016	0.0011	-	0.0067	0.0039	-
V-D4 (0.00-0.10)	MAC4	-	-	0.032	0.0058	0.046	0.0067	0.0345	0.0122	-	0.028	0.0453	-
V-D4 (1.00-1.10)	MAC4	-	-	0.0094	0.001	0.0072	0.0018	0.0037	0.0025	-	0.009	0.0078	-
V-D4 (2.00-2.10)	MAC4	-	-	0.172	0.0353	0.259	0.0216	0.135	0.0159	-	0.0653	0.205	-
V-D4 (3.00-3.10)	MAC4	-	-	0.231	0.0541	0.379	0.0638	0.232	0.0357	-	0.199	0.335	-
V-D4 (4.10-4.20)	MAC4	-	-	0.01	0.0008	0.0052	0.0021	0.0024	0.0022	-	0.0103	0.0067	-
V-D7 (0.00-0.10)	MAC5	-	-	0.102	0.0162	0.1359	0.0207	0.0913	0.0269	-	0.0895	0.1295	-
V-D7 (1.00-1.10)	MAC5	-	-	0.0175	0.0031	0.0325	0.0055	0.016	0.0032	-	0.0235	0.0265	-
V-D7 (2.00-2.10)	MAC5	-	-	0.382	0.0872	0.526	0.0564	0.351	0.0307	-	0.263	0.727	-
V-D7 (3.00-3.10)	MAC5	-	-	0.0295	0.004	0.0502	0.0058	0.0192	0.0038	-	0.0336	0.0519	-
V-D7 (4.00-4.10)	MAC5	-	-	0.0008	0.0002	0.0012	0.0002	0.0013	0.0005	-	0.0007	0.0014	-
V-E6 (0.00-0.10)	MAC6	-	-	0.0884	0.0139	0.1108	0.0161	0.0749	0.0199	-	0.0665	0.11	-
V-E6 (1.00-1.10)	MAC6	-	-	0.0287	0.0038	0.0417	0.006	0.0251	0.0099	-	0.025	0.0406	-
V-E6 (2.00-2.10)	MAC6	-	-	0.1594	0.0176	0.2517	0.0328	0.1103	0.0219	-	0.1542	0.2421	-
V-E6 (3.00-3.10)	MAC6	-	-	0.0564	0.0085	0.0806	0.015	0.0475	0.0217	-	0.0561	0.0865	-
V-E6 (4.00-4.10)	MAC6	-	-	0.1138	0.0188	0.1758	0.0288	0.1347	0.0411	-	0.092	0.1683	-
V-F2 (0.00-0.10)	MAC7	-	-	0.0502	0.0078	0.0785	0.0076	0.0513	0.0177	-	0.042	0.0737	-
V-F2 (1.00-1.10)	MAC7	-	-	0.003	0.0007	0.0049	0.0004	0.005	0.0011	-	0.0026	0.0059	-
V-F2 (2.00-2.10)	MAC7	-	-	0.1735	0.0187	0.347	0.051	0.097	0.0299	-	0.3075	0.2872	-
V-F2 (3.00-3.10)	MAC7	-	-	0.0063	0.0017	0.0087	0.0013	0.0118	0.0033	-	0.0052	0.0109	-
V-F2 (4.00-4.10)	MAC7	-	-	0.0072	0.0017	0.0116	0.001	0.0114	0.0021	-	0.0061	0.0148	-
VH1 (0.00-0.10)	MAC8	-	-	0.0007	0.0002	0.0009	0.0001	0.002	0.0005	-	0.0005	0.001	-
VH1 (1.00-1.10)	MAC8	-	-	0.1793	0.0329	0.272	0.0341	0.2199	0.0465	-	0.1307	0.2836	-
VH1 (2.00-2.10)	MAC8	-	-	0.0069	0.0014	0.0121	0.0015	0.0083	0.0023	-	0.0088	0.0121	-
VH1 (3.00-3.10)	MAC8	-	-	0.0019	0.0006	0.0026	0.0002	0.0038	0.0006	-	0.001	0.0025	-
VH1 (4.00-4.10)	MAC8	-	-	0.004	0.0003	0.0067	0.0005	0.003	0.0016	-	0.0032	0.0061	-
V-J1 (0.00-0.10)	MAC9	-	-	0.1669	0.021	0.255	0.0309	0.1061	0.0244	-	0.1599	0.2381	-
V-J1 (1.00-1.10)	MAC9	-	-	0.1517	0.0361	0.2403	0.0267	0.1566	0.0209	-	0.1584	0.2262	-
V-J1 (2.00-2.10)	MAC9	-	-	0.0166	0.0043	0.0228	0.0026	0.0214	0.0026	-	0.013	0.0439	-
V-J1 (3.00-3.10)	MAC9	-	-	0.0649	0.0113	0.0925	0.0081	0.0609	0.0063	-	0.0481	0.1197	-
V-J1 (4.00-4.10)	MAC9	-	-	0.1344	0.0202	0.2124	0.0261	0.1052	0.0189	-	0.1356	0.2339	-
V-K2A (0.00-0.10)	MAC10	-	-	0.0503	0.0072	0.083	0.0065	0.0353	0.0051	-	0.0473	0.0746	-
V-K2A (1.00-1.10)	MAC10	-	-	0.0616	0.0074	0.1155	0.0172	0.0317	0.0099	-	0.0643	0.108	-
V-K2A (2.00-2.10)	MAC10	-	-	0.0072	0.0004	0.0116	0.0021	0.003	0.0012	-	0.0058	0.0109	-
V-K2A (3.00-3.10)	MAC10	-	-	0.0013	0.0002	0.001	0.0004	0.0005	0.0004	-	0.0031	0.0011	-

V-K2A (4.00-4.10)	MAC10	-	-	0.0003	0.0001	0.0003	<0.0001	0.0003	0.0001	-	0.0007	0.0004	-
V-R01 (0.00-0.10)	-	-	-	0.0482	0.0101	0.0755	0.0074	0.0484	0.0081	-	0.0407	0.0735	-
V-R01 (1.00-1.10)	-	-	-	0.26	0.0465	0.431	0.0838	0.205	0.0616	-	0.273	0.366	-
V-R01 (2.00-2.10)	-	-	-	0.164	0.0367	0.3	0.0837	0.143	0.0645	-	0.159	0.238	-
V-R01 (3.00-3.10)	-	-	-	0.224	0.0408	0.451	0.199	0.186	0.123	-	0.531	0.364	-
V-R01 (4.00-4.10)	-	-	-	0.391	0.0495	0.781	0.165	0.194	0.29	-	0.757	0.695	-
V-R08 (0.00-0.10)	-	-	-	0.0105	0.0006	0.0128	0.0036	0.0024	0.0045	-	0.0087	0.0458	-
V-R08 (1.00-1.10)	-	-	-	0.0033	0.0002	0.0024	0.0007	0.0005	0.001	-	0.0037	0.0024	-
V-R08 (2.00-2.10)	-	-	-	0.0033	0.0003	0.001	0.0002	0.0006	0.0005	-	0.0026	0.0015	-
V-R08 (2.92-2.97)	-	-	-	0.0012	0.0003	0.0006	0.0001	0.0006	0.0009	-	0.0019	0.0008	-
V-R03 (0.00-0.10)	-	-	-	0.0194	0.0022	0.039	0.003	0.0161	0.0042	-	0.0175	0.0386	-
V-R03 (1.00-1.10)	-	-	-	0.1778	0.0213	0.346	0.0287	0.1546	0.0334	-	0.1562	0.3182	-
V-R03 (2.00-2.10)	-	-	-	0.1659	0.0189	0.2958	0.0553	0.1443	0.0572	-	0.1684	0.2756	-
V-R03 (3.00-3.10)	-	-	-	0.6951	0.0731	2.48	0.775	0.3742	0.3728	-	3.48	1.82	-
V-R03 (4.00-4.10)	-	-	-	0.235	0.0337	0.425	0.0824	0.174	0.1952	-	0.3428	0.3484	-
V-R07 (0.00-0.10)	-	-	-	0.1338	0.0234	0.2143	0.0306	0.1209	0.07	-	0.1324	0.197	-
V-R07 (0.85-0.95)	-	-	-	0.5165	0.0605	1.66	0.5446	0.287	1.48	-	1.12	1.56	-
V-R07 (1.95-2.05)	-	-	-	0.0113	0.001	0.0089	0.0035	0.0033	0.006	-	0.0155	0.0093	-
V-R10A (0.00-0.10)	-	-	-	0.1261	0.0182	0.1996	0.0166	0.0913	0.0138	-	0.1112	0.3284	-
V-R10A (1.00-1.10)	-	-	-	0.007	0.0005	0.0034	0.001	0.0015	0.0016	-	0.0062	0.0043	-
V-R10A (1.97-2.10)	-	-	-	0.0096	0.0009	0.0059	0.0014	0.0026	0.0019	-	0.008	0.0078	-
V-R11A (0.00-0.10)	-	-	-	0.1195	0.0134	0.2873	0.0943	0.0594	0.0084	-	0.2031	0.1892	-
V-R11A (1.00-1.10)	-	-	-	0.0006	<0.0001	0.0003	0.0002	0.0001	0.0008	-	0.0004	0.0003	-
V-R06 (0.00-0.10)	-	-	-	0.0686	0.0151	0.0984	0.01	0.0795	0.0129	-	0.0526	0.095	-
V-R06 (1.00-1.10)	-	-	-	0.2953	0.04	0.6546	0.3482	0.2195	0.4495	-	1.64	0.5698	-
V-R06 (2.00-2.10)	-	-	-	0.2222	0.0303	0.4619	0.2468	0.1591	0.6107	-	0.676	0.3532	-
V-R06 (3.00-3.10)	-	-	-	0.2735	0.0296	0.5319	0.1553	0.1791	0.09	-	0.5539	0.4311	-
V-R06 (4.00-4.10)	-	-	-	0.209	0.0273	0.3518	0.0574	0.1394	0.0447	-	0.221	0.2914	-
V-R05 (0.00-0.10)	-	-	-	0.2908	0.0325	0.3644	0.0361	0.189	0.0331	-	0.1536	0.3944	-
V-R05 (1.00-1.10)	-	-	-	0.45	0.0507	1.02	0.0731	0.2693	0.0431	-	0.2749	0.8619	-
V-R04 (0.00-0.10)	-	-	-	0.0194	0.0041	0.022	0.0026	0.0226	0.0055	-	0.0111	0.0344	-
V-R04 (1.00-1.10)	-	-	-	0.0008	0.0001	0.0004	0.0002	0.0003	0.0007	-	0.0007	0.0004	-
V-R02 (0.00-0.10)	-	-	-	0.0709	0.011	0.0848	0.015	0.0515	0.0297	-	0.0432	0.215	-
V-R02 (1.00-1.10)	-	-	-	0.0007	0.0001	0.0002	0.0001	0.0004	0.0004	-	0.0006	0.0005	-
V-R02 (2.00-2.10)	-	-	-	0.0009	0.0002	0.0003	0.0001	0.0005	0.0004	-	0.0008	0.0005	-
V-R02 (2.85-2.95)	-	-	-	0.0009	0.0002	0.0003	0.0001	0.0005	0.0005	-	0.001	0.0005	-

V-R09A (0.00-0.10)	-	-	-	0.0894	0.0144	0.1369	0.0154	0.0703	0.0167	-	0.0755	0.1261	-
V-R09A (1.00-1.10)	-	-	-	0.0057	0.0005	0.0037	0.0012	0.002	0.0013	-	0.0054	0.0052	-
V-R09A (2.00-2.10)	-	-	-	0.0208	0.002	0.0162	0.0051	0.0047	0.0065	-	0.0447	0.0229	-
V-R09A (2.98-3.08)	-	-	-	0.0188	0.0019	0.0139	0.0055	0.005	0.0047	-	0.0332	0.0169	-
Key	Below AL1												
	Above AL1												

A.14 Approach Channel, River Mersey, Dock Entrances and Eastham Locks (2013)

Table A.30. Trace metal and organotin concentrations from sediment samples collected from the Approach Channel, River Mersey, Dock Entrances and Eastham Locks (2013)

Laboratory Sample No.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
Cefas Guideline AL1			20	0.4	40	40	0.3	20	50	130	0.1	0.1
Cefas Guideline AL2			100	5	400	400	3	200	500	800	1	1
Sample 1+2 (Approach Channel)	-	-	9.5	0.27	24	14	0.31	13	32	118	<LOD	<LOD
Sample 4 (Approach Channel)	-	-	7.9	0.23	17	8.7	0.2	9.7	22	101	<LOD	<LOD
Sample 5 (Approach Channel)	-	-	9.4	0.24	26	14	0.36	15	34	128	<LOD	<LOD
Sample 9+10 (River Mersey Jetties, Stages and Cammell Laird)	-	-	14	0.54	49	36	0.69	21	68	260	0.008	0.016
Sample 11 (River Mersey Jetties, Stages and Cammell Laird)	-	-	21	0.82	85	54	1.3	30	121	350	0.017	<LOD
Sample 13 (River Mersey and Dock Entrances)	-	-	13	0.47	25	55	0.63	19	0.63	201	<LOD	<LOD
Sample 14 (River Mersey and Dock Entrances)	-	-	11	0.43	20	47	0.49	17	0.49	184	0.002	<LOD
Sample 15+16 (River Mersey and Dock Entrances)	-	-	13	0.4	18	39	0.37	15	0.37	157	0.002	<LOD
Sample 17 (River Mersey and Dock Entrances)	-	-	16	0.74	40	83	0.89	26	0.89	327	0.002	<LOD

Laboratory Sample N°	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
		Cefas Guideline AL1	20	0.4	40	40	0.3	20	50	130	0.1	0.1
		Cefas Guideline AL2	100	5	400	400	3	200	500	800	1	1
Sample 18 (River Mersey and Dock Entrances)	-	-	7.1	0.2	7.5	22	0.17	6.9	0.17	95	<LOD	<LOD
Sample 19 (Eastham Locks)	-	-	8.6	0.22	15	9	0.24	8	23	109	<LOD	<LOD
Sample 20 (Eastham Locks)	-	-	9.5	0.43	23	16	0.38	11	33	180	<LOD	<LOD

Key	
	Below AL1
	Above AL1, Below AL2
	Above AL2

Table A.31 Polycyclic aromatic hydrocarbon (PAH) concentrations and total hydrocarbon content (THC) from the Approach Channel, River Mersey, Dock Entrances and Eastham Locks (2013)

Laboratory Sample N°.	Figure ID	PAHs (mg/kg dry weight)										
		ACENAPH	ACENAPT	ANTHRAC	BAA	BAP	BBF	BENZGHI	BEP	BKF	C1N	C1PHEN
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-
Sample 1+2 (Approach Channel)	-	0.012	0.019	0.034	0.13	0.177	0.215	0.15	0.131	0.106	0.137	0.235
Sample 4 (Approach Channel)	-	0.006	0.018	0.024	0.063	0.082	0.101	0.069	0.06	0.049	0.075	0.126
Sample 5 (Approach Channel)	-	0.009	0.012	0.026	0.088	0.126	0.162	0.118	0.102	0.078	0.105	0.166
Sample 9+10 (River Mersey Jetties, Stages and Cammell Laird)	-	0.024	0.057	0.088	0.259	0.385	0.483	0.341	0.300	0.229	0.299	0.461
Sample 11 (River Mersey Jetties, Stages and Cammell Laird)	-	0.044	0.090	0.137	0.416	0.671	0.882	0.640	0.545	0.393	0.449	0.743
Sample 13 (River Mersey and Dock Entrances)	-	0.025	0.046	0.086	0.274	0.350	0.379	0.294	0.240	0.204	0.233	0.487
Sample 14 (River Mersey and Dock Entrances)	-	0.021	0.038	0.095	0.293	0.355	0.388	0.289	0.252	0.194	0.213	0.484
Sample 15+16 (River Mersey and Dock Entrances)	-	0.008	0.008	0.021	0.075	0.105	0.117	0.089	0.070	0.059	0.062	0.115
Sample 17 (River Mersey and Dock Entrances)	-	0.030	0.050	0.097	0.29	0.414	0.488	0.378	0.304	0.247	0.273	0.452

Sample 18 (River Mersey and Dock Entrances)	-	0.007	0.011	0.02	0.058	0.082	0.093	0.074	0.057	0.048	0.059	0.114
Sample 19 (Eastham Locks)	-	0.005	0.009	0.020	0.059	0.077	0.096	0.063	0.055	0.043	0.055	0.110
Sample 20 (Eastham Locks)	-	0.013	0.045	0.056	0.170	0.217	0.236	0.170	0.149	0.125	0.175	0.310

Laboratory Sample Nº.	Figure ID	C2N	C3N	CHRYSEN	DBENZAH	FLUORAN	FLUOREN	INDPYR	NAPTH	PERYLEN	PHENANT	PYRENE	THC
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	100
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-
Sample 1+2 (Approach Channel)	-	0.225	0.391	0.113	0.032	0.217	0.026	0.181	0.052	0.052	0.117	0.211	227
Sample 4 (Approach Channel)	-	0.123	0.194	0.056	0.014	0.121	0.022	0.081	0.029	0.027	0.08	0.119	111
Sample 5 (Approach Channel)	-	0.158	0.272	0.077	0.023	0.163	0.019	0.138	0.043	0.04	0.089	0.15	200
Sample 9+10 (River Mersey Jetties, Stages and Cammell Laird)	-	0.462	0.739	0.227	0.071	0.511	0.071	0.394	0.151	0.118	0.299	0.506	597
Sample 11 (River Mersey Jetties, Stages and Cammell Laird)	-	0.772	1.323	0.393	0.130	0.813	0.125	0.726	0.194	0.216	0.435	0.802	1182
Sample 13 (River Mersey and Dock Entrances)	-	0.401	0.714	0.208	0.063	0.530	0.058	0.347	0.100	0.106	0.266	0.500	476
Sample 14 (River Mersey and Dock Entrances)	-	0.344	0.602	0.240	0.060	0.576	0.051	0.331	0.096	0.107	0.277	0.550	455
Sample 15+16 (River Mersey and Dock Entrances)	-	0.093	0.173	0.055	0.019	0.108	0.013	0.106	0.026	0.032	0.052	0.115	145

Sample 17 (River Mersey and Dock Entrances)	-	0.440	0.764	0.224	0.077	0.572	0.067	0.442	0.123	0.130	0.283	0.543	620
Sample 18 (River Mersey and Dock Entrances)	-	0.099	0.178	0.041	0.015	0.107	0.014	0.089	0.025	0.026	0.061	0.103	129
Sample 19 (Eastham Locks)	-	0.090	0.189	0.044	0.012	0.119	0.012	0.076	0.024	0.024	0.060	0.117	128
Sample 20 (Eastham Locks)	-	0.293	0.476	0.142	0.035	0.357	0.044	0.202	0.075	0.066	0.207	0.339	329
Key	Below AL1												
	Above AL1												

A.15 Mersey Channel (C1 Buoy) (2013)

Table A.32. Trace metal and organotin concentrations from sediment samples collected from Mersey Channel (C1 Buoy) (2013)

Laboratory Sample Nº.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
Cefas Guideline AL1			20	0.4	40	40	0.3	20	50	130	0.1	0.1
Cefas Guideline AL2			100	5	400	400	3	200	500	800	1	1
E1 - Mersey Channel (C1 Buoy)	C1B1	-	11.6	0.176	86.6	41.2	0.315	29.4	45.8	146	-	-
G1 - Mersey Channel (C1 Buoy)	C1B1	-	12.5	0.246	300	56.4	0.318	33.8	44.4	156	-	-
I1 - Mersey Channel (C1 Buoy)	C1B1	-	5.47	0.067	120	50.2	0.01	19	7.77	55	-	-
M1 - Mersey Channel (C1 Buoy)	C1B1	-	13.1	0.228	85.6	42.1	0.501	29.6	59.6	191	-	-
O1 - Mersey Channel (C1 Buoy)	C1B1	-	17.1	0.222	117	157	0.006	63.3	63.8	203	-	-

Key		
	Below AL1	(green)
	Above AL1, Below AL2	(orange)
	Above AL2	(red)

Table A.33 Polychlorinated biphenyl (PCB) concentrations from sediment samples collected from Mersey Channel (C1 Buoy) (2013)

Laboratory Sample N$^{o.}$	Figure ID	PCBs (µg/kg dry weight)												
		#18	#28	#31	#44	#47	#49	#52	#66	#101	#105	#110	#118	#128
Cefas Guideline AL1		-	-	-	-	-	-	-	-	-	-	-	-	-
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-	-
E2 - Mersey Channel (C1 Buoy)	C1B1	-	0.1	-	-	-	-	0.1	-	0.1	-	-	0.1	-
G2 - Mersey Channel (C1 Buoy)	C1B1	-	0.1	-	-	-	-	0.1	-	0.1	-	-	0.1	-
I2 - Mersey Channel (C1 Buoy)	C1B1	-	0.1	-	-	-	-	0.1	-	0.1	-	-	0.1	-
M2 - Mersey Channel (C1 Buoy)	C1B1	-	0.3	-	-	-	-	0.2	-	0.2	-	-	0.28	-
O2 - Mersey Channel (C1 Buoy)	C1B1	-	0.1	-	-	-	-	0.1	-	0.1	-	-	0.1	-

Laboratory Sample N$^{o.}$	Figure ID	#138	#141	#149	#151	#153	#156	#158	#170	#180	#183	#187	#194	ΣICES 7 PCBs	Σ25 PCBs
Cefas Guideline AL1		-	-	-	-	-	-	-	-	-	-	-	-	10	20
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-	-	200
E2 - Mersey Channel (C1 Buoy)	C1B1	0.1	-	-	-	0.1	-	-	-	0.1	-	-	-	0.7	-
G2 - Mersey Channel (C1 Buoy)	C1B1	0.1	-	-	-	0.1	-	-	-	0.1	-	-	-	0.7	-
I2 - Mersey Channel (C1 Buoy)	C1B1	0.1	-	-	-	0.1	-	-	-	0.1	-	-	-	0.7	-
M2 - Mersey Channel (C1 Buoy)	C1B1	0.24	-	-	-	0.28	-	-	-	0.1	-	-	-	1.6	-
O2 - Mersey Channel (C1 Buoy)	C1B1	0.1	-	-	-	0.1	-	-	-	0.1	-	-	-	0.7	-

Key	
	Below AL1
	Above AL1, Below AL2
	Above AL2

Table A.34 Polycyclic aromatic hydrocarbon (PAH) concentrations and total hydrocarbon content (THC) from Mersey Channel (C1 Buoy) (2013)

Laboratory Sample N^{o.}	Figure ID	PAHs (mg/kg dry weight)										
		ACENAPH	ACENAPT	ANTHRAC	BAA	BAP	BBF	BENZGHI	BEP	BKF	C1N	C1PHEN
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-
E2 - Mersey Channel (C1 Buoy)	C1B1	-	-	0.002	0.006	0.0092	0.0077	0.01	-	-	-	-
G2 - Mersey Channel (C1 Buoy)	C1B1	-	-	0.0049	0.0114	0.0154	-	0.0143	-	-	-	-
I2 - Mersey Channel (C1 Buoy)	C1B1	-	-	0.002	0.0054	0.0063	-	0.01	-	-	-	-
M2 - Mersey Channel (C1 Buoy)	C1B1	-	-	0.0404	0.111	0.155	-	0.109	-	-	-	-
O2 - Mersey Channel (C1 Buoy)	C1B1	-	-	0.002	0.002	0.0029	-	0.01	-	-	-	-

Laboratory Sample N^{o.}	Figure ID	C2N	C3N	CHRYSEN	DBENZAH	FLUORAN	FLUOREN	INDPYR	NAPTH	PERYLEN	PHENANT	PYRENE	THC
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	100
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-
E2 - Mersey Channel (C1 Buoy)	C1B1	-	-	-	-	-	-	0.01	0.0816	-	0.01	0.0084	-
G2 - Mersey Channel (C1 Buoy)	C1B1	-	-	-	-	0.0156	-	0.013	0.0516	-	0.0168	0.0165	-
I2 - Mersey Channel (C1 Buoy)	C1B1	-	-	-	-	0.0036	-	0.01	0.00716	-	0.01	0.0046	-
M2 - Mersey Channel (C1 Buoy)	C1B1	-	-	-	-	0.152	-	0.104	0.137	-	0.121	0.152	-
O2 - Mersey Channel (C1 Buoy)	C1B1	-	-	-	-	0.0033	-	0.01	0.03	-	0.01	0.0049	-
Key	Below AL1												
	Above AL1												

A.16 Approach Channel (2014)

Table A.35. Trace metal and organotin concentrations from sediment samples collected from Approach Channel (2014)

Laboratory Sample N°.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
		Cefas Guideline AL1	20	0.4	40	40	0.3	20	50	130	0.1	0.1
		Cefas Guideline AL2	100	5	400	400	3	200	500	800	1	1
Approach Channel 1	MAC11	-	6.93	0.03	10.7	4.7	<0.05	7.09	17.1	53.9	-	-
Approach Channel 2	MAC12	-	6.82	0.05	6.05	2.2	<0.05	5.88	8.01	33	-	-
Approach Channel 3	MAC13	-	8.09	0.04	8.52	1.75	0.25	5.35	7.37	26.9	-	-
Approach Channel 4	MAC14	-	8.81	0.26	21.7	12.1	0.33	15	28.3	109	-	-
Approach Channel 5	MAC15	-	9.52	0.17	19.5	9.54	0.19	12.8	22.8	81.5	-	-
Approach Channel 6	MAC16	-	8.39	0.13	16.5	7.16	0.15	9.45	18.2	68.8	-	-
Approach Channel 7	MAC17	-	6.37	0.02	6.49	1.09	<0.05	4.29	5.85	22.3	-	-
Approach Channel 8	MAC18	-	8.25	0.02	4.1	1.24	<0.05	4.26	8.32	25.4	-	-
Approach Channel 9	MAC19	-	8.46	0.03	4.76	1.32	<0.05	4.72	6.59	24.4	-	-
Approach Channel 10	MAC20	-	6.7	0.21	15.7	7.13	0.12	10.1	19.3	82.8	-	-
Approach Channel 11	MAC21	-	6.39	0.02	7.22	1.27	<0.05	5.12	5.81	23.8	-	-
Approach Channel 13	MAC23	-	5.05	0.04	5.57	2.62	<0.05	4.79	10.1	28.4	-	-
Approach Channel 14	MAC24	-	5.89	0.06	6.46	2.59	0.26	6.2	8.72	35.8	-	-
Approach Channel 15	MAC25	-	7.86	0.02	4.04	1.05	0.11	4.58	7.69	27.4	-	-
Approach Channel 16	MAC26	-	18.6	0.62	42.1	39	0.94	27.9	72.8	238	-	-
Approach Channel 17	MAC27	-	14.3	0.51	26.6	25.6	0.66	17.4	49.5	189	-	-
Approach Channel 18	MAC28	-	15.8	0.74	43.3	35.8	0.9	20.2	65.6	250	-	-
Approach Channel 19	MAC29	-	12.1	0.02	5	1.18	<0.05	4.76	12.8	40.6	-	-
Approach Channel 20	MAC30	-	16.3	0.72	42.3	34.1	0.86	19.3	63.4	244	-	-
Key	Below AL1											
	Above AL1, Below AL2											
	Above AL2											

Table A.36 Polycyclic aromatic hydrocarbon (PAH) concentrations and total hydrocarbon content (THC) from Approach Channel (2014)

Laboratory Sample Nº·	Figure ID	PAHs (mg/kg dry weight)										
		ACENAPH	ACENAPT	ANTHRAC	BAA	BAP	BBF	BENZGHI	BEP	BKF	C1N	C1PHEN
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-
Approach Channel 1	MAC11	0.0039	0.0031	0.0104	0.0304	0.0324	0.0365	0.03	0.0265	0.0184	0.0237	0.0347
Approach Channel 2	MAC12	0.0012	0.001	0.0026	0.0031	0.0038	0.0055	0.0054	0.0048	0.0023	0.0092	0.0088
Approach Channel 3	MAC13	0.0001	0.0002	0.0004	0.0006	0.0009	0.0017	0.0021	0.0016	0.0006	0.0036	0.0012
Approach Channel 4	MAC14	0.0081	0.012	0.021	0.0599	0.0716	0.0739	0.0627	0.0516	0.0377	0.0471	0.0737
Approach Channel 5	MAC15	0.0048	0.009	0.0123	0.0283	0.0417	0.0514	0.0487	0.0359	0.0243	0.0385	0.0481
Approach Channel 6	MAC16	0.0058	0.0084	0.0146	0.0379	0.0471	0.055	0.0512	0.0396	0.0264	0.0433	0.0551
Approach Channel 7	MAC17	0.0001	0.0002	0.0003	0.0004	0.0008	0.0015	0.0014	0.0013	0.0006	0.0038	0.0008
Approach Channel 8	MAC18	0.0001	0.0002	0.0002	0.0005	0.0006	0.0012	0.0014	0.0011	0.0005	0.0038	0.0009
Approach Channel 9	MAC19	0.0001	0.0001	0.0004	0.0005	0.0006	0.0011	0.0012	0.0013	0.0004	0.0031	0.0007
Approach Channel 10	MAC20	0.0058	0.0116	0.0194	0.0422	0.0507	0.0568	0.0528	0.041	0.0271	0.0384	0.0618
Approach Channel 11	MAC21	0.0001	0.0002	0.0004	0.0008	0.0009	0.0018	0.002	0.0013	0.0007	0.004	0.0016
Approach Channel 12	MAC22	0.0213	0.0261	0.0573	0.124	0.155	0.169	0.123	-	0.0801	-	-
Approach Channel 13	MAC23	0.0009	0.0017	0.0031	0.0074	0.0093	0.0112	0.0093	0.0072	0.0054	0.0078	0.0085
Approach Channel 14	MAC24	0.0025	0.0021	0.0042	0.0148	0.016	0.0177	0.0148	0.0113	0.0091	0.0103	0.0177
Approach Channel 15	MAC25	0.0002	0.0003	0.0007	0.0014	0.0021	0.0028	0.0024	0.002	0.0013	0.004	0.0021
Approach Channel 16	MAC26	0.0194	0.0436	0.0719	0.155	0.203	0.246	0.182	0.158	0.116	0.143	0.227
Approach Channel 17	MAC27	0.0001	0.0002	0.0003	0.0003	0.001	0.0014	0.0011	0.001	0.0006	0.0039	0.0006
Approach Channel 18	MAC28	0.0229	0.0302	0.0606	0.14	0.163	0.184	0.137	0.123	0.0894	0.118	0.191
Approach Channel 19	MAC29	0.002	0.001	0.0034	0.0039	0.0056	0.0074	0.0048	0.006	0.0031	0.0072	0.0064
Approach Channel 20	MAC30	0.0248	0.0462	0.0822	0.172	0.22	0.263	0.172	0.17	0.126	0.136	0.238

Laboratory Sample Nº·	Figure ID	C2N	C3N	CHRYSEN	DBENZAH	FLUORAN	FLUOREN	INDPYR	NAPTH	PERYLEN	PHENANT	PYRENE	THC
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	100
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-
Approach Channel 1	MAC11	0.0491	0.0433	0.026	0.0074	0.048	0.0065	0.0261	0.0095	0.0093	0.0348	0.0406	-
Approach Channel 2	MAC12	0.0199	0.0207	0.0031	0.0011	0.0074	0.0018	0.0053	0.0031	0.0017	0.0055	0.0084	-

