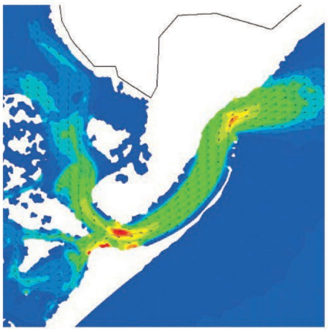
Solent Forum

Beneficial Use of Dredge Sediment in the Solent (BUDS) Phase 3

Disposal site characterisation assessment for two new beneficial use sites in the Lymington saltmarshes

June 2024



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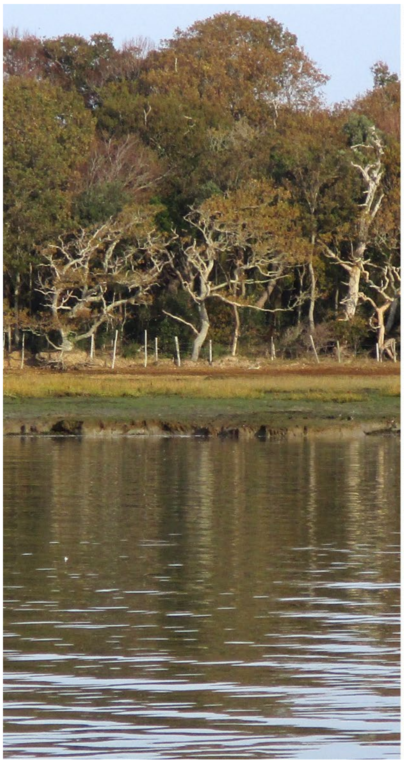

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Acknowledgements

We would like to thank the many people and organisations that were consulted and provided advice and information during this project. This includes members of the Technical Group overseeing the BUDS project as well as a wide range of interested parties and industry specialists who contributed during the consultation process and the BUDS workshops. We are also especially grateful to the Environment Agency who provided funding, through the Water and Environment Management (WEM) Framework fund, to support this innovative project.

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Executive Summary

Project background and objectives

This report has been produced to inform a Marine Licence Application to the Marine Management Organisation (MMO). This application will seek permission for the beneficial placement of dredge sediment at two sites close to the Lymington saltmarshes in the West Solent. It is intended that these two sites will become officially licensed disposal locations that can be used as and when suitable dredge materials become available from a range of appropriate local sources.

Placement of dredge sediment at these two locations will help to slow or stall the ongoing decline of intertidal habitats in the outer Lymington Estuary (see Images 1 and 2). It will also ensure that a greater proportion of the dredge resource in the Solent is retained within the nearshore sedimentary system and not lost through placement at existing offshore disposal sites.

The saltmarshes at Lymington provide wave protection to surrounding intertidal mudflats and to Lymington Harbour, its marinas and mooring sites. They contribute to enhanced biodiversity and improve water quality. The areas of remaining marsh that have the highest elevations are some of the last remaining intertidal roosting and nesting grounds for waterbirds in the west Solent. These marshes are, however, rapidly eroding and these functions are being lost. Placing sediment at the proposed sites will help to maintain them, or at least extend their life, and their functional benefits.

Source: Landwatch, 2019 for Solent Forum (BUDS Phase 2)

Image S1. Intertidal mudflats and saltmarshes east of Lymington Estuary

This Environmental Appraisal has been prepared to support the Marine Licence Application. It provides a 'disposal site characterisation assessment' of the two proposed beneficial use sites and an environment assessment of the proposed sediment placements. It describes the physical and ecological conditions at these sites and evaluates the impacts and benefits of the proposal. It also includes other stand-alone supporting assessments, including a Habitat Regulation Assessment (HRA) and a Water Framework Directive (WFD) compliance assessment. The results of sampling that was carried out in accordance with the sample plans that were received from the MMO for these proposed disposal sites are also included, as required under the London Convention London Protocol (LCLP) and Oslo and Paris (Convention and Commission) (OSPAR).

This report and the Marine Licence Application are outcomes of Phase 3 of the Solent Forum partnership's 'Beneficial Use of Dredge Sediment in the Solent' (BUDS) project. Further background to the BUDS project, as context for this proposal, is provided below. In summary, though, BUDS is being undertaken to find ways of beneficially using some of the large amounts of sediment that are dredged from harbours and navigation channels in the Solent each year. It is understood that achieving this goal requires some major changes to established practices and, particularly, the use of more collaborative and strategic ways of thinking and operating. The Solent Forum BUDS project is seeking to show how this can be done to manage and make best use of dredge sediment resources.

As an outcome of the BUDS process, and following several reviews and consultation exercises, it is proposed that dredge sediment would be deposited at the two locations within Lymington saltmarshes (named here as 'Pylewell' and 'Cockleshell') through 'bottom placement'. The term bottom placement refers to the direct disposal of sediment from beneath the hull of spilt hopper transport barges. This placement method has been carried out over the last nine years in front of the Boiler Marsh site at Lymington (as summarised further below). This means there is now confidence in this technique, its effects, and its effectiveness.

Source: Landwatch, 2019 for Solent Forum (BUDS Phase 2)

Image S2. Mudflats, saltmarshes and nature reserve area west of Lymington Estuary

What is distinctive for these two new BUDS disposal sites is that they would be used by more than one supplier of suitable dredged sediment. The Solent Forum recognises that having multiple parties beneficially using intertidal sediment placement site(s) sets a new precedent. It introduces a new way of thinking about, and regulating, the beneficial use of dredge sediment. However, this is a change that is urgently needed in the Solent and then, hopefully, at other appropriate UK locations.

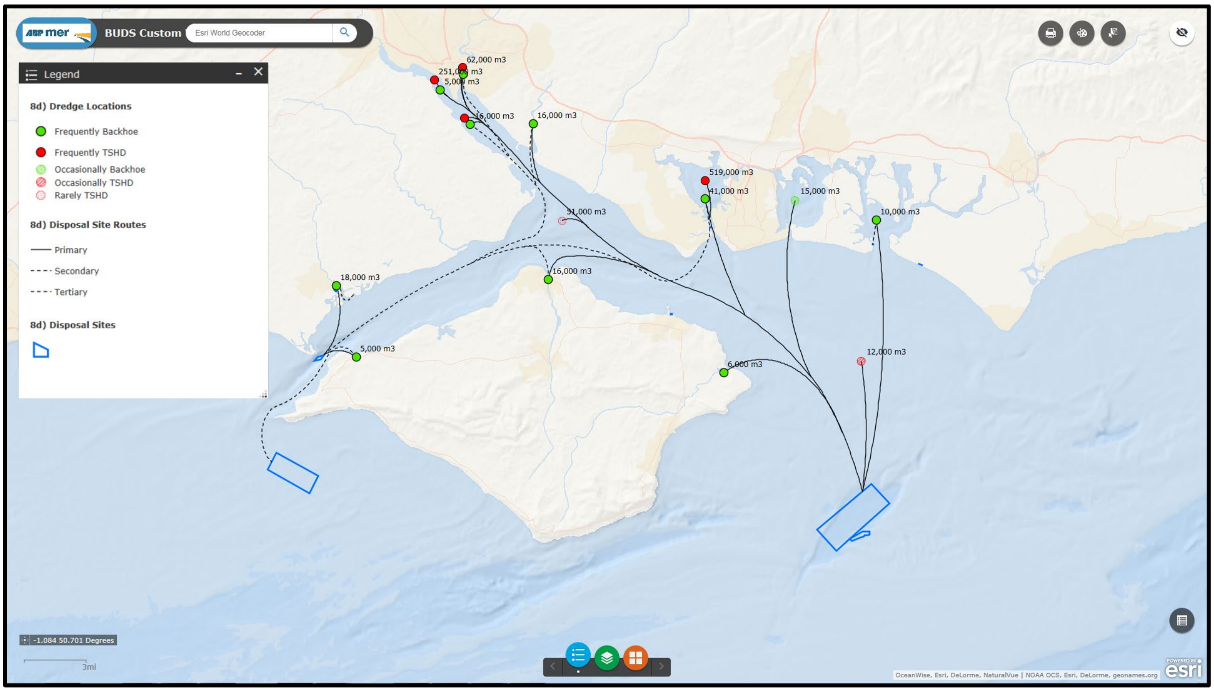
It is now long-established practice for offshore disposal sites to be used by more than one supplier (see Image 3 illustrating the situation in the Solent). That approach is not adopted when placing sediment inshore to benefit coastal habitats. Such beneficial use projects are, instead, always overseen by a single harbour authority, dredging operator, or other promoting organisation.

This proposed multi-user approach will have implications for project implementation because responsibilities for the monitoring and management of the sites and the licences will potentially need to be shared across site users or, ideally, led by the MMO. During the licensing process, therefore., further discussions will need to be had with the MMO about who oversees and manages the project (i.e. either the MMO or main site users) and how that leadership is enacted to ensure delivery of the project in accordance with regulatory requirements and agreed licensing conditions.

Solent Forum BUDS project background

The Solent Forum's BUDS project was started in 2017 and is being pursued in phases as set out in Table S1. Phase 1 was completed in 2018. This involved a high-level review of the Solent region to identify sites that would gain most from a beneficial use campaign and concluded that a 'stand out' candidate site for recharge work was along the Hurst Spit, Keyhaven, and Lymington frontages.

Phase 2 was then progressed in 2019 and 2020. This stage took forward the recommendations from Phase 1. It considered in more detail how beneficial use might be carried out on the Hurst to Lymington frontage. This included considering the costs and benefits of different approaches.



Source: BUDS Webapp; Cefas and ABPmer data-layers

Image S3. Dredging and disposal activities in the Solent (output from BUDS Phase 1)

This report is an outcome of Phase 3. Its aim was to agree a specific proposal, or set of proposals, and request necessary Marine Licence(s) from the MMO. Throughout this project, regular consultations and meetings were held with a wide range of partners, stakeholders and dredging specialists. These consultations, and the support of partners, is vital to the success of this, or any, beneficial use project.

Table S1. Overview of Solent BUDS project phases

Phase of work	Key objectives	Timescale	Report deliverable
Phase 1 - Identifying potential beneficial use sites across the Solent	To undertake a high-level review of the whole Solent region, and to identify sites that would gain most from a beneficial use campaign	2017 to 2018	ABPmer (2018). Beneficial Use of Dredge Sediment in the Solent (BUDS), Phase 1 Project Scoping and Partnership Building, ABPmer Report No. R.2845. A report produced by ABPmer for the Solent Forum.
Phase 2 - Reviewing options across the Hurst to Lymington frontage	To take forward the Phase 1 recommendations and consider options for the Hurst to Lymington frontage in greater detail.	2019 to 2020	ABPmer (2020). Beneficial Use of Dredge Sediment in the Solent (BUDS) Phase 2, Feasibility Review for Sediment Recharge Project(s) on the West Solent Saltmarshes, ABPmer Report No. R.3155. A report produced by ABPmer for Solent Forum, February 2020.
Phase 3 - Licensing new use disposal sites at Lymington	To agree a specific proposal for bottom placement sediment to protect and enhance the declining saltmarshes between Hurst Spit and Lymington; and To secure the necessary Marine Licence(s) for the agreed proposal.	2022 to 2024	This report.
Phase 4 - active beneficial placement of dredge sediment	Subject to obtaining the necessary approvals for these proposals, to deliver the proposed new beneficial use sites.	Not yet commenced.	Not yet commenced.

Over the period when this application was being prepared, other advances have occurred in the field of dredge sediment beneficial use in the UK. Some of these are outlined in the section following. Submission of this BUDS application (in early 2024) has been timed to follow on from these other initiatives and build upon the lessons learned from them.

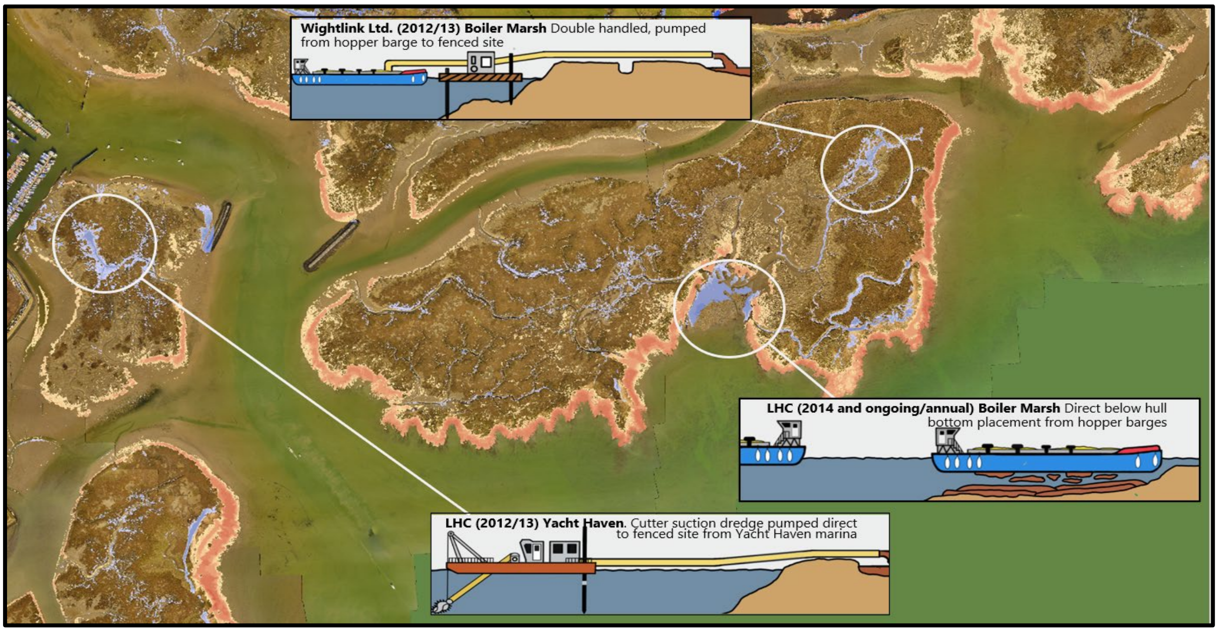
While the Lymington to Keyhaven shoreline has been a recent focus for the BUDS programme, the selection of this frontage as a priority candidate area with the most demonstrable 'needs case' does not mean that other locations in the Solent are being ignored. Instead, it is intended that BUDS project leads to new technical lessons and collaborations that will facilitate more projects in the region.

It is encouraging, therefore, that new beneficial use projects have been implemented or are under review in other parts of the Solent as well as at Lymington. There have been new investigations in the Medina Estuary and Langstone Harbour. Also, as summarised below, a new trial at West Itchenor in Chichester Harbour was recently implemented by Land and Water Services Ltd (L&WS) as part of the Solent Seascape project.

Lessons from recent projects and initiatives

For the last two decades, and increasingly over the last few years, valuable new lessons have been learned, and guidance shared, about how to use dredge sediment beneficially. This includes practical lessons from recent beneficial use projects at Lymington as well as at other locations in the Solent and UK. New initiatives have also been pursued to share lessons and enhance the delivery of such projects. It has been important for the Solent Forum BUDS project to both contribute to and learn from this range of other ongoing initiatives.

So far, at Lymington alone, three different 'alternative use' projects have been successfully undertaken using sediment dredged from Lymington Harbour (see Image 4). In 2012 and 2013, the Lymington Harbour Commissioners (LHC) carried out a sediment recharge on the Yacht Haven saltmarsh (L/2011/00306/2). Over the same period, Wightlink Ltd placed/pumped sediment in a deteriorating section of Boiler Marsh (L/2011/00308/2).



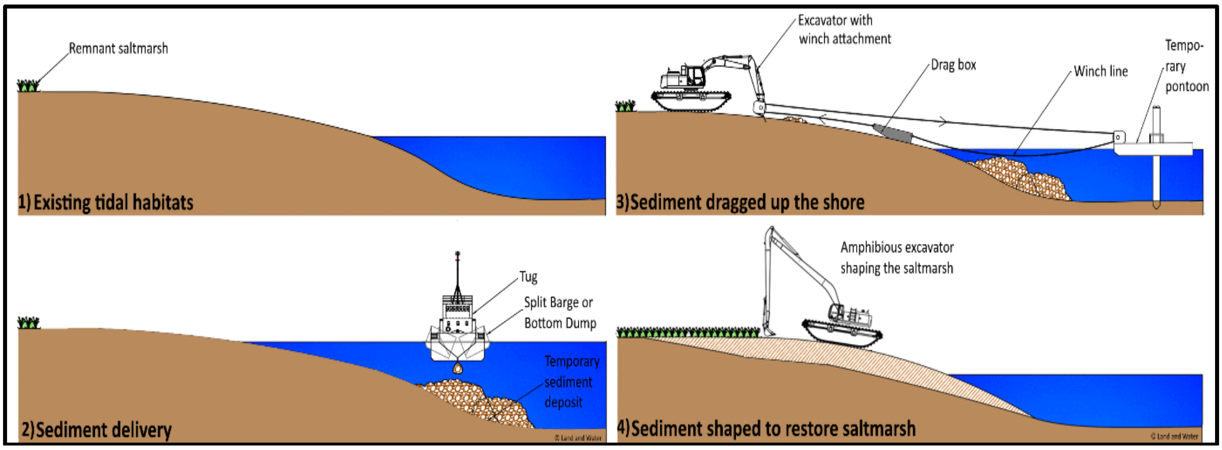
Source: ABPmer with Environment Agency LiDAR data

Image S4. Different techniques used for recharge projects at Lymington

On an annual basis since 2014, the LHC has also been beneficially placing sediment into a licensed disposal ground around part of Boiler Marsh (MMO Licence L/2014/00396/2). Under this consent, up to 10,000 wet tonnes of dredged sediment (approximately 8,000 m^3) can be deposited each year. This is done by 'bottom placement' from a hopper barge. Encouragingly, the deposited sediment is showing a high degree of persistence and there has been a gradual build-up of sediment in the deposit ground.

Building on this success, the LHC and L&WS have a Marine Licence to reuse and relocate this already deposited sediment at Boiler Marsh onto the higher marsh level to further enhance the ecological value and increase the resilience of this area of saltmarsh (L/2023/00294/1). Initially, this sediment movement will be done using a new Saltmarsh Restoration Drag Box (SRDB) technique (see Image 5).

A recent trial of the SRDB technique, at West Itchenor Chichester Harbour in February and March 2023 (MMO Licence L/2023/00042/1) has provided valuable lessons about the effectiveness of this approach. It has confirmed that this could be a potentially useful new way of beneficial using dredged sediment that has already been bottom placed through separate dredging operations. A further trial at Boiler Marsh, will provide valuable new lessons about this approach.



Source: Land and Water Ltd

Image S5. Illustration of Saltmarsh Restoration Drag Box (SRDB) technique

Proposal for sediment recharge at Pylewell and Cockleshell

During BUDS Phase 3, additional consultations were undertaken with stakeholders to develop proposals and secure the necessary Marine Licence. Further meetings and workshops were held in addition to those undertaken in Phases 1 and 2. This included a pre-application meeting with the MMO (ENQ/2022/00101) as well as meetings with stakeholder groups and specialists overseeing the BUDS programme. These discussions were held to develop the proposed approach. They were also informed by the practical lessons learned from recent and emerging beneficial use initiatives on the Lymington marshes (as summarised above).

As an outcome of this process, it is proposed that two new sites (Pylewell and Cockleshell) should become licensed disposal locations at Lymington. Their locations are shown in Figure S1. At these two BUDS sites, sediment would be bottom placed from hopper barges in the same way that sediment is now being placed at Boiler Marsh. From the practical lessons we have learned at Boiler Marsh (as outlined above), this would supply sediment to these areas, lead to the creation of a protective bund for the habitats behind and could become a source of sediment for further marsh raising (e.g. using the SRDB approach).

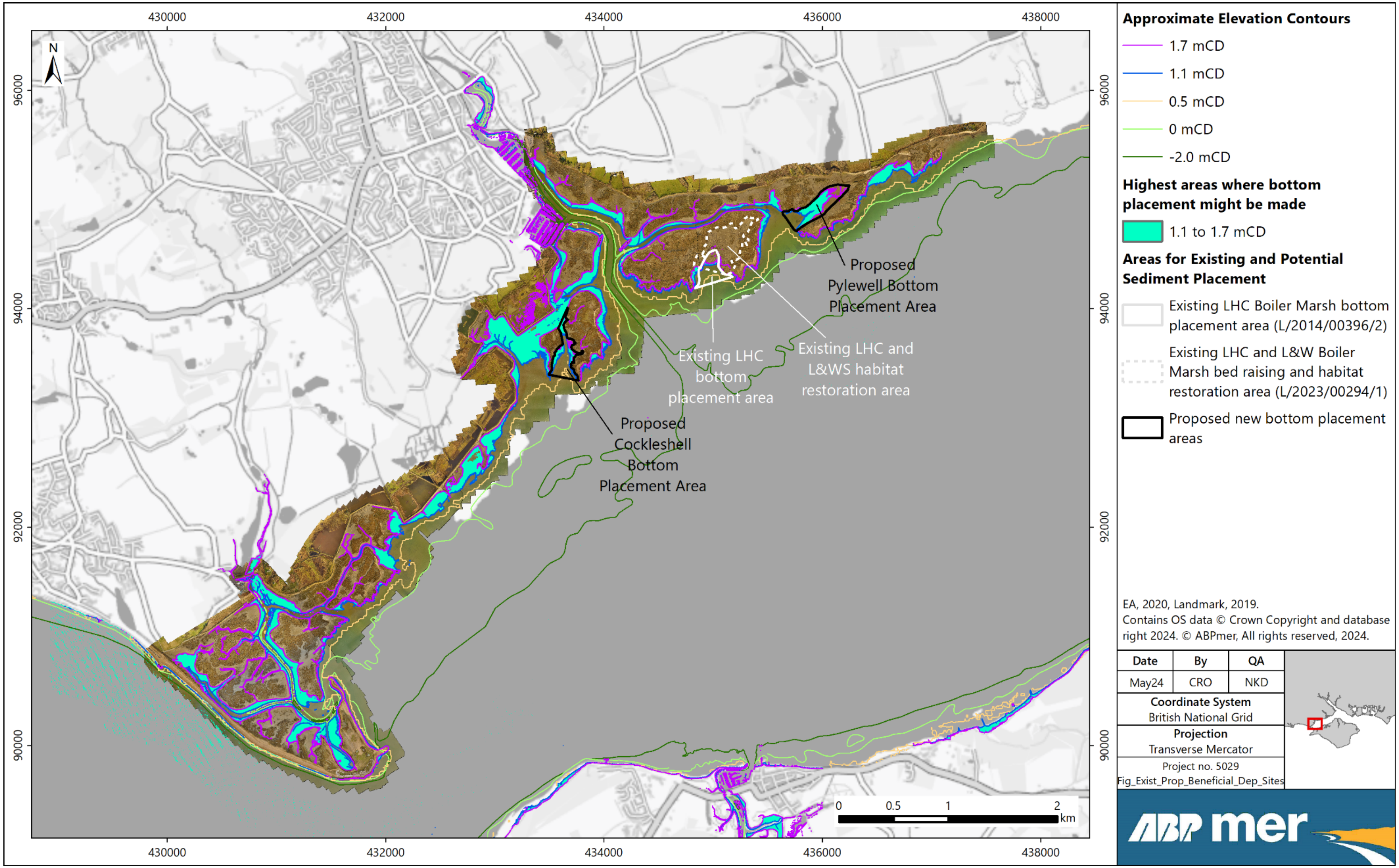


Figure S1. **Location of existing and proposed placement sites with bed elevation contours**

It is expected that sediment from a range of sources could be added to these sites. This could include sediment from the harbours of Lymington, Yarmouth, Beaulieu, Cowes or, occasionally, even the Hamble. These beneficial use sites would operate in the same way as an offshore disposal site. Each harbour would be responsible for ensuring that the dredge sediments are suitable for disposal at sea (under existing consenting regimes) and hence also placement at Pylewell or Cockleshell.

Having multiple possible sediment sources is not only novel for this type of inshore beneficial use location, it also means that it is not possible to know with certainty how much sediment could be placed at these locations or how regularly. That will be dependent upon the requirements of each harbour and their relevant consenting arrangements. It will be influenced by their dredge volumes, sediment type, sediment quality, dredging methods and the vessels they use to transport sediment.

Due to these uncertainties about project scale, and to provide regulators and all interested parties with confidence in the approach taken, it is anticipated that this project will be carried out in a phased and adaptive manner. It would begin with trials and be followed by scaling up across the deposit sites over time, if possible and where agreed. Sediment would initially be placed towards the upper reaches of mudflat habitats (as high as existing bathymetry and vessel access allows) at spring tide high water. Over time, and subject to monitoring and management advice, the sediment could increasingly be placed at lower elevations within the defined zones[1].

Where a harbour is able or required to place some dredge sediment at Pylewell or Cockleshell, then the total volume that can be placed is likely to still be affected by the bed elevations at the disposal locations. Any disposal will need to coincide with a high tide and the placement sites will be influenced by the vessel draught. For the purposes of consenting and appraisal though it is assumed that up to 29,000 wet tonnes (approximately 20,000 m^3) could be placed annually across the two sites. To achieve that would technically require around 66 vessel movements for a larger hopper barge (with 300 m^3 capacity) or 200 movements by smaller barges (with 100 m^3 capacity).

These volumes and vessel movement values may well not be realised because access to, and use of, the sites will be constrained by tidal state and sediment availability. It is more likely that these sites will be used at smaller scales and only intermittently (especially in the first few years). However, during pre-application the MMO advised that it was better to assume a high value and that more vessels will use the site(s) than is likely to occur. This is to provide assurances regarding the project's effects and avoid the risk of unnecessarily having to re-apply for licences. Other new aspects to the proposal that are pertinent to the Marine Licence Applications which are highlighted further below.

Impact assessment

To underpin the Environmental Appraisal and disposal site characterisation, an impact assessment of this proposed project was carried out. In keeping with guidance (Manning *et al*., 2021); the scope of this assessment was informed by an initial risk-based analysis. It was found to have medium risk given the nature and location of the project.

This project was not categorised as being of a low risk, as was the case for the new Boiler Marsh restoration proposal described above. This is mainly because the sites will potentially receive sediment from outside of the local sediment cell. The proposed disposal sites also lie within boundaries of internationally protected sites. The risk is not high for this project because a comparatively small volume of material will be placed and because the project is designed to work sustainably with natural

1 At later stages these sediment resources could also perhaps be used to raise the local saltmarshes as is currently proposed for Boiler Marsh. Any such measures to move the sediment out of the deposit zones would though require entirely separate consent(s).

processes. There will also be assurances (through consenting regimes and management) that the quality of the dredge sediment will be appropriate for disposal and beneficial use.

For this assessment, the impacts on physical processes, water and sediment quality, nature conservation and ecology, fish and fisheries, waterbird populations and cumulative and in-combination effects were examined. Overall, the proposed beneficial use disposal sites will have small, localised and temporary adverse effects that are negligible to minor (i.e., insignificant) during the sediment placement activities. The main effect will be local changes to the benthic infauna and habitat at the placement sites.

The project will have larger minor to moderate beneficial effects for ecology and nature conservation, which is a central goal of this proposal. The benefits come from enhancing the supply of sediment to the deteriorating marshes and helping to delay the rate at which parts of the existing saltmarsh complex and surrounding mudflats are lost through ongoing erosion (see Image 6). It is difficult at this stage to evaluate the scale of the benefits, as that will ultimately be dependent on the scale and effectiveness of each campaign and on how often and/or regularly they are undertaken.

Source: ABPmer July 2022, near Pylewell site

Image S6. Example of the eroding outer edges of saltmarshes at Lymingto

Mitigation, monitoring and management

The assessment conclusions were underpinned by available evidence and the practical experience gained from past projects at Lymington and elsewhere. In particular, a great deal has been learned in recent years from the ongoing Boiler Marsh bottom placement initiative. This has provided valuable lessons about the practicalities of the proposed approach and the value and persistence of fine-grained sediment deposits along this eroding coastline. This practical experience provides confidence in the proposed project, as well as a lot of inspiration for it.

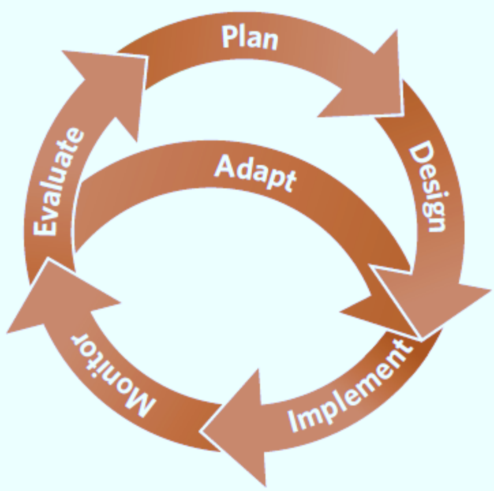
In light of this experience, it is proposed that the mitigation and monitoring commitments can be relatively modest. The monitoring programme does not need to be as detailed or as frequent as it has been for the Boiler Marsh project, for example. The main questions that such a programme needs to answer are:

- How much sediment is placed and where?
- How much of that sediment is retained where it was placed?
- What value is the placed material providing in terms of erosion protection? and
- What are the practical and cost implications to inform future projects?

It will be necessary therefore to take careful records of the locations and timings of all placements (as is done for the Boiler Marsh project). Available Environment Agency Light Detection and Ranging (LiDAR) data will then provide information about the topographic changes at the deposited site. This topographic information can be used to describe how much sediment remains at the placement sites and describe whether there are any notable changes to the surrounding habitats whether that be from sediment dispersion or erosion protection.

As noted above, a key consideration for this project will be how the project is managed and by whom. There will need to be oversight of this monitoring and responsibilities taken for enacting conditions of an MMO licence (if secured). Given the strategic multi-user nature of the disposal sites, it will not be possible or appropriate for the Solent Forum to take on the lead role and this may be something that the MMO leads (as noted above). This aspect will need to be discussed with the MMO during the application process.

Irrespective of the final agreements about who oversees this project, it is recommended that an adaptive management approach will be adopted to this project with oversight from a technical group. This will provide full confidence in the project for all stakeholders. Adaptive management is a 'learning by doing' process in which decisions are taken on a rolling basis that are informed by monitoring (see Image 7). This approach is a well-established way of managing novel and complex proposals[2]. Applying this approach will provide reassurances for all parties about a project's impacts and effectiveness.



1. **Plan:** defining the desired goals and objectives, evaluating alternative actions and selecting a preferred strategy with recognition of sources of uncertainty
2. **Design:** identifying or designing a flexible management action to address the challenge
3. **Implement:** implementing the selected action according to its design
4. **Monitor:** monitoring the results or outcomes of the management action
5. **Evaluate:** evaluating the system response in relation to specified goals and objectives
6. **Adapt:** adapting (adjusting upward or downward) the action if necessary to achieve the stated goals and objectives

Source: originally from CEDA (2015) and reproduced in Manning *et al.* (2021)

Image S7. Illustration of the adaptive management cycle

It is anticipated that a technical group advising on this management would include representatives from Natural England, New Forest District Council (NFDC), New Forest National Park Authority (NFNPA), Hampshire and Isle of Wight Wildlife Trust (HIWWT), Environment Agency and Hampshire County

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2 This approach was also successfully applied for the Wightlink Ltd recharge (Marine Licence L/2011/00308/2) at Lymington in 2012 and 2013 and is being adopted at the Boiler Marsh recharge site under Marine Licence L/2023/00294/1.

Council (HCC). This group is expected to meet annually throughout the ten-year programme, with the frequency being influenced by the extent to which the sites are used.

An annual technical group meeting could be held in March or April each year. This will allow a review of monitoring findings from the preceding campaign to take place that can then inform the technical group's advice on the approach for the up-coming year(s). This will include advice about the scale, frequency, approach and timing of the next campaign(s) in light of the lessons being learned.

Regulatory considerations

A slightly distinctive feature of the proposal is that it involves licensing two discrete sites at the same time. MMO has advised that it is rare for single licenses to be issued for multiple sites. However, it is also understood that this situation is changing especially when parties are seeking to licence separate habitat restoration projects[3]. It is anticipated that embedding multiple sites under a single application is likely to be increasingly important for regulatory efficiency. Most notably, having single combined permissions covering multiple locations and projects is likely to be increasingly critical for the efficient delivery of habitat restoration and Nature-based Solutions (NbS). It is going to be particularly important for 'seascape' initiatives that involve restoring many habitats with several techniques across a region. The last few years have seen a growing number of such regional projects[4].

From this project new practical and regulatory lessons will therefore emerge. It will be helpful to develop and share these with the technical group and the national Beneficial Use Working Group (BUWG) which is led by Environment Agency Restoring Marshes Meadows and Reefs (ReMeMaRe) team. Where new lessons do arise, then these could, if appropriate, be shared though relevant forums as well as through conferences and publications. Such publications would include, it is anticipated, future updates of the recently produced beneficial use handbook.

[3] A recent example of this is the consent for seagrass planting trials at multiple sites in the north Tees Estuary (MMO Reference MLA/2021/00191). Another example of consenting multiple locations is the combined licensing of maintenance and navigation dredging at 236 lifeboat stations operated by the Royal National Lifeboat Institute (RNLI) (MMO Reference L/2017/00149/2).

[4] Some examples in England include: the 'Solent Seascape' project under the Endangered Landscape Programme, the 'Stronger Shores' and 'Our Future Coast' projects under the Flood and Coastal Risk Innovation Programme (FCRIP) and restoration strategies for whole estuarine systems such as the Adur, Thames and Humber.

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1 Introduction

1.1 Report background

This Environmental Appraisal has been prepared on behalf of the Solent Forum partnership to accompany proposals for designating two alternative/beneficial use dredge disposal sites in the outer Lymington Estuary (see Figure 1 and Figure 2). These are sites where dredged sediment from harbours in the Solent could be placed to supply sediment to the area. This will help to protect the saltmarshes and slow the rates at which they are eroding. It would prolong the life of these marshes and the surrounding mudflats and help maintain the benefits these habitats provide for biodiversity, water quality and harbour protection.

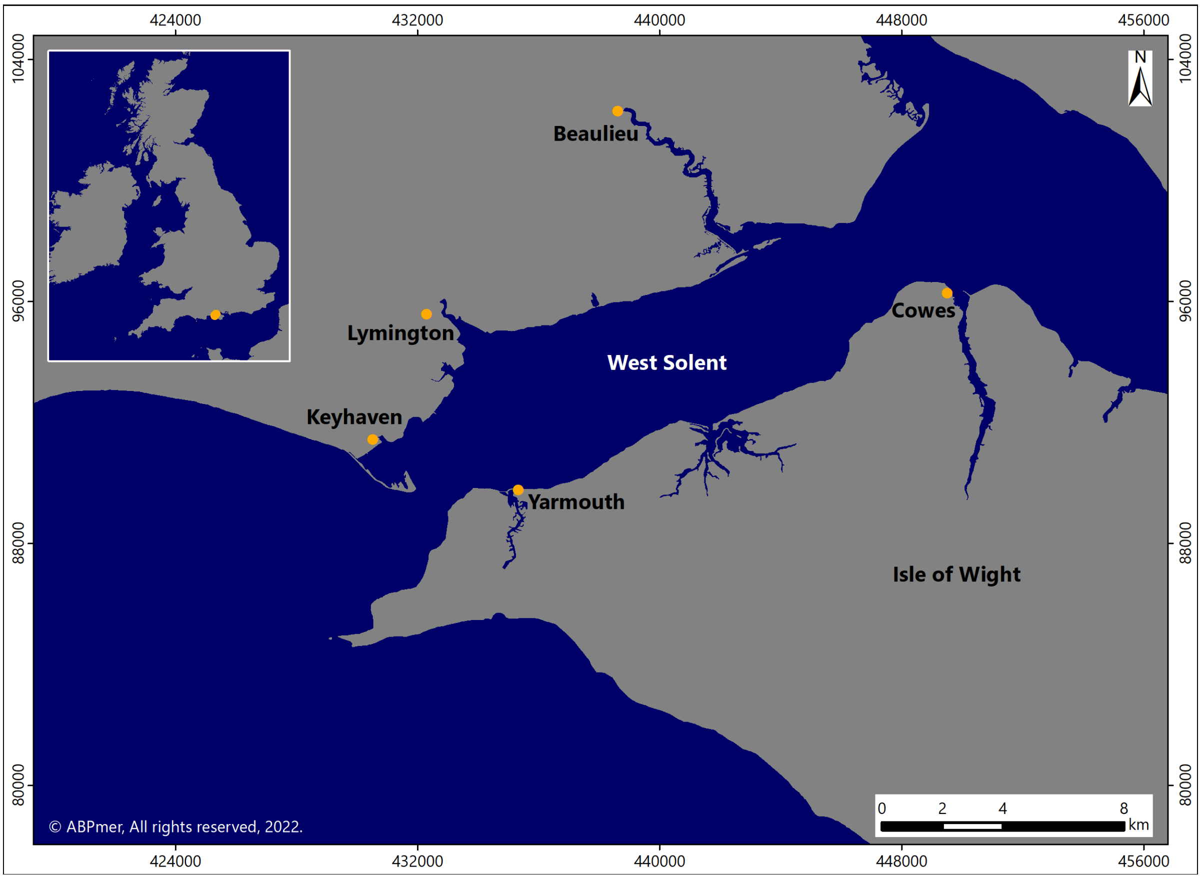

Figure 1. Location of Lymington town and harbours of the western Solent

To permit sediment disposal at these two sites, a Marine Licence will be needed from the Marine Management Organisation (MMO). This Environmental Appraisal has been prepared to support the Marine Licence Application. It provides a 'disposal site characterisation assessment' of the two proposed beneficial use sites which includes details about the baseline environmental conditions at each location, as well as background contextual information, and details about the consultation and survey work that has informed the selection of these sites and the development of this proposal. In addition, this report explains how the sediment placement could be undertaken, and the potential environmental effects associated with this placement. It also includes other stand-alone supporting assessments, including a Habitat Regulation Assessment (HRA) and a Water Framework Directive (WFD) compliance assessment.

1.2 Project Background

This report was produced under the Solent Forum's 'Beneficial Use of Dredge Sediment in the Solent' (BUDS) project which has been progressed in stages over the last six years. It has involved a series of site-selection reviews, consultations, workshops and technical studies that have strategically examined the opportunities for beneficially using dredge sediment in the Solent (ABPmer 2018, 2020)[5].

During Phase 1 of the Solent Forum BUDS project, the opportunities for beneficial use were reviewed across the Solent as a whole (ABPmer, 2018). Then, during Phase 2 (ABPmer, 2020) the review focussed on examining the opportunities along the saltmarshes between Lymington and Keyhaven in the West Solent (see Figure 2). This area was selected because it is here that the largest benefits were likely to be achieved from dredge sediment placement.

This report, which actively identifies and describes beneficial use options at Lymington, forms part of Phase 3 of the Solent Forum BUDS project. It was funded by the Environment Agency through the Water and Environment Management (WEM) Framework fund.

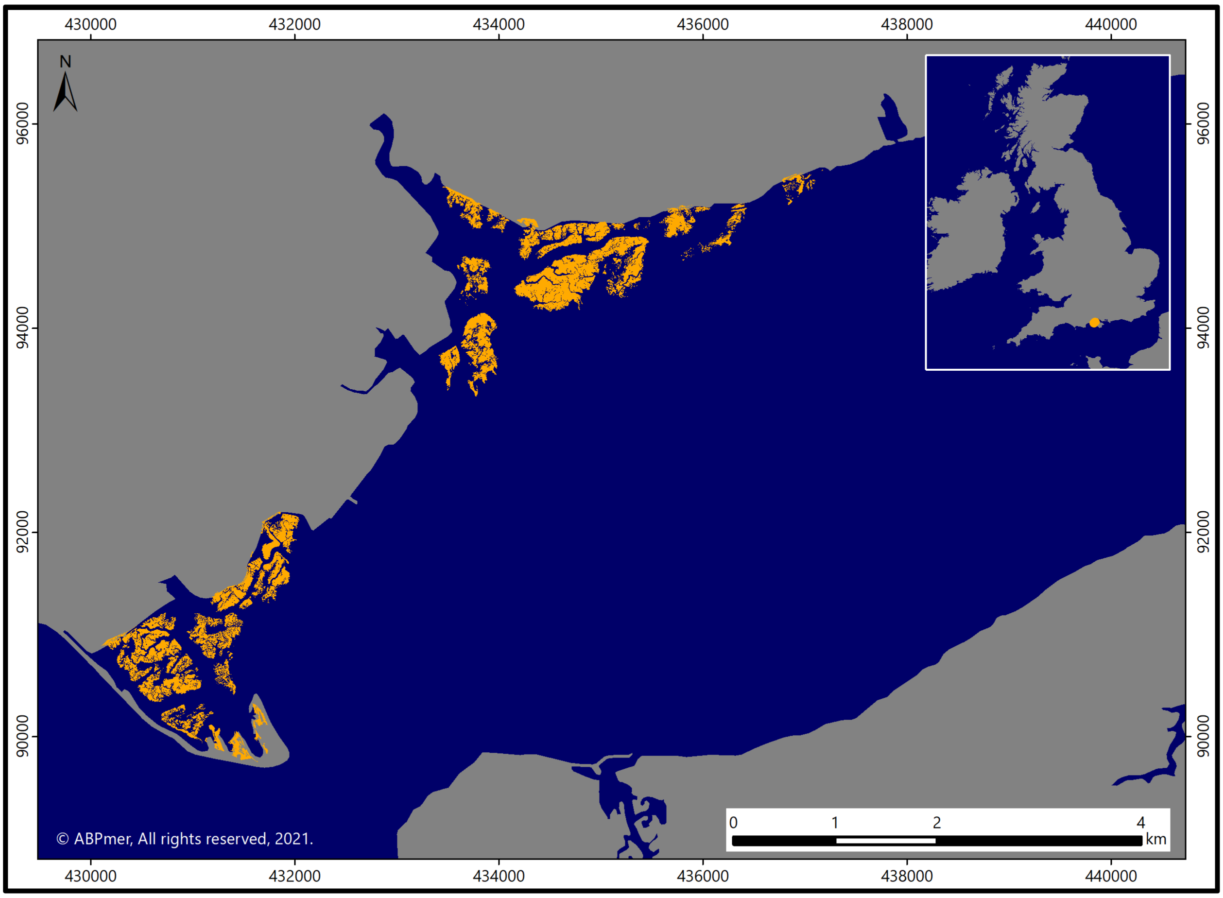

Figure 2 Location and extent of saltmarshes along the Hurst to Lymington frontage

For this third phase, two specific sites were identified where dredge sediment from the Solent area could be used for habitat restoration. These two proposed sediment recharge sites lie on either side of the entrance to Lymington Estuary. They are referred to here as 'Pylewell' and 'Cockleshell' and are shown on Figure 3.

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[5] Background details about the Solent Forum BUDS project and the outputs from this protect are available at http://www.solentforum.org/services/Current_Projects/buds

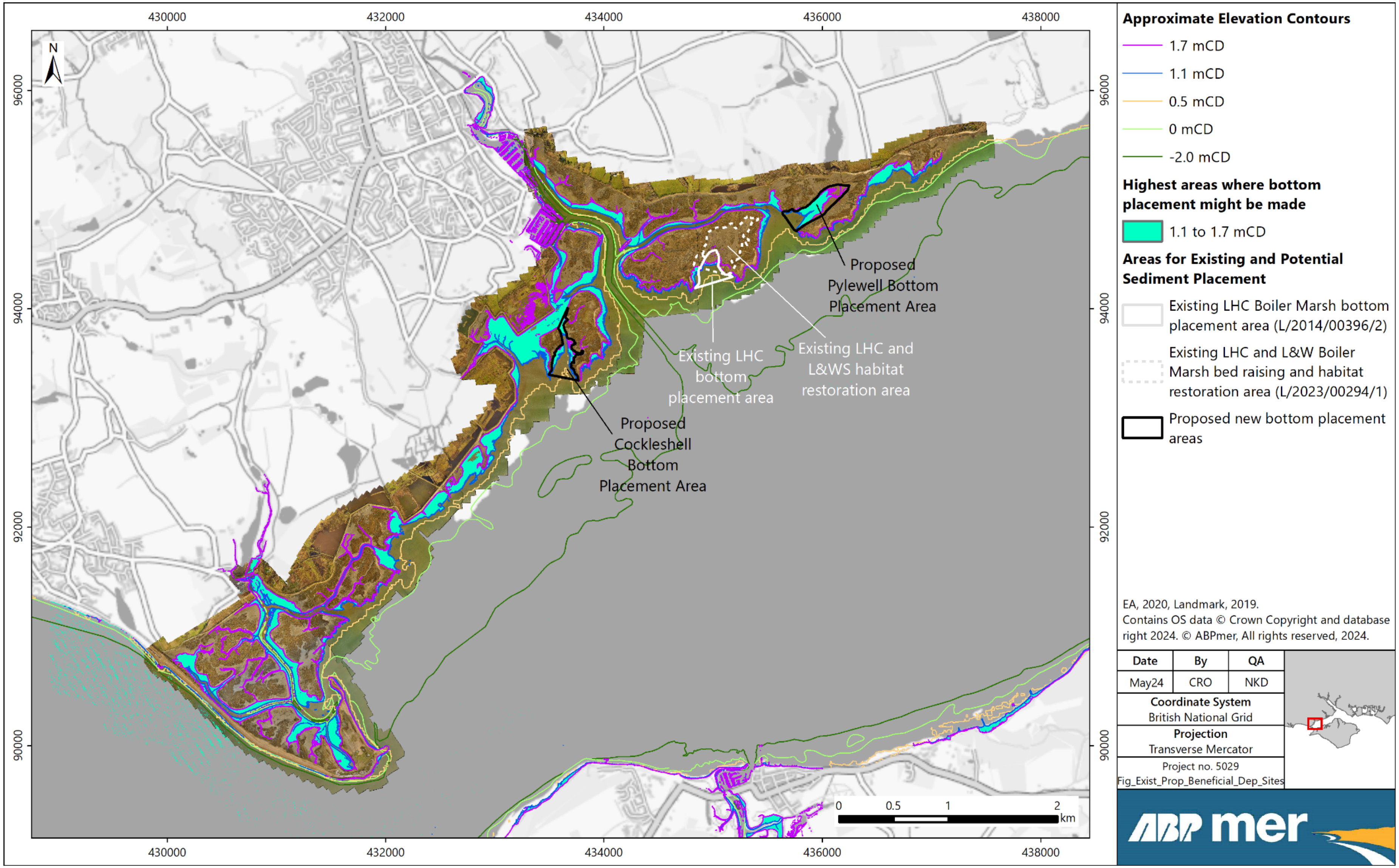


Figure 3. Location of existing and proposed placement sites with bed elevation contours

Figure 3 also shows two other sites which are consented for the placement of sediment to restore intertidal habitats. These two sites are:

- An existing site in front of Boiler Marsh where the Lymington Harbour Commissioners (LHC) have been beneficially placing dredged sediment for the last ten years (currently under MMO licence L/2014/00396/2); and
- An area of Boiler Marsh where the LHC, with Land and Water Services Ltd (L&WS), are proposing to use the sediment which has already been placed at the Boiler Marsh recharge site (L/2023/00294/1).

The ongoing LHC bottom placement at Boiler Marsh has provided important lessons, encouraging results and inspiration to help drive the Solent Forum BUDS project. Views of the saltmarsh and deposit ground at Boiler Marsh are provided in Image 1. The existing Marine Licence (L/2014/00396/2) currently allows for up to 10,000 wet tonnes of dredged sediment from Lymington harbour to be placed every year. A Marine Licence Application (MLA/2023/00549) was submitted in December 2023 to extend the period of the licence for a further 10 years to the end of 2034 and to increase the maximum amount of material that can be deposited at the Boiler Mash deposit ground to 20,000 wet tonnes per year, based on the success of this project.

ABPmer May 2022

Image 1. South of deposit site in spring showing vegetated and unvegetated clay

The results of this LHC project at Boiler Marsh have been encouraging because much of the deposited sediment has been staying in place. About half the placed sediment remains *in situ* between the recharge campaigns. There is also evidence that it is reducing erosion at the centre of the valuable Boiler Marsh complex (ABPmer, 2022a). The presence and persistence of the deposited sediment at Boiler Marsh is illustrated Figure 4. This shows seabed elevation and changes at this location by comparing Environment Agency LiDAR survey results from 2014 and 2021. On this plot, the deposited material is visible as a blue (raised bed) area.

Building on this success, the LHC and L&WS have a Marine Licence to reuse and relocate this already deposited sediment at Boiler Marsh onto the higher marsh level to further enhance the ecological value and increase the resilience of this area of saltmarsh (L/2023/00294/1).

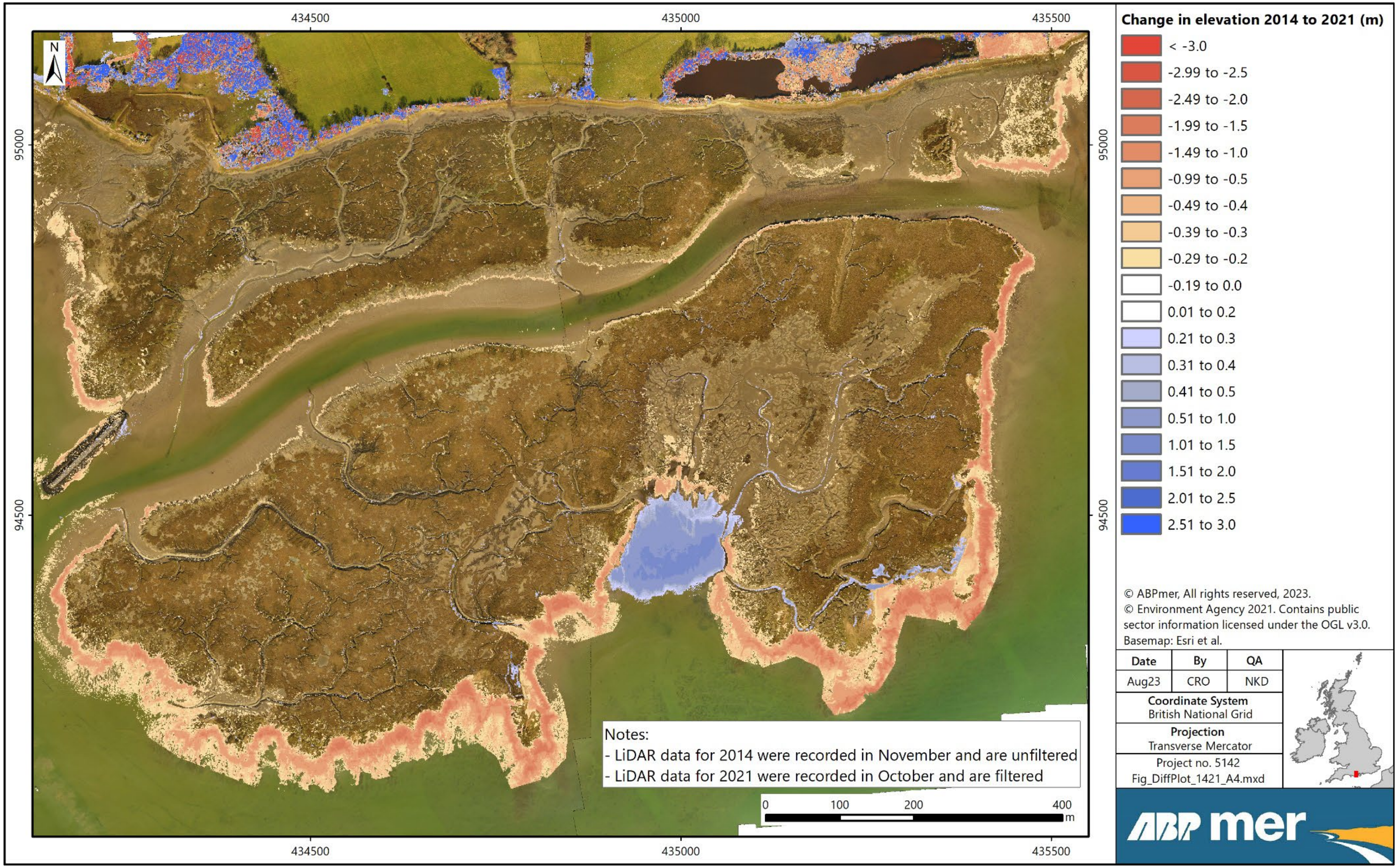


Figure 4 Changes in bed elevation at Boiler Marsh using LiDAR data from 2014 to 2021

1.3 Report structure and content

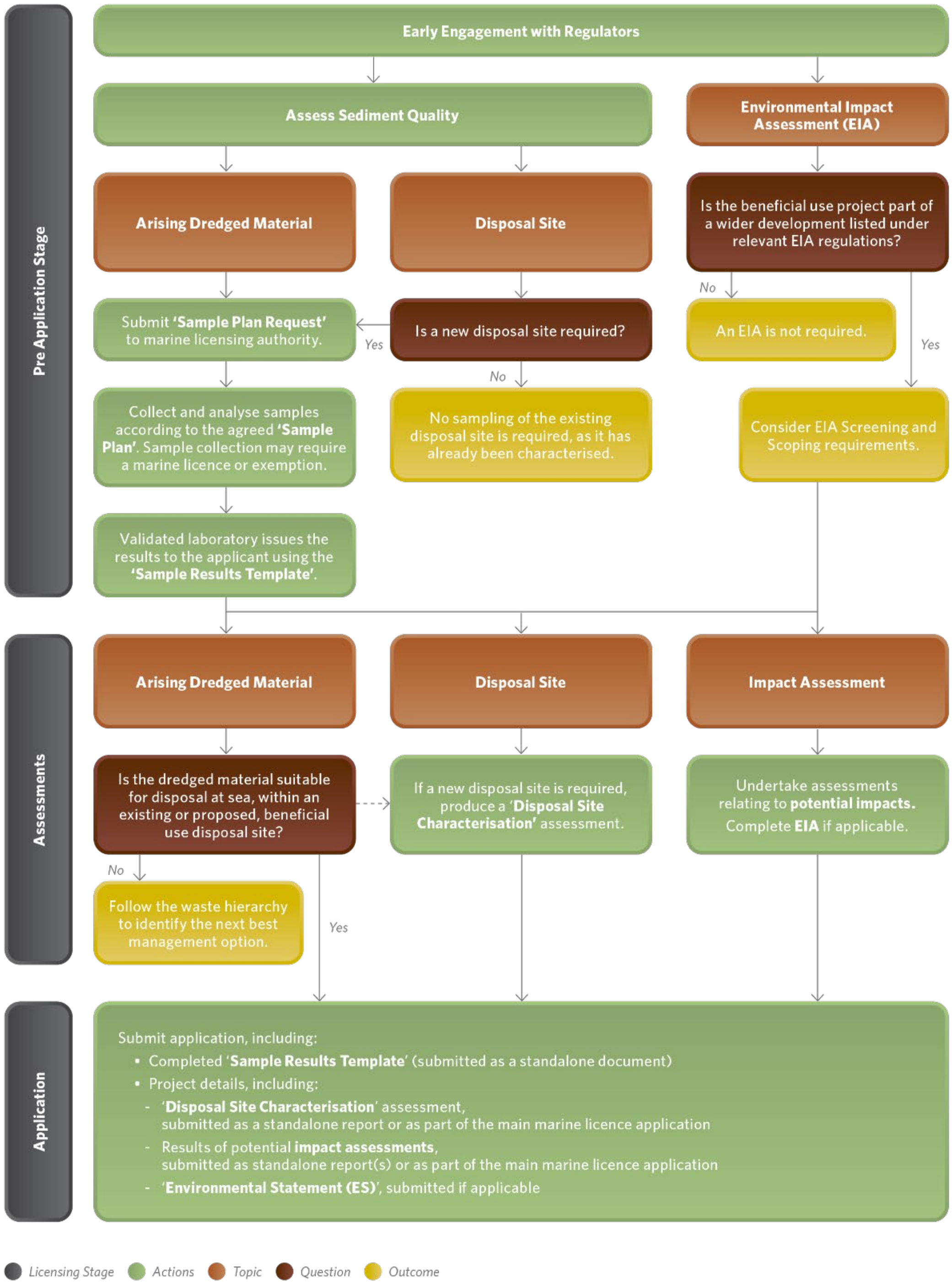
To enable sediment to be placed at Pylewell and Cockleshell, these two locations will need to be formally licensed as disposal/beneficial use sites. To achieve this, a Marine Licence will be required from the MMO. The compliance process for licensing sediment disposal sites is described in Image 2. This report has been prepared to inform these consenting requirements. This report is structured as follows:

- **Introduction (this section).** This opening section provides background details about the proposed project and information about the scope and structure of the report;
- **Project Description and Context (Section 2).** This section reviews how the BUDS project has been implemented and describes the proposed approach for the beneficial use of dredge sediment. It also outlines the consultations and surveys that were undertaken and indicates how alternatives to the project were considered to develop the proposed approach;
- **Regulatory framework (Section 3).** This section outlines the legislative framework and key assessment requirements that are pertinent to the proposed disposal/beneficial use sites;
- **Environmental Impact Assessment (Section 4).** This section describes the assessment scope, as identified by applying a risk-based approach in accordance with published guidance and the methods used to assess potential impacts. It then considers the baseline conditions and impacts of the proposed beneficial dredge placements on environmental topics (or receptors) scoped into the assessment; and
- **Conclusion (Section 5).** This section summarises the findings of the report.

The following appendices are included to provide background information and to support the application for a Marine Licence:

- **Solent Forum BUDS Project Review (Appendix A).** This provides further background information about the BUDS project to describe the context for this project. This includes details about all the work that has gone on before (including consultations undertaken and alternatives considered) and how this proposal fits into, and informs, a longer-term strategic vision for this coastline;
- **Sample Plan Advice and Returns (Appendix B).** This contains a summary description of the sample plan results for the two proposed disposal sites. It includes key correspondence from the MMO and the returns from the survey;
- **Lymington Harbour MDP Baseline 2022 (Appendix C).** This includes a full copy of the latest baseline maintenance dredging protocol (MDP) report for Lymington Harbour. This is included to provide some contextual information for this report only;
- **Habitats Regulations Assessment (Appendix D).** This provides the information needed to address the impacts (positive and negative) on European marine sites and Ramsar sites as required under the UK 'Habitats Regulations'; and
- **Water Framework Directive (WFD) Assessment (Appendix E).** This provides an assessment of the effects of the proposal on relevant water bodies as designated under the Water Environment (WFD) Regulations.

The baseline maintenance dredging document for Lymington Harbour provided in Appendix C was prepared by ABPmer (2022b) on behalf of LHC and previously issued to the MMO in fulfilment of the maintenance dredging protocol (MDP). This full report is included as an appendix because it provides background details about environmental characteristics and features of nature conservation value in the wider Lymington Estuary. Where required, the assessment presented in this report refers to the relevant sections of the baseline maintenance dredging document and other supporting documents. The main report text therefore focuses on describing the site-specific conditions at the proposed Pylewell and Cockleshell disposal sites.



Source: Manning *et al.* (2021)

Image 2. Outline of the marine licensing process for restoration projects using dredged material

2 Project Description and Context

2.1 Introduction

This section provides further details about the proposed beneficial use placement. It includes a description of the project aims (Section 2.2), as well as information about the anticipated placement methods (Section 2.3) and potential sediment sources (Section 2.4). It also describes some of the practical considerations that will need to be borne in mind when using these sites (Section 2.5). A separate commentary is also included about the alternative options that have been considered (Section 2.6). Sections 2.7 and 2.8 respectively provide detail about the consultations and the surveys that were undertaken to inform and develop this project. Finally, Sections 2.9 and 2.10 respectively contain a review of the proposed adaptive management approach for this project and also how this project could inform future adaptation and fit in with a longer-term vision for the coastline.

2.2 Project aims

The aim of this proposal is to allow depositions of dredged sediment (from potential West Solent sources) at the Pylewell and Cockleshell sites to help protect the adjacent saltmarshes. The outer Lymington Estuary marshes are currently progressively eroding and fracturing (see Section 4.4), and this proposal is being advanced, in large part, to help reduce the rate of this decline. Placing sediment at the desired locations will contribute to a reduction in the frequency and penetration of wave activity into the marshes behind and, therefore, slow the break-up and loss of both the marshes and the mudflats surrounding them.

As well as helping to slow or stall the decline of intertidal habitat, this proposal represents a fundamentally better use of dredged materials than is currently practiced. It will ensure a greater proportion of the annual dredge resource in this area is retained within the nearshore and local sedimentary system. The use of licensed offshore disposal sites by nearby marinas and harbours (e.g. at Hurst Fort and the Nab Tower) effectively depletes sediment over time, reducing the supply available that could allow the elevation of the saltmarsh and mudflats to rise and help keep pace with on-going sea level rise.

The proposal will, therefore, also reduce the rate at which the valuable functions/benefits of the marshes and mudflats are being lost. These functions include particularly, providing harbour protection and important bird nesting habitat. The amount of value achieved will depend on the scale and regularity of sediment placements, as well as the persistence of the deposited sediment and the patterns of sediment dispersal. As the placed sediment erodes (predominantly by wave activity), it will be released to the water column and subject to tidal influence, which will allow a proportion to be transported to the adjacent saltmarshes or moved over the mudflats.

The two sites were selected for a range of reasons. These include their accessibility and the technical viability of placing sediment. They were also selected because it is likely that, at these locations, a good proportion of the deposited sediment will remain where it is placed for sufficient length of time to achieve the desired benefits. Details about the site selection process and the proposed methods are provided later in this section.

There is also a strategic objective here. In keeping with the core vision of the BUDS programme, this proposal is seeking to show how existing practices can be changed and 'taken to the next level' and, in doing so, to describe the benefits that can accrue if they are. It is only by scaling up implementation, growing the practical evidence-base and communicating the lessons learned that increasingly large, ambitious and valuable beneficial use projects can be achieved (see also Section 2.10).

2.3 Placement method

2.3.1 Tidal elevation and vessel sizes

The proposed Pylewell and Cockleshell sediment placement sites extend over lower elevation mudflat areas from around the Mean Tide Level (MTL) at 2 mCD to below Mean Low Water Springs (MLWS) at around 0.5 mCD. This elevation range is comparable to the LHC bottom placement area at Boiler Marsh and the methods of beneficial sediment disposal at Pylewell and Cockleshell will, therefore, also be similar. Tidal ranges in the Lymington area are shown in Table 1.

Table 1. Tidal elevations at Lymington Tidal

Elevation	Chart Datum (CD)	Ordnance Datum (OD)
Highest Astronomical tide (HAT)	3.3	1.32
Mean High Water Springs (MHWS)	3.1	1.12
Mean High Water Neaps (MHWN)	2.6	0.62
Mean Tide Level (MTL)	2.09	0.11
Mean Low Water Neaps (MLWN)	1.5	-0.48
Mean Low Water Springs (MLWS)	0.7	-1.28
Lowest Astronomical tide (LAT)	0.1	-1.88

The Pylewell and Cockleshell sites will have to be accessed at high water on spring tides by split hopper barges. The barges will need to have enough water depth to approach and retreat safely and will need to be carrying relatively consolidated sediment that is mechanically dredged (e.g. by backhoe excavator) as opposed to sediment that is dredged hydraulically which will be too fluid to stay *in situ*.

Once at the deposit ground the hoppers can then deposit the sediment by opening the doors in the bottom of the barge. To maximise retention of sediment and create a protective bund feature it will be best to place material as high up the intertidal as possible. However, the placement locations can be made at a range of locations and will be influenced mainly by the size and draught depth of the barge being used. The potential options are set out in Section 2.3.2.

It is now known from practical experience at Boiler Marsh that smaller shallow-draughted barges (i.e. 60 to 100 m^3 carrying capacity, with a 1.5 to 2 m draught when loaded) can place sediment at and around the MLWN elevation (1.5 m above CD or 0.48 m below ODN). The main depths of placement occur across a zone between 1.1 to 1.7 mCD (or 0.9 to 0.3 m below ODN)[6] However, it is evident that some placements can also be made at higher elevations on favourable tides. The net effect has been to raise the bed levels at Boiler Marsh to around 2 mCD (or 0 m ODN) on average.

The zone of placement and heights reached by sediment placed at Boiler Marsh are illustrated in Figure 5. This plot shows topographic cross-sections through the island and the existing licensed deposit ground and illustrates how the placements occur around MLWN. The tidal elevations and tidal curves for Lymington Estuary are also shown in Figure 6.

[6] This placement zone around the MLWN elevation was translated into a single depth band for the whole frontage from Keyhaven to Lymington to inform the site section process (as shown in Figure 3 and discussed further within the review of alternatives in Section 2.6).

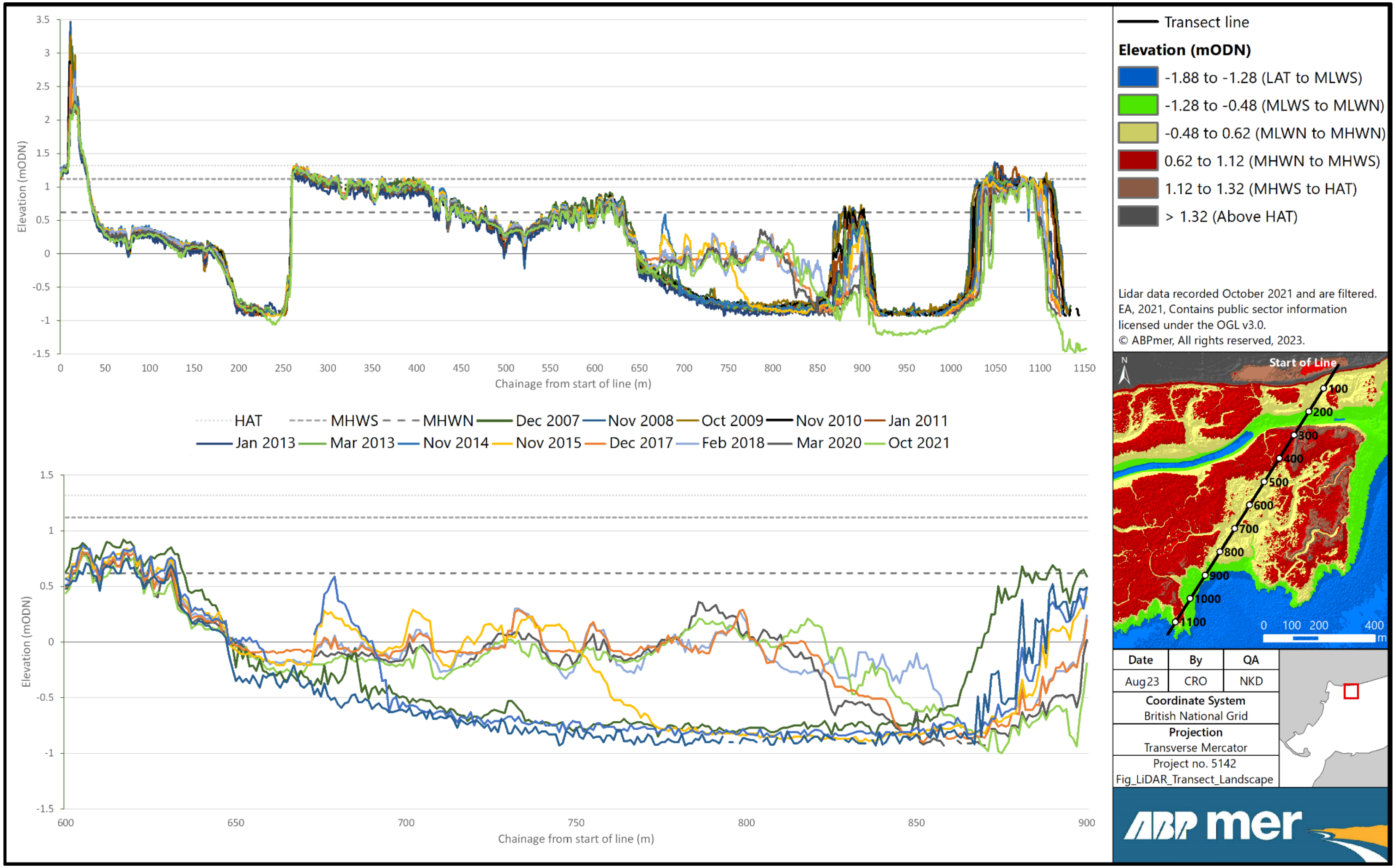


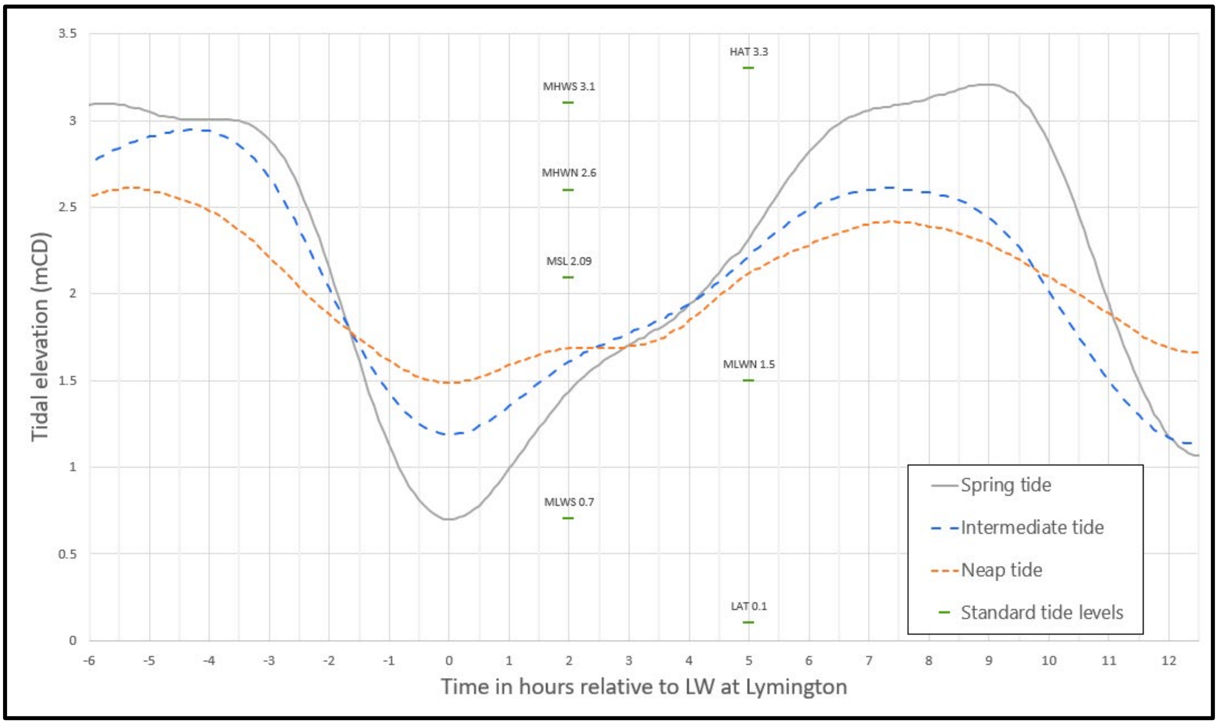
Figure 5 Cross section showing elevations of marsh and placed sediment (bottom: zoom into bottom placement chainage)

In a similar way to Boiler Marsh, sediment can be placed around the MLWN elevation at both Pylewell and Cockleshell using smaller barges. At Pylewell and Cockleshell, it may also be possible for some larger hopper barges (e.g. 300 to 450 m^3 capacity and 2 to 3 m draught when loaded) to access parts of the site because the licence application area extends down to around 0.5 mCD below MLWS. The potential placement locations are described further in the following section.

2.3.2 Disposal locations and phased strategy

The placement of sediment is proposed to be undertaken in phased manner at the proposed Pylewell and Cockleshell disposal sites. This will involve placing initial deposits at selected locations and then carrying out monitoring to verify the outcomes and, based on the outcomes, increasing the placement volumes. In general, it is proposed that the placements are made in a north to south or an east to west direction. This will maximise the chances for sediment retention while also ensuring (as will be critical) that early placements do not adversely affect site access for vessels during future phases of placement.

At Cockleshell, for example, initial deposits should ideally be placed at the northern (landward) part of the area and as high up the intertidal as feasible. This is the narrowest point between the Cockleshell and Normandy marshes and initial smaller scale placements could be made here to verify the persistence of the sediment at this location. The placement of sediment here would have to be done with the smaller (shallow draughted) barges with the retention of sediment then creating a bund across the intertidal that could start to rejoin these two fractured and separated marsh islands on either side (as would have historically been the case). This bund would further slow flows through the channel and facilitate greater sediment retention for the placements, possible using larger vessels, that then follow.