Approach Channel 3	MAC13	0.0038	0.0018	0.0006	0.0004	0.0012	0.0002	0.0019	0.0006	0.0005	0.0009	0.0015	-
Approach Channel 4	MAC14	0.0916	0.0808	0.0555	0.0147	0.106	0.0114	0.0557	0.0261	0.0206	0.0573	0.0962	-
Approach Channel 5	MAC15	0.077	0.068	0.0287	0.0104	0.0511	0.0077	0.0445	0.0158	0.0136	0.0332	0.0479	-
Approach Channel 6	MAC16	0.0846	0.0733	0.0373	0.0111	0.0703	0.0088	0.046	0.0188	0.0142	0.0437	0.0648	-
Approach Channel 7	MAC17	0.0035	0.0013	0.0004	0.0003	0.0008	0.0002	0.0014	0.0004	0.0005	0.0005	0.001	-
Approach Channel 8	MAC18	0.0037	0.0015	0.0005	0.0003	0.0009	0.0002	0.0012	0.0005	0.0003	0.0006	0.0009	-
Approach Channel 9	MAC19	0.0028	0.001	0.0005	0.0002	0.0014	0.0001	0.0011	0.0003	0.0005	0.0004	0.0017	-
Approach Channel 10	MAC20	0.084	0.0769	0.0404	0.0114	0.0834	0.0106	0.0464	0.017	0.0154	0.0538	0.0808	-
Approach Channel 11	MAC21	0.0048	0.0019	0.0008	0.0004	0.0015	0.0003	0.002	0.0008	0.0006	0.001	0.0015	-
Approach Channel 12	MAC22	-	-	0.126	0.0276	0.264	0.0278	0.106	0.0369	-	0.168	0.252	-
Approach Channel 13	MAC23	0.012	0.0088	0.007	0.0021	0.0129	0.0015	0.0088	0.0026	0.0034	0.0071	0.0134	-
Approach Channel 14	MAC24	0.02	0.0189	0.0149	0.0033	0.0282	0.0027	0.0134	0.0037	0.0051	0.0153	0.027	-
Approach Channel 15	MAC25	0.0049	0.0023	0.0013	0.0005	0.0027	0.0004	0.0025	0.0009	0.001	0.0015	0.0028	-
Approach Channel 16	MAC26	0.246	0.195	0.156	0.0421	0.285	0.0313	0.158	0.0462	0.0579	0.158	0.281	-
Approach Channel 17	MAC27	0.0037	0.0011	0.0003	0.0003	0.0006	0.0002	0.0014	0.0006	0.0007	0.0003	0.001	-
Approach Channel 18	MAC28	0.188	0.156	0.136	0.031	0.295	0.0277	0.117	0.0349	0.046	0.166	0.277	-
Approach Channel 19	MAC29	0.0106	0.0089	0.0038	0.001	0.0098	0.0023	0.0043	0.0106	0.0021	0.0041	0.0211	-
Approach Channel 20	MAC30	0.252	0.204	0.165	0.0401	0.326	0.0348	0.159	0.0489	0.0617	0.176	0.341	-
Key	Below AL1												
	Above AL1												

A.17 Mersey Docks (2014)

Table A.37. Trace metal and organotin concentrations from sediment samples collected from Mersey Docks (2014)

Laboratory Sample Nº.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
		Cefas Guideline AL1	20	0.4	40	40	0.3	20	50	130	0.1	0.1
		Cefas Guideline AL2	100	5	400	400	3	200	500	800	1	1
2014/18893 (Royal Seaforth Dock)	-	33.04	19.73	0.56	52.37	60.25	1.02	32.15	92.58	291.0	-	-
2014/18894 (Royal Seaforth Dock)	-	38.40	19.33	0.51	48.65	46.12	0.92	27.53	82.43	258.8	-	-
2014/18895 (Royal Seaforth Dock)	-	33.47	23.16	0.6	56.95	54.19	1.21	34.39	105.7	316.3	-	-
2014/18896 (Gladstone Dock)	-	40.49	17.52	0.57	43.25	43.05	0.95	26.43	77.44	254.3	-	-
2014/18897 (Gladstone Dock)	-	30.27	22.7	0.62	62.46	65.09	1.28	36.71	113.99	349.8	-	-
2014/18898 (Alexandra Dock)	-	40.26	20.41	0.71	54.76	60.39	1.34	35.05	123.41	371.5	-	-
2014/18899 (Langton Dock)	-	38.28	22.21	0.81	57.24	66.59	1.34	35.26	113.31	371.1	-	-
2014/18900 (Brocklebank Dock)	-	36.93	16.45	0.49	45.9	50.8	1.01	27.5	93.23	313.6	-	-
2014/18901 (Canada Dock)	-	30.82	21.06	0.61	58.2	63.13	1.27	34.69	118.89	389.8	-	-
2014/18902 (Canada Dock)	-	31.85	23.57	0.59	58.81	55.42	1.3	31.59	109.15	315.8	-	-
2014/18903 (Huskisson Dock)	-	32.02	21.07	0.42	59.85	86.95	1.27	38.49	118.2	354.1	-	-
2014/18904 (Huskisson Dock)	-	30.78	21.84	0.59	63.02	67.55	1.4	38.06	119.23	358.1	-	-
2014/18905 (Sandon Halftide Dock)	-	29.50	24.47	0.67	66.71	78.18	1.55	40.06	130.62	393.7	-	-
2014/18906 (Bramley Moore Dock)	-	42.13	29.08	1.09	68.01	120.48	1.81	31.47	163.66	418.4	-	-

Laboratory Sample N°.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
		Cefas Guideline AL1	20	0.4	40	40	0.3	20	50	130	0.1	0.1
		Cefas Guideline AL2	100	5	400	400	3	200	500	800	1	1
2014/18907 (Alfred Dock)	-	47.01	17.62	0.56	50.35	47.06	0.96	34.31	91.24	282.6	-	-
2014/18908 (East Float)	-	40.50	11.57	0.27	32.86	35.77	0.59	24.98	60.65	186.1	-	-
2014/18909 (East Float)	-	45.09	15.56	0.81	42.95	42.85	0.88	27.05	75.4	257.2	-	-
2014/18910 (Vittoria Dock)	-	32.60	16.48	0.41	52.34	51.65	0.99	34.87	96.13	275.7	-	-
2014/18911 (West Float)	-	23.56	24.64	0.63	78.03	93.89	1.28	50.13	139.13	414.4	-	-
2014/18912 (West Float)	-	40.07	15.94	0.9	45.6	138.69	0.86	30.29	119.21	376.2		
Key	Below AL1											
	Above AL1, Below AL2											
	Above AL2											

Table A.38 Polycyclic aromatic hydrocarbon (PAH) concentrations and total hydrocarbon content (THC) from Mersey Docks (2014)

Laboratory Sample Nº.	Figure ID	PAHs (mg/kg dry weight)										
		ACENAPH	ACENAPT	ANTHRAC	BAA	BAP	BBF	BENZGHI	BEP	BKF	C1N	C1PHEN
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-
2014/18893 (Royal Seaforth Dock)	-	0.02	0.04	0.08	0.27	0.40	0.48	0.41	0.32	0.24	0.32	0.48
2014/18894 (Royal Seaforth Dock)	-	0.02	0.05	0.09	0.27	0.40	0.47	0.38	0.31	0.23	0.33	0.50
2014/18895 (Royal Seaforth Dock)	-	0.02	0.04	0.08	0.26	0.41	0.52	0.41	0.33	0.25	0.29	0.46
2014/18896 (Gladstone Dock)	-	0.02	0.05	0.10	0.37	0.47	0.55	0.43	0.35	0.25	0.34	0.59
2014/18897 (Gladstone Dock)	-	0.02	0.04	0.08	0.30	0.44	0.55	0.42	0.35	0.27	0.35	0.57
2014/18898 (Alexandra Dock)	-	0.02	0.05	0.10	0.34	0.45	0.54	0.41	0.33	0.27	0.31	0.57
2014/18899 (Langton Dock)	-	0.02	0.04	0.08	0.30	0.42	0.57	0.41	0.32	0.26	0.30	0.51
2014/18900 (Brocklebank Dock)	-	0.02	0.04	0.08	0.29	0.41	0.52	0.41	0.33	0.25	0.28	0.50
2014/18901 (Canada Dock)	-	0.02	0.04	0.08	0.26	0.36	0.47	0.38	0.32	0.23	0.29	0.49
2014/18902 (Canada Dock)	-	0.03	0.05	0.09	0.30	0.41	0.49	0.41	0.34	0.25	0.36	0.53
2014/18903 (Huskisson Dock)	-	0.02	0.03	0.07	0.26	0.37	0.47	0.41	0.32	0.24	0.31	0.51
2014/18904 (Huskisson Dock)	-	0.02	0.04	0.08	0.28	0.39	0.45	0.42	0.34	0.23	0.33	0.50
2014/18905 (Sandon Halftide Dock)	-	0.02	0.03	0.08	0.28	0.40	0.55	0.41	0.34	0.26	0.29	0.48

2014/18906 (Bramley Moore Dock)	-	0.04	0.05	0.13	0.29	1.09	1.33	1.62	0.79	0.55	0.41	0.61
2014/18907 (Alfred Dock)	-	0.02	0.04	0.07	0.25	0.32	0.40	0.31	0.24	0.20	0.25	0.48
2014/18908 (East Float)	-	0.01	0.02	0.04	0.15	0.21	0.29	0.23	0.18	0.14	0.16	0.27
2014/18909 (East Float)	-	0.02	0.04	0.79	0.29	0.39	0.48	0.35	0.28	0.20	0.28	0.47
2014/18910 (Vittoria Dock)	-	0.02	0.02	0.06	0.22	0.33	0.47	0.34	0.27	0.21	0.29	0.40
2014/18911 (West Float)	-	0.01	0.02	0.06	0.23	0.37	0.54	0.41	0.29	0.24	0.30	0.41
2014/18912 (West Float)	-	0.02	0.06	0.11	0.55	0.90	1.25	0.91	0.70	0.52	0.36	0.64

Laboratory Sample Nº.	Figure ID	C2N	C3N	CHRYSEN	DBENZAH	FLUORAN	FLUOREN	INDPYR	NAPTH	PERYLEN	PHENANT	PYRENE	THC
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	100
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-
2014/18893 (Royal Seaforth Dock)	-	0.496	0.733	0.240	0.089	0.525	0.065	0.500	0.148	0.131	0.268	0.480	867
2014/18894 (Royal Seaforth Dock)	-	0.479	0.723	0.218	0.080	0.559	0.069	0.459	0.167	0.127	0.315	0.499	784
2014/18895 (Royal Seaforth Dock)	-	0.425	0.660	0.218	0.087	0.486	0.062	0.499	0.145	0.131	0.251	0.435	738
2014/18896 (Gladstone Dock)	-	0.490	0.757	0.282	0.095	0.692	0.075	0.527	0.159	0.146	0.351	0.609	857
2014/18897 (Gladstone Dock)	-	0.531	0.843	0.242	0.096	0.575	0.069	0.534	0.154	0.147	0.289	0.512	851
2014/18898 (Alexandra Dock)	-	0.473	0.777	0.259	0.092	0.633	0.070	0.517	0.133	0.142	0.330	0.556	769
2014/18899 (Langton Dock)	-	0.445	0.665	0.233	0.087	0.562	0.068	0.502	0.138	0.132	0.300	0.500	698
2014/18900 (Brocklebank Dock)	-	0.424	0.690	0.227	0.089	0.574	0.065	0.515	0.132	0.134	0.293	0.502	609

2014/18901 (Canada Dock)	-	0.482	0.664	0.212	0.076	0.469	0.063	0.454	0.150	0.125	0.262	0.425	720
2014/18902 (Canada Dock)	-	0.549	0.745	0.238	0.085	0.522	0.079	0.517	0.199	0.132	0.310	0.467	786
2014/18903 (Huskisson Dock)	-	0.522	0.759	0.199	0.080	0.454	0.062	0.489	0.140	0.128	0.268	0.434	801
2014/18904 (Huskisson Dock)	-	0.501	0.701	0.214	0.086	0.495	0.064	0.502	0.150	0.133	0.276	0.459	808
2014/18905 (Sandon Halftide Dock)	-	0.511	0.757	0.197	0.086	0.468	0.063	0.519	0.138	0.131	0.238	0.459	863
2014/18906 (Bramley Moore Dock)	-	0.653	1.040	0.211	0.163	0.540	0.095	1.568	0.211	0.254	0.318	1.448	2666
2014/18907 (Alfred Dock)	-	0.436	0.620	0.178	0.068	0.483	0.068	0.399	0.100	0.101	0.282	0.424	850
2014/18908 (East Float)	-	0.270	0.376	0.106	0.047	0.265	0.033	0.286	0.067	0.071	0.119	0.250	674
2014/18909 (East Float)	-	0.370	0.528	0.182	0.076	0.547	0.060	0.468	0.125	0.119	0.253	0.461	660
2014/18910 (Vittoria Dock)	-	0.368	0.514	0.155	0.070	0.392	0.049	0.438	0.112	0.107	0.187	0.357	753
2014/18911 (West Float)	-	0.382	0.526	0.165	0.083	0.450	0.052	0.512	0.118	0.127	0.191	0.416	987
2014/18912 (West Float)	-	0.455	0.670	0.379	0.174	1.122	0.084	1.094	0.174	0.334	0.341	1.166	2764

Key	
Below AL1	(green)
Above AL1	(orange)

A.18 Garston (2015)

Table A.39. Trace metal and organotin concentrations from sediment samples collected from Garston (2015)

Laboratory Sample N°.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
Cefas Guideline AL1			20	0.4	40	40	0.3	20	50	130	0.1	0.1
Cefas Guideline AL2			100	5	400	400	3	200	500	800	1	1
2015/21868 (Garston Approach)	GAR1	-	14.77	0.64	36.53	24.59	0.49	17.44	42.63	195.96	<0.002	<0.002
2015/21869 (Garston Approach)	GAR2	-	12.22	0.22	19.91	10.68	0.2	10.42	23.49	94.06	<0.002	<0.002
2015/21870 (Stalbridge Dock)	GAR5	-	34.65	1.12	94.53	68.21	1.35	44.96	112.96	384.62	<0.002	<0.002
Key	Below AL1											
	Above AL1, Below AL2											
	Above AL2											

Table A.40 Polycyclic aromatic hydrocarbon (PAH) concentrations and total hydrocarbon content (THC) from Garston (2015)

Laboratory Sample N°.	Figure ID	PAHs (mg/kg dry weight)										
		ACENAPH	ACENAPT	ANTHRAC	BAA	BAP	BBF	BENZGHI	BEP	BKF	C1N	C1PHEN
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-
2051/21875 (Garston Approach)	GAR2	0.0271	0.0452	0.0982	0.283	0.393	0.320	0.293	0.284	0.171	0.261	0.466
2051/21876 (Garston Approach)	GAR3	0.00623	0.0122	0.0221	0.0628	0.106	0.108	0.0761	0.106	0.0461	0.0758	0.130
2051/21877 (Garston Approach)	GAR4	0.0342	0.0394	0.115	0.296	0.438	0.417	0.408	0.374	0.214	0.312	0.575

Laboratory Sample N°.	Figure ID	C2N	C3N	CHRYSEN	DBENZAH	FLUORAN	FLUOREN	INDPYR	NAPTH	PERYLEN	PHENANT	PYRENE	THC
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	100
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-
2051/21875 (Garston Approach)	GAR2	0.455	0.706	0.248	0.0733	0.447	0.0568	0.333	0.115	0.089	0.282	0.465	-
2051/21876 (Garston Approach)	GAR3	0.123	0.231	0.0585	0.0197	0.919	0.0169	0.0862	0.0478	0.0236	0.0592	0.0973	-
2051/21877 (Garston Approach)	GAR4	0.480	0.778	0.295	0.0889	0.455	0.0642	0.430	0.137	0.106	0.308	0.509	-

Key		
	Below AL1	(green)
	Above AL1	(orange)

A.19 Mersey Approaches, Cammell Laird and Eastham Channel (2016)

Table A.41. Trace metal and organotin concentrations from sediment samples collected from Mersey Approaches, Cammell Laird and Eastham Channel (2016)

Laboratory Sample No.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
		Cefas Guideline AL1	20	0.4	40	40	0.3	20	50	130	0.1	0.1
		Cefas Guideline AL2	100	5	400	400	3	200	500	800	1	1
Mersey Approaches A	MER1	69.87	7.32	0.12	15.17	6.48	0.12	9.27	18.1	63.5	<0.001	<0.001
Mersey Approaches B	MER2	60.70	12.05	0.49	27.31	18.72	0.51	14.72	35.37	158.49	<0.001	<0.001
Mersey Approaches C	MER3	71.64	7.63	0.19	13.42	7.25	0.75	8.64	17.72	83.89	<0.001	<0.001
Mersey Approaches D	MER4	61.56	9.43	0.31	23.04	14.12	0.32	13.98	33.71	125.33	<0.001	<0.001
Mersey Approaches E	MER5	67.66	8.74	0.48	20.59	10.62	0.24	12.24	24.78	114.57	<0.001	<0.001
Mersey Approaches F	MER6	58.56	12.58	0.34	36.68	18.69	0.32	21.81	42.96	149.84	<0.001	<0.001
River Mersey Jetties Cammell Laird A	-	56.55	9.66	0.22	27.97	16.99	0.12	18.46	38.38	107.43	<0.001	<0.001
River Mersey Jetties Cammell Laird C	MER7	72.73	6.64	0.14	14.59	7.35	0.25	10.96	15.85	67.09	<0.001	<0.001
River Mersey Jetties Cammell Laird D	MER8	70.49	7.63	0.22	18.53	10.88	0.21	10.96	22.8	97.84	<0.001	0.014
River Mersey Jetties Cammell Laird E	-	65.09	5.3	0.2	7.01	2.23	<0.037	5.01	10.01	33.21	<0.001	<0.001
River Mersey Jetties Cammell Laird F	MER9	72.69	7.67	0.31	17.58	8.99	0.22	9.91	22.29	118.08	<0.001	<0.001
River Mersey Jetties Cammell Laird G	-	64.63	9.8	0.42	26.03	18.35	0.52	13.14	36.98	152.54	<0.001	<0.001
River Mersey Jetties Cammell Laird H	MER10	81.02	16.2	0.02	6.54	1.43	<0.031	10.76	16.01	50.93	<0.001	<0.001
River Mersey Jetties Cammell Laird I	MER11	80.93	25.74	0.14	12.04	6.9	0.13	9.37	26.07	94.87	<0.001	<0.001
River Mersey Jetties Cammell Laird J	MER12	79.65	17.69	0.02	5.87	1.28	<0.028	5.01	15.57	51.67	<0.001	<0.001
River Mersey Jetties Cammell Laird K	-	80.98	10.53	0.04	4.84	1.76	<0.03	3.52	12.57	39.77	<0.001	<0.001

Laboratory Sample Nº.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
Cefas Guideline AL1			20	0.4	40	40	0.3	20	50	130	0.1	0.1
Cefas Guideline AL2			100	5	400	400	3	200	500	800	1	1
River Mersey Jetties Cammell Laird L	MER13	72.38	7.47	0.3	12.63	5.96	0.12	7.95	17.93	109.16	<0.001	<0.001
Eastham Channel A	MER14	79.84	8.1	0.04	6.53	1.67	<0.032	4.58	11	42.86	<0.001	<0.001
Eastham Channel B	MER15	80.07	9.27	0.03	7.13	1.5	<0.029	4.82	11.45	49.53	<0.001	<0.001
Eastham Channel C	MER16	29.15	17.92	0.32	70.54	32.47	0.27	45.63	86.21	265.88	<0.002	<0.002
Eastham Channel D	-	80.5	8.04	0.04	4.9	1.09	<0.023	3.35	9.01	32.51	<0.001	<0.001
Eastham Channel E	MER17	64.30	10.85	0.51	27.53	18.84	0.5	14.44	39.74	163.5	<0.001	<0.001
Eastham Channel F	-	80.28	5.03	0.09	6.16	3.82	<0.029	3.93	7.92	42.43	<0.001	<0.001
Eastham Channel G	-	74.36	7.61	0.23	17.85	9.28	0.21	8.1	21.28	83.12	<0.001	<0.001
Key	Below AL1											
	Above AL1, Below AL2											
	Above AL2											

Table A.42. Total hydrocarbon content (THC) from sediment samples collected from Mersey Approaches, Cammell Laird and Eastham Channel (2016)

Laboratory Sample Nº.	Figure ID	THC (mg/kg dry weight)
	Cefas Guideline AL1	100
	Cefas Guideline AL2	-
Mersey Approaches A	MER1	56
Mersey Approaches B	MER2	462
Mersey Approaches C	MER3	66
Mersey Approaches D	MER4	224
Mersey Approaches E	MER5	118
Mersey Approaches F	MER6	179
River Mersey Jetties Cammell Laird A	-	27
River Mersey Jetties Cammell Laird C	MER7	64
River Mersey Jetties Cammell Laird D	MER8	113
River Mersey Jetties Cammell Laird E	-	7
River Mersey Jetties Cammell Laird F	MER9	63
River Mersey Jetties Cammell Laird G	-	343
River Mersey Jetties Cammell Laird H	MER10	4
River Mersey Jetties Cammell Laird I	MER11	128
River Mersey Jetties Cammell Laird J	MER12	33
River Mersey Jetties Cammell Laird K	-	17
River Mersey Jetties Cammell Laird L	MER13	57
Eastham Channel A	MER14	6
Eastham Channel B	MER15	10
Eastham Channel C	MER16	22
Eastham Channel D	-	4
Eastham Channel E	MER17	281
Eastham Channel F	-	5
Eastham Channel G	-	158
Key	Below AL1	
	Above AL1, Below AL2	

Table A.43 Polychlorinated biphenyl (PCB) concentrations from sediment samples collected from Mersey Approaches, Cammell Laird and Eastham Channel (2016)

Laboratory Sample N^{o.}	Figure ID	PCBs (µg/kg dry weight)												
		#18	#28	#31	#44	#47	#49	#52	#66	#101	#105	#110	#118	#128
Cefas Guideline AL1		-	-	-	-	-	-	-	-	-	-	-	-	-
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-	-
Mersey Approaches A	MER1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Mersey Approaches B	MER2	<0.2	0.866	0.774	<0.2	0.207	0.483	0.969	0.531	0.714	0.395	0.771	0.767	0.242
Mersey Approaches C	MER3	<0.2	0.441	0.372	<0.2	<0.2	0.242	0.325	<0.2	0.265	0.416	0.324	0.32	<0.2
Mersey Approaches D	MER4	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Mersey Approaches E	MER5	<0.2	0.296	0.265	<0.2	<0.2	<0.2	0.271	<0.2	<0.2	0.302	0.25	0.274	<0.2
Mersey Approaches F	MER6	<0.2	0.528	0.451	<0.2	<0.2	0.236	0.439	0.284	0.415	0.211	0.442	0.482	<0.2
River Mersey Jetties Cammell Laird A	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
River Mersey Jetties Cammell Laird C	MER7	<0.2	0.232	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.211	<0.2
River Mersey Jetties Cammell Laird D	MER8	<0.2	0.355	0.305	<0.2	0.627	1.35	0.295	<0.2	0.219	0.349	0.289	0.343	<0.2
River Mersey Jetties Cammell Laird E	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
River Mersey Jetties Cammell Laird F	MER9	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
River Mersey Jetties Cammell Laird G	-	0.272	0.804	0.575	0.325	<0.2	0.426	0.645	0.711	0.616	0.334	0.619	0.674	0.207
River Mersey Jetties Cammell Laird H	MER10	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
River Mersey Jetties Cammell Laird I	MER11	<0.2	0.319	0.296	<0.2	<0.2	<0.2	0.263	<0.2	<0.2	<0.2	0.217	0.218	<0.2
River Mersey Jetties Cammell Laird J	MER12	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
River Mersey Jetties Cammell Laird K	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
River Mersey Jetties Cammell Laird L	MER13	<0.2	0.257	0.276	<0.2	<0.2	<0.2	0.242	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Eastham Channel A	MER14	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

Eastham Channel B	MER15	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Eastham Channel C	MER16	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Eastham Channel D	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Eastham Channel E	MER17	<0.2	0.699	0.64	<0.2	<0.2	0.391	0.751	0.409	0.461	0.261	0.724	0.605	<0.2
Eastham Channel F	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Eastham Channel G	-	13.9	0.555	0.399	0.207	<0.2	0.275	0.522	0.343	0.304	0.255	0.339	0.51	<0.2

Laboratory Sample Nº·	Figure ID	#138	#141	#149	#151	#153	#156	#158	#170	#180	#183	#187	#194	ΣICES 7 PCBs	Σ25 PCBs
Cefas Guideline AL1		-	-	-	-	-	-	-	-	-	-	-	-	10	20
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-	-	200
Mersey Approaches A	MER1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-
Mersey Approaches B	MER2	0.904	0.226	0.95	0.287	1.03	<0.2	<0.2	0.472	0.825	<0.2	0.467	0.503	6.075	12.383
Mersey Approaches C	MER3	0.319	<0.2	0.258	<0.2	0.295	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	1.965	3.577
Mersey Approaches D	MER4	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-
Mersey Approaches E	MER5	0.272	<0.2	0.233	<0.2	0.238	<0.2	<0.2	0.201	<0.2	<0.2	<0.2	<0.2	1.351	2.602
Mersey Approaches F	MER6	0.493	<0.2	0.382	<0.2	0.466	<0.2	<0.2	<0.2	0.269	<0.2	<0.2	<0.2	3.092	5.098
River Mersey Jetties Cammell Laird A	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-
River Mersey Jetties Cammell Laird C	MER7	0.208	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.651	0.651
River Mersey Jetties Cammell Laird D	MER8	0.29	<0.2	0.289	<0.2	0.269	<0.2	<0.2	<0.2	<0.2	<0.2	0.417	<0.2	1.771	5.397
River Mersey Jetties Cammell Laird E	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-
River Mersey Jetties Cammell Laird F	MER9	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-
River Mersey Jetties Cammell Laird G	-	0.719	<0.2	0.596	<0.2	0.722	<0.2	<0.2	0.879	0.441	<0.2	0.341	<0.2	4.621	9.906
River Mersey Jetties Cammell Laird H	MER10	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-
River Mersey Jetties Cammell Laird I	MER11	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.8	1.313
River Mersey Jetties Cammell Laird J	MER12	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-
River Mersey Jetties Cammell Laird K	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-

River Mersey Jetties Cammell Laird L	MER13	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.499	0.775
Eastham Channel A	MER14	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-
Eastham Channel B	MER15	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-
Eastham Channel C	MER16	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-
Eastham Channel D	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-
Eastham Channel E	MER17	0.568	<0.2	0.54	<0.2	0.573	<0.2	<0.2	0.275	0.372	<0.2	<0.2	<0.2	4.029	7.269
Eastham Channel F	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-
Eastham Channel G	-	0.328	<0.2	0.514	<0.2	0.397	<0.2	<0.2	<0.2	0.205	<0.2	<0.2	<0.2	2.821	19.053
Key	Below AL1														
	Above AL1, Below AL2														
	Above AL2														

Table A.44. Polybrominated diphenyl ether (PBDE) concentrations from sediment samples collected from Mersey Approaches, Cammell Laird and Eastham Channel (2016)

Laboratory Sample Nº.	Figure ID	Polybrominated Diphenyl Ethers (PBDEs) (mg/kg dry weight)										
		BDE17	BDE28	BDE47	BDE66	BDE85	BDE99	BDE100	BDE138	BDE153	BDE154	BDE183
Cefas Guideline AL1		-	-	-	-	-	-	-	-	-	-	-
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-
Mersey Approaches A	MER1	0.00006	0.00004	0.00015	<0.0002	<0.0002	0.00014	0.00003	<0.0002	0.00003	0.00004	0.00004
Mersey Approaches B	MER2	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.00002
Mersey Approaches C	MER3	<0.0002	<0.0002	0.00005	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Mersey Approaches D	MER4	0.00003	0.00003	0.00009	<0.0002	<0.0002	0.00013	0.00003	<0.0002	0.00003	0.00002	0.00003
Mersey Approaches E	MER5	<0.0002	<0.0002	0.00004	<0.0002	<0.0002	0.00004	<0.0002	<0.0002	0.00003	0.00003	<0.0002
Mersey Approaches F	MER6	0.00003	<0.0002	0.00014	<0.0002	<0.0002	0.00017	0.00004	<0.0002	0.00004	0.00006	<0.0002
River Mersey Jetties Cammell Laird A	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
River Mersey Jetties Cammell Laird C	MER7	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
River Mersey Jetties Cammell Laird D	MER8	<0.0002	<0.0002	0.00005	<0.0002	<0.0002	0.00003	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
River Mersey Jetties Cammell Laird E	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.00006	<0.0002	<0.0002	<0.0002
River Mersey Jetties Cammell Laird F	MER9	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
River Mersey Jetties Cammell Laird G	-	0.00005	0.00003	0.00010	<0.0002	<0.0002	0.00010	0.00003	0.00005	<0.0002	0.00005	0.00007
River Mersey Jetties Cammell Laird H	MER10	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
River Mersey Jetties Cammell Laird I	MER11	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
River Mersey Jetties Cammell Laird J	MER12	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
River Mersey Jetties Cammell Laird K	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
River Mersey Jetties Cammell Laird L	MER13	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Eastham Channel A	MER14	<0.0002	<0.0002	0.00002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002

Laboratory Sample N^{o.}	Figure ID	Polybrominated Diphenyl Ethers (PBDEs) (mg/kg dry weight)										
		BDE17	BDE28	BDE47	BDE66	BDE85	BDE99	BDE100	BDE138	BDE153	BDE154	BDE183
Cefas Guideline AL1		-	-	-	-	-	-	-	-	-	-	-
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-
Eastham Channel B	MER15	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Eastham Channel C	MER16	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Eastham Channel D	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Eastham Channel E	MER17	0.00003	0.00002	0.00009	<0.0002	<0.0002	0.00011	<0.0002	<0.0002	0.00003	<0.0002	0.00004
Eastham Channel F	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Eastham Channel G	-	<0.0002	0.00002	0.00006	<0.0002	<0.0002	0.00004	0.00002	<0.0002	<0.0002	0.00003	0.00004

Table A.45. Organochlorine pesticide (OCP) concentrations from sediment samples collected from Mersey Approaches, Cammell Laird and Eastham Channel (2016)

Laboratory Sample N$^{o.}$	Figure ID	Organochlorine Pesticides (OCP) (µg/kg dry weight)	
		Dieldrin	DDT
	Cefas Guideline AL1	5.0	1.0
	Cefas Guideline AL2	-	-
Mersey Approaches A	MER1	0.3	0.5
Mersey Approaches B	MER2	<0.2	<0.2
Mersey Approaches C	MER3	<0.2	<0.2
Mersey Approaches D	MER4	0.2	0.2
Mersey Approaches E	MER5	<0.2	0.3
Mersey Approaches F	MER6	0.3	0.2
River Mersey Jetties Cammell Laird A	-	<0.2	0.4
River Mersey Jetties Cammell Laird C	MER7	<0.2	<0.2
River Mersey Jetties Cammell Laird D	MER8	<0.2	<0.2
River Mersey Jetties Cammell Laird E	-	<0.2	<0.2
River Mersey Jetties Cammell Laird F	MER9	<0.2	<0.2
River Mersey Jetties Cammell Laird G	-	0.3	10.4
River Mersey Jetties Cammell Laird H	MER10	<0.2	<0.2
River Mersey Jetties Cammell Laird I	MER11	0.2	1.1
River Mersey Jetties Cammell Laird J	MER12	<0.2	<0.2
River Mersey Jetties Cammell Laird K	-	<0.2	<0.2
River Mersey Jetties Cammell Laird L	MER13	<0.2	0.3
Eastham Channel A	MER14	<0.2	<0.2
Eastham Channel B	MER15	<0.2	<0.2
Eastham Channel C	MER16	<0.2	<0.2
Eastham Channel D	-	<0.2	<0.2
Eastham Channel E	MER17	0.3	0.6
Eastham Channel F	-	<0.2	<0.2
Eastham Channel G	-	0.3	4.9
Key	Below AL1		
	Above AL1		

A.20 Canning Dock (2017)

Table A.46. Trace metal and organotin concentrations from sediment samples collected from Canning Dock (2017)

Laboratory Sample N^{o.}	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
Cefas Guideline AL1			20	0.4	40	40	0.3	20	50	130	0.1	0.1
Cefas Guideline AL2			100	5	400	400	3	200	500	800	1	1
Canning Dock 1	-	-	16.1	0.422	56	32.1	0.583	26.8	57.2	243	<0.006	<0.002
Canning Dock 2	-	-	22	0.574	85	48.7	0.911	35.8	94.1	323	0.0308	0.013
Canning Dock 3	-	-	17.9	0.447	74.2	39.1	0.709	32.4	73.6	270	<0.007	<0.002
Canning Dock 4	-	-	22.3	0.485	86.7	49.5	1.01	38	100	349	0.0294	0.033
Canning Dock 5	-	-	19.3	0.41	79.8	44.9	0.763	36.9	83.4	296	<0.006	<0.002
Canning Dock 6	-	-	23.4	0.602	95	52.3	1.05	38.8	104	339	0.0196	<0.002
Key	Below AL1											
	Above AL1, Below AL2											
	Above AL2											

Table A.47 Polychlorinated biphenyl (PCB) concentrations from sediment samples collected from Canning Dock (2017)

Laboratory Sample Nº.	Figure ID	PCBs (µg/kg dry weight)												
		#18	#28	#31	#44	#47	#49	#52	#66	#101	#105	#110	#118	#128
Cefas Guideline AL1		-	-	-	-	-	-	-	-	-	-	-	-	-
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-	-
Canning Dock 2	-	0.728	2.67	1.84	0.759	0.448	1.65	1.19	1.91	2.09	0.214	1.77	1.66	0.181
Canning Dock 4	-	0.636	2.72	1.9	0.865	0.49	1.6	1.1	2.02	2.15	0.241	1.83	1.81	0.163
Canning Dock 6	-	0.792	3.18	2.12	0.891	0.536	1.92	1.29	2.39	2.22	0.28	2.09	1.99	0.176
Laboratory Sample Nº.	Figure ID	#138	#141	#149	#151	#153	#156	#158	#170	#180	#183	#187	#194	ΣICES 7 PCBs	Σ25 PCBs
Cefas Guideline AL1		-	-	-	-	-	-	-	-	-	-	-	-	10	20
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-	-	200
Canning Dock 2	-	0.943	<0.08	1.18	0.262	1.62	0.166	<0.08	0.825	1.03	0.15	0.559	0.732	11.20	24.58
Canning Dock 4	-	0.982	0.106	1.24	0.247	1.68	0.159	<0.08	0.827	1.01	0.13	0.612	0.794	11.45	25.31
Canning Dock 6	-	0.938	0.138	1.53	0.273	1.73	0.177	0.123	0.957	1.19	0.164	0.579	0.907	12.54	28.58

Key	
Below AL1	
Above AL1, Below AL2	
Above AL2	

Table A.48 Polycyclic aromatic hydrocarbon (PAH) concentrations and total hydrocarbon content (THC) from Canning Dock (2017)

Laboratory Sample N^{o.}	Figure ID	PAHs (mg/kg dry weight)										
		ACENAPH	ACENAPT	ANTHRAC	BAA	BAP	BBF	BENZGHI	BEP	BKF	C1N	C1PHEN
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-
Canning Dock 1	-	0.054	0.0258	0.0956	0.289	0.445	0.457	0.359	0.358	0.212	0.251	0.504
Canning Dock 2	-	0.279	0.0449	0.251	0.504	0.754	0.799	0.608	0.619	0.355	0.632	1
Canning Dock 3	-	0.043	0.0221	0.0826	0.233	0.392	0.473	0.338	0.343	0.214	0.22	0.395
Canning Dock 4	-	0.0602	0.03	0.121	0.319	0.565	0.732	0.511	0.522	0.305	0.309	0.543
Canning Dock 5	-	0.0329	0.024	0.076	0.224	0.381	0.469	0.352	0.343	0.213	0.223	0.36
Canning Dock 6	-	0.0545	0.0301	0.112	0.272	0.482	0.635	0.438	0.454	0.262	0.277	0.469

Laboratory Sample N^{o.}	Figure ID	C2N	C3N	CHRYSEN	DBENZAH	FLUORAN	FLUOREN	INDPYR	NAPTH	PERYLEN	PHENANT	PYRENE	THC
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	100
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-
Canning Dock 1	-	0.419	0.903	0.246	0.0691	0.626	0.0627	0.453	0.104	0.128	0.312	0.582	-
Canning Dock 2	-	1.09	1.92	0.438	0.119	1.21	0.268	0.777	0.231	0.229	0.85	1.16	-
Canning Dock 3	-	0.426	0.726	0.188	0.065	0.474	0.0546	0.474	0.0946	0.113	0.251	0.452	-
Canning Dock 4	-	0.617	1.24	0.256	0.0937	0.689	0.0933	0.693	0.136	0.203	0.321	0.672	-
Canning Dock 5	-	0.419	0.716	0.19	0.0639	0.412	0.0536	0.481	0.098	0.109	0.22	0.392	-
Canning Dock 6	-	0.531	0.884	0.258	0.0801	0.578	0.0846	0.595	0.122	0.172	0.297	0.566	-

Key	
Below AL1	(green)
Above AL1	(orange)

A.21 Huskisson, Seaforth, Canada, Gladstone and Langton Docks (2018)

Table A.49. Trace metal and organotin concentrations from sediment samples collected from Huskisson, Seaforth, Canada, Gladstone and Langton Docks (2018)

Laboratory Sample Nº.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
		Cefas Guideline AL1	20	0.4	40	40	0.3	20	50	130	0.1	0.1
		Cefas Guideline AL2	100	5	400	400	3	200	500	800	1	1
Huskisson A	DOC1	-	13.4	0.56	54.2	90.9	0.64	33.4	68.6	241	-	-
Huskisson B	DOC2	-	13.1	0.55	52.7	93.5	0.64	32	71.5	243	-	-
Seaforth A	DOC3	-	15.9	0.41	44.1	53.3	0.6	29.6	64.9	218	-	-
Seaforth B	DOC4	-	12	0.38	32.6	32.6	0.47	22.1	45.5	159	-	-
Seaforth C	DOC5	-	12.8	0.47	39.4	32	0.53	26.4	56.8	168	-	-
Seaforth D	DOC6	-	15.1	0.42	45.5	42.2	0.69	28.4	63.6	217	-	-
Seaforth E	DOC7	-	13.7	0.85	42.9	37.5	0.57	27.1	61.3	202	-	-
Seaforth F	DOC8	-	13.5	0.47	40.3	37.5	0.64	25.8	57.1	209	-	-
Canada A	DOC9	-	13.6	0.44	41.1	42.6	0.68	25.6	61	209	-	-
Canada B	DOC10	-	17.1	1.58	55.5	59.4	0.69	31.4	74.4	328	-	-
Canada C	DOC11	-	13.1	0.59	41	37.4	0.61	27.2	61.3	207	-	-
Canada D	DOC12	-	13.4	0.74	44.1	37.1	0.58	29.4	64.8	205	-	-
Canada E	DOC13	-	12.9	0.46	39.7	36.1	0.58	30	59.9	187	-	-
Canada F	DOC14	-	13.9	0.69	40.7	37.9	0.57	27.7	61.6	210	-	-
Gladstone A	DOC15	-	16.6	0.52	48.7	53.5	0.84	26.8	77.4	270	-	-
Gladstone B	DOC16	-	13.5	0.63	38.9	40.7	0.68	24	61.7	230	-	-
Gladstone C	DOC17	-	15.2	0.43	42.1	39.6	0.73	26.7	62.9	239	-	-
Gladstone D	DOC18	-	14.3	0.47	41.6	42.1	0.68	26.3	63.1	241	-	-
Langton A	DOC19	-	15.1	0.62	46.4	46.5	0.68	29.1	70.8	250	-	-
Langton B	DOC20	-	13.9	0.41	40	39.2	0.59	26	63.5	206	-	-
Key	Below AL1											
	Above AL1, Below AL2											
	Above AL2											

Table A.50 Polycyclic aromatic hydrocarbon (PAH) concentrations and total hydrocarbon content (THC) from Huskisson, Seaforth, Canada, Gladstone and Langton Docks (2018)

Laboratory Sample Nº.	Figure ID	PAHs (mg/kg dry weight)										
		ACENAPH	ACENAPT	ANTHRAC	BAA	BAP	BBF	BENZGHI	BEP	BKF	C1N	C1PHEN
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-
Huskisson A	DOC1	0.0351	0.0312	0.0712	0.215	0.349	0.417	0.342	0.329	0.167	0.218	0.25
Huskisson B	DOC2	0.0326	0.0251	0.0562	0.171	0.269	0.331	0.271	0.252	0.134	0.201	0.205
Seaforth A	DOC3	0.0346	0.0446	0.110	0.229	0.303	0.324	0.262	0.25	0.129	0.181	0.233
Seaforth B	DOC4	0.0412	0.0309	0.0638	0.223	0.307	0.341	0.277	0.268	0.127	0.184	0.217
Seaforth C	DOC5	0.0634	0.0329	0.079	0.245	0.347	0.391	0.326	0.313	0.177	0.221	0.226
Seaforth D	DOC6	0.0400	0.0365	0.0643	0.191	0.284	0.346	0.268	0.267	0.149	0.197	0.219
Seaforth E	DOC7	0.0266	0.0354	0.0645	0.190	0.305	0.369	0.303	0.284	0.140	0.196	0.221
Seaforth F	DOC8	0.0321	0.0387	0.0740	0.210	0.344	0.423	0.342	0.325	0.151	0.212	0.241
Canada A	DOC9	0.0389	0.0533	0.0803	0.253	0.392	0.437	0.343	0.343	0.132	0.212	0.267
Canada B	DOC10	0.0477	0.0444	0.0903	0.262	0.362	0.345	0.287	0.270	0.203	0.133	0.229
Canada C	DOC11	0.0397	0.0523	0.0782	0.237	0.350	0.394	0.321	0.305	0.184	0.185	0.253
Canada D	DOC12	0.0380	0.0450	0.0712	0.199	0.323	0.378	0.315	0.301	0.179	0.195	0.242
Canada E	DOC13	0.0418	0.0464	0.0754	0.254	0.374	0.436	0.335	0.348	0.200	0.216	0.244
Canada F	DOC14	0.0324	0.0300	0.0673	0.210	0.342	0.406	0.311	0.303	0.116	0.203	0.229
Gladstone A	DOC15	0.0488	0.0915	0.121	0.305	0.451	0.501	0.383	0.393	0.202	0.376	0.364
Gladstone B	DOC16	0.0422	0.0517	0.0872	0.297	0.393	0.452	0.327	0.343	0.196	0.228	0.291
Gladstone C	DOC17	0.0400	0.0387	0.0792	0.228	0.328	0.338	0.285	0.272	0.126	0.168	0.242
Gladstone D	DOC18	0.0688	0.0777	0.121	0.318	0.467	0.522	0.400	0.393	0.188	0.243	0.317
Langton A	DOC19	0.0423	0.0410	0.0923	0.239	0.361	0.403	0.339	0.324	0.197	0.204	0.235
Langton B	DOC20	0.0401	0.0283	0.0690	0.188	0.328	0.393	0.312	0.309	0.181	0.2	0.231

Laboratory Sample Nº.	Figure ID	C2N	C3N	CHRYSEN	DBENZAH	FLUORAN	FLUOREN	INDPYR	NAPTH	PERYLEN	PHENANT	PYRENE	THC
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	100
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-
Huskisson A	DOC1	0.209	0.2	0.184	0.0654	0.401	0.0563	0.344	0.107	0.111	0.247	0.413	66

Huskisson B	DOC2	0.191	0.167	0.16	0.0487	0.326	0.0484	0.276	0.0874	0.0906	0.193	0.335	64.1
Seaforth A	DOC3	0.17	0.177	0.251	0.0487	0.452	0.0606	0.27	0.114	0.088	0.3	0.433	74.1
Seaforth B	DOC4	0.179	0.174	0.231	0.0503	0.401	0.0512	0.281	0.0892	0.0948	0.214	0.394	127
Seaforth C	DOC5	0.266	0.245	0.242	0.0617	0.427	0.0686	0.337	0.1	0.116	0.229	0.426	82.2
Seaforth D	DOC6	0.18	0.178	0.185	0.0487	0.404	0.0525	0.274	0.0901	0.0897	0.218	0.407	59.1
Seaforth E	DOC7	0.175	0.172	0.183	0.0549	0.365	0.0488	0.312	0.0861	0.0958	0.214	0.379	54.1
Seaforth F	DOC8	0.201	0.21	0.204	0.0636	0.431	0.0566	0.358	0.0991	0.115	0.227	0.439	76.5
Canada A	DOC9	0.197	0.205	0.218	0.063	0.509	0.0636	0.343	0.1	0.12	0.261	0.523	148
Canada B	DOC10	0.133	0.137	0.223	0.054	0.514	0.0566	0.283	0.0766	0.105	0.277	0.495	352
Canada C	DOC11	0.177	0.168	0.205	0.068	0.485	0.0566	0.336	0.0923	0.104	0.271	0.487	131
Canada D	DOC12	0.192	0.187	0.195	0.0601	0.387	0.0554	0.315	0.0896	0.102	0.24	0.4	75.5
Canada E	DOC13	0.203	0.192	0.235	0.0644	0.479	0.0607	0.35	0.104	0.119	0.273	0.47	78.9
Canada F	DOC14	0.186	0.165	0.208	0.0665	0.392	0.0522	0.31	0.1	0.107	0.227	0.403	82.1
Gladstone A	DOC15	0.368	0.356	0.289	0.0683	0.641	0.098	0.395	0.176	0.15	0.428	0.631	242
Gladstone B	DOC16	0.231	0.236	0.267	0.0607	0.611	0.0661	0.336	0.115	0.129	0.289	0.574	171
Gladstone C	DOC17	0.172	0.19	0.207	0.0529	0.443	0.0567	0.296	0.085	0.102	0.259	0.436	184
Gladstone D	DOC18	0.248	0.247	0.302	0.0732	0.669	0.0924	0.417	0.12	0.144	0.403	0.644	110
Langton A	DOC19	0.191	0.169	0.208	0.0638	0.472	0.0577	0.358	0.103	0.115	0.251	0.451	171
Langton B	DOC20	0.195	0.184	0.165	0.0585	0.377	0.053	0.321	0.104	0.105	0.212	0.381	108
Key	Below AL1												
	Above AL1												

A.22 Garston (2019)

Table A.51. Trace metal and organotin concentrations from sediment samples collected from Garston (2019)

Laboratory Sample No.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
Cefas Guideline AL1			20	0.4	40	40	0.3	20	50	130	0.1	0.1
Cefas Guideline AL2			100	5	400	400	3	200	500	800	1	1
MAR00402.005	GAR6	-	25.6	0.84	66.8	55.6	1	40.4	93.6	348	-	-
MAR00402.006	GAR7	-	19.9	0.65	53.2	41.3	0.78	31.7	78	297.1	-	-
MAR00402.007	GAR8	-	24.1	0.8	64.2	49.3	0.94	39.7	93.3	347	-	-
MAR00402.008	GAR9	-	25.3	0.94	69.3	55.6	1.12	42.6	102.9	377.9	-	-
MAR00402.009	GAR10	-	24.9	0.86	69.6	53.7	1.02	41.7	100.9	382.2	-	-
MAR00402.010	GAR11	-	43.8	1.54	112.7	89.4	1.9	64.4	171.8	664.9	-	-
MAR00402.011	GAR12	-	43.6	1.31	123.7	106.4	2.1	71.4	198.9	622.3	-	-
MAR00402.012	GAR13	-	45.6	1.4	128.4	110.3	2.26	72.3	202.9	654.8	-	-
MAR00402.013	GAR14	-	47.2	1.5	137.7	119.9	2.36	78.8	223.6	700.1	-	-
MAR00402.014	GAR15	-	40.3	1.22	124.9	101.1	2.02	73.9	198.4	625	-	-
MAR00402.015	GAR16	-	46.1	1.45	141.2	112.9	2.33	81.1	224.2	699.1	-	-
MAR00402.016	GAR17	-	45.1	1.43	131.4	111.2	2.31	75.5	209	673.8	-	-
Key	Below AL1											
	Above AL1, Below AL2											
	Above AL2											

Table A.52. Total hydrocarbon content (THC) from sediment samples collected from Garston (2019)

Laboratory Sample N°.	Figure ID	THC (mg/kg dry weight)
	Cefas Guideline AL1	100
	Cefas Guideline AL2	-
MAR00402.005	GAR6	181
MAR00402.006	GAR7	115
MAR00402.007	GAR8	65
MAR00402.008	GAR9	161
MAR00402.009	GAR10	173
MAR00402.010	GAR11	163
MAR00402.011	GAR12	74
MAR00402.012	GAR13	227
MAR00402.013	GAR14	169
MAR00402.014	GAR15	150
MAR00402.015	GAR16	178
MAR00402.016	GAR17	171
Key	Below AL1	
	Above AL1, Below AL2	

A.23 Gladstone Docks (1) (2020)

Table A.53. Trace metal and organotin concentrations from sediment samples collected from Gladstone Docks (1) (2020)

Laboratory Sample Nº.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
		Cefas Guideline AL1	20	0.4	40	40	0.3	20	50	130	0.1	0.1
		Cefas Guideline AL2	100	5	400	400	3	200	500	800	1	1
MAR00590.001 (Gladstone Dock)	GLD1	34.4	17.1	0.46	70.8	42.5	0.71	32.9	73.2	246	0.004	<0.001
MAR00590.002 (Gladstone Dock)	GLD1	32.1	15.3	0.54	76.9	44.9	0.66	32.4	69.2	218	0.005	<0.001
MAR00590.003 (Gladstone Dock)	GLD1	31.4	15.4	0.54	84.4	39.1	0.71	31.9	67.4	216	0.004	<0.001
MAR00590.004 (Gladstone Dock)	GLD1	30.6	16.6	0.4	82.9	47	0.66	36	63.3	198	0.007	<0.001
Key	Below AL1											
	Above AL1, Below AL2											
	Above AL2											

Table A.54 Polychlorinated biphenyl (PCB) concentrations from sediment samples collected from Gladstone Docks (1) (2020)

Laboratory Sample Nº.	Figure ID	PCBs (µg/kg dry weight) #18	#28	#31	#44	#47	#49	#52	#66	#101	#105	#110	#118	#128
Cefas Guideline AL1		-	-	-	-	-	-	-	-	-	-	-	-	-
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-	-
MAR00590.001 (Gladstone Dock)	GLD1	-	1.31	-	-	-	-	1.08	-	0.95	-	-	1.14	-
MAR00590.002 (Gladstone Dock)	GLD1	-	1.35	-	-	-	-	1.12	-	0.97	-	-	1.09	-
MAR00590.003 (Gladstone Dock)	GLD1	-	1.3	-	-	-	-	1.06	-	0.92	-	-	1.11	-
MAR00590.004 (Gladstone Dock)	GLD1	-	1.37	-	-	-	-	1.18	-	0.95	-	-	0.98	-

Laboratory Sample Nº.	Figure ID	#138	#141	#149	#151	#153	#156	#158	#170	#180	#183	#187	#194	ΣICES 7 PCBs	Σ25 PCBs
Cefas Guideline AL1		-	-	-	-	-	-	-	-	-	-	-	-	10	20
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-	-	200
MAR00590.001 (Gladstone Dock)	GLD1	1.04	-	-	-	1.18	-	-	-	0.56	-	-	-	7.26	-
MAR00590.002 (Gladstone Dock)	GLD1	1.29	-	-	-	1.32	-	-	-	0.62	-	-	-	7.76	-
MAR00590.003 (Gladstone Dock)	GLD1	1.21	-	-	-	1.26	-	-	-	0.58	-	-	-	7.44	-
MAR00590.004 (Gladstone Dock)	GLD1	1.23	-	-	-	1.19	-	-	-	0.6	-	-	-	7.5	-

Key		
	Below AL1	
	Above AL1, Below AL2	
	Above AL2	

Table A.55 Polycyclic aromatic hydrocarbon (PAH) concentrations and total hydrocarbon content (THC) from Gladstone Docks (1) (2020)

Laboratory Sample Nº.	Figure ID	PAHs (mg/kg dry weight) ACENAPH	ACENAPT	ANTHRAC	BAA	BAP	BBF	BENZGHI	BEP	BKF	C1N	C1PHEN
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-
MAR00590.001 (Gladstone Dock)	GLD1	0.0339	0.0423	0.0738	0.2170	0.3480	0.3760	0.3230	-	0.1740	-	-
MAR00590.002 (Gladstone Dock)	GLD1	0.0336	0.0323	0.0620	0.1810	0.3130	0.3450	0.2990	-	0.1780	-	-
MAR00590.003 (Gladstone Dock)	GLD1	0.0348	0.0365	0.0646	0.1890	0.3200	0.3450	0.3110	-	0.1960	-	-
MAR00590.004 (Gladstone Dock)	GLD1	0.0339	0.0334	0.0668	0.2080	0.3380	0.3680	0.3310	-	0.1870	-	-

Laboratory Sample Nº.	Figure ID	C2N	C3N	CHRYSEN	DBENZAH	FLUORAN	FLUOREN	INDPYR	NAPTH	PERYLEN	PHENANT	PYRENE	THC
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	100
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-
MAR00590.001 (Gladstone Dock)	GLD1	-	-	0.2810	0.0580	0.3960	0.0460	0.3350	0.0944	-	0.2340	0.4180	408
MAR00590.002 (Gladstone Dock)	GLD1	-	-	0.2420	0.0583	0.3290	0.0461	0.3030	0.0816	-	0.2000	0.3490	377
MAR00590.003 (Gladstone Dock)	GLD1	-	-	0.2440	0.0639	0.3270	0.0483	0.3260	0.0949	-	0.2060	0.3440	405
MAR00590.004 (Gladstone Dock)	GLD1	-	-	0.2670	0.0671	0.3600	0.0509	0.3390	0.0980	-	0.2190	0.3980	396

Key		
	Below AL1	(green)
	Above AL1	(orange)

A.24 Gladstone Docks (2) (2020)

Table A.56. Trace metal and organotin concentrations from sediment samples collected from Gladstone Docks (2) (2020)

Laboratory Sample Nº.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
		Cefas Guideline AL1	20	0.4	40	40	0.3	20	50	130	0.1	0.1
		Cefas Guideline AL2	100	5	400	400	3	200	500	800	1	1
MAR00658.001 (Gladstone B2)	GLD2	37.4	15.6	0.47	60.2	40.8	0.78	28.5	71.9	230	<0.005	<0.005
MAR00658.002 (Gladstone B2)	GLD3	37.5	14.5	0.43	51.4	38.5	0.71	26.3	67	211	0.019	<0.005
MAR00658.003 (Gladstone B2)	GLD4	37.6	15.8	0.41	57.9	41.3	0.78	31.4	74.9	237	0.015	<0.005
MAR00658.004 (Gladstone B2)	GLD5	36.6	13.7	0.38	52.6	40.3	0.71	27.3	66.4	212	0.015	<0.005
MAR00658.005 (Gladstone B2)	GLD6	36.2	14.5	0.37	54.3	41.1	0.69	28.3	68.2	216	<0.005	<0.005
MAR00658.006 (Gladstone B2)	-	38.6	15.1	0.46	56.6	42.2	0.75	28.4	71.4	239	<0.005	<0.005
MAR00658.007 (Gladstone B2)	GLD8	34.1	15.8	0.41	60.7	45	0.72	30	71.2	231	0.017	<0.005
MAR00658.008 (Gladstone B2)	GLD9	34.8	16.5	0.44	63.1	44.9	0.78	31.6	76.1	249	<0.005	<0.005
MAR00658.009 (Gladstone B2)	GLD10	37.6	16.2	0.5	78.4	45.7	0.8	30.3	77.1	256	0.02	<0.005
MAR00658.010 (Gladstone B2)	GLD11	34.7	15	0.4	73.5	42.6	0.7	28.5	68.4	226	<0.005	<0.005
MAR00658.011 (Gladstone B2)	GLD12	33.9	15	0.42	67.2	42.7	0.75	29.3	71.7	226	<0.005	<0.005
MAR00658.012 (Gladstone B2)	GLD13	34.4	16.4	0.46	68.2	44	0.78	30.6	73.8	242	<0.005	<0.005
MAR00658.013 (Gladstone B2)	GLD14	34.7	14.7	0.42	61.1	40.4	0.7	26.9	65.7	221	<0.005	<0.005
MAR00658.014 (Gladstone B2)	GLD15	36.5	14.7	0.42	58.3	39.9	0.69	26.6	66.1	218	<0.005	<0.005
MAR00658.015 (Gladstone B2)	GLD16	37.5	15.3	0.42	70.5	42	0.72	27.5	68.4	227	0.014	<0.005

Laboratory Sample N°.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
		Cefas Guideline AL1	20	0.4	40	40	0.3	20	50	130	0.1	0.1
		Cefas Guideline AL2	100	5	400	400	3	200	500	800	1	1
MAR00658.016 (Gladstone B2)	GLD17	35.9	14.5	0.41	61.9	38.9	0.67	25.6	63	210	0.015	<0.005
MAR00658.017 (Gladstone B2)	GLD18	37.2	13.5	0.4	57.5	38.4	0.64	24.3	61.7	207	<0.005	<0.005
MAR00658.018 (Gladstone B2)	GLD19	37.8	12.6	0.35	52.6	34.3	0.6	22.7	56.7	191	<0.005	<0.005
MAR00658.019 (Gladstone B2)	GLD20	37.0	15.4	0.42	64.8	40.8	0.69	27.5	68.6	229	<0.005	<0.005
MAR00658.020 (Gladstone B2)	GLD21	37.4	13.9	0.41	54.4	36.8	0.68	24.9	64.2	213	0.017	<0.005
MAR00658.021 (Gladstone B2)	GLD22	38.2	13	0.36	50.4	33.5	0.6	21.7	55.7	186	<0.005	<0.005
MAR00658.022 (Gladstone B2)	GLD23	41.1	14.6	0.43	55.9	38.2	0.67	25.2	64.4	216	0.016	<0.005
MAR00658.023 (Gladstone B2)	GLD24	37.4	12.6	0.36	48	33.8	0.59	22.2	58.3	191	<0.005	<0.005
MAR00658.024 (Gladstone B2)	GLD25	40.5	13.4	0.42	50.8	33.7	0.6	21.5	55.2	197	0.015	<0.005
MAR00658.025 (Gladstone B2)	GLD26	53.7	12.5	0.39	52.8	29.9	0.54	19.7	51.6	185	0.011	0.014
MAR00658.026 (Gladstone B2)	GLD27	67.7	11.4	0.41	47	25.2	0.5	16.9	42.7	176	0.037	<0.005
MAR00658.027 (Gladstone B2)	GLD28	48.7	11	0.36	52.3	28.8	0.48	18.3	46.5	169	<0.005	<0.005
Key	Below AL1											
	Above AL1, Below AL2											
	Above AL2											

Table A.57 Polychlorinated biphenyl (PCB) concentrations from sediment samples collected from Gladstone Docks (2) (2020)

Laboratory Sample N^{o.}	Figure ID	PCBs (µg/kg dry weight)												
		#18	#28	#31	#44	#47	#49	#52	#66	#101	#105	#110	#118	#128
Cefas Guideline AL1		-	-	-	-	-	-	-	-	-	-	-	-	-
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-	-
MAR00658.001 (Gladstone B2)	GLD2	-	2.12	-	-	-	-	1.79	-	1.53	-	-	1.83	-
MAR00658.002 (Gladstone B2)	GLD3	-	1.83	-	-	-	-	1.47	-	1.21	-	-	1.47	-
MAR00658.003 (Gladstone B2)	GLD4	-	1.76	-	-	-	-	1.42	-	1.25	-	-	1.65	-
MAR00658.004 (Gladstone B2)	GLD5	-	2.07	-	-	-	-	1.75	-	1.43	-	-	1.74	-
MAR00658.005 (Gladstone B2)	GLD6	-	1.93	-	-	-	-	1.61	-	1.44	-	-	1.63	-
MAR00658.006 (Gladstone B2)	-	-	2.01	-	-	-	-	1.53	-	1.37	-	-	1.71	-
MAR00658.007 (Gladstone B2)	GLD8	-	1.99	-	-	-	-	1.57	-	1.35	-	-	1.67	-
MAR00658.008 (Gladstone B2)	GLD9	-	1.91	-	-	-	-	1.56	-	1.33	-	-	1.62	-
MAR00658.009 (Gladstone B2)	GLD10	-	1.95	-	-	-	-	1.54	-	1.34	-	-	1.7	-
MAR00658.010 (Gladstone B2)	GLD11	-	1.89	-	-	-	-	1.56	-	1.31	-	-	1.69	-
MAR00658.011 (Gladstone B2)	GLD12	-	1.91	-	-	-	-	1.51	-	1.32	-	-	1.72	-
MAR00658.012 (Gladstone B2)	GLD13	-	1.99	-	-	-	-	1.54	-	1.45	-	-	1.79	-
MAR00658.013 (Gladstone B2)	GLD14	-	1.97	-	-	-	-	1.74	-	1.7	-	-	2.07	-
MAR00658.014 (Gladstone B2)	GLD15	-	2.29	-	-	-	-	2.04	-	1.45	-	-	1.81	-
MAR00658.015 (Gladstone B2)	GLD16	-	1.8	-	-	-	-	1.46	-	1.32	-	-	1.68	-
MAR00658.016 (Gladstone B2)	GLD17	-	1.74	-	-	-	-	1.52	-	1.26	-	-	1.51	-
MAR00658.017 (Gladstone B2)	GLD18	-	1.75	-	-	-	-	1.39	-	1.2	-	-	1.61	-
MAR00658.018 (Gladstone B2)	GLD19	-	1.75	-	-	-	-	1.42	-	1.28	-	-	1.62	-

MAR00658.019 (Gladstone B2)	GLD20	-	1.86	-	-	-	-	1.65	-	1.31	-	-	1.57	-
MAR00658.020 (Gladstone B2)	GLD21	-	1.67	-	-	-	-	1.54	-	1.3	-	-	1.62	-
MAR00658.021 (Gladstone B2)	GLD22	-	1.61	-	-	-	-	1.43	-	1.09	-	-	1.36	-
MAR00658.022 (Gladstone B2)	GLD23	-	1.61	-	-	-	-	1.43	-	1.15	-	-	1.62	-
MAR00658.023 (Gladstone B2)	GLD24	-	1.59	-	-	-	-	1.37	-	1.21	-	-	1.67	-
MAR00658.024 (Gladstone B2)	GLD25	-	1.61	-	-	-	-	1.31	-	1.04	-	-	1.41	-
MAR00658.025 (Gladstone B2)	GLD26	-	1.34	-	-	-	-	1.25	-	0.92	-	-	1.37	-
MAR00658.026 (Gladstone B2)	GLD27	-	0.92	-	-	-	-	0.82	-	0.68	-	-	0.81	-
MAR00658.027 (Gladstone B2)	GLD28	-	1.23	-	-	-	-	2.03	-	1.02	-	-	1.13	-