Generated from Admiralty Tide Tables

Figure 6 Tidal curves for the Lymington entrance

It will be necessary to avoid having substantial volumes of sediment entering the Yacht Haven Marina from the northern part of Cockleshell. The risk of this occurring is thought to be low. This is based on considering the configuration of the channels and relatively benign nature of the flows through this area (as indicated by the intertidal morphology). It is also relevant that a lot of movements will be immediately after each high-water placement, and this will be on the ebb tide that will carry sediment away rather than towards the Yacht Haven.

Based on these considerations, and experience at Boiler Marsh, it is expected that suitable sediment will largely remain in place at this location. However, to provide full reassurances on this matter, it should be verified by having an early study (under an agreed adaptive monitoring regime) that examines whether sediment moves north and potentially enters the channel that leads to the marina. This could be done through aerial drone surveys and selected water sampling.

The options of having different types of sediment retention structures or silt curtains were considered to further ensure that sediment does not migrate in large amounts to the Yacht Haven. At this stage though this has been ruled out because of the low perceived risk and the complexity and costs of such an action. If monitoring showed large movements of sediment through the area and out to the north, then sediment placements could be stopped, the volumes reduced, or the positions moved to the southern end of the Cockleshell areas. Alternatively, in the future, brush/bale fencing might be used at the back narrow section of the channel, if considered necessary, but options for any such fencing are not included in this proposal.

For the initial deposits at Cockleshell, it will be helpful if relatively consolidated sediment is chosen. The levels of consolidation will be evident during dredging and that information can be used to determine which loads are taken to Cockleshell. Once it is clear that the placed sediment is stable, and a bund is building up, then the volumes placed in this zone over time could be increased and greater volumes placed further south in slightly deeper parts of the ground. Decisions about how much would be placed in any given year would be based on the lessons learned and influenced by the availability of dredged sediment (see Section 2.4).

At Pylewell, there are no equivalent concerns of adverse effects from sediment dispersal, but it will be appropriate to ensure that drainage from the outfall at the top end of the Pylewell is not adversely affected. This can be done simply through ongoing monitoring of the changes after placement. Here, as with the Cockleshell site, it is also advised that the process is carried out in a phased manner. Initial placement could be made with smaller barges at the northern edge of the area. Then, based on how these initially placed sediments behave, the volumes of placements could potentially be increased and directed to other locations over time.

Fundamentally, the approaches at either site will be influenced by the sediment suppliers and the requirements of their own consenting arrangements. The key issue for this project is to clarify with the MMO how it will be managed and by whom. These issues and the sediment sources are discussed in the following section.

2.4 Sediment sources and supply

2.4.1 Dredging locations and volumes

What makes the Solent Forum project different from past initiatives is the expectation that dredged sediment could be received from a range of harbours and marinas in the West Solent. The sources could include Lymington, but also the other nearby harbours at Beaulieu, Yarmouth and Cowes[7] which are all less than 20 km away from the proposed disposal sites. In addition, dredge sediment could, under certain weather conditions, come from the Hamble or Southampton Water, although these sites are further away (more than 30 km).

The sediment that is dredged, during maintenance campaigns, from each of these potential source locations is fine silt and is expected to be suitable for deposition at Pylewell and Cockleshell (details about the baseline sediment composition at Pylewell and Cockleshell is presented in Section 4.5).

For each of these potential source locations, there are bespoke practical, environment and financial issues to be considered that will influence how much dredged sediment can be provided. The generic issues are discussed further in Section 2.5. However, the main considerations include whether the sediment from the source locations is suitable for placement, and that is affected especially by the methods of dredging and the size of the barge transporting the arisings. For example, where dredging is done using a trailing suction hopper dredger (TSHD), the sediment is fluid in the hold and not suitable for bottom placement.

These considerations will limit the amount that can be placed at Pylewell and Cockleshell. So, it is expected that only a proportion of suitable dredged sediment could be received from the suitable sources as and when it is both available and feasible to do so.

In summary, it is envisaged that around 29,000 wet tonnes (approximately 20,000 m^3) of muddy sediment could be available for beneficial use across the two sites from nearby harbours and marinas each year. However, in the short term, it is expected that a small proportion of this available material would be placed on a trial basis (perhaps no more than 12,000 wet tonnes (approximately 8,000 m^3) annually during the early years). This would follow an approach adopted at the Lymington Boiler Marsh site (as described further in Section 2.4.2). The volume that is deposited could then increase over time, based on the findings of accompanying monitoring programmes and changes in the approaches taken and equipment used at the dredging sites.

In part, this review was based on dredge volumes that are expressed in extant Marine Licences which were derived from using the MMO's public register on their Marine Case Management System (MCMS). These are typically indicative of the maximum volumes of material that are licensed for removal and therefore potentially available for the proposed beneficial use disposal sites. Actual dredge returns from each potential source location are likely to differ from the values stated in the Marine Licences and will vary over time in response to specific dredging needs. Rather than just rely on the licences, therefore, external consultations were also undertaken to indicate the realistic dredge volumes where possible.

There is also a fundamental expectation that the sediment is suitable qualitatively because maintenance dredging and offshore disposal are already licenced for the potential source locations. Further details about sediment quality at the potential source locations are provided below. It is understood that it will also be the responsibility of those carrying out the dredging at these source locations to be assured that that the sediment is of a suitable quality for disposal at the proposed beneficial use sites, in the same way that they currently do so for depositing dredge material at licensed offshore disposal sites.

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7 It is understood that, under MMO guidance (https://www.gov.uk/guidance/deposits#deposit-of-any-substance-or-object) if any disposal site is designated following a licence application and characterisation report, the applicant does not have exclusive use of that site. A licence may be granted to other operators to use the same location. However, we are not aware of an intertidal beneficial use site being used by multiple operators before. The intention of this Solent Forum application is to change that and encourage multiple operators to use such a site where it is feasible to do so.

2.4.2 Lymington River

Dredging activities

To maintain the marinas and harbour approaches at Lymington, LHC currently hold a licence (L/2014/00396/2) that allows for around 48,200 wet tonnes of fine sediment to be dredged and deposited each year. Of this, 38,200 wet tonnes can be placed annually to the Hurst Fort licensed disposal site (WI080). The current licence permits these placements until the end of 2024, but it is vital to the functioning of the harbour that this permission continues and so, a 10-year extension to this is being sought from the MMO (MLA/2023/00549). As described in Section 1.2, as a condition of the existing licence, up to 10,000 wet tonnes can be bottom placed at Boiler Marsh for beneficial use purposes.

A preceding licence (L/2014/00084/6) also provided permission for initial trials of these bottom placements at Boiler Marsh. These trials were undertaken between 2014 and 2016 with the licence allowing for progressive increases in the amount that could be placed annually (2,380, 7,000 and then 10,000 wet tonnes). These placements were summarised within recent monitoring reports that was prepared as a condition of the extant licence (ABPmer 2019, 2021, 2022a and 2023a). A summary of the amount of sediment placed each year is shown in Table 2.

Table 2. Intertidal bottom placement campaigns at Lymington over past nine winters

Years		Quantity (Wet Tonnes)	Quantity (m^3)	MMO Licence Ref.
2014	(Nov/Dec)	2,287	1,759	L/2014/00084/6
2015	(Nov/Dec)	6,883	5,295	
2016	(Oct to Dec)	9,942	7,648	
2017/18	(Nov to Jan)	9,286	7,143	L/2014/00396/2
2018	(Nov/Dec)	6,446	4,958	
2019/20	(Nov to Jan)	9,942	8,645	
2020/21	(Nov to Jan)	9,396	8,170	
2021/22	(Nov to Mar)	8,959	7,790	
2022/23	(Nov to Mar)	9,286	8,075	

Where volumes were made available as tonnages only for the LHC bottom placements, a 1.3 conversion factor for 'soft silt mud' (HELCOM, 2024) is used to provide an estimate in both units.

Source ABPmer (2023a)

Sediment quality

To underpin these activities and adhere to the required Marine Licences, regular analyses of sediment quality are carried out at several sites in Lymington Harbour to assess the nature and degree of any chemical contamination present (Black & Veatch, 2017a; Binnies UK Ltd, 2021, ABPmer 2023b). This is carried out every five years as per Condition 5.2.2 of Licence L/2014/00396/2).

The most recent sediment quality survey was undertaken in December 2019. Samples were collected from eight stations (4492707 to 4492714) across Lymington Estuary and harbour areas (see Figure 7). The sediment samples were then analysed by MMO-approved laboratories for the following physical and chemical parameters:

- Particle size analysis (PSA);
- Trace metals: Arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc;
- Organotins: Dibutyltin (DBT) and tributyltin (TBT); and
- Total hydrocarbon content (THC).

In summary, the levels of sediment contamination in the Lymington Estuary were found to be low (ABPmer 2023b). The majority of contaminants were below Cefas Action Level (AL) 1, and none of the sediment samples exceeded AL 1 for cadmium, mercury, lead, zinc or organotins. There were exceedances of AL 1 for chromium and nickel across all eight samples, but no exceedances of AL 2 for these metals.

The highest level of contamination was in the sample from 'Town Quay and Moorings'. This is the furthest upstream site, and the one that lies closest to potential anthropogenic sources of pollution such as surface runoff. The sample taken from this site exceeded AL 1 for arsenic, chromium, copper, nickel, and total hydrocarbon content. The results are very similar to those recorded previously in 2014, when arsenic and nickel slightly exceeded AL 1 in all locations, while lead slightly exceeded the AL 1 level at the 'Town Quay and Moorings' location (Black & Veatch, 2017a).

Particle size analysis (PSA) confirms that these sediments are predominantly silt, with smaller sand and gravel fractions. This material will be dredged and will be suitable for recharge. All but one sample remained below 1 % Gravel (>2 mm), with only the sample taken from 'Railside and main channel' containing 8.7 % gravel. The Sand (2 mm to 63 µm) portion of the samples never exceeded 17 %, with the greatest sand portion belonging to Sample 4492710, taken from the 'Horn Reach main channel'. Finally, the Silt fraction (<63 µm) contained proportions in the region of 80 % in all samples, with the greatest being observed to be 87.35 %, at the 'Harbour Master and Dan Bran Pontoon' site (ABPmer 2023b).

The next sediment quality survey is scheduled for 2024. A sample plan request to deliver this was submitted to the MMO (SAM/2024/00012) on 1 February 2024.

Figure 7 **Location of the sediment quality sampling sites in Lymington River (December 2019)**

Future use of Solent Forum sites at Lymington

For the last 12 years and more, the LHC has been actively pursuing and developing projects which beneficially use dredge sediment to enhance and protect the saltmarshes at Lymington (see Section 1.2). In the future, the LHC also intends to continue with their successful programme of bottom placing dredge sediment to protect Boiler Marsh as well as with additional habitat enhancement measures (as described in Section 1.2).

The LHC has also supported and informed the Solent Forum BUDS project. In future years, there may well be opportunities to provide some dredge sediment to the proposed beneficial use sites. In particular, the LHC are keen to see sediment placed at the Cockleshell site. This could help to reconnect the two now separated marsh islands at this location and start to recreate a single larger island feature (as was historically the case).

Initially placements at this location should be as small-scale trials (around 400 m^3 which is around four hopper loads) to understand the stability of the deposited material and be assured it does not enter the Yacht Haven Marina area in substantial quantities (Section 2.3.2). Over time, the volume placed here could then increase in response to the findings from the trials.

The saltmarshes either side of the proposed Cockleshell site provide protection to Lymington Harbour as well as being features of ecological value and seascape interest. They still have a relatively high elevation, which means that they are valuable, alongside Boiler Marsh, as one of the last viable saltmarsh bird nesting grounds in the West Solent. LHC are keen to support activities which will help maintain or enhance these important features and their benefits.

2.4.3 Yarmouth

Dredging activities

In Yarmouth Harbour, regular dredging takes place when required to maintain navigable water depths in mooring areas and the approach channel. For this ongoing and essential maintenance dredging requirement, the Yarmouth Harbour Commissioners (YHC) currently hold a Marine Licence (L/2014/00309/3). This was issued in 2014 and extends until November 2024. It permits in the region of 9,965 wet tonnes to be excavated annually from five different areas. This represents a limit of, roughly, 7,000 to 8,000 m^3 per year. The harbour is maintained on an 'as required' basis. The need for dredging is informed by the findings from regularly scheduled bathymetric surveys.

Generally, the maintenance arisings are taken to the Hurst Fort disposal ground or, if required, the Needles (WI090) disposal ground. The haulage distance to Hurst Fort is around 1.7 nm, while the distance to the Needles is around 8 nm. The transport distance to Hurst is relatively short, especially in the context of some of the large haulage distances experienced elsewhere in the Solent. Where larger amounts of sediment need to be dredged (i.e. for any capital deepening works), then these tend to be taken to the Nab disposal ground (WI060), which is around 27 nm from Yarmouth. This is infrequent however, and the last such capital dredge of the harbour and estuary was undertaken in 2018.

The maintenance dredge campaigns are generally carried out in the winter months and last for approximately two to three weeks (ABPmer, 2015). They are usually done by a backhoe excavator mounted on a self-propelled spud leg pontoon (see Image 3) and transported to the disposal site by a propelled hopper barge. In 2023, the Yarmouth Harbour Commissioners began to test the use of Water Injection Dredging (WID). This was undertaken by Van Ord in February 2023.

Sediment quality

Sediment quality analysis is carried out as required for these dredging operations. The results of past analyses were summarised within the Western Yar Estuary Baseline Document (YHC, 2011). This includes analysis by Cefas of samples taken between 1984 and 2007. This showed that contaminant levels did not exceed AL 2 over this period. These were occasional exceedances of AL 1 for cadmium, mercury and nickel between 1997 and 1999. Also, between 2004 and 2007 tributyltin (TBT) levels were above AL 1. The sediments were considered to be suitable for disposal at sea.

Future use of Solent Forum sites at Lymington

The YHC are keen to support the Solent Forum BUDS project and there may be opportunities to provide some dredge sediment occasionally to the proposed beneficial use sites. At the present time this is dependent on when dredging takes place and whether WID is adopted as the preferred dredge method (WID does not involve the disposal of dredge arisings at sea). The opportunities for enhancing habitats within the Western Yar are also being actively explored (ABPmer, 2023c).

2.4.4 Beaulieu River

Dredging activities

Buckler's Hard Yacht Harbour on the Beaulieu River is part of the Beaulieu Estate who are the responsible (non-statutory) navigation authority for ensuring that navigational safety is maintained on the river. Dredging was historically carried out at the site in 2001 and, due to reducing navigable depths, a new licence was obtained in 2018 to deepen and maintain the sites.

Copyright: Jenkins Marine

Image 3. Jenkins Marine's 'Doreen Dorward' self-propelled pontoon with excavator

A single licence in Beaulieu River is currently in operation (L/2018/00279/1). This covers an initial capital dredge of 15,000 m^3 between 2019 and 2021, and a maximum maintenance dredging requirement of 6,000 m^3 annually between 2021 and 2028. This annual maximum is to maintain the marina area and moorings located at Bucklers Hard. Material is exclusively silt and is currently licensed to be disposed of at the Nab Tower disposal site. Additionally, it is possible to deposit up to 10 % of material at both the Hurst Fort and the Needles licensed disposal sites. Some of this material could be placed at the proposed beneficial use disposal sites, although it is also understood that opportunities for beneficially using this material locally within the Beaulieu Estuary are being explored.

Sediment quality

Sediment quality analysis was carried out at three sites in Bucklers Hard Yacht Harbour on the Beaulieu River in 2017 and 2021 to support marine licensing requirements (L/2018/00279/1). Sediment quality analysis continues to be carried out as needed on dredged sediment, typically at 3 or 5-year intervals. To inform the 2021 sampling condition, sediment samples were collected to measure trace heavy metal and organotin concentrations. The data indicated that concentrations of trace heavy metals in the sediment were below Cefas AL 1. Dibutyltin (DBT) and TBT was also below AL 1 in all the samples. The PSA found that approximately 75 % of the material was in the 1.0 to 8.0 phi range (i.e., 3.9 μm to 0.5 mm range), which comprises clay, silt and sand. There are no recorded polycyclic aromatic hydrocarbon (PAH) results.

Future use of Solent Forum sites at Lymington

The Buckler's Hard Yacht Harbour are keen to support the Solent Forum BUDS project and there may be opportunities to provide some dredge sediment occasionally to the proposed beneficial use sites. At the present time there is the potential for a further maintenance dredge deployment under the current licence (L/2018/00279/1), which may result in a volume of up to 6,000 m^3 during the 2024/25 winter.

With the designated status of the Beaulieu River and the stewardship undertaken by the Harbour Authority and wider estate, there are ambitions for Buckler's Hard Yacht Harbour to deliver beneficial reuse, even where volumes are proportionally infrequent and modest within the Solent. Lessons from the Solent Forum trials at Lymington are expected to help with this process.

2.4.5 Cowes Harbour

Dredging activities

In Cowes Harbour, several sites need to be regularly dredged to maintain appropriate navigational depths. These include Shepards Wharf Marina, East Cowes Marina (Boatfolk), and Cowes Yacht Haven. Other locations are intermittently deepened, such as the UKSA Basin, Cowes Corinthian Yacht Club, Island Harbour and the Wight Shipyard.

There is no formal scheduling plan, but typically these sites are dredged every two to three years, and individual locations dredged in alternate years as required. The dredging is not, therefore, undertaken at all sites in any given year. East Cowes Harbour and Yacht Haven might be maintained one year and then the other locations dredged the following year. In recent years for example, East Cowes Harbour was dredged in 2020 and the Yacht Haven in 2019. Previous reviews have found that the volume dredged annually is variable but is typically around 12,000 to 14,000 m^3 (Nunny, 2020).

Intermittent and small-scale dredging is also undertaken at Island Harbour Marina on the east side of the estuary, upstream of Werrar Marsh. This sediment is currently taken to the Nab Tower disposal site, but this marina facility is looking to alternative and closer placement locations (to reduce fuel costs), including within the Island Harbour Marina itself.

There are also individual capital dredge projects that require greater volumes of dredging in any given year. This includes the recent dredging in the Eastern Approaches in 2019, which removed some 34,000 m^3 of mainly mud (Nunny, 2020). In 2021, a new capital dredge of Newport Harbour was also undertaken. The previous dredge at this site was 20 years prior to this latest campaign. Following completion of this campaign there are no scheduled plans to carry out maintenance dredging at Newport in the future.

Sediment quality

Sediment quality analyses is carried out as required for the various licensed maintenance dredging operations that take place at Cowes Harbour. For example, at the Town Quay Mooring Basin and Shepard's Wharf Marina (L/2016/00191/1) and at the Cowes Royal Yacht Squadron (RYS) Jubilee Haven location (L/2016/00132/1). These Marine Licences allow for the disposal of dredge material at Nab Tower, and at Hurst Fort during adverse weather conditions.

To support both these licences, three sediment samples were collected in 2015 to measure trace heavy metal and organotin concentrations. The data indicated that concentrations of trace heavy metals in the sediment were below Cefas AL 2. Arsenic and nickel showed elevated levels above AL 1 at all three sites; while cadmium, copper, lead, mercury, zinc, DBT and TBT were below AL 1 levels at all three locations. PSA was also undertaken at the three sample locations. The data shows that sample location one comprised of slightly sandy mud (18.7 % sand, 16 % very fine sand and 81 % silt/clay). Sample two comprised of sandy mud (27.2 % sand, 25.5 % very fine sand, and 72.5 % silt/clay). Lastly, sample three also comprised of slightly sandy mud (22.6 % sand, 20.8 % very fine sand, and 77.3 % silt/clay).

Sediment quality analysis was also carried out in the Cowes Harbour as part of the marine licensing requirements for a navigational capital dredge, and thereafter, annual maintenance dredge activities (L/2018/00459/1). This Marine Licence allows for the dredged material to be disposed at the Nab Tower and Hurst Fort disposal sites.

To support this Marine Licence, three sediment samples were collected in 2018 to measure trace heavy metal and organotin concentrations. The data indicated that concentrations of trace heavy metals in the sediment were below Cefas AL 2. Nickel, lead and mercury were below AL 1 in two samples, however, exceeded AL 1 in one sample location each; while arsenic, cadmium, copper, zinc, DBT and TBT were below AL 1 in all three sample locations. The PAH results in the 2018 dataset showed elevated levels above Cefas AL 1 for fluoranthene in three samples. C3-naphthalenes, diben(ah)anthracene, and pyrene were below AL 1 in the three samples; for benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene and ideno(1,2,3-cd)pyrene, one sample was elevated and two were below AL 1.

Additionally, PSA was undertaken at the three sample locations. The data shows that Sample 1 comprised of slightly gravelly, slightly sandy, mud (0.47 % gravel, 8.27 % sand, and 91.28 % mud). At this location, there was a relatively equal distribution between particles of size 88.39 μm to 1.95 μm inclusive. Sample 2 comprised of muddy gravel with a small amount of sand (18.71 % mud, 70.2 % gravel, 10.98 % sand). Lastly, Sample 3 comprised of muddy gravel with a small amount of sand (15.02 % mud, 75.22 % gravel, 9.76 % sand).

Future use of Solent Forum sites at Lymington

The Cowes Harbour Commission are keen to support the Solent Forum BUDS project, and there may be opportunities to provide some dredge sediment occasionally to the proposed beneficial use sites. There are several dredging locations in Cowes Harbour that could provide a reliable source of suitable sediment for this and other future beneficial use projects. Opportunities are also being explored for beneficial use in the Medina itself. This includes a small project on Werrar Marsh. Lessons from the Solent Forum trials at Lymington are expected to help with this process.

2.4.6 River Hamble

Dredging activities

The River Hamble is a major recreational harbour adjoining Southampton Water. A home to 3200 vessels afloat, it is an internationally recognised centre for yachting and motorboating, as well as a popular destination and launching point for visiting craft (HCC, 2024). To maintain adequate water depth in the various boat yards and marinas, maintenance dredging must be undertaken for the most part on an intermittent basis.

A review of dredging activities from the late 1980s to 2010 found that the total volume of sediment dredged from the estuary was around 19,400 m^3 each year. If capital dredging is excluded, the annual maintenance dredge average was about 16,000 m^3. Currently, the following licensed maintenance dredging activities are in operation in the River Hamble:

- **Swanwick and Universal Marinas (Premier Marinas):** licensed to remove 15,000 m^3 annually across both sites until 2034 (L/2023/00362/1);
- **Mercury Yacht Harbour (Marine Developments Ltd (MDL)):** licensed to remove 7,500 m^3 annually until 2026 (L/2016/00323/1);
- **Hamble Point Marina (MDL):** licensed to remove 7,500 m^3 annually until 2026 (L/2016/00318/1);
- **Port Hamble Marina (MDL):** licensed to remove around 7,500 m^3 annually until 2026 (L/2015/00381/1); and
- **Hamble Yacht Services**: licensed to remove a total of 12,000 m^3 (maximum of 6,000 m^3 per campaign) until 2028 (L/2018/00485/1).

These licensed volumes, typically, represent a maximum allowable. In practice, the actual dredge commitment each year is lower than the licensed volumes (RHHA pers. comm.). The routine annual maintenance dredge requirement at Mercury Yacht Harbour, Port Hamble Marina and Hamble Point Marina equates to around 3,000, 5,000 and 6,000 m^3 respectively. The dredging at Swanwick Marina is also intermittent. Typically, for example, at the MDL marinas, there is an annual dredge over a third of each marina every year (i.e., there is a repeat of the same sections every third year). The Mercury and Port Hamble sites sometimes skip a year, but Hamble Point tends to be every year (RHHA pers. comm.).

Capital dredging and periodic maintenance dredging has also been carried out at other marinas on the Hamble, although less frequently. For example, the Royal Southern Marina undertook a capital dredge around ten years ago and last winter 2022/23, did their first resultant maintenance dredge. Up to 2,000 m^3 was licenced to be removed as part of this maintenance campaign until August 2023 (L/2022/00054/2).

Sediment quality

Material from the dredge source locations of these various licensed activities is mainly fine silt with some firmer clay depending upon the locations and frequency of maintenance. This material is currently disposed at the Nab Tower, Hurst Fort or Needles licensed disposal sites. The Hurst Fort deposit site is used in bad weather, but otherwise, the material predominantly goes to the Nab. Sediment quality analysis is carried out as required for these dredging operations.

For example, the three samples tested for the Swanwick and Universal Marinas in 2023 (L/2023/00362/1) returned slight exceedances of AL1 for copper, nickel and zinc; and individual samples also just exceeded AL1 for mercury and lead.

Future use of Solent Forum sites at Lymington

The River Hamble Harbour Authority has been actively involved in, and supported, the Solent Forum BUDS project. On an ongoing basis, there will be maintenance dredge arisings that are taken from marinas in the Hamble which could be technically suitable (in terms of sediment grain and quality) for placement at the two proposed beneficial use sites.

For these maintenance dredging activities, the opportunities for the beneficial reuse of sediment will continue to be explored, however there will be technical issues to consider. The vessels used in the Hamble have a relatively deep draught because they need to be able to navigate to the Nab Tower disposal site. As such, they will not be able to reach the higher elevation parts of the intertidal areas within the proposed beneficial use sites. There will also be challenges with timing activities to reach the disposal sites at the correct tidal state tide (spring tide high water) given the distances involved. The RHHA will learn the lessons from the Solent Forum trials at Lymington to understand the practicalities of delivering any sediment to the site in the longer term.

2.4.7 Other possible sources

In addition to the harbours listed above, there are other locations from which sediment might be sourced. This includes the Esso Fawley Terminals or the BP Oil jetty.

Sediment quality analysis has been carried out at several sites at the Fawley Marine Terminal as part of the marine licensing procedure for the disposal of maintenance dredged material at the Nab Tower disposal (L/2016/00108/1). In 2015, for example, seven sediment samples were collected to measure trace heavy metal and organotin concentrations.

The data indicated that concentrations of trace heavy metals and organotins in the sediment fall well below Cefas AL 2. However, arsenic and nickel both showed elevated levels above AL 1 in six locations, and below AL 1 in one location each; chromium showed elevated levels above AL 1 in five locations and were below in two locations; copper, lead and zinc all showed elevated levels above AL 1 in three locations and were below in four locations each; cadmium, mercury DBT and TBT were on below AL 1. There was also further sediment quality sampling undertaken in 2022. There was no PAH data gathered.

PSA was also undertaken at the seven sample locations. The data shows that sample location one, six and seven comprised of sandy mud (19.89, 24.97, and 20.04 % sand respectively; 80.11, 75.03, and 79.96 % silt/clay respectively). Sample two, three and four comprised of slightly gravelly, sandy mud (24.98, 34.17, and 22.24 % gravel respectively; 55.36, 50.08, and 56.94 % sand respectively; and 19.66, 15.76, 20.82 % silt/clay respectively). Sample five comprised of slightly sandy, slightly muddy gravel containing (24.97 % sand, 19.92 % silt/clay, and 68.44 % gravel).

Sediment quality analysis was carried out at the BP Oil jetty and approaches in Southampton Water as part of the marine licensing procedure for the disposal of maintenance dredged material at Nab Tower disposal site (Licence L/2017/00105/1). This was carried out to assess the nature and degree of any chemical contamination present. The one sample taken in 2016 was collected to measure trace heavy metal and organotin concentrations. The data from the one sample recorded indicated that concentrations of trace heavy metals and organotins in the sediment are well below Cefas AL 2. Nickel slightly exceeded AL 1; while, arsenic, cadmium, copper, lead, mercury, zinc, DBT and TBT were below ALs. There are no PAH or PSA results in the sample data.

2.5 Practical considerations

2.5.1 Changing existing ways of working

The preceding sections have described the potential sediment sources/suppliers which could use Pylewell or Cockleshell as deposit grounds. It is recognised though that for each of them there will be practical considerations relating to how, when and whether sediment from these source locations can be used. These issues are reviewed below.

When considering these issues it is recognised that the Solent Forum BUDS project is seeking to address these issues and achieve a systematic change to established practices and ways of thinking. The difficulties with realising this change and using dredge sediment to recharge marshes are real and have been understood for years. They are also rehearsed regularly in reviews and guidance documents (PIANC Envi Com, in prep; Manning *et al.*, 2021; Bell *et al.*, 2021; CEDA, 2019; CEDA UK, 2019; PIANC, 2009). This is not unique to the Solent or the UK but is, instead, a well-understood international challenge.

The BUDS project is seeking to address this challenge and change the way in which the placement of dredge sediment is thought about and managed in the Solent. It is a unique project in this respect and a precedent for similar work in other locations (whether regionally, nationally or even internationally). Certainly, over the last few years the Solent Forum BUDS project has become a cited example of how change might be brought about. The lessons emerging from it have been shared nationally and internationally, to achieve greater impetus for, and benefits from, reusing dredge sediment both within the Solent and beyond.

This lesson sharing has been pursued through a range of conferences and reviews during the last few years. For example, the Solent Forum BUDS project is highlighted in the Environment Agency's new handbook on beneficial use of dredge sediment (Manning *et al.*, 2021[8]). It has also been described in a range of other recent, and emerging, national and international reviews about beneficial use (PIANC EnviCom, in prep; CEDA, 2019; CEDA UK, 2019; RSPB, 2018). Furthermore, the strategic approach that has been taken for the Solent Forum BUDS project, is now also being applied In Essex for the Blackwater Estuary Partnership (led by Essex Wildlife Trust) (ABPmer, 2022c).

It recognised though that achieving such change is not simple. It requires ongoing and active strategic oversight. This is needed to facilitate cross-sector collaboration/communication; fully understand available sediment resources; and prioritise habitat restoration options. It is also understood that any change will take time and incur additional fees for consenting, equipment management and monitoring. Despite this, a major next step forward will be to licence the two proposed beneficial use deposit sites at Pylewell and Cockleshell so that they can be used, or at the very least be considered for use in the future.

2.5.2 Whether existing vessels can be used

One key consideration is that the sediment needs to be placed relatively high up the shore at Pylewell and Cockleshell to achieve the maximum benefits. Therefore, these two sites can only be accessed by certain types of smaller split-hopper barges that have shallow draughts and only on certain tides (high spring tides). This will limit the type vessels that can access and the times that the sites are accessible for deposition.

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8 See Box 2.1 page 35 of this handbook (Manning *et al.*, 2021) for a summary of the BUDS project. Available at: https://catchmentbasedapproach.org/learn/restoring-estuarine-and-coastal-habitats-with-dredged-sediment/ (accessed May 2024).

The type of vessel being used already (and the nature of the existing dredging actives) therefore influences the costs and practicalities of delivering sediment to Cockleshell and Pylewell. Most of the 1 million m^3 of excavated material in the Solent annually is dredged using large dredgers or transported using large hopper barges. The large dredgers are not able to easily discharge their materials at the Solent marshes without the need for both specialist discharge equipment and substantial sediment-retaining infrastructure at the receptor site(s).

The larger hoppers would also not be able to access the Cockleshell and Pylewell sites due to their size (vessel draught). At Cowes and on the Hamble relatively large hopper barges are used because of the need to transport sediment to the Nab Tower disposal site. At these potential source locations therefore additional smaller barges might well have to be hired, at cost, if any sediment were to be transported to the proposed Cockleshell and Pylewell sites.

Smaller hopper barges are, however, usually used in Lymington, Beaulieu and Yarmouth. These could readily be used at Cockleshell and Pylewell without the need to bring in new equipment.

2.5.3 How the projects alter transport distances

A key practical aspect to consider with respect to the proposed Cockleshell and Pylewell sites is the extent to which placing sediment at these sites changes the haulage distance and fuel costs of existing dredging and disposal operations. The above-listed harbours already send at least some of their materials to the nearby Hurst Fort deposit ground. This is especially true for Lymington, Beaulieu and Yarmouth who place some or all of their dredge arisings at this licensed disposal site. For these three harbours therefore, there will be modest changes (and in some case potential reductions) in the transport distances by using the Cockleshell and Pylewell sites instead of Hurst Fort that could lead to limited change or some improvements to fuel costs

For Cowes Harbour and sites on the Hamble the sediment is generally taken to the Nab Tower deposit ground or placed at Hurst Fort under certain conditions (e.g. adverse weather conditions). Vessel size and differences in transport distances are also interlinked factors. This is because larger open water hoppers are required to reach the more exposed Nab Tower site. By contrast smaller inshore-operating hoppers can be used at the Hurst Fort site. This means that while the transport distance might be reduced if sediment dredged at Cowes were to be deposited at the proposed beneficial use sites, there would be a need (as described in the preceding section) to introduce some new smaller hopper vessels that would incur an additional cost.

2.5.4 The need to work within defined tidal windows:

The sediment deposits at the proposed beneficial use sites will have to be made at high water on the larger spring tides to ensure that the sediment is placed as high up the shore as possible (as described in Section 2.3.1). This means that there will be a limited period of time during which the sediment can be placed in any individual dredging campaign. Where individual dredging campaigns are being carried out and where they will direct some sediment to the proposed disposal sites, then the timing of the dredging and delivery at the proposed beneficial use sites will have to be carefully planned to achieved the beneficial placement.

It will already be the case that dredging operations are timed around tidal conditions, and in many instances there can also be tidal constraints on the disposal operations. The placements of sediment from Lymington at the licensed Hurst Fort disposal site for example, have to be carried out during the first four hours of the ebbing tide (L/2014/00396/2) to minimise the risk of smothering of designated shellfish beds.

Planning for, and making any adjustments to, existing dredging practices should not be too onerous in many instances. However, changes to dredging operations may be more substantial in some instances including where there are long haulage distances from the dredge locations to the disposal sites.

2.5.5 The potential for vessel damage

As the hopper barges would be operating in shallow depths, there is the potential for the sediment disposal to cause damage to features such as the propellor. Concerns have been expressed about this aspect as part of the ongoing LHC bottom placement work at Boiler Marsh. However, the operational activities at Boiler Marsh have proven to be effective and regular placements are being made there without any issues arising. It will be important therefore for suppliers of sediment to the proposed beneficial use sites to be aware of the practical techniques that are being followed for the LHC work and recognise how these have been overcome.

2.5.6 The need to update existing disposal consents and practices

If Pylewell and Cockleshell sites become licensed disposal sites, this will be a signal that existing practices are changing in the Solent, and will be a successful outcome for Phase 3 of the Solent Forum BUDS project. This licensing on its own, however, will not be enough to ensure that the proposed sites are used. That will need to be done through the ongoing licensing of dredging and disposal activities in each of the relevant harbours identified in Section 2.4.

2.6 Review of alternatives

The preceding sections have described how the Solent Forum BUDS project has been developed progressively over several years and in several sequential phases. This illustrates how the consideration of alternatives has been a fundamental part of the process. Phases 1 and 2 were pursued to identify the areas where habitat restoration could and should be undertaken, which identified the Hurst Lymington frontage as the preferred area to focus.

Phase 3 has then narrowed the focus onto two final and relatively localised disposal sites where sediment could be bottom placed. The map shown in Figure 3 was used to review and consult upon the options and ultimately select these two sites. Figure 3 was produced to describe the bathymetric contours along this section of the coast and highlight the zone between 1.05 and 1.7 mCD which is the accessible and optimal zone for bottom placing sediment from shallow draughted split hopper barges between Hurst Spit and Lymington[9]. The most accessible part of this zone will be along its seaward edge between 1.05 and 1.1 mCD as distinguished on Figure 3.

The map shown in Figure 3 was reviewed and further discussed at the stakeholder workshop on 12 October 2021. During this process several different locations and technical approaches were considered. Other sites that were considered included sites inside Lymington Channel at Tanners Lane and further towards Keyhaven at Stoney Point.

Particular thought was given to Tanners Lane as a potential candidate site because this is also accessible and was also seen to be a suitable receptor site. However, following a site inspection it was found that the sediment is relatively coarse at this site. Not only will this sediment type be incompatible with fine

9 In creating this map it was recognised that tidal elevations change along the Hurst to Pitt's Deep saltmarsh frontage. The tidal range increases by around half a metre between the two points. This difference was highlighted by Ke and Collins (1993), who noted that the level of Mean High Water increased '*from 2.2 m to 2.7 m [Chart Datum (CD)] to 2.6 to 3.0 m [CD]*' between Keyhaven and Lymington.

deposited dredge materials, it indicates that the hydrodynamic conditions are unlikely to be suitable for retaining such material.

The two proposed beneficial use sites at Pylewell and Cockleshell were selected because they are likely to be the most suitable and accessible. In the future this map can be used to identify future bottom placement sites in addition to those identified as part of Phase 3 of the Solent Forum BUDS project. Informed by the successes of the LHC bottom placements, therefore, a similar bottom placement approach is proposed to be adopted at Pylewell and Cockleshell to have wider benefits for more of the saltmarsh areas. It may be appropriate to reconsider Tanner's Lane and other sites in the future.

The two sites identified during this BUDS Phase 3 review, and for which consent is being sought, are therefore, considered to be the best locations for disposal at this time following a long term and thorough review. They are comparatively modest in size and scale but still represent an advancement of the current situation because they will allow more sediment from more sources to be placed on the eroding marshes at Lymington. There are other sites that are more exposed, less accessible and are likely to require more substantial volumes of sediment. These are not considered to be suitable at this time but in the near future there may well be a need for a larger and more ambitious beneficial use project. This future vision is discussed in the Section 2.10.

2.7 Stakeholder consultations

The importance of early and regular engagement with the MMO for any Marine Licence Application is understood. For the Solent Forum BUDS project, working collaboratively and developing partnerships is also a fundamental element and is vital to its success. The project is therefore being overseen by a Technical Group that includes representatives from the Solent Forum; Natural England (NE); the Environment Agency; LHC; Lymington Technical Services; River Hamble Harbour Authority (RHHA); New Forest Distinct Council (NFDC); and Associated British Ports (ABP).

In addition, a wide range of other stakeholders have participated in, and provided advice for, both for this Phase 3 stage of the Solent Forum BUDS project and throughout the development of the project. Phase 3 of the Solent Forum BUDS project has in particular included consultation with the New Forest National Park Authority (NFNPA); The Hampshire and Isle of Wight Wildlife Trust (HIWWT), the RSPB, Cowes Harbour Commission, and Beaulieu Harbour. The following key consultation events have also been undertaken:

- **21 June 2021:** Meeting with MMO Senior Licensing Case Manager) online;
- **22 July 2021:** Meeting with LHC online;
- **30 July 2021:** Meeting with Natural England;
- **9 September 2021:** Meeting with Environment Agency and JBA;
- **12 October 2021:** Project workshop with a range of stakeholders;
- **15 December 2021:** Sample plan request issued to MMO SAM/2021/00081;
- **6 July 2022:** Meeting with Hampshire County Council ecologist;
- **11 March 2022**: Sample plan received from MMO (ENQ/2022/00101);
- **22 July 2022:** Meeting with MMO Senior Licensing Case Manager at Newcastle Offices;
- **2 November 2022:** Presentation to the Solent Forum Natural Environment Group which includes several key stakeholders, including Natural England and the Environment Agency; and
- **14 and 20 march 2023:** Follow up consultations with the technical group and stakeholders.

In addition to these specific discussions, stakeholders have also been regularly consulted about dredging and beneficial uses activities in Lymington and more widely. This has included consultation on the update to the Lymington Harbour maintenance dredge baseline review (ABPmer 2022b) which is included in Appendix C and for the separate proposed restoration on Boiler Marsh (ABPmer, 2023d).

More widely the project team has been heavily involved in national events and discussions about beneficial use and this included participating in the Environment Agency-led national Beneficial Use Working Group (BUWG) of which ABPmer is a member.

2.8 Site visits and surveys

To inform this Environmental Appraisal and disposal site characterisation assessment, several site visits, surveys and data collation exercises were undertaken to describe the proposed beneficial use disposal sites at Pylewell and Cockleshell. These included the following:

- **Sample Plan surveys** (December 2019 and November 2021). To describe the seabed composition in the proposed beneficial use disposal sites, and fulfil requirements of agreed sampling plan strategies (see Section 2.8.1 and Appendix B), surface sediment samples for PSA were taken from each of the proposed disposal sites;
- **Benthic invertebrate surveys** (July 2022). To characterise the mudflat habitat in the proposed disposal sites, quantitative surface sediment samples were taken from six locations (three in each proposed disposal site) and the infaunal species in each sample identified to species level (where possible) at a specialist laboratory;
- **Site visit** (May 2022). To view the deposit ground and consider the proposed approach an extra site visit was made to the proposed Cockleshell recharge zone;
- **Aerial drone imagery/habitat surveys (**November 2021 and July 2022). To describe the habitats and the vegetation cover at the proposed disposal sites and surrounding areas bespoke aerial drone surveys were undertaken by ABPmer at each location;
- **Analysis of Environment Agency LiDAR data.** To further describe the morphology of the proposed disposal sites and the rate at which the existing marshes are eroding in the surrounding area, available Environment Agency LiDAR data was reviewed.
- **Collection of bird surveys data from the BTO WeBS**. To describe the abundance of overwintering bird species in the area, data from the Wetland Bird Survey (WeBS) programme was obtained; and
- **Breeding bird records from Hampshire County Council (HCC).** To describe the value of the marshes for breeding birds, the HCC ecologist was consulted, and a recent HCC monitoring report of breeding birds was obtained and reviewed.

The areas covered by these surveys and the sampling site locations are shown in Figure 8. Collation of the results from past studies to describe the baseline environmental conditions in the estuary and on Boiler Marsh are also shown on this plot. The results of the drone surveys are shown in Figure 9 and Figure 10.

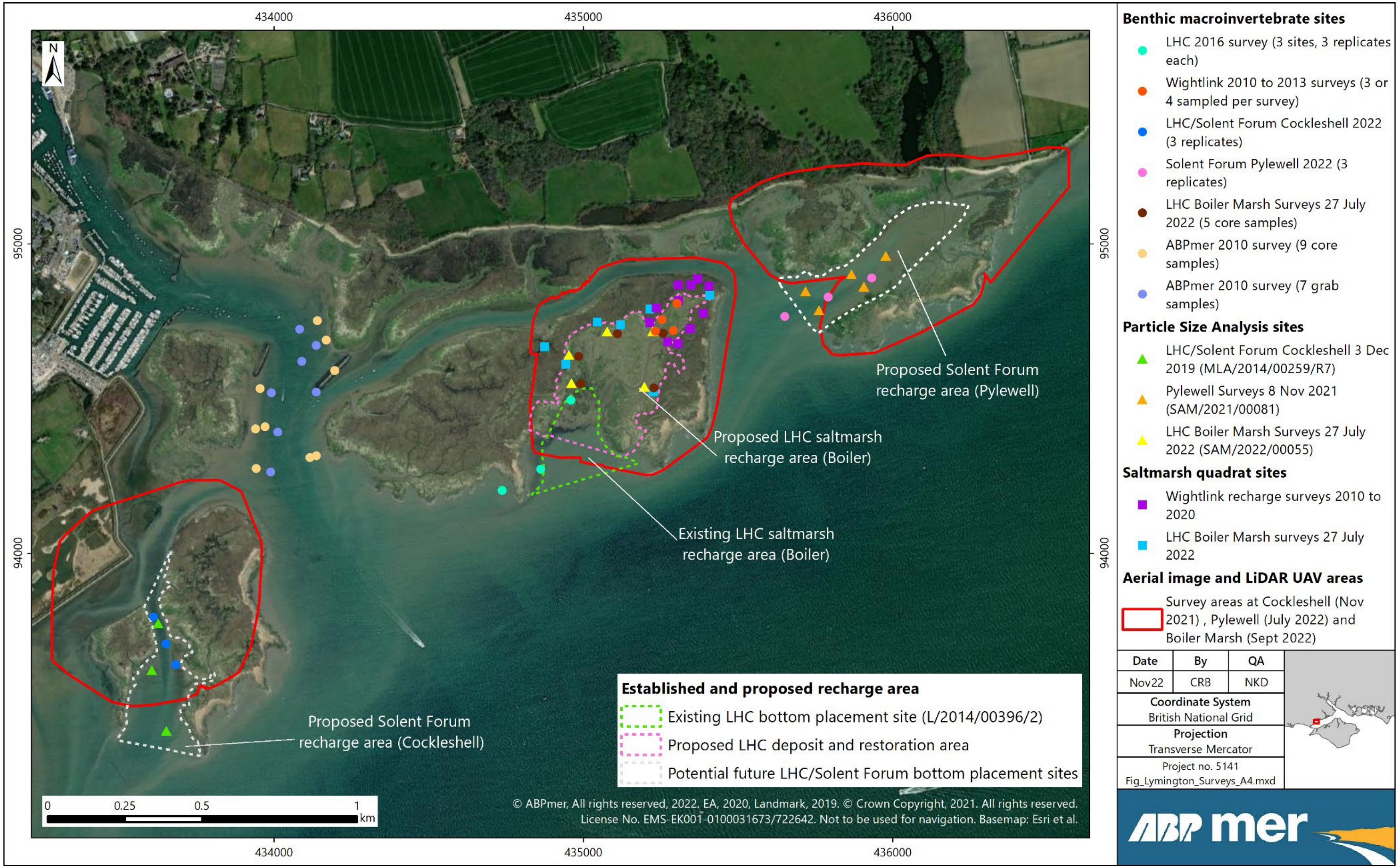


Figure 8. Survey locations used for describing baseline conditions at proposed beneficial use disposal sites

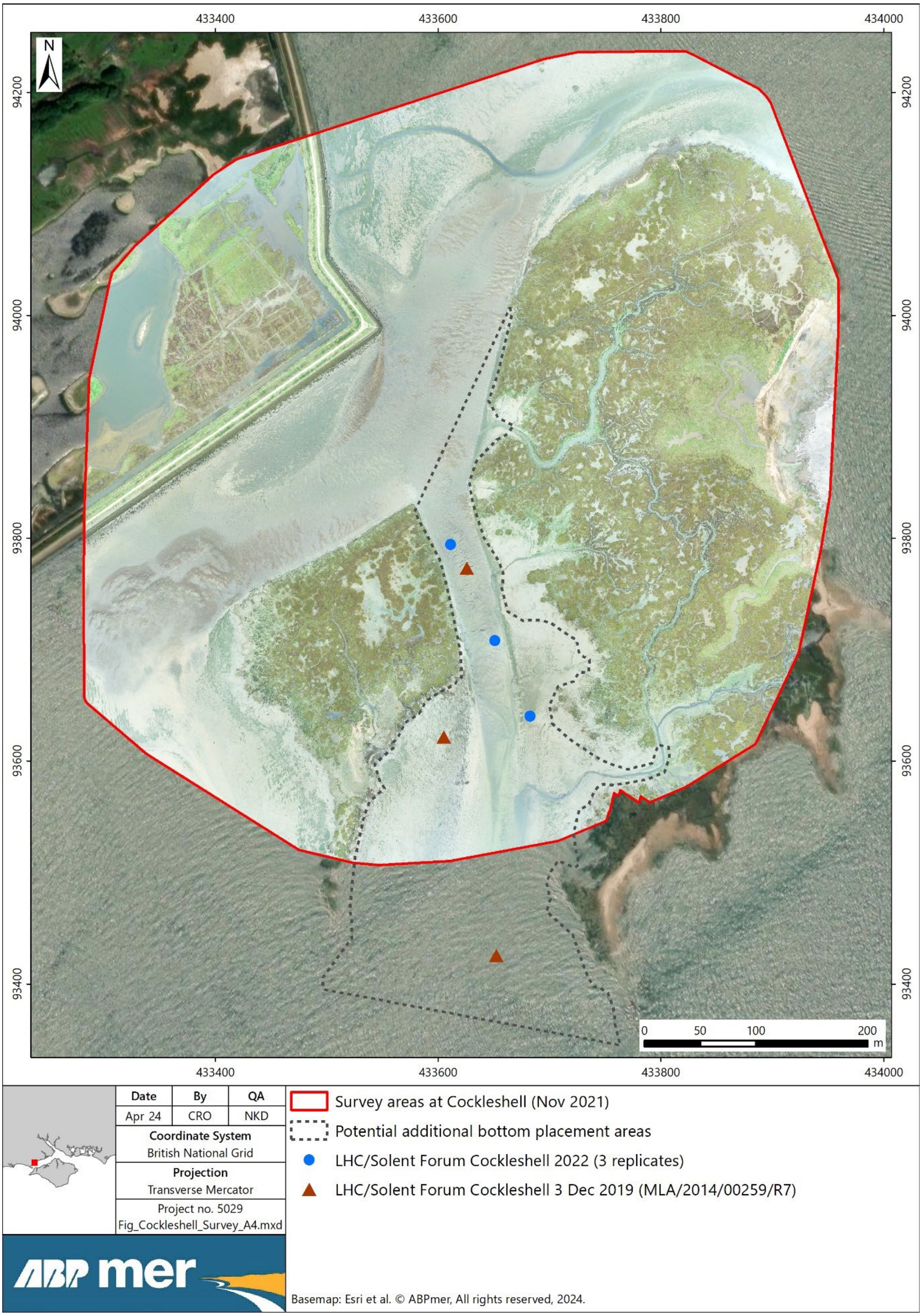


Figure 9. Photogrammetric map of Cockleshell deposit site and marshes

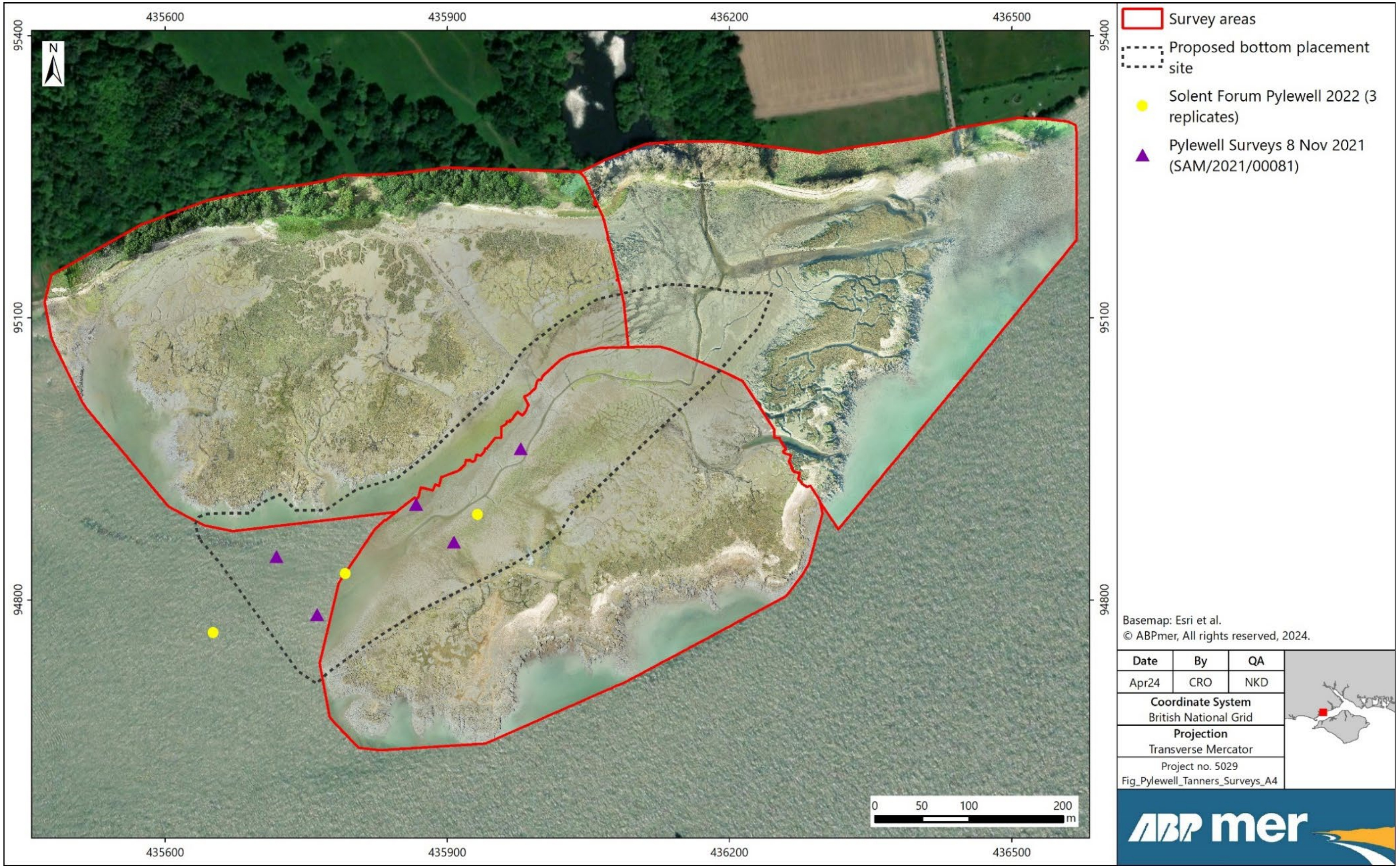


Figure 10. **Photogrammetric map of Pylewell deposit site and marshes**

2.8.1 Sample plan

In accordance with published guidance, and as shown in Image 2, the main initial stages before preparing a disposal site characterisation assessment involve implementing a sample plan. This plan is requested from the MMO and Cefas, and then sampling and analysis is undertaken in accordance with that plan. This sample plan stage was carried out separately for each of the two proposed disposal sites.

For the Cockleshell site, the sample plan stage was carried out prior to the commencement of Phase 3 of the Solent Forum BUDS project. This is because the LHC had identified this site as a potential deposit ground and had already submitted a sample plan request to the MMO (SAM/2019/00042 as a variation to their Marine Licence L/2014/00396/2). Following the provision of this sample plan by the MMO, the survey was carried out on 3 December 2019. Three samples were collected for PSA by an approved laboratory. The sediment analysis results were issued to the MMO in the required MMO results template, and a formal acknowledgement of this submission was received on 24 June 2020 (see Appendix B).

The sample plan survey for Pylewell was undertaken in November 2021[10]. Five sites were sampled and were subject to PSA by an approved laboratory. The sample plan requirements for the Pylewell site were discussed with the MMO, and a sample plan request submitted in December 2021 through the MMO's MCMS. This request included a stand-alone report (ABPmer, 2021) which described and provided background to the beneficial use proposals.

A sample plan was then formally received from the MMO on 11 March 2022 (SAM/2021/00081), and this is included within Appendix B. It was then agreed with the MMO, at the pre-application meeting on the 2 July 2022 (see consultations details in Section 2.7), that the sediment analysis results could be included in this report in support of the Marine Licence Application and did do not need to be issued separately to the MMO. These sediment analysis results are included in Appendix B in the required MMO results template.

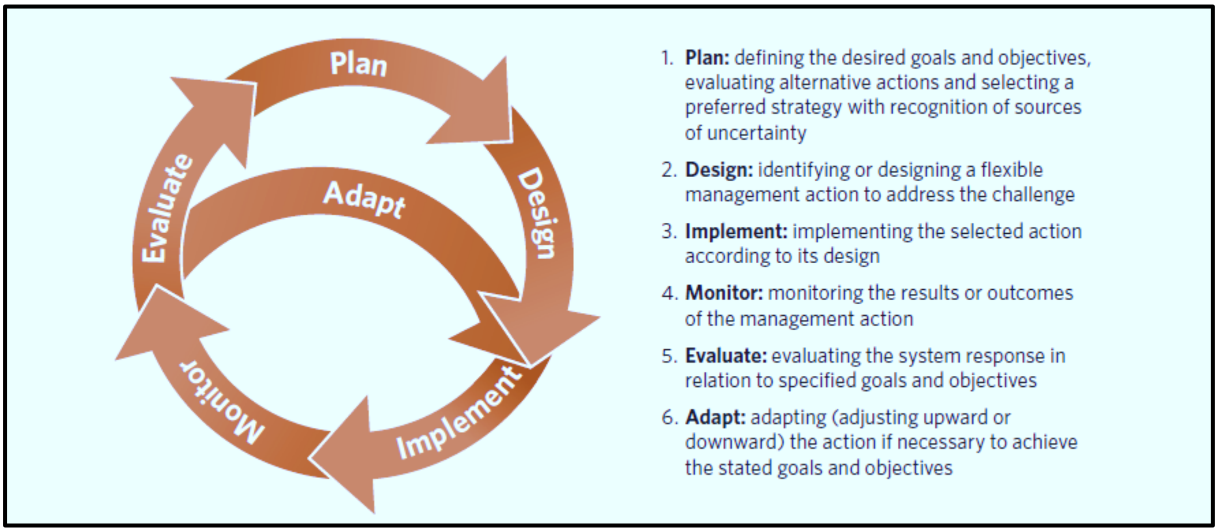
2.9 Adaptive Management

The proposal of placing relatively consolidated fine dredged sediment at the leading edge of a deteriorating marsh habitat is relatively new but no longer unique. The existing LHC bottom placement initiative has already shown that this approach works (Section 1.2). This provides valuable confidence in the approach.

Notwithstanding this, any new site that is used will be accompanied by some uncertainties. This includes uncertainties about the level of sediment persistence. It is recommended therefore, as best practice, that an adaptive management approach is applied to deliver this project. Adaptive management is an evolving process of phased 'learning by doing' that is carried out to provide assurance regarding the effects and effectiveness of proposed actions. It is a well-established approach to managing natural resources and complex coastlines and issues.

The generic processes and concepts of adaptive management are described in 0. It essentially consists of a rolling and iterative process which includes targeted monitoring, regular evaluation and informed management actions that are undertaken on a regular basis during a project's delivery (see Image 4). This process informs the project and addresses potential risks and impacts.

10 This was carried out in advance of a formal agreement from the MMO but was done in a deliberately robust way (with more than the anticipated number of samples required) in order to be assured, based on past experience of other disposal sites, that it would more than meet the MMO's requirements.



Source: originally from CEDA (2015) and reproduced in Manning *et al.* (2021)

Image 4. Illustration of the adaptive management cycle

Adaptive management is defined as a way of "*managing complex coastal areas by monitoring changes and acting on them in a planned but flexible way, increasing our understanding over time*" (Environment Agency, 2009). Adaptive management is also a recognised mechanism for pursuing developments and activities in areas of conservation value while having certainty that important ecological features will not be adversely affected (CIEEM, 2018).

For the proposed beneficial use disposal sites, the adaptive management process will need to incorporate monitoring and consultations with key stakeholders. The details of the monitoring programme can be reviewed as the appropriate disposal licences are developed but in essence it needs to include the following:

- **Seabed topography/bathymetry studies:** These will involve surveys of intertidal seabed elevations across the proposed disposal sites and surrounding habitats using mainly available LiDAR surveys but also occasionally bathymetry surveys. These can be used to assess how the marsh habitat levels are changed after each survey; and
- **Saltmarsh habitat surveys:** This will involve aerial imagery drone surveys across the proposed disposal sites to determine how the habitats are altered and especially describe changes in the extent/evolution of the surrounding saltmarsh habitat.

These surveys are expected to provide the core of the monitoring programme, and it is likely that both the seabed topography and vegetation cover can be very effectively, and non-invasively, described at the same time through ongoing LiDAR/drone surveys. More details about these techniques are provided in Section 2.8. Comparable surveys of the existing and proposed LHC deposit grounds on Boiler Marsh are expected to also continue and can be integrated with the findings from the proposed monitoring programme for the disposal sites.

The approach, frequency and detail of all these surveys will be dictated by the advice from stakeholders as part of the adaptive management process. To oversee this adaptive management programme, therefore, it is proposed that a Technical Group is set up that includes representatives from Natural England, New Forest District Council (NFDC), New Forest National Park Authority (NFNPA), the HIWWT, the Environment Agency and HCC. This group will also include representatives from LHC and Land and Water Ltd.

The advice received from this group will then inform the scope of the campaigns and the monitoring for the next stages of the project. This board would meet between February and April each year. This will allow a review of monitoring findings from the preceding campaign to take place that can then inform the Technical Group's advice on the approach for the upcoming year(s). It is anticipated that forward planning will be over two to three-yearly cycles, to facilitate planning and scheduling of dredging plant and equipment.

2.10 Informing future adaptation

The bottom placement beneficial use disposal sites proposed by the Solent Forum will, if implemented, provide benefits for the marshes and mudflats of the outer Lymington Estuary as described in Section 2.2. But, more than that, they will advance understanding about these benefits as well as about the technical approaches and best ways of achieving project delivery through collaboration across different stakeholder groups.

In the short term, securing consents for these two proposed beneficial use sites, and allowing them to be used when the opportunities exist to do so will constitute a major change to, and advancement of, established ways of doing things. It will help advance understanding about how beneficial use can be undertaken.

Over the medium term (the next 5 to 10 years), it is hoped that the volume of sediment that is placed at these sites, as well as the number of such sites, increases. It is expected that the disposals will be done in a defined and phased manner with limits on of the total volumes that are placed and with monitoring as a condition of the Marine Licence. Ultimately this is seen as the next stage in a gradual long-term build up in the scale and ambitions of such marsh recharge projects (both in the Solent and elsewhere in the UK) to address the ongoing loss of saltmarshes and other coastal habitats.

For the next 20 to 30 years, the marshes in the Solent will continue to face threats, and are continuing to deteriorate in many other areas. Along the Keyhaven to Lymington section alone, the saltmarshes are expected to be lost by the middle of this century. They are low lying and vulnerable to sea level rise (especially at Keyhaven) and are furthermore often wave-exposed and retreating rapidly (especially at Lymington). Also, the coastal defences along this section of the coast will be subject to ongoing management. Delivering measures to further protect the marshes and mudflats here will be one component of this ongoing work.

It is hoped, therefore, that more beneficial use can be achieved at ever larger scales, over time. A longer-term strategy, underpinned by collaboration and a broadly agreed consensus, is needed. The details about such future plans are uncertain at this stage, but there are likely to be other locations where sediment could be bottom placed in the future. Determining the location of these will be influenced by lessons learned the other bottom placement initiatives. The value of learning by doing has already been demonstrated by the existing LHC Bottom Placement works which have provided confidence in this technique and led to these new proposals for delivering further comparable initiatives (Section 1.2). In the same way it is expected that new ideas and ambitions will emerge over time if this practice increases, and new lessons are learned. The maps provided in this report (especially Figure 3) can be used to underpin such further site selection.

Bottom placement alone will not be enough to protect and restore the marshes, and new approaches that deliver sediment onto marsh surfaces to recharge them will need to be considered. This will be the main way in which substantial marsh protection and restoration can be achieved. This could be done by pumping from a dredger or large hopper or, as a brand-new concept, excavating sediment that is already deposited by bottom placements. The latter approach is one that has been newly employed at West Itchenor and is licensed to be undertaken at Boiler Marsh (L/2023/00294/1).

Depending upon the approach taken, these are likely to require at least some sediment retainment structures (large fences, geotubes etc.). Such structures would need to be most substantial where fluid sediment is pumped. When considering structures there may be a role for introducing features that can protect the exposed and eroding outer faces of the marshes.

Active marsh restoration in the West Solent has all, so far, been directed at the Lymington side of this frontage. This is because there are more uncertainties and challenges towards the Keyhaven area. These include access difficulties, greater concerns about the impacts on navigable channels and the absence of any specific ambitions allied to uncertainty regarding future coastal defence proposals and plans for the management of Hurst Spit. Along the Keyhaven section, there is the possibility that large dredgers could be moored alongside the deeper water adjacent to the spit so that they could pump sediment over the marsh surfaces to raise them up. The viability of such a project could be considered further in the future. It will be valuable to also consider the wider Keyhaven and Hurst frontage in more detail.

It is understood that all such ideas for more innovative and ambitious projects in the future will need to be accompanied by further review and consultations and closely allied to the ongoing long-term Hurst Spit to Lymington Flood and Coastal Risk Management Strategy11. Part of the role of this current proposal is to inform and lay the groundwork for this.

This section has concentrated on intertidal habitats of the West Solent but the lessons from the projects proposed here will have implications for other parts of the Solent and elsewhere in the UK. For example, there may well be areas where the landward side of a seawall could be recharged to make them less vulnerable to flooding or to allow for the realignment of sea defences. Such longer terms options and wider vison will be considered regionally by the Solent Forum and other individual partner organisations as well as nationally by the national Beneficial Use Working Group (BUWG).

[11] More detail about this are available at www.hurstspit2lymington.co.uk/

3 Regulatory Framework

3.1 Introduction

To take this sediment translocation and habitat restoration proposal forward, a Marine Licence from the MMO will be needed for the proposed beneficial use disposal sites at Pylewell and Cockleshell. In addition, other permissions and consents may be required. This section provides further details about the necessary permissions (Section 3.2), as well as the assessment requirements (Section 3.3) and key policy context (Section 3.4).

3.2 Required permissions

3.2.1 Marine Licence (and disposal site characterisation)

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. This process requires anybody wishing to undertake works below MHWS to obtain a Marine Licence from the MMO. The proposed beneficial use disposal sites, therefore, require a Marine Licence. The licence will cover those works that affect the marine environment, namely the placement (disposal) of dredged material at the proposed beneficial use sites at Pylewell and Cockleshell.

To authorise the proposed disposal sites, a disposal site characterisation assessment is required (Manning *et al.*, 2021). A disposal site can be authorised solely for the objectives of the beneficial use (e.g. frequency and volume of disposal, as well as the physicochemical characteristics of the sediment that it can accept) and essentially represents the direct 'footprint' of the habitat restoration project.

Disposal sites are not themselves licensed, but a Marine Licence is required to dispose of dredged material within them (Manning *et al.*, 2021). Therefore, if a site is designated because of the characterisation report and licence application, that does not mean there can be exclusive use of that site. A licence may be granted to other operators to use the same site (MMO, 2022). It is precisely the intention of the Solent Forum BUDS project that more than one operator can use the Pylewell and Cockleshell sites.

In accordance with the guidance (Manning *et al.*, 2021), the disposal site characterisation assessment includes the following:

- The identification of a suitable area and an assessment of the need for a new site including site selection and consultations. The sites and the reason why they were selected is presented in Section 2 of this report and further details about the project and the consultation process are provided in Section 2.7;
- A comparison with other candidate disposal sites and an assessment of relevant environmental and socio-economic impacts resulting from disposal according to the overall design of the project (see Section 4);
- An assessment of the dredged material characteristics and an interpretation of the sediment quality sampling results (see Section 2.4 and Appendix B); and
- Any relevant assessments which in this case are expected to include an HRA, a MCZ assessment and a WFD compliance assessment (see Appendices D to E).

This disposal site characterisation assessment will be submitted to the MMO in support of the Marine Licence Application. On receiving an application, the MMO will assess the suitability of the dredged material for disposal at sea and make an evidence-based decision on whether it considers the proposed disposal sites are suitable to receive the material. Following this, the MMO will undertake a public consultation before deciding on the acceptability of the proposed beneficial use disposal sites. If the sites are considered acceptable, the MMO will designate the sites as open.

The impacts associated with beneficial use disposal sites and the level of assessment required will be project and site specific and dependent on the nature, complexity, location and size of the project. For relatively smaller and simpler projects generally posing less risk, a comparatively reduced assessment may be carried out in comparison to more extensive assessments that may be required for higher risk projects. This is discussed further in Section 4.

3.2.2 Other consent considerations

In addition to the Marine Licence, consideration has been given to the need for the other licences and permits. In most cases, they are not currently considered to be required; however, formal written response to this effect and landowner consents are all likely to be needed. These relevant consents are as follows:

- **Seabed ownership permission:** The deposit zone and surrounding intertidal areas lie within ownership of The Crown Estate. It is leased to the New Forest District Council (NFDC) and managed by the Hampshire and Isle of Wight Wildlife Trust (HIWWT). The Crown Estate, NFDC and HIWWT will need to be consulted further and permission from all three parties will be required;
- **Planning permission**: It is not expected that separate planning permission will be needed under the Town and Country Planning Act 1990. However, a formal response from NFDC and NFNPA to this effect will be sought;
- **Environmental permit:** For works taking place on or near a flood defence or sea defence structure, and also in a flood plain, a Flood Risk Activities environmental permit (FRAP) can be required. That is not likely to be needed as the works are not directly located alongside defences, but a formal view to this effect will be obtained from the Environment Agency;
- **Harbour works licence**: The LHC are the Competent Harbour Authority for the estuary with a statutory conservancy duty to maintain safety of navigation in the harbour. The LHC are also consultees on this project. The need for a separate Harbour Works Licence will need to be determined through further consultation with LHC; and
- **Site of Special Scientific Interest (SSSI) notification**: The proposed works overlap with a nationally designated site, the Hurst Castle and Lymington River Estuary SSSI, which is notified for its saltmarsh and mudflats and the overwintering birds these habitats support, as well as various other habitats. Natural England may require a discrete SSSI notification but could also rely on the information here provided for that purpose.

3.2.3 Protected habitats and species

The area where the sediment placement will occur has a high nature conservation value (see Section 4.6 for more details). Detailed consideration therefore must be given to the nature conservation issues and the presence of protected species and habitats.

In addition to the protections afforded by the designated sites, various species and habitats are protected from being killed, injured or disturbed under provisions of the Habitats Regulations and

Section 9(4) and Schedule 5 of the Wildlife and Countryside Act 1981 (as amended)[12]. In particular, Regulation 43 of the Habitats Regulations makes it an offence to deliberately disturb wild animals of any 'European Protected Species' in such a way as to be of likely significance:

- To impair their ability:
  - To survive, to breed or reproduce, or to rear or nurture their young; or
  - In the case of animals of a hibernating or migratory species, to hibernate or migrate; or
- To significantly affect the local distribution or abundance of the species to which they belong.

European Protected Species include a range of terrestrial and marine species such as bats, otters, great crested newts and cetaceans (i.e. dolphins, porpoises and whales). Section 9(4) of the Wildlife and Countryside Act 1981 (as amended) makes it an offence intentionally or recklessly to disturb dolphins, whales or basking sharks subject to a defence that the act was the incidental result of a lawful operation and could not reasonably have been avoided.

The Natural Environment and Rural Communities (NERC) Act came into force in October 2006. Section 41 (S41) of the Act requires the Secretary of State, in consultation with Natural England, to publish a list of habitats and species of principal importance for the conservation of biodiversity in England. The S41 list is used to guide decision-makers such as public bodies, including local and regional authorities, in implementing their duty under Section 40 of the NERC Act 2006.

Section 40 of the NERC Act 2006 used to require that public authorities 'have regard' to the conservation of biodiversity in England, when carrying out their normal functions. However, that has now been reframed and made stronger following implementation of the Environment Act 2021 (see Section 3.3.4). Now there is more of a proactive duty (under new section 40(1)) to "*from time to time consider what action the authority can properly take, consistently with the proper exercise of its functions, to further the general biodiversity objective*". This should be taken with reference to Local Nature Recovery Strategies (LNRS) and any species conservation strategy or protected site strategy prepared by Natural England as described in the Section 40(2A) of the extended NERC Act.

There are 943 species of principal importance and 56 habitats of principal importance included on the NERC S41 list. There are no records of European Protected Species at the location of the proposed beneficial use disposal sites and, therefore, requirements for protected species licences are not considered further in this report. Mudflats and coastal saltmarsh, both of which are S41 habitats, are present at the sites and will be improved by the proposed restoration. The impacts to these habitats are also appropriately reviewed in this report and the supporting appendices.

3.3 Assessment requirements

As part of the various approval processes, the MMO will take account of environmental and project information. The following sections summarise the assessments and documentation that are likely to be required to support the Marine Licence Application for the proposed disposal and restoration sites.

3.3.1 Environmental Impact Assessment

The Environmental Impact Assessment (EIA) Directive (2011/92/EU), amended by the 2014 Directive (2014/52/EU), requires plans, programmes or projects likely to have significant effects on the environment to undergo an environmental assessment, prior to their approval or authorisation. The EIA Directive was transposed into UK law, for development in the marine environment, by the Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended).

12 These have been modified by the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019.

These were amended by the Marine Works (Environmental Impact Assessment) (Amendment) (England and Wales) Regulations 2009, the Marine Works (Environmental Impact Assessment) (Amendment) Regulations 2011, 2015, 2017, the Marine Works (Environmental Impact Assessment) and Marine Strategy (Amendment) Regulations 2018, and the Environment, Food and Rural Affairs (Environmental Impact Assessment) (Amendment) (EU Exit) Regulations 2019 (all of which are hereafter referred to as the Marine Works EIA Regulations).

The designation of a beneficial use disposal site does not require an EIA (Manning *et al.*, 2021); and the recharge and restoration work is not considered to be of a scale which triggers an EIA. It is therefore considered that the proposal can be screened out of requiring an EIA. This Environmental Appraisal has been prepared to document all the relevant environmental assessment information in support of the Marine Licence Application. It also provides a disposal site characterisation assessment of the two proposed beneficial use sites.