Laboratory Sample Nº.	Figure ID	#138	#141	#149	#151	#153	#156	#158	#170	#180	#183	#187	#194	ΣICES 7 PCBs	Σ25 PCBs
Cefas Guideline AL1		-	-	-	-	-	-	-	-	-	-	-	-	10	20
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-	-	200
MAR00658.001 (Gladstone B2)	GLD2	1.92	-	-	-	2.03	-	-	-	0.95	-	-	-	12.17	-
MAR00658.002 (Gladstone B2)	GLD3	1.62	-	-	-	1.74	-	-	-	0.88	-	-	-	10.22	-
MAR00658.003 (Gladstone B2)	GLD4	1.65	-	-	-	1.86	-	-	-	0.86	-	-	-	10.45	-
MAR00658.004 (Gladstone B2)	GLD5	1.84	-	-	-	1.92	-	-	-	0.99	-	-	-	11.74	-
MAR00658.005 (Gladstone B2)	GLD6	1.84	-	-	-	2	-	-	-	0.92	-	-	-	11.37	-
MAR00658.006 (Gladstone B2)	-	1.75	-	-	-	1.94	-	-	-	0.98	-	-	-	11.29	-
MAR00658.007 (Gladstone B2)	GLD8	1.84	-	-	-	1.96	-	-	-	0.83	-	-	-	11.21	-
MAR00658.008 (Gladstone B2)	GLD9	1.84	-	-	-	1.94	-	-	-	0.91	-	-	-	11.11	-
MAR00658.009 (Gladstone B2)	GLD10	1.83	-	-	-	1.94	-	-	-	0.9	-	-	-	11.2	-
MAR00658.010 (Gladstone B2)	GLD11	1.67	-	-	-	1.94	-	-	-	0.92	-	-	-	10.98	-

MAR00658.011 (Gladstone B2)	GLD12	1.78	-	-	-	1.94	-	-	-	0.96	-	-	-	11.14	-
MAR00658.012 (Gladstone B2)	GLD13	1.65	-	-	-	2.01	-	-	-	0.94	-	-	-	11.37	-
MAR00658.013 (Gladstone B2)	GLD14	2.14	-	-	-	2.28	-	-	-	0.99	-	-	-	12.89	-
MAR00658.014 (Gladstone B2)	GLD15	1.82	-	-	-	1.91	-	-	-	0.9	-	-	-	12.22	-
MAR00658.015 (Gladstone B2)	GLD16	1.75	-	-	-	1.99	-	-	-	0.9	-	-	-	10.9	-
MAR00658.016 (Gladstone B2)	GLD17	1.82	-	-	-	1.9	-	-	-	0.86	-	-	-	10.61	-
MAR00658.017 (Gladstone B2)	GLD18	1.66	-	-	-	1.77	-	-	-	0.79	-	-	-	10.17	-
MAR00658.018 (Gladstone B2)	GLD19	1.55	-	-	-	1.74	-	-	-	0.87	-	-	-	10.23	-
MAR00658.019 (Gladstone B2)	GLD20	1.79	-	-	-	1.84	-	-	-	0.86	-	-	-	10.88	-
MAR00658.020 (Gladstone B2)	GLD21	1.51	-	-	-	1.8	-	-	-	0.78	-	-	-	10.22	-
MAR00658.021 (Gladstone B2)	GLD22	1.37	-	-	-	1.64	-	-	-	0.79	-	-	-	9.29	-
MAR00658.022 (Gladstone B2)	GLD23	1.48	-	-	-	1.7	-	-	-	0.78	-	-	-	9.77	-
MAR00658.023 (Gladstone B2)	GLD24	1.49	-	-	-	1.74	-	-	-	0.83	-	-	-	9.9	-
MAR00658.024 (Gladstone B2)	GLD25	1.39	-	-	-	1.47	-	-	-	0.7	-	-	-	8.93	-
MAR00658.025 (Gladstone B2)	GLD26	1.24	-	-	-	1.31	-	-	-	0.64	-	-	-	8.07	-
MAR00658.026 (Gladstone B2)	GLD27	0.79	-	-	-	0.97	-	-	-	0.44	-	-	-	5.43	-
MAR00658.027 (Gladstone B2)	GLD28	0.98	-	-	-	1.24	-	-	-	0.55	-	-	-	8.18	-
Key	Below AL1														
	Above AL1, Below AL2														
	Above AL2														

Table A.58 Polycyclic aromatic hydrocarbon (PAH) concentrations and total hydrocarbon content (THC) from Gladstone Docks (2) (2020)

Laboratory Sample N°.	Figure ID	PAHs (mg/kg dry weight)										
		ACENAPH	ACENAPT	ANTHRAC	BAA	BAP	BBF	BENZGHI	BEP	BKF	C1N	C1PHEN
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-
MAR00658.001 (Gladstone B2)	GLD2	0.0271	0.0427	0.0681	0.186	0.319	0.348	0.316	-	0.145	-	-
MAR00658.002 (Gladstone B2)	GLD3	0.0365	0.0445	0.0893	0.251	0.401	0.425	0.396	-	0.211	-	-
MAR00658.003 (Gladstone B2)	GLD4	0.0226	0.036	0.0589	0.17	0.3	0.33	0.311	-	0.139	-	-
MAR00658.004 (Gladstone B2)	GLD5	0.0202	0.0268	0.0466	0.119	0.212	0.237	0.222	-	0.101	-	-
MAR00658.005 (Gladstone B2)	GLD6	0.0299	0.0412	0.076	0.226	0.387	0.415	0.387	-	0.17	-	-
MAR00658.006 (Gladstone B2)	-	0.029	0.0392	0.0713	0.198	0.342	0.379	0.355	-	0.154	-	-
MAR00658.007 (Gladstone B2)	GLD8	0.0224	0.0371	0.0605	0.172	0.293	0.323	0.301	-	0.158	-	-
MAR00658.008 (Gladstone B2)	GLD9	0.0274	0.0366	0.0674	0.191	0.315	0.387	0.333	-	0.18	-	-
MAR00658.009 (Gladstone B2)	GLD10	0.0384	0.0435	0.0756	0.213	0.348	0.389	0.355	-	0.167	-	-
MAR00658.010 (Gladstone B2)	GLD11	0.0397	0.046	0.0927	0.275	0.441	0.416	0.438	-	0.188	-	-
MAR00658.011 (Gladstone B2)	GLD12	0.0255	0.0422	0.0667	0.194	0.323	0.38	0.332	-	0.155	-	-
MAR00658.012 (Gladstone B2)	GLD13	0.0309	0.0412	0.0778	0.221	0.365	0.454	0.386	-	0.203	-	-
MAR00658.013 (Gladstone B2)	GLD14	0.0384	0.0578	0.103	0.307	0.483	0.519	0.48	-	0.219	-	-
MAR00658.014 (Gladstone B2)	GLD15	0.0407	0.0298	0.067	0.179	0.279	0.296	0.258	-	0.139	-	-
MAR00658.015 (Gladstone B2)	GLD16	0.035	0.0403	0.0752	0.212	0.358	0.412	0.371	-	0.134	-	-
MAR00658.016 (Gladstone B2)	GLD17	0.0383	0.0523	0.0923	0.287	0.438	0.454	0.415	-	0.172	-	-

MAR00658.017 (Gladstone B2)	GLD18	0.0276	0.0388	0.074	0.218	0.344	0.395	0.347	-	0.201	-	-
MAR00658.018 (Gladstone B2)	GLD19	0.0753	0.0532	0.107	0.307	0.474	0.518	0.462	-	0.198	-	-
MAR00658.019 (Gladstone B2)	GLD20	0.0396	0.0499	0.0967	0.276	0.477	0.506	0.474	-	0.211	-	-
MAR00658.020 (Gladstone B2)	GLD21	0.0456	0.0585	0.0888	0.249	0.414	0.466	0.405	-	0.17	-	-
MAR00658.021 (Gladstone B2)	GLD22	0.0324	0.048	0.0775	0.237	0.396	0.447	0.404	-	0.144	-	-
MAR00658.022 (Gladstone B2)	GLD23	0.0331	0.0307	0.0649	0.205	0.322	0.322	0.276	-	0.146	-	-
MAR00658.023 (Gladstone B2)	GLD24	0.0318	0.0334	0.0689	0.192	0.309	0.353	0.301	-	0.161	-	-
MAR00658.024 (Gladstone B2)	GLD25	0.0415	0.0251	0.0609	0.154	0.234	0.255	0.215	-	0.1	-	-
MAR00658.025 (Gladstone B2)	GLD26	0.0346	0.0348	0.0825	0.249	0.34	0.375	0.278	-	0.156	-	-
MAR00658.026 (Gladstone B2)	GLD27	0.0653	0.0189	0.112	0.289	0.344	0.253	0.233	-	0.128	-	-
MAR00658.027 (Gladstone B2)	GLD28	0.0236	0.0321	0.0615	0.186	0.284	0.248	0.237	-	0.111	-	-

Laboratory Sample Nº·	Figure ID	C2N	C3N	CHRYSEN	DBENZAH	FLUORAN	FLUOREN	INDPYR	NAPTH	PERYLEN	PHENANT	PYRENE	THC
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	100
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-
MAR00658.001 (Gladstone B2)	GLD2	-	-	0.239	0.0512	0.342	0.0536	0.314	0.0884	-	0.224	0.365	69.7
MAR00658.002 (Gladstone B2)	GLD3	-	-	0.314	0.0668	0.469	0.0631	0.404	0.0974	-	0.308	0.493	71.3
MAR00658.003 (Gladstone B2)	GLD4	-	-	0.215	0.0532	0.3	0.0477	0.319	0.0812	-	0.189	0.322	72.5
MAR00658.004 (Gladstone B2)	GLD5	-	-	0.153	0.0434	0.223	0.0378	0.225	0.0722	-	0.156	0.237	57.3
MAR00658.005 (Gladstone B2)	GLD6	-	-	0.278	0.0702	0.412	0.058	0.382	0.0869	-	0.247	0.428	50.6
MAR00658.006 (Gladstone B2)	-	-	-	0.247	0.0567	0.365	0.0571	0.364	0.0939	-	0.228	0.386	60
MAR00658.007 (Gladstone B2)	GLD8	-	-	0.209	0.0613	0.308	0.0472	0.318	0.0739	-	0.189	0.317	39.1

MAR00658.008 (Gladstone B2)	GLD9	-	-	0.242	0.0656	0.348	0.0533	0.349	0.0876	-	0.215	0.368	42.7
MAR00658.009 (Gladstone B2)	GLD10	-	-	0.261	0.0644	0.384	0.0629	0.37	0.0908	-	0.266	0.411	20.4
MAR00658.010 (Gladstone B2)	GLD11	-	-	0.336	0.0779	0.517	0.0692	0.436	0.113	-	0.313	0.536	53.6
MAR00658.011 (Gladstone B2)	GLD12	-	-	0.239	0.0597	0.332	0.0538	0.34	0.0824	-	0.201	0.354	37.5
MAR00658.012 (Gladstone B2)	GLD13	-	-	0.272	0.0696	0.4	0.0614	0.406	0.0998	-	0.243	0.423	55.6
MAR00658.013 (Gladstone B2)	GLD14	-	-	0.38	0.0946	0.565	0.0721	0.486	0.104	-	0.327	0.581	56.6
MAR00658.014 (Gladstone B2)	GLD15	-	-	0.224	0.0466	0.343	0.0551	0.267	0.0623	-	0.252	0.356	21
MAR00658.015 (Gladstone B2)	GLD16	-	-	0.27	0.0644	0.4	0.0587	0.391	0.0921	-	0.257	0.415	28
MAR00658.016 (Gladstone B2)	GLD17	-	-	0.334	0.073	0.475	0.0631	0.445	0.0903	-	0.257	0.485	64.5
MAR00658.017 (Gladstone B2)	GLD18	-	-	0.26	0.0707	0.371	0.0523	0.368	0.0826	-	0.227	0.384	66.6
MAR00658.018 (Gladstone B2)	GLD19	-	-	0.358	0.0837	0.558	0.0828	0.488	0.0968	-	0.385	0.567	62.7
MAR00658.019 (Gladstone B2)	GLD20	-	-	0.356	0.0956	0.525	0.0735	0.502	0.123	-	0.336	0.544	93
MAR00658.020 (Gladstone B2)	GLD21	-	-	0.299	0.0742	0.465	0.0691	0.425	0.0892	-	0.3	0.473	53.5
MAR00658.021 (Gladstone B2)	GLD22	-	-	0.291	0.0693	0.424	0.0614	0.428	0.0933	-	0.254	0.438	70.7
MAR00658.022 (Gladstone B2)	GLD23	-	-	0.24	0.0584	0.366	0.0454	0.293	0.0609	-	0.243	0.374	94.5
MAR00658.023 (Gladstone B2)	GLD24	-	-	0.231	0.0614	0.359	0.0519	0.319	0.0803	-	0.219	0.372	53
MAR00658.024 (Gladstone B2)	GLD25	-	-	0.188	0.0471	0.292	0.048	0.227	0.0569	-	0.214	0.299	63.3
MAR00658.025 (Gladstone B2)	GLD26	-	-	0.279	0.0616	0.453	0.0519	0.297	0.0673	-	0.411	0.452	68.5
MAR00658.026 (Gladstone B2)	GLD27	-	-	0.299	0.045	0.58	0.057	0.246	0.062	-	0.412	0.563	138
MAR00658.027 (Gladstone B2)	GLD28	-	-	0.218	0.0496	0.313	0.0401	0.231	0.0644	-	0.189	0.331	99.8
Key	Below AL1												
	Above AL1												

A.25 Queen Elizabeth II Dock (2020)

Table A.59. Trace metal and organotin concentrations from sediment samples collected from Queen Elizabeth II Dock (2020)

Laboratory Sample Nº.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
		Cefas Guideline AL1	20	0.4	40	40	0.3	20	50	130	0.1	0.1
		Cefas Guideline AL2	100	5	400	400	3	200	500	800	1	1
VC 01 R 0m (Queen Elizabeth II Dock)	QED1	38.10	12.4	0.95	84.2	45.1	0.53	30	65.6	237	<LOD	<LOD
VC 01 R 1m (Queen Elizabeth II Dock)	QED1	57.30	18	0.72	87	50.6	1.18	28.8	85	283	0.01	<LOD
VC 01 R 2m (Queen Elizabeth II Dock)	QED1	60.80	21.1	0.87	86.7	55.1	1.36	25.6	95.9	298	0.031	<LOD
VC 01 R 3m (Queen Elizabeth II Dock)	QED1	60.50	37.3	2.12	121	112	3.37	31.6	167	549	0.028	<LOD
VC 01 R 3.35m (Queen Elizabeth II Dock)	QED1	57.70	39.6	2.29	124	121	4.31	35	192	689	0.047	<LOD
VC 01 R 3.7m (Queen Elizabeth II Dock)	QED1	71.60	31.7	1.83	109	83.7	2.95	26.5	138	541	0.033	0.015
VC 02 R 0m (Queen Elizabeth II Dock)	QED2	49.50	13.1	0.54	86.7	40.8	0.71	21.8	60.8	229	0.012	<LOD
VC 02 R 1m (Queen Elizabeth II Dock)	QED2	64.80	10.5	0.5	66.9	30.9	0.58	16.2	44.8	194	0.016	<LOD
VC 02 R 2m (Queen Elizabeth II Dock)	QED2	64.20	17	0.73	86.2	43	0.97	24.6	71.5	271	0.009	<LOD
VC 02 R 3m (Queen Elizabeth II Dock)	QED2	63.30	13.3	0.49	75.6	30.6	0.67	19.2	51.8	200	0.013	<LOD
VC 02 R 4m (Queen Elizabeth II Dock)	QED2	61.60	19.3	0.81	89.5	49.6	1.15	25.4	81.8	304	0.008	<LOD
VC 03 0m (Queen Elizabeth II Dock)	QED3	56.30	13.8	0.48	84.8	34.7	0.7	23.2	60.5	221	<LOD	<LOD
VC 03 1m (Q Queen Elizabeth II Dock)	QED3	65.00	16	0.65	85.2	41.8	0.88	22.7	66	256	0.026	<LOD

Laboratory Sample N°.	Figure ID	Total Solids (%)	Trace Metals and Organotins (mg/kg dry weight)									
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	DBT	TBT
Cefas Guideline AL1			20	0.4	40	40	0.3	20	50	130	0.1	0.1
Cefas Guideline AL2			100	5	400	400	3	200	500	800	1	1
VC 03 2m (Queen Elizabeth II Dock)	QED3	63.60	16.2	0.61	89.2	42.4	0.98	22.5	66.8	247	0.031	<LOD
VC 03 3m (Queen Elizabeth II Dock)	QED3	64.30	23	0.99	95.8	60.6	1.68	26	105	341	0.036	<LOD
VC 03 4m (Queen Elizabeth II Dock)	QED3	64.40	28.4	1.37	105	79.2	2.34	27.5	132	415	0.046	<LOD
VC 03 4.4m (Queen Elizabeth II Dock)	QED3	61.50	33.7	1.62	112	92.2	2.84	29.6	153	475	<LOD	<LOD
GS01 0m (Queen Elizabeth II Dock)	QED4	57.00	7.8	0.32	52.1	20.2	0.4	12.6	31.9	148	<LOD	<LOD
Key	Below AL1											
	Above AL1, Below AL2											
	Above AL2											

Table A.60 Polychlorinated biphenyl (PCB) concentrations from sediment samples collected from Queen Elizabeth II Dock (2020)

Laboratory Sample Nº.	Figure ID	PCBs (µg/kg dry weight)												
		#18	#28	#31	#44	#47	#49	#52	#66	#101	#105	#110	#118	#128
Cefas Guideline AL1		-	-	-	-	-	-	-	-	-	-	-	-	-
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-	-
VC 01 R 0m (Queen Elizabeth II Dock)	QED1	0.76	1.44	1.65	0.83	0.35	0.89	1.17	1.35	1.07	0.35	1.18	1.07	0.2
VC 01 R 1m (Queen Elizabeth II Dock)	QED1	1.14	2.05	2.63	1.21	0.42	1.38	1.77	1.89	1.69	0.44	1.72	1.73	0.33
VC 01 R 2m (Queen Elizabeth II Dock)	QED1	1.63	2.97	3.38	1.84	0.63	2.13	2.73	2.71	2.47	0.56	2.34	2.3	0.51
VC 01 R 3m (Queen Elizabeth II Dock)	QED1	4.79	8.18	9.74	5.09	1.65	6.05	7.75	7.11	5.18	1.19	5.2	4.31	0.96
VC 01 R 3.35m (Queen Elizabeth II Dock)	QED1	11.22	18.15	21.83	11.56	3.09	12.32	15.6	16.15	11.44	3.07	11.13	9.81	1.82
VC 01 R 3.7m (Queen Elizabeth II Dock)	QED1	12.21	16.87	20.63	10.36	2.85	11.74	14.29	13.77	8.95	2.49	8.42	7.65	1.55
VC 02 R 0m (Queen Elizabeth II Dock)	QED2	0.5	1.01	1.06	0.53	0.21	0.62	0.81	0.98	0.77	0.23	0.85	0.89	0.18
VC 02 R 1m (Queen Elizabeth II Dock)	QED2	0.55	1.1	1.11	0.56	0.31	0.73	0.83	1.19	0.83	0.21	0.79	0.93	0.27
VC 02 R 2m (Queen Elizabeth II Dock)	QED2	0.69	1.37	1.38	0.7	0.31	0.87	1.07	1.29	0.95	0.26	0.99	0.96	0.2
VC 02 R 3m (Queen Elizabeth II Dock)	QED2	0.4	0.85	0.89	0.38	0.19	0.54	0.65	0.85	0.6	0.17	0.6	0.66	0.11
VC 02 R 4m (Queen Elizabeth II Dock)	QED2	1.17	2.08	2.36	1.16	0.52	1.41	1.86	1.94	1.64	0.36	1.54	1.55	0.29
VC 03 0m (Queen Elizabeth II Dock)	QED3	0.54	1.17	1.18	0.6	0.26	0.72	0.96	1.07	0.94	0.32	0.98	0.94	0.25
VC 03 1m (Q Queen Elizabeth II Dock)	QED3	0.71	1.48	1.52	0.76	0.35	0.96	1.19	1.47	1.13	0.36	1.09	1.14	0.22
VC 03 2m (Queen Elizabeth II Dock)	QED3	1.86	2.51	2.83	1.31	0.49	1.58	1.94	2.05	1.65	0.51	1.71	1.53	0.35
VC 03 3m (Queen Elizabeth II Dock)	QED3	2.08	3.48	4.04	2.26	0.75	2.51	3.5	3.33	3.09	0.76	2.99	2.89	0.7

VC 03 4m (Queen Elizabeth II Dock)	QED3	2.64	4.9	5.35	3.15	1.04	3.63	4.72	4.97	4.39	1.13	4.27	4.01	0.88
VC 03 4.4m (Queen Elizabeth II Dock)	QED3	4.88	8.18	9.64	5.12	1.49	5.57	8.77	7.1	6.02	1.84	6.12	5.36	1.2
GS01 0m (Queen Elizabeth II Dock)	QED4	0.47	0.81	0.81	0.43	0.17	0.48	0.7	0.74	0.75	0.18	0.62	0.64	0.14

Laboratory Sample Nº·	Figure ID	#138	#141	#149	#151	#153	#156	#158	#170	#180	#183	#187	#194	ΣICES 7 PCBs	Σ25 PCBs
Cefas Guideline AL1		-	-	-	-	-	-	-	-	-	-	-	-	10	20
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-	-	200
VC 01 R 0m (Queen Elizabeth II Dock)	QED1	1.45	0.21	0.92	0.3	1.52	0.13	0.25	0.34	0.81	0.15	0.56	0.2	8.53	19.15
VC 01 R 1m (Queen Elizabeth II Dock)	QED1	2.14	0.18	1.34	0.42	2.47	0.21	0.38	0.47	1.2	0.22	0.8	0.34	13.05	28.57
VC 01 R 2m (Queen Elizabeth II Dock)	QED1	3.09	0.38	2.05	0.6	3.79	0.25	0.59	0.88	2.21	0.5	1.31	0.82	19.56	42.67
VC 01 R 3m (Queen Elizabeth II Dock)	QED1	6.09	0.89	4.28	1.22	6.95	0.44	0.9	1.36	3.62	0.97	2.31	0.97	42.08	97.2
VC 01 R 3.35m (Queen Elizabeth II Dock)	QED1	12.6	1.88	9.37	2.93	14.38	0.94	2.1	3.36	8.71	2.01	4.89	2.36	90.69	212.72
VC 01 R 3.7m (Queen Elizabeth II Dock)	QED1	9.62	1.35	7.37	2.25	11.9	0.85	1.55	2.63	6.93	1.58	4.1	1.83	76.21	183.74
VC 02 R 0m (Queen Elizabeth II Dock)	QED2	1.21	0.19	0.75	0.17	1.17	0.11	0.46	0.27	0.68	0.13	0.44	0.17	6.54	14.39
VC 02 R 1m (Queen Elizabeth II Dock)	QED2	1	<LOD	0.68	0.25	1.09	<LOD	0.19	0.17	0.52	0.17	0.44	0.16	6.3	14.08
VC 02 R 2m (Queen Elizabeth II Dock)	QED2	1.22	0.1	0.83	0.22	1.41	0.09	0.29	0.32	0.73	0.15	0.5	0.17	7.71	17.07
VC 02 R 3m (Queen Elizabeth II Dock)	QED2	0.79	<LOD	0.53	0.14	0.83	<LOD	0.14	0.18	0.45	0.11	0.32	0.11	4.83	10.49
VC 02 R 4m (Queen Elizabeth II Dock)	QED2	1.96	0.24	1.36	0.36	2.18	0.12	0.32	0.41	1.07	0.3	0.76	0.25	12.34	27.21
VC 03 0m (Queen Elizabeth II Dock)	QED3	1.16	0.14	0.79	0.26	1.35	0.1	0.19	0.21	0.69	0.15	0.46	0.18	7.21	15.61

VC 03 1m (Q Queen Elizabeth II Dock)	QED3	1.54	0.19	0.99	0.2	1.7	0.12	0.24	0.34	0.82	0.19	0.54	0.24	9	19.49
VC 03 2m (Queen Elizabeth II Dock)	QED3	2.2	0.35	1.42	0.44	2.36	0.2	0.41	0.52	1.31	0.32	0.88	0.31	13.5	31.04
VC 03 3m (Queen Elizabeth II Dock)	QED3	3.73	0.49	2.66	0.68	4.39	0.32	0.59	0.95	2.35	0.57	1.45	0.66	23.43	51.22
VC 03 4m (Queen Elizabeth II Dock)	QED3	5.26	0.67	3.82	1.23	6.11	0.42	0.8	1.56	3.85	0.97	2.46	1.1	33.24	73.33
VC 03 4.4m (Queen Elizabeth II Dock)	QED3	8.09	1.25	5.24	1.46	8.59	0.68	1.45	1.91	5.06	1.25	2.93	1.31	50.07	110.51
GS01 0m (Queen Elizabeth II Dock)	QED4	0.83	<LOD	0.47	0.13	0.95	<LOD	0.18	0.18	0.52	0.13	0.3	0.14	5.2	10.77
Key	Below AL1														
	Above AL1, Below AL2														
	Above AL2														

Table A.61 Polycyclic aromatic hydrocarbon (PAH) concentrations and total hydrocarbon content (THC) from Queen Elizabeth II Dock (2020)

Laboratory Sample N°.	Figure ID	PAHs (mg/kg dry weight)										
		ACENAPH	ACENAPT	ANTHRAC	BAA	BAP	BBF	BENZGHI	BEP	BKF	C1N	C1PHEN
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-
VC 01 R 0m (Queen Elizabeth II Dock)	QED1	0.0375	0.0521	0.0768	0.224	0.357	0.377	0.305	0.323	0.14	0.166	0.223
VC 01 R 1m (Queen Elizabeth II Dock)	QED1	0.0526	0.0545	0.104	0.262	0.401	0.394	0.346	0.355	0.188	0.183	0.261
VC 01 R 2m (Queen Elizabeth II Dock)	QED1	-	-	-	-	-	-	-	-	-	-	-
VC 01 R 3m (Queen Elizabeth II Dock)	QED1	0.106	0.135	0.221	0.515	0.872	0.817	0.649	0.718	0.259	0.286	0.489
VC 01 R 3.35m (Queen Elizabeth II Dock)	QED1	0.124	0.173	0.25	0.539	0.903	0.865	0.692	0.763	0.37	0.311	0.442
VC 01 R 3.7m (Queen Elizabeth II Dock)	QED1	0.174	0.127	0.246	0.554	0.797	0.697	0.545	0.611	0.298	0.205	0.52
VC 02 R 0m (Queen Elizabeth II Dock)	QED2	0.0381	0.0328	0.0556	0.142	0.22	0.218	0.192	0.197	0.0967	0.103	0.149
VC 02 R 1m (Queen Elizabeth II Dock)	QED2	0.0507	0.0339	0.0777	0.22	0.315	0.301	0.247	0.259	0.161	0.136	0.211
VC 02 R 2m (Queen Elizabeth II Dock)	QED2	0.0716	0.0662	0.128	0.336	0.525	0.491	0.426	0.429	0.199	0.186	0.312
VC 02 R 3m (Queen Elizabeth II Dock)	QED2	0.0456	0.0566	0.0762	0.205	0.345	0.332	0.299	0.298	0.141	0.135	0.188
VC 02 R 4m (Queen Elizabeth II Dock)	QED2	0.0449	0.0438	0.0727	0.196	0.32	0.318	0.256	0.281	0.127	0.129	0.184
VC 03 0m (Queen Elizabeth II Dock)	QED3	0.0542	0.0603	0.0919	0.224	0.341	0.334	0.286	0.293	0.139	0.133	0.257
VC 03 1m (Q Queen Elizabeth II Dock)	QED3	0.0418	0.0556	0.0794	0.222	0.327	0.29	0.25	0.269	0.134	0.116	0.209

VC 03 2m (Queen Elizabeth II Dock)	QED3	0.0491	0.0546	0.095	0.324	0.482	0.425	0.367	0.389	0.194	0.144	0.289
VC 03 3m (Queen Elizabeth II Dock)	QED3	0.0734	0.0758	0.12	0.299	0.486	0.479	0.399	0.428	0.228	0.176	0.283
VC 03 4m (Queen Elizabeth II Dock)	QED3	0.0776	0.1	0.152	0.367	0.586	0.561	0.466	0.499	0.213	0.222	0.34
VC 03 4.4m (Queen Elizabeth II Dock)	QED3	0.0774	0.101	0.153	0.375	0.622	0.57	0.479	0.521	0.221	0.187	0.415
GS01 0m (Queen Elizabeth II Dock)	QED4	0.0295	0.0273	0.0492	0.158	0.237	0.232	0.197	0.199	0.0787	0.101	0.173

Laboratory Sample Nº.	Figure ID	C2N	C3N	CHRYSEN	DBENZAH	FLUORAN	FLUOREN	INDPYR	NAPTH	PERYLEN	PHENANT	PYRENE	THC
Cefas Guideline AL1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	100
Cefas Guideline AL2		-	-	-	-	-	-	-	-	-	-	-	-
VC 01 R 0m (Queen Elizabeth II Dock)	QED1	0.153	0.137	0.223	0.0648	0.349	0.0528	0.331	0.091	0.104	0.239	0.375	131
VC 01 R 1m (Queen Elizabeth II Dock)	QED1	0.165	0.142	0.24	0.0706	0.461	0.0609	0.362	0.0811	0.133	0.29	0.494	41.3
VC 01 R 2m (Queen Elizabeth II Dock)	QED1	-	-	0.343	0.0969	0.665	0.0998	0.47	0.112	0.166	0.492	0.722	119
VC 01 R 3m (Queen Elizabeth II Dock)	QED1	0.286	0.317	0.569	0.11	0.905	0.137	0.688	0.181	0.256	0.484	0.897	260
VC 01 R 3.35m (Queen Elizabeth II Dock)	QED1	0.315	0.308	0.591	0.15	0.922	0.16	0.739	0.205	0.262	0.481	0.923	150
VC 01 R 3.7m (Queen Elizabeth II Dock)	QED1	0.27	0.298	0.581	0.122	1.14	0.179	0.577	0.146	0.224	0.814	1.07	234
VC 02 R 0m (Queen Elizabeth II Dock)	QED2	0.107	0.0963	0.138	0.0412	0.245	0.038	0.2	0.0532	0.0692	0.161	0.304	103
VC 02 R 1m (Queen Elizabeth II Dock)	QED2	0.118	0.105	0.211	0.053	0.408	0.0435	0.262	0.0631	0.0962	0.228	0.421	38.1
VC 02 R 2m (Queen Elizabeth II Dock)	QED2	0.197	0.195	0.311	0.0867	0.578	0.0745	0.445	0.0898	0.157	0.409	0.619	72.4

VC 02 R 3m (Queen Elizabeth II Dock)	QED2	0.119	0.108	0.211	0.0641	0.334	0.0484	0.312	0.0688	0.11	0.226	0.365	86.2
VC 02 R 4m (Queen Elizabeth II Dock)	QED2	0.118	0.104	0.206	0.0528	0.354	0.0497	0.272	0.0621	0.103	0.212	0.378	94.2
VC 03 0m (Queen Elizabeth II Dock)	QED3	0.161	0.162	0.226	0.0569	0.406	0.0585	0.297	0.0642	0.102	0.298	0.447	107
VC 03 1m (Q Queen Elizabeth II Dock)	QED3	0.11	0.106	0.225	0.0505	0.349	0.047	0.261	0.0634	0.0922	0.22	0.395	99
VC 03 2m (Queen Elizabeth II Dock)	QED3	0.136	0.139	0.308	0.0817	0.497	0.053	0.384	0.0813	0.134	0.29	0.606	154
VC 03 3m (Queen Elizabeth II Dock)	QED3	0.188	0.187	0.323	0.0874	0.51	0.0765	0.424	0.0943	0.15	0.315	0.547	90.1
VC 03 4m (Queen Elizabeth II Dock)	QED3	0.202	0.212	0.395	0.1	0.635	0.0956	0.493	0.123	0.176	0.379	0.67	232
VC 03 4.4m (Queen Elizabeth II Dock)	QED3	0.252	0.311	0.408	0.106	0.643	0.0981	0.509	0.12	0.18	0.386	0.668	176
GS01 0m (Queen Elizabeth II Dock)	QED4	0.104	0.0931	0.159	0.04	0.308	0.0334	0.195	0.058	0.0668	0.161	0.31	303
Key	Below AL1												
	Above AL1												

B SSSI Favourable Condition Status

This appendix provides details of favourable condition status for the following Sites of Special Scientific Interest (SSSIs) within the study area, based on data from Natural England's Designated Sites View[17]:

- Dee Estuary SSSI (Section B.1);
- Mersey Estuary SSSI (Section B.2);
- Mersey Narrows SSSI (Section B.3);
- New Ferry SSSI (Section B.4);
- North Wirral Foreshore SSSI (Section B.5);
- Red Rocks SSSI (Section B.6);
- Ribble Estuary SSSI (Section B.7); and
- Sefton Coast SSSI (Section B.8).

17 https://designatedsites.naturalengland.org.uk (Accessed August 2021).

B.1 Dee Estuary SSSI

Table B.1 Condition status of Dee Estuary SSSI units

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
001	811.30	Littoral Sediment	01/12/2010	Favourable	Typical saltmarsh zonation observed. Sward height varies from circa 1m at upper marsh to between 5 and 10cm at lower marsh. Species zonation observed from Sea Club Rush, Hastate Orache and Red Fescue at upper marsh through Sea Plantain, Cord Grass, Sea Lavendar in mid marsh and sea purslane and grass leaved orache at lower marsh. 10-15cm of standing water underfoot from mid marsh to low marsh. Evidence of mechanical creek widening, creeks and open water pools in mid marsh. Presence of Mallard, Teal, Widgeon, Knot, Dunlin and Canada Geese on survey day. No evidence of damage or disturbance of unit attributes.	
002	690.23	Littoral Sediment	01/12/2010	Favourable	Typical saltmarsh zonation observed. Sward height varies from circa 1m at upper marsh to between 5 and 10cm at lower marsh. Species zonation observed from Sea Club Rush, Hastate Orache and Red Fescue at upper marsh through Sea Plantain, Cord Grass, Sea Lavendar in mid marsh and sea purslane and grass leaved orache at lower marsh. 10-15cm of standing water underfoot from mid marsh to low marsh. Extensive network of creeks and open water pools in mid marsh. Presence of Mallard, Teal, Widgeon, Heron, Little Egret, Knot, Dunlin and Canada Geese on survey day. No evidence of damage or disturbance of unit attributes. Low number of recreational craft moored at seaward extent of unit, not currently adversely affecting saltmarsh condition - continued monitoring of boat numbers and use recommended.	

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
003	4762.71	Littoral Sediment	21/12/2010	Favourable	Based on current available information significant changes in habitat extent have not been determined. Current knowledge of bird numbers on the estuary does not present a concern. Measures introduced to control cockleing have been successful with this activity now licenced by the Environment agency. Further assessment of the unit will be carried out in January 2011 on receipt of more detailed habitat information which is due to be reported then.	
004	55.93	Inland Rock	07/10/2019	Favourable	Rapid walk over. Heathland grassland looked appropriate. No negative indicator species observed. Occasional bracken patches, not excessive. *Sabellaria* reef extensive along east side of Hilbre. 400+ Oystercatcher, 50+ Redshank, 2 Curlew. 200+ Cormorant visible on sandbank to east (Unit 3).	

B.2 Mersey Estuary SSSI

Table B.2 Condition status of Mersey Estuary SSSI units

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
001	2639.13	Littoral Sediment	18/02/2020	Unfavourable - No Change	Based on evidence no change in unit extent can be determined. There are decline in teal, wigeon, pintail, golden plover and the >20,000 non-breeding waterbird assemblage by more than 50% at designation, these declines appear to be occurring across the whole estuary. The dramatic decline in pintail need to be investigated further. Favourable numbers of wintering waterbirds observed across all units including curlew, redshank and dunlin. The Mersey estuary favours some SSSI features and is the best site in the UK for dunlin and shelduck (2013/14-2017/18).	See comments
002	112.14	Supralittoral Rock	26/11/2020	Unfavourable - Recovering	There are declines in teal, wigeon, pintail, golden plover and the >20,000 non-breeding waterbird assemblage by more than 50% at designation, these declines appear to be occurring across the whole estuary. The dramatic decline in pintail need to be investigated further. Favourable numbers of wintering waterbirds observed across all units including curlew, redshank and dunlin. The condition of this unit is deteriorating in condition due to unconsented vehicle damage to the saltmarsh vegetation in the upper marsh and encroachment of spartina in the pioneer and lower marsh. The ungrazed saltmarsh is diverse with a number of positive species recorded in the low-mid marsh. Saltmarsh vegetation included red fescue, saltmarsh-grass and sea aster with extensive cordgrass in the upper zone. Full range of zonation, extensive mid to upper marsh, saltmarsh appears to be accreting along the unit to Garston. Natural creeks and pans were present supporting large numbers of teal. Site Visit in September 2019 following reports of unconsented vehicle access along foreshore	

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					resulting in heavy rutting. Soft cliff present, natural processes are exposing the cliff face and allowing movement. There is evidence of 'cutting' and removal of material by third parties, this may be in association with the public footpath.	
003	157.75	Littoral Sediment	18/02/2020	Unfavourable -- Recovering	Unit is unfavourable due to a decrease in teal, wigeon, pintail, golden plover and the >20,000 non-breeding waterbird assemblage. Teal, wigeon and pintail have fallen by more than 50% since the baseline set at SSSI notification. The reasons are currently being investigated but it is thought site-specific factors may be for the declines e.g. increasing Canada geese population, competition for food course and changes/loss in supporting habitat.	
004	23.86	Littoral Sediment	18/02/2020	Unfavourable - No Change	Unit is declining due to the condition of the saltmarsh habitat. Grazing (ideally by cattle) is required to improve the species composition, reduce the sward height and remove rank vegetation. This would also improve the feeding habitat available for wigeon and teal and help to improve their condition status. Natural processes are eroding the front of the marsh with an active network of creeks.	Agriculture - Other Agriculture - Undergrazing
005	3.23	Standing Open Water and Canals	18/02/2020	Favourable	Decoy under positive management and holding suitable water levels. This is an important habitat for breeding herons and cormorants.	
006	31.65	Littoral Sediment	18/02/2020	Unfavourable - No Change	Unit is unfavourable due to condition of the saltmarsh. Changes to the grazing regime is required to allow the saltmarsh habitat to improve in species composition and improve the number of positive species. The marsh is currently heavily used and grazed by Canada geese adding to the grazing pressure.	Agriculture - Overgrazing Agriculture - Undergrazing
007	980.37	Littoral Sediment	21/02/2020	Unfavourable - Recovering	Unit failing on saltmarsh structure and variation of zonation within saltmash. Pioneer marsh absent for much of the Ince Bank and Frodsham Score marsh where a shift of channels in the estuary have eroded much of the lower margin of the marsh. Saltmarsh	

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					vegetation at Frodsham Marsh is heavily grazed with sheep and wildfowl providing a very low sward (1-3cm). This area of saltmarsh supports large numbers of Canada geese contributing to the poor sward structure. Upper saltmarsh dominated by red fescue and creeping bent. At the lower marsh the saltmarsh is eroding rapidly by natural processes resulting in loss of saltmarsh habitat. The saltmarsh becomes more diverse probably due to a result of lighter grazing, sea aster and knotgrass present. Although, there are population declines in pintail, teal, widgeon, golden plover and the non-breeding waterbird assemblage, this unit provides an important feeding habitat and high tide roost. The exposed mudbank to the north of the unit supports important numbers of lapwing, golden plover, curlew, redshank and dunlin.	
008	279.92	Littoral Sediment	18/02/2020	Unfavourable - No Change	Unit is in unfavourable no change condition due to a decrease in the populations of Teal, Pintail, Wigeon and Golden Plover, non-breeding waterbird assemblage by more than 50% compared to numbers at designation. Wigeon and teal numbers may have declined due to the changes in saltmarsh species composition, sward height, increase in Canada geese population and competition for food. The saltmarsh vegetation provides an important food source for species such as teal, wigeon and pintail. It is also an important roost site for waders such as dunlin, grey plover and curlew. Seaward edge of the saltmarsh is eroding rapidly, this is considered to be due to natural estuarine processes. Saltmarsh grazed by sheep and geese providing a very short sward height resulting in poor species composition.	Agriculture - Overgrazing
009	372.11	Littoral Sediment	17/02/2020	Unfavourable - Recovering	Unit is in unfavourable recovering condition due to a decrease in the populations of Teal, Pintail, Wigeon and Golden Plover, non-breeding waterbird assemblage by more than 50% compared to numbers at designation. Wigeon and teal numbers may have	

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					declined due to the changes in saltmarsh species composition, sward height, increase in Canada geese population and competition for food. The saltmarsh vegetation provides an important food source for species such as teal, wigeon and pintail. Waders roost along the edge especially dunlin, grey plover and curlew. Saltmarsh vegetation at Ince Marsh is heavily grazed with sheep and wildfowl providing a very low sward (1-3cm). The short sward favours lapwing, wigeon and golden plover. Saltmarsh comprises of SM13 and SM16. The top of the marsh was dominated by creeping bent with some red fescue, Yorkshire-fog and spear-leaved orache (SM16). At the bottom of the marsh, there appears and more species present i.e. sea aster, annual sea-blite, sea milkwort and common scurvy grass amongst common saltmarsh grass. Changes in the saltmarsh community and in particular the reduced coverage of saltmarsh plants such as *Atriplex* and *Salicornia* may partly explain the observed drop in numbers of teal on the estuary. Changes to pioneer vegetation due to shifts in river channels and erosion of frontal marsh by natural processes.	
010	122.22	Littoral Sediment	17/02/2020	Unfavourable - Recovering	Based on available evidence no change in unit extent can be determined. The saltmarsh is eroding fast rate by natural processes. The unit is unfavourable condition due to a decrease in wigeon, teal, pintail, golden plover and >20,000 non-breeding waterbird assemblage. This unit is ungrazed saltmarsh dominated by sea aster, sea plantain with salt-marsh grass and cord grass becoming more dominant. This saltmarsh provides an important food source for teal, redshank and black-tailed godwits.	
011	1965.38	Littoral Sediment	19/02/2020	Favourable	This unit is favourable condition. Based on available information no change in unit extent determined. Whilst there are declines in teal, wigeon, pintail and golden plover across the whole site, this is not attributable to changes within this unit. The site at Eastham Locks	

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					is a very important high tide roost site for redshank and dunlin. Habitat includes large expanse of intertidal mud at low tide which provides an important feeding habitat for redshank, dunlin, curlew and shelduck.	
012	26.77	Standing Open Water and Canals	19/02/2020	Unfavourable - Recovering	This unit is Unfavourable Recovering due to the presence of non-native New Zealand Pigmyweed (*Crassula*) within two of the pools. Unit is grazed by both cattle and sheep.	

B.3 Mersey Narrows SSSI

Table B.3 Condition status of Mersey Narrows SSSI units

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
001	25.90	Littoral Sediment	20/12/2010	Favourable	Habitat extent unchanged lagoon providing roosting habitat with intertidal feeding resource. Analysis of bird numbers indicates decline in turnstone and bar tailed godwit with over a 50% decline since designation but were not species that used the Seaforth reserve. Good numbers of breeding common turn. Assessment will be revised once further habitat information has been received in January 2011.	
002	89.04	Littoral Sediment	20/12/2010	Unfavourable – Recovering	Data gaps within WeBs counts have resulted in no recent counts for this unit taking place. Information from a number of sources indicates that the turnstone habitat for which this unit was designated for is no longer there as a result of the placement of 3 groynes by Wirral Borough Council shortly before the site was designated. Investigations are ongoing as to the extent of habitat loss and possible measures that can be put in place to improve turnstone habitat at this site.	
003	1.40	Littoral Sediment	20/12/2010	Unfavourable Recovering	Data gaps within WeBs counts have resulted in no recent counts for this unit taking place. Information from a number of sources indicates that the turnstone habitat for which this unit was designated for is no longer there as a result of the placement of 3 groynes by Wirral Borough Council shortly before the site was designated. Investigations are ongoing as to the extent of habitat loss and possible measures that can be put in place to improve turnstone habitat at this site.	

B.4 New Ferry SSSI

Table B.4 Condition status of New Ferry SSSI units

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
001	56.71	Littoral Sediment	19/03/2020	Unfavourable - Recovering	The site is in Unfavourable Recovering due to declines in Pintail by more than 50% compared to numbers at designation. Further investigation is required to understand decline in Pintail numbers across the whole estuary, however, historically New Ferry supported healthy numbers of Pintail. The exposed mudflat at low tide provides an excellent feeding habitat for turnstone, redshank, oystercatcher and curlew. The north of the site towards the Rock Ferry Pier supports good numbers of redshank and oystercatcher. Port Sunlight River Park provides an important high tide roost for hundreds of black-tailed godwit and redshank that feed on the mudflats. There is no net loss in habitat extent, an extensive area of mudflat present at low tide providing suitable feeding habitat for waders. Areas of saltmarsh developing, pioneer species include Glasswort *Salicornia* spp, sea aster *Aster tripolium* and saltmarsh grass *Puccinellia maritima*. Patches of Spartina present to the north of the SSSI, becoming dominant in the upper shore at the southern end of the unit with an extensive area of soft mud below. The upper shore of the northern half of the survey area consisted mainly of muddy gravel and cobble with barnacles and winkles with occasional patches of mud and a large expanse of mud at the very northern end of the shore (2011). Further surveys are required to monitor changes in mudflat/sandflat habitat.	
002	16.72	Littoral Sediment	19/03/2020	Unfavourable - Recovering	The site is in Unfavourable Recovering due to declines in Pintail by more than 50% compared to numbers at designation. Further investigation is required to understand decline in Pintail numbers across the whole estuary, however, historically New Ferry supported	

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					healthy numbers of Pintail. The mudflats within this unit provides an important feeding habitat for redshank, black-tailed godwit, curlew, dunlin, ringed plover and oystercatcher which feed here at low tide and roost on the exposed mudflats. There is no net loss of mudflat extent in this unit. Mudflat comprises of fine sand with a large expanse of mud at northern end of the shore. There is an increased cover of Spartina in the upper shore in this unit. Further surveys are required to monitor changes in mudflat/sandflat habitat.	

B.5 North Wirral Foreshore SSSI

Table B.5 Condition status of North Wirral Foreshore SSSI units

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
001	1065.47	Littoral Sediment	23/10/2012	Unfavourable – Declining	Following assessment of bird numbers during October 2012 Turnstone and Bar-tailed Godwit have both been found to be unfavourable. Turnstone numbers have declined due to a loss of feeding habitat at Egremont Foreshore, Mersey Narrows SSSI, this is currently being investigated. There is circumstantial evidence that Bar-tailed Godwit numbers have declined due to disturbance and they have been displaced from the roost at North Wirral Foreshore and move to other sites during the high tide.	See comments
002	807.55	Littoral Sediment	23/10/2012	Unfavourable – Declining	Following assessment of bird numbers during October 2012 Turnstone and Bar-tailed Godwit have both been found to be unfavourable. Turnstone numbers have declined due to a loss of feeding habitat at Egremont Foreshore, Mersey Narrows SSSI, this is currently being investigated. There is circumstantial evidence that Bar-tailed Godwit numbers have declined due to disturbance and they have been displaced from the roost at North Wirral Foreshore and move to other sites during the high tide.	See comments
003	89.27	Littoral Sediment	23/10/2012	Unfavourable - Declining	Following assessment of bird numbers during October 2012 Turnstone and Bar-tailed Godwit have both been found to be unfavourable. Turnstone numbers have declined due to a loss of feeding habitat at Egremont Foreshore, Mersey Narrows SSSI, this is currently being investigated. There is circumstantial evidence that Bar-tailed Godwit numbers have declined due to disturbance and they have been displaced from the roost at North Wirral Foreshore and move to other sites during the high tide.	See comments

B.6 Red Rocks SSSI

Table B.6 Condition status of Red Rocks SSSI units

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
001	3.246	Supralittoral Sediment	01/04/2012	Unfavourable – Declining	This site is subject to accretion and some of the habitats and features are moving into the Dee Estuary SSSI. The site is clearly in declining condition, Unit 1 Green Beach - this feature is moving out into the Dee Estuary, zonation, natural function and sediment supply are present but outside of the site boundary. Unit 2 Reedbed and Dunes, the natterjack pools (which are outside of the site boundary) have 90%+ cover of common reed, toadlet production has been 0 in 2005, 40000 in 2006, 8000 in 2007, 10 in 2008, 0 in 2009, 2010 and 2011. The transition habitats have been lost due to the cover and spread of common reed, sources of enrichment should be investigated. Unit 3 Southern Dunes - the fixed dunes have a high level of invasive non-native *Rosa spp* (Japanese Rose) which is beginning to encroach into the reedbed.	See comments
002	5.51	Supralittoral Sediment	18/03/2014	Unfavourable – Recovering	Conservation Enhancement Scheme in place. Work has begun to introduce rotational cutting and reed removal to the reedbed. Work has also begun to control invasive plant species within the dunes.	
003	2.68	Supralittoral Sediment	18/03/2014	Unfavourable - Recovering	Conservation Enhancement Agreement in place and management being undertaken to control invasive plant species within the dunes. Rotational cutting of dune grassland with cutting being removed also introduced.	

B.7 Ribble Estuary SSSI

Table B.7 Condition status of Ribble Estuary SSSI units

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
001	2461.87	Littoral Sediment	03/02/2009	Favourable	Biotopes within this unit were characteristic of mid to outer estuary on the middle/low shore and generally associated with clean mobile sands characterised by polychaetes such as *nephtys cirrosa* with amphidods such as *bathyporeia spp*. A few other biotopes occurred sporadically notably areas of mussel and *sabellaria alveolata* along cobbles and boulders of disused training wall. Notified bird features (individual and non-breeding assemblage) are also maintaining Favourable Condition. Most recently published WeBS data (5year Mean 2000/01-2004/05) mean wintering population 236,569 birds with 16 species.	
002	980.99	Littoral Sediment	22/12/2010	Favourable	Bird species observed: Heron, Lapwing, Avocet, Greylag geese (>100), Canada geese (>100), Shelduck, Mute Swan, mallard, bean geese, ruff, knot (>150), pink footed geese (>70), Sandpiper (>300) and little egret. Sward height ranges from 5-40cm, some standing open-water and natural channels present; Flora observed: Shrubby sea blite, Sea arrow grass, cord grass, Hastate orache, Annual sea blite, Sea couch grass, Common and lax flowered sea lavender, Sea aster; Salicornia and sheeps and red fescue dominant in areas, common scurvy grass, English scurvy grass and meadow grass. Patch of marsh between two gulleys (WP7) ungrazed, evidence of wash out, hastate orache dominant. Other areas very flat, low diversity, standing water, grazed and small poached areas.	
003	494.22	Littoral Sediment	03/02/2009	Favourable	The biotopes characterised by slightly muddy sands on mid to upper shore adjacent to saltmarsh. communities characterised by lugworm or amphipods. Notified bird features (individual and non-breeding assemblage) are also maintaining Favourable Condition. Most	

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					recently published WeBS data (5year Mean 2000/01-2004/05) mean wintering population 236,569 birds with 16 species.	
004	275.84	Littoral Sediment	22/06/2006	Favourable	The special interest of this unit is wintering and breeding birds, saltmarsh habitat continues to provide suitable conditions for birds as extent and sward structure continued to be maintained by appropriate grazing regime.	
005	73.08	Littoral Sediment	01/10/2008	Favourable	This unit has been reassessed using CSM, where saltmarsh extent, sward structure and bird populations meet the targets set within the objectives. The vegetation composition on this site is low in diversity and in some cases did fall below the generic standard. However, the saltmarsh habitat for this site has never been diverse, and the site-specific objectives should evolve to reflect this. The unit maintains essential requirements for supporting bird populations which is its special interest.	
006	297.43	Littoral Sediment	24/11/2010	Favourable	Currently grazed by between 75-100 beef cattle between 1st April and 30th September. No cattle on site on day of survey. Clear zonation in species from the upper marsh to the waters edge. *Festuca rubra* dominate at high marsh level, evidence of intense grazing and land is deeply hummocked with standing water. Mid marsh has higher species abundance and network of healthy creeks. Average sward height 10-20cm. Lower marsh is extensively covered in creeks and mud banks, evidence of Spartina and Salicornia. High number of geese and wading birds including Canada geese, lapwing, knot and bar tailed godwit.	
007	9.14	Neutral Grassland - Lowland	12/09/2013	Favourable	Site in favourable condition and meeting objectives, with hay cutting followed by winter grazing. The numbers of marsh orchids were low, this being due to the very cold late spring. There was some localised poaching cause by a horse grazing, this activity has since been stopped.	

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
008	1882.92	Littoral Sediment	12/02/2008	Favourable	A range of biotopes recorded characterised by sandy muds, muddy sands and mobile sands. North of the area containing polychaete worms and *Macoma balthica* and *Corophium voltatoe* also common, areas appeared important feeding for birds. Areas further South more impoverished with upper shore to more dynamic sandy habitats from mid to low water. Notified bird features (individual and non-breeding assemblage) are also maintaining Favourable Condition. Most recently published WeBS data (5year Mean 2000/01-2004/05) mean wintering population 236,569 birds with 16 species.	
009	789.16	Littoral Sediment	13/02/2008	Favourable	This unit was mainly comprised of mobile sand waves rippled of fine sands characterised by amphipods, isopods and polychaetes. A difficult unit to access, located in middle of estuary Notified bird features (individual and non-breeding assemblage) are also maintaining Favourable Condition. Most recently published WeBS data (5year Mean 2000/01-2004/05) mean wintering population 236,569 birds with 16 species.	
010	1288.49	Littoral Sediment	13/02/2008	Favourable	Habitats in this unit relatively consistent comprising of more sheltered areas of slightly muddy sand on the mid to upper show which then graded into well drained rippled sand or mobile areas of large sand waves characterised by amphipods, polychaetes or isopods. Biotopes highly variable spatially with patchy or aggregate species composition Notified bird features (individual and non-breeding assemblage) are also maintaining Favourable Condition. Most recently published WeBS data (5year Mean 2000/01-2004/05) mean wintering population 236,569 birds with 16 species.	
011	161.94	Littoral Sediment	24/11/2010	Favourable	This unit maintains a good range of tussocks, variation in sward height, creeks and open water. PDWC have done some creek digging. Clear zonation in flora from upper to lower marsh. Range of geese, waders and other birds present including: crows, herons, curlew, snipe, lapwing, bar tailed godwit and Canada geese. Review	

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					of PDWC plans for management of this unit required. Currently meeting objectives.	
012	70.39	Littoral Sediment	29/09/2005	Favourable	In the west there are large moderate to sparsely grazed fenced areas (43.62ha) dominated by mosaics of salt-marsh communities. In the centre is a wildfowl sanctuary area with 13.42ha of moderately grazed swards and in the east a much more heavily-grazed sward extending over 23.46ha. The site is grazed predominately by cattle.	
013	34.84	Neutral Grassland - Lowland	20/12/2010	Favourable	Grazed by 40 - 50 cattle. Ryegrass (*Lolium spp*) dominant, occasional dandelion and creeping thistle. Creeping buttercup, clover, sphagnum and ribwort plantain also present. Sward height <10cm, flat in areas with some gentle undulations. Extensive creek (25m - 50m wide x 100m long) extending into open pond system, with reed beds up to 2m high, 5m wide around 80m long); small hummocks around perimeter of creek. Some poached areas around feeding stations (40m x 100m) and exposed sandy areas with scrapes/setts (?) Birds species present, Snipe, mallard, widgeon; Islands present with copse of mixed height and species with bramble thicket, Cherry, Alder, Silver Birch and evergreens.	
014	282.21	Littoral Sediment	01/10/2008	Favourable	This unit has been reassessed using CSM, where saltmarsh extent, sward structure and bird populations meet the targets set within the objectives. The vegetation composition on this site is low in diversity and in some cases did fall below the generic standard. However, the saltmarsh habitat for this site has never been diverse, and the site-specific objectives should evolve to reflect this. The unit maintains essential requirements for supporting bird populations which is its special interest.	
015	83.61	Neutral Grassland - Lowland	22/12/2010	Unfavourable - No Change	Mix of dominant rye grass, clover and dandelions present. Sward height 5-20cm and patchy, bare and mulched sandy/soil areas, cattle still grazing. Sheep exclosed. Extensive pond systems connected by wide creeks. 220+ wigeon, 20 coot, teal, mallard and shoveller all	Agriculture – Fertiliser use

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					present on water and fringing reed beds. Creeping thistle present indicative of soil enrichment. 2 mute swan with cygnet. Island in middle of main pond, hooper feeders present among mixed height copse and evidence of pond deepening work. Stinging nettle present and evidence of moles at north western end of unit. Sward height <10cm. Pond/creek system extending some 250+m and 50m wide in places.	Agriculture – Inappropriate Cutting/ Mowing Agriculture - Overgrazing Lack of Corrective Works – Inappropriate Ditch Management
016	115.73	Neutral Grassland - Lowland	19/09/2013	Favourable	Conditions are ideal for wintering waders and wildfowl, sward height is at target and there is a good coverage of tussocks. Stock management ideal, water control features are all in place. Site reasonably dry at time of visit, this is not a concern in mid Sept. Presence of brackish water crowfoot in ditches confirmed. Cover of undesirable species less than 5% and mostly located at back of marsh. On Rimmers Marsh thistles and ragwort concentrated on narrow ridge running through the parcel towards the back. Area around cattle pen on Sutton currently longer sward but still time for cattle to graze this. Overall site management excellent and unit in Favourable Condition.	
017	45.84	Neutral Grassland - Lowland	23/10/2013	Favourable	Conditions are ideal for wintering waders and wildfowl, sward height is at target and there is a good coverage of tussocks. Stock management ideal, poaching only at site entrance by road tunnel this is unavoidable and in the natural gutters. Site reasonably dry at time of visit, this is not a concern in mid Sept. (Presence of brackish water crowfoot in ditches confirmed on adjacent unit 16, we did not specifically survey the ditches for this species). Cover of undesirable	

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					species less than 5% and mostly located at back of marsh. Overall site management excellent and unit in Favourable Condition.	
018	1.00	Neutral Grassland - Lowland	23/11/2010	Favourable	Sea wall has been breached as part of realignment and pool is now totally tidal. Large expanses of mud to the east of the channel entrance with new creek formed due to tidal action. Presence of healthy *Sueda maritima*, *Festuca rubra*, *Atriplex hastata*, *Aster tripolium*, *Salicornia europaea*, *Halimione portulacoides*, *Pucinella maritima*. No evidence of pollution/damage. Typical pioneer/early saltmarsh zonation and succession evident. Unit border, considering HoM West realignment, may need changing.	