3.3.2 Marine Plan Conformance Assessment

The UK Marine Policy Statement (HM Government, 2011) contributes to the achievement of sustainable development in the UK marine area. Prepared under Section 44 of the Marine and Coastal Access Act 2009, it provides the framework for the preparation of marine plans and informing decisions affecting the marine environment. It ensures that marine resources are used in a sustainable way in line with marine objectives thereby:

1. Promoting sustainable economic development;
2. Enabling the UK's move towards a low-carbon economy, in order to mitigate the causes of climate change and ocean acidification and adapt to their effects;
3. Ensuring a sustainable marine environment which promotes healthy, functioning marine ecosystems and protects marine habitats, species and our heritage assets; and
4. Contributing to the societal benefits of the marine area, including the sustainable use of marine resources to address local social and economic issues.

The proposed beneficial use disposal sites are within the area covered by the South Marine Plans, published in July 2018 by the Department for Environment, Food and Rural Affairs (Defra, 2018). The South Marine Plans extend across an area of around 12,000 km^2 of inshore and offshore waters across 1,000 km of coastline (Defra, 2018). It stretches from Folkestone in Kent to the river Dart in Devon. It includes:

- The area from the MHWS tide to 12 nautical miles (nm);
- Any area submerged at MHWS tide;
- The waters of any estuary, river or channel, so far as the tide flows at MHWS tide;
- Waters in any area which is closed (permanently or intermittently) by a lock or other artificial means against the regular action of the tide, but into and from which seawater is caused or permitted to flow (continuously or occasionally).

The vision for the South Marine Plans will be achieved through its cross-cutting economic, social and environmental objectives.

This marine plan area includes one of the busiest shipping channels in the world, with significant numbers of freight and passenger transport, as well as military activity, with almost two thirds of Royal Navy ships stationed at Portsmouth. This intense activity and shipping takes place alongside 60 marine protected areas, including nine MCZs and a UNESCO world heritage site. The region is one of the most complex and used areas of the English coastline.

Policies are presented within an economic, social and environmental framework, helping to support the high-level objectives set out in the UK Marine Policy Statement, as well as sustainable development of the marine area. In considering an application for a Marine Licence, the MMO will take into account Government policy statements and guidance including the Marine Policy Statement (MPS) and South Marine Plans. In addition, consideration will be given to the principles of sustainable development.

The vision for the South Marine Plans will be achieved through its objectives. The objectives are cross-cutting rather than specific to individual topics and sectors. The order of the objectives is not a reflection of priorities. Economic, social and environmental objectives must be considered alongside one another. Objectives should be applied in an integrated way, though not every objective will apply to every situation and in every location.

In this case the proposed beneficial use sites are in keeping with the vision, objectives and policies of the South Marine Plans. Most notably they help to proactively fulfil policy S-DD-2 on beneficial use of dredge sediment. This states that "*proposals must identify, where possible, alternative opportunities to minimise the use of dredged waste disposal sites by pursuing reuse opportunities through matching of spoil to suitable sites*". This policy recognises that re-use of dredged material can reduce the pressure on existing marine habitats with some materials being able to support beneficial re-use and ecosystem services. This policy also enables and reduces the need to dispose of excavated material at marine disposal sites.

The proposed beneficial use disposal sites are also in fulfilment of policy S-DD-1 which states that "*Proposals within or adjacent to licenced dredging and disposal areas should demonstrate that they will, in order of preference: a) avoid, b) minimise, c) mitigate significant adverse impacts on licenced dredging and disposal areas, d) if it is not possible to mitigate significant adverse impacts, proposals should state the case for proceeding*".

A review of the implications of the proposed beneficial use sites on the policies of the South Marine Plans has been provided as part of the Marine Licence application. This has been informed by the information provided in the Environmental Appraisal.

In taking a proportionate approach to applying policies, consideration has also been given to the scale, complexity and impact of the proposed beneficial use disposal sites. Given the small-scale nature of the proposed disposal activities and the fact that no significant environmental effects are envisaged, it is considered that this Marine Licence Application complies with the vision, objectives and policies of the South Marine Plans. This is supported by the review of potential impact pathways provided in Section 4 of this report.

3.3.3 Habitats Regulations Assessment

The two proposed sediment placement sites are in areas of high nature conservation value. They are part of the Solent Maritime Special Area of Conservation (SAC) and the Solent and Southampton Water Special Protection Area (SPA) and Ramsar wetland areas. This is described further in Section 4.6 and Appendix D.

Under Part 6 of the Habitats and Species Regulations 2017 (as amended) (referred to as the Habitats Regulations)[13], a competent authority, in this case the MMO, needs to determine whether the proposed intertidal habitat restoration project will have a likely significant effect (LSE) on a designated European site. If an LSE will occur, or cannot be excluded, the competent authority needs to carry out an Appropriate Assessment (AA) evaluating the implications of the proposals in light of the site's

13 These have been modified by the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 (HMSO, 2019a).

conservation objectives. The AA takes account of the in-combination effects of the proposal on the protected areas in association with other relevant projects and plans.

The information contained in the HRA in Appendix D will enable the competent authority to undertake an AA, assessing the effects of the proposed works on the features for which the sites are designated. Based on this information, it is considered that the proposed works will not have an AEOI either alone or in-combination with other plans and projects.

3.3.4 Environment Act 2021

The Environment Act became law in November 2021. It provides the Government with powers to set new binding targets, including for air quality, water, biodiversity, and waste reduction. It also will include targets, tools and polices that are designed to reverse the decline in biodiversity in fulfilment of objectives within the Government's 25-year plan.

To help achieve these ambitions, the Act includes targets for achieving biodiversity net gain (BNG) as part of future developments. This will require all planning permissions granted in England (with a few exemptions) to deliver at least 10% biodiversity net gain from February 2024. BNG will be measured using Defra's biodiversity metric and habitats will need to be secured for at least 30 years. Alongside delivering net gain there are also the elements/requirements for:

- A strengthened legal duty for public bodies to conserve and enhance biodiversity (see also reference to revised Section 40 of the NERC 2006 Act in Section 3.2.3);
- New biodiversity reporting requirements for local authorities; and
- Mandatory LNRS as new spatial strategies for nature

The Environment Act also establishes a new environmental watchdog, the Office for Environmental Protection (OEP) that was legally created in November 2021. The OEP is responsible for England and Northern Ireland, with its role being to protect and improve the environment by holding government and other public authorities to account.

Following advice from Natural England, this report contains the information needed to allow the MMO to undertake an AA, assessing the effects of the beneficial use restoration projects on designated features. This is included in Appendix E, which concludes (in advance of MMO review) that the proposed disposal site will not have AEOI either alone or in-combination with other plans and projects.

3.3.5 Marine Conservation Zone assessment

The Marine and Coastal Access Act 2009 facilitates the establishment of an ecologically coherent network of Marine Protected Areas (MPAs). The Act established a new type of Marine Protected Area (MPA) called a Marine Conservation Zone (MCZ) to protect nationally important marine wildlife, habitats, geology and geomorphology.

The Needles MCZ is approximately 4 km away from Cockleshell and 7 km away from Pylewell, and Yarmouth to Cowes MCZ is approximately 3 km away from Cockleshell and 4 km away from Pylewell. Given the distances involved and separation from any zone of potential effect identified in Section 4 of this report, an MCZ assessment is not considered to be required.

3.3.6 Water Framework Directive Compliance Assessment

The Water Framework Directive (WFD) (2000/60/EC) established 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 2017, known as the Water Framework Regulations[14].

The overall objective of the WFD as implemented by the Water Environment Regulations is to achieve "good ecological and good chemical status" in all inland and coastal waters by 2021 (now working towards revised objectives for 2027) unless alternative objectives are set or there are grounds for time limited derogation. For example, where pressures preclude the achievement of good status (e.g. navigation, coastal defence) in heavily modified water bodies (HMWBs), the WFD provides that an alternative objective of "good ecological potential" is set. Groundwater waterbodies are included in the WFD and are assessed on quantitative and chemical status. There is also a general "no deterioration" provision to prevent decline in status.

The proposed beneficial use disposal site at Pylewell lies within the Solent coastal water body (ID: GB650705150000). This water body is a HMWB and is currently at moderate ecological potential (2022) with a chemical status of fail (2019). The proposed beneficial use disposal site at Cockleshell overlaps the Solent coastal water body (ID: GB650705150000) and also the Lymington transitional water body (ID: GB520704202100) which is a heavily modified water body (HMWB) and is currently at moderate ecological potential (2022) and failing chemical status (2019).

To support the Marine Licence Application, a WFD compliance assessment has been undertaken to determine whether the proposed beneficial use disposal sites comply with the objectives of the WFD. This assessment follows the format specified in the latest Environment Agency 'Clearing the Waters for All' guidance and is provided in Appendix E. It concludes that the proposed disposal sites and restoration activities are unlikely to result in non-temporary (i.e. permanent) effects on WFD parameters and that deterioration to the current status of the relevant water bodies is not predicted, nor would the proposed sites prevent these water bodies from achieving long-term future WFD status objectives.

3.3.7 Waste Hierarchy Assessment

Dredged material is classified as a 'waste' which is defined, in Article 3 of the EU Waste Framework Directive (2008/98/EC), as "*any substance or object which the holder discards or intends or is required to discard*"[15]. This Directive is transposed in England and Wales through the Waste (England and Wales) Regulations 2011[16].

Under this legislation, a Waste Hierarchy Assessment (WHA) should be applied which requires consideration of whether beneficial use options are available. The waste hierarchy sets out the five tiers for managing all types of waste according to what is best for the environment and comprises the following in order of most to least favoured (top to bottom):

1. Prevention;
2. Re-use;
3. Recycle;
4. Other recovery; and
5. Disposal.

[14] Following the UK leaving the EU, the main provisions of the WFD have been retained in English law through the Floods and Water (Amendment etc.) (EU Exit) Regulations 2019 (HMSO, 2019b).

[15] It is unclear whether the dredge sediment that has already placed at Boiler Marsh and which will now be reused is also formally classified as such. However, that is assumed to be the case although it ultimately has no implications for the evidence requirements. This issue could be formally clarified for future applications.

[16] Following the departure of the UK from the EU, the main provisions of the Waste Framework Directive have been retained in English law through the Waste and Environmental Permitting etc. (Legislative Functions and Amendment etc.) (EU Exit) Regulations 2020 (HMSO, 2020).

The hierarchy strongly governs waste management policy in the UK and is considered by the relevant authorities when deciding whether or not to grant a dredging licence or authorise a disposal site (Manning *et al.*, 2021).

The waste hierarchy places emphasis on waste prevention or minimisation of waste, followed where possible by re-use of the material. The 'prevention' of waste generation in the first instance is the primary aim (tier 1 of the waste hierarchy). For all arising dredged material, 'preparing for re-use' is considered the most favoured management option (tier 2 of the waste hierarchy). This includes habitat restoration (i.e. direct disposal of dredged material to enhance or restore habitats), or using dredged material in a manner that will benefit society and the natural environment (Manning *et al.*, 2021).

Further consideration of the waste hierarchy or options within it are not deemed necessary for this proposal. Firstly, this is because the proposed habitat restoration projects may technically already fall under tier 2 of the waste hierarchy 'preparing for re-use'. This is considered the Best Practical Environmental Option (BPEO).

3.4 Policy context

3.4.1 Shoreline Management Plan

A Shoreline Management Plan (SMP) is a high-level, non-statutory, policy document setting out a framework for future management of the coastline and coastal defences. It promotes management policies into the 22nd Century that will achieve long-term objectives without committing future generations to unsustainable practices.

An SMP aims to define the coastal flooding and erosion risks to people and the developed, historic and natural environments, identify the preferred policies for managing those risks, identify the consequences of implementing the preferred policies, set out procedures for monitoring the effectiveness of the policies, inform others so future land use and coastal zone development can take account of the risks, the time frame of risks and the policies, and comply with environmental legislation and social obligations.

Shoreline management policies include:

- Hold the Line (HTL): Maintain or upgrade the level of protection provided by existing coastal defences.
- Advance the Line (ATL): Build new defences seaward of the existing defence line.
- Managed Realignment (MR): Allowing the shoreline to move backwards or forwards, with management to control or limit movement.
- No Active Intervention (NAI): a decision not to invest in providing or maintaining any defences.

The proposed beneficial use sites are in Policy Unit 5C20 of the North Solent SMP (2010), which has a NAI policy in place, for short (0 – 20 years), medium (20 – 50 years) and long-term (50 – 100 years) epochs. However, the marshes fronting Lymington help to shield Policy Unit 5C21, which covers the west side of Lymington Estuary. This has a HTL policy for all three future epochs, and the proposed restoration at the proposed beneficial use sites will support this policy in principle.

A key benefit from the proposed restoration at the disposal sites will be to inform new coastal defence proposals that are likely to emerge from the 'Hurst Spit to Lymington Strategy' over the next few years. This flood protection strategy is being led by the Environment Agency, in partnership with New Forest District Council, Hampshire County Council, Natural England and JBA Consulting. It may well be that recommendations for new/additional beneficial use projects may emerge from this process. The lessons learned from the proposed beneficial use sites will therefore inform any such initiatives.

4 Environmental Impact Assessment

4.1 Introduction

As stated in the preceding section and described in the handbook for restoring estuarine and coastal habitats with dredged sediment (Manning *et al.*, 2021), disposal sites are not licensed. Instead, a Marine Licence is required to dispose of dredged material within these sites, as is proposed for this project. Also, as indicated in the handbook, a formal EIA is not needed for a beneficial use project like this one, unless it forms part of a wider development listed under the relevant EIA regulations. That is not the case for this proposal, which is being implemented entirely independently of dredging activities or other developments.

To inform the Marine Licence Application, however, it is still necessary for an Environmental Appraisal to be prepared to document all the relevant environmental assessment information. This report provides a disposal site characterisation which includes details about the baseline environmental conditions at each proposed beneficial use site, as well as assessing the potential positive and negative environmental impacts of the proposed placement of dredged sediment and habitat restoration. This assessment needs to consider the significance of relevant environmental and socio-economic effects and include an interpretation of the sediment quality sampling results.

This is required by the MMO for authorising a disposal site and for agreeing additional mitigation measures, appropriate monitoring conditions and adaptive management strategies. If significant negative impacts are identified, then these will need to be removed or reduced, as far as reasonably practical, through refinement or embedded mitigation within the design.

Crucially, the level of detail required for such a disposal assessment varies between projects. This is because the level of risk varies greatly between projects, based on site-specific considerations and the proposed approach. A reduced assessment can, therefore, be carried out for lower risk initiatives, but a more detail assessment is required where the risk of environmental effects is greater.

To gauge where any new project fits within this range, a generic, pragmatic and risk-based decision-making processes, adapted from Lonsdale *et al*. (2021), is provided in the Manning *et al*. (2021) handbook. This identifies the level of detail that may be required, or expected, for characterising the disposal site and then assessing the effects of the disposal. The risk-based approach is used to ensure that the evidence base, monitoring and associated costs of beneficial use projects are proportionate to the perceived risk. As highlighted in the handbook, this approach is indicative, not prescriptive. It requires a degree of expert judgement and should be informed by early stakeholder engagement.

For this proposed project, the risks of any significant damaging effects arising were expected to be low at the design stage. This is because any changes will be localised, and the placement of dredge material will be in a manner that is specifically designed to enhance the resilience and value of the habitats. To verify this view, the risk-based framework included in Tables 3.9 and 3.10 of the handbook was applied. Scores were assigned to each of the relevant risk criteria for the proposed beneficial use disposal sites, and the results are presented in Table 3.

Table 3. Risk based framework with scores assigned to relevant criteria

Risk Criterion	Score (Risk)	Reasoning/Justification
Volume (m^3) of material disposed per annum	1 (low)	A low risk is assigned because the volumes are very likely to be less than 10,000 m^3 at any site in any given year, especially in the short term (Section 2.4). This is because the volumes will be influenced by sediment availability and practical constraints (as has been highlighted in Section 2.5). At less than 10,000 m^3 the risk is expected to be low. Similar values are being deposited successfully each year at Boiler Marsh for example. In the event that volumes larger than 10,000 m^3 were placed at any site, the risk would still be medium at worst (a medium score would correspond to volumes up to 100,000 m^3), and this would not affect the overall appraisal risk score for the project.
Sediment quality	2 (medium)	The potential sediment that will be deposited has been and will continue to be tested to ensure it is suitable for disposal at sea. The maintenance dredge material from the potential sediment sources (i.e., nearby harbours and marinas) generally comprises silts with contaminants well below Cefas AL 2 (see Section 2.4). For the most part sediments were below Cefas AL 1. However, the levels of contaminants in some samples marginally exceed AL 1 and thus this risk criterion is scored as medium on a precautionary basis. The physical characteristics of the material that is present at the proposed beneficial use disposal sites is characterised in Section 4.5.1.
Location of the disposal site	3 (high)	The risk levels associated with the location of disposal sites is scored high on a precautionary basis given the placement of material lies within the boundaries of internationally protected sites and will potentially receive sediment from outside of the local sediment cell. It should be emphasised, though, that the proposed activity is to the benefit of the designated habitat features (saltmarsh and mudflat habitats) and is being undertaken deliberately to help protect and prolong the life of designated saltmarsh and mudflat habitats.
Nature of the disposal site	1 (low)	The proposed disposal sites have been selected to work with natural processes and be as sustainable, as possible. They are designed to help resupply sediment to an area that has lost substantial amounts of sediment over the last century and continues to lose sediment annually. The disposal of sediment is therefore seeking to slow an ongoing process. This Environmental Appraisal (and disposal site characterisation assessment) has concluded that the negative effects will be negligible to minor, and insignificant (Section 5) and, therefore, the overall risk associated with this criterion is assessed as low. There is a small degree of uncertainty or residual potential negative effects associated with uncontrolled dispersal. These are considered acceptable and will be mitigated through the adoption of an adaptive management strategy.
Total risk score	**7 (medium)**	The overall risk level is medium.

The total risk score is 7 (medium) and, therefore, in accordance with the handbook (Manning *et al*., 2021), a full characterisation and assessment has been carried out and is included in this Environmental Appraisal. In accordance with the handbook (Manning *et al*., 2021), this has involved consideration of the following:

- Dedicated characterisation surveys may be required, unless appropriate information is available to inform assessments;
- Understanding and full assessment of the potential extent, duration and significance of impacts on identified receptors;
- Above may require some simple numerical modelling or conceptual assessment; and
- Site specific monitoring and mitigation measures likely to be required.

These considerations are all included within this assessment (Sections 4.4 to 4.9). The following section also further reviews the environmental topics (or receptors) that were scoped into and out of this assessment.

4.2 Assessment scope

4.2.1 Topics excluded

A number of environmental assessment topics have been 'scoped out' of the assessment on the basis that there are no direct or indirect impact pathways associated with the proposed beneficial use disposal sites. The environmental receptors which have not been given any further consideration in the Environmental Appraisal, including the rationale for that, are as follows:

- **Terrestrial ecology**: The proposed beneficial use disposal sites at Pylewell and Cockleshell are intertidal habitats and wholly within the marine environment. There will, therefore, be no interaction or potential effects on terrestrial ecology features (including changes in air quality as noted below);
- **Traffic and transport**: The proposed sites will not result in a change in landside traffic and transport;
- **Commercial and recreational navigation**: The proposed beneficial use sites are well away from navigable areas, and given the relatively small volumes to be deposited annually, vessel movements will be minor and temporary during each disposal campaign. These movements will be negligible in this busy estuary and will be overseen by the LHC as the competent harbour authority;
- **Air quality**: Any changes in local air quality associated with the operation of the dredging plant at the proposed sites will be very short term/intermittent and negligible in scale;
- **Airborne noise and vibration**: The proposed sites at Pylewell and Cockleshell are remote from residential areas and properties (such as Embers Camping Pylewell Park and Lymington Yacht Haven) and will not cause substantial noise or vibration effects. Furthermore, the area is already used regularly by a range of vessels transiting along the adjacent navigation channel into and out of Lymington. There is, therefore, considered to be no risk of the very short term and intermittent placement of material at the proposed sites by small dredge plant to result in any significant disturbance to humans. The potential disturbance to marine species and waterbirds is considered in the relevant marine ecological topics scoped into the assessment (Sections 4.6 to 4.8);
- **Landscape, seascape and visual impact**: The proposed beneficial use disposal sites will be used on an intermittent and temporary basis, and are considered to be similar in character to the use of the existing adjacent main navigation channel into Lymington and the existing beneficial use disposal activities undertaken by LHC at Boiler Marsh. Given the level of existing

activity and operations, and the nature of the proposed disposal sites, there will be no significant change to the landscape/seascape character or visual appearance;

- **Coastal archaeology**: The project will not involve any excavation of sediment. It will only involve covering rather than exposing existing marine sediment. Therefore, there will be no damage to any features of archaeological value. There is also a very low likelihood of the Pylewell and Cockleshell marsh sediments, on which the dredged sediment will be placed, containing features of ancestral cultural and archaeological heritage. These sediments were only laid down in the late 1800s; and
- **Other users, marine infrastructure and flood defences**: The project will have no direct effects on infrastructure and flood defences. It is designed to delay the loss of saltmarsh and that has the potential to delay the implementation of the next phases of the harbour protections breakwaters. It is not possible to quantify the level of this delay, if it occurs, but that will be a beneficial outcome.

4.2.2 Topics included

The topics which were 'scoped in' to the assessment, along with a summary of the rationale for their inclusion and the section in which they are considered, are as follows:

- **Physical/coastal processes**: It is recognised that the physical effects of this proposal will be localised, and the project will also be seeking to move, modestly, towards a physical condition that existed historically, whilst not introducing new and unsustainable features. Notwithstanding this, it is important to examine these aspects further, especially to inform the nature conservation review. This topic is assessed in Section 4.4;
- **Water and sediment quality**: It is necessary to consider the potential effects of the proposed beneficial use disposal sites on water and sediment quality. This offers an opportunity to highlight and review the latest sediment quality sampling results. It is also valuable to examine the effects on water quality from any sediments that are exported and dispersed from the disposal and restoration sites. This topic is assessed in Section 4.5, and the potential impacts upon WFD water bodies and protected areas are evaluated in further detail in the WFD compliance assessment that is provided in Appendix E;
- **Nature conservation and ecology**: A key issue that needs to be addressed is the potential effect of the proposed disposal sites on marine habitats and species. It is also vital to examine the implications that these changes will have on the nature conservation value of the location. This topic is assessed in Section 4.6, and the potential impacts upon protected sites and features are evaluated in the HRA that is provided in Appendix D;
- **Fish and fisheries**: Alongside the consideration of nature conservation and ecology, it is also appropriate to consider the potential effects on fish and fisheries. Any such effects will be small but this topic warrants consideration in light of the assessment conclusion across the other related topics. This topic is therefore assessed in Section 4.7;
- **Waterbird populations**: In addition to the above ecological receptors, it is appropriate to consider potential effects on waterbirds especially. This topic is assessed in Section 4.8, and the potential impacts upon bird interest features and supporting habitats are evaluated in further detail in the HRA that is provided in Appendix D.
- **Cumulative and in-combination effects**: Finally, it is also necessary to consider the potential effects of the project in addition to the effects arising from any other known projects or plans. This assessment of cumulative and in-combination effects is included in Section 4.9, and also in relation specifically to protected sites and features in the HRA that is provided in Appendix D.

The standardised methods that were used to carry out the assessments of these topics are set out below in Section 4.3. Where each topic is assessed, the relevant baseline characteristics of the environment, and especially the disposal and restoration sites, are first considered. The impacts via defined pathways are then reviewed in this context. Mitigation measures are summarised in Section 5.

To avoid any unnecessary repetition of text, some elements of these assessment (the baseline reviews particularly) are presented as summaries of, or with reference to, supporting documents. Where more detail is needed, this is presented in the supporting documents, some of which are in the following appendices:

- Appendix B: Sample plan advice and returns;
- **Appendix C**: Baseline Document for Maintenance Dredging in Lymington Harbour;
- Appendix D: HRA; and
- Appendix E: WFD compliance assessment.

4.3 Impact assessment methods

Although the proposed beneficial use disposal sites do not require a statutory EIA, to facilitate the impact assessment process and ensure a robust disposal site characterisation assessment is undertaken, a standardised methodology consistent with the requirements of EIA has been applied.

This framework, which is presented in the following sections, has been developed from a range of sources, including the Town and Country Planning (EIA) Regulations 2017 (as amended), Marine Works (EIA) Regulations 2007 (as amended), the new EIA Directive (2014/52/EU), statutory guidance, consultations and ABPmer's previous (extensive) EIA project experience.

ABPmer has an Institute of Environmental Management and Assessment (IEMA) Quality Mark, demonstrating a commitment to excellence in leading the co-ordination of statutory EIAs in the UK. The assessment has also followed the principles of relevant guidance, including the Chartered Institute of Ecology and Environmental Management (CIEEM) guidelines for ecological impact assessment in the UK and Ireland (which consolidate advice for terrestrial, freshwater and coastal environments) (CIEEM, 2018) and IEMA guidelines (IEMA, 2016).

The environmental issues are divided into distinct 'receiving environments', 'receptors' or 'features'. The effect of the proposed disposal sites on each of these is assessed by describing in turn: the baseline (existing) environmental conditions of each receiving environment; the 'impact pathways' by which the receptors could be affected; the significance of the impacts occurring; and the measures to mitigate for significant adverse impacts where these are predicted.

This Impact Assessment Framework, which is presented in the following sections, is designed to incorporate the key criteria and considerations without being overly prescriptive.

4.3.1 Stage 1 – Identify receptors and changes

The first stage identifies the potential environmental changes resulting from the proposed activity and the features of interest (receptors) that are likely to be affected (which are together referred to as the impact pathway). The potential impact pathways which are considered relevant to this Environmental Appraisal (and disposal site characterisation assessment) are set out at the beginning of the impact assessment section for each environmental receptor.

4.3.2 Stage 2 – Understand change, sensitivity and importance

The second stage involves understanding the nature of the environmental changes to provide a benchmark against which the changes and levels of exposure can be compared.

The scale of the impacts via the impact pathways depends upon a range of factors, including the following:

- Magnitude (local/strategic):
    - Spatial extent (small/large scale);
    - Duration (temporary/short/intermediate/long-term);
    - Frequency (routine/intermittent/occasional/rare);
    - Reversibility;
- Probability of occurrence;
- The margins by which set values are exceeded (e.g., water quality standards);
- The sensitivity of the receptor (resistance/adaptability/recoverability);
- The importance of the receptor (e.g., designated habitats and protected species or local features);
- The baseline conditions of the system;
- Existing long-term trends and natural variability; and
- Confidence, or certainty, in the impact prediction.

4.3.3 Stage 3 – Impact assessment

The likelihood of a feature being vulnerable to an impact pathway is then evaluated as a basis for assessing the level or magnitude of the impact and its significance. The key impact levels are described in Table 4.

Minor impacts may be discernible but tolerable and are, therefore, not significant. Where moderate impacts are adverse, they may require mitigation. Major impacts are highest in magnitude and reflect the high vulnerability and importance of a receptor (e.g., to nature conservation). Where these changes are adverse, they will require mitigation.

Table 4. Summary of assessment criteria

Type	Level or Magnitude of Impact	Indicative Criteria	Significance
Neutral	No change	There is no change from baseline conditions.	Not significant
Adverse or beneficial	Negligible	There is likely to be a change, but the level will not be discernible from baseline conditions.	Not significant
	Minor	Small spatial scale; Low intensity; Short-term; Low sensitivity/importance of receptors; and/or High tolerance/reversibility of receptors.	Not significant
	Moderate	Medium spatial scale; Moderate intensity; Medium-term; Moderate sensitivity/importance of receptors; and/or Moderate tolerance/reversibility of receptors.	Significant
	Major	Large spatial scale (size/number); Major intensity (level/magnitude); Long-term (duration/frequency); High sensitivity/importance of receptors; and/or Low tolerance/reversibility of receptors.	Significant

4.3.4 Stage 4 – Impact management

The final stage is to identify any impacts that are found to be moderate and/or major adverse significant and require mitigation measures to reduce residual impacts, as far as possible, to environmentally acceptable levels. Within the assessment procedure, the use of mitigation measures will alter the risk of exposure and, hence, will require significance to be re-assessed and thus the residual impact (i.e. with mitigation) identified.

4.3.5 Cumulative impact and in-combination assessment

It is good environmental assessment practice to assess the potential cumulative impacts of a proposed activity on all environmental receptors together with other existing or consented developments in the area. Under the Habitats Regulations, it is also necessary to consider the in-combination effects of a development proposal specifically on the interest features of European sites.

The cumulative and in-combination effects assessment takes account of the total effects of all pressures from the proposed beneficial use disposal sites alone acting upon all relevant receptors in seeking to assess the overall significance of cumulative and in-combination effects. Additionally, consideration is given to any other plans, projects or activities, including any impacts that do not directly overlap spatially, but may indirectly result in a cumulative and/or in-combination impact.

The cumulative impact and in-combination assessment is presented in Section 4.9.

4.4 Physical processes

4.4.1 Baseline description

A description of the physical processes of the Lymington Estuary is provided in Section 4.2 to Section 4.4 of the baseline MDP document included in Appendix C. A summary is provided below.

Tidal conditions

The Lymington Estuary is a 4 km long tidally dominated system, where the fronting saltmarshes either side of the entrance are eroded by predominantly wave activity. The tidal regime in the estuary (and across the western Solent) is semi-diurnal but is unusual in that it has a characteristic double peak or "stand" over high water, with a well-defined low water of relatively short duration (Black & Veatch, 2017a).

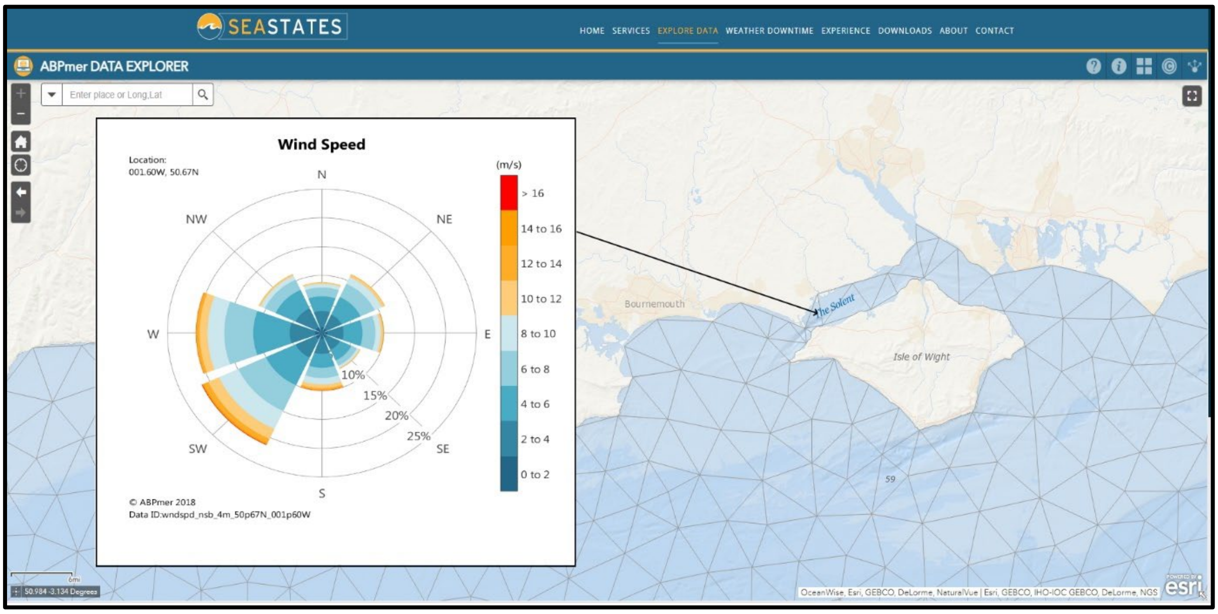
The spring tide range is 2.3 m, and the neap tide range is 1.2 m. The principal tide levels were previously provided in Table 1 above.

Tidal currents are very strong in the Solent, and despite the high-water stand, slack water is of short duration (Black & Veatch, 2017a). This contrasts with the situation within the Lymington estuary itself, where tidal currents are generally weak and slack high water exists for several hours (Black & Veatch, 2017a).

Wind and waves

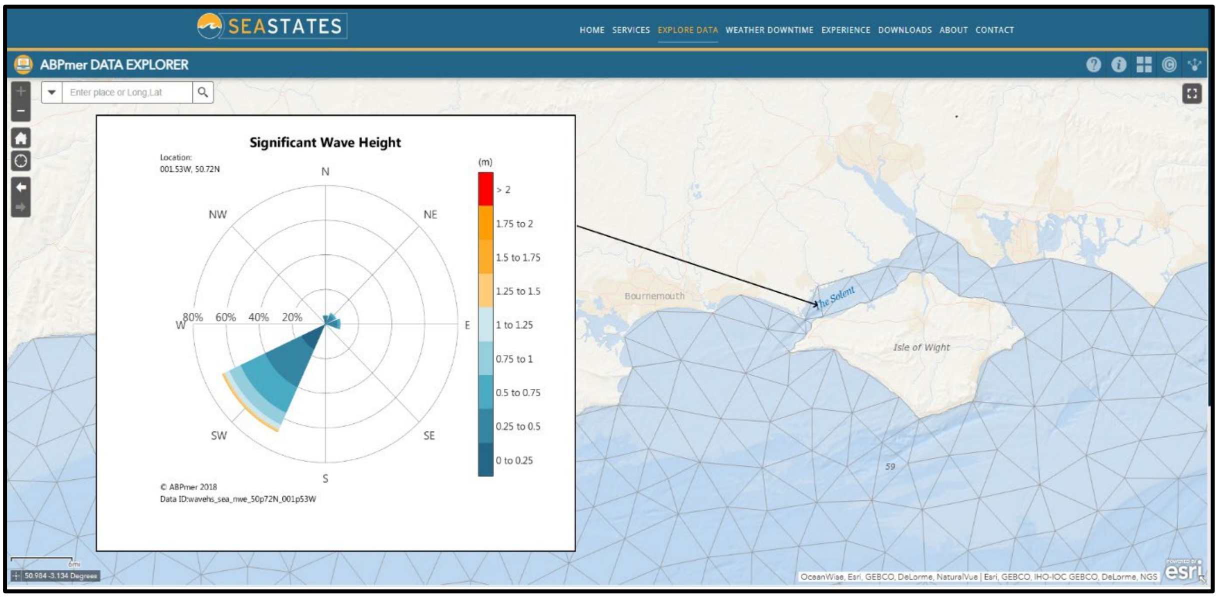
In the western Solent, the prevailing wind is south-westerly. Ke and Collins (1993) recorded that the maximum annual frequency of occurrence of south-westerly wind is as high as 18 %; the total frequency of westerly, west-south-westerly and south-south-westerly winds can be over 39 %. Such a pattern is maintained throughout the year, with little seasonal change. To illustrate this further, Image 5 and Image 6 respectively show wind and wave roses for the Western Solent.

The northern shore of the Solent, within which the Lymington Estuary lies, is protected from the prevailing winds by Hurst Spit and the Isle of Wight, which limits the fetch (Black & Veatch, 2017a). Lymington is, therefore, exposed to a substantially less energetic wave climate than most of the English south coast. The proximity of Lymington to Hurst Spit (approximately 5 km to the southeast) results in the longest fetch and hence largest waves at the mouth of the estuary being associated with easterly, rather than westerly, winds.



Source: ABPmer at https://www.seastates.net/

Image 5. Wave rose describing main wave directions in the West Solent



ABPmer at https://www.seastates.net/

Image 6. Predominant wave directions for coastal waters at Lymington

Marsh erosion

To describe the changes taking place to the existing saltmarsh habitats, Environment Agency LiDAR data was reviewed during Phase 2 of the Solent Forum BUDS project (ABPmer, 2020). The study area extended from Hurst to Pitt's Deep marshes, including the proposed beneficial use disposal sites at Pylewell and Cockleshell (Appendix A).

The LiDAR survey data covering this area was used to extract multiple topographic transects of the marshes for the period between 2007 and 2018. These transects were then analysed to determine the rate of erosional changes to the exposed outer edges of the marshes, as well as to identify any vertical bed-elevation changes inside the marshes (ABPmer, 2020). The locations of the transects and the overall extent of lateral marsh retreat are shown in Figure 11.

This analysis verified that erosion rates were around 2 to 3 m per year on the exposed outer edges of the marshes. It was additionally estimated that these marshes are losing 2 % of total volume and 2 % of vegetated marsh extent every year. This study also confirmed the findings from Cope *et al*. (2008), that the vegetated marshes will probably be gone by around 2045 to 2050 (ABPmer, 2020).

At Pylewell, the marsh is retreating between 2.3 m and 3.7 m per year (see Transects G and D respectively in Figure 11). At Cockleshell, it is retreating at 2 m per year (Transect N in Figure 11).

To update this analysis, and also to further visually describe the rate and pattern of marsh retreat, a new LiDAR 'difference plot' is shown as Figure 12. This shows bed elevation changes between the Environment Agency LiDAR surveys taken in December 2007 and in December 2020. This plot shows, in red, the elevation reduction (i.e., erosion) of the marshes and higher mudflat areas over this 14-year period. It also shows areas where there have been increases in bed level, in blue, which shows areas where recent dredge sediment placement projects have been undertaken.

The ABPmer (2020) review also described how the more sheltered intertidal areas showed fairly limited change (whether erosional or accretional). This includes, for example, the big marsh complex behind Hurst Spit, or the Lisle Court marshes that are sheltered by the Boiler/Pylewell marsh island. The highest rates of erosion are noted along the outer edges, in the section from Cockleshell to Pitt's Deep, where elevations have been lowered by between 1 to 2 m along the majority of the outer edges of these intertidal areas over the 10 years studied between 2007 and 2017. Where the largest outer edge erosion occurred, higher rates of internal accretion are also evident. This supports the hypothesis that much of the internal accretion occurs due to materials being derived from marsh erosion, i.e., not from external sources.

Those areas where recharge has taken place are also visible in the difference plots; they can be seen as clear areas of accretion in Figure 12. Relatively subtle benefits of the recharge schemes could be indicated in the adjacent marsh systems (ABPmer, 2020). Notably, there appear to be slightly increased incidences of accretion in the creeks, and slightly reduced rates of erosion. Given the margins of error associated with LiDAR data, however, benefits to the land-side areas from localised erosion reduction and/or improved bed accretion are not yet conclusively apparent; these are anticipated to become clearer (i.e., be better detectable by LiDAR survey techniques) over a longer time frame.

It is possible that the marshes are accreting in some areas. It is however difficult to measure this accurately and consistently, and they are not of a scale that will be recorded with LiDAR data. Also, if any accretion is taking place, it is probably at not at a sufficient rate to allow the marshes to keep pace with ongoing relative sea level rise[17] (ABPmer, 2020). It may well be that the marshes are also settling and compacting, which would counter any effects of accretion.

Wave action is considered the predominant factor influencing the distribution and relative erosion rates of the Solent facing saltmarshes between Hurst and Pitt's Deep. Tidal currents (velocity, strength and duration) are the main processes for redistributing the eroded sediment within the Solent, over the saltmarsh and within Lymington Estuary itself.

Sediment supply and transport

Currently the saltmarshes are receding with only a proportion (around 30%) of the sediment being retained within the immediate system (Ke and Collins (1993)). Much of this material is transported with the tidal regime into Lymington Estuary to be deposited within the deepened berths and marinas. This sediment is then required to be dredged to maintain depths. Until *circa* 2012, all the sediment was moved to Hurst Spit disposal ground or to the southwest of the Isle of Wight whereby most of this material would be widely dispersed away from the Lymington frontage, causing a continual lowering of overall volume of sediment within the marsh system. This depletion will have slowed slightly since 2012 due to the beneficial use schemes undertaken, notably at Boiler Marsh.

The current supply of sediment to the marshes would appear to be insufficient to allow the saltmarsh and mudflat to rise in line with sea level rise. As a consequence, erosion rates are likely to increase further with time. It has been estimated that most if not all of the saltmarsh will have eroded (or drowned) by 2045 to 2050 (ABPmer, 2020).

One of the critical influencing factors affecting the distribution and erosion of the marshes along this frontage is the sediment supply (ABPmer, 2020). The sediments in this area are derived predominantly from marine sources, with a net input of suspended sediment into the West Solent through the Hurst Narrows (SCOPAC, 2004). This is likely to include marine sediments and suspended clay sediments derived from cliff erosion to the west.

Analysis of fine sediments undertaken in the Beaulieu Estuary in the 1970s also confirmed that the majority of sediments deposited in the intertidal areas of this system were derived from marine rather than fluvial sources (Codd, 1972). This is very likely to be true for the Lymington Estuary, where the upstream causeway (built in 1731) will be constraining fluvial sediment releases. This is notwithstanding the Environment Agency's installation (in 2009) of a self-regulating tide-gate to allow controlled amounts of water up-river on the larger tides, which is likely to have somewhat improved the release of riverine sediments into the system (Environment Agency, 2011).

The sediment budget of the mudflat/saltmarsh system was recognised by SCOPAC (2004) as being complex. While it was considered likely that the erosional scour of the intertidal shore face would be supplying some suspended sediment input to the marsh surface, an on-going and very strong trend of net sediment loss was concluded, especially from the more exposed marshes near Lymington. For example, Ke and Collins (1993) estimated that there was an average loss of saltmarsh at a rate of 3.6 ha per year and an export of around 120,000 m^3 of fine materials per year from the subtidal and intertidal zones, with around 38,000 m^3 being attributed to saltmarsh edge erosion. It was estimated that around 70 % of the sediment yielded from intertidal erosion at these marshes was lost entirely as suspended sediment input into the remainder of the Solent system. The remaining 30 % was thought to be available for accretion on the marsh surfaces (at a rate of 2 to 5 mm per year), and in the creek and

17 From 1980 to 2011, relative sea level has risen at a rate of 3.1 ± 0.7 mm year^{-1} at Southampton (Wahl *et al.*, 2013). This rate has been derived from analysis of tide gauge records and corresponds to a total sea-level rise of between approximately 0.08 and 0.1 m during this time.

channel boundaries. The accretion rates were estimated from isotopic geochemistry dating and *Spartina* deposit analysis.

Tidal niche for saltmarsh habitat

The marshes between Hurst to Pitt's Deep occupy a slightly narrower tidal niche than is typically associated with saltmarshes (ABPmer, 2020). The mudflat-saltmarsh transition occurs at a higher elevation than might be expected, between around 0.8 mOD and 1.2 mOD. As a result, vegetated areas are mainly found at, or around the MHWS) mark, and do not generally extend down to MHWN. As MHWN is at 0.62 mODN, the saltmarshes thus occur 0.2 m to 0.6 m higher than might be expected. This is likely to be due to their exposed location and longer inundation duration due to local tidal patterns, in particular the prolonged double high tides of this area (e.g., NFDC, 2010).

Tidal elevations differ along the Hurst to Pitt's Deep marsh frontage, with tidal range increasing by around half a metre between the two points (ABPmer, 2020). This difference was also highlighted by Ke and Collins (1993), who noted that the level of Mean High Water increased "from 2.2 m to 2.7 m [Chart Datum (CD)] to 2.6 to 3.0 m [CD]' between Keyhaven and Lymington".

Channel bathymetry

Bathymetric surveys of the estuary channel (covering the subtidal and lower intertidal areas) are regularly undertaken by the LHC to inform management and maintenance of the harbour. The topography of intertidal areas is also additionally mapped by regular LiDAR surveys undertaken by the Environment Agency. From these bathymetric and topographic surveys, it is evident that the sheltered areas along the main estuary channel are relatively stable (ABPmer, 2020).

There is no indication from these bathymetric surveys of detectable and ongoing retreat of the CD positions away from the outer estuary. Instead, in recent surveys, the CD positions along much of the inner channel are often aligned on the channel side, rather than to landward, which would technically indicate a narrowing rather than a widening of the channel. The accuracy of the measurements plays a key role in these observations and this needs to be carefully considered. In reality, the channel edges are thought to be relatively stable and not detectably changing in any net direction (ABPmer, 2020).

Larger and detectable changes are, however, occurring in the more exposed outer estuary. The mouth of the estuary is also continuing to widen due to natural processes (ABPmer, 2020). Here, the CD alignment and marsh edges are continuing to retreat at a relatively rapid rate in many areas (especially on their wave-exposed outer edges). These changes are shown in Figure 13.

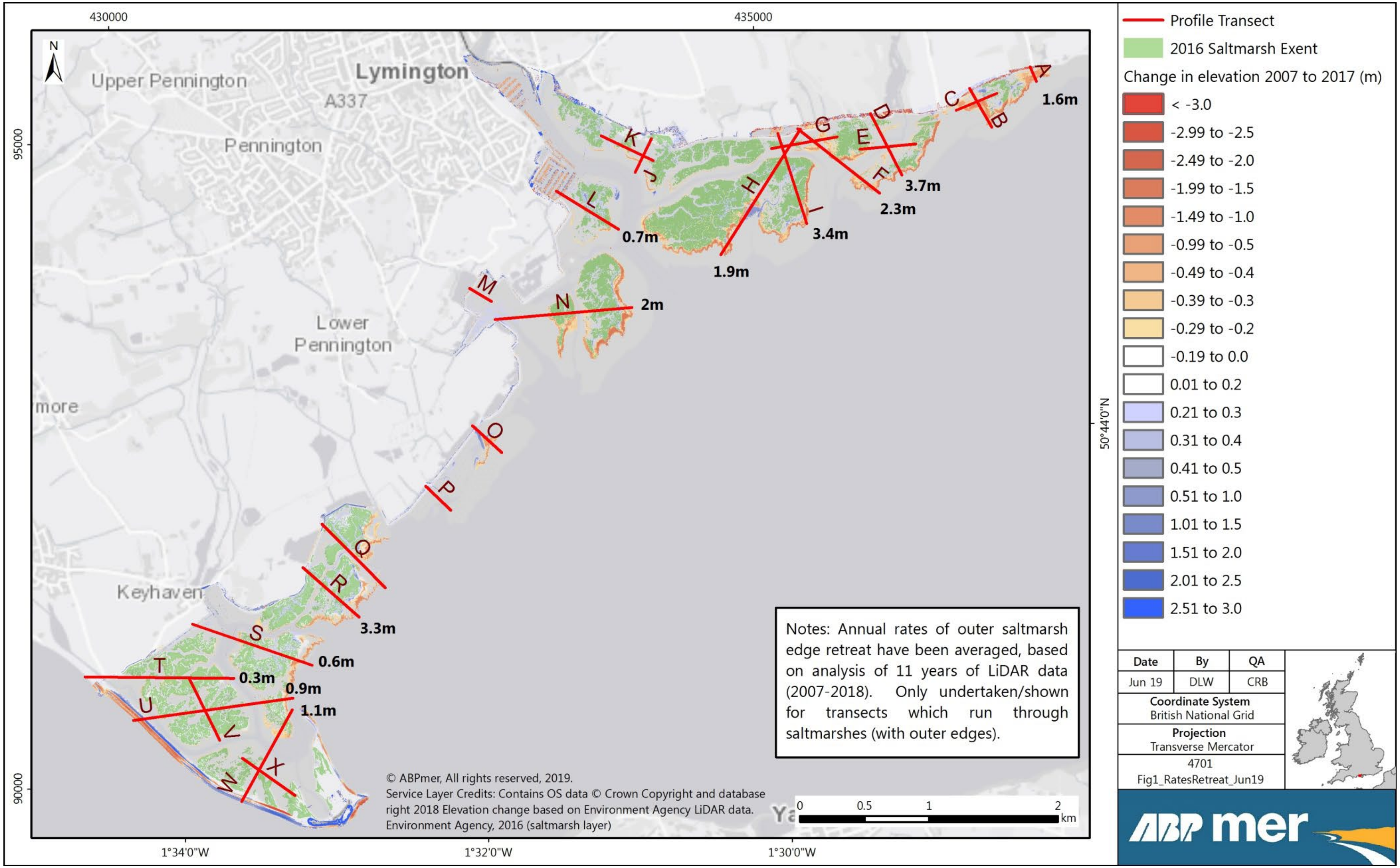


Figure 11. **Average annual rates of saltmarsh edges retreat at transect from 2007 to 2017**

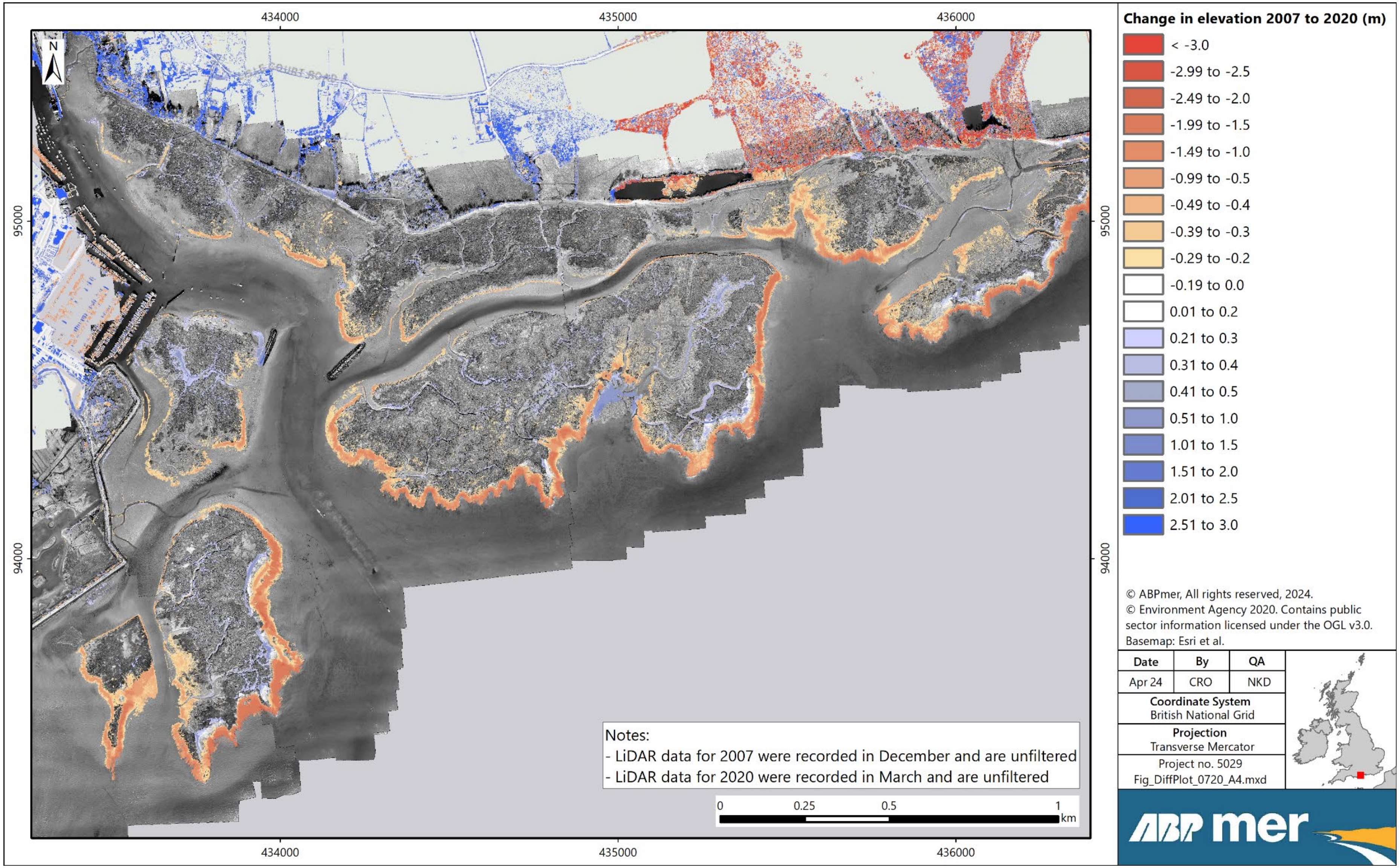


Figure 12. Spatial changes in upper intertidal elevation using LiDAR data 2007 and 2020

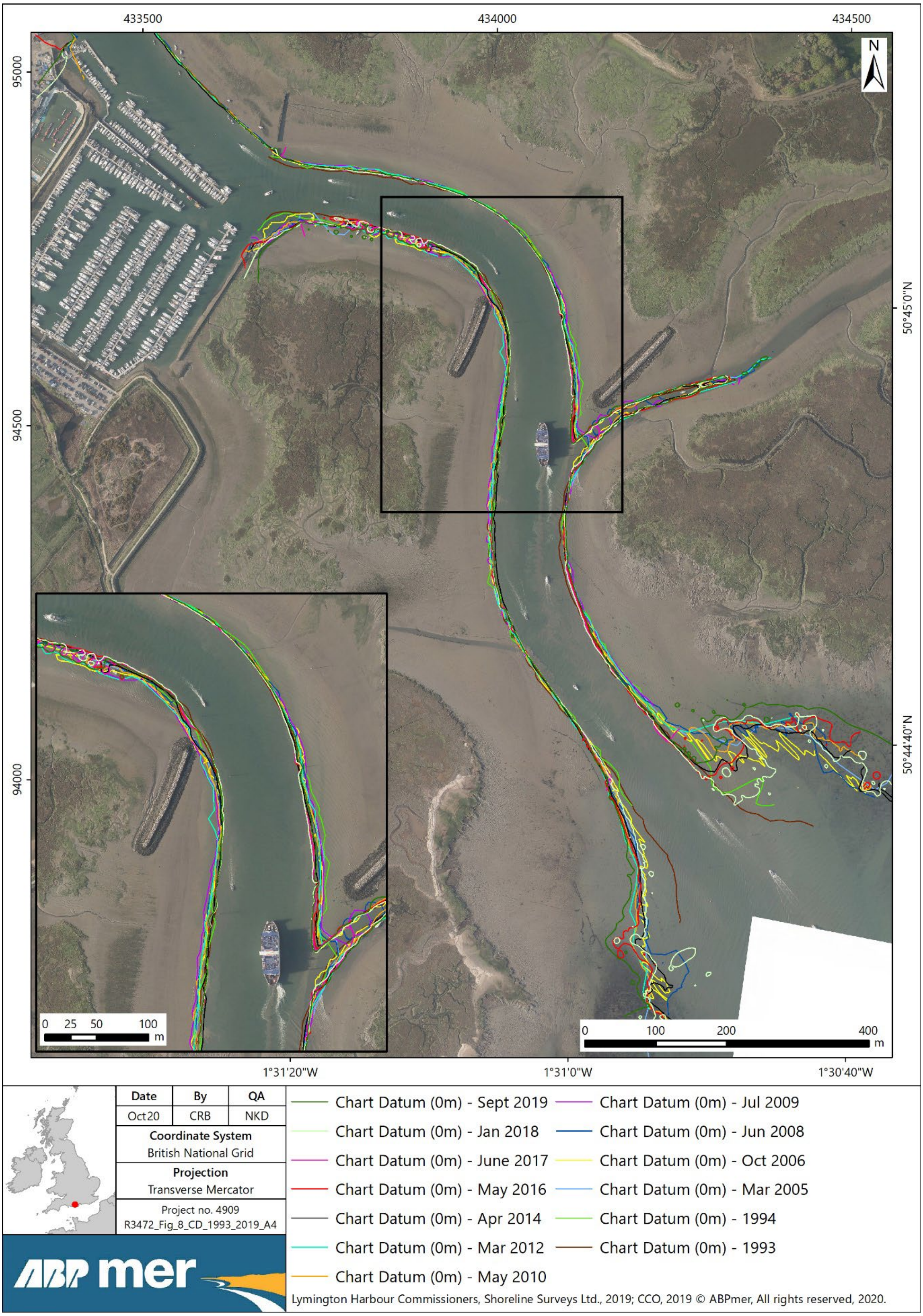


Figure 13. Chart Datum alignment from 1993 to 2019 using LHC bathymetry data

4.4.2 Impact assessment

The following impact pathways have been considered with respect to physical processes:

- Changes to the suspended sediment concentrations;
- Changes to the seabed bathymetry and morphology;
- Changes to the hydrodynamics; and
- Changes to the sediment transport regime.

Please note that, as physical processes are not a receptor *per se*, only likely magnitude of change is assessed here.

Changes to the suspended sediment concentrations

It is estimated that a maximum total annual volume of up to 10,000 m^3 *in situ* of maintenance dredge material from the nearby harbours and marinas could potentially be placed at each of the proposed beneficial disposal sites over a series of intermittent dredge campaigns.

Bottom placement, whereby material is deposited by opening a split hopper barge directly above a deposit location, has been practiced by the LHC at the edge of Boiler Marsh for a number of years now (see Section 2.4.2). In the same way as is practiced at Boiler Marsh, the dredged material will be deposited at the proposed beneficial use disposal sites at Pylewell and Cockleshell as high up the shoreline as possible, in the less exposed areas, with the aim of such deposits acting as a temporary 'sacrificial bund' or feature that will progressively erode over time (as per the other areas of the surrounding marsh edge) (ABPmer, 2020).

The retention and persistence of LHC's regular and cumulative deposits at Boiler Marsh over periods of months and years suggests that this is likely to also occur at the nearby proposed beneficial use sites at Pylewell and Cockleshell and which would, therefore, fulfil the aims of these sites (Section 2.2).

The bottom placement of material will take place on the highest tides and as high on the shore as possible to minimise its dispersal by tidal currents and help maximise its retention. In practice, the sediment will be placed between around 1.1 mCD and 1.7 mCD (0.4 to 1 m above MLWS, or 2 m to 1.4 m below MHWS) (Section 2.3). The maximum water depths at the sites during the periods of bottom placement will, therefore, be in the order of 2 m.

In terms of sediment suspension, the fine sediment comprising the potential dredge material sources (Section 2.4) will generally be contained within the bulk of the dredged material and will primarily move as a cohesive mass from the hopper to the seabed. As the dredged material falls through the water column, there is likely to be a degree of stripping of material from the boundaries of the mass with subsequent entrainment into the water column. Further, as the mass reaches the seabed some material may rebound into the lower part of the water column; however, this then falls and settles back to the seabed. Increased suspended sediment concentrations (SSC) will be greatest at the immediate site of the disposal. Dispersion of material will be limited given the placement activities will take place as high up on the shore as possible, predominantly at the times of low or even slack tidal flows. Due to the nature of the vessels used, placement will not occur during high wave activity, again minimising the disturbance of the sediment to the water column for immediate onward dispersal.

Overall, the increase in SSC and sediment plume will be discernible but highly localised and temporary at the beneficial use disposal site locations. The spatial and temporal magnitude of changes in SSC is, therefore, assessed as **minor**.

Changes to the seabed bathymetry and morphology

The bathymetric surveys that have been undertaken between 2019 and 2023 at the LHC's Boiler Marsh beneficial reuse site indicate that much of the sediment is remaining *in situ* at the placement site and that there is a progressive build-up of sediment (ABPmer, 2023a). One sign of this is that the locations where sediment is being placed have progressively been very slightly adjusted over time. As certain parts of the site become shallower and less accessible to the hopper barges, sediment is increasingly being placed slightly seaward, or to the east, of previous locations. The relative persistence of the material will have been helped by the manner in which the disposal work is being done, with deposits being placed on top of, or as close as possible to, previous ones.

Losses of sediment occurred between the winter disposal campaigns at Boiler Marsh, as would be expected to occur, but also from settlement and compaction of the placed material (ABPmer, 2023a). The extent of these losses varies between years and is influenced by the composition of the sediment and the deposit location.

In total, almost 60,000 m^3 have now been deposited on the site over the last nine winter campaigns (ABPmer, 2023a). A substantial amount of this material remains where it is placed, which has led to a gradual increase in the size of the raised mudflat feature over time. It is difficult to accurately measure the proportions of material that are either retained or exported because of the effects of sediment settlement and compaction. However, roughly half the deposited material remains during the winter campaigns, and this placed sediment then reduces in volume, through settlement and compaction, by about half as much again over the following summer. The ongoing and regular recharge placements have, therefore, been effective in creating a raised bed feature.

The placement of dredged sediment at the proposed beneficial use disposal sites at Pylewell and Cockleshell is expected to develop a similar raised feature at each of these sites. The continued regular placement of material will further help to maintain and potentially build up these features over time, although their size and persistence will be influenced by a range of factors, including the consolidation of the deposits, as well as the occurrence and nature of storm events.

The magnitude of the changes in seabed elevation at the proposed beneficial use disposal sites, in the context of the existing elevations and water depths at these sites, are assessed as **minor to moderate** in terms of the local marsh complex and **negligible** further afield.

Changes to the hydrodynamics

The proposed beneficial use disposal sites have the potential to result in changes to hydrodynamics (e.g., water levels and flow rates). Any hydrodynamic changes that occur would happen slowly as the deposits accumulate at each proposed site, with greater effects occurring on completion of each maintenance dredge and disposal campaign.

The proposed beneficial use disposal sites will cause a change in the local estuary geometry which in turn will marginally decrease the estuary tidal volume and tidal prism. The proposed beneficial use disposal sites are within sheltered areas and outside of the main Solent tidal stream. The amount of sediment to be disposed and the area over which it will be disposed is also limited (9.2 ha at Pylewell and 7.3 ha at Cockleshell) and, therefore, will not affect dominant currents in the area (Binnies UK Ltd, 2021).

The scale of any changes in tidal volume and tidal prism is considered to be negligible and will not modify the way the tide propagates through the estuary to the area, in terms of the shape of the tidal curve, water levels and tidal range. Changes to flows following the proposed disposal activities will also be negligible in magnitude and extent and confined to the close proximity of the proposed beneficial use disposal sites, whereby elevated areas associated with the deposits encourage slightly enhanced local flow, but will not result in a change in the overall hydrodynamic working of the estuary. Considering the low existing flow speeds in the area (generally up to *circa* 0.3 m/s) and a minor decrease in overall estuary area during higher states of the tide, it is suggested that any decreases would be negligible in magnitude.

Overall, the proposed beneficial use disposal sites at Pylewell and Cockleshell are considered to result in a very localised and **negligible** change on hydrodynamics (e.g., water levels, flow rates, changes to tidal prism). The extent and magnitude of the changes will remain negligible in response to climate change and sea level rise.

Changes to the sediment transport regime

The regular recharge placements at the proposed beneficial use disposal sites will act as 'sacrificial bund' feature that will be protecting parts of the inner marsh and helping to retain sediment in the area. There has still been no clear or detectable change to the marshes behind the LHC's Boiler Marsh beneficial reuse site, but benefits to the landside areas from localised erosion reduction and/or improved bed accretion may become apparent (i.e., detectable by the bathymetry and LiDAR survey techniques) over time (ABPmer, 2023a).

The placement of material at the proposed beneficial use disposal sites will help to slow marsh decay and the rate of marsh fracturing to some degree, depending upon the location and scale of the work, as well as on the composition and persistence of the deposited sediments (ABPmer, 2020). In addition, placing material from Lymington Harbour at these sites will help to add or retain more sediment within the local sedimentary system rather than disposing of this material at more distant licensed sea disposal sites.

Overall, the changes to the sediment transport regime as a result of the proposed beneficial use disposal sites are assessed as **minor** in extent and magnitude.

4.5 Water and sediment quality

4.5.1 Baseline description

Water quality

Under the Water Framework Directive (WFD), a River Basin Management Plan (RBMP) has been developed for each river basin district in England and Wales. The proposed beneficial use disposal sites are within the South East river basin district (Environment Agency, 2015a), and overlap the Solent coastal water body (ID: GB650705150000) and Lymington transitional water body (ID: GB520704202100) (Section 3.3.6).

As summarised by the Environment Agency (2024a), the Solent coastal water body (ID: GB650705150000) is a heavily modified water body (HMWB) and is currently at moderate ecological potential (2022) with a failing chemical status (2019). Moderate ecological potential is due to the biological quality element 'Angiosperms' (saltmarsh) and the physico-chemical quality element 'Dissolved inorganic nitrogen' being classified as moderate. In 2019, the chemical status failed to achieve good status due to priority hazardous substances 'mercury and its compounds' and 'polybrominated diphenyl ethers (PBDE)'.

The Lymington transitional water body (ID: GB520704202100) is a HMWB due to its use or modification for coastal protection and flood protection (Environment Agency, 2024a). It is currently at moderate ecological potential (2022) and failing chemical status (2019). Moderate ecological potential is due to the 'Mitigation measures assessment'. Chemical status is failing to achieve good status due to priority hazardous substances 'mercury and its compounds' and 'polybrominated diphenyl ethers (PBDE)'.

The Lymington River (ID: GB107042011220) river water body flows into the Lymington transitional water body. The Lymington River water body is currently at good ecological status (2022) and failing chemical status (2019) (Environment Agency, 2024a). Two 'main rivers', as designated by the Environment Agency (2015b), enter the western Solent adjacent to the proposed beneficial use disposal sites.

The proposed beneficial use disposal site at Pylewell is located within the Lymington and Sowley Shellfish Water Protected Area and the Cockleshell site is located within the Pennington Shellfish Water Protected Area (Defra, 2016; Figure 14). The Food Standards Agency classifies the designated bivalve mollusc production areas in England and Wales. From 1 September 2015 to 31 August 2016, Lymington River was classified as 'Class C'; however as of 1 September 2016, Lymington River was no longer classified as a bivalve mollusc production area (Black & Veatch, 2017a). The nearest classification zones are over 10 km distance in the East Solent Production Area: the 'Chilling to Gilkicker Point' classification zone which is designated as Class B (long-term) for the production of clams (*Mercenaria mercenaria*) and oysters (*Ostrea edulis*) and the 'Ryde Middle & Sturbridge' classification zone which is designated as Class B for *O. edulis* (Food Standards Agency, 2024; Cefas, 2024).

Colwell Bay bathing water on the western coast of the Isle of Wight is the nearest designated bathing water to the proposed beneficial use disposal sites and is located more than 5 km away (Figure 14). Colwell Bay bathing water has been classified as 'excellent' under the revised Bathing Water Directive from 2019 through to 2023 (Environment Agency, 2024b).

Dissolved oxygen (DO) is currently (2022) at 'high' status for the Lymington transitional water body and the Solent coastal water body (Environment Agency, 2024a). It is frequently measured, along with oxygen saturation levels, at the Environment Agency monitoring stations near to the proposed disposal sites.

The proposed beneficial use disposal sites at Pylewell and Cockleshell are located 1.5 km respectively from the nearest Nitrate Vulnerable Zone (NVZ) at Sowley Pond Eutrophic lake NVZ and Avon Water NVZ respectively, as designated under the Nitrates Directive (Environment Agency, 2024c; Figure 14). These NVZs are located on land, outside of the marine environment.

Newtown Harbour, located on the coast of the Isle of Wight over 6 km from the proposed beneficial use disposal sites, is designated as a Sensitive Area (Eutrophic) under the Urban Waste Water Treatment Directive (91/271/EEC) (Defra, 2019).

Toxic and non-toxic contaminants may enter Lymington harbour from numerous sources including via effluent outfalls (domestic and industrial), from waste disposal sites, from land run-off, from historically polluted sediments and from illegal discharges from onshore and from boats (Black & Veatch, 2017a). Water quality within Lymington Harbour is no longer monitored by the Environment Agency and, therefore, data on water quality parameters have been informed by published reports (Black & Veatch, 2017a). Results from the National Monitoring Programme surveys conducted between 1999 and 2001 revealed no evidence that Environmental Quality Standards (EQS) for Cadmium (Cd), Copper (Cu), Nickel (Ni), Lead (Pb), Zinc (Zn) or Mercury (Hg) were exceeded in Lymington Harbour or surrounding waters (Marine Environment Monitoring Group, 2004). Concentrations of organic compounds are extremely low as organic compounds are not soluble in water. Results from the National Monitoring Programme surveys show most organic compounds were below detection levels with only total hexachlorocyclohexane (HCH) generally exceeding the limit of detection and approaching the EQS (Marine Environment Monitoring Group, 2004).

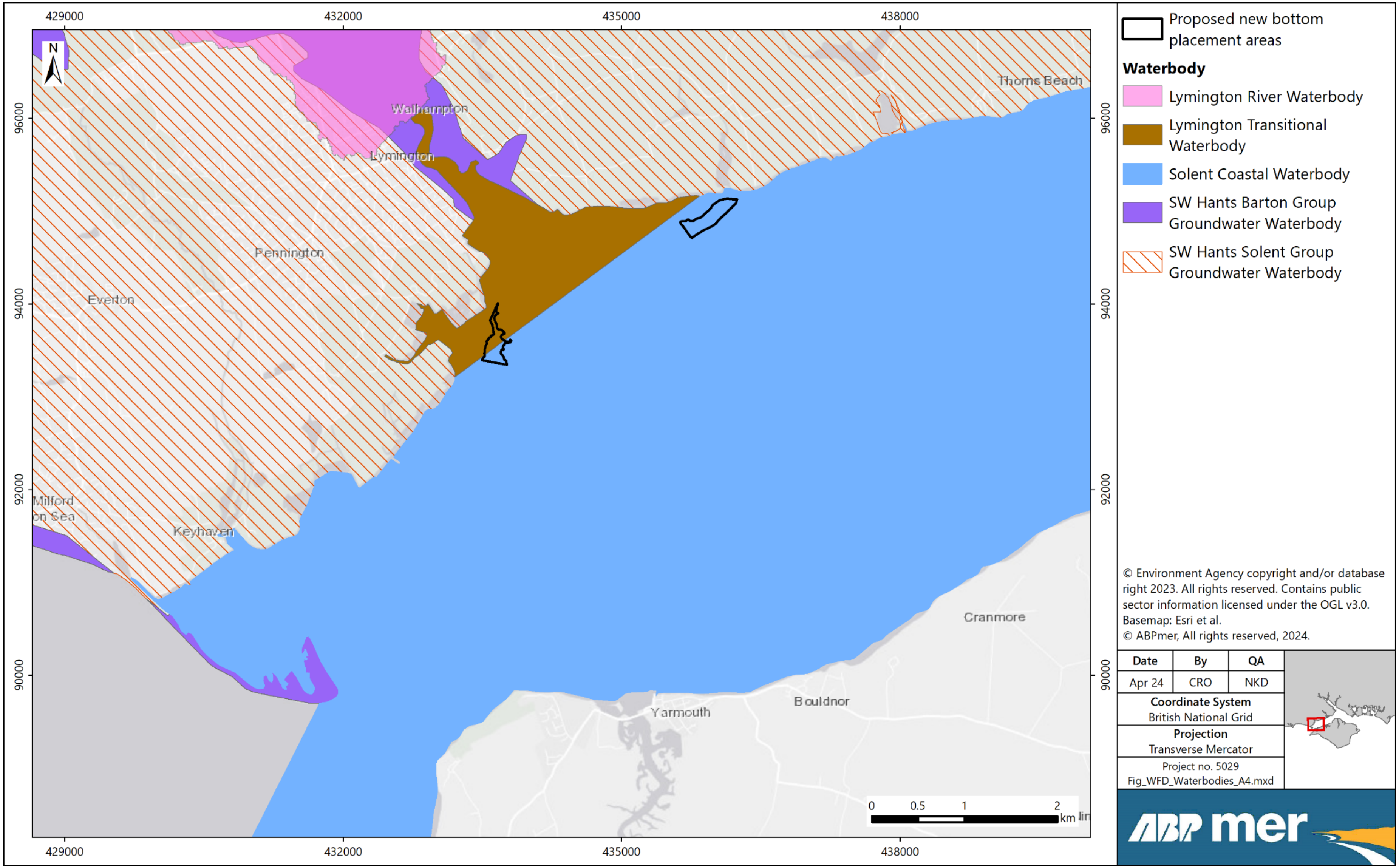


Figure 14. Water bodies in the vicinity of the proposed beneficial use disposal sites

Sediment quality

There are no formal quantitative environmental quality standards (EQSs) 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 (ALs) to assist in the assessment of dredged material (and its suitability for disposal to sea). In general, contaminant levels in dredged material below AL 1 are of no concern and are unlikely to influence the licensing decision. However, dredged material with contaminant levels above AL 2 is generally considered unsuitable for disposal at sea. Dredged material with contaminant levels between AL 1 and AL 2 requires further consideration before a decision can be made.

The Cefas Guideline ALs 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.

Sediment analysis has routinely been undertaken throughout harbours and marinas of the area in respect of maintenance dredge activities. Sediment quality within Lymington Harbour is also reported in the Baseline Document for Maintenance Dredging in Lymington (Appendix C). The physical and chemical characteristics of the potential sources of dredge material (i.e., nearby harbours and marinas) for the proposed beneficial use disposal sites are described in Section 2.4. In summary, the maintenance dredge material from these potential sediment sources generally comprises silts with contaminants below Cefas AL 2 and either below Cefas AL 1 or marginally exceeding AL 1. This material has been deemed acceptable for disposal at sea and Marine Licences have been issued by the MMO.

Further details of the sample plan requests that were made to the MMO and the subsequent sample plans that were received from the MMO for the proposed beneficial use sites at Cockleshell and Pylewell are provided in Section 2.8.1 and Appendix B. The sample locations for both proposed beneficial use disposal sites are shown on Figure 8.

The PSA results are presented in Table 5.

Table 5. Particle size analysis (PSA) results from samples collected at Cockleshell and Pylewell

Sample	Visual Appearance	Particle Size Distribution (%)		
		Gravel (>2 mm)	Sand (2 mm - >63 µm)	Silt (≤63 µm)
Cockleshell – Site A	Slightly Gravelly Sandy Mud.	1.83	61.76	36.40
Cockleshell – Site B	Slightly Gravelly Sandy Mud.	0.02	62.74	37.24
Cockleshell – Site C	Slightly Gravelly Sandy Mud.	0.06	69.51	30.43
Pylewell - Site D	Odourless Brown Mud.	0.00	5.77	94.25
Pylewell - Site E	Odourless Brown Sandy Mud with Shell Fragments and Organic Matter.	0.27	25.92	73.82
Pylewell - Site F	Odourless Brown Mud with Organic Matter and Shell Fragments.	0.20	22.31	77.51
Pylewell - Site G	Odourless Brown Gravelly Sandy Mud with Shell Fragments and Organic Matter.	1.69	46.60	51.72
Pylewell - Site H	Brown Gravelly Sandy Mud with Shell Fragments and Organic Matter and a Peaty Odour.	4.98	47.56	47.45

Sediments from the Cockleshell site comprised slightly gravelly sandy mud. Samples from Site A, Site B and Site C all comprised more than 60 % sands and less than 40 % mud, with a very small component of gravel (< 2 %). Sediments from the Pylewell site were more variable in sediment composition. Site D comprised predominantly mud (> 90 %), with a small proportion of sand (< 6 %). Sites E and F comprised over 70 % mud and less than 26 % sand with a very small component of gravel (< 1 %). The more exposed Sites G and H comprised around 50 % mud and just under 50 % sand, with a small proportion of gravel (< 5 %).

4.5.2 Impact assessment

The following impact pathways have been considered with respect to water and sediment quality:

- Potential changes to dissolved oxygen;
- Potential changes to levels of chemical contaminants (including accidental spillages) in water;
- Potential impacts from redistribution of sediment-bound chemical contaminants; and
- Improvements due to nutrient cycling/burial service of saltmarshes.

Potential changes to dissolved oxygen

The increase in chemical and biological oxygen demand associated with elevated SSC in the water column during the disposal activities may have the potential to reduce DO concentrations. The maintenance dredge material may contain an organic rich surface layer that has been recently deposited and not dispersed by existing vessel movements. There is, therefore, anticipated to be a proportion of organic rich material associated with the maintenance dredge material that could contribute to oxygen depletion.

The proposed disposal methods (bottom placement) at the highest elevations that the hopper barges are able to reach (Section 2.3) reduces the surface area of material exposed to the water column and transfers the material quickly and directly from the barge to the seabed with little time in the water column, therefore, minimising the potential resuspension and dispersion of sediment. The spatiotemporal changes in SSC will be discernible but highly localised and temporary (Section 4.4.2).

Furthermore, DO is currently at 'high' status for the Solent coastal water body and Lymington transitional water body, and the wider area is subject to regular disturbance from dredging and disposal. It is, therefore, considered that there is a low probability that levels will fall below the standards set by the WFD.

Overall, any changes in DO are expected to be localised and temporary, and are not considered to result in an effect at the WFD water body level. The potential changes to DO as a result of the placement of maintenance dredge material at the proposed beneficial disposal sites are, therefore, assessed as **negligible/insignificant**.

Potential changes to levels of chemical contaminants (including accidental spillages) in water

As sediment is disturbed and re-distributed into the water column, any sediment-bound contaminants may be partitioned from the solid phase (i.e., bound to sediments or suspended matter), to the dissolved or aqueous phase (i.e., dissolved in pore water or overlying water) (Luoma, 1983). The levels of contaminants present in the potential dredge material sources are considered to be relatively low, mostly below, or marginally exceeding, Cefas AL 1 (Section 2.4). The material has been deemed acceptable for disposal at sea and continued maintenance dredge and disposal activities have been licensed. Furthermore, the deposits are unlikely to cause a measurable change in the levels of chemical contamination in the water at or around the site given that the proposed bottom placement method of disposal is aimed at retaining as much sediment as possible at the proposed beneficial use disposal sites and minimising the potential resuspension and dispersion of sediment (Section 4.4.2).

With regards to the 2019 failing levels of 'mercury and its compounds' and 'polybrominated diphenyl ethers (PBDE)' in the Solent coastal water body and Lymington transitional water body (Section 4.5.1), the issue extends beyond the zone of influence for potential impacts associated with disposal activities. This supports the finding that the contaminants are from other sources and, therefore, it is highly likely that dredging and disposal activities are not contributing to these failures (Binnies UK Ltd, 2021).

Accidental spillages of oil and other substances have the potential to occur during the bottom placement activities at the proposed beneficial use disposal sites. Best practice pollution prevention guidelines (Defra and Environment Agency, 2016) will be followed to minimise the risk of accidental spillages and the risk of introduction of contaminants throughout the disposal process to minimise the risk of accidental spillages and the risk of introduction of contaminants.

Overall, the potential changes to levels of chemical contaminants in the water as a result of the disposal of dredge arisings at the proposed beneficial use disposal sites are assessed as **negligible/insignificant**.

Potential impacts from redistribution of sediment-bound chemical contaminants

The potential to impact the marine environment as a result of any sediment-bound contaminants arises primarily when the sediment that is released into the water column disperses and deposits elsewhere.

The potential sources of maintenance dredge material from nearby harbours and marinas and the physical and chemical characteristics of these sources are reviewed in Section 2.4. The majority of contaminants in the potential sediment sources are at relatively low concentrations, mostly below, or marginally exceeding, Cefas AL 1. Furthermore, the proposed method of placing material at the proposed beneficial use disposal sites is aimed at retaining as much sediment as possible at the sites and minimising the potential resuspension and dispersion of sediment (Section 4.4.2). It is, therefore, unlikely that sediment or water quality criteria, as a result of the small proportion of contaminated material redistributed and deposited during the bottom placement of material at the proposed beneficial use disposal sites, will be exceeded elsewhere. Furthermore, the disposal of dredge material is controlled by the MMO evaluation process for licensing disposals at sea.

Overall, the potential impacts from the redistribution of sediment-bound chemical contaminants are assessed as **negligible/insignificant**.

Improvements due to nutrient cycling/burial service of intertidal habitats

One of the key environmental ecosystem services associated with intertidal habitats is that of nutrient (nitrogen and phosphorus) cycling/burial and trapping of carbon. This trapping arises through a combination of primary production, sedimentation and denitrification.

The processes that lead to nutrient and sediment storage in estuaries are highly non-linear, and are dependent on the concentrations in the water column (Nedwell *et al.*, 1999). Nevertheless, the loss or gain of intertidal areas directly impacts storage capacity. For example, Jickells *et al.* (2000) estimate that a modern Humber estuary without land claim would retain or denitrify 58 % of the modern riverine nitrogen and 27% of the phosphorus input; whereas the current rate for both is below 4 %.

A recent study on water quality related benefits of marine habitats in the Solent calculated very high values for related saltmarsh services. Watson *et al.* (2020a) estimated the value of saltmarshes on the basis of replacement costs, i.e., the difference in costs associated with reaching a nutrient reduction target by relying on the capacity of natural systems as opposed to using a manufactured alternative (e.g. wastewater treatment upgrades, use of alternative fertilisers).

The total economic value provided by a hectare of saltmarsh was estimated to be £111,009 yr^{-1} for Nitrogen (N), and £13,807 yr^{-1} for Phosphorus (P). The differential between bare mudflat and saltmarsh was £71,709 ha^{-1} for N and £12,252 ha^{-1} for P. This was on the basis that '*saltmarsh communities are the most important habitat for N removal*', and also have higher benefits related to P when compared to bare littoral sediment areas (Watson *et al.*, 2020b). Saltmarshes were considered to remove almost 3 times more N and almost 8 times more P than bare mudflats (with the differentials to macroalgae-covered littoral sediments being lower).

Given the relatively small scale nature of the proposed beneficial use disposal sites, the magnitude of the cycling effects on a harbour scale would be considered to be negligible to small. The potential benefits are considered to be of a **negligible/insignificant to minor beneficial** nature.

4.6 Nature conservation and ecology

4.6.1 Baseline description

Designated sites

A summary of the nature conservation value of Lymington Estuary and the designations in the estuary is provided here; these are also described in detail in Section 3 of the baseline MDP document (Appendix C).

The location and extent of the designated areas of the outer Lymington Estuary are also illustrated in Figure 16. As shown in this figure, the proposed beneficial use disposal and intertidal habitat restoration sites are of high nature conservation value. They lie within the boundaries of the following international designated sites (Figure 15):

- The Solent Maritime Special Area of Conservation (SAC);
- The Solent and Southampton Water Special Protection Area (SPA); and
- The Solent and Southampton Ramsar Site.

The proposed disposal sites also lie adjacent to the recently designated Solent and Dorset Coast SPA. The Solent and Isle of Wight Lagoons SAC furthermore is within 400 m of the proposed Cockleshell disposal site.

With respect to nationally designated sites, the proposed beneficial use disposal sites are located within the Hurst Castle and Lymington River Estuary Site of Special Scientific Interest (SSSI) (Figure 16).

The Needles MCZ is approximately 4 km away from Cockleshell and 7 km away from Pylewell, and Yarmouth to Cowes MCZ is approximately 3 km away from Cockleshell and 4 km away from Pylewell (Figure 17).

Further details about the interest features of these sites are presented below.

The ecology, nature conservation value and water quality conditions of these sites are protected, in England and Wales, under the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 and The European Union (Withdrawal) Act 2018. This legislation repeals the European Communities Act 1972 while also maintaining EU-derived domestic legislation in UK law. It covers the requirements formerly accommodated in UK law by the European Union (EU) Habitats Directive and the Water Framework Directive (WFD).

Solent Maritime SAC

The Solent Maritime site was classified as a SAC in October 1998. It is designated because it contains a unique suite of functionally linked estuaries and dynamic marine and estuarine habitats. It is a complex site with open waters and inlets that are unique in Britain and Europe for the unusual tidal regime which, as described above, includes double tides and long periods of tidal stand at high and low tide.

The SAC also has the largest number of small estuaries in the tightest cluster anywhere in Great Britain, with examples of coastal plain estuaries (Yar, Medina, King's Quay Shore and Hamble) and bar-built estuaries (Newtown Harbour, Beaulieu, Langstone Harbour, Chichester Harbour). It is located in one of the only major sheltered channels in Europe, lying between a substantial island (the Isle of Wight) and the mainland. The primary reasons for its designations are:

- Estuaries;
- Spartina swards (Spartinion maritimae); and
- Atlantic salt meadows (*Glauco-Puccinellietalia*).

The following Annex I habitats that are present as a qualifying feature, but are not the primary reason for selection of this site are:

- Sandbanks which are slightly covered by sea water all the time;
- Mudflats and sandflats not covered by seawater at low tide;
- Coastal lagoons;
- Annual vegetation of drift lines;
- Perennial vegetation of stony banks;
- Salicornia and other annuals colonising mud and sand; and
- Shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes').

In addition, the Desmoulin's whorl snail (*Vertigo moulinsiana*) is an Annex II species that is present as a qualifying feature, but not a primary reason for the site's selection.

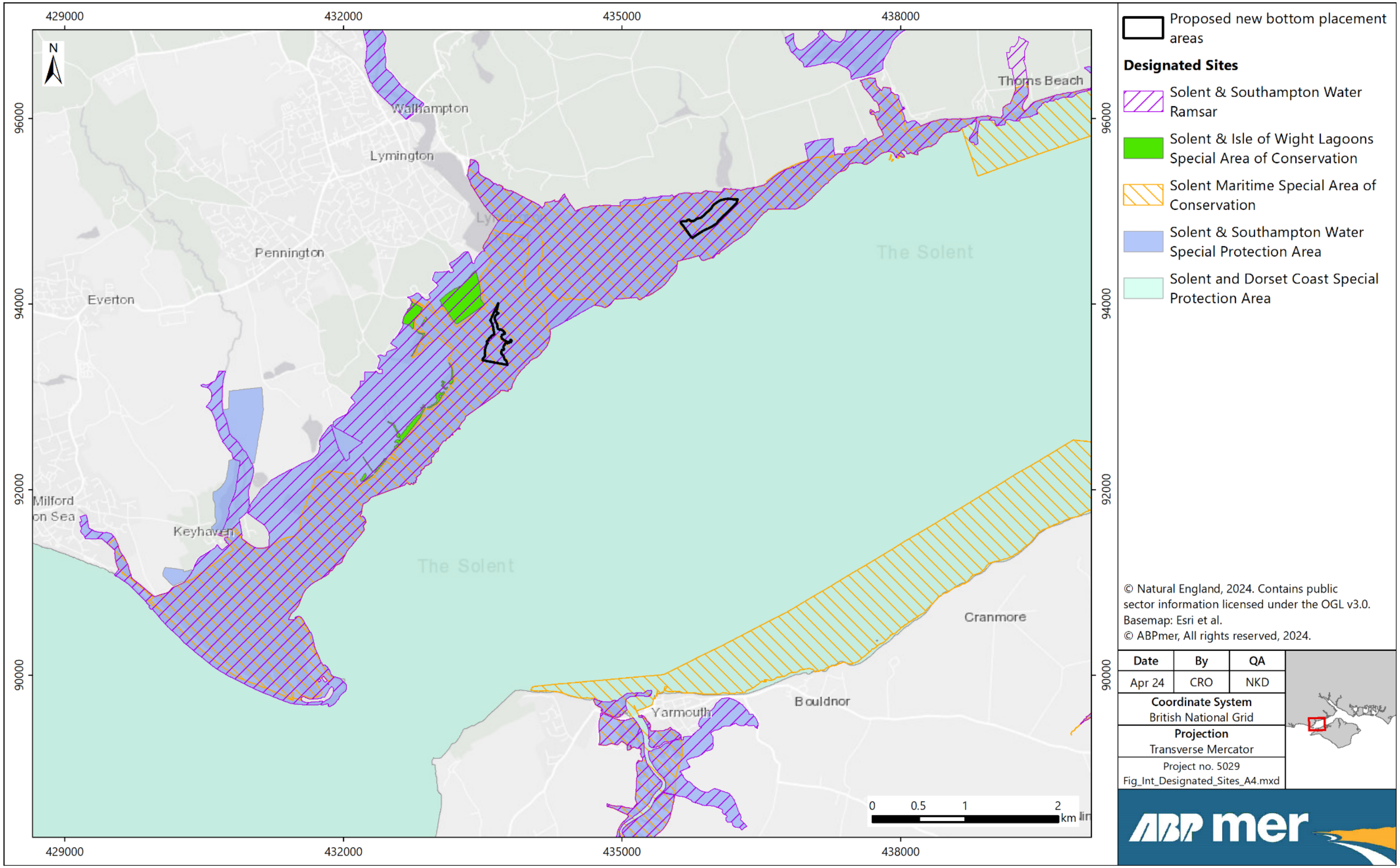


Figure 15. Location of international designations in relation to proposed beneficial use sites

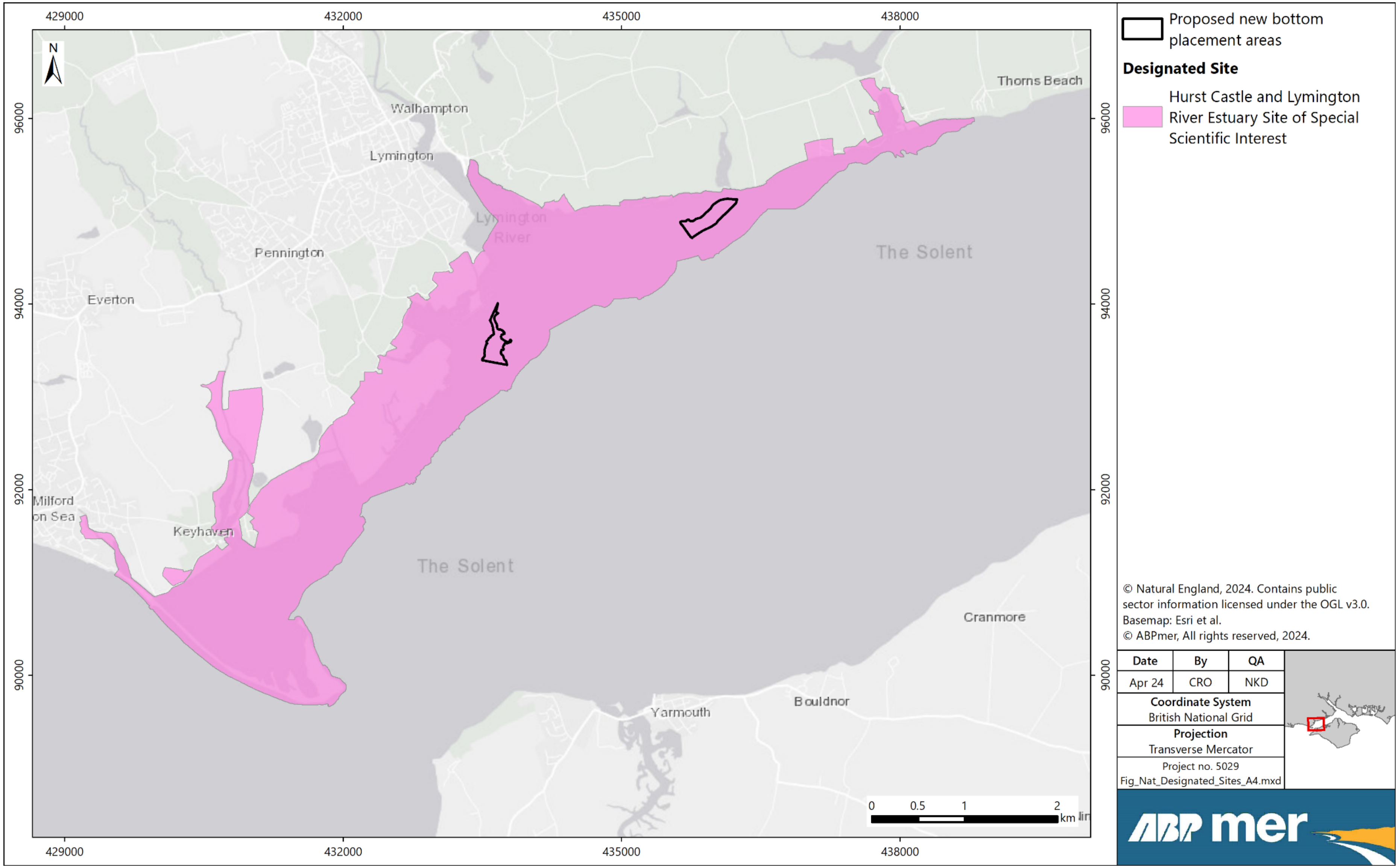


Figure 16. Location of Hurst Castle and Lymington River Estuary SSSI in relation to proposed beneficial use sites

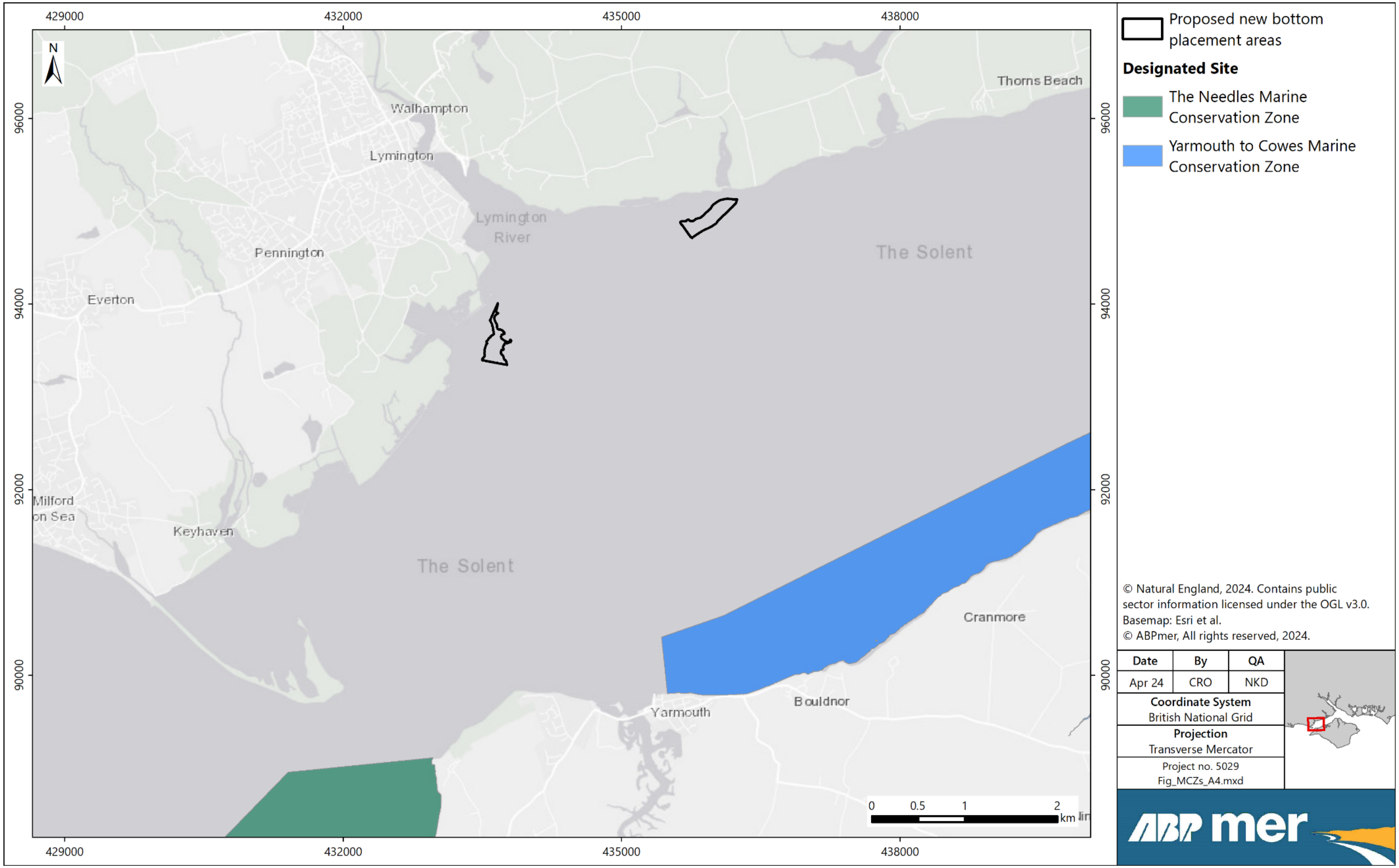


Figure 17. Location of Marine Conservation Zones in relation to proposed beneficial use sites

Solent and Isle of Wight Lagoons SAC

This SAC was classified in 2005, to protect one feature, namely 'coastal lagoons'. It encompasses a series of coastal lagoons, including percolation, isolated and sluiced lagoons.

The site includes a number of lagoons in the marshes in the Keyhaven to Pennington area, but also at other locations in the Solent and the Isle of Wight (e.g., Farlington Marshes/Langstone Harbour, at Bembridge Harbour, and at Gilkicker, near Gosport). The lagoons show a range of salinities and substrates, ranging from soft mud to muddy sand with a high proportion of shingle, which support a diverse fauna including large populations of three notable species: the nationally rare foxtail stonewort *Lamprothamnium papulosum*, the nationally scarce lagoon sand shrimp *Gammarus insensibilis*, and the nationally scarce starlet sea anemone *Nematostella vectensis*.

Solent and Southampton Water SPA

The Solent and Southampton Water SPA was classified in October 1998. The site qualifies under Article 4.1 of the Birds Directive by supporting populations of European importance of the following species listed on Annex I of the Directive during the breeding season:

- Common Tern Sterna hirundo;
- Little Tern Sterna albifrons;
- Mediterranean Gull Larus melanocephalus;
- Roseate Tern Sterna dougallii; and
- Sandwich Tern Sterna sandvicensis.

The area qualifies under Article 4.2 of the Directive by supporting populations of European importance. Over winter the area regularly supports

- Black-tailed Godwit *Limosa islandica;*
- Dark-bellied Brent Goose;
- Ringed Plover Charadrius hiaticula; and
- Teal Anas crecca.

The site also qualifies under Article 4.2 by regularly supporting at least 20,000 waterfowl.

Solent and Southampton Ramsar Site

Solent and Southampton Ramsar area extends from Hurst Spit to Gilkicker Point along the south coast of Hampshire and along the north coast of the Isle of Wight. The Ramsar Criteria which are applied to the designation of this site (as listed in the JNCC Ramsar Site Information Sheet) are:

- **Ramsar criterion 1:** The site is one of the few major sheltered channels between a substantial island and mainland in European waters, exhibiting an unusual strong double tidal flow and has long periods of slack water at high and low tide. It includes many wetland habitats characteristic of the biogeographic region: saline lagoons, saltmarshes, estuaries, intertidal flats, shallow coastal waters, grazing marshes, reedbeds, coastal woodland, and rocky boulder reefs;
- **Ramsar criterion 2**: The site supports an important assemblage of rare plants and invertebrates. At least 33 British Red Data Book invertebrates and at least eight British Red Data Book plants are represented on site;
- **Ramsar criterion 5**: Assemblages of international importance): Species with peak counts in winter: 51343 waterfowl (5 year peak mean 1998/99-2002/2003); and
- **Ramsar criterion 6**: Species/populations occurring at levels of international importance.

Solent and Dorset Coast SPA

The Solent and Dorset Coast was classified as a SPA on 16 January 2020. This SPA covers an area of nearly 89,000 ha along the coasts of Dorset, Hampshire, Isle of Wight and West Sussex and adjacent areas offshore. The site was designated because it regularly supports more than 1% of the Great Britain breeding populations of three tern species (Sandwich Tern, Common Tern and Little Tern) listed in Annex I of the European Union Birds Directive.

The SPA is an area that is important as a foraging ground for these three tern species. The westernmost extremity of the SPA area was defined by the modelled usage of Sandwich Terns foraging from the Poole Harbour SPA. The easternmost extremity was determined by the modelled usage of Sandwich Terns foraging from Chichester and Langstone Harbours SPA. The foraging ranges of the local Lymington/Keyhaven colonies ('Hurst to Pitts Deep') for Sandwich and Common Terns were also taken into consideration when the boundaries for this SPA were drawn.

Hurst Castle and Lymington River Estuary SSSI

This site is notified for supporting a range of coastal habitats, including saltmarsh, mudflats, lagoons, and the shingle spit known as Hurst Spit (Natural England, 2024). The site is also notified for providing nesting sites for important breeding populations of terns and black-headed gulls *Larus ridibundus*. The site is a very important component of The Solent estuarine system which supports internationally important over-wintering populations of wildfowl and waders. The rich invertebrate fauna includes eight nationally rare and 13 nationally notable species.

Needles MCZ

The Needles MCZ is designated for a range of habitat and species features, including subtidal chalk, seagrass beds, stalked jellyfish (*Lucernariopsis campanulata*) and native oyster (*O. edulis*).

Yarmouth to Cowes MCZ

Yarmouth to Cowes MCZ is designated for geological, habitat and species features, including Bouldnor Cliff, estuarine rocky habitats and native oyster (*O. edulis*).

Estuary wide habitats and species

A description of the habitats and species of Lymington Estuary is provided in Section 4.5 of the baseline MDP document in Appendix C. The main habitats in the estuary are also shown in Figure 18, which is derived from the latest CCO mapping outputs.

The intertidal and subtidal habitats in the estuary are mainly fine muddy sediments, with a mix of coarse sediment in some of the more exposed areas and locations with stronger tidal currents. Saltmarsh extends throughout much of the estuary. Other intertidal habitats that are also present in the estuary include sandflats, annual vegetation of drift lines, *Salicornia*, mixed sediment, sand and shingle, shallow coastal waters, Atlantic salt meadows and cordgrass swards.

As described previously, the estuary's intertidal habitats are changing, especially in the outer estuary, as the marshes and mudflats progressively retreat. While mudflat is generally increasing within the estuary at present, over time, it will progressively revert to subtidal habitats. This will especially occur in the outer estuary, which is already widening now, but this will extend to other areas over time, as the rest of the estuary becomes increasingly exposed to wind and wave action, and sea level rise accelerates.

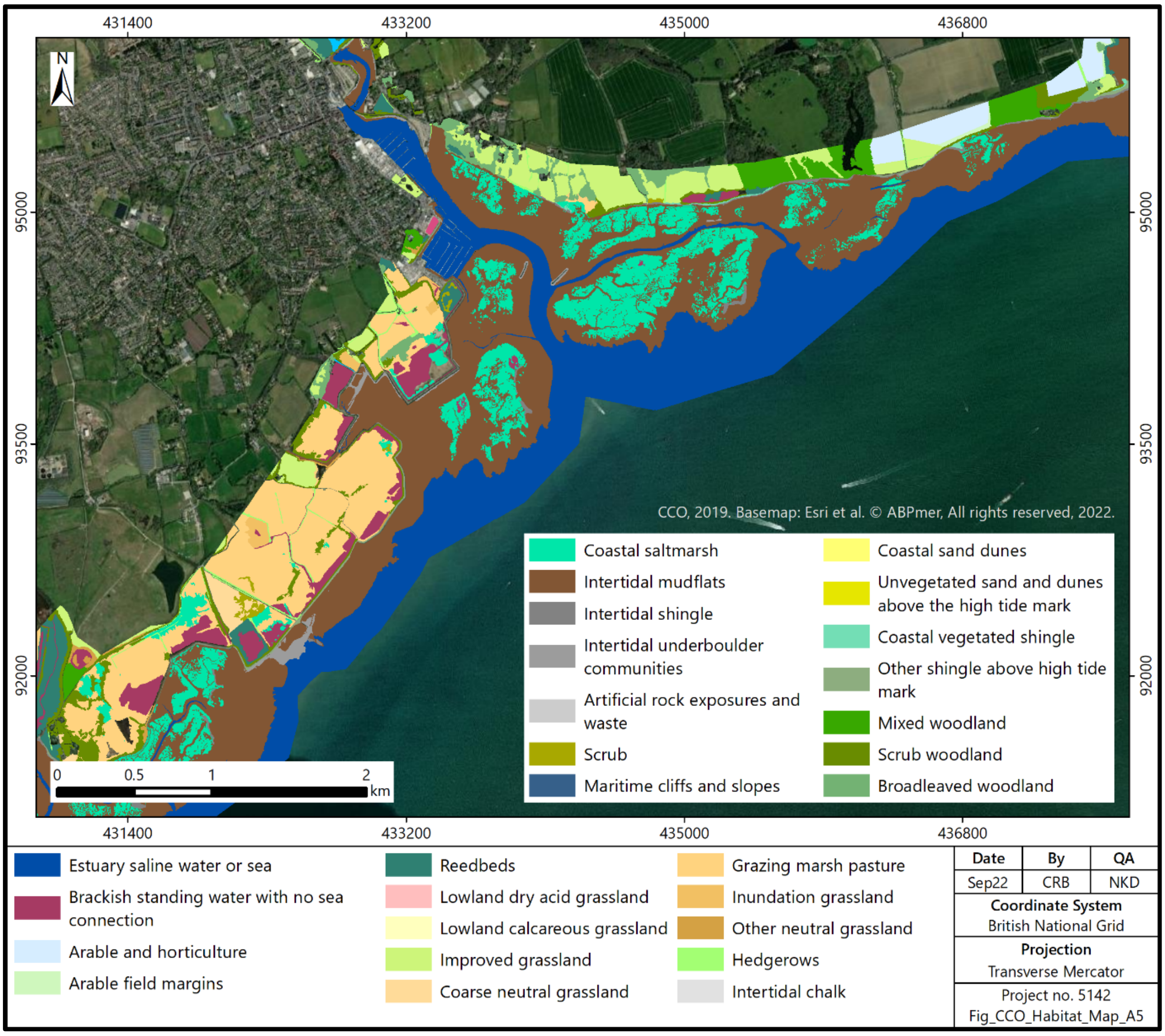


Figure 18. CCO habitat map of Lymington Estuary

The condition of these habitats in the western part of Solent European Marine Site is indicated in Figure 19. This is based on Natural England condition assessments for SSSI unit areas. The latest published assessment was undertaken in 2010[18]. This found that much of the area was in unfavourable recovering condition because sufficient habitat creation had begun by December 2010. However, it is still the case that the marshes are declining and that, while habitat creation has been done in the past, a lot more intervention will be needed to address and offset the ongoing losses of large sections of the outer estuary marshes.

At present, the main ongoing habitat interventions are those which are being undertaken by, or are proposed by, the LHC and L&WS (as described further in Section 4.9). It is recognised that more measures may emerge in the near future from the 'Hurst Spit to Lymington Strategy' as that progresses.

[18] A more recent assessment as carried out in 2019 for hinterland areas in the Lymington and Keyhaven Marshes Local Nature Reserve (LNR) and as shown in Figure 12, concluded that much of this area was favourable.

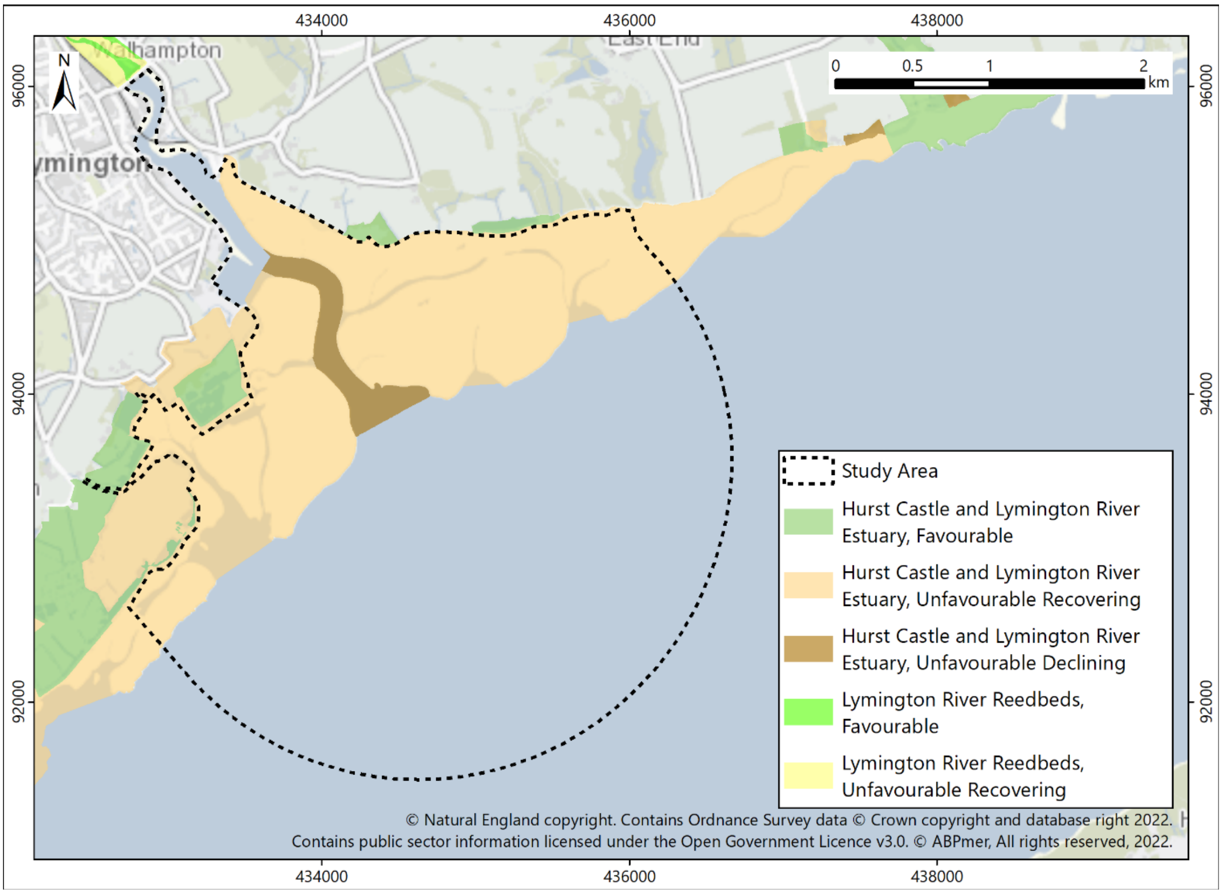


Figure 19. Location of individual SSSI units showing latest condition assessment

Cockleshell and Pylewell habitats and species

Intertidal mudflats are present along the length of the Lymington Channel around the lower fringes of the saltmarshes. Muds and finer sediments tend to settle in areas where water movement is relatively limited (such as in a sheltered harbour), which has led to the pattern of distribution of this habitat. Within the Lymington Estuary, the amount of intertidal mudflat also represents a balance between the rate of recession of the saltmarshes and the slower landward migration of the low water.

Mud-dominated intertidal habitats often support a relatively low diversity of species, but have high biomass (Browning, 2002). The invertebrate assemblages within mudflat habitats across the Solent are typically dominated by burrowing species such as polychaete worms and bivalve molluscs. Common species include the polychaete worm *Caulleriella* spp. and the peacock worm *Sabella pavonina*. The cockle *Cerastoderma edule*, and hard shell clam *Mercenaria mercenaria* are also common bivalve species, though the latter has declined in recent years (Black & Veatch, 2017a).

In order to characterise the benthic communities, present in the vicinity of the proposed disposal and restoration sites, intertidal sampling was undertaken in July 2022. Three intertidal samples were collected using a 0.025 m^2 Van Veen Grab from both the Cockleshell and Pylewell sites. The locations of these samples are shown in Figure 8. Samples were analysed for macrofaunal analysis (faunal composition, abundance and biomass), PSA and Total Organic Content (TOC). The results of this project specific benthic survey are summarised below and in Table 6.

The sediment in samples collected consisted of slightly gravelly sandy mud, gravelly mud, muddy sandy gravel, and gravelly muddy sand. The TOC in the samples ranged between approximately 2 % and 5 %. Overall, the number of taxa found in the samples was variable and ranged from 15 (Pylewell B) to 42 (Cockleshell A). The number of individuals was also variable and ranged from 58,120 organisms per m^2 (Pylewell A) to 180,680 organisms per m^2 (Cockleshell B). The range in total species biomass in the samples was between 52.88 g per m^2 at Cockleshell C and 1,962.55 g per m^2 at Pylewell B (which was primarily attributed to cockle *Cerastoderma edule*.

The assemblage recorded is considered typical of the community recorded on mudflats in the nearby area. At Pylewell, the dominant and characteristic species included nematodes, polychaetes *Tharyx* spp., *Streblospio* spp., *Aphelochaeta marioni, and Leiochone leiopygos,* the oligochaete *Tubificoides* spp., and the mudsnail *Peringia ulvae*. At Cockleshell, there was a greater proportion of epifaunal species over the sediment surface due to the presence of coarse sediment across this more exposed area. The dominant and characteristic infaunal species were similar to other parts of the estuary, and included nematodes, polychaetes *Spirorbinae, Aphelochaeta marioni, Lumbrineris latreilli*, *Euclymene oerstedii*, the oligochaete *Tubificoides* spp., the mudsnail *Peringia ulvae*, amphipods *Melita palmata* and Aoridae, and the tanaid *Apseudopsis latreilliid*. Most the species recorded from the samples in this area were considered commonly occurring in the region and not protected. However, the habitat is characteristic of the UK BAP Priority Habitat 'Sheltered Muddy Gravels (UK Biodiversity Action Plan, 2008). This habitat is also listed as a Habitat of Principal Importance in England under the NERC Act 2006 Section 41. It is also noted that *Sabellaria spinulosa* was recorded in Cockleshell B, though only 160 individuals per m^2 were found in one sample and on this basis is unlikely to be in abundances that could form biogenic reef structures in the locality of the proposed beneficial use disposal sites.

Non-native species recorded within the samples included slipper limpet *Crepidula fornicata* and the Manilla clam *Ruditapes philippinarum*. These are considered well established in the Solent region. The polychaete *Euchone limnicola*, free-living benthic ostracod *Eusarsiella zostericola* and the amphipod *Grandidierella japonica* were other non-native species recorded at the sites.

Many of the species recorded in the samples are considered prey species for coastal waterbirds such as polychaetes, cockle *Cerastoderma edule*, and mudsnail *Peringia* spp. (Woodward *et al.,* 2014). Wading bird species recorded in the area that would feed on these species include Dunlin, Knot, Black-tailed Godwit and Redshank. Geese and duck species found in the area, such as Dark-bellied Brent Goose *Branta bernicla bernicla,* Shelduck *Tadorna tadorna*, Teal *Anas crecca* and Wigeon *Anas penelope*, do not feed on benthic infauna.

Table 6. Intertidal benthic survey results

Station	Sediment Type	TOC (%)	No. of Taxa (per m^2)	No. of Individuals (per m^2)	Total Biomass (g per m^2)	Key Characterising Species (Number per m^2 shown in brackets)	
Pylewell A	Slightly gravelly sandy mud	4.17	25	58,120	538.23	*Nemotoda* *Streblospio* spp. *Tharyx* spp. *Leiochone leiopygos*	(18,320) (3,960) (18,520) (6,880)
Pylewell B	Slightly gravelly sandy mud	5.18	15	138,640	1,962.55	*Nemotoda* *Streblospio* spp. *Aphelochaeta marioni* *Tharyx* ssp. *Tubificoides* spp. *Peringia ulvae*	(48,640) (4,480) (11,200) (56,800) (13,920) (2,880)
Pylewell C	Gravelly mud	3.68	19	109,320	57.92	*Nemotoda* *Streblospio* spp. *Aphelochaeta marioni* *Tharyx* ssp. *Tubificoides* spp.	(51,520) (4,320) (4,000) (20,800) (20,960)
Cockleshell A	Gravelly mud	1.83	42	84,920	797.24	*Nemotoda* *Spirorbinae* *Tubificoides* spp. *Melita palmata* *Apseudopsis latreilliid*	(51,240) (10,680) (3,680) (2,320) (6,120)
Cockleshell B	Muddy sandy gravel	3.39	35	180,680	508.57	*Nemotoda* *Lumbrineris latreilli* *Spirorbinae* *Tubificoides* spp.	(154,720) (5,280) (3,000) (4,640)
Cockleshell C	Gravelly muddy sand	2.99	28	169,280	52.88	*Nemotoda* *Lumbrineris latreilli* *Euclymene oerstedii* *Tubificoides* spp. Aoridae *Peringia ulvae*	(116,640) (7,520) (2,080) (17,920) (7,520) (4,000)

4.6.2 Impact assessment

The proposed beneficial use disposal sites and associated habitat restoration activities are being undertaken deliberately to change habitats within the disposal sites, in a manner that will help enhance the resilience of Cockleshell and Pylewell marshes as a whole. To further examine this, the following relevant impact pathways were considered with respect to benthic ecology:

- Changes in habitat and loss of benthic organisms;
- Changes in water and sediment quality;
- Non-native species transfer and introduction; and
- Effects due to noise and vibration.

Changes in habitat and loss of benthic organisms

Intertidal and subtidal mudflat

The bottom placement of dredged material at the proposed beneficial use disposal sites will result in localised physical disturbance and smothering of mudflat habitats and species where the material settles onto the seabed. This smothering of benthic species may cause stress, reduced rates of growth or reproduction, and in the worst cases the effects may be fatal (Pineda *et al*., 2017). Habitats within estuarine and coastal environments have highly fluctuating conditions including 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). Subtidal and intertidal habitats are, therefore, characterised by such perturbations and the biological communities of these environments are well adapted to survival under fluctuating conditions.

If the amount of sediment deposited is too great to allow species to survive burial, then recovery occurs via re-colonisation and/or migration to the new sediment surface (Bolam *et al*., 2006a; 2006b). In general, the rate of recovery is dependent upon just how stable and diverse the assemblage was in the first place. A regularly disturbed sedimentary habitat with a low diversity benthic assemblage is likely to recover more quickly (i.e., return to its disturbed or 'environmentally-stressed' baseline condition) than a stable habitat with a pre-existing mature and diverse assemblage. Furthermore, in cases where the quantity and type of sediment deposited does not differ greatly from natural sedimentation, e.g., of similar particle size, the effects are likely to be relatively small as many of the species are capable of migrating up through the deposited sediments (Budd, 2005).

The Marine Evidence based Sensitivity Assessment (MarESA) approach (Tyler-Walters *et al*., 2018) found that benthic communities in both sandy and muddy estuarine sediments are typically considered to be tolerant to the deposition of up to 5 cm of fine material in a single event with burrowing species considered able to relocate to preferred depths through this level of deposition. Deposition of greater depths of fine sediment could result in some mortality, although evidence suggests that some characterising species are likely to be able to reposition. Bivalve and polychaete species have been reported to migrate through depositions of sediment greater than 30 cm (De-Bastos, 2016a; 2016b; Ashley, 2016; Tillin, 2016). A previous review by the University of Hull also concluded that benthic invertebrates in sediments are able to adapt and readjust if sediment laid is placed as thin veneers over several days although they can also tolerate moderate amounts (20 cm) of material being deposited at one time (IECS, 2001).

The smothering of benthic invertebrates within the footprint of the proposed beneficial use disposal sites is unavoidable. The smothering will be on a very localised scale and the area of the seabed that will be affected will be very small for each deposit load from the smaller split hopper barges that would be using these sites (Section 2.5.2). The total area covered by the proposed beneficial use sites (9.2 ha at Pylewell and 7.3 ha at Cockleshell) is also small in the context of the relevant Hurst Castle and

Lymington River Estuary SSSI unit (4.7 % for Pylewell and 3.5 % for Cockleshell) and SAC intertidal mudflat feature (0.18 % for Pylewell and 0.14 % for Cockleshell).

The proposed beneficial use disposal sites will result in a slight raising of habitat in the tidal frame and a potential short to medium term change in the extent or type of habitat (i.e., from lower intertidal mudflat to higher intertidal mudflat). Also, the sediment recharge will have beneficial effects on the adjacent vulnerable saltmarsh habitats and associated invertebrates (see next Section 'Saltmarsh'). Based on recent precedents at Boiler Marsh, it is expected that the proposed beneficial use disposal sites will become re-established relatively quickly with benthic invertebrates between dredge and disposal campaigns (Binnies UK Ltd, 2021).

A small proportion of the material that is placed on the seabed at the proposed beneficial use sites will be dispersed and re-deposited locally to the site (Section 4.4.2). Dispersion of material will be limited given the placement activities will take place as high up on the shore as possible. The small volume that is moved beyond the proposed sites is likely to be either dispersed widely in the outer estuary and Western Solent at very low concentrations, or settle in the low flow areas of the tidal creeks and marshes. The scale of change is considered to be minor and of a similar magnitude to deposition resulting from natural change, vessel movements and ongoing maintenance dredging in the wider area. Sedimentation away from the proposed beneficial use disposal sites is unlikely to be measurable, and will be short-lived and transient in nature, likely to be redistributed by natural physical processes and ongoing activities.

The mudflat benthic fauna recorded in the area of the proposed beneficial use disposal sites comprise species that are capable of rapidly recolonising disturbed habitats. These species are also considered to be commonly occurring in the wider area, and tolerant to some sediment deposition. Benthic communities are, therefore, considered to have a low sensitivity to minor fluctuations in sedimentation, particularly in areas with muddy sediments and those located adjacent to regularly disturbed areas, such as the main approach channel into Lymington Harbour. Any minor deposition outside of the immediate proposed beneficial use disposal sites is considered unlikely to cause significant smothering effects and recoverability is expected to be high.

Given the scale and nature of the proposed beneficial use disposal activities, it is considered that any impacts on mudflat and associated benthic invertebrate populations are likely to be localised, temporary and **negligible/insignificant to minor adverse** at worst.

The proposed beneficial use disposal sites are not expected to cause significant changes to physical processes (e.g., water levels, flow rates, accretion and erosion patterns) (Section 4.4.2). Therefore, impacts from indirect changes to seabed habitat extent and quality as a result of the works will be **negligible/insignificant**.

Saltmarsh

The proposed beneficial use disposal activities at Pylewell and Cockleshell will take place within the lower intertidal area, with the aim of the sediment creating a raised area or 'reef' on the seabed to provide some protection from wave action to the adjacent eroding saltmarshes. Most of the deposited material is not expected to remain in position in the long term, but will be redistributed by wave action and tidal movement so that a proportion washes and settles onto the adjacent saltmarsh. The remainder may be effectively 'lost' from Lymington Harbour but will remain present in low concentrations as an enhanced suspended sediment source for the Solent saltmarshes as a whole (Black & Veatch, 2017a).

Given the fact that sediment is not being directly placed on the saltmarsh, and the limited scale, extent and temporary nature of any resuspension and deposition, it is unlikely that saltmarsh habitat will be adversely affected by the proposed recharge activities at Pylewell and Cockleshell. The saltmarsh recharge trial which took place at Boiler Marsh from 2014 to 2017 went well and benthic habitat surveys carried out by Natural England demonstrated that there were no adverse impacts on the saltmarsh area following three deposit campaigns (Black & Veatch, 2017b; Binnies UK Ltd, 2021). The proposed beneficial use disposal sites may result in a temporary minor impact on SSC in the vicinity of the site (Section 4.4.2), however, based on the results of the recharge trial at Boiler Marsh, this did not affect the growth of the saltmarsh. Overall, therefore, no significant adverse effects are anticipated on the saltmarsh habitat.

In the long-term, the placement of material will act to retain sediment within the estuary system, with the aim of protecting the intertidal saltmarsh habitat and minimising or slowing down its current rate of loss from erosion. In this context, the proposed beneficial use disposal sites could help to re-supply sediment to the marshes at Pylewell and Cockleshell, and at least stall the progressive decline. Any measures which raise the bed levels up and/or slow the erosion of the outer marshes' edges have the potential to lead to marsh restoration. It is certainly known from past recharge work that, where dredged sediment is introduced to impoverished marsh surfaces, then marsh vegetation can develop/ or recover quickly (ABPmer, 2020).

Overall, the proposed beneficial use disposal sites will provide a valuable contribution to offsetting or delaying ongoing natural saltmarsh habitat loss that has been recorded in and around the Solent and impacts are considered of **minor to moderate beneficial significant**.

Changes in water and sediment quality

There is the potential for impacts associated with changes in water quality during the bottom placement of dredge material at the proposed beneficial use disposal sites, as a result of increases in SSC, changes to DO and the release of toxic contaminants bound in sediments.

Macrofauna living in estuarine systems which are subject to naturally high/fluctuating levels of SSC are considered well adapted to living in highly turbid conditions. An increased level of suspended sediments may result in an increase in food availability and, therefore, growth and reproduction for surface deposit feeders (such as certain polychaetes) within estuarine environments that rely on a supply of nutrients at the sediment surface. However, food availability would only increase if the additional suspended sediment contained a significant proportion of organic matter, and the population would only be enhanced if food was previously limiting (De-Bastos, 2016b).

Greater energetic costs for benthic species could occur as a result of higher particle loads due to elevated suspended sediments stimulating the secretion of mucus to protect branchial or feeding structures of filter feeding organisms (Perry, 2016). The level of suspended sediment has been found to have a negative linear relationship with sub-surface light attenuation. Light availability and water turbidity are principal factors in determining depth range at which kelp and other algae are recorded. In addition, certain mobile epistrate feeders (such as the amphipod *Bathyporeia* spp.) feed on diatoms within the sand grains and an increase in suspended solids that consequently reduced light penetration could alter food supply (Tillin *et al*., 2019). However, longer-term changes in turbidity levels rather than temporary elevations are likely to be required to elicit any measurable changes in these species.

Elevated suspended sediment levels can also cause increased scouring and damage of epifaunal species due to the potentially abrasive action of the suspended sediment in flowing water. Increased suspended sediments may favour the development of suspension feeders such as bivalves over other species. However, it should be noted that many benthic invertebrates can switch feeding modes depending on environmental conditions. The negative effects of suspended sediment may be particularly important during larval settlement in spring, with settling stages potentially being more sensitive to effects such as scour. However, this is generally thought to be of less concern where fauna is adapted to naturally high levels of suspended sediments (Boyd *et al*., 2004).

Any changes to SSC and DO will be temporary and intermittent, lasting the period of the proposed disposal activities associated with maintenance dredge campaigns of nearby harbours / marinas (Section 2.4). Overall, the spatial and temporal magnitude of changes in SSC is assessed as minor (Section 4.4.2). Any changes in DO are expected to be localised and temporary, and are assessed as negligible. The potential changes to levels of chemical contaminants in the water and the potential redistribution of sediment-bound chemical contaminants are assessed as negligible (Section 4.5.2).

Thus, in physical terms, any plumes resulting from placement of material at the proposed beneficial use disposal sites are expected to have a minimal and very localised effect on water and sediment quality. Benthic species in the area are considered to be well adapted to survival under fluctuating conditions. The benthic community present within and adjacent to the proposed sites is, therefore, expected to be tolerant to the predicted changes in water and sediment quality. In other words, they are not sensitive to the magnitude of changes in water quality that are predicted. Furthermore, standard practice pollution prevention guidelines will be followed to minimise the risk of accidental spillages and the risk of introduction of contaminants throughout the disposal process.

Overall, the potential impact to benthic ecology arising as a result of changes in water and sediment quality during the placement of dredge material at the proposed beneficial use disposal sites is assessed as **negligible/insignificant**.

Non-native species transfer and introduction

There is a potential risk that the proposed beneficial use disposal sites could result in the introduction or spread of invasive non-native species (INNS). The split hopper barges associated with the proposed disposal activities will not be carrying ballast water; thus, there is no risk that non-native invasive species will be transported via this pathway. Non-native species, however, have the potential to be transported into the local area on the hulls of the vessels if they have operated in differing water bodies. Potential biosecurity risks will be managed through biosecurity management procedures if required.

Overall, given the scale and nature of the proposed recharge activities, the risk in terms of introducing or transferring INNS and potential impacts on marine habitats and benthic species is assessed as **negligible/insignificant**.

Effects due to noise and vibration

There is the potential for noise and vibration during the movements and operation of the split hopper barges to disturb benthic species. Marine invertebrates lack a gas-filled bladder and are thus unable to detect pressure changes associated with sound waves (Carrol *et al*., 2017). However, some bivalves, echinoderms and crustaceans have a sac-like structure called a statocyst which includes a mineralised mass (statolith) and associated sensory hairs. Statocysts develop during the larval stage and may allow an organism to detect particle motion associated with soundwaves in water to orient itself (Carrol *et al*., 2017).

Scientific understanding of the potential effects of underwater noise on marine invertebrates is relatively underdeveloped (Hawkins *et al*., 2015). There is limited research to suggest that exposure to near-field low-frequency sound may cause anatomical damage (Carrol *et al*., 2017). There is also increasing evidence to suggest that benthic invertebrates behaviourally respond to sediment vibration or particle motion (Roberts *et al*., 2016; Spiga *et al*., 2016; Tidau and Briffa, 2016). The vibration levels at which these responses were observed generally correspond to levels measured near anthropogenic operations such as pile driving and up to 300 m from explosives testing (blasting) (Roberts *et al*., 2016).

The levels of noise and vibration that are anticipated from the barges are significantly lower than the levels of noise generated by the activities reported to have disturbed benthic invertebrates. Furthermore, the levels of noise and vibration from the proposed recharge activities are considered to be similar to maintenance dredging plant and the movement of vessels that are already regularly occurring in the area.

Overall, therefore, the potential vibration effects on the benthic community are assessed as **negligible/insignificant**.

4.7 Fish and fisheries

4.7.1 Baseline description

The baseline background for fish ecology at Lymington Estuary is provided in Section 4.6 of the baseline MDP document (in Appendix C). In summary, in the Lymington catchment, at least 15 species of fish are known to occur, with the most significant from a nature conservation point of view being migratory sea trout (which is a key species in the Lymington River SSSI designation), thin lipped mullet (which is nationally uncommon) and eels (which are protected by the Eels (England and Wales) Regulations 2009).

In addition, the river supports bullheads *Cottus gobio*, and lamprey species which are listed in Annex II to the EC Habitats Directive. Furthermore, the estuary is known to support populations of bass, flounder and flatfish (though it is not a designated bass in nursery area). The mudflats and creeks act as a nursery and feeding area for many of these species.

As noted previously, a small fishing fleet operates out of both Lymington and Keyhaven harbours; around 19 vessels are registered here. Some charter fishing boats are also available for hire by recreational anglers. The commercial fleet fishes for both shellfish (whelk being the highest value catch) and finfish (notably bass), and largely operate boats less than 10 m in size. The boats mostly fish in Christchurch Bay and within the adjacent inshore zone, though some fishing (such as long lining, bivalve dredging, potting and Cuttlefish trapping) also takes place in the Solent (ABPmer, 2019).

The commercial fishers are subject to many byelaws and regulations. For example, the use of bottom towed gear in the Lymington Estuary and its intertidal areas (including the marshes surrounding the proposed disposal sites) is forbidden under the bottom towed fishing gear Southern Inshore Fisheries and Conservation Authority (Southern IFCA) Bottom Towed Fishing Gear Byelaw 2016.

The Solent is furthermore a Bivalve Management Area, and, as of 2021, bivalve dredging can only be undertaken by those holding a permit. The oyster fishery is closed between 1 March to 31 October every year, and the cockle fishery from 1 February to 30 April inclusive. It is furthermore prohibited to retain bass in February and March. Additional restrictions and regulations are in place for these and other species; these can be found on the Southern IFCA's website.

4.7.2 Impact assessment

The following impact pathways have been considered with respect to fish and shellfish:

- Effects of habitat change on fish and shellfish receptors;
- Effects of changes in water quality on fish and shellfish receptors; and
- Effects due to noise and vibration.

Effects of habitat change on fish and shellfish receptors

Disposal of maintenance dredge materials at the proposed beneficial use disposal sites has the potential to result in temporary, localised, physical disturbance and smothering of seabed habitats and species. These changes have the potential to impact on fish and shellfish species through changes in prey resources and the quality of foraging, nursery and spawning habitats. Disposal also has the potential to result in changes to hydrodynamic and sedimentary processes (e.g., water levels, flow rates, changes to tidal prism, accretion and erosion patterns) which could affect the quality of marine habitats and change the distribution of marine species. However, these changes in physical processes are assessed as negligible to minor in extent and magnitude (Section 4.4.2). The potential impacts on intertidal and subtidal mudflat are assessed as negligible to minor adverse, and the potential impacts on saltmarsh are assessed as minor to moderate beneficial significant(Section 4.6.2).

Only a small area of low intertidal habitat would be temporarily affected by disposal activities. In addition, consideration is given to the mobile nature of the majority of fish and shellfish species and the widespread availability of other habitats and prey throughout the Solent and Lymington Estuary. Most species are opportunistic and generalist feeders meaning they are not reliant on a single prey item. Therefore, a slight change in dietary composition as a result of the disposal activities is unlikely to alter the fish and shellfish population as species can adapt (Pearce, 2008).

The changes in elevation of the mudflats, as well as smothering of benthic invertebrates under the thicker deposit areas, would affect a very small percentage of the Solent's extensive mudflats, and related functions that some fish rely on. It is of note that saltmarsh habitat, which would be afforded additional protection and resilience by the beneficial use activities, provides an important nursery and feeding ground for juvenile fish, and thus, the beneficial use activities would be considered to have a slight beneficial effect in this respect.

Overall, given the scale and temporary nature of the proposed dredging disposal activity, the changes in habitat on fish and shellfish overall are assessed as **negligible/insignificant** during the disposal of maintenance dredge material at the proposed disposal sites.

Effects of changes in water quality on fish and shellfish receptors

Changes in water quality during dredge disposal activities could potentially impact fish species, by increasing SSC, resulting in changes to DO and releasing toxic contaminants bound in sediments.

Fish and shellfish within the West Solent 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 proposed new disposal and restoration sites and will be short-lived (see also Sections 4.4.2 and 4.5.2). The predicted changes in SSC will therefore not result in significant displacement or a barrier to migratory fish. Furthermore, fish, including migratory species, 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 enables them to move freely to avoid areas of adverse conditions and to use other prey resources.

Standard practice pollution prevention guidelines will also be followed to minimise the risk of accidental spillages and the risk of introduction of contaminants throughout the disposal process.

Overall, given the above, and the fact that the proposed disposal activities are assessed as having only temporary, localised and negligible effects on water quality (see Section 4.5.2), the potential impacts on fish are assessed as **negligible/insignificant**.

Effects due to noise and vibration

Elevated noise and vibration levels can potentially disturb fish and shellfish by causing physiological damage and/or inducing adverse behavioural reactions and masking (Hawkins *et al.*, 2015). The ability to detect and localise the source of a sound is of considerable biological importance to many fish species and is often used to assess the suitability of a potential mate or during territorial displays and during predator prey interactions. In laboratory settings, cuttlefish have been shown to change their behaviour under exposure of sounds of 130 dB or more underwater which may increase predation risk and decrease the chances of feeding and reproduction (Gibson-Hall and Wilson, 2018). Crustaceans and bivalves are also thought to utilise particle motion (vibration) in a similar way to fish.

Information on underwater noise levels associated specifically with disposal of dredged material is limited. On this basis, noise levels associated with dredging activity more generally have been used to inform the assessment. Dredging noise impacts on fish are likely to be restricted to behavioural responses, which are predominantly limited to near and intermediate distances of several metres to tens of metres from the source (Popper *et al.*, 2014). At Pylewell and Cockleshell, split hopper barges will be present only intermittently and the works will be short term. As the vessels are moving, fish are not physically constrained and will be able to move away from the source of noise and return once disposal and restoration activity has ceased. Noise levels at the proposed disposal sites and amounts of disturbance will thus be temporary and relatively low, and of a similar magnitude to underwater noise generated by existing vessel movements and ongoing maintenance dredging in the wider area.

Overall, underwater noise and vibration disturbance effects on fish and shellfish will be localised and temporary and are assessed as **negligible/insignificant**.

4.8 Waterbird populations

4.8.1 Baseline description

The baseline background for waterbird populations in Lymington Estuary is provided in Section 4.7 of the baseline MDP document (in Appendix C). A summary is provided below.

The West Solent marshes support large populations of overwintering and breeding coastal waterbirds. The marshes in which the proposed beneficial use sites are located are of high conservation value and lie within the boundaries of the Solent and Southampton Water SPA and the Solent and Southampton Water Ramsar site (Section 4.6.1). The SPA qualifying bird species are listed in Table 7.

Table 7. Solent and Southampton Water SPA qualifying features.

Qualifying Bird Species in the Solent and Southampton Water SPA	
Internationally Important Populations of Regularly Occurring Annex 1 Species	
Species	Breeding Population
Mediterranean Gull	2 pairs (15.4% of British population) (1994-1998)
Sandwich Tern	231 pairs (1.7% of British population) (1993-1997)
Common Tern	267 pairs (2.2% of British population) (1993-1997)
Little Tern	49 pairs (2% of British population) (1993-1997)
Roseate Tern	2 pairs (3.3% of British population) (1993-1997)
Internationally Important Populations of Regularly Occurring Migratory Species	
Species	Wintering Population (5-year Peak Mean 1992/93-1996/97)
Dark-bellied Brent Goose	7,506 individual birds (2.5% of West Siberian/West European population)

Qualifying Bird Species in the Solent and Southampton Water SPA	
Eurasian Teal	4,400 individual birds (1.1% of Northwest European population)
Ringed Plover	552 individual birds (1.1% of European/Northwest African population)
Black-tailed Godwit	1,125 individual birds (1.6% of Icelandic breeding population)
Internationally Important Assemblage of Waterfowl	
Importance	Wintering Population
Wintering waterfowl assemblage	51,361 individual birds (21,401 wildfowl, 29,960 waders) including Dark-bellied Brent Goose, Eurasian Teal, Ringed Plover and Black-tailed Godwit.

The marshes also lie alongside, and are intrinsically linked to, the adjacent Solent and Dorset Coast SPA, which is designated for the protection of the foraging habitat of Terns (Table 8).

Table 8. Solent and Dorset Coast SPA qualifying features

Internationally Important Populations of Regularly Occurring Annex 1 Species	
Species	Breeding Population
Sandwich Tern	441 pairs (4.0% of British breeding population) (2008-2014)
Common Tern	492 pairs (4.8% of British breeding population) (2008-2014)
Little Tern	63 pairs (3.3% of British population) (2008-2014)

Overwintering bird populations

High tide surveys

The abundance of waterbirds using Lymington and its environs at high water is described by Wetland Bird Survey (WeBS) 'Core Count' data. These Core Counts are carried out during high tide periods by volunteer surveyors. The results therefore describe the abundance of birds when they are aggregating at roosting locations or on inland sites. Locally, two broad survey areas are covered by these surveys which overlap with the proposed disposal sites. Cockleshell falls within the 'Hurst to Lymington' count sector and Pylewell falls within the 'Pylewell' count sector. They cover the outer Lymington Estuary, but also much of the wider coastline from Hurst Spit to Tanners Lane.

For Hurst to Lymington, there is a complete set of monthly data for each of the winters from 2016/17 to 2020/21. For Pylewell, the latest data extends to the 2019/20 winter. To summarise the latest survey results, the annual peak abundance of individual key species is shown in Table 9 for the 'Hurst to Lymington' sector, and Table 10 for the 'Pylewell' area.

During these most recent winter periods, 75 and 38 bird species were respectively recorded at the Hurst to Lymington and Pylewell sections. The overall peak mean number of waterbirds across all winters is 12,073 at Hurst to Lymington, and 1,989 at Pylewell. The diversity and abundance of species is greater across Hurst to Lymington, because it is a larger area that covers a much broader range of coastal and landside wetland habitats (including the LNR), than the Pylewell count section. These abundance values equate to around 24 % and 4 % respectively of the total wintering waterbird assemblage value that is cited within the Solent and Southampton SPA designation (see Table 7).

Some of the main species recorded across both areas include Black-headed Gull, Brent Goose, Dunlin, Knot, Pintail and Wigeon. Ringed Plover and Teal are also present at both, so all four of the overwintering bird species that are individually cited in the Solent and Southampton Water SPA are recorded in these count sectors. Across the Hurst to Lymington area, the following species were present at nationally important levels: Black tailed Godwit, Brent Goose, Greenshank, Pintail and Spotted Redshank. These species are highlighted in green in Table 9.

Also occurring in the Hurst to Lymington sector at nationally important levels (simply because they are present at all) are Spoonbill, which evidently now regularly occur on the site (peak average five over five winters). Some other species that are abundant, even if they do not exceed thresholds of national importance due to larger aggregations elsewhere in the country, include Avocet, Curlew, Lapwing, Redshank, Ringed Plover, Shelduck, Teal and Turnstone in the Hurst to Lymington section and Grey Plover (peak average 58 over four winters) on the Pylewell section.

Table 9. Annual peak counts of key species in ''Hurst to Lymington' sector at high water

Species	2016/17	2017/18	2018/19	2019/20	2020/21	Peak Average (2015/16-2020/21)
Avocet	11	16	24	25	29	19
Barnacle Goose	2	0	3	3	9	2
Bar-tailed Godwit	9	8	3	33	12	13
Black-headed Gull	0	250	0	0	0	63
Black-tailed Godwit	478	355	670	563	220	517
Brent Goose (Dark-bellied)	1,085	1,273	1,942	1,426	1,395	1,432
Common Gull	11	3	3	2	2	5
Common Sandpiper	7	1	0	0	0	2
Common Scoter	1	0	1	0	0	1
Common Tern	1	1	0	0	0	1
Coot	160	125	83	143	97	128
Cormorant	23	17	26	18	18	21
Curlew	185	200	185	224	213	199
Curlew Sandpiper	9	0	0	0	1	2
Dunlin	2,480	2,500	2,750	2,000	2,440	2,433
Eider (except Shetland)	13	18	29	8	6	17
Gadwall	34	20	32	87	52	43
Golden Plover	250	300	400	650	470	400
Goldeneye	7	7	8	6	1	7
Great Black-backed Gull	5	6	7	14	7	8
Great Crested Grebe	8	14	17	15	26	14
Great Northern Diver	1	1	0	0	1	1
Greenshank	18	20	17	15	11	18
Grey Heron	6	7	6	5	6	6
Grey Plover	160	244	143	81	153	157
Greylag Goose	2	0	0	1	5	1
Herring Gull	29	30	50	68	32	44
Kingfisher	2	3	2	3	3	3
Knot	450	320	350	32	180	288
Lapwing	1,205	712	1,070	778	985	941
Lesser Black-backed Gull	3	3	1	0	0	2
Little Egret	29	25	29	22	53	26
Little Grebe	38	35	24	31	17	32

Species	2016/17	2017/18	2018/19	2019/20	2020/21	Peak Average (2015/16-2020/21)
Little Ringed Plover	0	0	1	0	0	0
Little Stint	3	0	0	0	4	1
Long-tailed Duck	0	0	2	1	0	1
Mallard	326	244	388	233	186	298
Mediterranean Gull	4	4	2	2	3	3
Moorhen	10	8	10	10	6	10
Mute Swan	44	46	62	41	47	48
Oystercatcher	303	187	160	186	196	209
Pintail	248	407	303	212	550	293
Pochard	9	0	11	1	1	5
Purple Sandpiper	0	0	0	1	0	0
Red-breasted Merganser	32	17	19	16	20	21
Red-necked Grebe	0	2	0	0	0	1
Redshank	410	250	265	191	273	279
Red-throated Diver	0	0	2	0	0	1
Ringed Plover	150	300	113	80	177	161
Ruff	3	5	13	12	7	8
Sanderling	0	0	2	0	0	1
Sandwich Tern	3	2	0	0	3	1
Scaup	0	0	1	0	0	0
Shag	1	0	0	0	0	0
Shelduck	148	187	165	192	160	173
Shoveler	110	137	162	210	140	155
Slavonian Grebe	1	1	0	2	0	1
Smew	0	0	0	0	3	0
Snipe	33	9	7	9	76	15
Spoonbill	2	6	2	10	6	5
Spotted Redshank	8	8	9	10	6	9
Teal	1,530	1,055	1,140	1,300	692	1,256
Tufted Duck	41	41	55	50	42	47
Turnstone	141	150	150	103	164	136
Water Rail	2	3	1	1	2	2
Whimbrel	0	0	0	1	0	0
Wigeon	1,760	1,267	1,660	1,015	1,245	1,426
Cells shaded green indicate 5-year averages greater than the National Threshold[19].						

[19] The thresholds levels are available at: Species Threshold Levels (https://www.bto.org/volunteer-surveys/webs/data/species-threshold-levels). The thresholds are set as 1% of the biogeographic population (internationally important) or national population (nationally important).

Table 10. Annual peak counts of key species in 'Pylewell' sector at high water

Species	2016/17	2017/18	2018/19	2019/20	Peak Average (2016/17-2019/20)
Avocet			20		5
Bar-tailed Godwit	1	8	9		5
Black-headed Gull		20	500	130	163
Black-tailed Godwit	2		3		1
Brent Goose (Dark-bellied)	270	300	350	200	280
Canada Goose	11	24	23	2	15
Common Gull		1	1		1
Cormorant	4	12	13	23	13
Curlew	20	27	35	30	28
Dunlin	700	1000	600	450	688
Eider (except Shetland)	10	33	1	11	14
Great Black-backed Gull	3	3	5	2	3
Great Crested Grebe	3	7	4	1	4
Great Northern Diver		1		1	1
Greenshank	1	3	1	1	2
Grey Heron	1	1	1	2	1
Grey Plover	60	90	30	50	58
Greylag Goose (British/Irish)			60		15
Herring Gull	3	7	9	6	6
Kingfisher	1	1			1
Knot	250	100	50		100
Lapwing		5			1
Little Egret	4	4	5	7	5
Mallard			7	14	5
Mediterranean Gull	2	5	13	4	6
Mute Swan	6	1	0	1	2
Oystercatcher	13	9	15	8	11
Pintail	28	50	60	40	45
Red-breasted Merganser	10	11	3	3	7
Redshank	8	19	30	25	21
Ringed Plover	30	30	3	5	17
Shelduck	18	8	14	9	12
Spoonbill	6	6	10		6
Teal	13	50	70		33
Turnstone	28	50	2	22	26
Wigeon	590	350	400	230	393
Avocet			20		5
Bar-tailed Godwit	1	8	9		5

Low tide surveys

The abundance and distribution of waterbirds across intertidal environments of the Lymington Estuary and its environs is described in occasional WeBS 'Low Tide' surveys. Under the WeBS programme, these surveys are carried out less frequently than the Core Counts because they require more intensive survey effort. They are also typically done between November and February (compared to monthly and through the year for WeBS Core Counts).