B.8 Sefton Coast SSSI

Table B.8 Condition status of Sefton Coast SSSI units

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
001	1331.87	Littoral Sediment	01/12/2010	Favourable	Car usage on beach limited to Northern end since 2000. 50m-wide band of established and pioneer saltmarsh present and extending southwards for several hundred metres. Obstacles (bin, flags and fences) and signage in evidence, low floral species diversity. Evidence of recreational activity near RNLI hut. Bivalves and razor shells in abundance and topographical variations in gradient of beach. Broad, distinct troughs and ridges, sandy sediment; Gull species present *Larus fuscus* and *Larus ridibundus*. Macro-algal bio-films also in evidence. Waders feeding (*Haematopus ostralegus*, *Calidris alba*, *C. canutus* and *Lamosa lapponica*) all undisturbed, muddy-sand sediment, low diversity and some vehicle traffic (4WD, quad-bikes and cockle tractors). Further North typical sandy sediment, saltmarsh/green beach encroachment, embryo dune and ridge systems, lyme and marram grasses. Bars and creek systems present, no pollution or disturbance low shell diversity and undulating sediment and sand. From Weld Rd evidence of embryo-dune formation and saltmarsh including by *Pucinellia* spp, *Scirpus maritimus, Batis maritima, Limonium vulgare, Plantago maritma, festuca rubra, Aster tripolium, Salicornia* spp, *Cochlearia officinalis, Spartina* spp, *Glaux maritima.* Lots of hummocks and standing open water seaward, with evidence of *Sabella* and *Cerastoderma edule*.	
002	128.30	Littoral Sediment	15/12/2010	Favourable	Outcrop of ancient saltmarsh mud; evidence of Sabellid worms, *Ensis ensis, Cerastoderma edule, Majidae* spp, *Semibalanus balanoides* and aggregations of various bivalve shells. 3 obvious undulating ridge and runnel systems and a typical sandy sediment; Permanent pools supporting blenniidae. No evidence of pollution although domestic	

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					debris apparent. *Larus ridibundus* and *L. argentatus* also present. Crab tiles on the lower shore and evidence of macro-algal mats.	
003	250.76	Littoral Sediment	01/12/2010	Favourable	Zonation in sediment type observed from granular sand in supralittoral to muddy sand at low water. Birds observed: Sanderling, Bar Tailed Godwit, Oystercatcher, Knot, juvenile and adult Lesser Black-backed Gulls. Species present in sediment: Sea Mouse, Common Mussel, Prickly Cockle, Sea Potato, Gammarus shrimp, Bryozoa, macroalgal biofilms present on sediment on mid-shore. Significant drops in gradient from upper shore area to mid shore, beach surface undulating with networks of shallow creeks, ridges and troughs. Healthy dunes evident, dominant species Marram Grass. Currently stabilised by fencing and Christmas Tree plantations. No evidence of damage or disturbance to unit attributes.	
004	494.92	Littoral Sediment	17/12/2010	Favourable	Sand and mudflats healthy with no evidence of damage or disturbance, extent of the unit also in favourable condition. Dunes stable and in favourable condition, dominated by Marram Grass, also Sea Spurge, Sea Holly and Lyme Grass present. BTO data has shown that populations of Grey Plover, Knot, Sanderling and Bar Tailed Godwit are in decline, this is thought to be related to natural movements in the National population and not sue to any activities within the network of sites leading to unfavourable condition. Further studies are due on the Mersey Estuary to investigate numbers dropping and this data may be valid in the wider interpretation of numbers on the Sefton Coast. Unit is being commercially surveyed in the New Year (2011) and this assessment will be edited accordingly.	
005	537.16	Littoral Sediment	17/12/2010	Favourable	sand and mudflats healthy with no evidence of damage or disturbance, extent of the unit also in favourable condition. Healthy strand line community also present on day of survey. Dunes healthy with Marram Grass stable and dominant also Sea Holly, Sea Spurge	

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					and Isle of Man Cabbage present. BTO data has shown that populations of Grey Plover, Knot, Sanderling and Bar Tailed Godwit are in decline, this is thought to be related to natural movements in the National population and not sue to any activities within the network of sites leading to unfavourable condition. Further studies are due on the Mersey Estuary to investigate numbers dropping and this data may be valid in the wider interpretation of numbers on the Sefton Coast.	
006	370.05	Littoral Sediment	17/12/2010	Favourable	sand and mudflats healthy with no evidence of damage or disturbance, extent of the unit also in favourable condition. Healthy strand line community also present on day of survey. Dunes healthy with Marram Grass stable and dominant also Sea Holly, Sea Spurge and Isle of Man Cabbage present. BTO data has shown that populations of Grey Plover, Knot, Sanderling and Bar Tailed Godwit are in decline, this is thought to be related to natural movements in the National population and not sue to any activities within the network of sites leading to unfavourable condition. Further studies are due on the Mersey Estuary to investigate numbers dropping and this data may be valid in the wider interpretation of numbers on the Sefton Coast.	
007	9.82	Supralittoral Sediment	18/08/2009	Unfavourable - Recovering	Areas of open dune dominated by Marram, the predominant dune type within this unit is semi-fixed. Note that some of the dunes at the edges of the unit may be manmade or modified. This unit needs to assess alongside unit 1 as the mobile, embryo dunes grading in to salt marsh are within unit 1. Some areas of the dunes have problems of sea buckthorn, Japanese rose and willow scrub invasion. This is particular problem along the edges of the site, and to a lesser extent within some of the dune slacks. The matter scrub is more complicated within this unit because of the presence of a number of rare hybrid willows so a higher level of tolerance to willow scrub is	

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					required. Recent scrub management was observed during the visit. One slack at the back of the unit is dominated by willow Carr, do not see this as unfavourable as it is an old slack with peaty soil. Note that the slack/wet woodland has a problem with Himalayan balsam and nettles indicating enrichment, management to control the balsam is underway. 2 areas of slack have recently been scraped to improve the habitats for natterjacks. The period 2005 to 2008 only two of the three slacks on the site produced log one metamorphosis and this was only in 2006. Unit is failing natterjack objective. Meeting objectives for sand lizards. NM ARG data supports findings. Due to the levels of scrub this unit is still unfavourable. However, given the efforts on scrub control, slack and dune restoration this unit can be classed as recovering as management is ongoing.	
008	84.01	Supralittoral Sediment	18/08/2009	Unfavourable - Recovering	Over condition Unfavourable recovering, 95 % of dune and slacks are doing well, scrub control is no going but more work is needed to keep on top of problem and deal with issues along coastal road. One large slack area is in need of restoration as it has become very rank. A small area of dunes at Ainsdale has had its zonation truncated due to recreation use. But this is less than 2% of the total unit and management/control underway. Note that for the northern part of the unit this unit needs to be assessed alongside the green beach that is within unit 1 as strand line, embryo dunes/slacks and mobile dunes are now within 1 unit due to natural costal change. The majority of the dunes within this unit are marram dominated semi fixed and fixed dune but at the south end of the unit mobile and embryo dune with lime grass and sand couch are also present. Active processes were observed all along the unit with sand movement frequent within the dunes. Dune slacks were over free from scrub with low growing sward of creeping willow and marsh pennywort, water mint lesser spearwort and sedges. Vascular plant assemblage	

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					objective met with round leafed winter green observed within dune slacks during visit in the 100s if not 1000s within some slacks. Unit meet natterjack, GCN and sand lizard objectives (Data from NM ARG and sefton rangers). Note did see common toad within some of the slacks at the landward side of the unit. Overall recovering condition maintained.	
009	94.39	Supralittoral Sediment	18/09/2009	Unfavourable - Recovering	The areas of dune habitats still have problems with localised scrub encroachment; indeed a large area of dune at the northwest end of the club still has a major problem with well-established buckthorn scrub. Areas of dune and dune grassland are becoming rank and willow herd locally abundant. Within the open dunes areas of open sand very limited, with thick sward of Marram and false Oat-grass. Therefore, unit is unfavourable, however significant scrub clearance works have occurred and are ongoing, mowing of dune slack areas is maintaining characteristic low sward despite low water levels in some of the slacks. The creation of new slacks is providing new habitat to replace that lost by succession and the slacks drying out. Thanks to their management provided by the club this unit has remained in recovering condition.	
010	52.04	Supralittoral Sediment	23/03/2010	Unfavourable - Recovering	Unit is meeting objectives for SD 7 dune and U1 and U4 acid grassland, small areas of the dunes are becoming a little rank but overall dunes and dune grasslands are in good condition within this unit. This unit is within favourable management and scrub control is ongoing, gorse, buckthorn, birch and broom are now low levels over most of the unit, however there are small local problems with re-gen. With respect to sand lizards there is very little open sand within this unit, however all the other habitat requirements are met.	
011	51.16	Supralittoral Sediment	12/02/2010	Unfavourable - Recovering	This unit was assessed using data from P. Smith 2007 and the 2010 site assessment. Unit is meeting objectives for SD 12 dune acid grassland and for the vascular plant objective, grey hair-grass.	

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					However, the age classes of heather are too uniformed, with up to 90% of the heather being pioneer or building. The end extent of gorse within fixed dune habitats and dune-heath also exceeded thresholds for unfavourable condition. Therefore, this unit fails objective relating to dune-heath and fixed dune. The unit is in favourable management and scrub control is ongoing, gorse still remains a problem, more intensive management is required. There were localised areas of scrub encroachment, which will need some management, but these were not a level where they would make the unit on unfavourable.	
012	117.59	Supralittoral Sediment	18/08/2009	Unfavourable - Declining	Overall conclusion Unit is unfavourable declining fixed dune habitat is scrubbing up and in some cases become birch woodland. The unit has a big problem with non-natives such as sea buckthorn, Japanese rose. Within the open areas even were scrub is not an issue the dune grassland is becoming rank. The some of the slacks at the back of the dune system show singes of drying out and possible enrichment, with scrub encroachment, phalris becoming dominant over more typical slack sp. Over all the dunes in this area are very stable and the natural geomorphology has been interrupted. No sand movement and very little areas of open sand. The slack next to the coast road are in much better condition and have rich flora including hydride Baltic rush, abundant marsh orchids. The slacks in this area represent a later stage in the development of slacks with a flora more typical of acid conditions with cotton grass frequent in some slacks, but still have a low sward of sedge, marsh pennywort and some creeping willow. Some management in slacks they are mown by the rangers to control scrub.	Lack of Corrective Works – Inappropriate Scrub Control
013	98.48	Supralittoral Sediment	18/08/2009	Unfavourable - Recovering	Scrub and tree cover is a localised problem in the more mature areas of the dune near the coast road. However, some of the slacks in this area are starting to develop birch scrub as well. Sea buckthorn and	

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					Japanese rose are present at low level and it is evident from the number of dead plants they are being controlled. The fixed dunes also some singes of over stability and possible enrichment, with thick rank grassland like sward developing, small areas the vegetation has become rank and dominated by non-dune sp. as well. On a positive note the majority of the slacks however and frontal dunes are in good condition and under active management and natural processes are allowed. Unit is clearly in unfavourable condition but due to active management is recovering. Zonation intact with, strand line, embryo, mobile and semi and fixed dunes all present along 98% 0f frontage. Not some assessment with unit 8 needed. Units has good population of round leaved wintergreen within slacks, this plant was recorded as in the 100s during recent field visit. Within the period 2005 to 2008 all breeding slacks had one successful metamorphosis, 2006 was a very good year with several slacks having log two production and three having log three. Objective for natterjack toads has been met for this unit. NM ARG data shows objective for sand lizard met. Recovering condition maintained	
014	24.70	Supralittoral Sediment	08/04/2009	Unfavourable - Declining	From walk over of the unit it is clear that some open dune is still on site, a good mix of vegetation heights and densities was evident within open areas. There was abundance of open sandy areas positive; however, some of these seemed to be heavily disturbed. The core area of dune habitat was fenced off, but this was badly damaged and lots of small ad-hoc pathways crossed the dunes. Of concern in this unit is the cover of scrub 30-40% (well over the CSM Unfavourable condition) within this unit, a program of scrub control on the open dunes is needed to maximise the available habitat for the lizards.	Lack of Corrective Works – Inappropriate Scrub Control
015	92.97	Supralittoral Sediment	03/04/2014	Unfavourable - Recovering	Failed on appropriate zonations for all transitional communities in the humid dune slacks. Failed on height of scrub in dunes with *Salix*	

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					repens. Failed on re-establishment capacity in geomorphology assessment. Sheep and rabbit grazing is beneficial, although Round-leaved wintergreen is absent inside enclosures. Outside the enclosures there is a build-up of False oat grass. Slacks to the rear of the unit are dominated by creeping willow and dewberry. There is also occasional sea buckthorn, birch and bramble in some slacks, but not at failure levels.	
016	51.45	Supralittoral Sediment	03/04/2014	Unfavourable - Recovering	The unit fails on height of sward; cover of non-natives; frequency of positive indicator species and lack of embryo / strandline communities. The frontal ridge is very high, with erosion, especially at the southern end, creating an abrupt transition from flat beach, to almost vertical sand face. Blow-outs and the movement of sand inland has created more mobile dune habitats; although the fixed dunes remain heavily vegetated and non-natives including sea buckthorn and balsam poplar are locally frequent. The unit backs onto the pine plantation, which prevents the dunes from rolling back and forming a new line of coastal defence. If the coast continues to erode, this could also lead to fragmentation of the mobile dune habitat.	
017	45.20	Supralittoral Sediment	03/04/2014	Unfavourable - Recovering	Failed to meet targets for dunes with *Salix repens* due to height of scrub and lack of bare ground. Failed to meet target for humid dune slacks to lack of appropriate zonations and frequency of positive indicator species. Failed to meet target for fixed dune grassland due to lack of bare ground cover and frequency of positive indicator species. This unit is an area that was formerly pine plantation and recovery back to dune habitat is progressing well, with Common birds foot trefoil, Creeping willow, Eyebright, Glaucous sedge, Red fescue and Sand sedge all found.	

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
018	30.98	Supralittoral Sediment	18/08/2009	Unfavourable - No change	Unfavourable on change given that 90% of the unit is ether pine or birch woodland and the areas of dune and slack lack positive sp and have high scrub cover, this unit is clearly unfavourable.	
019	141.39	Supralittoral Sediment	03/02/2014	Favourable	Royal Haskoning Report, Nov. 2013 states: given the vast widths of dune at this location, it would be expected to be the most stable area of the dunes within the NNR even if no woodland plantations were present and therefore it cannot readily be argued that the woodland is unduly inhibiting the functioning of these dunes. Given the projected rates of coastal change over the next 50 years, this unit would be expected to remain as stable dunes even if there were no afforestation.	
020	129.41	Supralittoral Sediment	18/08/2009	Unfavourable - No change	Unit has some local problems with scrub but overall the areas of dune and dune heath are well managed. However, the management of the heathland areas has resulted in a uniform age structure. Therefore, this unit is unfavourable for under this criterion. Club were asked to modify mowing on the heath areas to leave un-cut areas and they agree. Can confirm that this has now been implemented, areas of heather now left uncut giving a verity of heather heights within the heathland areas. Given time this will help with the age classes, however scrub can become a problem in the uncut areas so will need to go to a cutting cycle. This unit was formally within the inland part of the dune system however coastal erosion has now moved the frontal dunes within this unit. In open areas the dune system has rolled back and maintained some degree of zonation with new mobile dunes forming, indeed the club have moved parts of the course to adapt to this realignment of the coast. However large part of the frontal dune now back directly onto pine plantation, this affects about 95% of the frontage of this unit. There is no embryo, or mobile dunes in this area. There is a thin band of fixed dune and dune scrub and then the plantation. The toe of the dune is eroding, and	Coastal – Coastal Squeeze Lack of Corrective Works – Inappropriate Scrub Control

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					very little sand is moving inland, indeed there is no room for the dunes to rollback.	
021	27.51	Supralittoral Sediment	23/01/2009	Unfavourable - No change	Unit has some local problems with scrub but overall the areas of dune and dune heath are well managed. However, the management of the heathland areas has resulted in a uniform age structure. Therefore, this unit is unfavourable for under this criterion.	Agriculture – Inappropriate Cutting/ Mowing Lack of Corrective Works – Inappropriate Scrub Control
022	180.81	Supralittoral Sediment	18/08/2009	Unfavourable - Recovering	This section of coast is highly Active and is affected by coastal erosion, no embryo dune Strandline present. Human activity around the car park in accelerating the rate of erosion with sand sheeting and blow-outs moving inland all around this area. Brushwood fencing and re-profiling works have been undertaken to mitigate for the accelerated rates of erosion. The dune system is currently rolling back, the fixed dune and scrub is being replaced of by mobile dune. Marram colonisation was observed on the sand sheets. Behind the frontal dunes are considerable areas of dune scrub dominated by birch, sea buckthorn and willow, in some areas the canopy is closed and resembles Woodland. However, sand movement is burying these areas and replacing them with open dune habitat, this is also the case in the area of nicotine waste. Note that area of nicotine waste is dominated by nettles, the dunes are covered in a thick peat like organic layer. Note that the existing Natterjack pools in this area are being in-filled by sand movement. Note that this unit is not meeting objectives for natterjacks. This unit has a considerable areas of dune grassland that is now managed by grazing, the sward was low and dominated by characteristic species such sand sedge, red fescue and dewberry. Note that sand movement will also inundate this area in	

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					the near future. Of more concerned are the areas were dune roll-back is running into pine plantations, this appears to be stopping or slowing the dune roll-back and limiting the ability of the system to realign itself establishing zonation. Unit is clearly unfavourable due two zonation, scrub cover on dunes and Natterjack toads, however active management and natural processes are moving this unit towards favourable condition. Unfavourable recovering	
023	48.26	Supralittoral Sediment	09/04/2009	Unfavourable - Recovering	1. Dune grassland with semi-fixed dune. Area has a low sward due to heavy grazing by rabbits; scrub/tree in this area mostly limited to historic boundaries and pond so not an issue. However public access to this area is an issue with erosion evident along the manger footpaths that cross this area. Will need to keep an eye on this area, it is possible that the paths may need some work to address this. 2. Frontal dunes are eroding and highly mobile. Numerous blow-outs, sand is moving back to form new dunes. Some charismas tree revetment, but this is not significantly modifying the geomorphology. The active environment in the frontal dunes has removed the scrub problem; the trees and scrub have been overwhelmed by sand, Scrub now at 1-2% cover in this area.3. In the area around the car park scrub is more of an issue 10-20% locally Over all most of the scrub see in 2002 has gone due to the mass movement of sand within the frontal dunes. It seems that natural process has conspired to sort out the issues on a large part of this unit. The way this has been managed by the rangers has allowed the habitat to fall back and create new dunes. It is worth noting that the dunes in this area have historically been heavily modified by sand wining and farming. Resulting in a rather flat area inland, with high dune at the front, it seems that this area is naturalizing. This unit is clearly still in Unfavourable condition but due to the movement of	

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					sand and the redevelopment of new dunes I would say it is recovering.	
024	85.51	Supralittoral Sediment	18/08/2009	Unfavourable - Recovering	Site had a full range of dune types and developmental stages, from strandline, embryo dunes to mobile and semi-fixed dune. With the exception of the area arrowed lifeboat road that has required stabilisation work due to erosion, this dune system is accreting. Natural processes of sand movement are active, with dunes rolling inland in some areas. Slack development continues within the large slack at devils hole, with slack vegetation expanding within the slack. Sand movement at the back devils hole has been slowed by a pine plantation; however the dune is slowly over whelming the pines. A good population (100+ plants) of seaside centaury was seen within area next to the slack. Of concern was the areas of semi fixed dune and dune grassland within this unit seemed to be somewhat rank with dewberry, willow herb frequent in some areas and little open sand. There were also localised problems with scrub including sea buck thorn and white poplar; there was evidence of control work but also of re-growth. On a more positive note the fixed areas did have populations of Pyramidal orchids in the 100s. The slacks to the south of the unit had large populations of Marsh helleborines in the 1000s. Both Slacks within this unit have reported successful natterjack toad breeding within the 4-year period 2005-2008 therefore meeting objectives. One female adult sand lizard was also observed during the unit survey. NM ARG data also supports the sand lizard conclusion that this unit is meeting objective for sand lizard. The active movement of sand in to over stabiles areas combined with new dune formation, plus management have kept this unit in a recovering condition.	
025	25.56	Supralittoral Sediment	18/08/2009	Unfavourable - Recovering	This unit has a rich mix of habitats; within the dune system at the seaward side of the unit the full range of development stages in dune	

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					formation can be seen. From strand line and embryo dunes along the frontal dunes to more stable semi fixed dunes. The newly forming dunes with active sand movement are meeting objectives however the dunes inland are becoming rank with willow herb and dewberry, this combined with thick grassy sward covering the dunes in some areas contribute to this unit being unfavourable. Natterjack scrapes have been created in this area and have developed a low sward of horntail and sedges. Also in this area high numbers of pyramidal orchids were seen (400+). At the landward side of the unit is a complex of botanical very rich dune slacks. With a low sward horntail, sea club rush, creeping willow, spike rush, marsh pennywort, with large populations of Marsh orchids, helleborines and grass of Parnassus. The slack becomes dominated by common reed at the southern end; however, management in the form of a scrape across the slack has stopped the spread of the reed. In the dryer areas the slack grads in to dune grassland with abundant lady's bedstraw, grater birds foot trefoil. This area has some willows scrub including sands of creeping willow and hydrides. This area is managed by grazing but some areas are still rank with thick creeping willow and dewberry up to 60-70cm high covering some areas. Out of the 7 natterjack breeding slacks in this unit only 2 have had successful breeding over the period 2005-2008, not meeting objective. Over of the unit is in active management but is clearly unfavourable, unfavourable recovery.	
026	49.35	Supralittoral Sediment	08/05/2009	Unfavourable - Recovering	Have agreed 5-year management plan with defences estates and commandant, works on ground have started. 0.4ha semi mature sea buckthorn removed at north end of unit. And a significant area of White Poplar and Buckthorn scrub cleared at the south end of the unit. All stumps have been treated to stop re-growth. Within the over stable sand dunes a 320m long area of scraped sand has been	

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					created, this has stimulated some very local sand movement and excellent micro habitat for invertebrates. As well as providing open sand the works have also created valuable accesses for future habitat management. The dune slacks, and small area of grassland within the northern part of the unit have been mow. Further mowing is planned for the end of the summer within the dune grassland at the north end of the unit. The works have started to move the unit towards favourable condition, however there are still significant problems locally with non-native scrub such as White poplar, Sea Buckthorn and Japanese Rose. Also, the majority of the dunes have little if no areas of open sand and are over stable. So, this unit is clearly still Unfavourable but thanks to the management it is now Unfavourable recovering.	
027	40.94	Supralittoral Sediment	18/08/2009	Unfavourable - No change	Site has large and expanding scrub problem with white poplar, sea buckthorn and Japanese rose. Semi-fixed dune, dune grassland and slacks all affected. Also, the lack of grazing within the dunes and grassland has allowed thatch to build up and the habitat to become rank. Natterjack toads have attempted to breed but no successful breeding recorded between 2005 and 2008. Scrub encroachment on the dunes and in the slack combined with low water levels have contributed to the problems for the toads in this unit. This unit is clearly failing this objective. The north end of the site has good embryo and mobile dunes at the front of the system with strand line vegetation and salt marsh. NM ARG confirm that this site is meeting objective for sand lizard. Natural processes within the dunes have been restricted at the southern end of the unit due to historical tipping of bricks and concrete after war. The erosion of this has formed an artificial cliff and shingle beach along part of the system, coastal process are now moving the martial north towards the coast guard station. The shingle is moving into areas of embryo salt marsh	Lack of Corrective Works – Inappropriate Scrub Control

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					with cored grass and sea saltwort. This then develops into strand line vegetation on the beach proper, with Portland spurge and salt work. The dunes south of the UU outfall down to the coast guard station are eroding at the toe with blow-out associated with footpaths going into the dunes. Some mobile dune still present as the dunes slump at the front and then this is colonised by marram. Did note the alt seems to be moving towards the dunes and the beach level seems to have dropped in this area over the past 2 years. Overall declining	
028	23.69	Supralittoral Sediment	24/08/2009	Unfavourable - Recovering	The areas of heather not meeting age and structural criteria, however the introduction of cows to the heath has made a big difference to the structure. The uniform heath compartments have now become more heterogeneous. The sheep and cattle grazing is controlling birch scrub, this is only a problem is outside the grazing enclosures, but control by hand cutting is dealing with this. Areas of acid grassland / heath mosaic are recovering well after the fire, with abundant wavy hair grass, matt grass and red fescue with occasional heath bedstraw and heath rush. The area of massive gorse regeneration recorded in Jan 09 have been removed my mechanical scarification. If this area had been left to re-generate this unit would be declining as cover grater then 20%. A total of 1.5 ha of gorse scrub, enriched litter and root has been scraped off the heath as part of habitat enhancement works over the past winter 08-09. The cleared areas are starting to re-generate with a mix of sheep's sorrel, sand sedge and heath rush, with one or two heather plants also starting to grow along the edges of some of the areas, this is clearly indicating that a desirable plant community is starting to develop. It was noted on the enriched litter banks nettles are now growing, however the banks are also becoming cover in gorse. The areas of wet heath/slack habitat within this unit were badly encroached, with just relic areas holding on. However, the new pools and removal of	

Unit No.	Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					the gorse has revitalised this habitat. Marsh pennywort, water mint, heath rush, amphibious bistort, purple loosestrife and water crowfoot was observed within the new pools. Another positive singe was the mix of dry, wet and standing water within the pools. This will provide the widest range of habitats to the wet heath/slack community, as it is mimicking the natural hydrology. Royal fern was recorded within the woodland at the south end of the unit.	
029	3.79	Supralittoral Sediment	27/03/2013	Unfavourable - Recovering	Direct management by volunteers has started to control scrub issue, and an agreement for future management has been obtained. Area now recovering.	
030	7.71	Supralittoral Sediment	23/01/2009	Unfavourable - Recovering	Works to remove scrub started winter 2008-09 so unit has move into recovering condition. Has been problem with over mowing of dune grassland areas along banks but this was rectified, and mosaic cut now used. Further works planed April 09 to create small patches of sand.	
031	3.28	Supralittoral Sediment	23/01/2009	Unfavourable - Recovering	This unit is within a CSS agreement and scrub control and grazing are ongoing. However, this unit still fails for the % cover of *Ulex* and the cover of *Epilobium*. Also, the areas of grassland within the heath are rank and show signs of enrichment. Ongoing management is required on this unit to remove biomass and nutrients and control the re-growth of *Ulex*.	

C Information to Inform an Appropriate Assessment and Marine Conservation Zone Assessment

C.1 Background

The Mersey Estuary lies on the northwest coast of England and forms one of the largest estuaries in the United Kingdom (UK). The estuary is tidal from the River Mersey at Howley Weir in Warrington to its mouth at Liverpool Bay (forming part of the Irish Sea). The conurbation on both sides of the Mersey is generally referred to as 'Merseyside' and includes the City of Liverpool and Widnes on the north (east) bank, and Wallasey, Birkenhead, Eastham, Ellesmere Port and Runcorn on the south (west) bank.

The Mersey Estuary has a long and established maritime heritage, with regular transport routes as far back as the Middle Ages. Liverpool saw the development of the world's first recorded commercial wet dock, known as the 'Old Dock'. Current port capacity in the Mersey Estuary comprises a suite of enclosed docks, riverside terminals and the Manchester Ship Canal. 'Liverpool Docks' is an interconnected dock system extending over 12 km and remains one of the biggest port estates in the UK; it is complimented by additional riverside berths, including the new Liverpool2 Terminal at Seaforth. Further upstream, at Garston, there are three more enclosed docks. Another sequence of enclosed interconnected docks on the Wirral Peninsula in Birkenhead provides further capacity, with riverside facilities at Twelve Quays (Birkenhead) and the Tranmere Oil Terminal.

The Manchester Ship Canal, which starts in the Mersey Estuary, is capable of taking ocean-going vessels. It provides an important inland transport link, offering access for shipping between the Mersey Estuary and Manchester. Together, the Port of Liverpool and Manchester Ship Canal offer a comprehensive range of port facilities, handling more than 41 million tonnes of cargo in 2019 (Port of Liverpool – 34.31 million tonnes; Manchester Ship Canal – 7.31 million tonnes; Department for Transport, 2019), with over 10,000 ship movements per year.

Maintaining safe port access for commercial and recreational maritime transport is an important function for the Statutory Harbour Authority (SHA) for the Mersey Estuary, the Mersey Docks and Harbour Company (MDHC). This necessitates the maintenance dredging of access channels and berth pockets to remove recently deposited sediment.

The total annual quantity of maintenance dredging undertaken within the study area between 2002 and 2020 (not including WID) ranged from 350,208 hopper tonnes to 3.1 million hopper tonnes, with a mean dredge quantity of approximately 1.85 million hopper tonnes per year. A relatively large proportion of material was dredged from areas within the Approach Channel and river berths/entrances compared to the enclosed docks at Liverpool, Birkenhead and Garston. Further details are provided in Section 4.2 of the Maintenance Dredge Protocol (MDP) Baseline Document (main report).

This appendix provides the information deemed necessary to inform an Appropriate Assessment (AA) and Marine Conservation Zone (MCZ) Assessment of the maintenance dredging undertaken by or on behalf of the MDHC and ABP Garston in the Mersey and its approaches. The potential effects associated with the removal of the maximum total annual quantity of material since 2002 from the Mersey and its approaches have been assessed in this appendix as a worst case (i.e. 3.1 million hopper tonnes in 2007). In addition, the effects of other forms of dredging that do not involve the removal of sediment (i.e. WID and plough dredging) have also been assessed.

C.1.1 Report context

The Conservation of Habitats and Species Regulations 2017 (as amended) (hereafter referred to as the Habitats Regulations) implement the Habitats Directive (92/43/EEC, as amended) and Birds Directive (2009/147/EC) in UK waters and require that an AA be undertaken where a plan or project is not directly connected with, or necessary for the management of European sites and where the possibility of a likely significant effect (LSE) on these sites cannot be excluded, either alone or in-combination with other plans or projects.

European sites are defined in the Habitats Regulations as including the following:

- Special Areas of Conservation (SACs) designated under the EC Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (the Habitats Directive) for their habitats and/or species of European importance;
- Special Protection Areas (SPAs) classified under the EC Directive on the Conservation of Wild Birds (the Birds Directive) for rare, vulnerable and regularly occurring migratory bird species and internationally important wetlands;
- Sites of Community Importance (SCIs) that have been adopted by the European Commission but not yet formally designated by the government of each country; and
- Candidate SACs (cSACs) that have been submitted to the European Commission, but not yet formally adopted.

In England, it is also policy under the National Planning Policy Framework (DCLG, 2012) that the following wildlife sites should be given the same protection as European sites:

- Potential SPAs (pSPAs) and possible SACs (pSACs);
- Listed or proposed Ramsar sites under the 1971 Ramsar Convention on Wetlands of International Importance;[18] and
- Sites identified, or required, as compensatory measures for adverse effects on European sites.

These sites are therefore collectively referred to throughout this appendix as European/Ramsar sites.

It is the Government's view that maintenance dredging should be considered as a 'plan or project' for the purposes of the Habitats Regulations (Defra, 2007). This appendix presents the relevant information to allow the Competent Authority, the Marine Management Organisation (MMO), taking appropriate advice from Natural England, to record the AA.

In this context, ABPmer has been commissioned to produce a MDP Baseline Document to comply with the requirements of the Conservation Assessment Protocol for maintenance dredging. The Baseline Document provides current and historical information on dredging activities in the Mersey and its approaches, and synthesises existing relevant information about the environmental status of the area. The Baseline Document (main report), should be read alongside this appendix which specifically reviews the available evidence and provides information to determine whether maintenance dredging and disposal activities undertaken by or on behalf of the SHA and all known third party users in the Mersey (i.e. ABP Garston) and its approaches is having a potential impact on the interest features of any European/Ramsar sites.

Under Section 126 of the Marine and Coastal Act 2009 an assessment is also required to determine the significance of impacts on Marine Conservation Zone (MCZ) features and whether there is any significant

[18] pSPAs, pSACs and proposed Ramsar sites are sites on which Government has initiated public consultation on the scientific case for designation as a SPA, cSAC or Ramsar site.

risk of a project hindering the Conservation Objectives of the MCZ. This report also provides the information required for an MCZ Assessment.

C.2 Marine Protected Areas

C.2.1 European/Ramsar sites

Section 7 of the Baseline Document (main report) identifies European/Ramsar sites located within 5 km of the maintenance dredge and disposal sites in the study area. These sites are as follows:

- Dee Estuary/Aber Dyfrdwy SAC;
- Liverpool Bay/Bae Lerpwl SPA;
- Mersey Estuary SPA and Ramsar site;
- Mersey Narrows and North Wirral Foreshore SPA and Ramsar site;
- Ribble and Alt Estuaries SPA and Ramsar site;
- Sefton Coast SAC; and
- The Dee Estuary/Aber Dyfrdwy SPA and Ramsar site.

A European Marine Site (EMS) is the collective term for SACs and SPAs that are covered by tidal water (continuously or intermittently). In accordance with Government advice in both England and Wales, Ramsar sites must be given the same consideration as European sites when considering plans and projects which might affect them. EMS within the study area include Dee Estuary, Liverpool Bay, Mersey Estuary, Mersey Narrows and North Wirral Foreshore, Ribble and Alt Estuaries and Sefton Coast.

C.2.2 Marine Conservation Zones

Section 7 of the Baseline Document (main report) identifies MCZs located within 5 km of the maintenance dredge and disposal sites in the study area. These sites are as follows:

- Flyde MCZ; and
- Ribble Estuary MCZ.

C.2.3 MPA conservation advice

Natural England and Natural Resources Wales (NRW) have statutory responsibility to advise relevant authorities as to the conservation objectives for all Marine Protected Areas (MPAs) within English and Welsh territorial waters respectively and operations which may cause deterioration or disturbance of natural habitats and species. The Joint Nature Conservation Committee (JNCC) has a statutory responsibility to advise relevant authorities as to the conservation objectives for MPAs which extend from the edge of territorial waters out to the UK Continental Shelf. The role of the conservation objectives for a EMS is to define the nature conservation aspirations for the features of interest, thereby representing the aims and requirements of the Habitats and Birds Directives in relation to the site.

Natural England has produced formal marine conservation advice packages and supporting documents to help with individual site MPA assessments and the impact of marine activity in sensitive areas for all of the MPAs in the study area located within English territorial waters, namely Mersey Estuary SPA and Ramsar site, Mersey Narrows and North Wirral Foreshore SPA and Ramsar site, and Ribble and Alt Estuaries SPA and Ramsar site (Natural England, 2021). Natural England has also published advice on the Conservation Objectives for Dee Estuary SAC, Sefton Coast SAC and The Dee Estuary SPA and Ramsar site (Natural England, 2014a; b; c). Natural England and NRW (formerly Countryside Council for Wales, CCW) has published conservation advice for the Dee Estuary EMS (Natural England and CCW, 2010). Natural England, NRW and JNCC has jointly prepared formal marine conservation advice package for the offshore MPA, Liverpool Bay/Bae Lerpwl SPA (JNCC, 2021).

A detailed breakdown of the interest features and the associated conservation objectives for the MPAs that occur in the vicinity of the maintenance dredging and disposal operations can be found in Section 7 of the Baseline Document (main report).