These surveys extend across a single large area that is referred to as the 'North-west Solent' count sector. This area covers the coastline from Hurst Spit to the promontory east of Sowley, but it is also divided into subsections for different field recorders to cover. The most recent low water count which covered the Lymington Estuary was undertaken during the 2018/2019 winter. The data from these surveys were obtained from the BTO.

The summary results from the 2018/19 winter surveys are shown in Table 11. This describes the monthly peak abundance, the monthly average peak and the average density of birds as they are distributed across the survey area. The most abundant species across the foreshore during the 2018/19 low water survey period were Dunlin, Dark-bellied Brent Geese, Knot, Wigeon, Black-tailed Godwit and Teal. The peak counts of these species were 5,690; 1,304; 596; 696; 273 and 330 respectively.

The total abundance (as the sum of the peaks for each species) was 10,392. As with the high-water counts, this is around 20 % of the total wintering waterbird assemblage value that is cited within the Solent and Southampton SPA designation. All four of the overwintering bird species that are individually cited in the Solent and Southampton Water SPA (see Table 7) are recorded in these low water surveys.

Table 11. WeBS Low tide counts on the North-West Solent during the 2018/19 winter

Species	Month Peak	Month Average	Average Density
Brent Goose (Dark-bellied	1,304	1,023	1.16
Canada Goose	120	60	8.57
Mute Swan	78	46	6.57
Shelduck	113	61	0.14
Wigeon	696	433	0.78
Mallard	78	61	0.10
Pintail	82	37	0.09
Teal	330	177	0.58
Eider	1	1	0.01
Red-breasted Merganser	20	12	0.06
Coot	1	1	1.00
Little Grebe	5	3	3.00
Great Crested Grebe	21	14	0.06
Oystercatcher	157	124	0.22
Avocet	15	11	0.09
Lapwing	4	2	0.03
Golden Plover	8	4	0.67
Grey Plover	160	116	0.27
Ringed Plover	55	35	0.12
Curlew	105	84	0.22
Bar-tailed Godwit	11	9	0.03
Black-tailed Godwit	273	203	0.79
Turnstone	81	53	0.11
Knot	596	440	2.49
Dunlin	5,690	4,277	7.68

Species	Month Peak	Month Average	Average Density
Snipe	1	1	0.03
Redshank	177	149	0.29
Spotted Redshank	5	4	0.05
Greenshank	3	3	0.02
Black-headed Gull	125	93	(0.72)
Mediterranean Gull	2	1	(<0.01)
Common Gull	1	1	(0.02)
Great Black-backed Gull	15	10	(0.02)
Herring Gull	16	12	(0.06)
Cormorant	21	16	0.03
Spoonbill	1	1	0.02
Grey Heron	1	1	0.02
Little Egret	17	16	0.04
Kingfisher	1	1	0.14

Breeding birds

HCC breeding bird data and RSPB 2013-2018 breeding Tern data show that, during the breeding season, several of the marshes and shingle banks in the study area are used by a range of species (ABPmer, 2020). The most common breeding coastal waterbird is Black-headed Gull, with approximately 6,000 active nests in 2018.

The majority of this breeding activity is focused within the middle area of the West Solent marshes, around Cockleshell Island and Pylewell. There has been anecdotal evidence that some areas previously used by several species are now no longer used due to a decrease in available area as a direct result of erosion (ABPmer, 2020).

Several qualifying species of the Solent and Southampton Water SPA and Solent and Dorset Coast SPA also breed in this area. Sandwich, Common and Little Tern and Mediterranean Gull were all recorded as successfully breeding each year between 2013 and 2018 (noting that it is common to have mixed breeding colonies of terns and gulls), as can be seen in Table 12. Common Tern and Sandwich Tern peaked at 210 and 206 nests respectively (in 2013), with 2018 data showing a marked decrease to 94 and 90 nests (Table 12).

In the wider context, the 5-year mean (2014-2018) represents 20, 15 and 17 % of the Solent and Dorset Coast SPA populations of Common, Sandwich and Little Tern, respectively. The large percentage of the SPA features' population that regularly occurs within this area again highlights the importance of this region to multiple species of birds.

Table 12. Breeding tern data provided by the RSPB, for Lymington River to Sowley

Tern Species	Nests recorded (per year)						5-year mean (2014-2018)	% change 2018 to 5-year mean (2014-18)
	2013	2014	2015	2016	2017	2018		
Common	210	156	74	55	122	94	100.2	- 6
Sandwich	206	45	87	81	48	90	70.2	28
Little	23	10	10	16	12	8	11.2	- 29

In 2022, the central area of the marshes (i.e., Pylewell, Boiler and Cockleshell marshes) was an important area, with a large percentage of the species present here. Common Tern had a productive year with colonies established at Pylewell, Boiler, Cockleshell, Hawkers Island and Normandy Lagoon. A total of around 115 pairs bred (a small increase on 2021), and around 50 chicks fledged representing 43 % of nests. Little Tern also had a successful breeding season in 2022. Around five to six pairs bred on Cockleshell and four pairs on Hawkers Island, with seven to eight and three to four chicks fledging, respectively. The breeding success of Sandwich Tern nesting on Pylewell and Hawkers Island was relatively poor, with only five to seven chicks likely to have fledged from 85 nests recorded at the beginning of the season, though this is still an improvement compared with 2021. A pair of Roseate Tern's appeared in the colonies for the second year in a row in 2022, though did not raise any chicks.

A total of around 3,610 active nests of Black-headed Gulls were recorded within colonies nesting in the area in 2022. The majority were counted on Pylewell, with nests also at Boiler, Keyhaven, and Normandy Lagoon. This is a decline compared with 2021, primarily caused by a reduction in numbers nesting on the Normandy/Cockleshell marsh following fox predation problems in 2021. Colonies east of the river had good breeding success with between 800 and 1,000 chicks recorded, though the Normandy Lagoon colony fared less well possibly due to bird flu causing high chick mortality. Mediterranean Gulls had a record year of 610 active nests on Pylewell marsh in 2021 (10 times the size of colony in 2021) with at least 100 chicks fledging.

4.8.2 Impact assessment

The following impact pathways have been considered with respect to coastal ornithology:

- Effects of changes to intertidal and subtidal habitats on waterbirds;
- Effects of changes in water and sediment quality on waterbirds; and
- Visual and noise disturbance to waterbirds.

Effects of changes to intertidal and subtidal habitats on overwintering birds

Disposal of dredged material at the proposed Pylewell and Cockleshell disposal sites could affect the quality of marine habitats and change the distribution of marine species, which in turn has the potential to impact on overwintering birds (chiefly intertidal birds) through changes in habitat extent and prey resources. Impacts on benthic habitats and species are assessed as insignificant to minor adverse at a local level (Section 4.6.2), and impacts on fish are assessed as negligible (Section 4.7.2).

As noted previously, saltmarshes are declining, and the proposed works will restore some of the historic balance and are expected to help to return the saltmarsh habitats of outer estuary marshes towards favourable condition. Furthermore, the proposed disposal and restoration works will result in the creation of what will be ultimately more sustainable habitat than what is there at present. Impacts on saltmarsh are assessed as minor to moderate beneficial significant (Section 4.6.2). Subtidal habitats are not expected to be impacted, as deposition would take place over the lower intertidal.

There is therefore considered to be no substantial change in the functionality or extent of feeding resources for waders, other intertidal feeding birds and roosting species. An adaptive management process, which incorporates monitoring and consultations with key stakeholders, is proposed to determine how the habitats are altered by the proposed disposal activities and especially describe changes in the extent and evolution of the surrounding saltmarsh habitat (Section 2.9).

Overall, based on the above factors, the impact of changes in bird habitat as a result of proposed disposal and restoration activities is assessed as **negligible/insignificant**.

Effects of changes in water and sediment quality on overwintering birds

Any changes to SSC and DO will be temporary and intermittent, lasting the period of the proposed disposal activities associated with the maintenance dredge campaigns of nearby harbours and marinas (Section 2.4). Overall, the spatial and temporal magnitude of changes in SSC is assessed as minor (Section 4.4.2). Any changes in DO are expected to be localised and temporary, and are assessed as negligible (Section 4.5.2). The potential changes to levels of chemical contaminants in the water and the potential redistribution of sediment-bound chemical contaminants are assessed as negligible (Section 4.5.2). The disposal activities are predicted to have negligible effects on the benthic and fish prey species of these birds (Sections 4.6.2 and 4.7.2). These changes are therefore unlikely to be harmful to waterbirds.

Furthermore, standard practice pollution prevention guidelines will be followed to minimise the risk of accidental spillages and the risk of introduction of contaminants throughout the dredging and disposal process.

Overall, the potential effect of changes in water and sediment quality on overwintering birds as a result of the proposed beneficial use disposal activities is assessed as **negligible/insignificant**.

Visual and noise disturbance to waterbirds

The operation of the split hopper barge above a deposit location or its presence in the areas is not expected to cause significant bird disturbance. In general, disturbance from vessel movements occurs within 50 to 100 m of a receptor, with sensitive sites such as breeding colonies, foraging grounds and roosting sites most susceptible to disturbance (IECS, 2009; Chatwin *et al.*, 2013). Any local waterbird populations are expected to be tolerant of vessel movements to some degree (given the regular activities in the adjacent Lymington Estuary), but also will readily habituate to these activities. Importantly, there will be no constructive/piling activities or sudden impact noises. This is because birds habituate to continual noises (such as engine noise), if there is no sudden large amplitude 'startling' component (IECS, 2009), as occurs from piling.

The specific responses that waterbirds will have to disturbance varies between species as well as between birds of the same species due to a range of factors including the level of habituation and environmental conditions (Gill *et al.,* 2001; Müllner *et al.,* 2004; IECS, 2009; Collop *et al*., 2016).

Any birds that use the areas surrounding the proposed disposal sites in winter could potentially be affected by the presence of a split hopper barge. As noted in Section 4.8.1, the high water 'Pylewell' count sector, which extends across the eastern side of Lymington channel and all of Boiler and Pylewell marsh, supports 1,989 birds on average. This value is the average peak of all species over the four winters between 2016/17 to 2019/20. That is around 4 % of the SPA overwintering population, and the area of potential disturbance is around 2 % of the 'Pylewell' count sector. The 'Hurst to Lymington' count sector, which extends across the western side of the Lymington Channel to Hurst Spit and covers the Cockleshell site, supports 12,073 birds on average. This value is the average peak of all species over the four winters between 2016/17 to 2020/21. That is around 24 % of the SPA overwintering population, and the area of potential disturbance is around 0.3 % of the 'Hurst to Lymington' count sector.

The low water counts taken in 2018/19 show that all the marshes in the North West Solent (spanning the coastline from Hurst Spit to the promontory east of Sowley) support around 20 % of the full Solent SPA populations.

The levels of potential disturbances will be lower than that experienced during the preceding Wightlink recharge which involved more regular activities and a team of contractors on site. The level of disturbance during the Wightlink recharge did not give rise to any significant effects. Furthermore, many past recharge projects at Lymington and other sites have been done in winter without signs of significant adverse impacts. This precedent exists because beneficial reuse of dredged sediment often has to be done in winter when the dredge material is available.

In order to minimise any potential adverse effects on waterbirds, cold weather working conditions will be adhered to as embedded mitigation on the occasion(s) when work might be undertaken in winter (e.g., October to March).

In summary, given the magnitude and sensitivities discussed above, at worst, disturbance impacts due to any given campaign are assessed as **negligible/insignificant**.

4.9 Cumulative and in-combination effects

There are no indications that this proposal will have significant effects cumulatively or in combination with other plans or projects. In the first instance, this is because any potential adverse effects from the proposed works at Pylewell and Cockleshell are themselves temporary, localised and negligible to minor adverse at worse in their own right. These temporary effects will be required to deliver a net minor to moderate benefit from the project overall.

Secondly, no major new projects are proposed for the area, apart from saltmarsh enhancement works that can be considered in this context. The situation regarding other plans and projects in Lymington are outlined in Section 4.4.3 of the MDP baseline report (in Appendix C). For example, there are no defined shoreline management proposals at this time (although proposals are expected to emerge through the Hurst to Lymington Strategy over the coming years).

The main project interaction going forward will be disposal and habitat restoration activities at Boiler Marsh. As described in Section 1 and Appendix A, there is an existing site in front of Boiler Marsh where the LHC are placing dredged sediment under Marine Licence L/2014/00396/2. A Marine Licence Application (MLA/2023/00549) was submitted in December 2023 to extend the period of this licence for a further 10 years and to increase the maximum amount of material that can be deposited based on the success of this project. Furthermore, the LHC, with Land and Water Services Ltd., have a Marine Licence to move the sediment that has already been placed at the Boiler Marsh recharge site further up on the marsh elevation (L/2023/00294/1).

These Boiler Marsh projects supply additional dredge material to an area which is progressively exporting sediment, and this will come from other harbours in the Solent as and when appropriate. These placements are also being pursued to achieve a net benefit to the habitats in the area and a further assessment of these proposals has been included in the consent application to the MMO, to be assured that they have no significant adverse effects. LHC is also a lead partner and advisor to this project which will again help to facilitate full integration between projects.

Over time, and if this project is consented, this may lead to more ambitious projects that cause more fundamental changes. However, these are not proposed, planned or envisioned at this time. Any such larger projects, if they were to be enacted, would probably only be progressed in support of the delivery of broader and more substantial coastal defence or conservation management measures.

5 Conclusions

The findings from this assessment are that the proposed beneficial use disposal sites will have small, localised and temporary adverse effects that are negligible to minor (i.e., insignificant) during the sediment placement activities. However, the proposed beneficial use sites have the potential to deliver overall net minor to moderate benefits by helping to offset or delay ongoing natural saltmarsh habitat loss that has been recorded in and around the Solent.

There can be a high level of confidence in these conclusions because they are informed by past project experience, consultations with interested parties and the results from bespoke survey findings. In addition, it is also because the following embedded mitigation measures are included:

- Adoption of an adaptive management strategy overseen by a Technical Group of stakeholders and with regular monitoring and reviews; and
- Adhering to cold weather working conditions on the occasion(s) when work might be undertaken in winter (e.g., October to March).

As noted regularly throughout this assessment, the benefits are expected to extend beyond just the habitats at Lymington. This project will also provide a new illustration about how dredge sediment can be reused to benefit intertidal habitats. It is expected to be a platform for further lesson learning and research that will inform the delivery of more projects regional and nationally in the future.

This report will now form part of a Marine Licence Application to the MMO to seek the necessary permissions.

6 References

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7 Abbreviations/Acronyms

AA	Appropriate Assessment
ABP	Associated British Ports
AD	Anno Domini
AEOI	Adverse Effect of Integrity
AL	Action Level
ATL	Advance the Line
AWB	Artificial Water Body
BAP	Biodiversity Action Plan
BNG	Biodiversity Net Gain
BP	Before Present
BPEO	Best Practical Environmental Option
BTO	British Trust for Ornithology
BUDS	Beneficial Use of Dredging in the Solent
BUWG	Beneficial Use Working Group
CBA	Cost Benefit Analysis
CCO	Channel Coastal Observatory
CD	Chart Datum
CEDA	Central Dredging Association
Cefas	Centre for Environment Fisheries and Aquaculture Science
CIEEM	Charted Institute of Ecology and Environmental Management
cSAC	candidate Special Area of Conservation
CSD	Cutter Suction Dredger
DBT	Dibutyltin
DD	Dredging and Disposal
Defra	Department for Environment, Food and Rural Affairs
DETR	Department of the Environment, Transport and the Regions
DO	Dissolved oxygen
EC	European Commission
EEC	European Economic Community
EIA	Environmental Impact Assessment
EnviCom	Environmental Matters- Technical Commission (PIANC)
EQS	Environmental Quality Standard
EQSD	Environmental Quality Standards Directive
ES	Environmental Statement
EU	European Union
EUNIS	European Nature Information System
FCRIP	Flood and Coastal Risk Innovation Programme
FRAP	Flood Risk Activities environmental permit
GCS	Good Chemical Status
GEP	Good Ecological Potential
GES	Good Ecological Status
GIS	Geographic Information System
GS	Good Status
HAT	Highest Astronomical Tide
HCC	Hampshire County Council
HCH	hexachlorocyclohexane
HELCOM	Baltic Marine Environment Protection Commission, (aka Helsinki Commission)
HIWWT	Hampshire and Isle of Wight Wildlife Trust

HM	His Majesty’s
HMSO	His Majesty's Stationery Office
HMWB	Heavily Modified Water Body
HRA	Habitats Regulations Assessment
HTL	Hold the Line
ID	Identity
IECS	Institute of Estuarine and Coastal Services
IEMA	Institute of Environmental Management and Assessment
IFCA	Inshore Fisheries and Conservation Authority
INNS	Invasive Non-Native Species
IROPI	Imperative Reasons of Overriding Public Interest
JBA	JBA Consulting
JNCC	Joint Nature Conservation Committee
L&WS	Land and Water Services Ltd
LAT	Lowest Astronomical Tide
LCLP	London Convention London Protocol
LHC	Lymington Harbour Commissioners
LiDAR	Light Detection and Ranging
LNR	Local Nature Reserve
LNRS	Local Nature Recovery Strategies
LOI	Loss on Ignition
LSE	Likely Significant Effect
MarESA	Marine Evidence based Sensitivity Assessment
MarLIN	Marine Life Information Network
MCMS	Marine Case Management System
MCZ	Marine Conservation Zone
MDL	Marina Developments Limited
MDP	Maintenance Dredge Protocol
MHWN	Mean High Water Neaps
MHWS	Mean High Water Spring
µm	Micrometre
MLA	Marine Licence Application
MLWN	Mean Low Water Neaps
MLWS	Mean Low Water Springs
MMO	Marine Management Organisation
MPA	Marine Protected Area
MPS	Marine Policy Statement
MR	Managed Realignment
MSL	Mean Sea Level
MTL	Mean Tide Level
NA	Not Applicable
NAI	No Active Intervention
NbS	Nature-based Solutions
NERC	Natural Environment and Rural Communities
NFDC	New Forest District Council
NFNPA	New Forest National Park Authority
NSSMP	North Solent Shoreline Management Plan
NVZ	Nitrate Vulnerable Zone
OD	Ordnance Datum
ODN	Ordnance Datum Newlyn
OEP	Office for Environmental Protection
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic

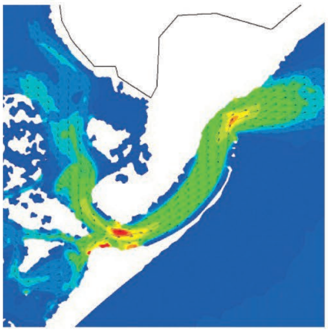
PAH	Polycyclic Aromatic Hydrocarbon
PBDE	Polybrominated Diphenyl Ethers
PIANC	Permanent International Association of Navigation Congresses
PM	Particulate Matter
PSA	Particle Size Analysis
PSD	Priority Substances Directive
pSPA	potential Special Protection Area
Ramsar	Wetlands of international importance, designated under The Convention on Wetlands (Ramsar, Iran, 1971)
RBMP	River Basin Management Plan
ReMeMaRe	Restoring Marshes Meadows and Reefs
RHHA	River Hamble Harbour Authority
RNLI	Royal National Lifeboat Institute
RSPB	The Royal Society for the Protection of Birds
RYS	Royal Yacht Squadron
SAC	Special Area of Conservation
SAM	Sample Plan
SCOPAC	Standing Conference on Problems Associated with the Coastline
SDCP	Solent Dynamic Coast Project
SEA	Strategic Environmental Assessment
SEABUDS	Precipitating a SEA Change in the Beneficial Use of Dredged Sediment
SMP	Shoreline Management Plan
SPA	Special Protection Area
SRDB	Saltmarsh Restoration Drag Box
SSC	Suspended sediment concentrations
SSSI	Site of Special Scientific Interest
TBT	Tributyltin
THC	Total Hydrocarbon Content
TOC	Total Organic Carbon
TSHD	Trailing Suction Hopper Dredging
UAV	Unmanned Aerial Vehicle
UK	United Kingdom
UKSA	United Kingdom Sailing Academy
UNESCO	United Nations Educational, Scientific and Cultural Organization
US	United States of America
UTM	Universal Transverse Mercator
UWWTD	Urban Waste Water Treatment Directive
WeBS	Wetland Bird Survey
WEM	Water and Environment Management
WER	Water Environment Regulations
WFD	Water Framework Directive
WGBU	Working Group on Beneficial Use of Sediment
WGS	World Geodetic System
WHA	Waste Hierarchy Assessment
WID	Water Injection Dredging
YHC	Yarmouth Harbour Commissioners

Cardinal points/directions are used unless otherwise stated.

SI units are used unless otherwise stated.

Appendices




Innovative Thinking - Sustainable Solutions

A Solent Forum BUDS Project Review

A.1 Introduction

To understand the context and history to this proposed beneficial use project, and the Marine Licence Application, this appendix provides more background detail about the Solent Forum BUDS project. It outlines the dredging activities in the Solent and work undertaken during the BUDS programme to identify projects in the Lymington area. This review illustrates the role of consultations and how alternatives to the project were considered when developing this BUDS proposal.

At the end of this appendix, outline details are also provided about other past, present and future sediment beneficial use projects in Lymington and the Solent. This is provided to show how the proposed BUDS project links with other initiatives and fits into longer-term strategies and ambitions for habitat restoration for the Solent.

A.2 BUDS Project Overview

In the Solent around 1 million m^3 of fine sediment is typically excavated each year through maintenance dredging of ports, harbours and navigation channels (ABPmer, 2018). However, no more than 0.02 % of this is used beneficially to help protect and restore saltmarshes and mudflats within the Solent. This limited use of dredge sediment occurs notwithstanding that the Solent's marshes have been progressively deteriorating and eroding over decades. Therefore, there has been an ongoing loss of the important ecological and socio-economic functions these habitats provide. Many of the marshes will be gone over the next 30 years or so with the lifespan and rate of loss varying across the Solent.

This rate of loss applies to the Lymington marshes and was confirmed during Phase 2 of the BUDS project (ABPmer, 2020), which reinforced findings of preceding studies by the NFDC Coastal Group (NFDC 2007a; 2007b) and in the Solent Dynamic Coast Project (SDCP) (Cope *et al.*, 2008). The forecasts for marshes in different parts of the Solent were also recently revisited by a study undertaken by the University of Portsmouth for Natural England (Parry and Hendy, 2022). This reaffirmed that there is expected to be no saltmarsh in the Lymington area, for example, by around 2045.

The Solent Forum BUDS project was initiated in 2017 in response to requests from the Forum's members who were keen to see more of the region's dredged sediment used to restore and protect deteriorating intertidal habitats within the Solent. To achieve this, a prescribed system, involving the licensing of beneficial use disposal sites, is required, so that operators can bring dredged sediment to these sites as a viable and beneficial alternative to the current practice of disposal at sea.

The BUDS project is therefore seeking to show how the dredge sediment resources can be strategically and collaboratively managed to restore the Solent's marshes and to achieve a range of ecological, economic and social benefits. To achieve these goals and deliver greater benefits over time it is necessary to identify and then secure consents for potential beneficial use dredge disposal sites. In the first instance this will ensure that options exist for beneficial use placement.

Ultimately, this project is seeking to change the way dredged sediment is used and is part of a longer-term strategy to deliver greater benefits for declining intertidal habitats in the Solent Region. Over time, it is hoped that the ambitions and scale of such beneficial use projects will continue to increase but the principal aim at this initial stage is to begin changing long established practices. Further details about how this project was implemented and the ambitions for the future are set out in the following sections.

A.3 BUDS Project Phases

The BUDS project has been progressed systematically and in stages over the last six years. Each stage has involved consultations with stakeholders and technical reviews. This phased approach is required to achieve progressive evidence-based change. In summary, the phases that have been completed are as follows:

- **Phase1**. Identifying potential beneficial use sites across the Solent;
- **Phase 2**. Reviewing options across the Hurst to Lymington frontage; and
- **Phase 3**. Identifying and seeking permission for specific disposal sites at Lymington.

Phases 1 and 2 (see Sections A.3.1 and A.3.2 respectively) are now complete. These first two stages involved a review of sites and options, as well as considering the baseline conditions at potential restoration sites between Hurst and Lymington. During Phase 3 (as described in Section A.3.3), more specific proposals were developed for beneficial use projects (i.e., bottom placement at the Cockleshell and Pylewell sites), and a Marine Licence is now being sought for these sites with this report.

If consent is obtained for placing dredged sediment at the Cockleshell and Pylewell sites, the next steps of the project (as described in Section A.3.4) will involve supporting the sediment placement work. It is hoped that, over the longer term, it will also inform the delivery of larger projects over more areas based on the lessons that are learned. The funding and management of these next steps will need to be agreed with the MMO. It is understood, however, that a long-term vision is required for this section of the coast and some of the considerations that are appropriate to this vision are described in Section 2.10 of the main report.

A.3.1 Phase 1 – Identifying potential beneficial use sites

Phase 1 of the BUDS project was undertaken in 2017 and 2018 (ABPmer, 2018). It involved a high-level review of the whole Solent region, to identify sites that would gain most from a beneficial use campaign. These were sites where dredge arisings (silts mainly) could be used to 'recharge' deteriorating habitats and achieve a range of environmental, social and economic objectives (especially increased coastal flood protection). Alongside this strategic review, a key aim of this initial stage was to begin developing collaborative partnerships with those willing to support one or more recharge initiatives, especially at a scale which will have material benefits.

As part of this phase, a data collation and mapping exercise of spatial information was undertaken to evaluate locations based on pre-determined site-selection criteria. An online data-viewer was also produced (see Image A1 for an example output) to enable this data to be widely and freely interrogated[20].

This review concluded that a 'stand out' candidate site for recharge work was along the Hurst Spit, Keyhaven, and Lymington frontages and that opportunities for beneficially using sediment on this frontage should be explored. It was recognised that the marshes in the Hurst to Lymington area are vulnerable and/or rapidly eroding and that they play a key role in coastal and harbour protection, as well as being of high conservation value. Therefore, a recharge project along this West Solent frontage had the potential to achieve the largest benefits.

[20] This Phase 1 data-viewer (custom map) is available through the Solent Forum BUDS webpage at http://www.solentforum.org/services/Current_Projects/buds/ and https://abpmer.maps.arcgis.com/apps/webappviewer/index.html?id=84f75915f4d64d3f84d82e7b8923e9ba

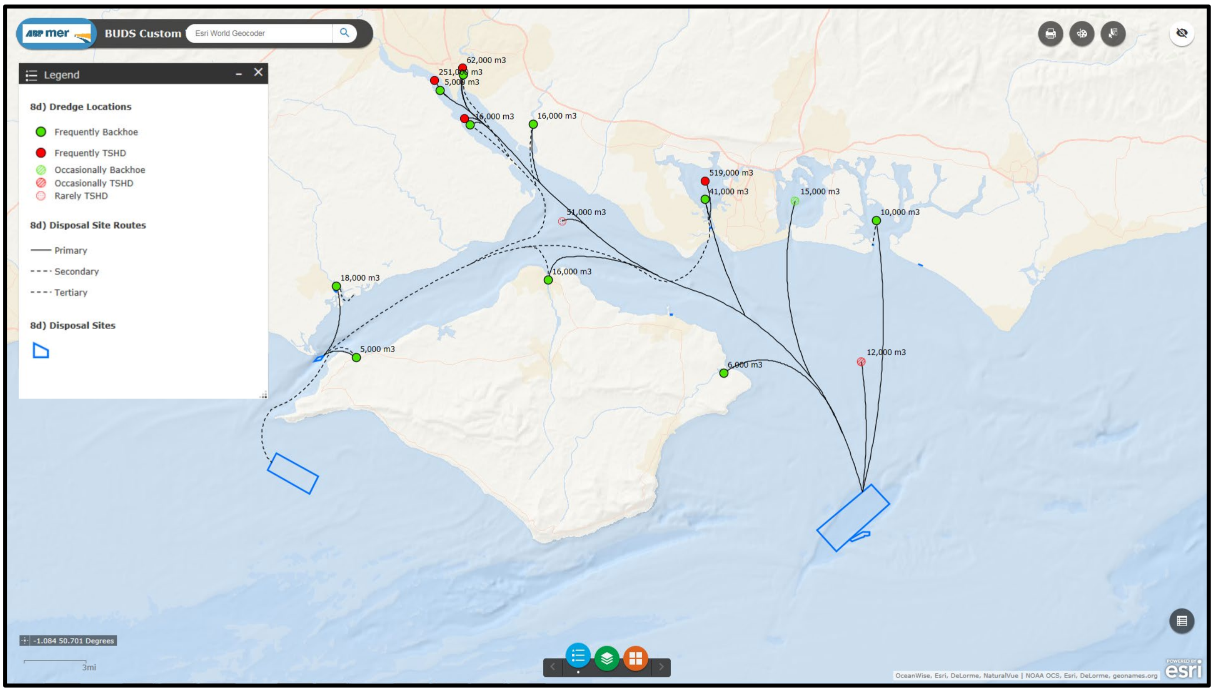


Image A1. **Illustration of dredging and disposal activities in the Solent**

A.3.2 Phase 2 – Refining options for Hurst to Lymington

Phase 2 of the BUDS project was then undertaken in 2019 and 2020 (ABPmer, 2020). This took forward the Phase 1 recommendations and considered options for the Hurst to Lymington frontage in greater detail. Among several aspects, this review considered the baseline conditions of the West Solent marshes and described the ways in which dredge sediment might be used to enhance and protect them.

The cost and benefits of each of the different techniques were also compared. The approaches ranged from small to large scale and all but the largest, most costly, technique were found to have benefits outweighing costs (by a Benefit:Cost ratio of around 2) compared to 'No Intervention' or 'business as usual' approach. The process of selecting the options for review was carried out in three stages as follows:

- **Step 1**: Informed by the baseline/background review, an **initial high-level review** was undertaken to identify all the sites where a recharge could technically be carried out;
- **Step 2**: A **site selection process** was undertaken that involved reviewing these sites based on a range of factors, and ranking them into High, Medium and Low priority options; and
- **Step 3**: Finally, different indicative **technical approaches were identified** for carrying out recharge work at the preferred locations.

During Step 1, 15 intertidal sites were identified where sediment recharge could technically be undertaken. These are shown in Figure A1. These were selected as potentially suitable sediment receptor sites because they were relatively (or completely) denuded of vegetation. Therefore, they were likely to have a relatively low diversity and/or be suitable for receiving sediment to protect marsh habitat, (depending on their sediment composition and elevation).

These areas where sediment could potentially be deposited, as shown in Figure A1, also did not have any major land drainage outfalls (where these were easily identifiable from aerial imagery) which could be affected by sediment placements. Furthermore they, ideally, had a 'bowl-shaped' morphology which could make them suitable to retain sediment.

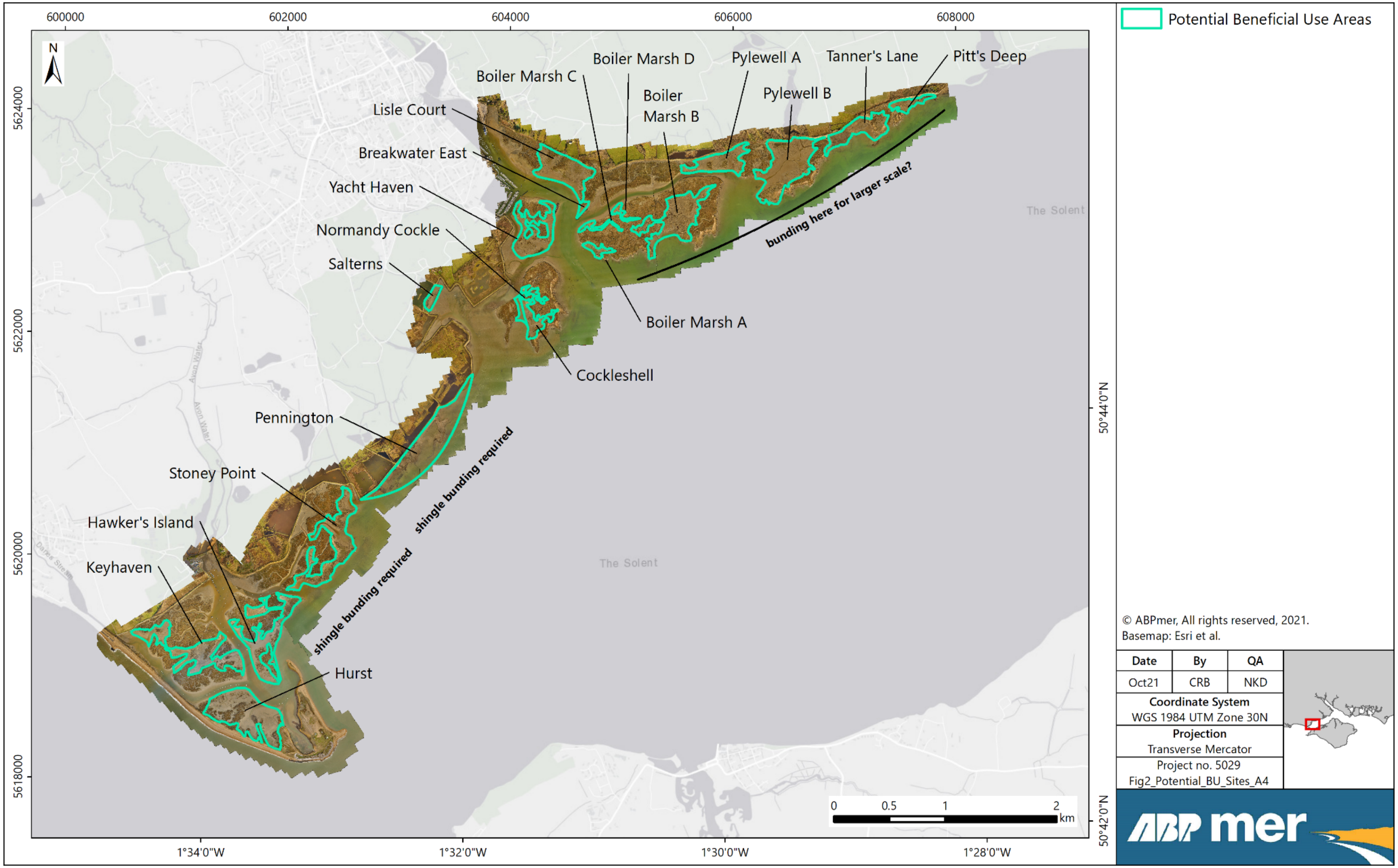


Figure A1. **Location of potential receptor sites based on high-level review during Phase 2**

At Step 2 of the analysis, these sites were compared, and a subset of preferred locations identified for further review and analysis, based on several factors. These factors included the potential of the site to achieve the greatest benefits, as well as the practical challenges and costs associated with a possible recharge; and the potential for adverse effects (e.g., to navigation).

As an outcome of Step 2, four locations and four very different technical approaches were selected for comparison. These approaches ranged from large to small scale to illustrate the scope of potential projects and to understand the implications of undertaking projects with different levels of ambition, cost, benefits and ultimately effectiveness in reducing marsh loss. The sites selected were:

- **Boiler Marsh B and Cockleshell Marsh**, which are each protecting the Lymington Harbour entrance;
- **Hawker's Island or Stoney Point Marshes**, which are each protecting the Keyhaven Harbour entrance and many buoy moorings; and
- **The shoreline at Pennington**, where the defences are most exposed and where a notable opportunity exists for a larger-scale project to protect the sea wall.

The four potential restoration approaches considered in Step 3 were as follows:

- **Extended bottom placement.** This involves depositing material as close to the lower marsh as possible by opening a split hopper barge above a deposit location. The deposits act as a temporary protective bund in front of the marsh and potentially supply sediment to the marsh;
- **Transfer station for 'thin layer' placement**. This was one way of pumping sediment directly onto existing vegetated saltmarsh areas to raise marsh bed levels and helps them keep pace with rising seas while also delaying the internal fracturing of these marshes;
- **Erosion protection and recharge**. This would involve installing physical protection features and to then, ideally, place dredged sediment directly behind these features to protect eroding marsh edges; and
- **Large-scale recharge and bunding**. This would involve pursuing a larger-scale project that creates saltmarsh habitat and enhances sea defences by installing a large fronting coarse-sediment bund and then recharging behind with silt.

The four sites and four methods were collated into four separate 'Project Examples' (see Image A2) as follows:

- **Project Example 1**: Bottom placement at Stoney Point;
- **Project Example 2**: Moveable transfer station for thin layer placement at Boiler/Pylewell;
- **Project Example 3**: Erosion protection and recharge at Boiler/Pylewell; and
- **Project Example 4**: Large scale bund and recharge at Pennington.

A comparative Cost:Benefit analysis (CBA) of these four project examples was then undertaken based on several assumptions including:

- The costs of the beneficial use options;
- The consequences of doing nothing (e.g., likely future rates of marsh decline and timing of new capital flood defence and harbour protection works);
- The effects of the beneficial use options in reducing rates of marsh erosion and deterioration and in deferring capital investment in flood defence and harbour protection works; and
- The monetary values of these benefits.

From this review, it was found that all but the largest most costly techniques had benefits outweighing costs compared to 'No Intervention' or 'business as usual'. The medium to small scale beneficial use projects (Project Examples 1 to 3 in this study) can achieve a net cost benefit (with Benefit:Cost ratios of around 2) so there is a societal case for proceeding with them. However, for this to happen, a level of external funding (perhaps from several stakeholders) will be required to facilitate the project(s).

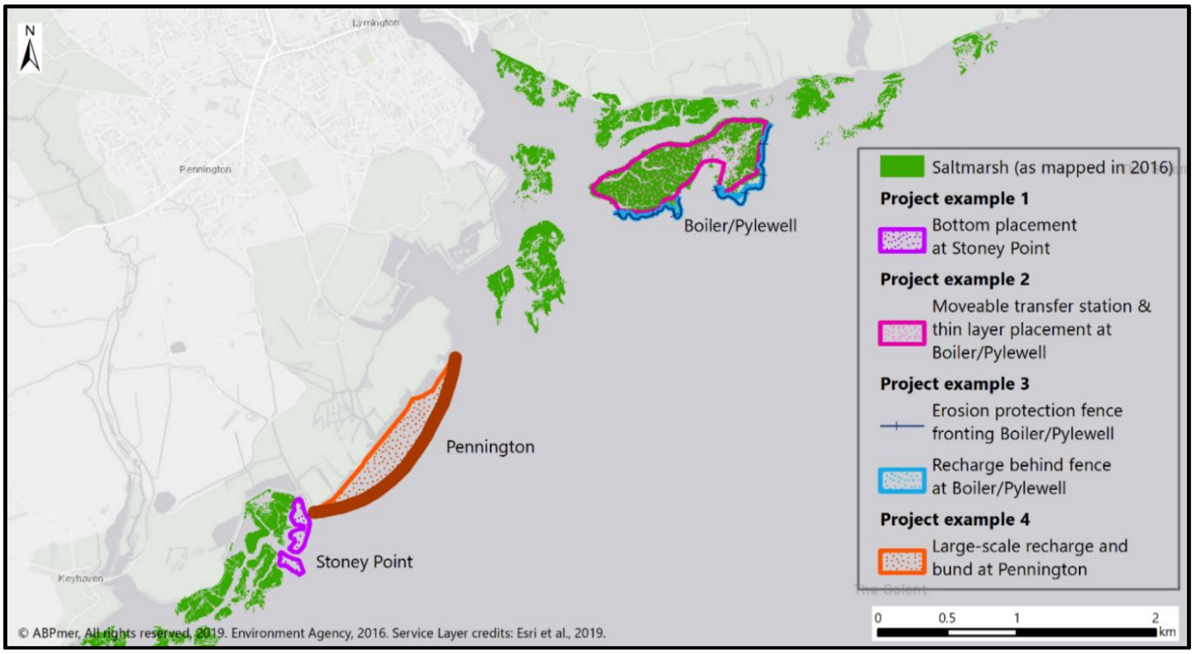
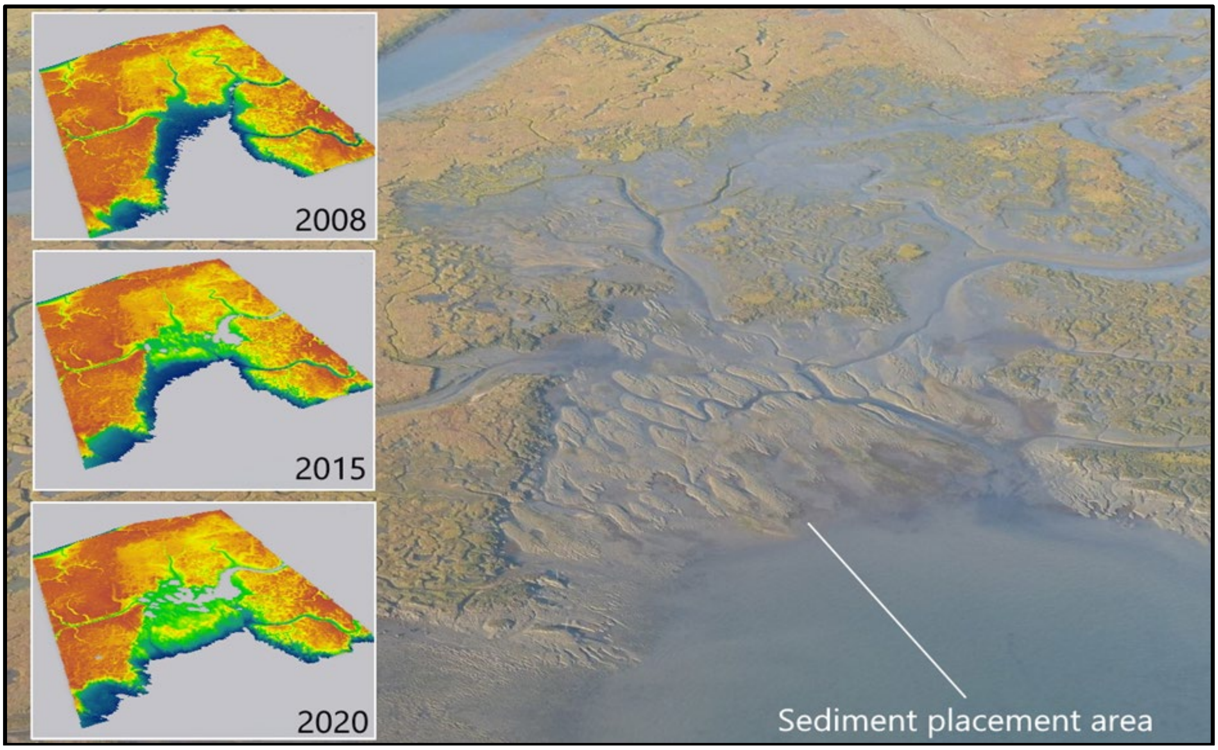


Image A2. Location of case study sites for the BUDS Phase 2 cost benefit analysis



Created by ABPmer using Environment Agency LiDAR data and 2018 S. Nunn aerial photo

Image A3. Sediment deposited by LHC at Boiler Marsh bottom placement site

It was concluded therefore that there was a need to advance more substantial beneficial use measures in this area. In particular, it was concluded that further bottom placement sites should be pursued. This conclusion was also supported by successful bottom placement measures being undertaken at that time by LHC (see Image A3 and Section A.3.4, and also Section 2.3 of the main report for more detail).

A.3.3 Phase 3 – Licensing new use disposal sites at Lymington

Phase 3 of the BUDS project was progressed to take the analysis from Phases 1 and 2 forward and start delivering new projects. This third phase commenced in 2021 and it had two major individual objectives. The first was to agree a specific proposal for bottom placement sediment to protect and enhance the declining saltmarshes between Hurst Spit and Lymington. The second was to secure the necessary Marine Licence(s) for the agreed proposal. Subject to obtaining the necessary approvals for these proposals, new beneficial use projects will be carried out.

Further analysis and consultations were held during Phase 3 to finalise sites for sediment deposition. This site selection process included a stakeholder workshop on 12 October 2021 (see Section 2.6), where the Phase 2 map (see Figure A1) was reviewed. The outcome of this review was that two sites at Cockleshell and Pylewell were selected for bottom placement work (as shown in Figure 3 of the main report).

The two proposed sites were identified based on a careful examination of available LiDAR data to select sites with appropriate and comparable tidal elevations that have similar habitat compositions and will be accessible by shallow draught hopper barges which can directly place sediment in these intertidal areas. The Cockleshell and Pylewell sites were selected because they have the largest potential for sediment retention (and hence to achieve benefits for intertidal habitats and the harbour), because they are locations that are comparatively sheltered by existing marshes. In summary, the characteristics of the two sites are as follows:

- **Pylewell**. This site is relatively enclosed and is shielded from prevailing south westerly winds and waves by Boiler Marsh that lies to the west. The site has a distinctive bowl shape and is likely to be an ideal place for retaining deposited sediment. In this area, a channel is evidently extending behind (landward of) the fronting marsh. If this continues, it will isolate the fronting marsh complex leading to accelerated erosion. Thus, if sediment can be placed here, there is likelihood that it could help recharge or at least delay the loss of the surrounding marsh.
-
- **Cockleshell**. This is also a relatively sheltered area for this part of the outer estuary. It is sandwiched between two marsh islands on either side (called Cockleshell and Normandy marshes). This means that there is a likelihood that sediment placed here could remain in place. This process could also lead over time (and with additional sediment placements) to these two marshes being combined into a single, more persistent, marsh island (as was historically present at this site).

In these areas, it is envisaged that up to 29,000 wet tonnes (approximately 20,000 m^3) of muddy sediment could be available for beneficial use across the two sites from nearby harbours each year (as explained in Section 2.4 of the report). The amount of sediment that is actually placed will depend on the activities of the individual harbours which could be Lymington, Beaulieu, Yarmouth, Cowes and potentially the Hamble. It is expected in the short term that a small proportion of this available material would be used on a trial basis (perhaps no more than 12,000 wet tonnes (approximately 8,000 m^3) annually during the early years).

It is understood that there will be challenges with respect to the disposal methodology that will need to be addressed during the placement process. A monitoring programme will be implemented to establish any effects of changes to the methodology. This information will be used to optimise how the sites can be best used and over what area in the future, thus creating an adaptive management approach which learns from prior placements. In effect each placement becomes a trial to lead to the optimum methodology, i.e. an adaptive management approach. This will address any uncertainties and ensure that lessons are learned and that stakeholders are regularly consulted about the work being undertaken. Further details about this adaptive management approach are presented in Section 2.9 of the main report.

Options for ensuing that the sediment placements do not migrate in large amount from the proposed beneficial use disposal sites at Pylewell and Cockleshell (e.g. sediment retention structure or silt curtains) are not included in this proposal. These options and the reasons for not taking them forward are explained in Section 2.3 of the main report.

A.3.4 Future for BUDS, Lymington, and Solent

It is intended that the next stages of the BUDS project will involve the active beneficial placement of dredge sediment at Pylewell and Cockleshell. This is subject to relevant approvals and in accordance with any associated MMO Marine Licence conditions.

It is recognised that only certain vessels and operators will be able to place sediment at these sites in this manner and that this will restrict the volumes placed. However, for those operators that can use these sites, this proposal provides a broader range of options for beneficial sediment placement than is currently available.

These proposed beneficial use disposal sites are expected to provide several benefits, including reduced rates of localised sediment and intertidal habitat loss. Additionally, there will be an inherent biodiversity value of retaining these marshes. Cockleshell Marsh is also a particularly important area for nesting and roosting birds. The Pylewell site[21] is at a lower elevation than Cockleshell and subject to more disturbance from humans and predators, and so is considered less valuable in this respect. Building up the marsh at Cockleshell would also help to protect the harbour, as well as potentially delay the need for more intrusive coastal defence works involving harder infrastructure.

Even with these beneficial use disposal sites in place, it is recognised that they are not an end in themselves. The marshes will continue to face threats and deteriorate. It is evident that the saltmarsh habitats along this coastline will be gone by the middle of this century. They are low lying and vulnerable to sea level rise (especially at Keyhaven), and they are wave-exposed and retreating rapidly (especially at Lymington). Therefore, for this coastline as for many others, it will be necessary to think about these proposals, and the lessons that emerge from them, as contributing to a longer-term strategy (see Section 2.10).

This section of the coast will need to be subject to ongoing management and measures to protect the marshes and mudflats, and this continuing BUDS work will therefore be one component of this. For example, one key benefit from the proposed restoration will be to inform new coastal defence proposals that are likely to emerge from the 'Hurst Spit to Lymington Strategy' over the next few years. This flood protection strategy is being led by the Environment Agency, in partnership with New Forest District Council (NFDC), Hampshire County Council (HCC), Natural England and JBA Consulting. It may well be that recommendations for new/additional beneficial use projects may emerge from this process. The lessons learned from the proposed beneficial use sites at Pylewell and Cockleshell will therefore inform any such initiatives.

Lessons have also, and will also, be learned from the separate previous, ongoing and future projects at Lymington. In total, three different 'alternative use' projects have been successfully undertaken in recent years. In addition to the ongoing bottom placement work at Boiler Marsh, these include the following:

- **Yacht Haven marsh recharge by LHC:** This recharge was undertaken in 2012 and 2013 as mitigation for the effects of the Lymington Harbour Protection Scheme. It involved replenishing and raising 0.5 ha of intertidal mudflat using up to 2,500 wet tonnes of sediment from maintenance dredging. This sediment was pumped (via cutter suction dredger (CSD) and a pipeline) from the adjacent Yacht Haven marina onto the adjacent saltmarsh. This project was consented under Marine Licence L/2011/00306/2;

21 In this BUDS review, the name Pylewell has been used for these marshes to the east of Boiler Marsh while Boiler Marsh is seen as being the whole island feature (see Figure A1). It is recognised that for HCC bird surveys of the area, Pylewell is used to refer to the eastern side of the Boiler Marsh Island which is the best location for breeding birds locally.

- **Boiler Marsh habitat restoration by Wightlink Ltd.:** This habitat restoration work was undertaken in 2012 and 2013 as mitigation for the potential ecological effects arising from the operation of Wightlink's cross-Solent ferry service. The sediment was pumped from hopper barges into this area over the two winter campaigns. This project was consented under Marine Licence L/2011/00308/2; and
- **Boiler Marsh sediment placement and protection by LHC:** For the last nine years the LHC have been carrying out an innovative project which involves placing sediment that is dredged from the harbour in front of the eroding Boiler Marsh. This dredge sediment 'beneficial use' project has been done annually, each winter, since 2014. The existing Marine Licence L/2014/00396/2 currently allows for up to 10,000 wet tonnes of dredged sediment from Lymington harbour to be placed every year until December 2024. A Marine Licence Application (MLA/2023/00549) was submitted in December 2023 to extend the period of this licence for a further 10 years to the end of 2034 and to increase the maximum amount of material that can be deposited at the Boiler Mash deposit ground to 20,000 wet tonnes per year based on the success of this project.

The location and nature of these projects are illustrated in Figure A2. Further details about them are provided in Section 2.5 of the Maintenance Dredge Protocol (MDP) baseline document in Appendix C.

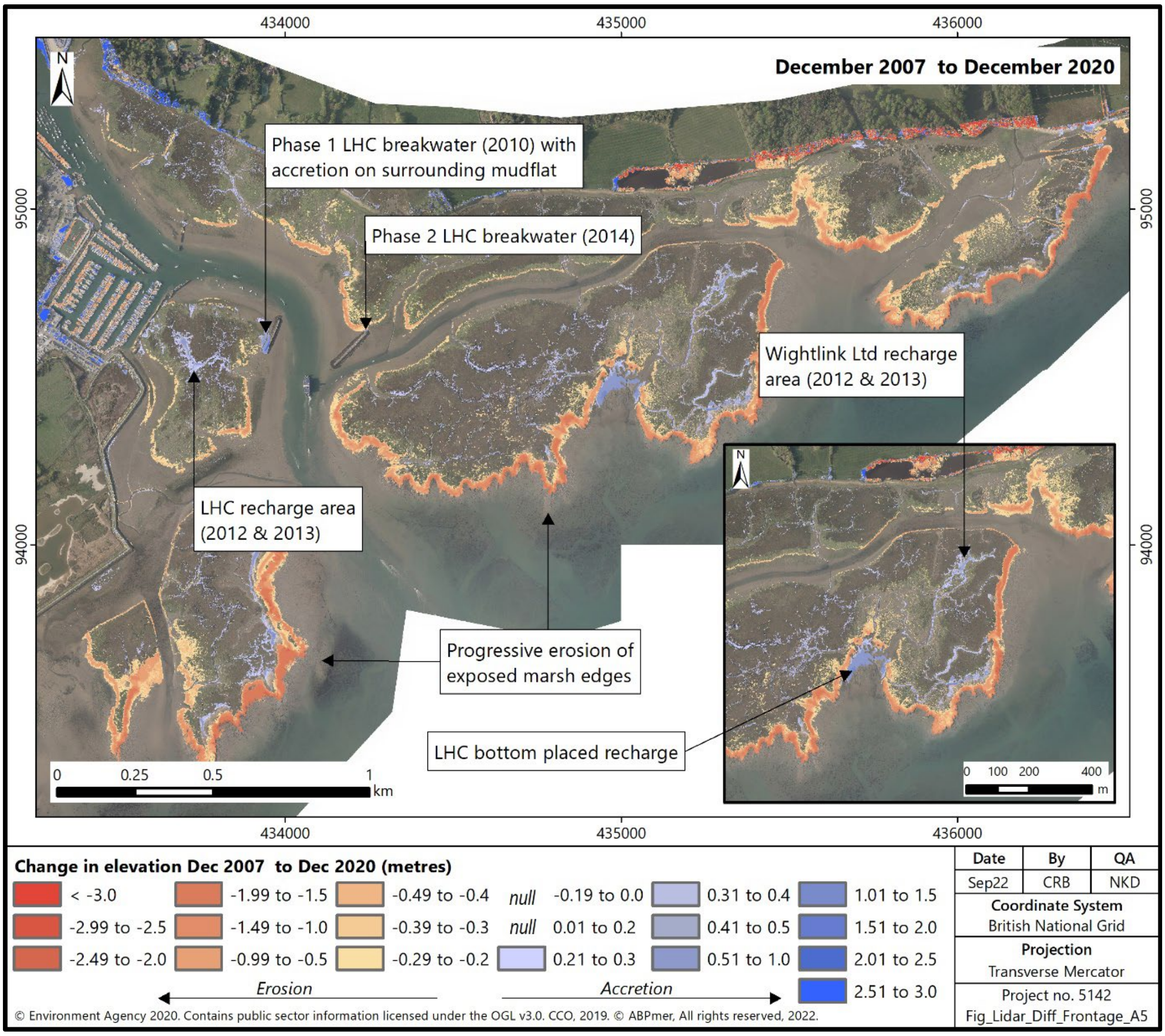


Figure A2. Habitat elevation change and recent recharge areas at Lymington

Building on this success, the LHC and L&WS have a Marine Licence to reuse and relocate this already deposited sediment at Boiler Marsh onto the higher marsh level to further enhance the ecological value and increase the resilience of this area of saltmarsh (L/2023/00294/1).

It is important to emphasise however that while the focus, under Phase 2 and 3 of BUDS project, has been along Hurst to Lymington frontage (as a priority candidate and with the most demonstrable 'needs case'), that does not mean that other locations in the Solent are being ignored. Instead, it is intended that all phases of the BUDS project will provide technical lessons and collaborations that will facilitate many more projects across the region.

Certainly, other sites in the Solent were identified during BUDS Phase 1 and others have been investigated and progressed since it was completed. This includes sites in the East Solent and on the Isle of Wight that are being progressed under the Solent Seascape project (Blue Marine Foundation, 2024). For example, the Isle of Wight Estuaries Project has been examining the opportunities for protecting saltmarshes with dredge sediment in the Western Yar and the Medina Estuaries. The feasibility of recharging the shoreline at Langstone (e.g. in front of the Royal Oak Pub) are also being explored (Coastal Partners pers. comm.).

Also, Land and Water Services Ltd and Chichester Harbour Conservancy have collaborated to implement a novel marsh recharge project at Itchenor. This project applied an innovative Saltmarsh Restoration Drag Box (SRDB) technique under Marine Licence L/2023/00042/1.

It is understood that for material change to be achieved, more will need to be done at ever larger scales, over time. A longer-term strategy, underpinned by a broadly agreed consensus, is needed. The BUDS project and other initiatives in the Solent and elsewhere in the country, will inform and support this longer-term strategy. The ambition and need will be to deliver similar but larger projects over time based on the lessons that are learned at these sites.

It is with this longer-term vision mind, as well as shorter term benefits, that the BUDS proposal is being pursued. If consented this proposal will constitute a major step towards a new way of doing things, in which the practice of beneficial use for coastal habitat restoration becomes more frequent and standardised.

A.3.5 National work

Away from the Solent, new lessons are also being learned about how to beneficially use dredge sediment and overcome the challenges of doing so. This includes several projects across the UK which are being considered and audited by the Environment Agency-led Beneficial Use Working Group (BUWG) on an ongoing basis. A new handbook has also been produced which provides useful guidance and lessons on the beneficial use of dredged sediment (Manning *et al.*, 2021).

B Sample Plan Advice and Returns

As described in Section 2.8.1 of the main report, the necessary sample plans for the proposed deposit sites were implemented in two stages. These two stages are summarised again in this appendix which includes copies of the relevant MMO advice and MMO results templates.

For the Cockleshell site, sampling in accordance with a sample plan (SAM/2019/00043) was carried out prior to the commencement of the Solent Forum Phase 3 review. This is because the LHC had previously identified this as one of a few potential deposit grounds locally and had submitted a sample plan request to the MMO.

At this site, surface sediment samples were taken from three positions in December 2019. The MMO results template plan returns which were issued to the MMO and a formal acknowledgement received in reply on 24 June 2020 are included at the end of this appendix. In addition to this, further surface sediment samples were taken from three benthic invertebrate sites at Cockleshell on 1 July 2022 (see Figure 8 and Section 2.8 of the main report) to inform the Marine Licence application. These were analysed for particle size analysis (PSA) and Loss on Ignition (LOI).

For the Pylewell site, ABPmer issued a sample plan request to the MMO in December 2021 through the MMO Marine Case Management System (MCMS). This request was supported by a report (ABPmer, 2021) which described the context to the proposal and explained the proposed sampling strategy. In response the MMO provided a sample plan in their letter dated 11 March 2022 (SAM/2021/00081).

At Pylewell, sediment samples were taken for PSA from five locations on 8 November 2021 (see Figure 8 and Section 2.8 of the main report). A copy of the sample plan and the MMO results template for these five sample sites are provided in this appendix. This asked for only one sample for PSA in Pylewell, so the five samples taken provide more data than was requested. In addition to this, surface sediment samples were taken from three benthic invertebrate sites at Pylewell on 1 July 2022 (see Figure 8 and Section 2.8 of the main report) to inform the Marine Licence application. These were analysed for PSA and LOI.

No additional sediment samples were taken from potential dredge sites themselves although this was requested in the sample plan SAM/2021/00081. This because that is not the role of, and is not possible for, this project. In part this cannot be done accurately because it remains uncertain exactly who will provide sediment and when. That makes it difficult to direct the sampling. But also, the aim of this project is to provide suppliers of dredge sediment with the opportunity to beneficially use the material arising but not to lead that work on their behalf.

The dredge sediment suppliers will have responsibility for providing the necessary assurances that the sediment meets the required quality standards. This quality testing of dredge sediment is happening and will be happen anyway as part of the standard marine licensing process that each dredge supplier undertakes for ongoing dredge and disposal activities. To reflect that, an overview of existing dredging practices is presented in Section 2.4 of the main report. This review is provided to show that consideration has been given to the potential composition and quality of the source sediment even if it is not possible, or necessary, to take additional samples from these locations at this time to support the Marine Licence application for the proposed beneficial use sites.

Marine Management Organisation

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www.gov.uk/mmo

Mr Ryan Willegers,
Lymington Harbour Commissioners

By email only

Our reference:
MLA/2014/00259/R7

24 June 2020

Dear Mr Willegers,

Lymington Harbour Dredge Disposal Sample Analysis 2019

Thank you for your submission of “MMO Results Template SAM-2019-00043” which was submitted to the Marine Management Organisation (MMO) on 24th January 2020 to fulfil condition 5.2.2 of the Marine Licence L/2014/00396/2:

Sampling must be carried out at the end of the original 5 year licence period (2019) and every 5 years thereafter.

The MMO has reviewed the report and is satisfied that the above report fulfils condition 5.2.2 of Licence L/2014/00396/2.

Monitoring every five years as per the licence condition 5.2.2 should still take place to ensure the material remains suitable for disposal to sea.

Organotins sampling

Due to the downward trend in organotin levels shown, and the ban on organotins meaning an increase is highly unlikely, organotin analysis can be omitted from any future sampling regime (unless additional evidence or information comes to light).

If you have any queries, please don’t hesitate to contact us.
Kind regards,

Nat Saunders
Marine Licensing Case Officer

D +44 (0)20 802 65865
E nat.saunders@marinemanagement.org.uk

Applicant Information

Instructions:

2. Full information must be provided under each relevant sheet of the workbook. Grey highlighted cells indicate where information can be entered.
3. Where information cannot be provided, the applicant should consult with the MMO prior to submission.
1. All applicants and laboratories should refer to the most recent guidance on sediment analysis in support of marine licence applications
4. Worksheets are protected to prevent accidental amendments to calculated values. If amendments are required please consult with the MMO.
5. Sample IDs used through the data output worksheets should correspond to Sample IDs provided on this worksheet. Sediment analysis guidance

6 Where more than 6 dredge areas or 30 samples are required, please contact MMO.

7. Macros must be enabled to use this workbook

Marine licence applicant information:

Applicant:	Lymington Harbour Commissioners
Application number:	SAM/2019/00042
Application title:	Sample plan for additional beneficial use sites in Lymington estuary.
Date sampled:	03/12/2019
Sampling location:	Lymington Harbour

Dredge area tonnages:

Dredge Area	Dredging tonnages	% total dredged material	Total dredged material
Area i			0
Area ii			
Area iii			
Area iv			
Area v			
Area vi			

MMO use only

Sample numbers and locations

Sample ID	Excluded sample (MMO use)	Sample location (decimal degrees, WGS84)		Location name (as per sampling plan)	Sampling depth (m)	Dredge area
		Position latitude	Position longitude			
1		50 44' 22.69"N	1 31' 29.28"W	Cockleshell/Normandy Site A	Top 20cm	
2		50 44' 29.18"N	1 31' 30.97"W	Cockleshell/Normandy Site B	Top 20cm	
3		50 44' 35.09"N	1 31 30.03"W	Cockleshell/Normandy Site C	Top 20cm	

Physical characteristics data

Instructions:

1. Record the laboratory/contractor responsible for analysis
2. Record the date the samples were analysed.
3. Enter full dataset for each sample in the analysis results table
4. Where copying and pasting entries please use paste values only
5. Where entering multiple Sample IDs please use the pop-up form

   IDs should be separated by a comma

Analysis information:

Laboratory/contractor: National Laboratory Service

Date of analysis: 05/12/2019

Physical characteristics analysis outputs:

Laboratory sample number	Dredge Area	Sample ID(s)	Visual appearance*	Exempt from chemical analysis ◦	Total Solids (% total sediments)	Organic matter (total organic carbon)
Cockleshell Normandy Site A		1	Slightly Gravelly Sandy Mud.			
Cockleshell Normandy Site B		2	Slightly Gravelly Sandy Mud.			
Cockleshell Normandy Site C		3	Slightly Gravelly Sandy Mud.			

	Particle size distribution (% at 0.5 phi intervals)																			
	-5.5	-5.0	-4.5	-4.0	-3.5	-3.0	-2.5	-2.0	-1.5	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
Laboratory sample number	45mm	31.5mm	22.4mm	16mm	11.2mm	8mm	5.6mm	4mm	2.8mm	2mm	1.4mm	1mm	707µm	500µm	353.6µm	250µm	176.8µm	125µm	88.39µm	63µm
Cockleshell Normandy Site A	0.00	0.00	0.78	0.01	0.09	0.82	0.85	0.47	0.65	0.60	0.32	0.81	1.69	2.03	2.25	2.78	3.64	4.36	5.06	5.92
Cockleshell Normandy Site B	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.06	0.02	0.77	1.86	2.45	2.77	3.30	4.13	4.74	5.38	6.33
Cockleshell Normandy Site C	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.02	0.04	0.05	0.06	0.81	1.95	2.40	2.68	4.07	6.95	9.66	10.40	9.25

											>14.5											
	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	
Laboratory sample number	44.2µm	31.3µm	22.1µm	15.6µm	11µm	7.8µm	5.5µm	3.9µm	2.75µm	1.95µm	1.38µm	0.98µm	0.69µm	0.49µm	0.34µm	0.24µm	0.17µm	0.12µm	0.09µm	0.06µm	0.04µm	<0.04µm
Cockleshell Normandy Site A	6.72	7.44	7.82	7.72	7.90	7.46	6.63	5.49	3.76	2.01	1.53	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cockleshell Normandy Site B	7.19	7.71	7.81	7.56	7.78	7.50	6.79	5.70	3.93	2.10	1.59	2.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cockleshell Normandy Site C	7.43	6.15	5.59	5.27	5.40	5.21	4.76	4.07	2.89	1.63	1.24	1.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

◦ **Exempt from chemical analysis:** enter 'y' where sediment samples contain glacial material or are too coarse and thus exempt from chemical analysis.

* **Visual appearance** : Incude a description of what the material looks like and what it contains, e.g. sandy material containing brick fragments, or black silt, or foreign man made matter caught in the sample.

Trace metal data

Instructions:

1. Record the laboratory/contractor responsible for trace metal analysis
2. Record the date the samples were analysed.
3. Enter full dataset for each sample in the analysis results table
4. Trace metal analysis results should be reported in mg/kg (ppm) dry weight
5. Enter methdological limit of detection for each trace metal prior to inputting raw data
6. Where analysis outputs are less than the limits of detection please enter text "<LOD"
7. Where copying and pasting entries please use paste values only
8. Where entering multiple Sample IDs please use the pop-up form
   IDs should be separated by a comma

Analysis information:

Laboratory/contractor:	
Date of analysis:	

Determinand analysis outputs:

Laboratory sample number	Dredge Area	Sample ID(s)	Total solids (%)	Metals as mg/kg dry weight							
				Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Mercury (Hg)	Nickel (Ni)	Lead (Pb)	Zinc (Zn)
			Limits of detection (mg/kg dry weight):								

Organotin data

Instructions:

1. Record the laboratory/contractor responsible for organotin analysis
2. Record the date the samples were analysed.
3. Enter full dataset for each sample in the analysis results table
4. Organotin analysis results should be reported in mg/kg (ppm) dry weight
5. Enter methdological limit of detection for each organotin prior to inputting raw data
6. Where analysis outputs are less than the limits of detection please enter text "<LOD"
7. Where copying and pasting entries please use paste values only
8. Where entering multiple Sample IDs please use the pop-up form
   IDs should be separated by a comma

Analysis information:

Laboratory/contractor:	
Date of analysis:	

determinand analysis outputs:

Laboratory sample number	Dredge Area	Sample ID(s)	Total solids (%)	Organotins as mg/kg dry weight	
				Dibutyltine (DBT)	Tributyltin (TBT)
			Limits of detection (mg/kg dry weight):		

Polyaromatic hydrocarbon data

Instructions:

1. Record the laboratory/contractor responsible for PAH analysis
2. Record the date the samples were analysed.
3. Enter full dataset for each sample in the analysis results table
4. Analysis results for individual PAHs should be reported in µg/kg (ppb) dry weight. THC should be reported as mg/kg (ppm)
5. Enter methdological limit of detection for each PAH prior to inputting raw data
6. Where analysis outputs are less than the limits of detection please enter text "<LOD"
7. Where copying and pasting entries please use paste values only
8. Where entering multiple Sample IDs please use the pop-up form IDs should be separated by a comma

Analysis information:

Laboratory/contractor:	
Date of analysis:	

determinand analysis outputs:

Laboratory sample number	Dredge Area	Sample ID(s)	Total Solids (%)	**PAHs as dry weight (µg/kg dry weight)**																						**Total hydrocarbon content (mg/kg)**
				Acenapthene	Acenapthylene	Anthracene	Benz[a]anthracene	Benzo[a]pyrene	Benzo[b]fluoranthene	Benzo[g,h,i]perylene	Benzo[e]pyrene	Benzo[k]fluoranthene	C1-Napthalenes	C1-Phenanthrenes	C2-Napthalenes	C3-Napthalenes	Chrysene	Dibenz[a,h]anthracene	Fluoranthene	Fluorene	Indeno[123-c,d]pyrene	Napthalene	Perylene	Phenanthrene	Pyrene	
Limits of detection (µg/kg dry weight)																										

Polychlorinated biphenyl data

Instructions:

1. Record the laboratory/contractor responsible for PCB analysis
2. Record the date the samples were analysed.
3. Enter full dataset for each sample in the analysis results table
4. Analysis results should be reported in mg/kg (ppm) dry weight.
5. Enter methdological limit of detection for each PCB prior to inputting raw data
6. Where analysis outputs are less than the limits of detection please enter text "<LOD"
7. ICES 7 PCBs are highlighted in bold
8. Where copying and pasting entries please use paste values only
9. Where entering multiple Sample IDs please use the pop-up form
   IDs should be separated by a comma

Analysis information:

Laboratory/contractor:	
Date of analysis:	

determinand analysis outputs:

Laboratory sample number	Dredge Area	Sample ID(s)	Total Solids (%)	PCBs as mg/kg dry weight																								
				2,2',4,5,5'-Pentachlorobiphenyl CB101	2,3,3',4,4'-Pentachlorobiphenyl CB105	2,3,3',4',6-Pentachlorobiphenyl CB110	2,3',4,4',5-Pentachlorobiphenyl CB118	2,2',3,3',4,4'-Hexachlorobiphenyl CB128	2,2',3,4,4',5'-Hexachlorobiphenyl CB138	2,2',3,4,5,5'-Hexachlorobiphenyl CB141	2,2',3,4',5',6-Hexachlorobiphenyl CB149	2,2',3,5,5',6-Hexachlorobiphenyl CB151	2,2',4,4',5,5'-Hexachlorobiphenyl CB153	2,3,3',4,4',5-Hexachlorobiphenyl CB156	2,3,3',4,4',6-Hexachlorobiphenyl CB158	2,2',3,3',4,4',5-Heptachlorobiphenyl CB170	2,2',5- Trichlorobiphenyl CB18	2,2',3,4,4',5,5'-Heptachlorobiphenyl CB180	2,2',3,4,4',5',6-Heptachlorobiphenyl CB183	2,2',3,4',5,5',6-Heptachlorobiphenyl CB187	2,2',3,3',4,4',5,5'-Octachlorobiphenyl CB194	2,4,4'-Trichlorobiphenyl CB28	2,4',5-Trichlorobiphenyl CB31	2,2',3,5'-Tetrachlorobiphenyl CB44	2,2',4,4'-Tetrachlorobiphenyl CB47	2,2',4,5'-Tetrachlorobiphenyl CB49	2,2',5,5'-Tetrachlorobiphenyl CB52	2,3',4,4'-Tetrachlorobiphenyl CB66
Limits of detection (mg/kg dry weight)																												

Organochlorine data

Instructions:

1. Record the laboratory/contractor responsible for analysis
2. Record the date the samples were analysed.
3. Enter full dataset for each sample in the analysis results table
4. Analysis results should be reported in mg/kg (ppm) dry weight.
5. Enter methdological limit of detection for each Organochlorine prior to inputting raw data
6. Where analysis outputs are less than the limits of detection please enter text "<LOD"
7. Where copying and pasting entries please use paste values only
8. Where entering multiple Sample IDs please use the pop-up form
   IDs should be separated by a comma

Analysis information:

Laboratory/contractor:	
Date of analysis:	

determinand analysis outputs:

Laboratory sample number	Dredge Area	Sample ID(s)	Total Solids (%)	Organochlorine pesticides as mg/kg dry weight							
				alpha-hexachlorocyclohexane (AHCH)	beta-hexachlorocyclohexane (BHCH)	gamma-hexachlorocyclohexane (GHCH)	Dieldrin	Hexachlorobenzene (HCB)	1,1-Dichloro-2,2-bis(p-chlorophenyl) ethylene (PPDDE)	Dichlorodiphenyltrichloroethane (PPDDT)	1,1-dichloro-2,2-bis(p-chlorophenyl)ethane (PPTDE)
Limits of detection (mg/kg dry weight):											

Brominated flame retardant data

Instructions:

1. Record the laboratory/contractor responsible for analysis
2. Record the date the samples were analysed.
3. Enter full dataset for each sample in the analysis results table
4. Analysis results should be reported in mg/kg (ppm) dry weight.
5. Enter methdological limit of detection for each BDE prior to inputting raw data
6. Where analysis outputs are less than the limits of detection please enter text "<LOD"
7. Where copying and pasting entries please use paste values only
8. Where entering multiple Sample IDs please use the pop-up form
   IDs should be separated by a comma

Analysis information:

Laboratory/contractor:	
Date of analysis:	

determinand analysis outputs:

Laboratory sample number	Dredge Area	Sample ID(s)	Total Solids (%)	Brominated flame retardants as mg/kg dry weight											
				2,2′,4,4′,6-penta-bromodiphenyl ether (BDE100)	Hexabromodiphenyl ether (BDE138)	2,2′,4,4′,5,5′-hexa-bromodiphenyl ether (BDE153)	2,2′,4,4′,5,6′-hexa-bromodiphenyl ether (BDE154)	2,2′,4-tri-bromodiphenylether (BDE17)	2,2′,3,4,4′,5′,6-heptabromodiphenyl ether (BDE183)	2,2',3,3',4,4',5,5',6,6'-decabrominated diphenyl ether (BDE 209)	2,4,4'-tribromodiphenyl ether (BDE28)	2,2′,4,4′-Tetrabromodiphenyl ether (BDE47)	2,3',4,4'-Tetrabromodiphenyl ether (BDE66)	2,2',3,4,4'-Pentabromodiphenyl ether (BDE85)	2,2',4,4',5-pentabromodiphenyl ether (BDE99)
Limits of detection (mg/kg dry weight):															

Marine Management Organisation

Marine Licensing
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Karen McHugh
Hampshire County Council
The Castle
Winchester
SO23 8UD

Our reference: SAM/2021/00081

11/03/2022

Dear Karen

Sample Plan Advice For Beneficial Use of Dredge Sediment in the Solent (BUDS) Phase 3

Thank you for your request to the Marine Management Organisation (MMO) for a sample plan to inform a future dredge application and disposal site characterisation. Please see our response below and any attachments, which has been compiled following consultation with our technical advisors The Centre for Environment, Fisheries and Aquaculture Science (Cefas).

Your feedback

We are committed to providing excellent customer service and continually improving our standards and we would be delighted to know what you thought of the service you have received from us. Please help us by taking a few minutes to complete the following short survey (https://www.surveymonkey.com/r/MMOMLcustomer).

If you require any further information please do not hesitate to contact me using the details provided below.

Yours Sincerely,

Deborah Nickless
Marine Case Officer

D 020 3025 7633
E deborah.nickless@marinemanagement.org.uk

Appendix 1 – MMO Sampling Plan

Marine Management Organisation

1. Description of the project

1.1 The advice relates to sampling to support the site characterisation report associated with a future application for a new disposal site at Pylewell. On behalf of the client (Solent Forum, Hampshire CC), ABPmer require a disposal licence for two sites. The disposal will be of dredge materials, in order to beneficially use sediment to restore saltmarsh at two sites. One of these sites has already had a Sample Plan agreed. This Sample Plan request relates to the identified potential new site of Pylewell.

1.2 This sample plan request is to seek samples to support sediment characterisation which will be used to inform the designation of a disposal site at Pylewell as part of a Beneficial Use of Dredged Sediment project. No licence is being sought at this time.

1.3 The applicant estimates that approximately 15,000 – 30,000 m^3 of material from nearby harbours (Yamouth, Beaulieu and Hamble) could be annually placed at Pylewell, with a further 20,000 m^3 which could be annually placed at Pylewell from Lymington Harbour. The MMO have presumed that these volumes will be on an annual basis.

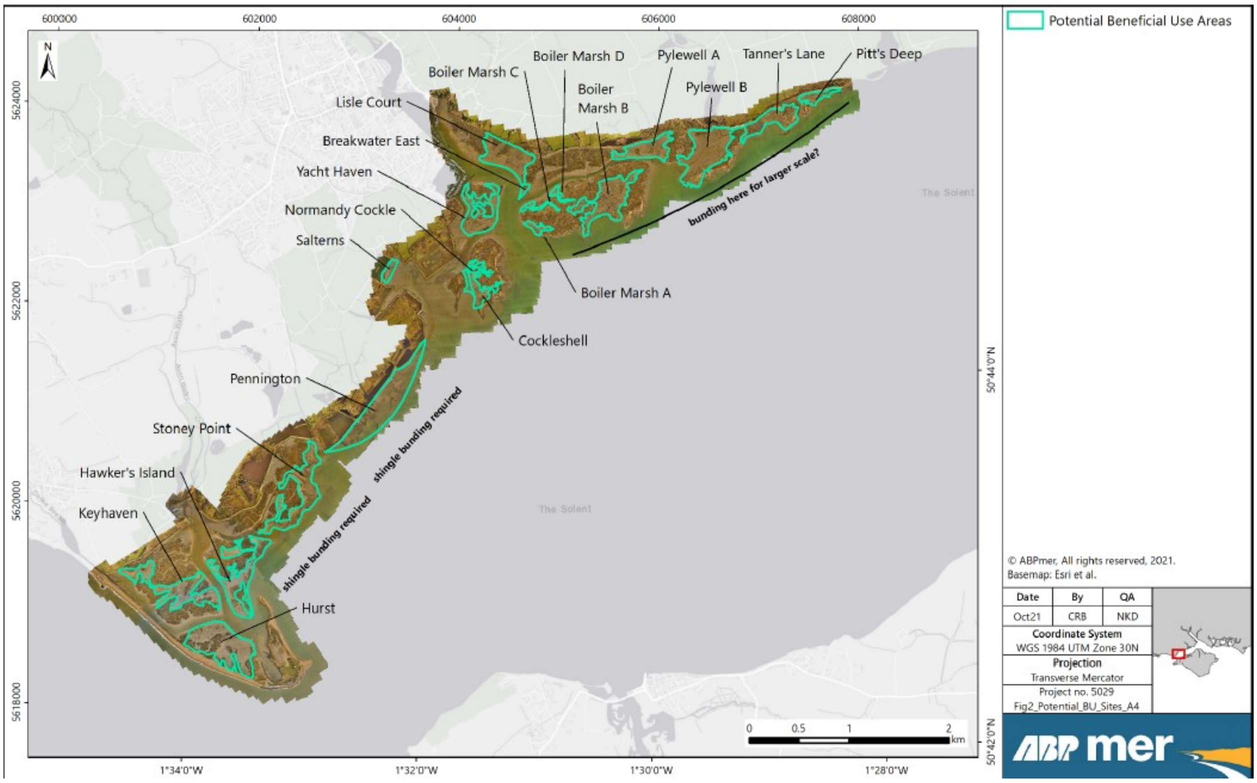

Figure 1. Location of potential receptor sites based on high-level review

2. Sampling required

2.1 In accordance with the recommendations of the OSPAR Guidelines for the Management of Dredged Material, samples should be taken to provide a good representation of the volume of material to be dredged. The distribution and depth of sampling should reflect the size and depth of the area to be dredged, the amount to be dredged and the expected variability in the horizontal and vertical distribution of contaminants. The MMO also uses the OSPAR guidelines to inform our advice on sampling requirements for other activities which are likely to lead to the mobilisation of sediments. Based on the information submitted (as described above), the following sampling and analysis is required

2.2 The MMO notes that the report presented indicates that much of the material that the project intends to use – i.e. material from Yarmouth, Beaulieu, and Hamble – is already subject to disposal at sea at Hurst Fort disposal site (WI080). If this is the case, then there may already be existing sediment data from these harbours' respective licence applications to support the application for BUDS Phase 3.

2.3 Whether existing data are sufficient or new data needs to be collected, the MMO consider that the following sampling will be necessary: **One sample station** from each of the three local harbours (Yarmouth, Beaulieu and Hamble), and **two sample stations** from Lymington Harbour. **One sample station** will also be required from the receiving site, Pylewell.

2.4 Samples must be taken at the surface (0 metres depth). Should any dredged sediment be sourced from depths deeper than 1m below the seabed surface, then repeat samples should be taken at 1m depth intervals down to the max depth.

2.5 This is in line with the minimum guidelines set by OSPAR, which recommends 4 - 6 sample station locations for volumes from 25,000m3 - 100,000 cubic metres (m3). The applicant estimates that approximately 15,000 – 30,000 cubic metres of material from nearby harbours (Yarmouth Beaulieu and Hamble) could be annually placed at Pylewell with a further 20000 metres cubed placed at Pylewell from Lymington harbour. Further details are provided on the attached sample plan form in Appendix 1.

2.6 Sample locations should be evenly spaced across the proposed areas to be dredged and samples must be representative of the material to be dredged (see attached sample plan in Appendix 1).

2.7 The following information must be included with any samples (irrespective of the laboratory to be used for analysis):

- Clearly labelled samples;
- Completed sample position sheet, including the latitude and longitude (decimal degrees and the projection i.e. WGS84) of each location
- Details of the method of sampling;
- A map/chart detailing the sample locations.

2.8 Surface samples should be taken from the upper layer of in-situ sediment using a non-metallic / stainless steel scoop. To maintain the integrity of the samples please ensure that they are frozen and remain in the freezer until they can be dispatched. Please ensure the samples are dispatched in a cool box - the cool box should not be placed in any other packaging.

3. Analysis Required

4. Typically, applications for beneficial use for habitat restoration or beach nourishment generally only require particle size analysis (PSA). The applicant indicates that this was the only analysis conducted for previous phases of the BUDS scheme. As such, the MMO consider that PSA will be necessary to support this application. However, the applicant may wish to test for other analyses to ensure that material will be of an acceptable contaminant risk so as to not impact the marshes being restored. In this regard, the MMO recommends the following analyses for both the origin sites and receiving site:

Essential

- Particle Size Analysis (PSA)

Beneficial

- Trace Metals including arsenic
- Organotins (only if material below 1m depth is being used – origin sites only)
- Polycyclic Aromatic Hydrocarbons (PAHs)

4.1. Please note, the beneficial analysis listed above are not required by the MMO in order to support a future marine licence application and are therefore optional. There may be additional costs associated with the beneficial analysis and any results submitted for these analysis would be considered as part of a marine licence application and would be used to inform the suitability of material to be disposed to sea.

4.2. Further details can be found on the attached sample plan form in Appendix 1 (sample plan form).
4.3. To ensure consistency between laboratories it is expected that all analysis required will be undertaken from the same sample container. It is the applicant's responsibility to ensure that sufficient sample is collected, in a single container, for all the analysis required. Where Cefas are analysing the samples, appropriate containers will be provided.

5. Laboratories

5.1. You have now obtained an approved sample plan from the MMO. Should you now require sample analysis for chemical, physical and biological determinands in support of a regulatory approval such as a marine licence, you have a choice between using a provider of your choice listed at the link below:

https://www.gov.uk/guidance/marine-licensing-sediment-analysis-and-sample-plans

This list indicates the laboratories which have been validated to undertake sediment analysis, as well as the specific determinands which they are validated to analyse. The MMO will not accept results from laboratories which have not been validated.

5.2. Irrespective of which validated laboratory is used to undertake sediment analysis, results accompanying a marine licence application must be submitted to the MMO on the correct results template (approved templates are available via the link in 4.1 above).

5.3. If the analysis is to be undertaken by a laboratory other than those validated by the MMO, that laboratory must meet the qualifying criteria as set out in the MMO guidance and become a validated laboratory (https://www.gov.uk/guidance/marine-licensing-sediment-analysis-and-sample-plans).

5.4. It is your responsibility to ensure that appropriate analysis is commissioned and supplied in support of a regulatory approval. However, if you have any queries about the process or would like clarity on this, please do not hesitate to contact the MMO by emailing: marineconsents@marinemanagement.org.uk

5.5. Due to the current coronavirus pandemic, some laboratories are experiencing delays in analysing certain chemicals for sediment samples. Please be mindful of this when considering project requirements and engage with your chosen validated laboratory in order to have a clear understanding of predicted timeframes.

6. Conclusion

6.1. This advice is based solely on the information provided in the sample plan request, and the sampling and analysis described will be adequate to inform a site characterisation report that mirrors the information in this pre-application request providing that no further issues come to light and an application is submitted in a suitable time-frame. The MMO will take a pragmatic approach to the requirement of repeat samples in relation to projects where works have not commenced. Samples taken at depth will remain a valid consideration for decision-making from the time they are taken. However, due to the dynamic nature of the marine environment and the potential for changes in the quantity and quality of sediments, there may be a need for surface sediments to be re-sampled and analysed if the project has not commenced within two years of the time of sampling.

6.2. Where long term licences for maintenance dredging will be applied for, additional sampling and analysis will need to be undertaken throughout the duration of the proposed longer licence term in order to comply with the OSPAR guidelines.

6.3. MMO reserves the right to request further sampling/analysis should any submitted Marine Licence application differ from that information submitted in this pre-application request. Any future application or return must clearly state this pre-application reference number.

Appendix 1

Sample	Station	**Metals	**‡Organotin	**THC	**PAHs	PCBs	PDBEs	OCs	PSA
1	Yarmouth – 0m	☒	☐	☒	☒	☐	☐	☐	☒
2	*Yarmouth – 1m	☒	☒	☒	☒	☐	☐	☐	☒
3	Beaulieu – 0m	☒	☐	☒	☒	☐	☐	☐	☒
4	*Beaulieu – 1m	☒	☒	☒	☒	☐	☐	☐	☒
5	Hamble – 0m	☒	☐	☒	☒	☐	☐	☐	☒
6	“Hamble – 1m	☒	☒	☒	☒	☐	☐	☐	☒
7	Lymington A – 0m	☒	☐	☒	☒	☐	☐	☐	☒
8	*Lymington A – 1m	☒	☒	☒	☒	☐	☐	☐	☒
9	Lymington B – 0m	☒	☐	☒	☒	☐	☐	☐	☒
10	*Lymington B – 1m	☒	☒	☒	☒	☐	☐	☐	☒
11	Pylewell	☒	☐	☒	☒	☐	☐	☐	☒
12		☐	☐	☐	☐	☐	☐	☐	☐
13		☐	☐	☐	☐	☐	☐	☐	☐
14		☐	☐	☐	☐	☐	☐	☐	☐
15		☐	☐	☐	☐	☐	☐	☐	☐
16		☐	☐	☐	☐	☐	☐	☐	☐
17		☐	☐	☐	☐	☐	☐	☐	☐
18		☐	☐	☐	☐	☐	☐	☐	☐
19		☐	☐	☐	☐	☐	☐	☐	☐
20		☐	☐	☐	☐	☐	☐	☐	☐

Comments:
Stations should be evenly distributed across the dredge area

***Subsurface samples only required where material to be dredged is below 1m depth**
****Non-essential analyses**
‡ Only required at subsurface stations if required

Applicant Information

Instructions:

1. All applicants and laboratories should refer to the most recent guidance on sediment analysis in support of marine licence applications [Sediment analysis guidance](#)
2. Full information must be provided under each relevant sheet of the workbook. Grey highlighted cells indicate where information can be entered.
3. Where information cannot be provided, the applicant should consult with the MMO prior to submission.
4. Worksheets are protected to prevent accidental amendments to calculated values. If amendments are required please consult with the MMO.
5. Sample IDs used through the data output worksheets should correspond to Sample IDs provided on this worksheet.

6 Where more than 6 dredge areas or 30 samples are required, please contact MMO.

7. Macros must be enabled to use this workbook

Marine licence applicant information:

Applicant:	Solent Forum
Application number:	SAM/2021/00081
Application title:	Beneficial Use of Dredge Sediment in the Solent (BUDS) Phase 3
Date sampled:	08/11/2021
Sampling location:	Pylewell (Lymington)

Dredge area tonnages:

Dredge Area	Dredging tonnages	% total dredged material	Total dredged material
Area i			0
Area ii			
Area iii			
Area iv			
Area v			
Area vi			

MMO use only

Sample numbers and locations

Sample ID	Excluded sample (MMO use)	Sample location (decimal degrees, WGS84)		Location name (as per sampling plan)	Sampling depth (m)	Dredge area
		Position latitude	Position longitude			
Site I		50.753127	-1.491345	Pylewell	0	
Site J		50.752605	-1.492929	Pylewell	0	
Site K		50.752242	-1.492363	Pylewell	0	
Site L		50.752114	-1.495038	Pylewell	0	
Site M		50.751555	-1.494430	Pylewell	0	

Physical characteristics data

Instructions:

1. Record the laboratory/contractor responsible for analysis
2. Record the date the samples were analysed.
3. Enter full dataset for each sample in the analysis results table
4. Where copying and pasting entries please use paste values only
5. Where entering multiple Sample IDs please use the pop-up form
   IDs should be separated by a comma

Analysis information:

Laboratory/contractor:	Socotech
Date of analysis:	08/11/2021

Physical characteristics analysis outputs:

Laboratory sample number	Dredge Area	Sample ID(s)	Visual appearance*	Exempt from chemical analysis ◦	Total Solids (% total sediments)	Organic matter (total organic carbon)
MAR01209.001		Site I	Odourless Brown Mud			
MAR01209.002		Site J	ss Brown Sandy Mud with Shell Fragments and Organic Matte			
MAR01209.003		Site K	urless Brown Mud with Organic Matter and Shell Fragments			
MAR01209.004		Site L	rown Gravelly Sandy Mud with Shell Fragments and Organic Matte			
MAR01209.005		Site M	Sandy Mud with Shell Fragments and Organic Matter and a Peaty Odou			

Particle size distribution (% at 0.5 phi intervals)

Laboratory sample number	-5.5	-5.0	-4.5	-4.0	-3.5	-3.0	-2.5	-2.0	-1.5	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0
	45mm	31.5mm	22.4mm	16mm	11.2mm	8mm	5.6mm	4mm	2.8mm	2mm	1.4mm	1mm	707µm	500µm	353.6µm	250µm
MAR01209.001	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
MAR01209.002	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.07	0.16	0.31	0.39	0.23	0.01	0.66	1.95	5.43
MAR01209.003	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.06	0.02	0.13	0.13	0.12	0.01	0.64	1.75	3.38
MAR01209.004	0.00	0.00	0.00	1.10	0.00	0.37	0.07	0.10	0.05	0.15	0.16	0.16	2.63	0.94	0.97	7.83
MAR01209.005	0.00	0.00	0.00	1.50	0.51	0.75	0.87	0.69	0.66	0.93	1.27	1.13	6.74	4.79	6.04	8.87

Laboratory sample number	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0
	176.8µm	125µm	88.39µm	63µm	44.2µm	31.3µm	22.1µm	15.6µm	11µm	7.8µm	5.5µm	3.9µm	2.75µm	1.95µm
MAR01209.001	1.43	3.77	0.56	6.33	10.77	11.35	10.28	7.67	6.74	7.11	7.32	6.40	4.75	3.23
MAR01209.002	6.60	7.89	2.45	3.10	5.93	7.28	7.58	6.38	6.01	6.42	6.62	5.78	4.28	2.91
MAR01209.003	6.01	7.20	2.94	8.44	10.86	10.19	8.11	5.40	4.92	5.19	5.16	4.44	3.34	2.34
MAR01209.004	17.44	13.79	2.53	3.07	4.34	5.18	5.26	4.74	4.50	4.68	4.79	4.11	2.91	1.82
MAR01209.005	7.77	6.53	3.49	5.20	5.51	5.82	5.19	3.93	3.49	3.55	3.49	2.92	2.08	1.35

Laboratory sample number	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	>14.5
	1.38µm	0.98µm	0.69µm	0.49µm	0.34µm	0.24µm	0.17µm	0.12µm	0.09µm	0.06µm	0.04µm	<0.04µm
MAR01209.001	2.39	1.97	1.72	1.56	1.40	1.19	0.89	0.63	0.38	0.15	0.02	0.00
MAR01209.002	2.16	1.75	1.53	1.43	1.36	1.19	0.90	0.65	0.39	0.15	0.02	0.00
MAR01209.003	1.77	1.45	1.24	1.11	1.01	0.88	0.68	0.51	0.32	0.13	0.02	0.00
MAR01209.004	1.25	1.01	0.88	0.81	0.73	0.61	0.45	0.31	0.19	0.07	0.01	0.00
MAR01209.005	0.97	0.79	0.69	0.62	0.55	0.46	0.35	0.26	0.16	0.06	0.01	0.00

◦ enter 'y' where sediment samples contain glacial material or are too coarse and **Exempt from chemical analysis:** thus exempt from chemical analysis.

* **Visual appearance** : Incude a description of what the material looks like and what it contains, e.g. sandy material containing brick fragments, or black silt, or foreign man made matter caught in the sample.

Trace metal data

Instructions:

1. Record the laboratory/contractor responsible for trace metal analysis
2. Record the date the samples were analysed.
3. Enter full dataset for each sample in the analysis results table
4. Trace metal analysis results should be reported in mg/kg (ppm) dry weight
5. Enter methdological limit of detection for each trace metal prior to inputting raw data
6. Where analysis outputs are less than the limits of detection please enter text "<LOD"
7. Where copying and pasting entries please use paste values only
8. Where entering multiple Sample IDs please use the pop-up form
   IDs should be separated by a comma

Analysis information:

Laboratory/contractor:	
Date of analysis:	

Determinand analysis outputs:

Laboratory sample number	Dredge Area	Sample ID(s)	Total solids (%)	Metals as mg/kg dry weight							
				Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Mercury (Hg)	Nickel (Ni)	Lead (Pb)	Zinc (Zn)
Limits of detection (mg/kg dry weight):											

Organotin data

Instructions:

1. Record the laboratory/contractor responsible for organotin analysis
2. Record the date the samples were analysed.
3. Enter full dataset for each sample in the analysis results table
4. Organotin analysis results should be reported in mg/kg (ppm) dry weight
5. Enter methdological limit of detection for each organotin prior to inputting raw data
6. Where analysis outputs are less than the limits of detection please enter text "<LOD"
7. Where copying and pasting entries please use paste values only
8. Where entering multiple Sample IDs please use the pop-up form
   IDs should be separated by a comma

Analysis information:

Laboratory/contractor:	
Date of analysis:	

determinand analysis outputs:

Laboratory sample number	Dredge Area	Sample ID(s)	Total solids (%)	Organotins as mg/kg dry weight	
				Dibutyltine (DBT)	Tributyltin (TBT)
Limits of detection (mg/kg dry weight):					

Polyaromatic hydrocarbon data

Instructions:

1. Record the laboratory/contractor responsible for PAH analysis
2. Record the date the samples were analysed.
3. Enter full dataset for each sample in the analysis results table
4. Analysis results for individual PAHs should be reported in µg/kg (ppb) dry weight. THC should be reported as mg/kg (ppm)
5. Enter methdological limit of detection for each PAH prior to inputting raw data
6. Where analysis outputs are less than the limits of detection please enter text "<LOD"
7. Where copying and pasting entries please use paste values only
8. Where entering multiple Sample IDs please use the pop-up form IDs should be separated by a comma

Analysis information:

Laboratory/contractor:	
Date of analysis:	

determinand analysis outputs:

Laboratory sample number	Dredge Area	Sample ID(s)	Total Solids (%)	PAHs as dry weight (µg/kg dry weight)																						Total hydrocarbon content (mg/kg)
				Acenapthene	Acenapthylene	Anthracene	Benz[a]anthracene	Benzo[a]pyrene	Benzo[b]fluoranthene	Benzo[g,h,i]perylene	Benzo[e]pyrene	Benzo[k]fluoranthene	C1-Napthalenes	C1-Phenanthrenes	C2-Napthalenes	C3-Napthalenes	Chrysene	Dibenz[a,h]anthracene	Fluoranthene	Fluorene	Indeno[123-c,d]pyrene	Napthalene	Perylene	Phenanthrene	Pyrene	
Limits of detection (µg/kg dry weight):																										

Polychlorinated biphenyl data

Instructions:

1. Record the laboratory/contractor responsible for PCB analysis
2. Record the date the samples were analysed.
3. Enter full dataset for each sample in the analysis results table
4. Analysis results should be reported in mg/kg (ppm) dry weight.
5. Enter methdological limit of detection for each PCB prior to inputting raw data
6. Where analysis outputs are less than the limits of detection please enter text "<LOD"
7. ICES 7 PCBs are highlighted in bold
8. Where copying and pasting entries please use paste values only
9. Where entering multiple Sample IDs please use the pop-up form
   IDs should be separated by a comma

Analysis information:

Laboratory/contractor:	
Date of analysis:	

determinand analysis outputs:

				PCBs as mg/kg dry weight																								
Laboratory sample number	Dredge Area	Sample ID(s)	Total Solids (%)	2,2',4,5,5'-Pentachlorobiphenyl CB101	2,3,3',4,4'-Pentachlorobiphenyl CB105	2,3,3',4',6-Pentachlorobiphenyl CB110	2,3',4,4',5-Pentachlorobiphenyl CB118	2,2',3,3',4,4'-Hexachlorobiphenyl CB128	2,2',3,4,4',5'-Hexachlorobiphenyl CB138	2,2',3,4,5,5'-Hexachlorobiphenyl CB141	2,2',3,4',5',6-Hexachlorobiphenyl CB149	2,2',3,5,5',6-Hexachlorobiphenyl CB151	2,2',4,4',5,5'-Hexachlorobiphenyl CB153	2,3,3',4,4',5-Hexachlorobiphenyl CB156	2,3,3',4,4',6-Hexachlorobiphenyl CB158	2,2',3,3',4,4',5-Heptachlorobiphenyl CB170	2,2',5- Trichlorobiphenyl CB18	2,2',3,4,4',5,5'-Heptachlorobiphenyl CB180	2,2',3,4,4',5',6-Heptachlorobiphenyl CB183	2,2',3,4',5,5',6-Heptachlorobiphenyl CB187	2,2',3,3',4,4',5,5'-Octachlorobiphenyl CB194	2,4,4'-Trichlorobiphenyl CB28	2,4',5-Trichlorobiphenyl CB31	2,2',3,5'-Tetrachlorobiphenyl CB44	2,2',4,4'-Tetrachlorobiphenyl CB47	2,2',4,5'-Tetrachlorobiphenyl CB49	2,2',5,5'-Tetrachlorobiphenyl CB52	2,3',4,4'-Tetrachlorobiphenyl CB66
Limits of detection (mg/kg dry weight):																												

Organochlorine data

Instructions:

1. Record the laboratory/contractor responsible for analysis
2. Record the date the samples were analysed.
3. Enter full dataset for each sample in the analysis results table
4. Analysis results should be reported in mg/kg (ppm) dry weight.
5. Enter methdological limit of detection for each Organochlorine prior to inputting raw data
6. Where analysis outputs are less than the limits of detection please enter text "<LOD"
7. Where copying and pasting entries please use paste values only
8. Where entering multiple Sample IDs please use the pop-up form
   IDs should be separated by a comma

Analysis information:

Laboratory/contractor:	
Date of analysis:	

determinand analysis outputs:

Laboratory sample number	Dredge Area	Sample ID(s)	Total Solids (%)	Organochlorine pesticides as mg/kg dry weight							
				alpha-hexachlorocyclohexane (AHCH)	beta-hexachlorocyclohexane (BHCH)	gamma-hexachlorocyclohexane (GHCH)	Dieldrin	Hexachlorobenzene (HCB)	1,1-Dichloro-2,2-bis(p-chlorophenyl) ethylene (PPDDE)	Dichlorodiphenyltrichloroethane (PPDDT)	1,1-dichloro-2,2-bis(p-chlorophenyl)ethane (PPTDE)
Limits of detection (mg/kg dry weight):											

Brominated flame retardant data

Instructions:

1. Record the laboratory/contractor responsible for analysis
2. Record the date the samples were analysed.
3. Enter full dataset for each sample in the analysis results table
4. Analysis results should be reported in mg/kg (ppm) dry weight.
5. Enter methdological limit of detection for each BDE prior to inputting raw data
6. Where analysis outputs are less than the limits of detection please enter text "<LOD"
7. Where copying and pasting entries please use paste values only
8. Where entering multiple Sample IDs please use the pop-up form
   IDs should be separated by a comma

Analysis information:

Laboratory/contractor:	
Date of analysis:	

determinand analysis outputs:

Laboratory sample number	Dredge Area	Sample ID(s)	Total Solids (%)	Brominated flame retardants as mg/kg dry weight											
				2,2′,4,4′,6-penta-bromodiphenyl ether (BDE100)	Hexabromodiphenyl ether (BDE138)	2,2′,4,4′,5,5′-hexa-bromodiphenyl ether (BDE153)	2,2′,4,4′,5,6′-hexa-bromodiphenyl ether (BDE154)	2,2′,4-tri-bromodiphenylether (BDE17)	2,2′,3,4,4′,5′,6-heptabromodiphenyl ether (BDE183)	2,2',3,3',4,4',5,5',6,6'-decabrominated diphenyl ether (BDE 209)	2,4,4'-tribromodiphenyl ether (BDE28)	2,2′,4,4′-Tetrabromodiphenyl ether (BDE47)	2,3',4,4'-Tetrabromodiphenyl ether (BDE66)	2,2',3,4,4'-Pentabromodiphenyl ether (BDE85)	2,2',4,4',5-pentabromodiphenyl ether (BDE99)
Limits of detection (mg/kg dry weight):															

C Baseline Document for Maintenance Dredging in Lymington Harbour

This appendix contains a copy of the latest Maintenance Dredge Protocol (MDP) baseline report for Lymington Harbour. This is included here to provide some background context to the application being made. It is not expected that the MMO or its consultees will need to review this document again. Instead, it is included here as a resource of useful contextual information for reference as required.

Lymington Harbour Commissioners

Baseline Document for Maintenance Dredging in Lymington Harbour

Updated Maintenance Dredge Protocol (MDP) baseline with Water Framework Directive (WFD)

January 2023

Innovative Thinking - Sustainable Solutions

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Baseline Document for Maintenance Dredging in Lymington Harbour

Updated Maintenance Dredge Protocol (MDP) baseline with Water Framework Directive (WFD)

January 2023

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Acknowledgements

This report builds directly upon previous baseline reviews for Lymington Harbour produced by Black & Veatch in 2011, 2014 and 2017. It also includes a recently updated Water Framework Directive (WFD) assessment for the Lymington maintenance dredge programme by Binnies (2021). We are grateful for these supporting studies and would also like to thank those that have provided additional recent data for this update. This includes Pete Durnell (Hampshire County Council) for his valuable for advice on the status of breeding birds on the Lymington saltmarshes. It also includes the British Trust for Ornithology (BTO), the Channel Coastal Observatory (CCO), the Solent Forum, the Environment Agency and Natural England who carried out relevant new studies and surveys. We also like to thank Shoreline Surveys Ltd. who carried out bathymetric surveys of Lymington Estuary on behalf of the Lymington Harbour Commissioners (LHC) and provided valuable data for this review.

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Executive Summary

Report Background

This report updates the Maintenance Dredge Protocol (MDP) 'baseline document' for Lymington Harbour. It has been produced in accordance with the 'Maintenance Dredging and Habitats Regulations[1]' conservation assessment protocol for England (Defra, 2007). It describes the status of ongoing maintenance dredging, disposal and beneficial use operations in Lymington Harbour so that the relationship between these activities and the condition of relevant internationally protected sites can be evaluated.

At Lymington these internationally protected sites include, as it has in past baseline studies, the Solent Maritime Special Area of Conservation (SAC), the Solent and Isle of Wight Lagoons SAC and the Solent and Southampton Water Special Protection Area (SPA) and Ramsar site. It now also includes the Solent and Dorset Coast SPA which was recently classified (in January 2020). These sites are all collectively part of the Solent European Marine Site. In addition, two other key protected areas at Lymington Harbour are the Lymington (Transitional) and Solent (Coastal) waterbodies[2].

The ecology, nature conservation value and water quality conditions of these sites are protected, in England and Wales, under the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 and The European Union (Withdrawal) Act 2018. This legislation repeals the European Communities Act 1972 while also maintaining EU-derived domestic legislation in UK law. It covers the requirements formerly accommodated in UK law by the European Union (EU) Habitats Directive and the Water Framework Directive (WFD).

A previous version of this baseline document was issued in 2011. This was then updated in 2014 and 2017. As required, these earlier documents included the latest baseline information for Lymington Estuary and the harbour. It is the Lymington Harbour Commissioners' (LHC) policy to update these baseline reviews every five years. This ensures they are up-to-date and available to inform management decisions and to underpin any new harbour proposals and accompanying marine licence submissions to the Marine Management Organisation (MMO), that may be required.

Now that five years have elapsed since the last document was produced, LHC have asked ABPmer to compile a new baseline review for 2022. This version updates the baseline document by considering the dredging activities and survey findings from the last five years.

Adopting this five-yearly review programme generally means that substantial revisions to the baseline are not required. However, it is necessary to provide the latest details on dredging and disposal activities as well as, for Lymington particularly, details about the value of ongoing beneficial use disposal operations. It is also important to add any new information about the environmental conditions as well as the latest expectations regarding future environmental changes (including the latest sea level rise projections). In addition, it is valuable to draw upon new survey data, research and recognise relevant changes to the legislative and relevant policy landscape.

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1 Refers to the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 which amended the previous Conservation of Habitats and Species Regulations 2017.

2 Other nationally protected areas include the Hurst Castle and Lymington River Estuary Site of Special Scientific Interest (SSSI) and the upstream Lymington River Reedbeds SSSI. These are designated under the Wildlife and Countryside Act 1981 and cover the same area as that of the European/Ramsar sites. This sites are also considered in this report.

Baseline Update and Assessment

Over the last five years the dredging requirements in Lymington Harbour have been maintained at agreed and typical rates. From 2017 to 2021 between 24,000 and 29,000 wet tonnes of sediment (approximately 20,000 to 22,000 m^3) were dredged annually in the system. The average dredging amount over this five-year period was 26,930 wet tonnes per annum. For these maintenance campaigns, sediments are dredged from marinas/berths within the middle estuary as well as from navigable approaches in the lower estuary.

Over this same five-year period, developments within the harbour have been of a relatively small-scale. These have included:

- Replacing northernmost wave breaks that protect the harbour (MMO Ref L/2021/00293/1);
- Reconfiguring of Town Quay Pontoon Moorings (MMO Ref L/2018/00400/1); and
- Adjustment to the location of commercial pontoons (MMO Ref L/2020/00330/1).

This updated assessment concludes, in common with previous reviews, that the effects of dredging and sediment disposal in Lymington Harbour are temporary and localised. These ongoing activities are not having a significant adverse effect on the international designated nature conservation sites (the SAC, SPA and Ramsar areas). Similarly, no negative effects on the status of WFD elements at the waterbody are anticipated.

This conclusion is underpinned by an understanding of the timing and nature of the dredging activities. There is no direct dredging of the intertidal (SAC-designated) habitats. There is no evidence or expectation of an indirect effect on intertidal habitats and, the winter dredging activities do not have a significant adverse effects to overwintering water birds.

This review also provides an updated description of the wider environmental changes that are continuing to occur in the outer estuary. This outer estuary is subject to an ongoing process of change as the marshes continue to retreat and the channel tries to adopt a more sinuous shape. The maintenance dredging activities have a negligible effect in the context of these broader and ongoing changes.

The LHC continue to carry out pro-active sediment management strategies to help address these changes. This includes the continuing beneficial placement of dredge sediment at Boiler Marsh on an annual basis. Over each of the last five winters (2017/18 to 2020/21) around 9,000 wet tonnes or 7,000 m^3 have been placed here and much of this deposited sediment is remaining where it is placed. In total, around 50,000 m^3 of material has been deposited here over the last eight years, and around half of this was still present at the time of the most recent surveys in April 2022. This habitat protection work is additional to two other completed beneficial use projects that were undertaken (as development mitigation measures) in Lymington Harbour in 2012 and 2013.

These ongoing and previous beneficial use projects have helped to protect and slow the rate at which intertidal habitats, and the functional/ecological benefits they provide, are being lost. These benefits include providing protection to the harbour and enhancing biodiversity. For example, Boiler Marsh is now the most valuable intertidal waterbird nesting ground in the area because it is set at the highest tidal elevation. Therefore, slowing the loss of this marsh will be delaying the loss of important habitat for spring and summer breeding birds.

As a result, of this beneficial use work, and the monitoring and communication work carried out alongside it, Lymington Harbour has become a valuable demonstration site for of this activity. It is showing what can be achieved with dredge sediment as well as illustrating the technical issues, costs and benefits of delivering such projects.

Natural England is always consulted during the production these baseline reviews and a draft version of this report was therefore issued to them for consideration on 14 October 2022. A written response was received from Natural England and a copy of this is included in Appendix A of this report. Natural England, the Marine Management Organisation (MMO) and other stakeholders and interested parties are also regularly consulted as part of Marine Licence applications for new and updated activities in Lymington Estuary.

Recommendations

In accordance with the maintenance dredge protocol and LHC policy (and as proposed in the past baseline documents) it is recommended that this baseline is updated periodically to incorporate new information as it becomes available (e.g. on sea level rise). As noted above, the LHC have a policy of doing this anyway on a five yearly cycle, therefore the next update would be in 2027. This next review can again consider the latest available dredging requirements, environmental conditions and survey results as well as pertinent changes to national and regional legislation and policies.

Over the next five years it is also envisaged that more beneficial use alternatives to offshore disposal of dredge sediment will have been adopted. Building on the lesson from past projects, the LHC as well as the Solent Forum, are currently exploring ways in which more maintenance dredge arisings can be beneficially used in the future to protect the deteriorating saltmarsh habitats in and adjacent to the estuary. The next baseline document can, therefore, provide update on these projects.

Another aspect to highlight is that new proposals are likely to emerge from the 'Hurst Spit to Lymington Strategy' over the next few years. This flood protection strategy is being led by the Environment Agency, in partnership with New Forest District Council, Hampshire County Council, Natural England and JBA Consulting. This team are examining the pressures this coastline is facing (both now and in the future) to consider how best to respond to these challenges. A short list of possible options has been identified under this programme and the next baseline review will, therefore, need to provide an update on the proposed strategies and consider their implications.

Contents

Appendices

Images

Tables

Figures

1 Introduction

1.1 Report background

Maintenance dredging and sediment is undertaken by many ports, marinas and other facility operators to maintain safe and navigable channels and berths. It is essential for the safe and continued operation of ports and is regulated, amongst other legal and policy drivers, under Part 4 (Section 66(1)) of the Marine and Coastal Access Act (MCAA) 2009. Under this regulation, licences are required from the Marine Management Organisation (MMO) in England to remove or deposit any substance or object (including dredged sediment) within the UK marine licensing area.

Maintenance dredging is also considered to be a 'plan or project' that needs to be assessed in accordance with the 'Habitats Regulations' as now enforced through the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019. This means that the effects of maintenance dredging on internationally protected nature conservation sites needs to be assessed.

A Conservation Assessment Protocol for maintenance dredging and the Habitats Regulations has been developed (Defra, 2007) to assist port and harbour authorities in fulfilling this obligation. Under this Maintenance Dredge Protocol (MDP) a 'Baseline Document' is required that provides current and historical information on dredging activities within the area concerned. The baseline document also collates existing and relevant information about the environmental status of the area concerned and describes what is known of the impacts of capital and maintenance dredging.

The MDP Baseline Document provides the foundation for consistent and informed decision-making by all the competent authorities, in compliance with the requirements of the Habitats Regulations. It is important that it is regularly updated, in the form of a reference document, as circumstances and requirements change.

This report therefore provides an update to the existing baseline document for the continuation of existing maintenance dredging within Lymington Harbour. It updates previous baseline reports that were produced in 2011, on an interim basis in 2014, and then most recently, in 2017 (Black & Veatch, 2011, Black & Veatch, 2017a). It draws upon recent baseline information to inform future licence applications for maintenance dredging disposal and beneficial use over the next five years.

1.2 Context and scope of report

1.2.1 Context

The Lymington Estuary is located in the western arm of the Solent, in the lee of the Isle of Wight and Hurst Spit (see Figure 1). The town of Lymington has a long history of port activities dating back to at least 1200 AD. The area was a thriving port in the 17th Century, when extensive coastal salt workings allowed the export of salt to America.

More recently, the 20th Century saw the harbour evolve into a major leisure boating centre with moorings for around 1,700 yachts. The river also supports a small commercial fishing fleet and a car and passenger ferry service to the Isle of Wight making around 8,700 trips per annum (LHC 2021)

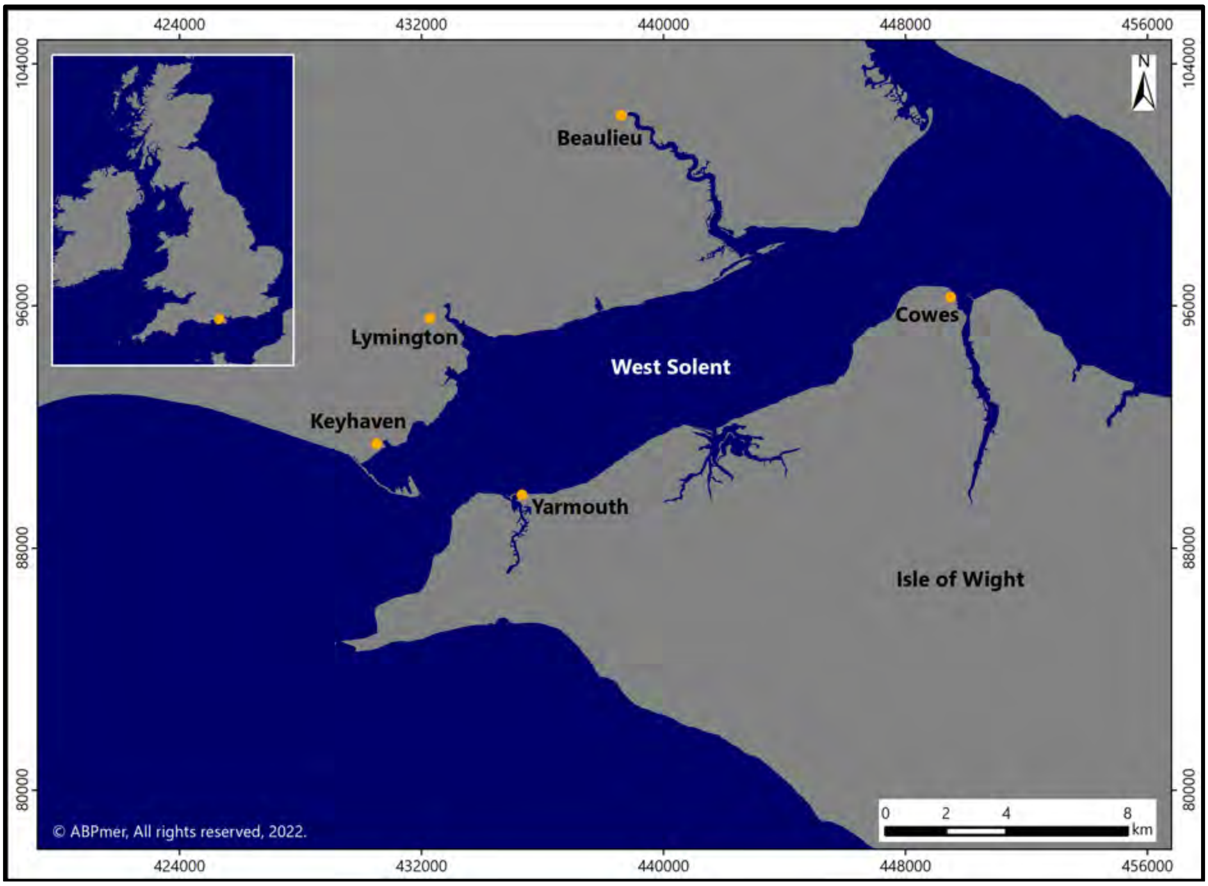


Figure 1. **Location of Lymington Harbour**

1.2.2 Study area

The study area for this review, as for previous baseline studies, is defined as a 2 km buffer. This study area zone is shown on Figure 2. The location and boundaries of internationally designated sites in and around this study area are also shown on this figure. These sites include the Solent Maritime Special Area of Conservation (SAC) and the Solent and Southampton Water Special Protection Area (SPA) and Ramsar wetland. They also include the newly designated Solent and Dorset Coast SPA. These sites are collectively referred to as the Solent European Marine Site.[3]

National designations are also present in the estuary. This includes the Hurst Castle and Lymington River Estuary Site of Special Scientific Interest (SSSI) covers parts of the outer estuary and adjacent intertidal. Also Marine Conservation Zone (MCZ) are located outside the study area at the Needles and Yarmouth to Cowes (see Figure 2)

Relevant statutory designations for nature conservation cover areas of the lower river where routine dredging of the main navigation channel is required. The upper river, where the majority of routine maintenance dredging is required, is 'in close proximity' to, but outside of the statutory designations.

The statutory designations also cover the area of saltmarsh recharge disposal area (the beneficial use site) at Boiler Marsh. This is also shown Figure 2.

[3] See the Solent forum website for information about the SEMS site http://www.solentems.org.uk/sems/SEMS_sites/

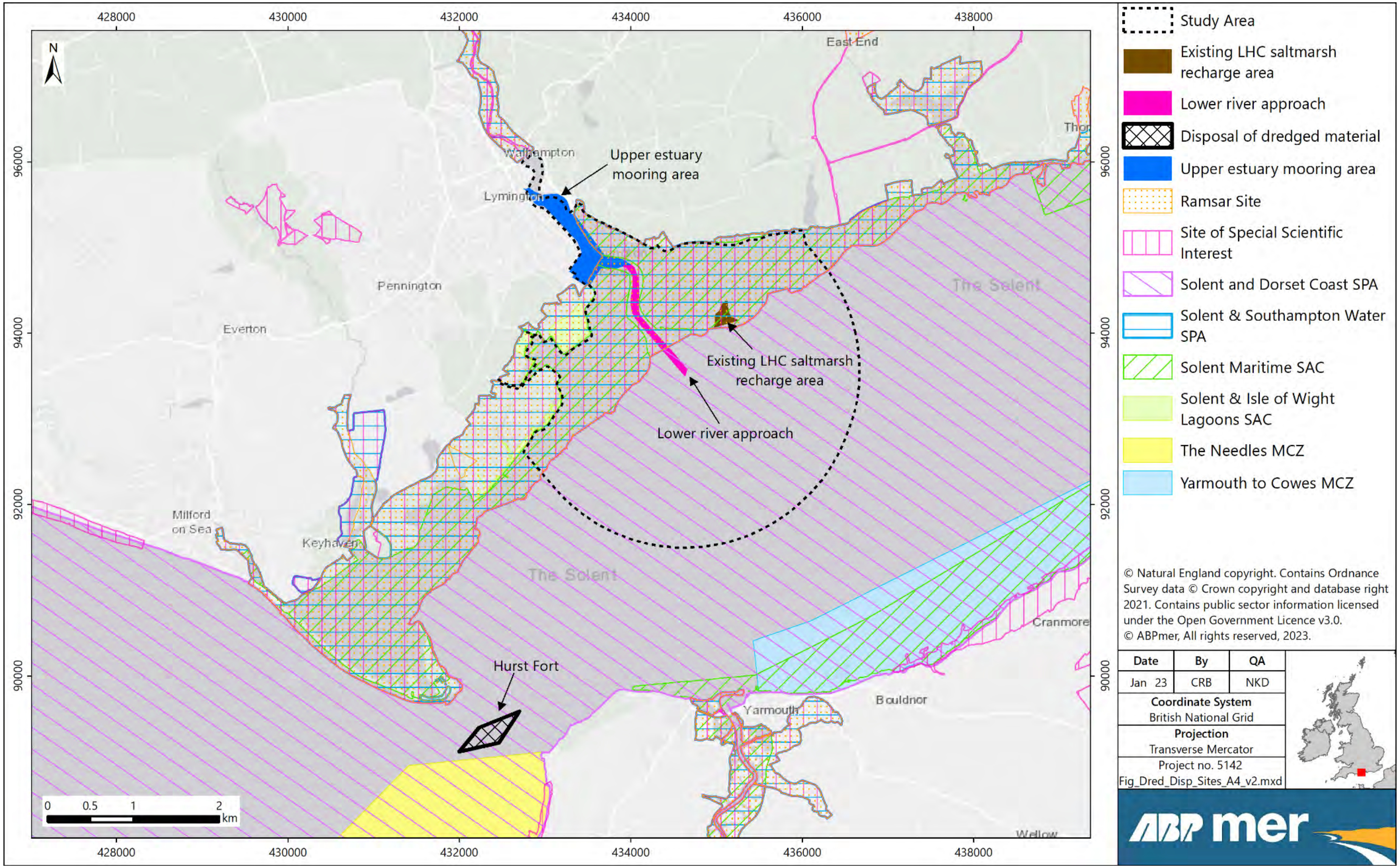


Figure 2. **Nature conservation sites and Lymington dredging and disposal locations**

1.2.3 Report objectives

The objectives of this Baseline Document are to:

- Provide current and historic data on dredging within Lymington Harbour, including data on dredging activities and quantities and information on bathymetry;
- Combine relevant information about the environmental status of the study area and describe what is known about the potential extent of impacts from previous capital and maintenance dredging undertaken by the Lymington Harbour Commissioners (LHC), their agents or other operators in Lymington Harbour;
- Provide data necessary to allow any maintenance dredging proposals for the Lymington Harbour to be assessed in accordance with the Habitats Regulations; and
- Assist competent authorities in identifying 'likely significant effects' in respect of future maintenance dredging applications or proposals.

This document is updated here according with these objectives. It will also require further updates as new data/information becomes available (e.g. ornithology data), and if circumstances, legislation, and requirements change, and potentially as a result of any wider consultations.

According to the protocol, baseline documents are to be based on existing and readily available information (e.g. from previous applications and/or Environmental Impact Assessment (EIA), dredge disposal returns and condition monitoring). Where possible, they are intended to identify the following:

- Existing need for maintenance dredging in individual areas;
- Existing volumes, frequencies and duration of dredging operations (where this should be based on actual dredge returns rather than volumes applied for in consents);
- Precise locations of dredging and disposal;
- Methods of dredging, transport and disposal, including any restrictions imposed as licence conditions or by physical constraints (e.g. depth, tidal flow, wave or weather conditions);
- Material type and chemical status (existing and historical);
- History of dredging and disposal at particular locations, as well as the variability in material type and volumes due to natural changes;
- Any monitoring requirements previously imposed through licences, and the outcomes of such monitoring;
- Any beneficial use and sediment cell maintenance schemes, or mitigation and compensation schemes entered into; and
- Any other relevant information from past studies or previous applications that have possible direct or indirect links to the maintenance dredging.

The baseline document should also include information supplied by Natural England and others (e.g. MMO, the Centre for the Environment, Fisheries and Aquaculture Science (Cefas) and the Environment Agency) on the condition characteristics of the European/Ramsar sites. In particular, this review and assessment needs to be directed at interest features of the European/Ramsar sites, with reference to their conservation objectives, where these could be affected by maintenance dredging activities.

This report is based on a desk study of existing and readily available data only. The data gathering exercise has deliberately focused on those environmental parameters that potentially could be affected by maintenance dredging and are of relevance to the integrity of the SPA, Ramsar and SAC areas shown in Figure 2.

1.3 Report structure

For consistency, this report is structured in the same way as the preceding Black & Veatch (2017a) baseline report. There are six chapters covering the following topics:

- **Introduction** (this section). Provides the background, context and scope of the baseline document and outlines the objectives of the document;
- **Dredging regime** (Section 2). Details the history and operations of dredging within Lymington Harbour;
- **Solent European/Ramsar Sites** (Section 3). Presents information about the relevant European/Ramsar sites, as well as a summary assessment of the effects of dredging on the Water Framework Directive (WFD) waterbodies and a review of the condition of Sites of Special Scientific interest (SSSI) units;
- **Baseline conditions** (Section 4). Provides a description of baseline conditions within the study area, along with additional details about the legal context (including a summary of National legislation, the Habitats Regulations, MCZs and the Water Environment (WFD) Regulations). This covers the following subject areas:
  - Coastal processes and geomorphology;
  - Sediment budget;
  - Sediment quality;
  - Water quality;
  - Estuarine habitats and ecology; and
  - Waterbird populations.
- **Information for Appropriate Assessment** (Section 5). Outlines the impacts associated with maintenance dredging in relation to the internationally designated sites; and
- **Discussion and recommendations** (Section 6). Presents a discussion on the influence of historic dredging activity on the internationally designated sites and puts forward recommendations for the future.

As required, this information is updated with new data and information that has been obtained over the past five years. It also includes, in Section 4.10, extra information about the legal context and changes to this since the last baseline report was produced.

2 Dredging Regime

2.1 Introduction

Lymington Harbour is a major recreational boating centre on the south coast. To illustrate the vessel activities, Figure 3 shows the movements of larger vessels using 24 weeks' of data throughout a calendar year of 2019[4]. This is based on Automatic Identification Systems (AIS) records, and it should be noted that most smaller leisure craft do not carry AIS equipment and so their movements will not be recorded on this plot.

In the harbour, there are around 1,700 resident leisure craft moorings on the river and in the two marinas. Over 20,000 visiting yachts use the river each year. The river also supports a small commercial fishing fleet and a car and passenger ferry service operating between Lymington and Yarmouth (see Figure 3).

Since 2014, the Wightlink ferry service has typically operated around 10,500 to 11,000 trips each year to Yarmouth, Isle of Wight, which is lower than preceding years from 2009 to 2013 (when it was around 16,000 trips). In 2020 this reduced further to 5,440 trips because of the COVID-19 pandemic (ABPmer, 2020a). In 2021 and 2022 annual trip numbers have started to recover from pandemic levels at 7,330 and 8,768 (forecast) respectively (LHC, 2021).

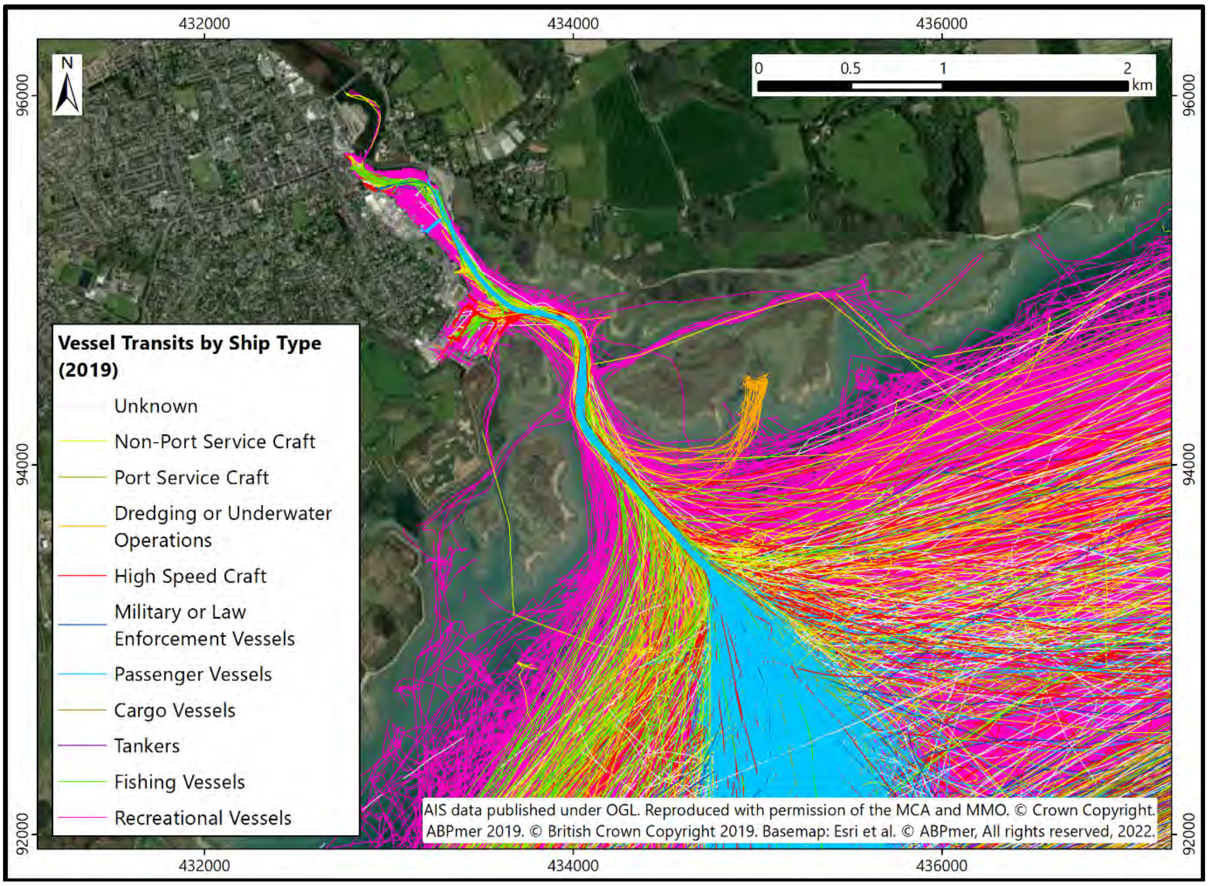


Figure 3. Map of vessel movements in Lymington Harbour in 2019 using AIS data

4 This dataset is derived from movements of vessels with AIS fitted and which occurred within the first 2 weeks of each month during 2019.

The harbour is accessed from the Solent via a winding approach channel between saltmarshes and intertidal mudflats. In the summer months, this channel is busy with ferries and recreational craft. Maintenance dredging is a fundamental requirement to ensure the continuation of navigation, harbour activities and marine industries based on and around Lymington Harbour.

As the Competent Harbour Authority, the LHC have a statutory conservancy duty to maintain safety of navigation in the harbour. Maintaining the navigable waterways through maintenance dredging is integral to fulfilling that duty. Dredging is focussed around the marinas, moorings and navigation channel. Further details about the dredging and sediment disposal activities in the harbour (both past and present) are set out in Sections 2.3 to 2.5. Firstly though (in Section 2.2), the MMO marine licensing history and status for these operations is summarised.

2.2 Marine licence overview

Prior to the 2002/03 winter period, the LHC, Lymington Yacht Haven and Lymington Marina separately applied for licences based on their individual needs. From that time onwards, though, the LHC have made a single application for dredging activities within the Lymington River estuary and associated disposal requirements. These regularly obtained and integrated applications are based on the consolidated requirements of all parties in the harbour.

Previously, three-year licences were granted covering the periods 2002 to 2005 and 2005 to 2008 for dredging up to 30,000 tonnes each year. A variation allowing for a further 10,000 tonnes to be dredged was subsequently granted in 2008.

Additionally, a marine licence (L/2011/00243) for the disposal of dredged material was granted and was valid from 2012 to 2014. This allowed a disposal of dredged silt at Hurst Fort (licensed disposal ground reference W1080).

More recently, marine licences covering the period 2008 to 2011, and 2011 to 2014 were granted which allowed up to 40,000 tonnes to be dredged each year. Then, from 2015 onwards, maintenance dredging and disposal licences were granted from the MMO as follows:

- **MMO Marine Licence Ref L/2014/00396/1**. This was valid from 1 January 2015 to 31 December 2019. This replaced marine licence L/2011/00243/3, and authorised maintenance dredging in the harbour and the disposal of up to 40,000 tonnes per year at Hurst Fort disposal site (Ref. WI080);
- **MMO Marine Licence Ref L/2014/00084/6**. This was valid from 1 November 2014 to 31 March 2017. It authorised disposal of both maintenance and capital dredge arisings from the above licence areas to be used beneficially at the Boiler Marsh Saltmarsh Recharge Site; and
- **MMO Marine Licence Ref L/2014/00396/2**. This is a current licence that is valid from 1 January 2015 to 31 December 2024[5]. It authorises disposal of both maintenance dredge arisings from the estuary and disposal at the Boiler Marsh Saltmarsh Recharge Site and the Hurst Fort grounds. This was issued in September 2017.

In addition to these past and present licences for maintenance dredging and disposal, the following licence was also obtained to cover the deepening of the navigable approach channel which had experienced accretion in the margins over time:

5 This extended period, compared to previous licences, was possible because the MMO began to offer ten-year licences to long established, sustainable dredging areas near to/within SSSIs

- **MMO Marine Licence Ref L/2013/00301/3**. This was valid from 1 November 2013 to 31 March 2017. It authorised capital dredge disposal of 13,000 tonnes from the lower river channel margins to Hurst Fort between 2013 and 2017. The extant maintenance dredge licence (Ref L/2014/00396/2), as cited above, covers work needed to maintain depths in the area where this capital dredging was undertaken.

As is described further in Section 2.5, the LHC are also currently preparing a new licence which would additionally facilitate more saltmarsh restoration work in the outer estuary. The LHC will be submitting a further application for this in 2022.

The LHC are also separately advising the Solent Forum partnership who are identifying, and seeking MMO consent for, other suitable beneficial use (alternative use) disposal sites in the outer estuary (at Pylewell and Cockleshell Marshes). This is being pursued under the Solent Forum's Beneficial Use of Dredge sediment in the Solent (BUDS) project, as funded by the Environment Agency (ABPmer 2018, 2020b). The Solent Forum will be submitting a separate application for this in 2022 (ABPmer, in prep).

2.3 Dredging review

2.3.1 Maintenance dredging

There has long been an historic dredging requirement in Lymington Harbour to maintain navigation and mooring facilities in the harbour. To describe past and present activities, the LHC maintain records of dredging and, as for the previous baseline report, these records which are presented here.

The volumes dredged arisings for each year from 1984 up to 2021 are shown in Table 1 and Figure 4[6].

The locations of the maintenance dredging activities are listed Table 2 and shown in Figure 5.

Records prior to 1984 are sparse and incomplete, although anecdotal evidence suggests that maintenance dredging has occurred in Lymington since 1918. Prior to 1999, only the total dredged arisings were recorded, with no reference to the precise location. After 1999, locations of dredging activities were recorded in some years, however local knowledge suggests this record may be incomplete. A comprehensive breakdown by location exists for the period since 2002.

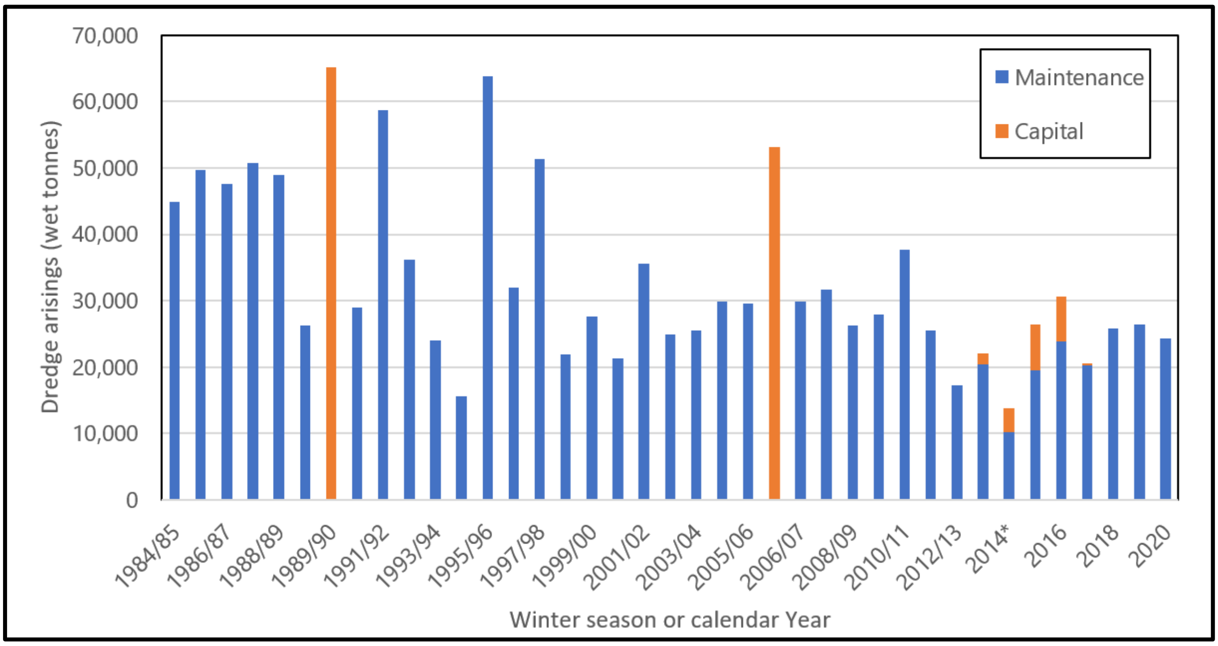
6 The LHC continues to take effective records and they represent the best of information for the estuary. The 2017 baseline report examined data held by the MMO and concluded that the records held by the LHC were more consistent by comparison.

Table 1. Combined operational dredged arisings from 1984 to 2021

Year	Annual Total (tonnes)[7]	Dredge Type	Year	Annual Total (tonnes)	Dredge Type
1984/85	44,897	Maintenance	2003/04	25,563	Maintenance
1985/86	49,648	Maintenance	2004/05	29,934	Maintenance
1986/87	47,535	Maintenance	2005/06	29,607	Maintenance
1987/88	50,744	Maintenance	2005/06	53,146	Capital (Dan Bran)
1988/89	48,956	Maintenance	2006/07	29,934	Maintenance
1989/90	26,294	Maintenance	2007/08	31,683	Maintenance
1989/90	65,090	Capital, Town Quay	2008/09	26,220	Maintenance
1990/91	28,922	Maintenance	2009/10	27,859	Maintenance
1991/92	58,666	Maintenance	2010/11	37,691	Maintenance
1992/93	36,174	Maintenance	2011/12	25,564	Maintenance
1993/94	23,950	Maintenance	2012/13	17,249	Maintenance
1994/95	15,598	Maintenance	2013/14	20,430/1,639	Maintenance/Capital
1995/96	63,862	Maintenance	2014*	10,270/3,489	Maintenance/Capital
1996/97	32,008	Maintenance	2015	19,556/6,883	Maintenance/Capital
1997/98	51,304	Maintenance	2016	23,926/6,664	Maintenance/Capital
1998/99	21,953	Maintenance	2017	20,211/328	Maintenance/Capital
1999/00	27,631	Maintenance	2018	25,783	Maintenance
2000/01	21,315	Maintenance	2019	26,439	Maintenance
2001/02	35,542	Maintenance	2020	24,308	Maintenance
2002/03	24,963	Maintenance	2021	20,976	Maintenance

* Covers the latter half of 2014 from July onwards

Data from LHC, records 2022



Data from LHC, records 2022

Figure 4. Dredge arisings in Lymington Harbour from 1984 to 2021

[7] The unit for recording historic dredging records is "wet tonnes" and typically comprises 25 to 40% of dry sediment, i.e. 1,000 wet tonnes contain 250 to 400 tonnes of sediment dry weight.

Table 2. Areas that are currently maintained in Lymington Estuary

Location	Frequency	Minimum Maintained Depth	Maximum Dredged Depth
Town Quay &moorings	Five-year rotation and as required	1.7 m ± 0.2 m	2.2 m ± 0.2 m
Rail Side & main channel upstream of Ferry Terminal	Five-year rotation and as required	1.7 m ± 0.2 m	2.2 m ± 0.2 m
Fortuna Area	Five-year rotation and as required	1.7 m ± 0.2 m	2.0 m ± 0.2 m
Horn Reach - main channel	As required	2.5 m ± 0.2 m	2.5 m ± 0.2 m
Horn Reach moorings, channel margins & approaches	Five-year rotation and as required	1.7 m ± 0.2 m	2.2 m ± 0.2 m
Harbour Master/Dan Bran Pontoon	Five-year rotation and as required	2.0 m ± 0.2 m	2.5 m ± 0.2 m
Lymington Marina (Berthon)	Annual	2.0 m ± 0.2 m	2.5 m ± 0.2 m
Lymington Yacht Haven	Annual	2.0 m ± 0.2 m	2.5 m ± 0.2 m
Lower River Approach channel	As required	At least 1 m below CD at marker posts which define the channel	

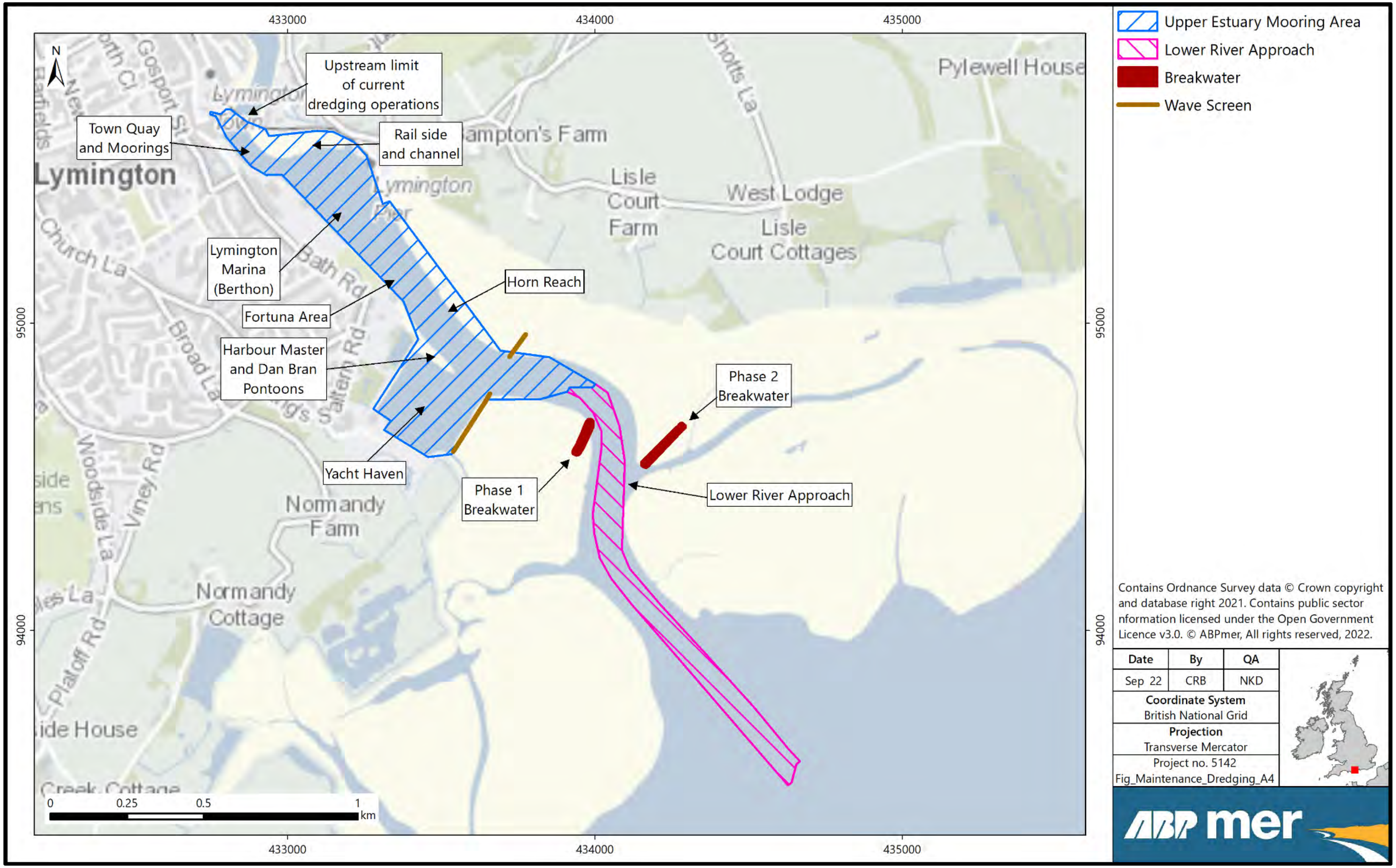


Figure 5. **Maintenance dredging areas in Lymington Estuary**

2.3.2 Maintenance dredging method

A typical maintenance dredging campaign involves a pre-dredge bathymetric survey to ascertain the amount of sediment to be dredged. The dredging operation is then undertaken to remove/move the identified sediment, and a post-dredge bathymetric survey is carried to confirm the outcome of the operation.