C.3 Potential Impacts on Interest Features of MPAs

This section provides a review of the potential impacts of the maintenance dredge and disposal operations within the SHA alone (Sections C3.1 to C3.2, and requirement for mitigation measures in Section C3.3) and in-combination with other relevant plans and projects (including third party maintenance dredge operations undertaken by ABP Garston) (Section C3.4), on the interest features of MPAs that were identified in Section C2. This assessment has been carried out in the context of the nature of the maintenance dredging and disposal activities, and the geographical locations of both the works and the interest features. As outlined in the Defra guidance (2007), it is based on existing knowledge and evidence with no new analysis undertaken. Figure C1 and Figure C2 show the location of the surrounding MPAs. Figure 4.1 to Figure 4.7 in the Baseline Document (main report) show the locations of relevant maintenance dredge areas and licensed marine disposal sites in the study area.

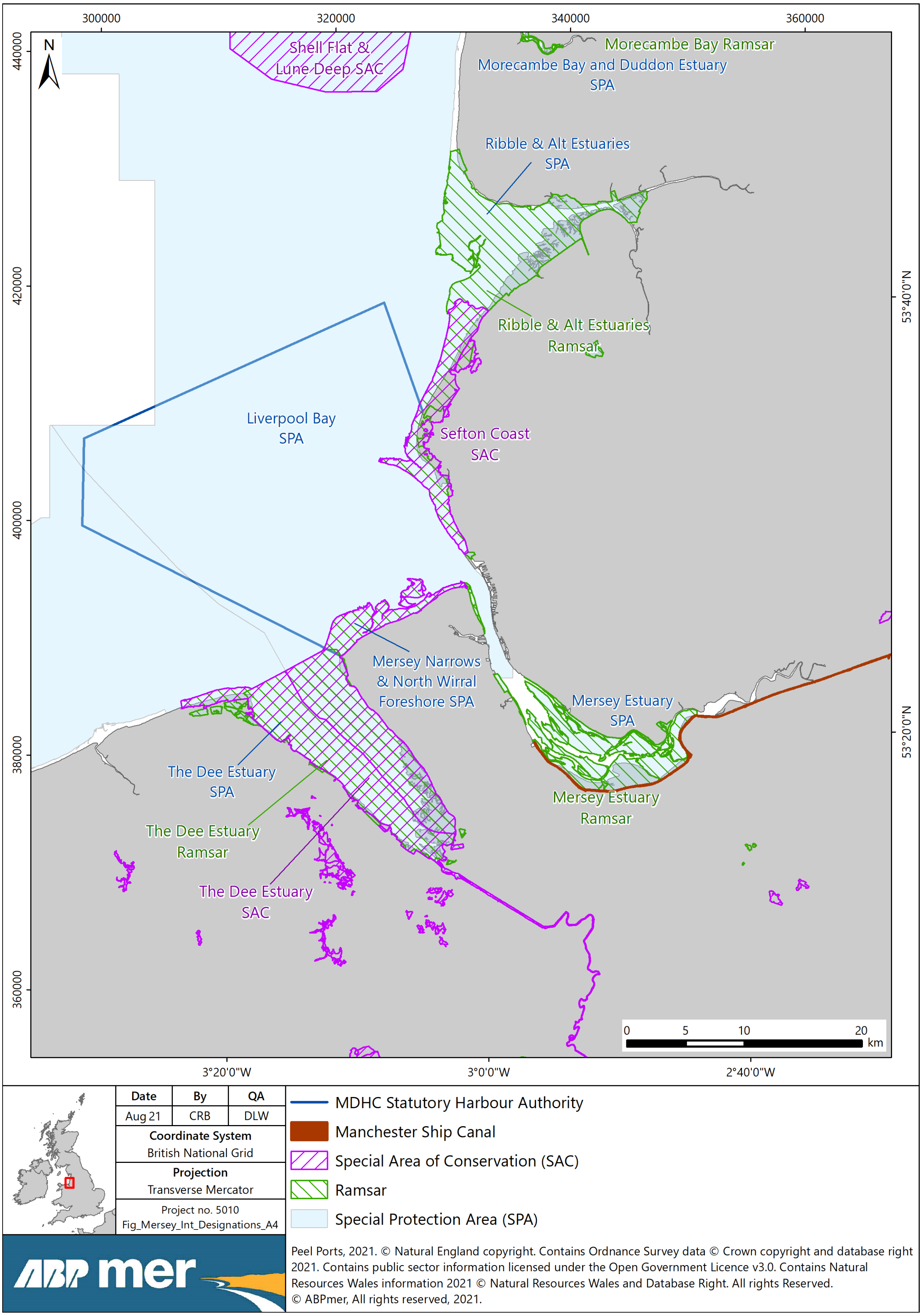


Figure C1. **European and international nature conservation designated sites in the study area**

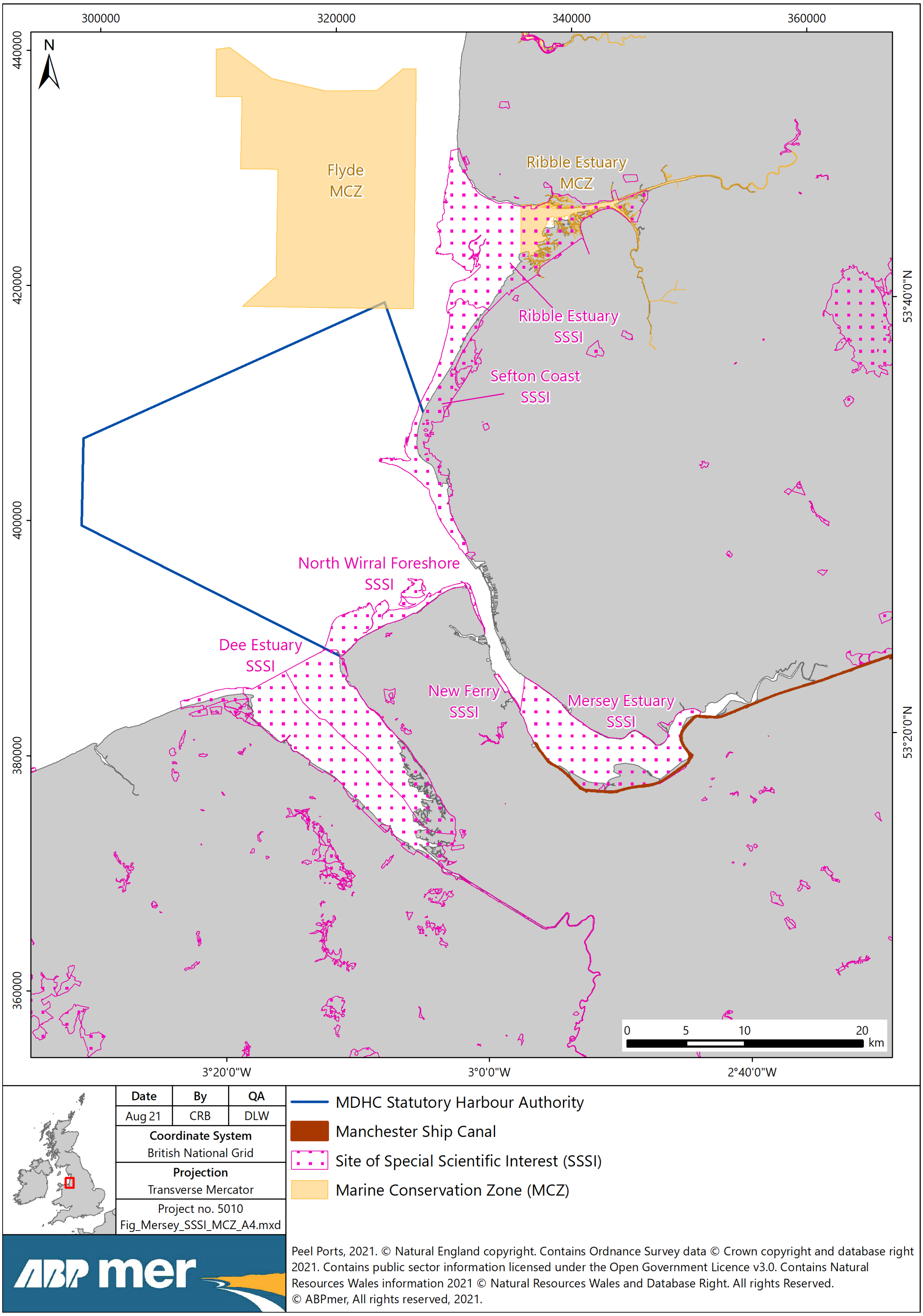


Figure C2. MCZs in the study area

C.3.1 Direct impacts on interest features

In general terms, depending on the nature, scale, timing, duration and magnitude of the change, the potential direct impacts of maintenance dredging and disposal on the interest features of the MPAs will vary. The risk profile associated with pressures identified in the available MPA conservation advice packages for maintenance dredging and disposal activities are included in Table C.1. The available MPA conservation advice packages also provide a detailed assessment of the sensitivity, resistance and resilience of feature/subfeatures or supporting habitat to these pressures and the underlying evidence and confidence underpinning this assessment. The sensitivity of interest features and supporting habitat to medium-high risk pressures associated with maintenance dredging and disposal activities across MPAs within study area are included in Table C.2. This information has been used as appropriate to inform the assessment.

Table C.1. Risk profiles of maintenance dredging activities including disposal across MPAs within the study area

Pressure Name	Risk Profile
Abrasion/disturbance of the substrate on the surface of the seabed	Medium-High Risk
Barrier to species movement	Medium-High Risk
Changes in suspended solids (water clarity)	Medium-High Risk
Habitat structure changes - removal of substratum (extraction)	Medium-High Risk
Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion	Medium-High Risk
Physical change (to another seabed type)	Medium-High Risk
Physical change (to another sediment type)	Medium-High Risk
Smothering and siltation rate changes (Heavy)	Medium-High Risk
Smothering and siltation rate changes (Light)	Medium-High Risk
Above water noise	Low Risk
Collision ABOVE water with static or moving objects not naturally found in the marine environment (e.g., boats, machinery, and structures)	Low Risk
Deoxygenation	Low Risk
Emergence regime changes, including tidal level change considerations	Low Risk
Hydrocarbon & PAH contamination	Low Risk
Introduction of light	Low Risk
Introduction of other substances (solid, liquid or gas)	Low Risk
Introduction or spread of invasive non-indigenous species (INIS)	Low Risk
Nutrient enrichment	Low Risk
Radionuclide contamination	Low Risk
Synthetic compound contamination (incl. pesticides, antifoulants, pharmaceuticals)	Low Risk
Transition elements & organo-metal (e.g. TBT) contamination	Low Risk
Underwater noise changes	Low Risk
Vibration	Low Risk
Visual disturbance	Low Risk

Source: Natural England (2021)

Table C2. Sensitivity of interest features to medium-high risk pressures associated with maintenance dredging and disposal activities across MPAs within study area

Pressure Name	All bird interest features	Coastal lagoons	Freshwater and coastal grazing marsh	Salicornia and other annuals colonising mud and sand	Atlantic salt meadows	Intertidal mixed sediments	Intertidal mud	Intertidal sand and muddy sand	Intertidal rock	Intertidal biogenic reef: mussel beds	Subtidal mud	Subtidal sand	Water column
Abrasion/ disturbance of the substrate on the surface of the seabed		S		S	S	S	S	S	S	S	S	S	
Barrier to species movement	S^	NS		S	S	NS	NS	NS	NS	S	NS	NS	S
Changes in suspended solids (water clarity)	S*	S		S	S	S	S	S	S	NS	S	S	S
Habitat structure changes - removal of substratum (extraction)		S		S	S	S	S	S		S	S	S	S
Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion		S		S	S	S	S	S		S	S	S	
Physical change (to another seabed type)		S		S	S	S	S	S	S	S			
Physical change (to another sediment type)		S		S	S	S	S	S		S	S	S	
Smothering and siltation rate changes (Heavy)		S		S	S	S	S	S	S	S	S	S	
Smothering and siltation rate changes (Light)		S		NS	NS	S	S	S	S	S	S	S	
S - sensitive													
NS – not sensitive													
Not relevant													
^ apart from Common Tern and Lesser Black-backed Gull * diving species only													

Source: Natural England (2022)

In the case of Low Risk pressures, unless there are evidence-based case or site specific factors that increase the risk, or uncertainty on the level of pressure on a receptor, these pressures generally do not occur at a level of concern and should not require consideration as part of the assessment. Given the recurring maintenance dredging of the study area since the early-mid 1800s, it is perceived that no new Medium-High risk pressures are likely to be relevant.

Taking account of the MPA conservation advice packages, the key potential direct impacts of maintenance dredging and disposal activities on features of MPAs are considered to be as follows:

- Change in habitat and loss of benthic organisms within the footprint of the dredge and disposal areas;
- Disturbance of sediment, resulting in the creation of sediment plumes causing an increase in turbidity, suspended sediment concentrations (SSC), organic matter, and ultimately smothering of habitats during the dredging process and/or during disposal;
- The potential remobilisation of contaminated sediments associated with suspended sediment as a result of dredging activity, which could in turn affect water quality; and
- Potential for disturbance caused by interruption of possible line of sight and noise during the dredging and disposal activities.

These potential pathways are assessed in turn in the following sections.Change in habitat and loss of benthic organisms

The MPAs that are directly affected by maintenance dredge and disposal activities in the Mersey and approaches are the Liverpool Bay/Bae Lerpwl SPA, and Mersey Estuary SPA and Ramsar site.

The direct removal of sediment and associated benthic community as a result of maintenance dredging within the boundary of the affected MPAs occurs at the Mersey Approach Channel, Eastham Lock Approaches, Eastham Channel and Garston Approach Channel.

There are currently four open marine disposal sites within the study area that directly overlap MPAs. Site Z licensed marine disposal site (IS140), which overlaps the Liverpool Bay/Bae Lerpwl SPA, is currently the most heavily used location, receiving dredge arisings from the Mersey Approach Channel in the Outer Estuary, Liverpool and Birkenhead enclosed docks and riverside berths in The Narrows. The mean annual disposal quantity to Site Z over the period 2002 to 2020 was approximately 1.25 million hopper tonnes. Since 2002, the Site Y (IS150) licensed marine disposal site, which overlaps the Liverpool Bay/Bae Lerpwl SPA, has only been used in 2020 to receive maintenance dredge material, with a total of 618,532 hopper tonnes deposited to the site from the Outer Mersey. Garston Rocks (IS110) licensed marine disposal site, which overlaps the Mersey Estuary SPA and Ramsar site, receives dredge material from the Garston Approach Channel and within the Stalbridge Dock. The mean annual disposal quantity at this site over the period 2002 to 2020 was approximately 280,000 hopper tonnes.

Maintenance dredging and disposal activities in the Mersey and approaches have been occurring since the early-mid 1800s in some places and, therefore, prior to designation of the MPAs. Furthermore, the maintenance dredge and disposal locations that directly overlap the MPAs are limited to subtidal areas of the main navigation channel which are accustomed to high levels of commercial and recreational vessel activity. These areas are already subject to regular vessels movements and maintenance dredging and disposal activities, and as such the potential for these areas to support established benthos and thus a food resource to birds is limited. These MPAs have been designated notwithstanding these ongoing and regular operations.

Following dredging and disposal activities, benthic communities and prey of bird interest features are expected to be able to recover (or adapt) between operations. Furthermore, maintenance dredging will not expose a different type of sediment to that which is currently present and, therefore, the nature of marine communities that will re-colonise the area would be similar to the communities that were present before. Re-colonisation of the seabed would take place by recruitment of larvae and the migration of adult individuals into the affected area from adjacent areas.

Overall, the sensitivity of the habitats and associated benthic communities is considered to be low. The exposure to change is negligible given the very low frequency occurrence of the disturbance event at any one location and small magnitude of the disturbance in the overall context of the MPAs. The potential impact of dredging causing a loss of benthic organisms within the dredged area and disposal sites is, therefore, considered to be insignificant, in the context of natural variability.

In the context of the site's conservation objectives, the condition of supporting habitat and the availability of prey will be maintained. In other words, there is not expected to be any discernible change to the overall extent or distribution of supporting habitat (and associated species) or a change to the structure and function of this habitat. Overall, the change in supporting habitat is considered to result in **no potential for an adverse effect on the integrity (AEOI) of any MPA supporting habitat interest features**.

Disturbance of sediment and smothering

Maintenance dredging creates temporary sediment plumes which in turn can increase turbidity and the concentration of suspended organic matter. The scale of any changes in SSC will vary spatiotemporally at any one time depending on the tidal state, range of tide and material type, as well as location, rates and methods of maintenance dredging.

The sediment plumes that are generated by maintenance dredging and disposal undertaken by MDHC and ABP Garston are likely to overlap with a number of the MPAs that have been screened into the assessment, in particular the Dee Estuary/Aber Dyfrdwy SAC, Liverpool Bay/Bae Lerpwl SPA, Mersey Estuary SPA and Ramsar site; Mersey Narrows and North Wirral Foreshore SPA and Ramsar site, Sefton Coast SAC and Flyde MCZ.

The main method of maintenance dredging is by TSHD which is used regularly in the Mersey and approaches (in particular the Outer Mersey, Docks, Mersey River and Channel, Garston Approach Channel, Stalbridge Dock and North/Old Dock). This is supplemented by occasional Grab Hopper Dredging (GHD) in the docks and lock approaches to the Port of Garston. These methods have the potential to cause an increase in SSC during the dredging process and during the disposal of the material at the marine licensed disposal sites at Site Z (IS140), Site Y (IS150), Mid River (IS120) and Garston Rocks (IS110). Further information on these methods of dredging is included in Section 4.2.2 of the Baseline Document (main report). The amount of suspended sediment that is released into the water column by a small/medium size TSHD or GHD is relatively small per load. During dredging, the material that is suspended into the water column disperses and re-settles after a short time. Sand and coarser grained material will be re-deposited within close proximity to the dredge site whereas fine silts may remain in suspension for a period of days following dredging. Furthermore, any material that settles is very short-lived, most likely only occurring during slack water periods and being re-dispersed as tidal currents increase. In summary, these periods of deposition are transient and the scale of any exposure at any one location is considered to be within the existing natural variability of the system.

There is potential for smothering of benthic organisms where the dredged material from the TSHD and GHD is deposited at the marine disposal sites. The majority of the material deposited will be muddy sand and will quickly settle to the bed before being redistributed by the ambient flow regime. Strategic placement of the deposited material throughout the disposal sites will minimise the initial depth change following each disposal, at the same time reducing the impact on the flow regime. If required, a sediment placement plan could be developed and agreed with Natural England as part of the marine licencing process for individual maintenance dredge disposal licence applications.

The other main method of maintenance dredging in the Mersey and approaches is by WID. This method is described in Section 4.2.2 of the Baseline Document (main report). The aim of this method is not to suspend sediments within the water column, but rather to move sediments from one area to another along the seabed, thus keeping the sediment within the system. The mobile bed layer moves along the bed by gravity to deeper areas in the vicinity of the dredge. The material disperses within the navigation channel over a number of tides contributing to local sediment supply. This method results in localised smothering as the sediments are transported along the seabed. Given the localised extent and reduced sediment suspension, the impact of dredging is considered to be reduced by using the WID method.

A small amount of plough dredging is also undertaken in the Mersey when smaller more manoeuvrable dredging vessels are required. Similar to WID, ploughing should not typically lead to significant re-suspension of sediment into the upper water column, but if the sediment ploughed is soft it may be sufficiently disturbed to raise smaller sediment fractions into suspension. Further information on the plough dredging methods is included in Section 4.2.2 of the Baseline Document (main report).

Intertidal and subtidal estuarine habitats and associated benthic communities are naturally adapted to fluctuating conditions and the resuspension and deposition of sediments on a daily basis (through tidal action), lunar cycles (due to the differing influences of spring and neap tides) and on a seasonal basis (due to storm activity and conditions of extreme waves). The sensitivity of benthic communities associated with interest features to smothering/ siltation rate changes (light), based on Natural England's advice on operations for maintenance dredging is typically 'not sensitive' to 'medium' (Natural England, 2021). These habitats have been historically exposed to changes in suspended sediments and sedimentation as a result of ongoing maintenance dredging since the early-mid 1800s in some places. Furthermore, these areas are already regularly disturbed through vessel movements and as such would be expected to be relatively species poor. In the context of existing suspended sediment concentrations within and around the Mersey and Liverpool Bay area, the habitats and associated benthic species that are present are expected to have a relatively high degree of tolerance to disturbance including smothering as a result of the redeposition of suspended sediment.

In terms of disposal activities, the MPA supporting habitat interest features have been characterised by the changes brought about by this regular disturbance over variable time periods for many years and these activities have not raised any concerns to date. Habitats and associated benthic communities have, therefore, developed to be accustomed to these variable conditions (a minor part of which comprise the maintenance dredge arisings) above the natural background variability of what is already a highly dynamic area.

In the context of the site's conservation objectives, the condition of supporting habitat and the availability of prey will be maintained. In other words, there is not expected to be any discernible change to the overall extent or distribution of habitat (and associated species) or a change to the structure and function of this habitat. Overall, the disturbance and smothering of habitat and associated species is considered to result in **no potential for an adverse effect on the integrity (AEOI) of any MPA supporting habitat interest features**.

An increase in suspended sediments may reduce visibility and affect the feeding success of fish and diving bird interest features of MPAs. Fish interest features within the wider area (specifically sea lamprey and river lamprey which are interest features of the Dee Estuary/Aber Dyfrdwy SAC and smelt which is an interest feature of the Ribble Estuary MCZ) are considered to be well adapted to living in an area with variable and often high suspended sediment loads. Any changes to SSC will be largely limited to the immediate vicinity of the maintenance dredge areas and disposal sites. Changes in SSC beyond the immediate vicinity of these areas will be temporary, short-lived and transient in nature. The resultant changes in dissolved oxygen (DO) will also be negligible and short-lived, with tidal exchange quickly replenishing the oxygen supply. In addition, only a very small proportion of the foraging area for fish and diving bird interest features of MPAs will be affected by maintenance dredge and disposal activities. These interest features feed on a range of food items and, therefore, their sensitivity to a temporary change in the availability of a particular food resource is considered to be low. Their high mobility also enables them to move freely to avoid areas of adverse conditions and to use other prey resources. These MPA interest features are, therefore, not considered to be significantly affected due to their ability to forage over extensive areas and the fact that any changes would be very short-lived and localised in nature.

In the context of the site's conservation objectives, the condition of fish and diving bird interest features as a viable component of the MPAs, and the availability of prey will be maintained. In other words, there is not expected to be any discernible change in the overall population or distribution of interest features or their prey. Overall, the disturbance of sediment is considered to result in **no potential for an adverse effect on the integrity (AEOI) of any MPA fish and diving bird interest features**.

Potential remobilisation of contaminated sediments

There is the potential for sediment-bound contaminants to be re-mobilised in the water column following an increase in SSC during maintenance dredging and disposal activities. There are strict legislation and sediment quality assessments in place that must be adhered to in order to obtain a maintenance dredge licence. If any sediment contaminant concentration is deemed too high then dredging and disposal of that material is restricted.

Some maintenance dredging activities within the Mersey can be carried out by MDHC under its own powers and do not require a marine licence. MDHC follows the same approach and principles as the MMO does in determining dredge licence applications (i.e. taking account of existing permitted depths, volumes/quantities and dredge and disposal methods etc. as well as contamination concentrations relative to the relevant Action Levels, see below) when it undertakes any maintenance dredging under its own powers to dredge within the Statutory Harbour Authority area.

There are no formal quantitative EQS for the concentration of contaminants in sediments, although the WFD has introduced optional standards for a small number of priority (hazardous) substances. The Centre for Environment, Fisheries and Aquaculture Science (Cefas) has prepared a series of Guideline Action Levels to assist in the assessment of dredged material (and its suitability for disposal to sea). In general, contaminant levels in dredged material below Cefas Guideline Action Level 1 (AL1) are of no concern and are unlikely to influence the licensing decision. However, dredged material with contaminant levels above Cefas Guideline Action Level 2 (AL2) is generally considered unsuitable for disposal at sea. Dredged material with contaminant levels between AL1 and AL2 may require further consideration before a decision can be made. The Cefas Guideline Action Levels should not be viewed as pass/fail thresholds. However, these guidelines provide an appropriate context for consideration of contaminant levels in sediments and are used as part of a 'weight of evidence' approach to assessing dredged material by the MMO as part of the marine licensing process and by MDHC when it undertakes any maintenance dredging under its own powers.

Over the last 20 years, sediment samples have been collected from various locations within the Mersey Estuary, docks and approaches to consider suitability of dredging and disposal activities. Sediment samples collected from across the study area show variable concentrations of chemical contaminants, both spatially and temporally. Contaminant concentrations in sediments within the Mersey Approach

Channel and wider Liverpool Bay area have been shown to be relatively low, typically below AL1 or marginally exceeding AL1. This is to be expected given the predominantly sandy composition of dredged material in this area, with contaminants largely associated with finer material such as mud/silt. Similarly, contaminant concentrations in sediments within the River Mersey (The Narrows and Inner Estuary) have been shown to be relatively low, particularly in more recent samples.

In contrast, some contaminant concentrations in sediments within the enclosed dock systems of the Mersey (Liverpool, Birkenhead and Garston) have been shown to be elevated compared to the Mersey Approach Channel and Mersey River. This is to be expected given the historic and current industrial usage of these facilities and the restricted flow of water behind dock gates, preventing the natural dispersion of contaminants. Many of the samples tested have shown levels in excess of AL1, with occasional samples exceeding AL2 (less frequent in recent years). Notwithstanding these variable concentrations, marine licences have been issued for the disposal of dredged material at sea from all of the sampling locations (with a few exceptions). However, it is noted that some of the existing marine licences include conditions which restrict maintenance dredging activity in certain docks or exclude the disposal at sea of dredge material which originates from specific docks. Further details of historic sediment sampling is available in Section 5 of the Baseline Document (main report).

Generally, the material with elevated levels of contaminants occurs at isolated locations within the enclosed dock systems of the Mersey and, therefore, comprises a negligible proportion of the total volume of maintenance dredge material, which could be redistributed and deposited during maintenance dredging within the docks and disposal. Any changes in maintenance dredge activities within the dock systems of the Mersey will involve consideration of further sampling if required. Based on the most recent sediment samples from 2016, contaminant concentrations in dredge material from the Mersey Estuary and approach channel are generally low and considered suitable for disposal at sea.

The extent of sediment dispersal as a result of maintenance dredging activity in the Mersey and approaches is considered to be spatially limited and significant elevations in the concentrations of contaminants within the water column are not anticipated. During disposal at marine licensed disposal sites, sediment will be rapidly dispersed in the water column. Therefore, the already low levels of contaminants in the dredged sediments will be dispersed further.

Overall, fish interest features are not considered to be sensitive to the small magnitude of changes in water quality that are predicted during maintenance dredging at any one time. These changes are, therefore, not anticipated to result in any significant displacement or a barrier to migratory fish interest features. The localised changes in water quality, as a result of the potential release of any sediment-bound contaminants, will be temporary and considered unlikely to be of a concentration that will be harmful to bird interest features or their prey (including Red-Throated Diver, Common Tern and Little Tern which are interest features of the Liverpool Bay/Bae Lerpwl SPA). Overall, the potential effects resulting from the release of sediment bound contaminants on interest features are assessed as negligible.

Subject to the existing maintenance dredging testing (i.e. sediment sampling and laboratory analysis for contaminants) and licensing regime remaining in place, it is unlikely that a significant impact would occur in the future. Furthermore, best practice pollution prevention guidelines will be followed in line with Marine Licence requirements to minimise the risk of accidental spillages and the risk of introduction of contaminants throughout the dredging process. Adherence to these guidelines will also mean that only materials that are suitable for use in the marine environment will be used, and all equipment, temporary works and debris will be removed from the site on completion of works. MDHC adheres to the same approach and principles when it undertakes any maintenance dredging under its own powers.

In the context of the site's conservation objectives, the condition of fish and bird interest features as a viable component of the MPAs and the availability of prey will be maintained. In other words, there is not expected to be any discernible change in the overall population or distribution of interest features or their prey. Overall, the potential remobilisation of contaminated sediments is considered to result in **no potential for an adverse effect on the integrity (AEOI) of any MPA fish and bird interest features**.

Potential disturbance caused by interruption of possible line of sight and noise

Noise levels generated by the dredgers are no greater than noise generated by other vessels that routinely use the Mersey and Liverpool Bay area throughout the year. The noise from dredgers is continuous and, therefore, in general, birds are considered to rapidly become habituated (Hill *et al.*, 1997) (although see also information on the Red-Throated Diver below).

With regard to disturbance from vessel movement, waterbirds are already accustomed to high levels of commercial and recreational activity in the area, and, therefore, the slow and relative infrequent movements of the vessels involved in the dredging process are unlikely to cause significant disturbance. Research has shown that disturbance to birds from vessel movements generally occurs within 50 to 100 m of a receptor with sensitive sites such as breeding colonies and roosting sites most susceptible to disturbance (IECS, 2009; Chatwin *et al.,* 2013). The navigation channel is already subject to ongoing vessel movements, and as such, it can be assumed that any birds occurring within this area are habituated to this form of disturbance. Dredging is not labour intensive on the deck of a vessel, and so the disturbance from human movement is considered negligible. Furthermore, machinery and vehicle movements are better tolerated than people at the source of the disturbance (Hill *et al.*, 1997; IECS, 1999). In addition, given that maintenance dredging has been ongoing since the early-mid 1800s in some places, the counts of birds, which were deemed to warrant designation would have occurred at a time when maintenance dredging of this site was already ongoing.

When foraging at sea, terns are reported to be relatively insensitive to disturbance by shipping activities (Natural England and JNCC, 2019). However, Red-Throated Diver is considered highly sensitive to noise and visual disturbance from vessels compared with other species (Jarret *et al.*, 2018; Fliessbach *et al.*, 2019; Natural England and JNCC, 2019). Disturbance can cause these birds to reduce or cease feeding in a given area or to be displaced. Movement of vessels and other activity have been shown to elicit flushing responses at distances of 1-2 km from a disturbance source in this species although most disturbance typically occurs within <1 km (Garthe and Hüppop, 2004; Schwemmer *et al.*, 2011; HELCOM, 2013). Approaching ships and smaller vessels have also been shown to cause displacement, even when several kilometres away (Dierschke *et al.*, 2017). As such, maintenance dredging of the Mersey Approach Channel and marine disposal activities has the potential to disturb Red-Throated Divers.

As the Mersey Approach Channel is already frequently used by shipping, and shipping channels are already known to be avoided by Red-throated Divers, any vessel movements associated with any such future maintenance dredge requirements would not be expected to result in any increase in disturbance to this species given that this activity will be taking place within well-used shipping channels. Furthermore, evidence from aerial sureys indicates that the key areas of usage by Red-throated Divers in Liverpool Bay do not overlap with the maintenance dredge and disposal activities taking place in the Mersey and its approaches (Lawson *et al*., 2016).

Dredging noise impacts on fish and bird interest features or their prey are restricted to behavioural changes through avoidance, which are limited to a relatively localised area around the dredger. As the dredger vessel is moving, interest features or their mobile prey are not physically constrained and will be able to move away from the source of the noise and return once dredging activity has ceased. Noise generated during dredging would not, therefore, exclude species occurring in the study area from habitats and/or prey. Furthermore, levels of underwater noise generated by dredgers are similar to vessels and no different to maintenance dredging activities that are already regularly present. Overall, the ability of highly mobile interest features to catch prey items is not considered to be impaired, particularly given the scale of their foraging ranges.

In the context of the site's conservation objectives, there will be no significant disturbance or displacement of fish or bird MPA interest features or their prey. Overall, the levels of noise and visual disturbance effects during maintenance dredging and disposal activities are considered to result in **no potential for an AEOI on the fish and bird interest features of any MPAs**.

C.3.2 Indirect impacts on interest features

The potential indirect impacts of maintenance dredging and disposal operations in the Mersey and surrounding area are limited to changes in the sediment supply and any associated effects on the MPAs and interest features.