Under the current licence, all the dredging is performed by backhoe dredging. Back-hoe dredgers are used for dredging cohesive and non-cohesive sediment and are similar to land-based excavators. They use an articulating bucket head to remove material from the seabed. The material is raised to the surface through movement of the crane and bucket. While they are limited in their reach and relatively slow, they are well suited to smaller dredging exercises. Due to the force they exert, they can also handle denser sediments (Manning *et al.*, 2021)

Backhoe dredgers re-suspend a limited amount of sediment when the grab impacts the seabed, and also due to spillage as the bucket is lifted or lowered through the water column, as well as when its contents are loaded into a barge. This method of dredging is highly accurate and is noted as being particularly beneficial when working in environmentally sensitive areas and within designated sites (UK Marine SACs Project, 2001). Because backhoe dredgers work relatively slowly with low overspill rates, they have a lower impact on turbidity levels and the formation of plumes with high suspended solids compared to other dredgers, such as cutter suction or trailer dredgers (CIRIA, 2000).

The material dredged for the maintenance works within Lymington Harbour is silt. Due to the nature of the dredging method, a full hopper consists of approximately 35% silt, with the remainder being water. It takes time (hours) to gradually fill a hopper barge from a comparatively small bucket head. By contrast, emptying the hopper at the disposal ground by opening the hopper doors can take as little as five minutes (as described in Section 2.5.2below for the beneficial use site).

2.3.3 Locations of current maintenance dredging

Maintenance dredging within Lymington Harbour is concentrated in the upper estuary in the marinas, moorings, pontoons as well as along the lower river navigable channel. The dredging areas are shown in Figure 5. The maintained depths differ within the licensed dredging area. Table 2 describes the minimum maintained depths and maximum dredged depth for each of the maintenance dredging areas.

From 2013 onwards, it became necessary to also dredge the subtidal margins of the main navigation channel to maintain safe navigation following a period of accretion. This was authorised under MMO Marine Licence L/2013/00301/3. It was treated as capital dredging for the purpose of this licence application (see Section 2.3.4). This area of the lower river is now included in the ongoing maintenance dredging programme. as shown on Figure 4 and in Table 2.

2.3.4 Capital dredging

Several capital dredging projects have also been undertaken historically which have influenced the shape of Lymington Harbour and made it into the popular recreational haven that it is today. The main historical developments in the Lymington River that required capital dredging are outlined in Table 3. The relatively recent lower river dredging areas are also shown in Image 1. No further capital deepening projects are expected in the near future, and none are anticipated over the coming five years.

Table 3. Past capital dredging projects

Year	Capital Dredging Area	Arisings Quantity (tonnes)
1965 to 1970	Construction of 300 berth Lymington Marina (Berthon)	Unknown
1972	Construction of 450 berth Lymington Yacht Haven/ Fortuna Pontoon	264,500/ unknown
1989/90	Town Quay Moorings	65,090
2005/06	Dan Bran Pontoon	53,146
2013/16	Lower River Dredging (L/2013/00301/3 and L/2014/00084/6)	19,003

Image 1. Location and timing of LHC lower river capital dredging campaigns

2.4 Disposing dredged material

Disposal of maintenance dredging material from Lymington Harbour (both historically and at present) is undertaken at Hurst Fort (W1080) in the western Solent (see Figure 2). This disposal site is important for Lymington Harbour, because the confined nature of much of the maintenance dredging area within the harbour means that the hopper barges are necessarily small.

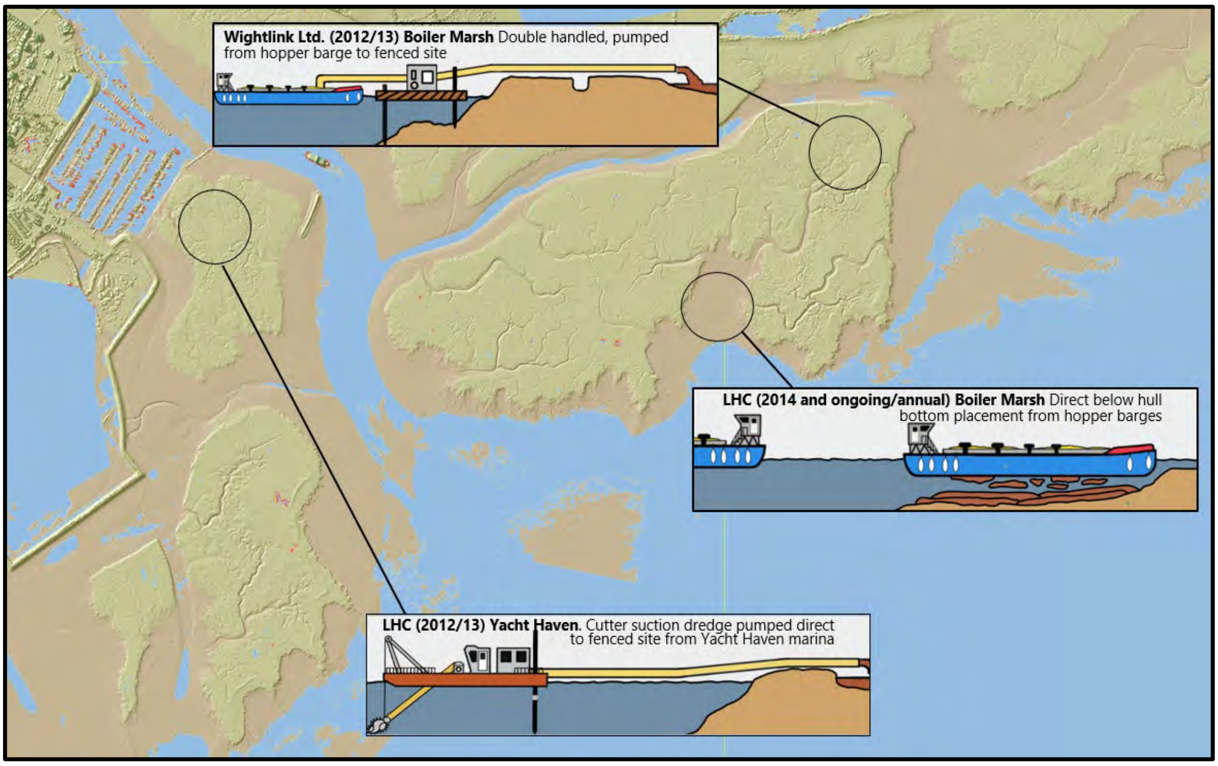
The hopper barges which operate in the estuary are therefore not licensed to travel outside of sheltered waters and cannot access the more exposed Needles and Nab Tower disposal grounds. Disposal at Hurst Fort is licensed to take place on the first four hours of the ebb tide.

2.5 Alternative use

Over the last few years, increasing attention has been paid, in the UK, to finding alternatives to traditional methods of dredging and disposal. Such alternatives are of growing interest to the relevant authorities, including Natural England and the Environment Agency, who have a remit for continual improvement of the environment.

There are many considerations and challenges associated with finding alterative use options (Manning *et al*., 2021). There is a need to take account of factors such as: the type of material that needs to be dredged, the location of materials, impacts on water quality, hydrography and the sediment budget. In addition, potential impacts to habitats and species of designated sites must be considered.

At Lymington, however, three 'alternative use' projects have been successfully undertaken in recent years. These projects include the bottom placement work at Boiler Marsh which is being undertaken by the LHC (as identified in past baseline document (Black & Veatch, 2017a)). Further details about this and other beneficial use projects at Lymington are summarised in Section 2.5.1 to 2.5.3, and illustrated in Image 2.



Source ABPmer using Environment Agency LiDAR data

Image 2. Three different beneficial use projects undertaken at Lymington

These beneficial/alternative use schemes at Lymington have provided a valuable contribution to offsetting or delaying ongoing natural habitat losses in and around the estuary. They have also helped to advance understanding about how such beneficial use initiatives can be progressed. New lessons have been learned about the technical challenges, the costs they incur, and the benefits they can achieve. As a result of such lessons, these projects have been highlighted as case examples in a range of recent national and international reviews (PIANC, in prep; Manning *et al*., 2021; CEDA, 2019).

Building on this experience, as noted above, the LHC are exploring options for carrying out more such initiatives to protect the eroding and vulnerable saltmarsh and mudflat habitats of the outer estuary. The Solent Forum partnership are also pursuing new bottom placement beneficial use initiatives under the Solent BUDS project (ABPmer 2018, 2020b, in prep).

Over the longer term, these projects may inform and provide confidence in the delivery of similar and even larger schemes in the future at Lymington. And, on an ongoing basis, the LHC will continue working with Natural England, the Environment Agency, the New Forest District Council (NFDC), the New Forest National Park Authority and other landowners, regulatory authorities and interested parties to identify and consider future replenishment schemes which may be beneficial to the management of the designated sites and the coastline. In particular, it is noted that the Environment Agency, the NFDC and other partners are separately progressing the Hurst Spit to Lymington Strategy, and recommendations for new beneficial use projects may emerge from this process.

2.5.1 Yacht Haven marsh restoration (LHC)

Habitat restoration on Yacht Haven marsh (see Image 3) was undertaken as mitigation for the temporary residual significant effects of the Lymington Harbour Protection Scheme. It involved replenishing and raising 0.5 ha of intertidal mudflat using up to 2,500 wet tonnes of sediment from maintenance dredging.

Source LHC, 2013

Image 3. Yacht Haven recharge area in August 2013

This sediment was placed where it could be protected in the long-term, behind the breakwaters, within saltmarsh adjacent to and immediately south of Lymington Yacht Haven. This project was consented under Marine Licence MLA/2011/00306. Phase I of the replenishment works was carried out in January and February 2012 and Phase II was completed in February 2013.

By August 2013 (six months after Phase II), sediment levels were between 9 cm and 19 cm higher than the pre-recharge levels. There was also a covering of *Salicornia* spp. (Samphire) which had colonised much of the recharge site. To a lesser extent, *Spartina* sp. plants had started to grow.

Plant colonisation was most prolific in the northern two thirds of the site, where mud levels were higher. There was also evidence of bird footprints, illustrating that the replenished habitat was ecologically functioning to the extent that birds were encouraged to the location (Black & Veatch, 2017a).

2.5.2 Boiler Marsh habitat restoration (Wightlink Ltd.)

Habitat restoration work was also undertaken at the north-east corner of Boiler Marsh which lies at the mouth of the Lymington Estuary (see Image 2). Boiler Marsh is a large saltmarsh island which provides shelter to Lymington Harbour and is a valuable high tide roost site and nesting location for waterbirds.

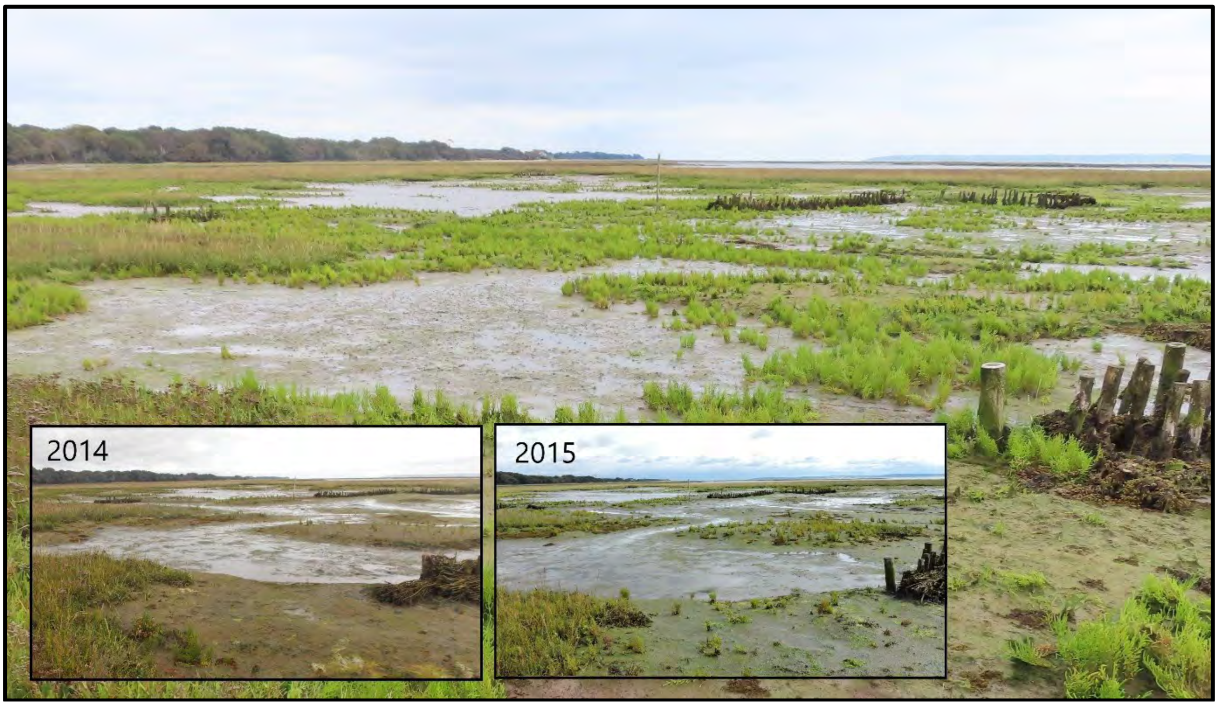
The restoration work on this marsh was carried out as mitigation for potential ecological effects that might arise from the operation of Wightlink's cross-Solent ferry service (operating between Lymington and Yarmouth). It was implemented to ensure there would be no adverse effect on the integrity of the Solent European Marine Site (SEMS), with reference to the relevant SEMS Conservation Objectives.

This marsh recharge was carried over two winters, in 2012 and 2013. The restoration site was initially prepared by installing a series of polder and hay bale fences across a decaying section of Boiler Marsh. These were designed to help retain sediment in place. The sediment was then pumped from hopper barges into this area over the two winter campaigns.

The main aim of this project was to delay the natural progression of a creek that was threatening to rapidly fracture this marsh section, which would in turn further exacerbate and accelerate erosion of the marshes and the surrounding intertidal areas. In reducing the rate of intertidal loss in this manner, this mitigation was designed to offset any accelerated mudflat erosion that may occur from ferries operating within the estuary. The mitigation measures were also designed to be adaptable. If needed, the scale and frequency of the recharge could be altered (i.e. increased) as needed in response to the results of the separate ferry impact monitoring (ABPmer, 2010).

This adaptive mitigation process was overseen by an Environment Management Panel (EMP). This EMP was set up as a condition of a 'Section 106' (S106) agreement which accompanied permissions for Wightlink's Lymington to Yarmouth ferry service. The tasks for the EMP included: evaluating the effects of the ferries; reviewing the success of the saltmarsh recharge works; and, if needed, advising on adaptations to the recharge works to ensure project objectives are achieved

The site was monitored for eight years until 2020, and a final monitoring report for the EMP was prepared in December that year (ABPmer 2020a). This review concluded that the recharge mitigation site had performed well. It was found that most of the sediment deposited within the recharge area had remained in place, and that the area outside it, to the south, also had a greater volume of sediment than was present prior to the works being carried out. The quality of the habitats within and around the recharge area was enhanced relative to the baseline conditions (see Image 4).



Source ABPmer, 2020

Image 4. Boiler Marsh recharge area in 2014, 2015 (inset photos) and 2020 (main photo)

It was concluded that the recharge had achieved its core objective, which was to slow the physical progression of the major channel though Boiler Marsh. It was also recognised that this process had not been stopped, and Boiler Marsh would still become severed in the future. However, the physical fracturing of the marshes has been slowed. As a result of this, and the absence of any evidence that the ferries had had an adverse effect, the EMP concluded that the project was successful and no further sediment placement or monitoring was needed at this site.

2.5.3 Boiler Marsh bottom placement recharge (LHC)

As noted above, the LHC are now carrying out further saltmarsh restoration at Boiler Marsh by beneficially using sediment dredged from Lymington Estuary. This proposal was developed from an initial feasibility study (Black & Veatch, 2010) and formed the basis of a successful application to the MMO for a Marine Licence (L/2014/00084/6), which was granted in April 2014 (Black & Veatch, 2017a). This was then extended in September 2017 under a new licence L/2014/00396/2).

For the beneficial use initiative, hopper barges carrying the dredged material move to the placement site and discharge the sediment by opening the hopper doors in the bottom of the barge. The barges then return to the dredging site(s) to collect more sediment. The location of the beneficial use placement site is shown in Figure 2, as well as Image 4 and Image 5.

Image 5. Aerial view of the beneficial use deposit ground at Boiler Marsh

To place this sediment as high on the shoreline as possible, this disposal is only undertaken at high water on larger spring tides. At these tidal states, the barges are guided to their deposit location by post markers, and an effort is made to place each new deposit as close as possible to, or even on top of, previous ones. The deposition process itself lasts for only a few minutes.

The main aim of the placement is to help protect and improve the important and designated intertidal habitats on Boiler Marsh, and to delay the rate at which this island is eroding and breaking up. This placement is also a beneficial alternative to depositing the dredge arisings at a licensed subtidal disposal ground, 'Hurst Fort' (Ref. WI080). Furthermore, this innovative initiative is also providing valuable new practical lessons about how to beneficially use dredged sediments effectively.

The authorised amount of dredged material on this licence was 2,380 tonnes in 2014/15, 7,000 tonnes in 2015/16, and 10,000 tonnes in 2016/17. The extant licence authorises the placement of up to 10,000 tonnes each winter, from 2017/18 to 2023/24. Table 4 summarises the completed campaigns, with details of the timings of each programme and the volumes of sediment placed.

Table 4. Intertidal bottom placement campaigns at Lymington over past eight years

Years	Quantity (Wet Tonnes)	Quantity (m^3)	MMO Licence Ref.
2014 (Nov and Dec)	2,287	1,759	L/2014/00084/6
2015 (Nov and Dec)	6,883	5,295	
2016 (Oct to Dec)	9,942	7,648	
2017/18 (Nov to Jan)	9,286	7,143	L/2014/00396/2
2018 (Nov and Dec)	6,446	4,958	
2019/20 (Nov to Feb)	8,959	7,790	
2020/21 (Nov to Mar)	9,942	8,645	
2021/22 (Nov to Mar)	8,194	7,125	
Where volumes were made available as tonnages only for the LHC bottom placements, a 1.3 conversion factor for 'soft silt mud' (HELCOM, 2015) is used to provide an estimate in both units.			

This beneficial use site is being surveyed frequently and regular monitoring reports are being produced to describe how the site is performing (ABPmer, 2019, 2021 and 2022). These surveys and reports are carried out as a requirement of Conditions 5.2.11 and 5.2.12 of the extant MMO Marine Licence L/2014/00396/2 (ABPmer, 2019; 2021; 2022).

The results confirm that much of the deposited sediment is remaining where it is placed (see Image 6).

Source: ABPmer, 5 May 2022

Image 6. Deposited sediment (middle distance) at Boiler Marsh bottom placement site

Thus, there has been a gradual build-up of sediment in the deposit ground over time. For this reason, the deposition locations have gradually moved seaward each year (while still staying well inside the licensed disposal area). This retained sediment will be protecting the eroding central section of Boiler Marsh and helping to slow the rate at which this marsh fractures. It is also helping to retain sediment locally.

3 Solent European/Ramsar Sites

The Solent European Marine Site includes one SAC, four SPAs and three Ramsar Sites. The Solent Maritime SAC and the Solent and Southampton Water SPA and Ramsar site are of relevance to this Lymington review, as is the newly designated Solent and Dorset Coast SPA. The other SPA/Ramsar areas (Chichester and Langstone Harbour SPA and Portsmouth Harbour SPA) are outside the study area and are not reviewed further in this document.

In addition, there is also the Solent and Isle of Wight Lagoons SAC which is considered in this review. This includes part of lagoons behind the seawall to the west Lymington Estuary. This SAC forms one part of the wider Lymington to Keyhaven Local Nature Reserve area.

The ecology and nature conservation of these SAC, SPA and Ramsar sites are protected, in England and Wales under UK Habitats Regulations which transpose into national law the requirements of the EU Habitats Directive. The original 1994 UK Habitats Regulations were consolidated and updated by the Conservation of Habitats and Species Regulations of 2010 and then 2017.

The latter legislation (The Conservation of Habitats and Species Regulations 2017 (as amended)) continues to have effect in domestic law under the European Union (Withdrawal) Act 2018, which repealed the European Communities Act 1972 while also maintaining EU-derived domestic legislation in national law. The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 then later made some minor changes to this legislation to accommodate it into UK law.

These 'Habitats Regulations' and the HRA regime as set out in the Conservation of Habitats and Species Regulations 2017 (as amended) therefore continue to apply, largely unaltered, following this recent legislation. One of the requirements under these regulations is to determine whether a project or plan would result in an Adverse effect on the Integrity (AEOI) of European/Ramsar site(s). The integrity of a site is defined as the coherence of its ecological structure and function, across its whole area that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was classified[8].

The judgement about whether a project or plan will have an AEOI (or whether such an effect cannot be excluded) is made on the basis of the site's conservation objectives. Further details about each of the designated European/Ramsar sites in the study area are presented in the following sections, and details of the conservation objectives are included in Appendix B.

3.1 Solent and Southampton Water SPA

3.1.1 Interest features

The Solent and Southampton Water SPA was classified in October 1998. The site comprises a series of estuaries and harbours with extensive mudflats and saltmarshes, together with adjacent coastal habitats including saline lagoons, shingle beaches, reedbeds, damp woodland and grazing marsh.

The mudflats support beds of *Enteromorpha* and *Zostera* spp. and have a rich invertebrate fauna that provides a food resource for waterbirds. In summer, the site is of importance for breeding seabirds, including gulls and four species of terns. In winter, the SPA holds a large and diverse assemblage of

8 HM Government and MMO website on Marine Licensing: impact assessments https://www.gov.uk/guidance/marine-licensing-impact-assessments#:~:text=The%20integrity%20of%20a%20site,for%20which%20it%20was%20classified.

waterbirds, including geese, ducks and waders. Dark-bellied Brent Goose *Branta bernicla bernicla* also feed in surrounding areas of agricultural land outside the SPA.

The site qualifies under Article 4.1 of the Birds Directive by supporting populations of European importance of the following species listed on Annex I of the Directive during the breeding season:

- Common Tern *Sterna hirundo;*
- Little Tern *Sterna albifrons;*
- Mediterranean Gull *Larus melanocephalus;*
- Roseate Tern *Sterna dougallii; and*
- Sandwich Tern *Sterna sandvicensis*.

The area qualifies under Article 4.2 of the Directive by supporting populations of European importance. Over winter the area regularly supports

- Black-tailed Godwit *Limosa limosa islandica;*
- Dark-bellied Brent Goose;
- Ringed Plover *Charadrius hiaticula; and*
- Teal *Anas crecca*.

The site also qualifies under Article 4.2 by regularly supporting at least 20,000 waterfowl.

3.1.2 Conservation objectives

The conservation objectives for the SPA are detailed by Natural England. These objectives seek to ensure that the integrity of the site is maintained or restored as appropriate, and ensure 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.

3.2 Solent Maritime SAC

3.2.1 Interest features

The Solent Maritime site was classified as a SAC in October 1998. It comprises sea inlets, tidal rivers, mud and sand flats, lagoons, saltmarsh and coastal sand dunes. The site is designated under the Habitats Directive and the Annex I habitats. The primary reasons for designations are:

- Estuaries;
- *Spartina* swards (*Spartinion maritimae*); and
- Atlantic salt meadows (*Glauco-Puccinellietalia*).

Annex I habitats that are present as a qualifying feature, but are not the primary reason for selection of this site are:

- Sandbanks which are slightly covered by sea water all the time;
- Mudflats and sandflats not covered by seawater at low tide;
- Coastal lagoons;

- Annual vegetation of drift lines;
- Perennial vegetation of stony banks;
- Salicornia and other annuals colonising mud and sand; and
- Shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes').

In addition, the Desmoulin's whorl snail (*Vertigo moulinsiana*) is an Annex II species that is present as a qualifying feature, but not a primary reason for the site's selection.

3.2.2 Conservation objectives

The conservation objectives for the Solent Maritime SAC are detailed by Natural England. They seek to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring the following:

- 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.

3.3 Solent and Isle of Wight Lagoons SAC

3.3.1 Interest features

The Solent and Isle of Wight Lagoons SAC includes a number of coastal lagoons that are either isolated from tidal water or are connected through percolation or sluice lagoons. These include lagoons in the marshes in the Keyhaven to Pennington area as well as at Farlington Marshes in Langstone Harbour, behind the sea-wall at Bembridge Harbour and at Gilkicker, near Gosport.

As described in the SAC citation, the lagoons show a range of salinities and substrata, ranging from soft mud to muddy sand with a high proportion of shingle, which support a diverse fauna including large populations of three notable species: the nationally rare foxtail stonewort *Lamprothamnium papulosum,* the nationally scarce lagoon sand shrimp *Gammarus insensibilis*, and the nationally scarce starlet sea anemone *Nematostella vectensis*. Species diversity in these lagoons is high and the fauna includes very high densities of *N. vectensis* and the nationally rare Bembridge water beetle *Paracymus aeneus.*

3.3.2 Conservation objectives

The conservation objectives for the Solent and Isle of Wight Lagoons SAC are detailed by Natural England as follows:

- The extent and distribution of qualifying natural habitats;
- The structure and function (including typical species) of qualifying natural habitats; and
- The supporting processes on which qualifying natural habitats rely.

3.4 Ramsar sites

The Solent and Southampton Water Ramsar Site extends from Hurst Spit to Gilkicker Point along the south coast of Hampshire and along the north coast of the Isle of Wight. The site comprises a series of estuaries and harbours with extensive mudflats and saltmarshes, together with adjacent coastal habitats including saline lagoons, shingle beaches, reedbeds, damp woodland and grazing marsh.

The diversity of habitats support internationally important numbers of wintering waterfowl, important breeding gull and tern populations and an important assemblage of rare invertebrates and plants. The Ramsar Criteria which are applied to the designation of this site (as listed in the JNCC Ramsar Site Information Sheet) are:

- **Ramsar criterion 1:** The site is one of the few major sheltered channels between a substantial island and mainland in European waters, exhibiting an unusual strong double tidal flow and has long periods of slack water at high and low tide. It includes many wetland habitats characteristic of the biogeographic region: saline lagoons, saltmarshes, estuaries, intertidal flats, shallow coastal waters, grazing marshes, reedbeds, coastal woodland, and rocky boulder reefs;
- **Ramsar criterion 2**: The site supports an important assemblage of rare plants and invertebrates. At least 33 British Red Data Book invertebrates and at least eight British Red Data Book plants are represented on site;
- **Ramsar criterion 5**: Assemblages of international importance): Species with peak counts in winter: 51343 waterfowl (5 year peak mean 1998/99-2002/2003); and
- **Ramsar criterion 6**: Species/populations occurring at levels of international importance.

3.5 Solent and Dorset Coast SPA

The Solent and Dorset Coast was classified as a SPA on 16 January 2020. This SPA covers an area of nearly 89,000 ha along the coasts of Dorset, Hampshire, Isle of Wight and West Sussex and adjacent areas offshore. The site was designated because it regularly supports more than 1% of the Great Britain breeding populations of three tern species (Sandwich Tern, Common Tern and Little Tern) listed in Annex I of the European Union Birds Directive.

The SPA is an area that is important as a foraging ground for these three tern species. The westernmost extremity of the SPA area was defined by the modelled usage of Sandwich Terns foraging from the Poole Harbour SPA. The easternmost extremity was determined by the modelled usage of Sandwich Terns foraging from Chichester and Langstone Harbours SPA.

3.5.1 Conservation objectives

The conservation objectives for the Solent and Dorset Coast SPA detailed by Natural England seek to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring the following:

- 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.

3.6 Water Framework Directive

The Water Framework Directive (WFD) (2000/60/EEC) establishes a framework for the management and protection of Europe's water resources. It was originally implemented in England and Wales through the WFD (England and Wales) Regulations 2017, known as the Water Framework Regulations. Following the UK leaving the EU, the main provisions of the WFD have been retained in English law through the Floods and Water (Amendment etc.) (EU Exit) Regulations 2019.

The overall objectives of the WFD is to achieve "good ecological and good chemical status" in all inland and coastal waters by 2021 unless alternative objectives are set or there are grounds for time limited derogation. For example, where pressures preclude the achievement of good status (e.g. navigation, coastal defence) in heavily modified water bodies (HMWBs), the WFD provides that an alternative objective of "good ecological potential" is set. Groundwater waterbodies are included in the WFD and are assessed on quantitative and chemical status. There is also a general "no deterioration" provision to prevent decline in status.

A Water Framework Directive (WFD) Compliance Assessment was recently produced by Binnies (2021). This latest WFD was undertaken as a requirement of the continuation of the Marine Licence (L/2014/00396/2). It was updated in fulfilment of Condition 5.2.3 of that licence which requires that that the original WFD assessment (part of the 2017 Baseline Document for Maintenance Dredging in Lymington Harbour (Black & Veatch, 2017a)), be reviewed by 2021, when the next RBMP cycle and classification results are available.

A copy of this latest WFD assessment is included as Appendix C. It includes details of the waterbodies that could be affected (see also Figure 6) and assesses the impacts of maintenance dredging on these waterbodies as well as the European/Ramsar sites.

This assessment finds that the effects of dredging and sediment disposal are temporary in nature and localised in extent, with implementation of the incorporated mitigation measures. Thus, no significant adverse environmental effects or negative consequence on the status of WFD elements at the waterbody level are encountered.

This WFD assessment concludes that continued maintenance dredging and disposal complies with the objectives of the WFD, and the works are not anticipated to cause a deterioration to the current overall WFD status of Lymington (Transitional) waterbody or Solent (Coastal) waterbody. Also it is not expected to adversely affect the features of the Protected Areas.

3.7 Sites of Special Scientific Interest

To complement this review, the condition of Sites of Special Scientific Interest (SSSI) in Lymington Estuary were also briefly considered. These sites are reviewed here (as they have been in past baseline reviews) because they cover the same area as that of the European/Ramsar sites. As a result, they share many of the same interest features. For example, both the Solent Maritime SAC and the Hurst Castle and Lymington River Estuary SSSI are designated for supporting cordgrass and *Salicornia* species.

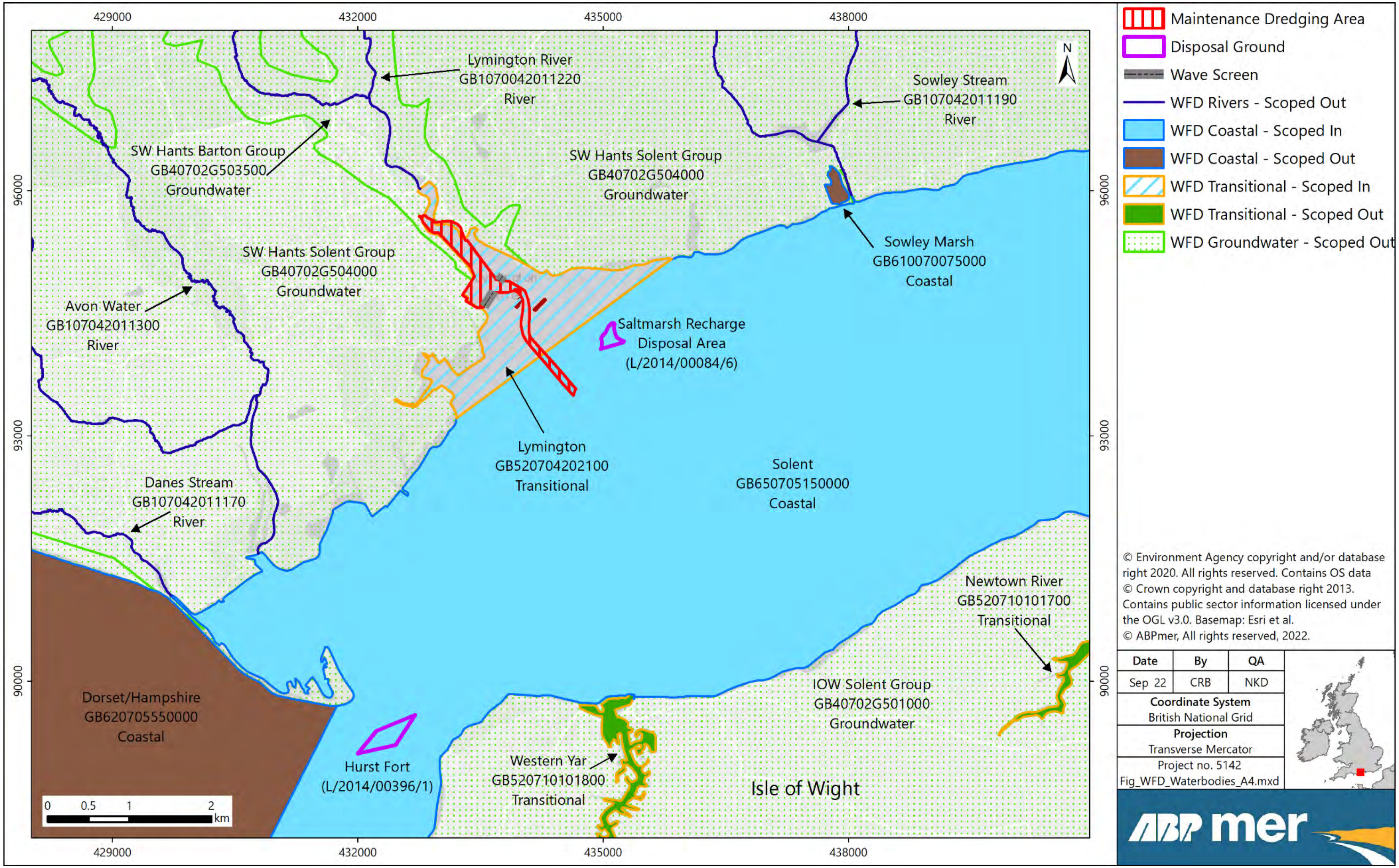


Figure 6. WFD Waterbodies in the vicinity of the dredging and disposal activities

The SSSIs are divided up into management units so their requirements to reach a favourable status can be tailored on an individual basis. For each of these units, Natural England has assessed their condition according to a number of criteria and assigned them a term which best represents the unit in question. The locations and condition status of SSSIs in the western part of Solent European Marine Site are shown in Figure 7, and the condition terms are defined in Table 5.

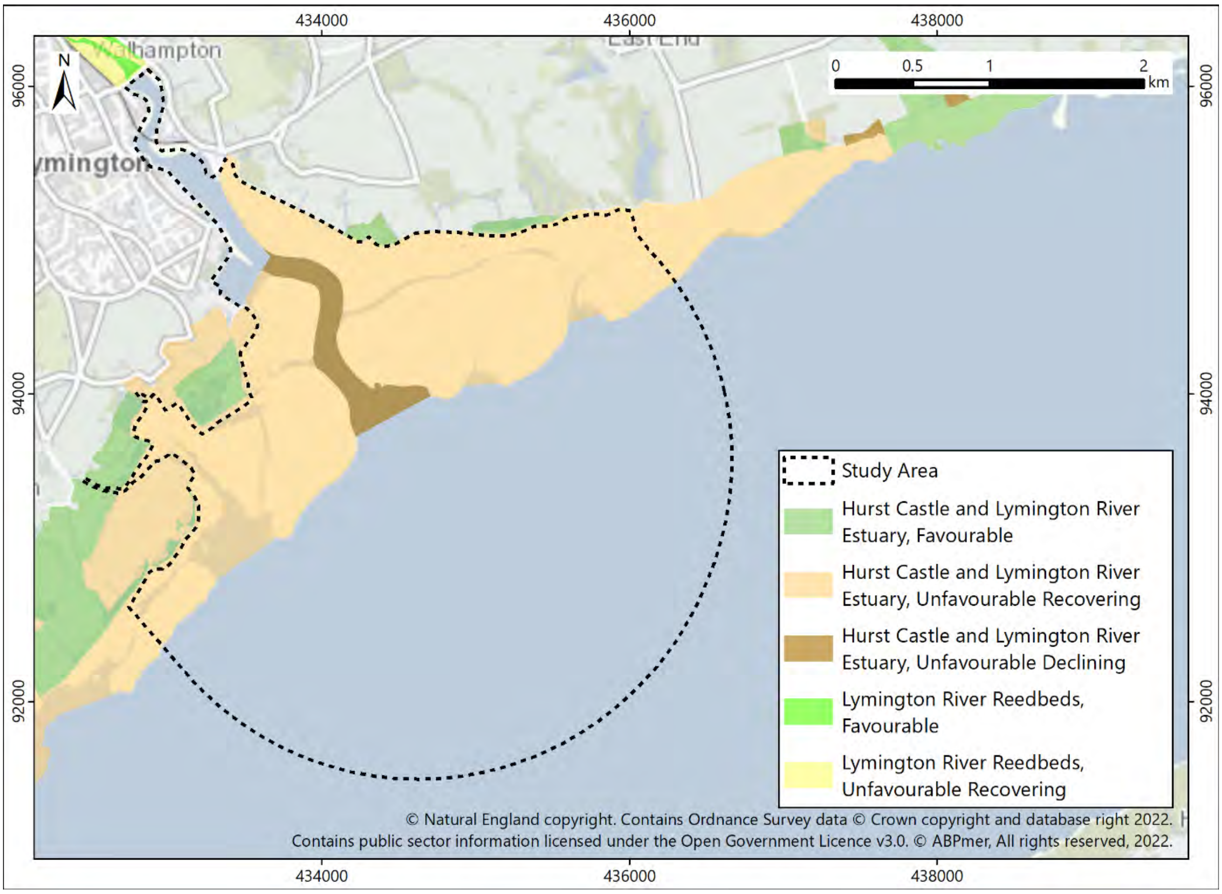


Figure 7. Location of individual SSSI units showing latest condition assessment

The condition assessment for these SSSI units have, however, not been updated since the preceding baseline review (Black & Vetch 2017a). The last published assessment by Natural England, which covers the intertidal and subtidal area that form the study area for this review, was undertaken as in 2010[9]. As this was prior to the previous baseline review, a detailed updated review of the site condition is not presented here.

It is valuable however to record again that much of the area was deemed to be in unfavourable recovering condition (as also shown in Figure 7). It was said to be recovering because sufficient habitat recreation had begun by December 2010.

The units were deemed to be remedied by the Lymington reed bed water level management plan, which re-established tidal exchange in the Lymington River to deliver 21 ha of intertidal habitat to offset coastal squeeze. It was recognised that, beyond December 2010, further additional habitat creation will need to be delivered through Shoreline Management Plans and/or regional coastal habitat recreation programmes for this unit to remain in `recovering' status.

9 A more recent assessment as carried out in 2019 for hinterland areas in the Lymington and Keyhaven Marshes Local Nature Reserve (LNR) and as shown in Figure 8, concluded that much of this area was favourable.

Table 5. Definition of SSSI condition assessment terms

Term	Description
Favourable	Habitats and features are in a healthy state and are being conserved by appropriate management
Unfavourable recovering	if current management measures are sustained the site will recover over time
Unfavourable no change or Unfavourable declining	special features are not being conserved or are being lost, so without appropriate management the site will never reach a favourable or recovering condition
Part destroyed or Destroyed	there has been fundamental damage, where special features have been permanently lost and favourable condition cannot be achieved

Source: HM Government, 2022[10]

The situation with respect to the condition of the SSSIs therefore remains unchanged from the preceding baseline. At present, the main habitat inventions are those which are being undertaken by, or are proposed by, the LHC and the Solent Forum (as described in Section 2.5). More measures may emerge in the near future from the 'Hurst Spit to Lymington Strategy' and that is briefly outline below.

3.8 Shoreline Management Plan policies and strategy

The Shoreline Management Plan Policy is 'hold the line' for the western side of the Lymington Estuary area along to Hurst Spit, but is no active intervention much of the eastern side of the estuary (see Image 7). The existing defences protect a large flood plain area that extends into Milford on Sea, Lower Pennington and areas of Lymington. It also covers the designated areas of the Lymington and Keyhaven Marshes (see Figure 2) and Local Nature Reserve (LNR). The extent of this potential flood plain area is shown in Figure 8.

The management of this section of the coast is being reviewed under the 'Hurst Spit to Lymington Strategy'. This strategy is being led by the Environment Agency, in partnership with New Forest District Council, Hampshire County Council, Natural England and JBA Consulting. This team are examining the pressures this coastline is facing (both now and in the future) to consider how best to respond to these challenges. No new formal proposals are in place yet, although initial options are being identified. This follows a series of stakeholder engagement exercises which were undertaken over recent years to gather evidence and gauge the views of interested parties.

10 From UK Government site describing Sites of special scientific interest: managing your land https://www.gov.uk/guidance/protected-areas-sites-of-special-scientific-interest#sssi-condition-and-assessment

From Solent Forum online data viewer produced for BUDS project (ABPmer, 2018) [11]

Image 7. Shoreline Management Plan policies for the north western Solent

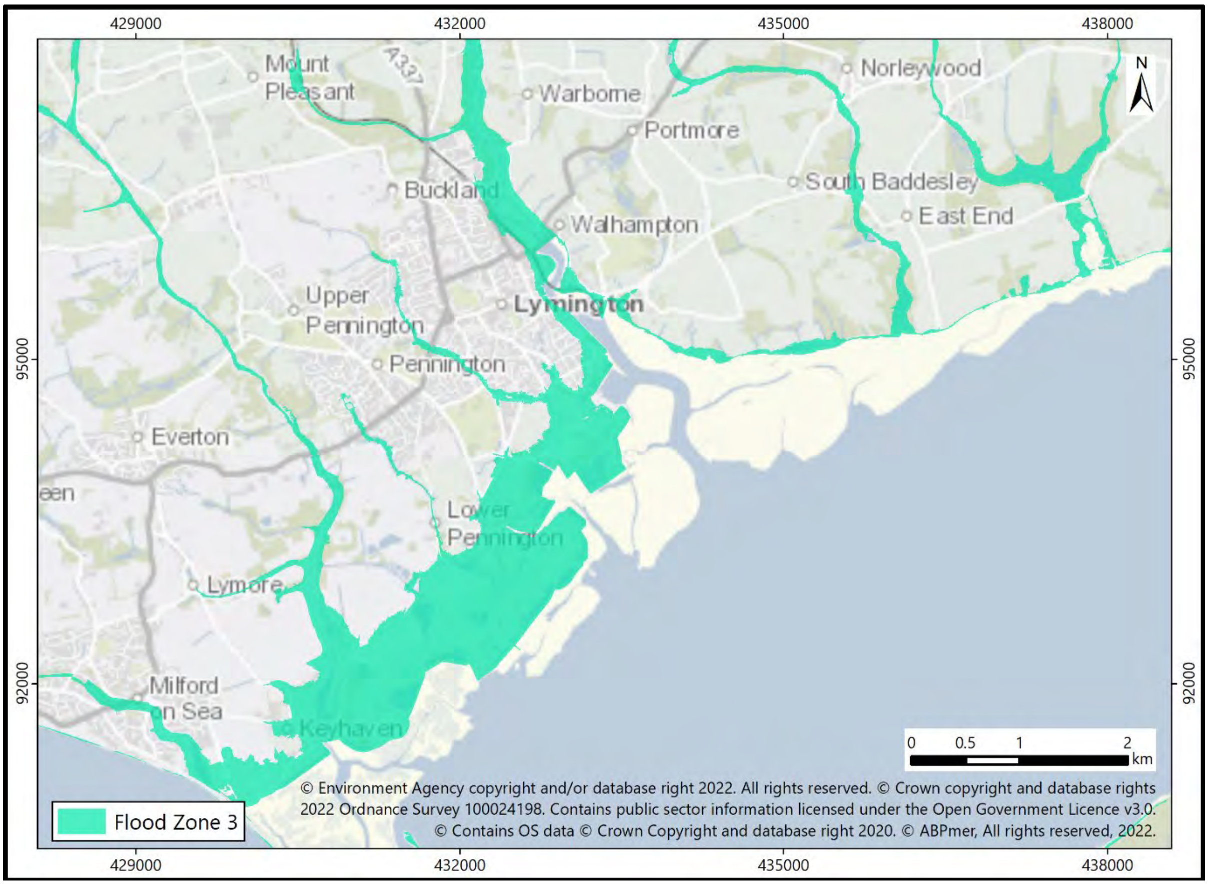


Figure 8. Floodplain zones in the north wester Solent

11 Solent Forum BUDS map is available at https://abpmer.maps.arcgis.com/apps/webappviewer/index.html?id=84f75915f4d64d3f84d82e7b8923e9ba

4 Baseline Conditions

4.1 Introduction, new data and reviews

This section provides an updated review of baseline conditions in the Lymington Estuary. It follows the same structure as the previous baseline reviews (most recently Black & Veatch (2017a)), to ensure consistency and ease of reference. This standardised structure covers each of the following topics in turn:

- Coastal Processes and geomorphology;
- Geomorphological evolution of estuary;
- Sediment supply and budget;
- Estuarine habitats and ecology;
- Sediment quality;
- Waterbird populations; and
- Recent relevant legislation.

Under each of these topics, relevant new data and reviews are considered where these have been obtained and produced over the last five years. These details add to, and update, the studies considered within the preceding baseline report (Black & Veatch, 2017a). The relevant new information includes the following:

- A recent review that was commissioned by Natural England, and undertaken by the University of Portsmouth, which describes changes in saltmarsh extents across the whole Solent including Lymington (Parry and Hendy, 2022);
- A national review of saltmarsh change that has been recently undertaken by the Environment Agency based on interpretations of aerial images taken in 2008 and 2016 (Environment Agency, 2022);
- A review undertaken for the Solent Forum BUDS project (ABPmer 2020b), which analysed the condition and erosion rates of saltmarshes in the West Solent, including Lymington, to help identify locations where dredge sediment could be beneficially placed;
- The results of regular bathymetric surveys that are undertaken by the LHC to assesses the requirements for, and outcomes of, dredging activities in the harbour and which provide a detailed description of intertidal mudflat profiles and the subtidal channel shape in the estuary;
- The results of additional and frequent bathymetric surveys that are undertaken by the LHC across the Boiler Marsh site to assess how the bottom placement dredge disposal site is performing. These survey results were recently reviewed by ABPmer (2022);
- The results of regular LiDAR surveys that are undertaken by the Environment Agency (including the latest available data which was collected in December 2020) that describe intertidal topography across the areas;
- A review of the morphology of the Lymington Estuary that was undertaken for Wightlink Ltd (ABPmer 2020a) using LHC bathymetry data from 1993 until September 2019. This review also examined the effectiveness of habitat restoration measures on Boiler Marsh, using field data and the latest LiDAR surveys undertaken by the Environment Agency;
- The results of a sediment quality survey that was undertaken by the LHC in December 2019, which covered the maintenance dredging sites in the estuary in fulfilment of MMO marine licence conditions;
- The latest available results from the Wetland Bird Survey (WeBS) which describe the abundance of overwintering birds in the area. This includes the latest core count (high water) surveys results that were taken during the five winters between 2016/17 and 2020/21, as well as the results

from low water survey in 2018/19 (although there are some key gaps in the low water dataset for the Lymington area); and
- The findings from a recently updated WFD Compliance Assessment for the Lymington maintenance dredge that was produced to accompany Marine Licence application dredging and disposal activities (Binnies, 2021).

4.2 Coastal processes and geomorphology

4.2.1 Tidal regime

The Lymington Estuary is a tidally dominated system that is around 4 km long. Its tidal regime (and that of the wider western Solent) is semi-diurnal, but is unusual in that it has a characteristic double peak or "stand" over high water with a well-defined, but short duration, low water period (Black & Veatch, 2017a).

The spring tide range in the estuary is 2.3 m, while the neap tide range is 1.2 m. The principal tide levels given in the Admiralty Tide Tables for Lymington entrance are:

- Highest Astronomic Tide (HAT): 3.3 m above CD[12];
- Mean High Water Springs (MHWS): 3.0 m above CD;
- Mean High Water Neaps (MHWN): 2.6 m above CD;
- Mean Tide Level (MTL): 2.0 m above CD;
- Mean Low Water Neaps (MLWN): 1.4 m above CD;
- Mean Low Water Springs (MLWS): 0.7 m above CD; and
- Lowest Astronomic Tide (LAT): 0.2 m above CD.

Tidal currents are very strong in the Solent. They are stronger than is normally associated with a small tidal range, and despite the high-water stand, slack water is of a short duration. This contrasts with the situation within the estuary itself, where tidal currents are generally weak and slack high water exists for several hours (Black & Veatch, 2017a).

Tidal characteristics change over relatively short lengths of the Dorset and Hampshire coastline, and the tidal curves and elevations vary between individual ports. For example, Ke and Collins (1993), compared tidal elevations between Keyhaven and Lymington and noted that the level of Mean High Water increased 'from 2.2 m to 2.7 m [Chart Datum (CD)] to 2.6 to 3.0 m [CD]' respectively.

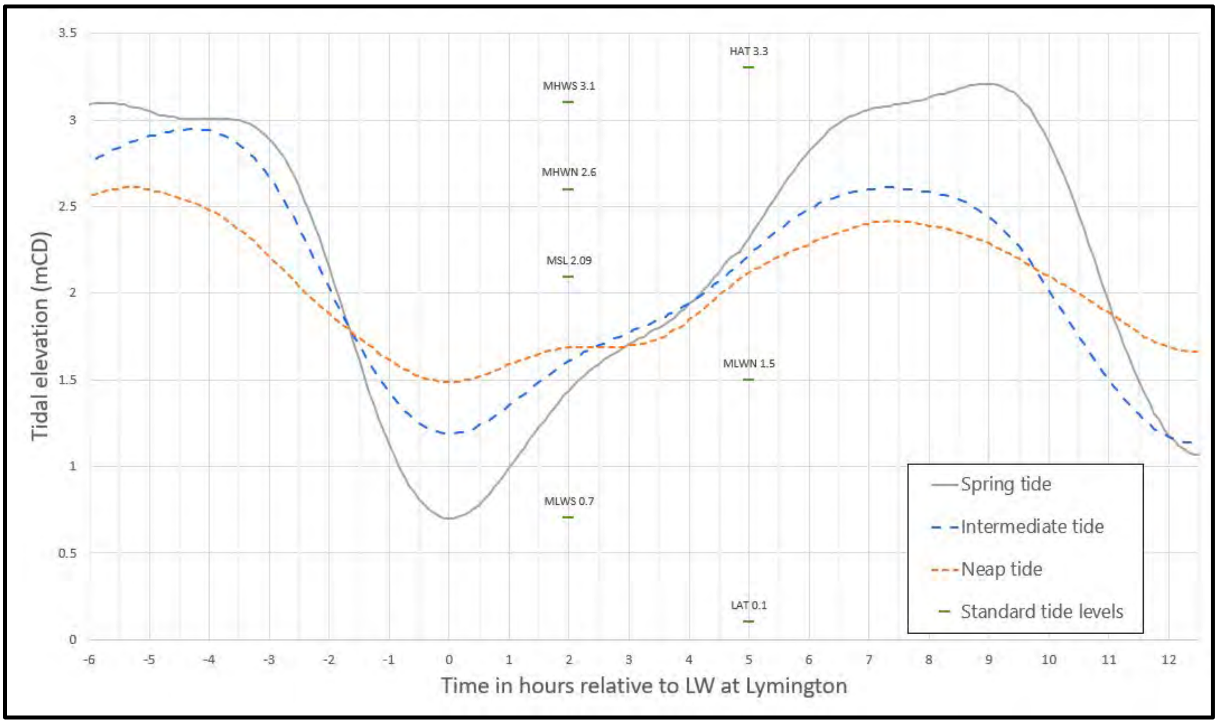
It is a characteristic of the tides in the area that high water is less sharply defined than low water, as illustrated in Image 8. The double high water therefore results in a comparatively short ebb period and thus stronger flows than on the flood tide.

A previous study by HR Wallingford (1991) took flow measurements from the reach immediately upstream of the Lymington Yacht Haven. This demonstrated how within Lymington Estuary, as opposed to in the Solent, the weak flood tide can last as long as 8.5 hours before turning for the much shorter (4-5 hours), and stronger, ebb. Bed shear stresses were found to be negligible on the flood tide but up to six times greater on the ebb.

Data collected during this study over a full 13-hour tidal cycle on a spring tide provides some information on baseline conditions within the main navigation channel. A peak ebb flow of 0.35 m/s was recorded just before low water at a current sampling site on the edge of the estuary channel

12 At Lymington the Chart Datum (CD) elevation is 1.98 m below Ordnance Datum (OD) (source: Admiralty Tide Tables, 2017).

approximately 50 m downstream of the Harbour Master's pontoon and to the east of Lymington Yacht Haven. Smaller peaks of around 0.14 m/s were observed on the flood tide, just after low water slack and just before high water. These tidal velocities are relatively low and are to be expected in an estuary with a relatively small tidal range and restricted tidal prism.



Generated from Admiralty Tide Tables

Image 8. Tidal curves for the Lymington entrance

More recent flow data was collected in the estuary by BMT for a navigation risk assessment study (BMT 2008a; 2008b). This described how there is a marked reduction in flow speed within the main channel in an up-estuary direction. During a survey in January, when there was a spring tide of 2.63 m, the maximum flow in the channel near the Pylewell Boom navigation post was 1.1 knots (0.57 m/s); that measured in Horn Reach on a similar tide was 0.33 knots (0.17 m/s).

4.2.2 Tidal volume

The average tidal volume of the estuary has been calculated to be 1.6 million m^3 (Blain, 1974). Since this calculation of tidal prism in the early 1970s however, there have been a number of increases in the tidal prism[13], including due to the following:

- Construction of Lymington Yacht Haven in the early 1980s where dredging increased the tidal prism by approximately 100,000 m^3; and
- Dredging for the Town Quay moorings (1989), widening of Horn Reach (1998) and Dan Bran Pontoon (2005) resulted in relatively small increases in tidal prism, because most of the dredging was below Mean Low Water.

A comparable tidal prism value of 1.85 million m^3 for this estuary was calculated by Townend (2005). This study estimated the difference volume at low water to be around 600,000 m^3, and the volume at high water to be around 2.45 million m^3.

[13] The volume of water exchanged with the open coast on an average tide

The tidal exchange volume of the Lymington Estuary is however limited by the presence of a causeway, constructed in 1731, approximately 3 km from the mouth of the river. The channel is maintained over-deep by a combination of maintenance dredging and the regular passage of ferries, hence the relatively weak tidal streams within the estuary.

On an average tide (range 1.7 metres), approximately 670,000 m^3 flows between and around the wave screens. Estimates made following the 1999 bathymetry survey indicated that this figure can be plus or minus 200,000 m^3 on a large spring tide, or small neap tide, respectively. There have been no major changes to the bathymetry above low water since that time that would lead to a significant change to the tidal prism.

The Environment Agency has modified the management of the causeway sluices, to allow salt water into the upriver reed beds. This project, called the 'Lymington Water Level Management Plan', involved the installation, in 2009, of a self-regulating tide-gate to allow controlled amounts of water up-river on the larger tides (see Image 9)[14]. The habitats created and altered by this intervention contributed to delivering 100 ha of habitat across the Solent as compensation for coastal squeeze effects under agreed Public Service Agreement (PSA) targets that were established in 2007 (Coastal Partners, 2021).

A preliminary impact appraisal of this project, before it was implemented, by Halcrow in 2005 anticipated that, if one of the culverts remained open on the flood tide (the current practice), it would allow 126,000 m^3 past the causeway on spring tides, compared to the potential volume of 368,000 m^3. On this basis, the tidal prism measured at the wave screens would have increased by about 15 % on spring tides (Black & Veatch, 2017a).

Source: ABPmer, May 2012

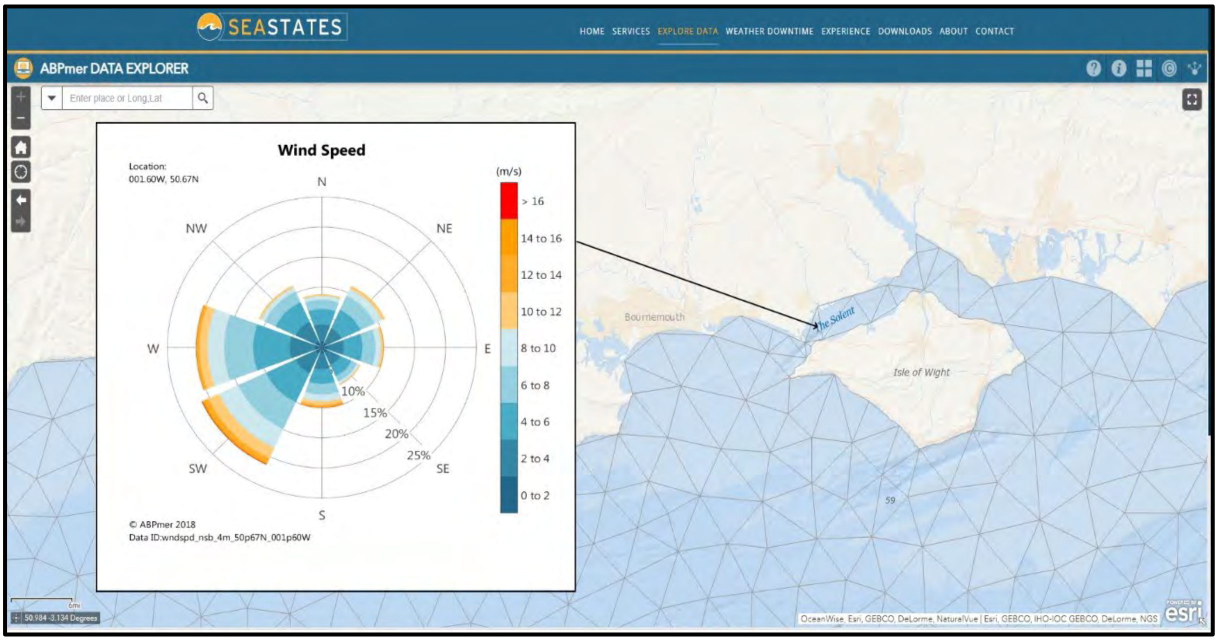
Image 9. Regulated tidal exchange operating in the upper reaches of Lymington Estuary

[14] See ABPmer habitats creation website at https://www.omreg.net/query-database/113-lymington-estuary/ for more details and photographs

4.2.3 Wind and waves

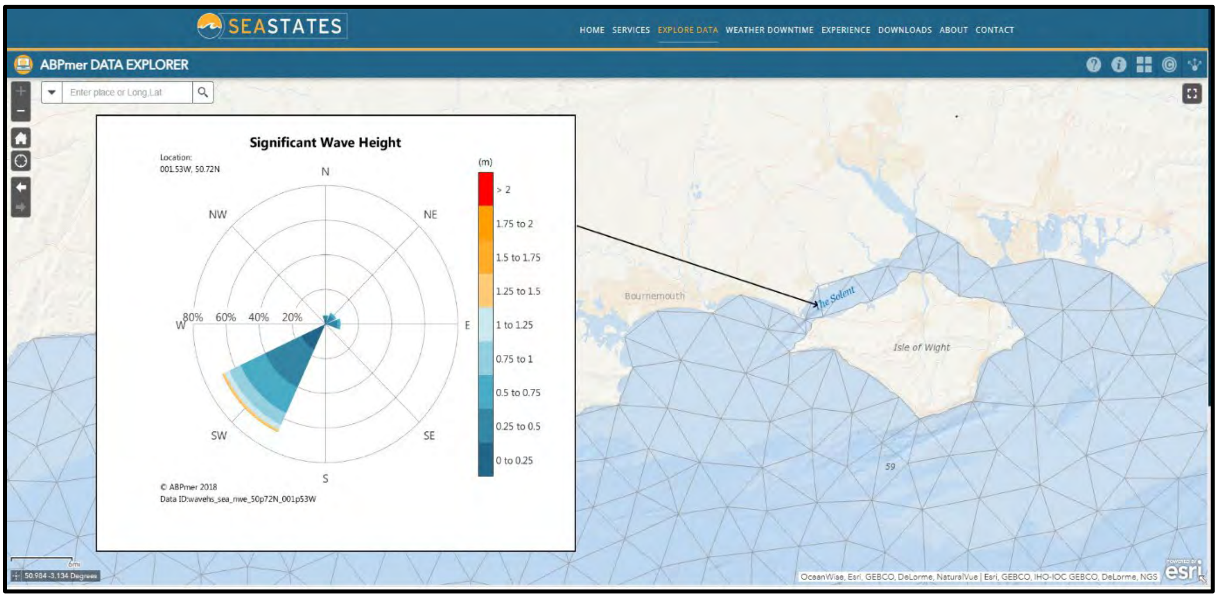
In the western Solent, the prevailing wind is south-westerly. Ke and Collins (1993) recorded that the maximum annual frequency of occurrence of south-westerly wind is as high as 18 %; the total frequency of westerly, west-south-westerly and south-south-westerly winds can be over 39 %. Such a pattern is maintained throughout the year, with little seasonal change.

To illustrate this further, Image 10 and Image 11 respectively show wind and wave roses for the Western Solent.



ABPmer at https://www.seastates.net/

Image 10. Prevailing wind directions for coastal waters at Lymington



ABPmer at https://www.seastates.net/

Image 11. Predominant wave directions for coastal waters at Lymington

These outputs (from the ABPmer 'SEASTATES' website[15]) describe wind and wave data in individual coastal and offshore unit areas, based on real-time hydrodynamic readings dating back to 1979. Image 8 shows how the main wind direction in the Western Solent is from the west and south-west (for more than 40 % of the time).

Image 10 also shows that the dominant wave direction and the main source of significant wave heights in the western end of the Solent is from the south-west (for 70 % of the time). The northern shore of the Solent and Lymington Estuary are however protected from the prevailing winds by Hurst Spit and the Isle of Wight, which limits the fetch. Lymington is therefore exposed to a substantially less energetic wave climate than most of the English south coast.

The proximity of Lymington to Hurst Spit (around 5 km to the south-east) means that the longest fetch at the mouth of the estuary is from the east, thus locally generated waves are likely to be largest from this direction. The largest waves, however, are generated within the English Channel and tend to penetrate from the south-west (see Image 11).

Small, locally generated waves (i.e. those created by wind action in the immediate area, within the saltmarsh barrier) dominate the wave climate in the Lymington Estuary. Since the 1920s however, the long-term trend of recession of the saltmarsh in the outer estuary and die back of vegetation within the estuary has resulted in an increase in wave heights in the middle estuary, and this trend is expected to continue (Tubbs, 1999)

The rates of retreat and erosion are more rapid along the more exposed sections of the Lymington frontage than they are on the sheltered locations just behind Hurst Spit and behind major saltmarsh islands such as Boiler/Pylewell (ABPmer 2020b). This is described further in Section 4.5. Engineering works, such as wave screens and breakwaters downstream of Lymington Yacht Haven (see Image 12), have been constructed to maintain the wave climate in the inner harbour where most of the maintenance dredging takes place.

4.3 Geomorphological evolution of estuary

4.3.1 Background

When sea levels were much lower in geological tertiary period, the Lymington River was a tributary draining into the Solent. During a period of rapid sea level rise between five and ten thousand years ago, the Isle of Wight was severed from the mainland (Ke and Collins, 1993). The mainland shore is characterised by soft, geologically recent deposits, which are susceptible to erosion. Cartographic evidence suggests that the shoreline has been receding since at least the 18th Century.

The geomorphology of the Lymington Estuary has largely been a function of human intervention, particularly over the past three hundred years. Construction of the causeway across the upper reaches in 1731 restricted the tidal volume (as described above), as did land claim by embankment of marshland in the 18th and 19th Centuries. In the latter part of the 20th Century, sea defences, regular ferry movement and other interventions, including channel dredging, have further contributed to the channel form.

The estuary's saltmarshes, which have had such an impact on the economic life of Lymington, are a relatively recent feature. They are understood to have developed in part from the rapid spread of *Spartina* spp. in the late 19th Century. The *Spartina* colonised intertidal mudflats and areas of eelgrass, and was more or less at its maximum extent around 1925; it has been receding ever since (Black & Veatch, 2017a).

15 ABPmer SEASTATES: www.seastates.net

Bathymetric surveys of the estuary channel (covering the subtidal and lower intertidal areas) are regularly undertaken by the LHC to inform management and maintenance of the harbour. The topography of intertidal areas is also additionally mapped by regular LiDAR surveys undertaken by the Environment Agency. From these bathymetric and topographic surveys, it is evident that the sheltered areas along the main estuary channel are relatively stable (ABPmer, 2020b; 2009).

Source: Landwatch Consulting for Solent Forum BUDS project

Image 12. View east over the Lymington River (February 2019)

To illustrate this, Figure 9 shows the recorded alignment of the CD elevations (which also marks the boundary of the SAC along the Lymington channel). This compares data taken regularly from 1993 to September 2019. The shape of the lower estuary is also illustrated in Image 13, from bathymetric surveys carried out in May 2016, June 2017, January 2018 and September 2019.

There is no indication from these bathymetric surveys of detectable and ongoing retreat of the CD positions away from the outer estuary. Instead, in recent surveys, the CD positions along much of the inner channel are often aligned on the channel side, rather than to landward, which would technically indicate a narrowing rather than a widening of the channel. The accuracy of the measurements plays a key role in these observations and this needs to be carefully considered. In reality, the channel edges are thought to be relatively stable and not detectably changing in any net direction (ABPmer, 2020a).

Larger and detectable changes are, however, occurring in the more exposed outer estuary. The mouth of the estuary is also continuing to widen due to natural processes (ABPmer, 2020a). Here, the CD alignment and marsh edges are continuing to retreat at a relatively rapid rate in many areas (especially on their wave-exposed outer edges). These changes are also shown in Figure 9.

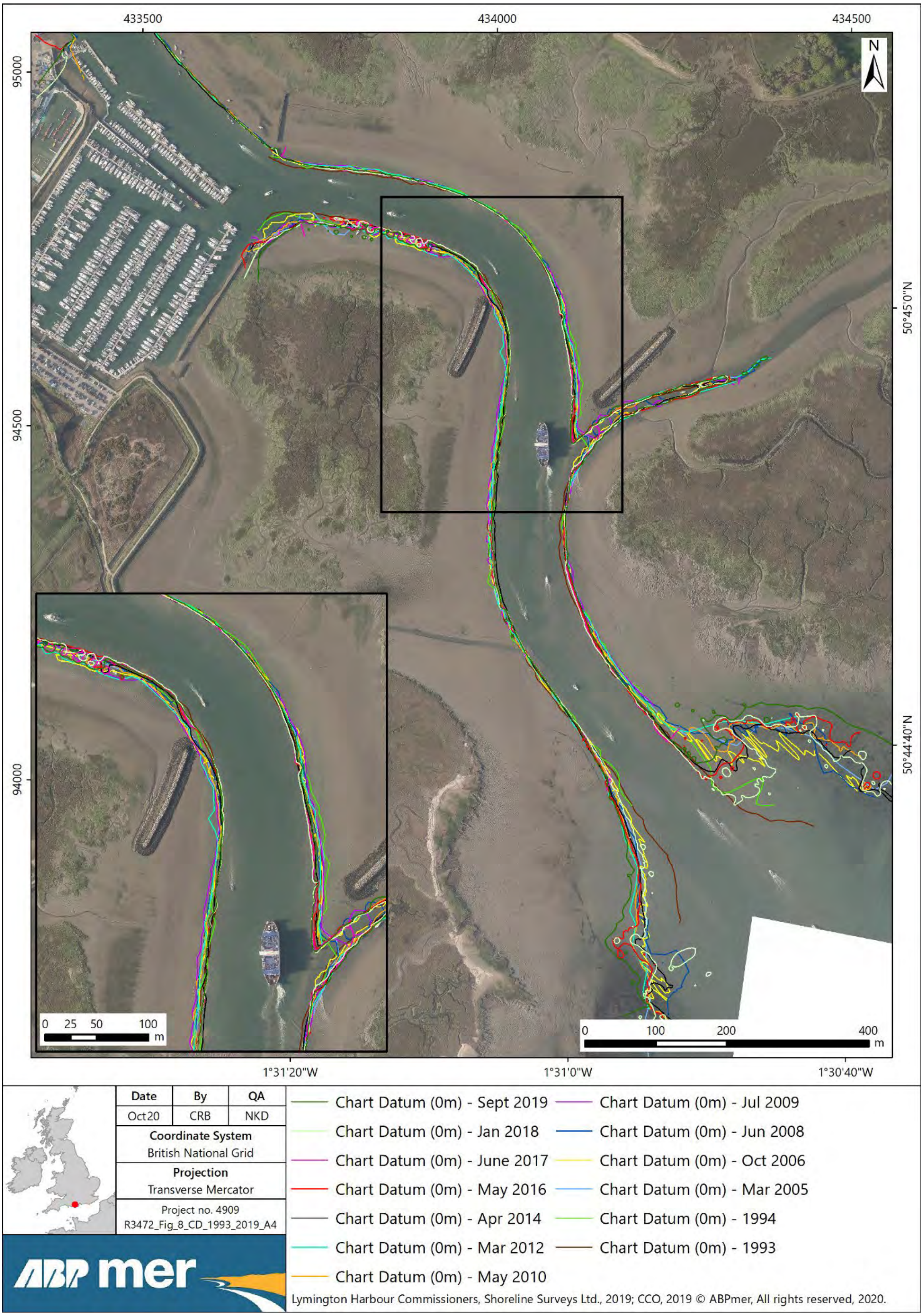
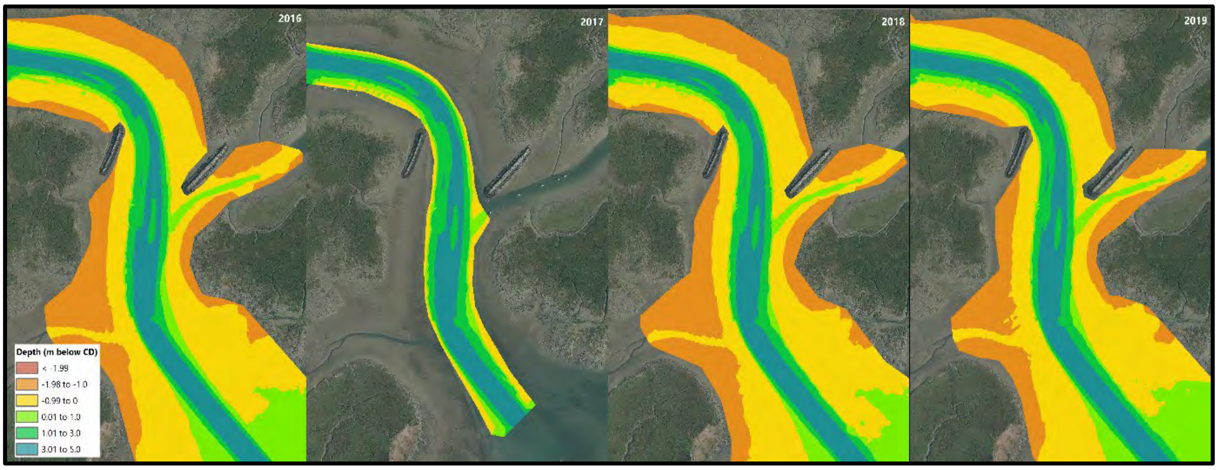


Figure 9. Chart Datum alignment from 1993 to 2019 using LHC bathymetry data

The channel is also exhibiting a tendency to adjust and meander (Black & Veatch, 2017a; ABPmer, 2010). As an illustration of this, in April 2010 the LHC relocated three of the navigation posts at 'Cocked Hat', 'Bag of Halfpence' and 'Seymour's Post' on the west bank to better mark the deep-water channel; this indicates a movement of the outer channel to the east (ABPmer, 2010).



Source: ABPmer (2020a) using LHC/Shoreline Survey Ltd bathymetric data

Image 13. Overview of bathymetric surveys carried out by LHC (2016 to 2019)

Recent analysis on the bathymetric and topographic data along the estuary described how there are areas of accretion and erosion over the mudflats along the channel. This includes an area of accretion on the west side of the inner estuary, and erosion on the west side of the outer estuary. These changes also indicate that channel is trying to meander slowly and probably adjust towards a more sinusoidal shape (ABPmer, 2020a).

In summary, there are several natural and anthropogenic factors which are likely to have impacted on the morphology of the estuary. These changes and the influencing factors include the following:

- There is increasing wind-wave penetration into the estuary which is resulting in erosion of intertidal mudflat and saltmarsh especially at the estuary entrance;
- There is evidently a decreasing availability of sediment to the estuary and marshes due to changes in the long-term sediment supply and balance;
- Die-back of *Spartina* spp.[16] has increased the potential for erosion of trapped sediment, whilst cliffing of saltmarshes at the estuary mouth has increased their vulnerability to lateral erosion;
- There was an increase of 7 % in the estuary tidal prism due to the capital dredging for the Yacht Haven and Berthon marinas in the 1970s. This would have increased the flows through the main channel and increased the potential for the channel to be widened and deepened;
- Since the early 20th Century, ferries have been regular operating out of Lymington, and they have increased in size. Hydrodynamic changes associated with these ferry and other vessel movements in the estuary contributed to morphological change, particularly in subtidal and low intertidal areas (ABPmer, 2009)[17]; and

16 The process of plant die-back is probably influenced by several factors including the low lying tidal elevation of the marshes as well as limitations in the amount of oxygen reaches the roots (due to sediment waterlogging liked to limited sediment porosity/drainage given the composition and compaction) of the sediment. These factors will all be exacerbated by reduced sediment supply.