Over the past 5 years (2016 to 2020), approximately 1.0 million tonnes per annum (not including WID) has been dredged from the Mersey Estuary, approaches and dock system. In 2016 and 2017, the outer Mersey approaches were not dredged and all the maintenance dredge material from the estuary and docks was disposed of at the Mid River (IS120) and Garston Rocks (IS110) disposal sites, where it was available for redistribution within the estuary system. In 2018 to 2020, the majority (65 %) has been placed at Site Z (IS 140) in the Outer Estuary (with around 42 % disposed of also at Site Y (IS150) in the Outer Estuary in 2020) where it is subject to redistribution by coastal processes prevalent at the sites. The remainder is deposited back within the local system at either the Mid River (IS120) (from the Docks) or Garston Rocks (IS110) (from ABP Garston) disposal sites, where it is available for redistribution within the estuary system. The reason for the proportionately high disposal at Site Z in recent years (and Site Y in 2020) is due to the sea channels (approaches) having the greatest dredging requirement, in which all this material is then deposited directly back within the Outer Estuary. Due to the position of the Site Z and Site Y disposal sites, dredge material is frequently deposited in flood-dominated transport paths. This practice contributes to the health of the sediment budget since what is removed is ultimately returned in a self-sustaining way (Comber *et al*., 1993).

As detailed in Section 4.2 of the Baseline Document (main report), maintenance dredging undertaken by WID commenced in 2013 and has continued in varying intensities up to 2018. Sediment is typically retained in the system by this method of dredging and dispersed locally in the water column, therefore, promoting relocation of material and contributing to local sediment supply. Some of the material dredged by WID may potentially move up onto the intertidal designated sites following the dispersion of the mobile bed layer. It is anticipated that WID will continue to support maintenance dredging operations on the Mersey in the future, alongside TSHD and other dredging/disposal activities.

To put this dredging in context, the sediment budget for the Mersey Estuary (see Section 3.4 of the Baseline Document (main report)) is thought to be positive (i.e. the sediment sources are greater than the sinks). It is, therefore, unlikely that maintenance dredging at the present level would have any significant effect on the sediment supply to these areas. In addition, there is currently no evidence, anecdotal or otherwise, of changes to accretion patterns as a result of maintenance dredging.

MDHC is aware of the need to achieve a balance between efficient and sustainable maintenance dredging and disposal. To this end, MDHC is working with stakeholders as part of the Mersey Sediment Management Stakeholder Group (MSMSG) to identify potential alternative or beneficial uses of maintenance dredge material within the Mersey Estuary and approaches (see Section 4.3 of the Baseline Document (main report)). This is in response to several factors, including comments made by Natural

England during consultation on the first draft MDP Baseline Document (ABPmer, 2012), specifically that it may be beneficial to retain a higher proportion of dredged sediment in the wider estuarine system.

While the majority of dredge material originating from the Mersey Approach Channel has been deposited at licensed marine disposal sites in recent years, transferring a proportion of the sediment away from the Mersey Estuary, since 2016 (apart from in 2020), an average of 302,000 m^3 per year has been disposed beneficially to the Mid River (IS120) site, retaining this sediment in the system. Natural England has indicated a preference to retain fine material dredged from the enclosed docks system within the Estuary, *inter alia* to ensure the supply of sediment to the upstream mudflats and saltmarshes in the face of sea level rise. While technically referred to as a licensed marine disposal site, the Mid River site is recognised as a valuable beneficial use location to support the sediment system within the Mersey Estuary.

In 2014/2015, Natural England developed Site Improvement Plans (SIPs) for each European nature conservation designated site in England. SIPs provided a high-level overview of the issues (both current and predicted) affecting the condition of the site's qualifying features. They also outlined the priority measures required to improve the condition of these features. There are three SIPs relevant to the dredge areas and disposal site within the study area[19], namely Dee Estuary/Aber Dyfrdwy and Mersey Narrows (SIP056), Liverpool Bay/Bae Lerpwl (SIP123) and Mersey Estuary (SIP 138).

Only Liverpool Bay/Bae Lerpwl (SIP123) included an action for Natural England relevant to maintenance dredging and disposal activity (Action 5A; Natural England, 2015). The action was to investigate whether the change in the use of dredged material from the Mersey, a greater proportion of which has in recent years been disposed of within the Mersey Estuary system at the Mid River (IS120) licensed marine disposal site, rather than at Site Z (IS140) within the Liverpool Bay/Bae Lerpwl SPA, has resulted in the improved condition of supporting habitat for bird interest features and whether this could be repeated for other disposal sites within the SPA to provide further benefits. This work has been progressed through collaborations by the MSMSG.

There is currently no evidence that the existing maintenance dredging and disposal activity is detrimentally affecting the habitat supporting interest features in the Mersey Estuary SPA and Ramsar site. This is supported by the condition statement assessment of the respective Sites of Special Scientific Interest (SSSI) Units for the Mersey Estuary which were predominantly classed as in favourable/unfavourable recovering condition (55.70 %). No unit was identified as unfavourable declining. Further information on the condition assessment of each of the SSSIs within the study area is provided in Section 7.1.5 of the Baseline Document (main report).

In the context of the site's conservation objectives, the condition of supporting habitat and the availability of prey will be maintained. In other words, there is not expected to be any discernible change to the overall extent or distribution of supporting habitat (and associated species) or a change to the structure and function of this habitat. Overall, the indirect changes in sediment budget are considered to result in **no potential for an AEOI on the supporting habitat interest features of any MPAs**.

C.3.3 Mitigation measures

Through the collation of material to support the AA, there has been no identification of a need for new mitigation measures to be introduced. However, it should be noted that existing licence conditions include constraints on dredging and disposal, and such conditions thus form an important part of the baseline against which the potential effects have been assessed. These general and specific conditions

19 http://publications.naturalengland.org.uk/category/6329101765836800 (Accessed August 2021).

are described in Section 6 of the Baseline Document (main report) and include, but are not limited to, the following:

- The licence holder must ensure suitable bunding, storage facilities are employed to prevent the release of fuel oils, lubricating fluids associated with the plant and equipment into the marine environment. *Reason: To ensure licence holders are aware of their responsibilities under counter pollution legislation*;
- Any oil, fuel or chemical spill within the marine environment must be reported to the MMO Marine Pollution Response Team within 12 hours. *Reason: To ensure that any spills are appropriately recorded and managed to minimise the risk to sensitive receptors and the marine environment*;
- The licence holder must employ best practice to minimise resuspension of sediment during the dredging operations. *Reason: To prevent the mobilisation of contaminated sediment material*;
- The licence holder must ensure that the Environment Agency's Pollution Prevention Guidelines for works in or near water (PPG5) are adhered to at all times. *Reason: To ensure that best environmental practice is used at all times*;
- The licence holder must ensure that no material from West Float, Wellington Dock or Victoria Dock are disposed of at sea, unless further sample analysis is submitted and the material is approved by the MMO as suitable for disposal at sea. *Reason: To prevent the deposit of contaminated material*;
- The licence holder must ensure that only material down to 0.5 m within Sandon half-tide dock is disposed of to sea, unless further sample analysis is submitted and the material is approved by the MMO as suitable for disposal at sea. *Reason: To prevent the mobilisation of contaminated material*; and
- The disposal of the dredged material into the Mersey should not be carried out over high and low water when there will be no or little tidal current to disperse the sediment. *Reason: To provide maximum dispersion and minimise sedimentation.*

C.3.4 In-combination effects

Section 4 of Baseline Document (main report) provides information on the MDHC and ABP Garston maintenance dredge operations which are ongoing and classified as 'maintenance' at the time of publication. This section summarises any known and publicised 'plans or projects' which could have implications for maintenance dredging within the study area if constructed in the future. After publication of the baseline, any new proposed plans or projects which might give rise to an in-combination effect with respect to maintenance dredging should be assessed against the existing maintenance dredging regime described in the Baseline Document (main report). Defra (2007) states that "*the onus will also be on the developer [of a future project] to resource the updating of the Baseline Document*" in respect of the new plan or project which affect the context, assessment or detail within the Maintenance Dredge Protocol (MDP) Baseline Document and, as a result, this assessment.

Where such developments entail reclamation, capital dredging or the construction of infrastructure in tidal waters, potential impacts would be considered through an Environmental Appraisal or Environmental Impact Assessment (EIA) that would be required to support an application for development permission. Where the development has the potential to affect an MPA, the requirements of the Habitats Regulations and/or the MCZ provisions in the Marine and Coastal Access Act (MCAA) 2009 would also need to be complied with. In such cases, these developments will require their own mitigation/compensation, prior to considering the future effects on maintenance dredging, which is the focus of this appendix.

The following known consented and unconsented plans, projects and activities occur in the study area:

Liverpool Cruise Terminal (Case Ref: MLA/2019/00012): Liverpool City Council proposes to construct a new Cruise Passenger Terminal at the existing Princes Jetty Site to cater for the year on year increase in passenger numbers since the opening of the existing cruise terminal in 2008. The marine works include dismantling/demolition of the redundant Princes Jetty, construction of a new cruise passenger terminal building on a concrete suspended deck on piles, construction of a vehicular and passenger linkspan bridge and construction of a new floating pontoon to connect the linkspan to the existing landing stage and removal of two exiting mooring dolphins and construction of two new steel pile mooring dolphins(Work Package 5). The marine licence was issued in April 2021 and will end in June 2025 (Licence ref: L/2021/00058/1).

The likely significant effect (LSE) alone assessment undertaken by the MMO concluded that the Liverpool Cruise Terminal project would be likely to have a significant effect on the Liverpool Bay SPA for all species and supporting habitats and Mersey Narrows and North Wirral Foreshore SPA for common tern, bar tailed godwit, knot and waterbird assemblage. An alone and in combination AA was therefore undertaken by the MMO of the implications of the proposal in consideration of the applicable conservation objectives (MMO, 2021). It concluded that this project will not have an adverse effect on the integrity (AEOI) of any of the screened in sites, either alone or in combination with other plans and projects. This conclusion is dependent on mitigation measures being implemented: The use of rotary drilling to install piles; no piling or noisy activities between 1900-0700 hours; the installation of floating pontoons for birds to rest on; the incorporation of structures for birds to rest on in the terminal design; severe winter weather working restriction; lighting strategy; and a biosecurity management plan. The conclusions of the AA were in accordance with the advice and recommendations of Natural England.

Isle of Man Ferry Terminal (Case Ref: MLA/2021/00100): The Isle of Man Government is seeking to obtain planning permission and a marine licence for a new ferry terminal and associated infrastructure. The new ferry terminal is essential to the continued operation of vital ferry services between the Isle of Man and Liverpool. The site encompasses an area covering approximately 1.8 ha located at West Waterloo Docks and Princes Half-Tide Docks, Liverpool on the east bank of the Mersey Estuary. The proposed development would replace the existing ferry terminal at Liverpool, located on the waterfront at Princes Parade, approximately 750 m south. The ferry terminal needs to be moved to make way for the proposed new Liverpool Cruise Terminal. The marine works include a capital dredge in the River Mersey to provide a berthing pocket and approach channel, disposal of dredged material to sea and the construction of a steel linkspan bridge and floating pontoon (involving piling) to provide vehicle and pedestrian access to the rear of the vessels. The construction has commenced and the project is anticipated to be completed in March 2022[20].

The HRA that was undertaken for the proposed Isle of Man Ferry Terminal Development concluded that there would be no adverse effect on site integrity (AEOI) on any European Sites either alone or in combination, following the application of the mitigation proposed for cormorant resting and roosting areas (Waterman, 2021).

Depositing of dredged material at any of the proposed dredge disposal sites during construction and operation would have insignificant effects given the relatively small volume of dredged material that would be deposited compared to existing operations at the disposal sites. To minimise impacts on the marine environment the Mersey Maintenance Dredging Protocol (MDP) will be followed and any information available from maintenance dredging at this location will be included within future iterations of the MDP to ensure that a robust baseline document for the estuary is produced (Waterman, 2021).

[20] https://www.bbc.co.uk/news/world-europe-isle-of-man-56904428

Fishing activity: There is potential for in-combination effects as a result of physical disturbance from abrasion and biological disturbance due to fishing activity. There are a number of fishing vessels that operate in the Mersey Estuary and Liverpool Bay area (Brown and May Marine, 2019). The gear types used in this area are relatively small and light due to the predominant size of the fishing vessels (i.e. less than 10 m). In this context, fishing is an ongoing activity that has occurred within the boundaries of MPAs prior to their designation. The marine habitats and species associated with fishing areas are generally of low conservation value with relatively high recovery rates. The temporary, small and localised disturbance resulting from the maintenance dredging and disposal activities is, therefore, not considered to result in significant in-combination effects with the disturbance effects from existing fishing activities. Overall, the potential for in-combination impacts through ongoing fishing activities on interest features of MPAs is considered to be negligible.

Conclusion

Taking account of the potential impacts of maintenance dredging and disposal activities in the Mersey and its approaches on interest features of MPAs, in addition to the sensitivity and importance of protected sites and features, the potential cumulative and/or in-combination effects are assessed as negligible. In the context of the site's conservation objectives, the above plans, projects and activities are not anticipated to result in in-combination effects of a scale that would change the existing condition status of the interest features recognised within the MPAs screened into this assessment. Overall, there is considered to be **no potential for an AEOI on any interest features either alone and/or in-combination with other plans, projects and activities**.

C.4 Application of the Habitats Regulations

For the purposes of this appendix and application of the MDP (Defra, 2007), the Habitats Regulations are applied as follows:

- Regulation 63 (1) - a competent authority, before deciding to undertake, or give any consent, permission or other authorisation for, a plan or project which either:
  - Is likely to have a significant effect on a European site or a European offshore marine site (either alone or in combination with other plans or projects), and
  - Is not directly connected with or necessary to the management of that site

must make an AA of the implications for that site in view of that site's conservation objectives. For the purposes of the Regulation 63 (1), the volumes that are maintenance dredged and disposed from the Mersey and approaches (Section 4.2.3 in the Baseline Document (main report)) are sufficient to conclude that there could be an LSE. As a consequence, Regulation 63 (2) and those following are applied.

- Regulation 63 (2) - a person applying for any such consent, permission or other authorisation must provide such information as the competent authority may reasonably require for the purposes of the assessment or to enable them to determine whether an AA is required. This appendix provides the information deemed necessary to inform an AA of the MDHC's maintenance dredging commitments within their SHA area.

- Regulations 63 (3) and 63 (4) - the competent authority must for the purposes of the assessment consult the appropriate nature conservation body and have regard to any representations made by that body within such reasonable time as the authority specifies. They must also, if they consider it appropriate, take the opinion of the general public, and if they do so, they must take such steps for that purpose as they consider appropriate. The MMO is considered the Competent Authority responsible for undertaking the AA according to these regulations.

C.5 Application of the MCZ provisions of the Marine and Coastal Access Act 2009

For the purposes of this appendix, the MCZ provisions of the MCAA 2009 are applied as follows:

- Section 126(5) - The authority must not grant authorisation for the doing of the act unless the condition in subsection (6) or the condition in subsection (7) is met;
- Section 126(6) - The condition in this subsection is that the person seeking the authorisation satisfies the authority that there is no significant risk of the act hindering the achievement of the conservation objectives stated for the MCZ.
- Section 126(7) - The condition in this subsection is that, although the person seeking the authorisation is not able to satisfy the authority that there is no significant risk of the act hindering the achievement of the conservation objectives stated for the MCZ, that person satisfies the authority that—
    - (a) there is no other means of proceeding with the act which would create a substantially lower risk of hindering the achievement of those objectives,
    - (b) the benefit to the public of proceeding with the act clearly outweighs the risk of damage to the environment that will be created by proceeding with it, and
    - (c) the person seeking the authorisation will undertake, or make arrangements for the undertaking of, measures of equivalent environmental benefit to the damage which the act will or is likely to have in or on the MCZ.

In response to Section 126(5) of the MCAA, this appendix provides the information considered necessary to confirm that the maintenance disposal and disposal activities associated with the Mersey and approaches will not hinder the achievement of the conservation objectives of any MCZ interest features in the study area and, therefore, complies with Section 126(6).

C.6 Outcome of the Assessment

In the preparation of this appendix, it is concluded that maintenance dredging in the Mersey and approaches will not result in an AEOI on any of the following MPAs:

- Dee Estuary/Aber Dyfrdwy SAC;
- Liverpool Bay/Bae Lerpwl SPA;
- Mersey Estuary SPA and Ramsar site;
- Mersey Narrows and North Wirral Foreshore SPA and Ramsar site;
- Ribble and Alt Estuaries SPA and Ramsar site;
- Sefton Coast SAC;
- The Dee Estuary/Aber Dyfrdwy SPA and Ramsar site;
- Flyde MCZ; and
- Ribble Estuary MCZ.

The reasons for the above conclusions are outlined below.

Direct Impacts: The frequency and scale of disturbance as a result of the MDHC and ABP Garston maintenance dredging is considered to be very low at any one time and in the context of the MPAs. Furthermore, interest features and supporting features of MPAs (i.e. habitats, benthic communities, fish and birds) have been historically exposed to this disturbance since the early-mid 1800s in some places and are, therefore, considered to be accustomed to these changes. In summary, none of the direct impacts related to the continuation of maintenance dredging and disposal activities at the existing levels are likely to change the condition of the interest features of the relevant MPAs.

Indirect Impacts: The majority of the maintenance dredge material has generally been deposited at marine disposal sites in the Outer Estuary where some of it returns to the estuary and approaches through existing coastal processes. A large proportion of the maintenance dredge material, comprising all the material dredged from within the dock system, has in recent years been deposited at marine disposal sites within the estuary where it is available for redistribution within the estuary system. A small proportion of maintenance dredging is also undertaken by WID which does not require disposal but results in sediment being retained in the system and contributes to local sediment supply. MDHC will continue to work with stakeholders as part of the MSMSG to identify potential alternative or beneficial uses of maintenance dredge material, including options that maximise the retention of sediment. There is currently no evidence that the existing maintenance dredging and disposal activity is adversely affecting the habitat supporting interest features of any MPAs within the Mersey Estuary and this is supported by the condition statement assessment of the respective SSSIs. In summary, indirect changes in sediment budget are considered to result in no potential for an AEOI on the supporting habitat interest features of any MPAs.

In-combination Effects: Although the details of some of the other plans, projects of activities in the study area are currently unknown, based on currently available information, the in-combination effects are not anticipated to be of a scale that would change the existing condition status of the interest features recognised within any MPAs.

C.7 Summary

In summary, none of the potential impacts arising from ongoing maintenance dredging and disposal activities are assessed as being significant. They are not, therefore, likely to change the condition of the MPA interest features that have been screened into the assessment and are considered to result in no potential for an AEOI to occur. It should be noted that this assessment has been based on levels of maintenance dredging undertaken within the study area since 2002. If maintenance dredge locations, volumes (outside existing variability) or techniques from existing operations (as at October 2021) are required to change in the future, this would require an additional assessment in the context of the MPA interest features.

C.8 References

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D Natural England Comments Log

This appendix presents the comments that were received from Natural England on a draft version of the Updated MDP Baseline Document and WFD Assessment for the Mersey and its approaches. The responses and/or actions to address each individual comment is included.

Table D.1. Comments received from Natural England and how they have been addressed

No	Report	Topic	Section	Comment	Response/Action
1	MPD Baseline Doc	HRA	Appendix C	For completeness it would be useful to include who is responsible for undertaking the HRA for the relevant dredging, and disposal activities. It is our current understanding that the MMO undertake the HRA for the disposal activities but we are not clear on who is producing the HRAs for the different dredging activities. A clear list of the HRA assessments that you provide as Statutory Harbour Authority for your activities and those that will be undertaken for third party dredging would be helpful.	Peel Ports acknowledges the comment regarding the completion of HRAs for third party activities. In Mersey, Garston is the only third-party undertaking dredging activities and it is the Port of Liverpool's understanding that they are responsible for undertaking their own HRA.
2	MPD Baseline Doc	Habitats Regulations	1.3, 2.2, 7.1.1, C.1.1	The Mersey Maintenance Dredge Protocol Baseline document makes reference to the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019. However, this legislation amend the existing Regulations, therefore when referring to the Regulations the reference should read; Conservation of Habitats and Species Regulations 2017 (as amended).	The relevant references in MDP Baseline Document have been updated.
3	MPD Baseline Doc	Liverpool Bay SPA	7.1.1, Table 7.1, C.2.3	The conservation advice package for Liverpool Bay SPA is currently been updated since new features were added and the site was extended in 2017. Please note the current published Regulation 35 package for the site is out of date and does not include	Noted. The regulation advice package had not been published at the time of finalising the MDP Baseline Document Update and therefore it has not been possible to review the advice for the site extension and new features.

No	Report	Topic	Section	Comment	Response/Action
				reference to the site extension or new features. The up to date citation is available on Natural England's Access to Evidence Catalogue. Natural England, Natural Resources Wales and the Joint Nature Conservation Committee are currently working together to publish a Regulation 37/ Regulation 21 package in April 2022 (subject to sign off) to include the new features.	
4	MPD Baseline Doc	Liverpool Bay SPA	C.3	It is advised that once this conservation advice package is published that the Mersey MDP is reviewed to ensure it is still compliant with updated information released. Given the size of Liverpool Bay SPA and seasonality of the sites features; when considering activities and development it is advised that the key areas and months of greatest sensitivity are identified and avoided where possible.	As the conservation advice package has yet to be published, it will be reviewed and its implications considered as part of the next MDP update.
5	MPD Baseline Doc	Sediment Budget	3.4	The document refers to the lack of a quantified sediment budget to understand the full implications of the dredging and disposal activities. Although the information provided on page12 provides information on sediment pathways and sediment sources it is recommended that a commitment be made to identify a method to fill this evidence gap in the longer term, for	The Port of Liverpool would welcome a meeting with Natural England to discuss further.

No	Report	Topic	Section	Comment	Response/Action
				example through sponsoring academic research. Natural England would welcome further engagement to try and support this work.	
6	MPD Baseline Doc	Sediment Budget	3.4	A useful guide to the sediment budget analysis has been published in 2021 by the Environment Agency available from: Sediment budget analysis: practitioner guide - GOV.UK (www.gov.uk).	Noted.
7	MPD Baseline Doc	Sediment Budget	3.4	Currently Guy Walker-Springett (g.r.w.springett@bangor.ac.uk) from Bangor University is a post graduate investigating the sediment budget and coastal vulnerability of Liverpool Bay, this could provide additional evidence for future revisions of the Mersey Maintenance Dredge Protocol.	Peel Ports supports Natural England's enthusiasm to collaborate with Bangor University to investigate the sediment budget and coastal vulnerability of Liverpool Bay as this will provide evidence for future MDP revisions.
8	MPD Baseline Doc	Disturbance of sediment and smothering	C.3.1	Whilst we do not disagree with the conclusions of this section it is noted that some potential recommendations have been made. Further detail should be provided on when a sediment placement plan may be required, the Report to Inform Appropriate Assessment should set out clearly where and under what circumstances.	Further clarification has been included to explain that a sediment placement plan can be developed and agreed with Natural England, if required, as part of the marine licencing process for individual maintenance dredge disposal applications.
9	MPD Baseline Doc	Potential remobilisation of contaminat	C.3.1	We welcome the inclusion of sediment samples to establish contaminant concentrations within the Estuary and approach channels to assess potential	Justification for use of samples from 2016 has been included in the HRA.

No	Report	Topic	Section	Comment	Response/Action
		ed sediments		impacts from contaminants. However, we note that the justification for use of sediment samples from 2016 should be incorporated into the assessment (i.e. most recent sampling).	
10	MPD Baseline Doc	Potential remobilisation of contaminated sediments	C.3.1	Further discussion should be included with regard to the enclosed dock systems where the sediment typically has the higher levels of contaminants.	Further discussion has been included in the HRA to clarify the situation and that any changes in activities will involve consideration of the need for further sampling.
11	MPD Baseline Doc	Potential remobilisation of contaminated sediments	C.3.1	Natural England advises that the continuation of sediment testing for contaminants is continued to support future dredge and disposal licence applications, ensuring that the most up to date evidence is available to support HRAs.	Noted.
12	MPD Baseline Doc	Potential disturbance caused by interruption of possible line of sight and noise	C.3.1	While we accept that dredging activities have been ongoing within the Mersey Estuary for a significant time (the document makes reference to the 'early-mid 1800s') the Appropriate Assessment should include the level of activity that is currently occurring and take note of the current conservation objectives and condition assessments of the designated sites.	This information is provided for historical context only. The assessment and determination of AEOI is made on the basis of the current baseline levels of dredging activity and the existing condition of the sites and features.
13	MPD Baseline Doc	HRA	C.3	We note the detail supplied for the Sites of Special Scientific Interest (SSSI) condition assessment, but recognise the lack of	Information on the risk profiles of pressures associated with maintenance dredge and disposal activities is included

No	Report	Topic	Section	Comment	Response/Action
				condition assessment information for the other designated sites to support the MDP. Where available the Supplementary Advice on Conservation Objectives along with sensitivity information for the internationally designated sites may provide helpful further detail and should be referred to within the MDP for a clear audit trail (Conservation Advice packages are available on Natural England's Designated Sites Viewer).	in Table C.1 of the HRA, including reference to the latest conservation advice packages for the relevant sites in the study area. Information on the sensitivity of features/sub-features that is available from the 'advice on operations' part of the conservation advice packages has now been included and referenced also in the HRA. This has identified the key relevant pathways of effects that should be assessed in the HRA and the particular features/subfeatures that are sensitive to those impact pathways.
14	MPD Baseline Doc	Condition assessments and conservation advice packages	All	We acknowledge that the MDP is reviewed every 5 years, however we would welcome a trigger to review the MDP once any relevant condition assessments have been completed, as well as any significant updates to conservation advice packages.	If there is any change in the condition of a feature or an update to site advice that NE believe could have implications for maintenance dredging and disposal activity in the Mersey and its approaches, it would be helpful for NE to alert the Port of Liverpool so that it can be considered and addressed as appropriate (either as part of an MDP update or the licensing process). As noted in comment 21 below, this could be done through the Mersey Sediment Management Stakeholder Group.
15	MPD Baseline Doc	HRA	All	We would welcome a map representing the dredge site locations and the	The MAGIC map website provides site maps and the location of some but not all qualifying marine habitat and species

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				habitats/species features of the designated sites.	interest features of designated sites. This data is displayed publicly for viewing purposes only on MAGIC, but is not available for download. This information is updated on MAGIC as and when new information becomes available. Clear reference to the MAGIC website resource and the features that have been mapped and occur near to the dredge areas are now included in Section 7 of the Updated MDP Baseline Document for information.
16	MPD Baseline Doc	HRA	C.3.1	In relation to impacts on red-throated divers (a feature of Liverpool Bay SPA) page 13 of Appendix C states that; 'maintenance dredging of the Mersey Approach Channel and marine disposal activities has the potential to disturb Red-Throated Divers'. There is no further discussion with regard to the level of impact or mitigation measures, therefore Natural England cannot agree with the statement at the end of this section which conclude no adverse effect on site integrity for the bird features of any MPAs. Further discussion, justification, and where appropriate mitigation measures (as well as general best practice measures), need to be set out. We advise that further consideration is made regarding potential areas of impact	The paragraph following this sentence explains why future maintenance dredging is not anticipated to result in any increase in disturbance to this species. On this basis, mitigation is not considered necessary. The JNCC Report has been reviewed and it can be confirmed that the dredge areas and disposal sites and main shipping routes to and from these areas do not overlap any of the areas that have a higher density of red throated diver recorded from aerial surveys.

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				from evidenced areas of usage by red-throated divers and maintenance dredging and disposal activities. The JNCC have published a paper assessing the abundance and distribution of seabirds within Liverpool Bay which may be useful for further assessment of impacts in relation to red-throated divers (JNCC Report No: 5761).	
17	MPD Baseline Doc	Mitigation	C.3.3	Any mitigation measures, including those within existing marine licences, need to be included in an assessment before the conclusion of no adverse effect on site integrity can be concluded. The mitigation measures are set out after these conclusions have been drawn and there is no reference to the mitigation in the assessments. For example, the marine licence condition requiring further sample analysis from the docks to prevent the deposition of contaminated materials at sea, or tidal restrictions on disposal.	The mitigation measures that are referred to in Section C3.3. of the HRA form part of the baseline against which the potential effects have been assessed as explained in the introduction to this section. The assessment has not identified the need for any further mitigation measures to be introduced.
18	MPD Baseline Doc	Mitigation	C.3.3	Natural England advise that all the mitigation measures should be clearly linked to the activities and carried through to any subsequent permissions (either from the MMO or by yourselves as the Statutory Harbour Authority).	As noted above, the assessment has not identified the need for any further mitigation measures to be introduced. Peel Ports request clarity on this comment.
19	MPD Baseline Doc	HRA	C.7	Natural England agrees with the concluding statement, of the Information to an Inform	Noted.

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				Appropriate Assessment setting out that should locations or volumes of dredges, or techniques beyond those already occurring change, that these would be subject to further assessment within a HRA.	
20	MPD Baseline Doc	HRA	C2.2	The works, as set out in the information supplied by the applicant, are not sited within a Marine Conservation Zone (MCZ), however the document has identified Fylde MCZ and Ribble Estuary MCZ within the wider study area. Natural England have not identified a pathway by which impacts from the dredging and disposal activities would affect the interest features of the sites. We are therefore confident that the works will not hinder the conservation objectives of these sites.	Noted.
21	MPD Baseline Doc	SSSIs	7.1.5	If we have any updated evidence regarding the condition of our SSSIs, we will liaise with Peel Ports through the Mersey Sediment Management Stakeholder Group.	Noted. This links with comment 14 above.
22	MPD Baseline Doc	SSSIs	7.1.5	Natural England advises that the proposal, if undertaken in strict accordance with the details submitted, is not likely to damage the interest features for which the site has been notified.	Noted.
23	MPD Baseline Doc	Beneficial Use	4.3	Natural England welcomes section 4.3 Beneficial use, which sets out the waste hierarchy and the Mersey Sediment	Noted.

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				Management Stakeholder Group as a forum to investigate potential beneficial uses of the dredged materials. We are keen to support engagement through this group to explore further opportunities for beneficial use and will endeavour to keep the group informed of any opportunities that Natural England may identify through site condition assessments. You may already be aware, but the recent publication of the handbook " Restoring Estuarine and Coastal Habitats with Dredged Sediment" may provide additional useful evidence and information and can be accessed here: Restoring Estuarine and Coastal Habitats with Dredged Sediment - CaBA (catchmentbasedapproach.org).	
24	MPD Baseline Doc	Beneficial Use	4.3	The document details the current dredge practices and dredge disposal sites. The use of the Mid River disposal site is welcomed as a mechanism to maintain fine sediment within the Estuary system. In terms of trying to keep as much sediment in the natural system it is recommended that a review of the applicability of dredge practices, such as the preferential use of Water Injection Dredging to maintain a more natural flow of sediment within the estuary system may be beneficial.	Noted.

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25	MPD Baseline Doc	Beneficial Use	4.3	There are currently two projects Natural England is aware of which could provide further potential beneficial use of dredge spoil which could be investigated through the Mersey Sediment Group; 1. Wyre Borough Council are currently reviewing opportunities for habitat restoration through the Environment Agency funded project Ecologically Community Owned Buffer Strips. 2. There is also currently a refresh of the Shoreline Management Plan for North Wales and the North West, as part of this work the environment group are investigating opportunities for habitat creation in the North West.	Peel Ports welcome raising such opportunities in the Mersey Sediment Management Stakeholder Group.

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