17 More recent and detailed studies have however found no signs of the upgraded W-Class ferry service having had any distinguishable effects on the channel shape or intertidal habitats in the context of natural processes since it came into service in 2009 (ABPmer, 2020a).

- Within the Solent, the current saltmarsh area is being rapidly eroded at its seaward edge. This then changes to exposed clay platforms and mudflat habitats which in turn are eventually reverting to become the subtidal habitat. In addition, at a much slower rate, the inner estuary is being eroded. The rate of natural loss of designated intertidal habitats on the Solent shore is around 6 ha year^{-1}, far higher than elsewhere in the estuary. It has been predicted that this area of designated intertidal features will be substantially reduced by 2055, and lost by 2105-2155 (Black & Veatch, 2008). Further description of the of the rate of saltmarsh loss particularly is presented in Section 4.3.2.

All maintenance dredging in Lymington is below the Lowest Astronomical Tide (LAT) level, and will have no impact on the tidal prism. These dredging areas are naturally accreting, and this tendency can be expected to persist.

4.3.2 Saltmarsh habitat loss

The intertidal habitats of the outer Lymington Estuary have been subject to progressive change for well over a century. Prior to the late 19th Century, the area was made up of gently sloping shallow mudflat habitat. This was then colonised by *Spartina anglica* and other plant species, as saltmarshes developed and expanded rapidly from the late 1800s to early the 1900s. In the 1920s, saltmarsh in Lymington Harbour had a width of the order of 1,500 m, and the marsh islands overlapped, providing sheltered water within the harbour. However, from the 1920s onwards, the saltmarshes in this area have been progressively declining (Tubbs, 1999; Chatters, 2017).

The rates of saltmarsh erosion in the estuary (and across the wider Solent) have been evaluated on several occasions over the last decade or so. Detailed analyses of the rate and pattern of marsh retreat up until the early part of this century were made by the NFDC Coastal Group (NFDC 2007a; 2007b) and the Solent Dynamic Coast Project (SDCP) (Cope *et al.*, 2008).

The early NFDC study used aerial photographs taken after the 1940s to show that the typical rates of marsh edge retreat were around 2 to 5 m year^{-1} on their wave-exposed outer edges. This has also been verified by direct measurements taken by harbour staff. The NFDC also identified some exposed locations that were eroding at faster rates of 8 to 11 m year^{-1}. Away from the exposed areas, including the approach channel at Lymington, the retreat rates were shown to be generally lower; anywhere between 0.2 m year^{-1} and 1 m year^{-1}, depending upon the location.

The follow up SDCP study (Cope *et al.*, 2008) used both LiDAR data and aerial imagery to map the physical and ecological marsh changes and project the future timelines for their ongoing decline. This study showed that, in 1946, the marshes covered 266 ha, while in 2001, only 111 ha remained. Between 1946 and 2001, an average annual loss rate of 1.1% was calculated, and the highest rate of loss was again observed in the period between 1984 and 2001, at 1.9%. This study predicted that the saltmarshes in the outer estuary would be lost by between around 2040 and 2050. This would be from substantial edge erosion along the seaward margins of the outer marshes and increased internal dissection (see Image 14).

In recent years, further work has been undertaken on to examine the rate of marsh decline while at the same time the resolution of survey data has improved. For the Solent Forum BUDS review, ABPmer (2020b) analysed LiDAR data collected from ten surveys undertaken between 2007 and 2018. For this study, LiDAR cross-shore transects were created using all ten surveys and spatial 'difference plots' were produced to map the net bed elevation changes between 2007 and 2017.

This analysis verified that erosion rates were around 2 to 3 m per year on the exposed outer edges of the marshes. It was additionally estimated that these marshes are losing 2 % of total volume and 2 %

of vegetated marsh extent every year. This study also confirmed the findings from Cope *et al*., (2008), that the vegetated marshes will probably be gone by around 2045 to 2050 (ABPmer, 2020b).

Source: ABPmer, May 2022

Image 14. Eroding and 'cliffed' eastern side of Boiler Marsh

To update this analysis for this baseline review, and also to further visually describe the rate and pattern of marsh retreat, a new LiDAR 'difference plot' is shown as Figure 10. This shows bed elevation changes between the Environment Agency LiDAR surveys taken in December 2007 and in December 2020 (as the most recently available dataset). This plot shows, in red, the elevation reduction (i.e. erosion) of the marshes and higher mudflat areas over this 13 year period. It also shows areas where there have been increases in bed level, in blue, which shows areas where recent dredge sediment placement projects have been undertaken.

The ABPmer (2020b) review also described how the more sheltered intertidal areas showed fairly limited change (whether erosional or accretional). This includes, for example, the big marsh complex behind Hurst Spit, or the Lisle Court marshes that are sheltered by the Boiler/Pylewell marsh island. The highest rates of erosion are noted along the outer edges, in the section from Cockleshell to Pitt's Deep, where elevations have been lowered by between 1 to 2 m along the majority of the outer edges of these intertidal areas over the 10 years studied between 2007 and 2017.

In addition to this past work, this year, the University of Portsmouth completed a Solent-wide review of marsh habitat change for Natural England (Parry and Hendy, 2022). This study further examined aerial photographs between 2008 and 2019 and came to similar conclusion: that the marshes in the outer estuary are retreating by around 1.5 % annually and will be lost by 2045.

The previous baseline review (Black & Veatch, 2017a) noted that resolution of survey data had improved and monitoring and analysis techniques have become significantly more sophisticated. As a result it was possible to identify and monitor both the vegetated saltmarsh and the fringing areas of high mud where the vegetation itself has died back (see Image 15), both of which dissipate wave energy and provide a natural flood defence function[18].

Source: ABPmer, May 2022

Image 15. Unvegetated clay mounds on south side of Boiler Marsh following die back

Black & Veatch, (2017a) concluded that this refined definition of the 'saltmarsh' edge has the effect of changing the 'baseline' for projecting the future extent of saltmarsh systems from that used for the 2002 projections. They revised the long-term projections for the extent of the vegetated and high mud, non-vegetated saltmarsh and concluded that the estimated area of saltmarsh in 2050 is likely to be higher than originally estimated in 2002, and that in 2050 the remaining habitat is expected to still make a significant contribution to harbour protection in 2050.

This prediction is encouraging, and it is likely that lower lying unvegetated mudflats and clay mounds will remain in 2050 to provide a harbour sheltering function. However, a range of factors also need to be considered which may combine to accelerate marsh loss. These included progressive marsh fracturing, changes in tidal elevations from the lunar nodal cycle over the next decade, or the effects of accelerated sea level rise.

Also, while the unvegetated intertidal areas may well provide some harbour protection, there will be a substantial loss of the vegetated saltmarsh and biodiversity as a consequence. It is still appropriate to assume the high elevation vegetated habitats will be gone by 2050 without active intervention.

A study by Ke and Collins (1993) indicated that, while there was this lateral retreat, the marshes were accreting by around 2 to 5 mm year-1. This may be occurring, but there is no indication from analyses of available LiDAR data of this, as changes of a few millimetres per year would not necessarily be

[18] As described on the LHC website at https://www.lymingtonharbour.co.uk/harbour-protection

recorded by LiDAR results. It is likely, however, that if the marshes are accreting, it will not be at a rate which would enable them to keep pace with ongoing relative sea level rise[19] (ABPmer, 2020b).

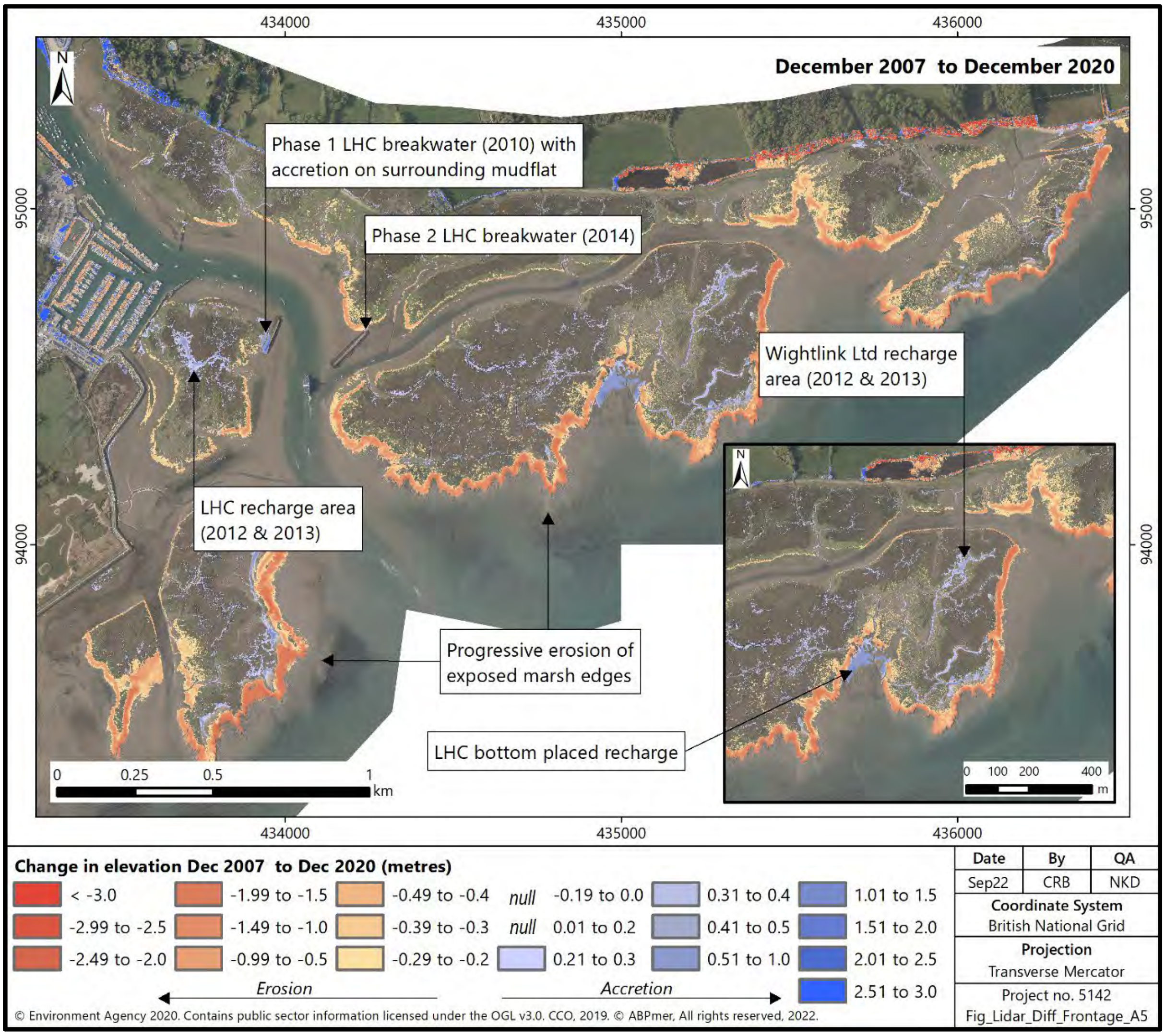


Figure 10. Habitat elevation change at Lymington frontage between 2007 and 2020)

Erosion of saltmarsh is also an ongoing process on a wider scale within the Solent, and is not limited to areas local to where dredging is carried out (Parry and Hendy 2020; Raybould *et al.*, 2000). The causes of marsh loss in the Solent have been regularly reviewed and they will vary to some degree between location. Increased storminess and sea level rise (and hence wave height) are also likely to be contributing factors (ABPmer 2020b).

The recent analysis of saltmarsh change is shown in Figure 11. This is part of the national change map produced by the Environment Agency. It shows erosion of the outer marsh edges, but also gains of marsh extent in some areas. Care needs to be taken with interpreting this output in isolation though because some of this analysis can be an artefact of the aerial image quality and resulting interpretations of the vegetation boundaries.

19 During the period 1980 to 2011 relative sea level has risen at a rate of 3.1 ± 0.7 mm year^{-1} at Southampton (Wahl *et al.*, 2013). This rate has been derived from analysis of tide gauge records and corresponds to a total sea-level rise of between approximately 0.08 and 0.1 m during this time.

What is evident at Lymington, however, from all the available evidence, is that the edge of the marsh is eroded predominantly by wind wave action undercutting the roots, and there is a correlation between the rate of erosion and exposure to wind waves with the most aggressive erosion occurring on the Solent edge of the marsh (Black & Veatch 2017a, ABPmer 2020b). By contrast, sheltered intertidal areas including, for example, the marsh complex behind Hurst Spit, show fairly limited change (whether erosional or accretional) when compared to the outer marshes (see Figure 10).

The body of the marsh may well still be trapping suspended sediment, but it is losing plant biomass in some areas. This plant loss has been linked to anoxic soil conditions and random soil sampling in the early 1990s by the LHC and their consultants found a strong correlation between this '*Spartina* dieback' and anoxic soil conditions (Black & Veatch, 2017a). The role of anoxic soil conditions in die back was also proposed by Goodman *et al*. (1959).

Poor drainage has also been mooted as a factor, but that on its own this is not an explanation. Drainage of the remaining marshes at Lymington is expected to be very efficient. Instead, die back is almost certainly a function of multiple factors operating together. This includes reduced sediment supply to the Western Solent (Lawn, 2001), sediment compaction, reduced seabed elevation, reduced sediment porosity and oxygenation, prolonged tidal inundation, increased wave exposure and even an evolutionary tendency for *Spartina* marshes (Lawn, 2001).

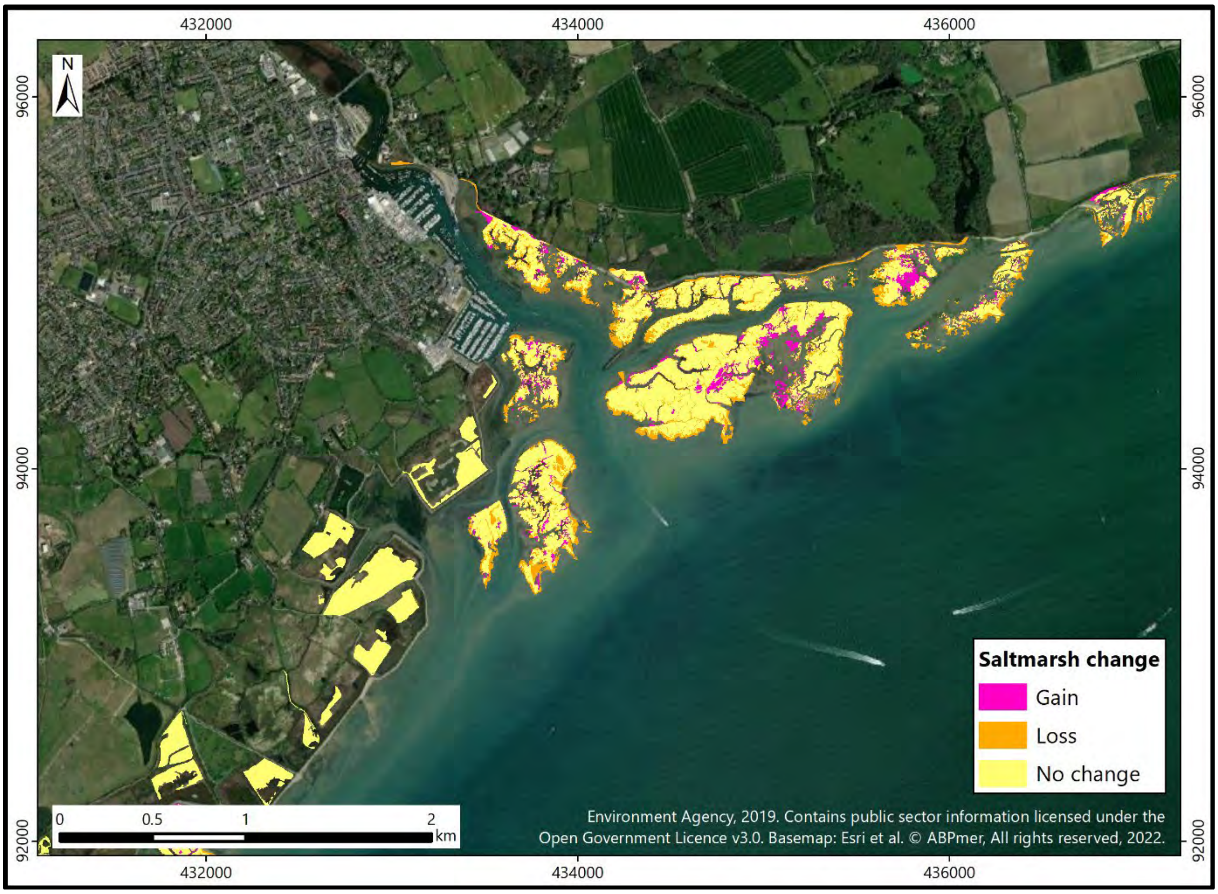


Figure 11. Saltmarsh change in Lymington Estuary from 2008 to 2016 aerial images

Furthermore, there are also ecological factors that will be relevant. For example, it is evident that macroalgal growth is occurring on or around the margins of the marshes and that green algal mats can form, or be 'thrown' by storms, on the marsh surface. This would then lead to localised shading and marsh plant growth retardation.

Fundamentally, and relatively simply, the tidal elevation of the habitat is an accurate indicator of marsh health. The areas of saltmarsh that are sufficiently high in the tidal frame have a dense coverage of plant spies while it is generally the lowest lying areas that have low or poor marsh plant growth.

4.4 Sediment supply and budget

4.4.1 Sediment sources

The sediment supply to the estuary is primarily of marine origin, and this supply has reduced significantly since the 1930s following the installation of coastal defences in Christchurch Bay (Pontee, 2004). The fluvial supply has been estimated at between 1,620 and 16,200 m^3 $year^{-1}$ (Blain, 1974). These figures were based on an average river flow of 1.03 m^3 s^{-1} between 1961 and 1972, assuming a suspended sediment load in the range 50 to 500 ppm. In the absence of measured data, a reasonable estimate of the average suspended sediment load is considered to be 150 ppm or 5,000 dry tonnes per annum, but the uncertainty in the estimate of the fluvial sediment supply is large.

As noted in Section 4.2.1, the average tidal volume of the estuary is around 1.6 million m^3. Using this figure with average suspended solid concentrations of 25 ppm, as measured in the West Solent (reported in Ke and Collins, 1993), the sediment flux into the estuary on a flood tide would be 40 tonnes, or approximately 30,000 dry tonnes per annum[20]. However, more recent data from SCOPAC gives values of 45-60 mg l^{-1}, which would imply a sediment flux of about 60,000 dry tonnes per annum.

Not all this material will fall to the bed on each tide, but there will be occasions when the suspended solids load of the flood tide is elevated by the action of waves on exposed intertidal mud. Taking account of the subsequent increases in the tidal prism that are listed in Section 4.2.2 (from construction of Lymington Yacht Haven in the early 1980s and dredging for the Town Quay moorings), the potential marine-derive sediment flux would increase by about 2,000 tonnes per annum to 62,000 dry tonnes.

The tidal prism was further increased by about 126,000 m^3 as a result of the Lymington River Reedbed Restoration Project, which allows saltwater to pass through sluices in the causeway on the rising tide. It was thought that at an average suspended solids concentration of 50 ppm, this draws a further 4,600 tonnes of sediment into the estuary each year. As described above, a self-regulating tide (SRT) gate was installed in 2010, and monitoring of its operation showed that the maximum current velocity and its duration did not significantly change, and therefore did not lead to erosion in the estuary (Black & Veatch, 2017a)

There is no doubt that significant quantities of material are being lost from the exposed marsh edges, and Ke and Collins (1993) showed that the erosion at the edge of the marsh relative to the ongoing increase in the level of the marsh amounted to a net loss of fine material. They estimated that there was an average loss of saltmarsh at a rate of 3.6 ha per year, and an export of around 120,000 m^3 of fine materials per year from the subtidal and intertidal zones, with around 38,000 m^3 being attributed to saltmarsh edge erosion.

It was estimated that around 70 % of the sediment yielded from intertidal erosion at these marshes was lost entirely as suspended sediment input into the remainder of the Solent system. The remaining 30 % was thought to be available for accretion on the marsh surfaces (at a rate of 2-5 mm per year), and in

[20] Sedimentation and maintenance dredgings are variously referred to by wet or dry weight or by volume. For licensing, the tonnage removed from Lymington is quoted in wet tonnes based on a count of barge hopper loads. Sediment budgets often start from an estimate of the dry weight of the sediment particles which may have specific gravities in the range 2.2 to 2.7. If these settle out as a layer of soft mud which is 70 % water, 30 % solids, the bulk density is about 1.45 tonnes/m^3 (1 m^3 of soft silt sediment will have a wet weight of about 1.45 tonnes and a dry weight of 0.8 tonnes). 1 tonne of dry sediment would give rise to a dredging return of about 1.8 wet tonnes.

the creek and channel boundaries. The accretion rates were estimated from isotopic geochemistry dating and *Spartina* deposit analysis.

Material eroded from the edge of the marsh, especially the Solent shore, is carried away by the ebb tide. Although some erosion products will be carried into the estuary on the flood tide, most of this becomes unavailable to the marsh. Much of the material is eventually deposited in the mooring areas further upstream, which are subject to maintenance dredging.

4.4.2 Sediment budget

No formal sediment budget has been made for the Lymington Estuary, and there is insufficient existing data on hydrodynamics and sediment movement to do so with any reliability. Sediment is known to accumulate in the marinas and mooring areas in Lymington Harbour, these being deeper pockets which act as sediment traps. Anecdotal evidence suggests the infill rate is greatest during a relatively small number of events in the winter months. Strong winds from the south-east lead to wave action in the lower estuary, which re-suspends recently deposited silt in the intertidal and erodes the saltmarsh cliff edge.

It is thought that the material that is lost from the saltmarsh is not transported directly to the areas which currently require maintenance dredging. The material that needs maintenance dredging is drawn from a combination of re-suspension of recently deposited material on the intertidal mud areas and sediment brought into estuary in suspension on the flood tide.

Calculations show the area of saltmarsh reduced by about 6,500 m^2 per annum between 2005 and 2010 (Black & Veatch, 2010), which released about 5,000 wet tonnes of sediment. At the same time, 10 ha of saltmarsh may be trapping about 500 wet tonnes per annum (based on the assumption that the saltmarsh is accreting by 3.5 mm per annum).

The intertidal Lymington saltmarshes are likely to draw their supply of sediment mainly from marine sources. This situation has been proven in the nearby Beaulieu Estuary where it was shown that most sediments were derived from marine rather than fluvial sources (SCOPAC, 2004) via tidal currents (Posford and Duvivier, 1994).

The study undertaken by Ke and Collins (1993) for the West Solent found the dominant suspended sediment particle size in the West Solent to be very fine to medium silt, which matches very closely with the median grain size sediments of the Lymington saltmarshes. It is likely that fine marine sediments and suspended clay sediments derived from cliff erosion become drawn into the West Solent (SCOPAC, 2004). Remote sensing studies of suspended sediments within Christchurch Bay and the Western Solent support these conclusions (SCOPAC, 2004). The principal sources of sediment, expressed in wet tonnes per annum, in descending order of magnitude, are given in Table 6.

Table 6. Principal sources of sediment to Lymington Estuary

Sources	Wet Tonnes per year
Marine input on flood tide, based on an estimated tidal prism of 1.6 million m^3 and suspended solids range in the Solent of 45 to 60 ppm	100,000 to 135,000
Fluvial input, based on an average flow of 1.03 m^3/sec and suspended solids range of 50 to 500 ppm	3,000 to 30,000
Erosion of saltmarsh edge	4,500 to 5,500
Approximate Total	110,000 to 170,000

Source Black & Veatch, 2017a

The principal losses from the estuary, expressed in wet tonnes per annum, in descending order of magnitude, are given in Table 7.

Table 7. Principal losses of sediment from Lymington Estuary

Sources	Wet Tonnes per year
Carried out on the ebb tide, of the order of 90% of marine input	90,000 to 120,000
Maintenance dredging from marinas and other mooring areas	28,000
Approximate total	120,000 to 150,000

Source Black & Veatch, 2017a

Approximately 500 m^3 $year^{-1}$ might be trapped on the top of the marsh, but this is negligible in the context of the overall sediment budget. There is considerable uncertainty in the calculation of most elements of the sediment budget, which will vary from year to year, but, if reasonable assumptions are made as to the most likely average values (e.g. 150 ppm for fluvial inputs 50 ppm for marine inputs and that 90% of the suspended solids are exported on the ebb tide), then there appears to be a small net loss in the range 0 to 5,000 wet tonnes per annum, which is consistent with the observed erosion of the saltmarsh edges by wave action. An example calculation, set out in Table 8, shows a deficit of 3,500 wet tonnes annually after including the sediment trapped on the marsh (Black & Veatch, 2017a). ABPmer (2020b) recently also examined the volumes of marsh loss in areas above the Mean High Water Neap elevations using LiDAR data between 2007 to 2018.

Table 8. Principal losses of sediment from Lymington Estuary

Parameter	Units	Value
Fluvial Sediment Inflow		
Freshwater flow (Blain)	m^3/sec	1.03
Suspended solids	ppm	150
Annual input	Dry tonnes	4,872
Ratio dry to wet tonnes	Ratio	1.80
Annual Input	**Wet tonnes**	**8,770**
Marin Sediment Inflow		
Tidal prism (Blain)	m^3	1,600,000
Tidal Prism increase Capital Dredging	m^3	100,000
Suspended solids in Solent	ppm	50
Marine Input	Dry tonnes	62,050
Ratio dry to wet tonnes	Ratio	1.80
Annual Input	**Wet tonnes**	**111,690**
Sediment Budget		
Fluvial Input	Wet tonnes	8,770
Marine Input	Wet tonnes	111,690
Marsh erosion	Wet tonnes	5,000
Total Input	**Wet tonnes**	**125,460**
Dredging	Wet tonnes	28,000
Trapped on marsh	Wet tonnes	500
% Retention	%	10
Lost outgoing tide (90% of marine input)	Wet tonnes	100,521
Total Lost	**Wet tonnes**	**129,021**
Net Balance	**Wet tonnes**	**-3,561**

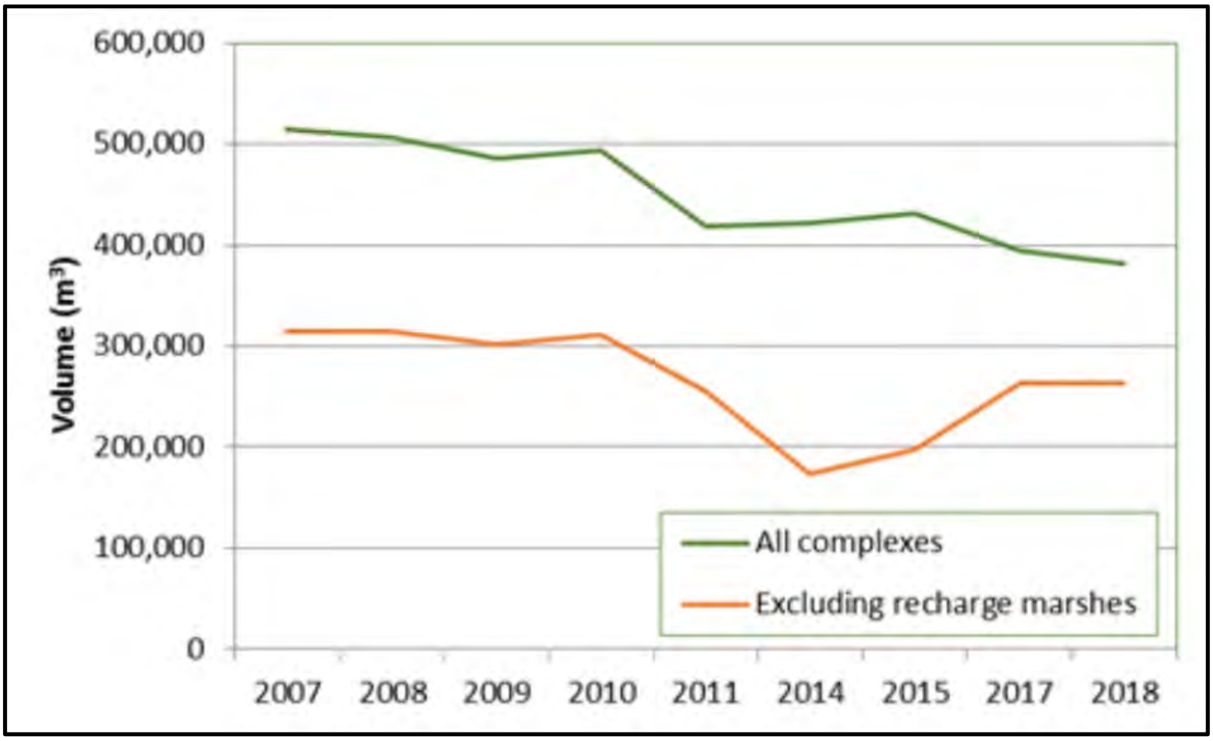
Source Black & Veatch, 2017a

There were also inherent uncertainties with the approach taken and the methods are not compatible with the Black & Veatch (2017a). However, the study found that around 4,500 m^3 of sediment was being lost annually from the three major marsh complexes at the entrance to Lymington Estuary. The marsh volume changes over the 2007 to 2018 period are also illustrated in Figure 12.

The estimated natural sediment supply from fluvial sources (and the incoming tide) exceeds the average maintenance dredging requirement, and the surplus may be deposited in the intertidal areas or lost in suspension on the outgoing tide. The important aspect is that, although there is a direct source-pathway-sink link between the saltmarshes, mudflats and the dredged mooring areas, there is no such direct link from the dredged mooring areas to the saltmarsh and intertidal areas.

If the material presently removed from the "sediment traps" (dredged mooring areas), were to be left in the system, it could not be naturally eroded on a state of the tide that could transport it to potential areas of deposition in the lower estuary, as the tide would have to be falling to carry it back down river, and sediment cannot accrete on a falling tide. It is concluded that maintenance dredging at current levels has no direct impact on estuary function.

Despite this conclusion, it is acknowledged that, for a small estuary, the volume of sediment dredged each year, about 20 % of the annual sediment flux, is large. If this sediment was not dredged each year, some may find its way onto the intertidal areas in the vicinity of the dredged areas. The areas that could reasonably be expected to benefit from the cessation of maintenance dredging, in the form of increased intertidal deposition, are generally outside the designated European/Ramsar sites.



Source: ABPmer, 2020b

Figure 12. Changes in marsh volume above MHWN 2007 to 2018

Removal of this sediment reduces opportunities for the estuary to adapt to sea level rise. Since the 18th Century, the estuary has undergone substantial landscape level loss of the marshes and intertidal areas, and this change is anticipated to continue and possibly accelerate with predicted accelerated sea level rise and climate change. The Lymington Estuary is highly modified, and has been since the 18th Century when the causeway was built. It has since developed into a regionally important harbour for leisure boating and is likely to continue to be of importance for these activities in the future.

If the estuary had a more natural form, then the erosion of the marshes in the mouth of the estuary would cause a redistribution of the sediment in upstream reaches of the estuary so that new intertidal areas could form higher up in the tidal reaches. That cannot be possible now, but it may be possible to

allow intertidal habitats greater opportunity to adapt to sea level rise by keeping some of this large volume of currently dredged sediment within the estuary.
As described in Section 2.5.3, the LHC's bottom placement recharge project on Boiler Marsh has been underway since 2014. Since then, placements of sediment have been made annually on the marsh. Over this eight-year period from 2014 to 2021, over 60,000 wet tonnes (more than 50,000 m^3) of material has been diverted from the Hurst disposal site to this site on the outer edge of the saltmarsh (see Table 4). This approach is "beneficial" in slowing erosion of the saltmarsh and will be extending its life (ABPmer, 2022); the effect is on the sediment budget of the western Solent rather than the Lymington estuary here, as some of the deposited material is dispersed by wave action.

4.4.3 Harbour developments

Over the last decade or so, there have been a few new developments in the harbour. The previous baseline review by Black & Veatch (2017a) described the following in particular:

- The Environment Agency's Lymington Water Level Management Plan (Reedbed restoration);
- The Lymington Harbour Protection Scheme by the LHC which involved the phased construction of two rock armour breakwaters; and
- The replacement by Wightlink Ltd of the Lymington to Yarmouth ferries with a new W class vessel which started operating in 2009.

Since that previous Black & Veatch (2017a) baseline review, there have only been minor interventions. These interventions, and the marine licences which accompanied them, are as follows:

- The replacement of the northernmost wave breaks that protect the harbour. This was done by the LHC under MMO Marine Licence L/2021/00293/1); see Image 16;
- The reconfiguration of Town Quay Pontoon Moorings in 2020 (L/2018/00400/1); and
- A subsequent adjustment to the location of the commercial pontoons (L/2020/00330/1).

Source. Solent Forum Review - ABPmer, 2020b

Image 16. Inner Harbour and wave screens in 2019 (northern screen now upgraded)

These small-scale adjustments or replacements of existing structure have had no impact on the maintenance dredging requirements. The navigation and moorings at Town Quay still need to be maintained (see Table 2) to the same depths and with the same dredging requirements as previously.

4.5 Estuarine habitats and ecology

4.5.1 Estuarine habitats

Lymington Harbour is characterised by a sinuous approach channel that passes between a network of saltmarsh islands and intertidal mudflats (Black & Veatch, 2017a). The intertidal and subtidal habitats are predominantly comprised of fine muddy sediment with a mix of coarse sediment in some of the more exposed areas and locations with stronger tidal currents. Subtidal rock is rare within Lymington Harbour, in line with the rest of South East England. Only harbour walls and other man-made structures provide hard substrate within Lymington Harbour.

To illustrate the mix of habitats that are present in the Lymington Estuary, two recently produced habitat maps for this estuary are shown as Figure 13 and Figure 14. Figure 13 was obtained from the Channel Coastal Observatory (CCO) website[21] and is based on interpretation of aerial imagery from 2019 to 2021[22]. Figure 14 is derived from an Environment Agency map of saltmarsh habitat.

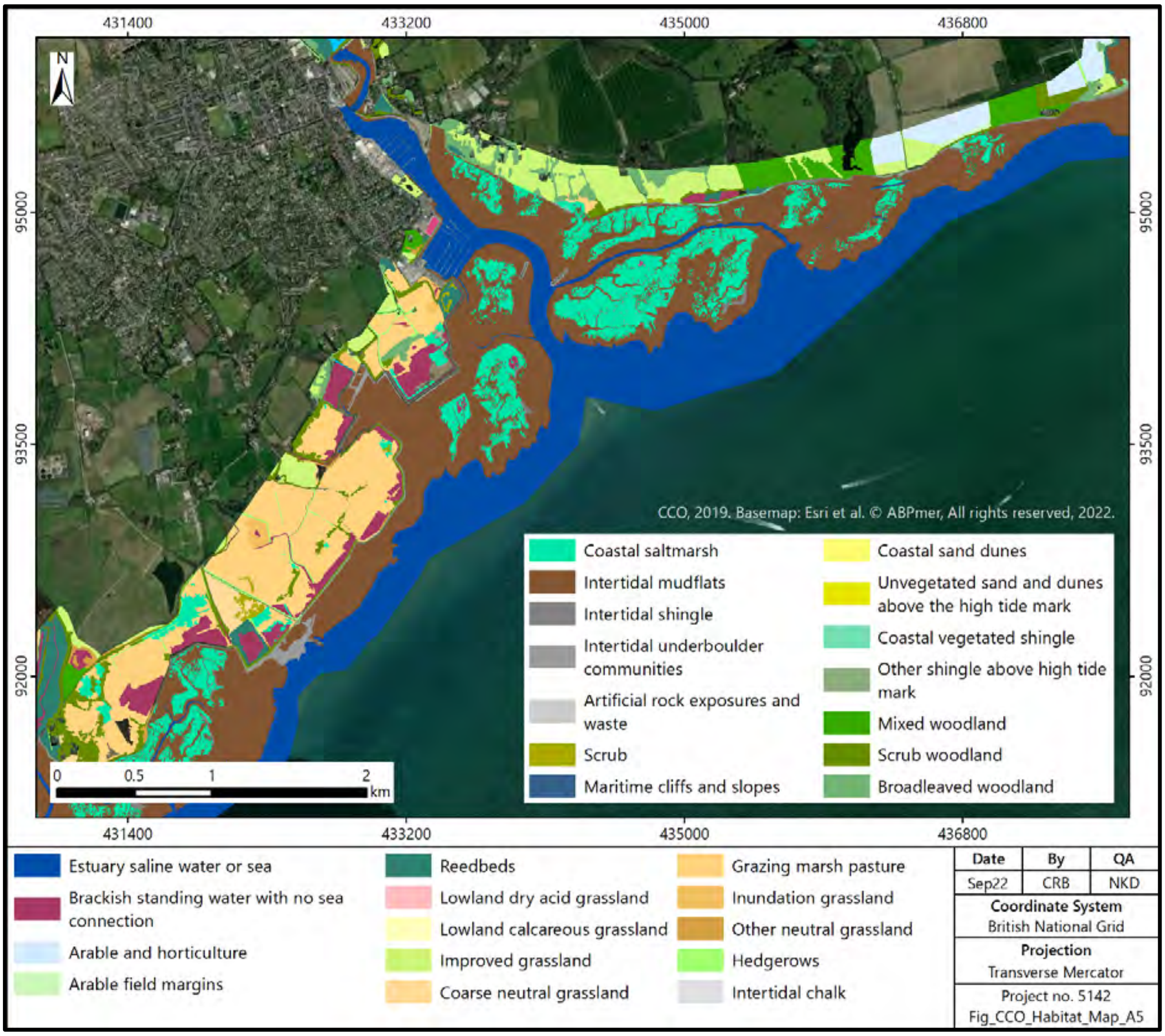


Figure 13. CCO habitat map of Lymington Estuary

21 Channel Coastal Observatory (CCO) website: https://coastalmonitoring.org/cco/
22 As available from the Channel Coastal Observatory (CCO) website: https://coastalmonitoring.org/cco/

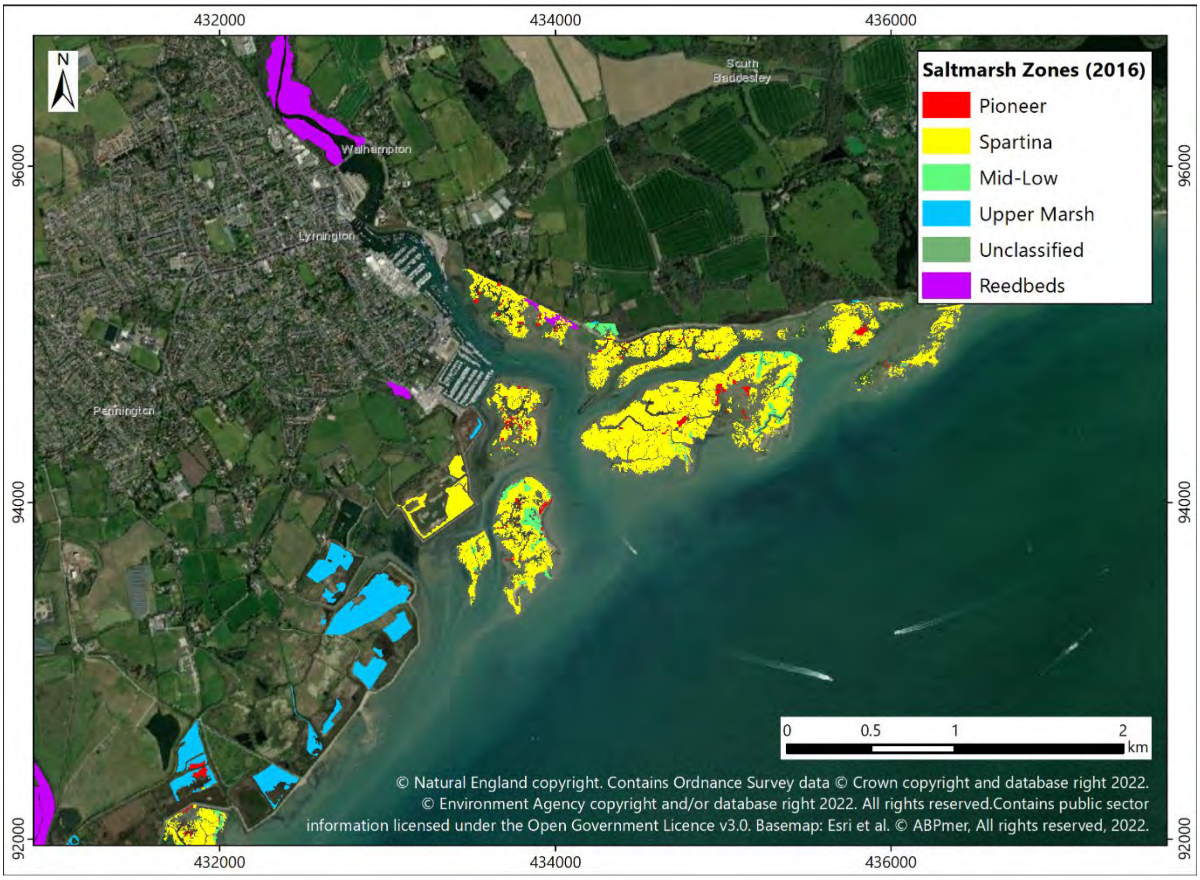


Figure 14. Environment Agency saltmarsh and reedbed map of Lymington Estuary

As illustrated in these figures, saltmarsh extends throughout much of the estuary. Other intertidal habitats that are also present in the estuary include sandflats, annual vegetation of drift lines, *Salicornia*, mixed sediment, sand and shingle, shallow coastal waters, Atlantic salt meadows and cordgrass swards (Black & Veatch, 2017a). Reedbeds (*Phragmites*) are also located in the upper reaches of the estuary. Further details about the key habitats are presented in Section 5.2, which reviews the habitats interest features of the SAC. More details about the composition of the main intertidal and subtidal habitats are described in Section 4.5.2.

The mudflat and saltmarsh habitats provide foraging, refuge nesting sites for nationally important waterbird species. This includes bird species that are interest feature of the SPA and Ramsar wetland. These SPA and Ramsar interest features are described further in Section 4.7.

4.5.2 Intertidal and subtidal habitats

Intertidal mudflats are present along the length of the Lymington Channel around the lower fringes of the saltmarshes. Muds and finer sediment tend to settle in areas where water movement is relatively low (such as in a sheltered harbour), which has led to the pattern of distribution of this habitat. Within the Lymington Estuary, the amount of intertidal mudflat also represents a balance between the rate of recession of the saltmarshes and the slower landward migration of the low water.

As described in Section 4.3, the estuary's intertidal habitats are changing, especially in the outer estuary, as the marshes and mudflats progressively retreat. In the sheltered inner estuary, they are more stable. In general, the low water limit of mudflat habitat, as defined by the Chart Datum (CD) position, has been relatively stable (aside from at the exposed estuary mouth, where CD position is retreating as the channel entrance gradually widens). The ongoing recession of marsh is currently leading to an overall gain in intertidal mudflat; at least since around 1946 (ABPmer, 2010).

While mudflat is generally increasing within the estuary at present, over time, it will progressively revert to subtidal habitats. This will especially occur in the outer estuary which is already widening now, but this will extend to other areas over time, as the rest of the estuary becomes increasingly exposed to wind and wave action, and sea level rise accelerates.

Mud-dominated intertidal habitats often support a relatively low diversity of species, but have high biomass (Browning, 2002). The invertebrate assemblages within mudflat habitats across the Solent are typically dominated by burrowing species such as polychaete worms and bivalve molluscs. Common species include the polychaete worm *Caulleriella* spp. and the peacock worm *Sabella pavonina*. The cockle *Cerastoderma edule*, and hard shell clam *Mercenaria mercenaria* are also common bivalve species, though the latter has declined in recent years (Black & Veatch, 2017a).

Over the last 15 years, a number of surveys have been undertaken to examine the benthic macroinfaunal assemblages specifically within Lymington Estuary. These were carried out to underpin impact assessment studies and they include the following:

- **July 2007,** six core or grab samples were taken and analysed from intertidal and subtidal mudflat sites in the channel. These were collected by Physalia (2007) along the alignments of then proposed (but now completed) Phase 1 and Phase 2 rock armour breakwaters. The results informed the Environmental Impact Assessment (EIA) of these LHC breakwater proposals;
- **June 2010,** 20 samples were taken from 16 sites intertidal and shallow subtidal locations along both side of the channel. This was carried out to inform impact assessments for the operation of W class Wightlink ferries by ABPmer (2010). A single core or grab sample was taken from most sites, but three replicates were retrieved from two sites that had also been sampled by Physalia (2007);
- **September 2016,** three sites were surveyed over the mudflat fronting Boiler Marsh by the Environment Agency. This intertidal invertebrate sampling was done to monitor the LHC's beneficial use of dredge sediment bottom placement initiative. Three replicate samples of the surface sediment were taken for each site (nine in total) using a 0.01 m^2 hand corer. These were taken to compare the benthic assemblages in the deposit ground after the first three trials with those at adjacent control locations; and
- **July 2022,** six core and grab samples were taken on the mudflat habitat in front of Pylewell and Cockleshell marshes. These were collected to inform a Disposal Site Characterisation Assessment (ABPmer, in prep) that will support an application by the Solent Forum for a marine licence to beneficially deposit more dredge sediment through bottom placement at these two sites.

In addition to these surveys, there have also been surveys of the higher level mudflat and clay exposures[23] on saltmarsh fringes. These were undertaken in the north-east corner Boiler Marsh to inform the Wightlink recharge work in that area (ABPmer, 2010). More recently, further samples were taken across wider areas of Boiler Marsh, to inform a future applications for the beneficial placement of more sediment on this site by the LHC. The locations of the sampling stations from all these survey are shown in Figure 15[24].

23 Thee clay exposures are the previously vegetated but now relatively denuded areas of former saltmarsh habitat
24 This figure also shows the location of established and proposed beneficial use placement sites.

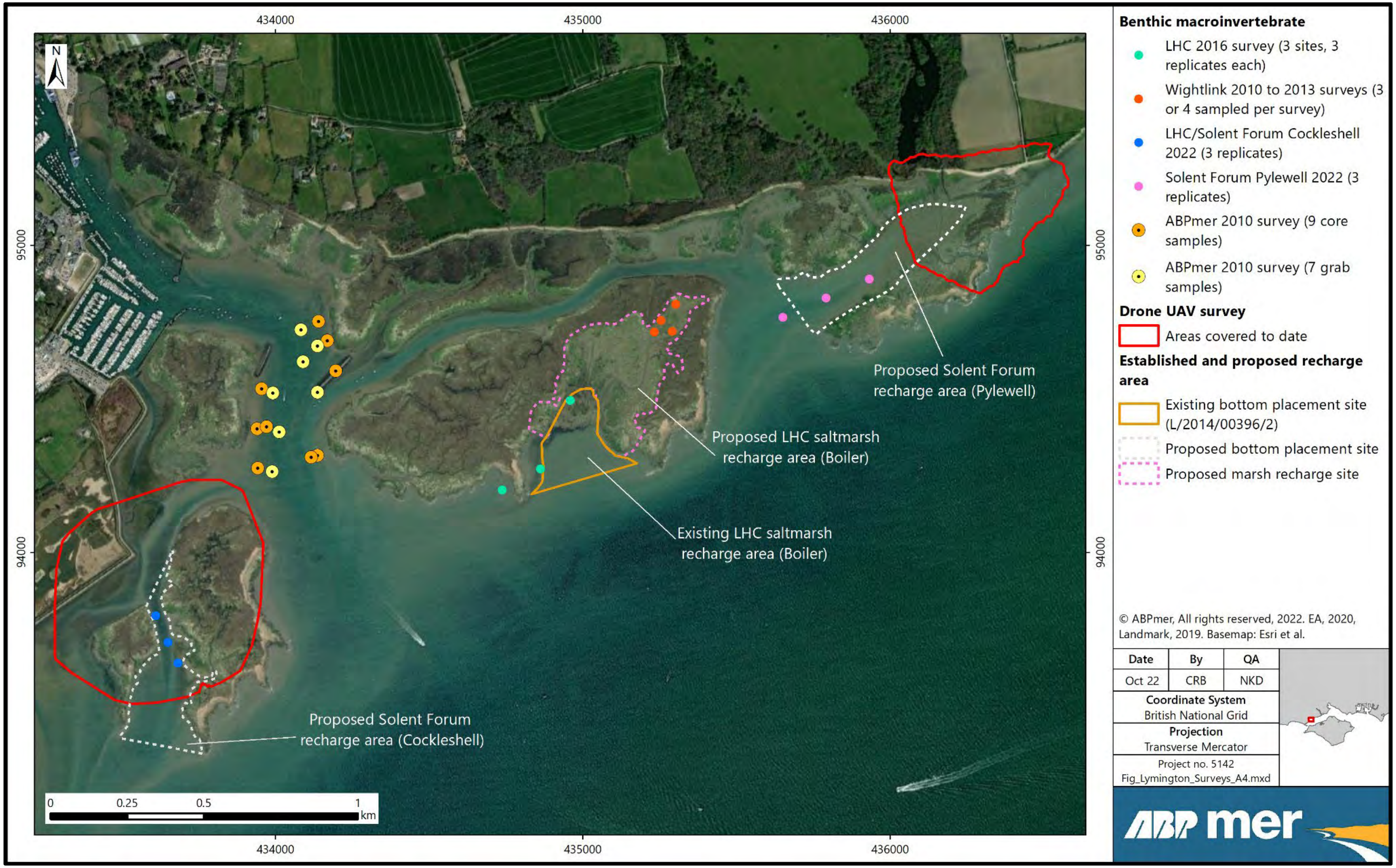


Figure 15. **Location of benthic invertebrate sampling sites from surveys over last 15 years**

During the Physalia survey, 30 invertebrate species were recorded, with polychaetes and oligochaetes being the most common taxonomic groups present. Detritivorous polychaetes were the most abundant faunal group, while one species, the cirratulid *Caulleriella caput-esocis*, accounted for 150,000 organisms m^{-2} on the east side of the channel. Other abundant species included the mud snail *Peringia ulvae*, which was widespread and present at densities of up to 58,000 organisms m^{-2} to the west of the channel. Crustacea were recorded at two of the six sampling stations and included four amphipod taxa.

The ABPmer 2010 survey along the main Lymington channel found that the benthic invertebrate assemblages were typical for what is a comparatively exposed but still relatively stable estuarine habitat. Most sites had a relatively high species-richness for intertidal sites, with around 20 taxa at each site and a moderate overall species abundance of around 22,000 organisms m^{-2}. This applied across all the sites sampled, although there were typical between-site variations according to location and tidal elevation. Following multivariate statistical analysis, the sites were separated into five types (see Figure 16 and Table 9).

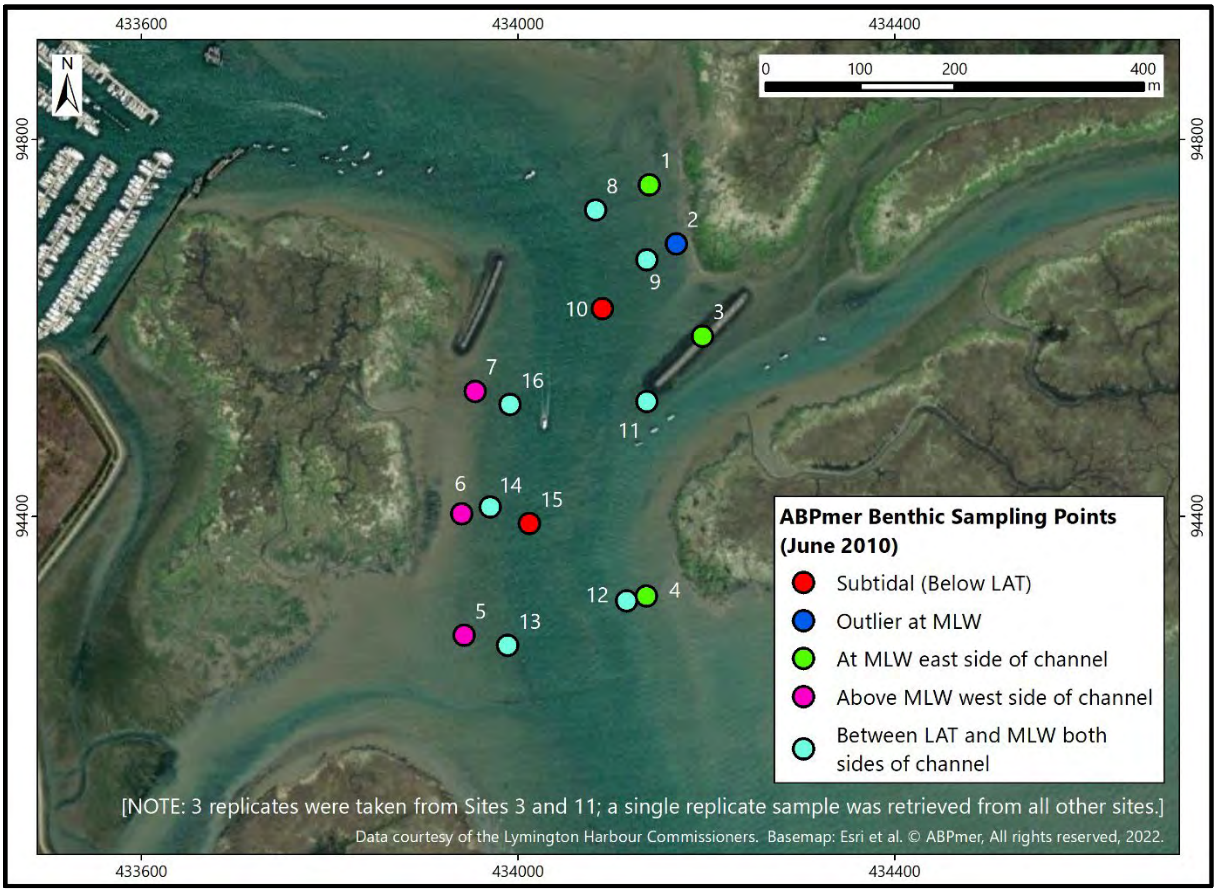


Figure 16. Distribution of five invertebrate assemblages recorded during July 2010 survey

For the most part, the assemblages were characterised by annelid worm species, such as the cirratulid polychaetes *Aphelochaeta* spp and *Chaetozone* gibber, the spionid polychaete *Streblospio shrubsolii*, tubificid oligochaetes, nematodes, the ragworm *Hediste diversicolor* and bristle worm *Melinna palmata*. They were therefore largely polychaete-dominated and/or oligochaete-dominated assemblages but they also supported a range of bivalve species at lower abundance (e.g. cockles *Cerastoderma edule* and Tellinid bivalves such as *Macoma balthica* and *Abra tenuis*), as well as occasional crustacean species.

Table 9. Benthic macroinfaunal assemblages in Lymington Estuary (June 2010 survey)

Site No.	Location and Tidal Elevation	Total No Taxa	Total No. Organisms (per m^2)	Total Biomass (g/m^2)	Benthic Macroinvertebrate Assemblage Characteristics
5	Above MLW west channel	22	39,706	2267	**Type 1) Oligochaete and polychaete dominated highest abundance**: These sites are characterised particularly by annelid worm species such as *Aphelochaeta* spp, Tubificid oligochaetes, *Streblospio shrubsolii*, Nematodes and *Chaetozone gibber*. A range of other annelids are also present while crustacean and bivalve species are only incidentally occurring.
6		19	63,677	1439	
7		15	23,530	17	
1	At MLW east channel	20	24,118	218	**Type 2) Oligochaete and nematode dominated highest abundance**: These sites are characterised and numerically-dominated by Tubificid oligochaete and nematode species but they also support good numbers of a range of polychaete species such as *Mediomastus fragilis*, *Aphelochaeta* spp, *Galathowenia oculata* and Melinna palmata. The bivalve *Abra tenuis* is also present throughout, but other crustacean and bivalve species are only incidentally occurring.
3(1)		16	27,500	48	
3(2)		26	51,618	23	
3(3)		24	53,824	190	
4		11	11,618	9	
2	At MLW east channel	8	2,647	5	**Type 3) Polychaete dominated low abundance**: Site 2 is an 'oultier' site that is not directly compatible with other locations due to an absence of many of the species that are recorded in high abundances elsewhere on the foreshore. However, it supports low numbers of polychaetes species such as *Hediste diversicolor*, *Aphelochaeta* spp., *Melinna palmata* and occasional bivalves.
8	Between CD and MLW	34	15,388	21	**Type 4) Oligochaete and polychaete dominated intermediate abundance:** These sites are highly variable and are generally characterised by high numbers of Aphelochaeta species as well as *good numbers of* Tubificid oligochaetes, *Streblospio shrubsolii*, *Chaetozone gibber* and *Hediste diversicolor*. Bivalve species such as Cerastoderma edule and telinids such as *Abra tenuis* and *Macoma balthica* are also regularly occurring.
9		24	14,502	102	
11(1)		32	15,638	12	
11(2)		28	9,160	1028	
11(3)		26	20,502	1207	
12		15	11,177	5	
13		24	7,296	122	
14		21	29,853	1136	
16		18	16,843	6	
10	Subtidal (below CD)	13	1,887	0.5	**Type 5) Polychaete and oligochaetes at low abundance:** A much lower abundance of organisms compared with intertidal sites but with many of the same species being characteristic of the assemblage including particularly Aphelochaeta spp but also low numbers of *Streblospio shrubsolii and Polydora cornuta*. There is a slightly greater range of species (including a number of crustaceans and *P ulvae*) at Site 15 compared to Site 10. There were though, no bivalve species at either site.
		17	1,364	7	

Source ABPmer, 2010

For the 2016 Environment Agency survey in front of Boiler Marsh, the sediments at each site were found to be a mix of silt and sand, with an increased sand fraction and some gravel in spoil deposit areas. As deposited material mainly consists of silt, the sand and gravel fractions, as with the control sites, are naturally occurring at Boiler Marsh, rather than being sourced from the placed material derived from maintenance dredging (Black & Veatch, 2017b).

The abundance and diversity of macrofauna varied across the three Environment Agency sampling sites, with the assemblages generally reflecting the variable nature of the local sedimentary environment. One of the two control locations (Site B) had the highest abundances overall, due to a very high number of nematodes. The other control location (Site A) had the lowest abundances, but the highest species diversity, indicating a less stressed/changeable environment.

The lowest diversity was found at Site C, in the disposal area, as expected. However, the newly placed deposits had been colonised by opportunistic species, as evidenced by a high abundance of ragworms (*Hediste diversicolor*) here (n= 67), when compared with relatively low numbers present in Sites A and B (n= 6 and 7, respectively). Other species at Site C with more than 10 individuals, included: the polychaete worm *Capitella capitata* and the oligochaete *Tubificoides benedeni* (Black & Veatch, 2017b).

There was also a similar mix of some coarse sediment within a mainly fine sediment matrix across the mudflat habitats at Cockleshell and Pylewell. Surveys of these sites in 2022 at Pylewell and Cockleshell (ABPmer, in. prep) showed that there were around 20 to 40 taxa at each site. At Cockleshell, there was a greater proportion of epifaunal species over the sediment surface due to the presence of coarse sediment across this more exposed area. The dominant and characteristic infaunal species were similar to other parts of the estuary, and included nematodes, *Aphelochaeta marioni, Tubificoides* spp. and *Peringia ulvae*.

4.5.3 Habitat restorations and pressures

Over the last few years, increasing effort has been directed towards restoring and protecting intertidal and subtidal habitats in the Solent. At Lymington, this has included the recent beneficial use campaigns by the LHC. And, as described in Section 2.5, it is hoped that more such programmes will be pursued in the coming years to protect the local saltmarshes. There are other projects now underway, in the estuary and across the Solent more widely, to restore seagrass beds and native oyster habitats.

At Lymington and across the Solent, there has been an historic decline of seagrass/eelgrass beds. They were once prolific in Lymington Estuary, but were evidently wiped out during the 1930s by a wasting disease outbreak and have never recovered. The roots of seagrass plants can help to stabilise the seabed and the plants produce large amounts of organic matter, providing a rich, sheltered environment for a variety of invertebrates and fish such as plaice and sandeel. Sublittoral beds of *Zostera marina* occur on clean muddy sands in shallow, sheltered locations. In the Solent, *Zostera marina* occurs on more open shores on shallow subtidal sand and gravel and is only uncovered during extreme low water spring tides.

In the last few years, a great deal of work has been done in the Solent and across the UK to try and restore seagrass beds. In the north-west Solent, a new restoration site has recently been established, under the Life ReMEDIES project. This site lies close to the Beaulieu Estuary entrance. In early 2022, seeds were planted at this site that had been gathered from healthy seagrass meadows around Osborne Bay, Yarmouth and Bouldnor in July 2021[25]. Another planting project has been undertaken at Langstone Harbour by the HIWWT.

[25] More detail about this ReMEDIES project can be found at https://saveourseabed.co.uk/

There are also many efforts underway to try and restore native oyster populations the Solent. At Lymington, in 2021, Wightlink Ltd and the Blue Marine Foundation placed cages of 300 mature 'brood stock' oysters at Wightlink's berth in the Lymington Estuary. It is intended that these brood stock adults will release larvae into the estuary to promote the natural settlement of native oyster on suitable subtidal substrata.

There is much work still to be done to understand the effectiveness of these restoration measures and, if possible, to scale them up. There continue to be concerns about the risks posed by other pressures, including Invasive Non Native Species (INNS).

From the six samples collected in 2022 at Pylewell and Cockleshell for benthic macroinfaunal analysis (as described in Section 4.5.2), four INNS were recorded at comparatively low abundances (ABPmer, in prep). One of these INNS included *Crepidula fornicate*; this was a single juveniles recorded at two of the sampling sites in the Cockleshell area. As noted in past baseline reviews, subtidal habitat in some areas of the Solent has been modified with the introduction of the slipper limpet *Crepidula fornicata* at the end of the 19th Century.

The shells of live and dead slipper limpets cover the mud surface, modifying the habitat so that it provides a home for species more typical of gravels and mixed ground. The slipper limpet competes with other filter-feeding invertebrates for food and space, and in waters of high concentrations of suspended material, it encourages deposition of mud owing to the accumulation of faeces and pseudofaeces (Barnes et al., 1973).

4.6 Fish species

In the Lymington catchment, at least 15 species of fish are known to occur, with the most significant from a nature conservation point of view being migratory sea trout (which is a key species in the Lymington River SSSI designation), thin lipped mullet (which is nationally uncommon) and eels (which are protected by the Eels (England and Wales) Regulations 2009). In addition, the river supports bullheads *Cottus gobio*, and lamprey species which are listed in Annex II to the EC Habitats Directive (ABPmer, 2010).

Sea trout arrive in the Lymington Estuary in late spring and summer and remain until the autumn before moving north upstream to spawn. The sea trout migrate downstream to the sea between November and January and may return to spawn in subsequent years. The majority of trout migrate to sea as smolts at around two years of age between late March and June. There is however limited monitoring of fish in the estuary (ABPmer, 2010), and no records are shown on the Environment Agency data explorer[26].

Eels reportedly pass through the Lymington Estuary in May and June, returning to the sea after several years in freshwater. This seaward migration of adults can however occur throughout the year. There is no specific data available which defines the numbers of eels that migrate through the estuary (ABPmer, 2010). The Eels (England and Wales) Regulations 2009 came into force on 15 January 2010. These implement the measures as set out in a series of management plans, that identify a number of short- and long-term measures intended to achieve the goal of ensuring that at least 40 % of the potential production of adult eels (under conditions with no anthropogenic disturbance due to fishing, water quality or barriers to migration) return to the sea to spawn.

[26] The Environment Agency ecological data explorer is available at https://environment.data.gov.uk/ecology/explorer/ [accessed August 2022]

Thin lipped mullet is a local and uncommon species of estuaries and coastal waters, breeding in the sea or in brackish waters. Its current use of the estuary is unknown.

In addition, the estuary is known to support populations of bass, flounder and flatfish (though it is not a designated bass in nursery area). The mudflats and creeks act as a nursery and feeding area for many of these species.

4.7 Waterbird populations

4.7.1 Background and key data sources

The Lymington Estuary habitats (including mudflat, saltmarsh, reedbed) support a range of waterbird species. This includes species that use the estuary for feeding and refuge during the overwintering period, as well as those that use the area as a nesting ground during the spring and early summer.

The invertebrate assemblages of the intertidal mudflats (including bivalves and other 'infaunal' species within the sediment as described above) provide feeding resources for certain bird species at low water. The saltmarsh habitats, especially in the outer estuary, provide valuable refuges (roost sites) for waterbirds at high-water as well as nesting grounds for breeding species. The saltmarshes habitats also provide food resources for waterfowl species. In addition to the tidal habitats along the estuary, the nearby hinterland areas including, most notably, the Lymington and Keyhaven Marshes Local Nature Reserve (LNR), are also very valuable for bird populations.

As described in Section 3.1, the international nature conservation value of the Lymington Estuary for bird species is recognised through its designation as a SPA and Ramsar wetland. Much of the outer estuary and the nearshore waters of the north-west Solent, as well as the Lymington and Keyhaven Marshes LNR, all form part of the larger Solent and Southampton Water SPA which was classified in October 1998. These areas are also part of Solent and Southampton Water designated Ramsar wetland which was also classified in 1998.

The Solent and Southampton Water area qualified for SPA status under Article 4.1 of the EU Birds Directive by virtue of supporting populations of European importance of bird species listed on Annex I of the directive. This SPA area also qualifies under Article 4.2 of the directive by regularly supporting at least 20,000 waterfowl. The qualifying species/features for this SPA are outlined in Table 10.

Since the previous baseline review (Black & Veatch, 2017a), the wider Solent and surrounding coastal water have now also been designated as SPA. Classification of the Solent and Dorset Coast SPA was confirmed in 2020. This newly defined SPA encompasses a large swathe of the nearshore waters (nearly 89,000 ha) from Worbarrow Bay in Dorset to Elmer in West Sussex. This SPA protects foraging habitats for breeding Sandwich Tern, Common Tern and Little Tern. The three qualifying species/features for this SPA are listed in Table 11.

As described in Section 1.2 and 4.10, in England and Wales, SPAs and Ramsar wetlands are protected under the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 and The European Union (Withdrawal) Act 2018. These repeal the European Communities Act 1972 while also maintaining EU-derived domestic legislation in UK law.

To provide an up-to-date baseline description of birds using Lymington Estuary and its environs, the latest data from the British Trust for Ornithology (BTO) Wetland Bird Survey (WeBS) programme were obtained. These data provide information on the numbers of non-breeding birds using the areas at high water and at low water, including during the important overwintering period. This latest data is presented in Section 4.7.2 (high tide surveys) and Section 4.7.3 (low water surveys).

Table 10. Solent and Southampton Water SPA qualifying features.

Qualifying Bird Species in the Solent and Southampton Water SPA	
Internationally Important Populations of Regularly Occurring Annex 1 Species	
Species	**Breeding Population**
Mediterranean Gull	2 pairs (15.4% of British population) (1994-1998)
Sandwich Tern	231 pairs (1.7% of British population) (1993-1997)
Common Tern	267 pairs (2.2% of British population) (1993-1997)
Little Tern	49 pairs (2% of British population) (1993-1997)
Roseate Tern	2 pairs (3.3% of British population) (1993-1997)
Internationally Important Populations of Regularly Occurring Migratory Species	
Species	**Wintering Population (5-year Peak Mean 1992/93-1996/97)**
Db Brent Goose	7,506 individual birds (2.5% of West Siberian/West European population)
Eurasian Teal	4,400 individual birds (1.1% of Northwest European population)
Ringed Plover	552 individual birds (1.1% of European/Northwest African population)
Black-tailed Godwit	1,125 individual birds (1.6% of Icelandic breeding population)
Internationally Important Assemblage of Waterfowl	
Importance	**Wintering Population**
Wintering waterfowl assemblage	51,361 individual birds (21,401 wildfowl, 29,960 waders) including Dark-bellied Brent Goose, Eurasian Teal, Ringed Plover and Black-tailed Godwit.

In addition, to update the baseline information about the value of the estuary for nesting birds, the findings from recent breeding bird surveys were discussed with Hampshire County Council (HCC) ecologist. The latest breeding bird survey report for the area was also provided by HCC which describes findings from 2021 surveys (HCC, 2021). This latest HCC report, and discussions with HCC, helped to describe the status of breeding birds on the Lymington marshes and to clarify some of the spatial and temporal changes that are occurring on these habitats. These results, along with counts from a previous review of breeding birds in the outer estuary (Black & Veatch, 2008), are summarised in Section 4.7.4.

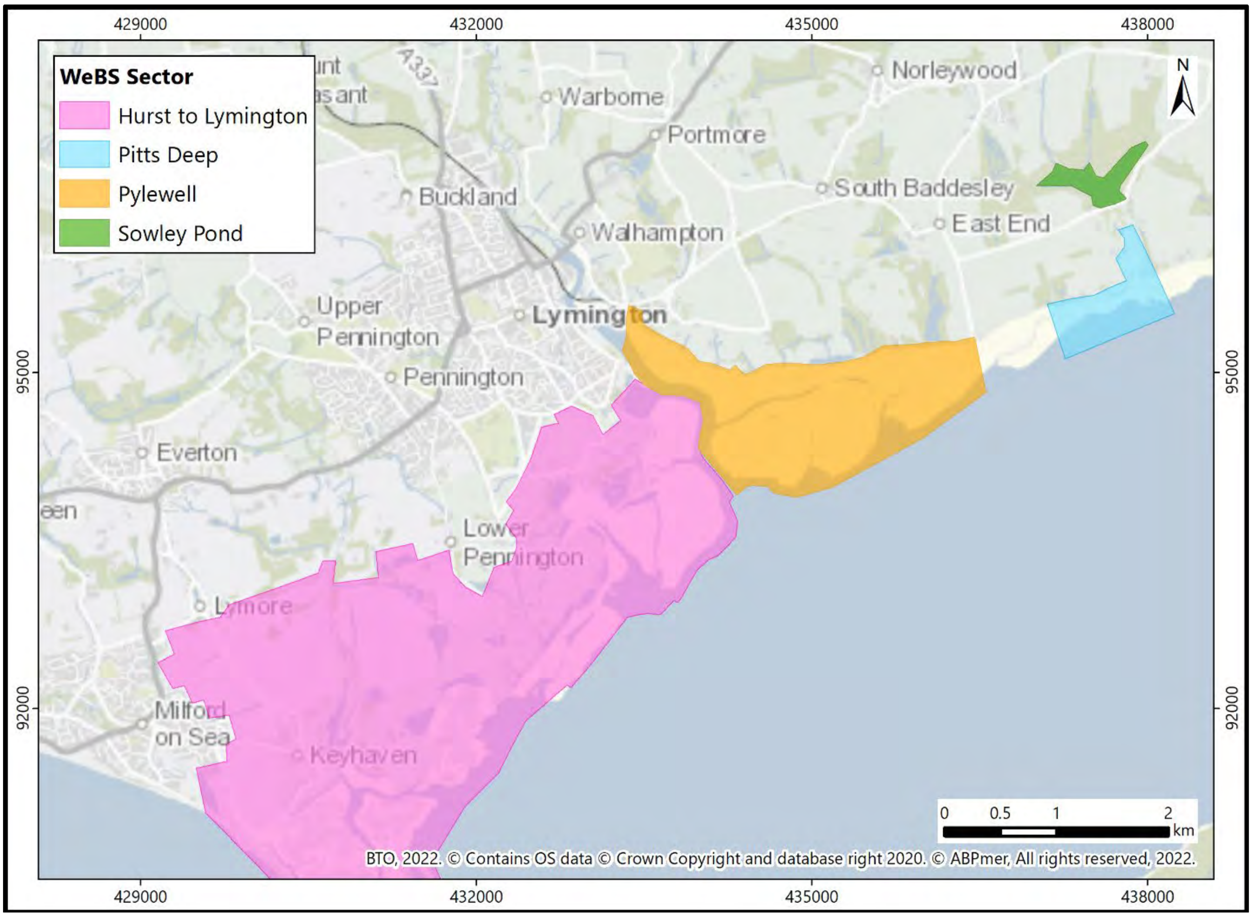
Table 11. Solent and Dorset Coast SPA qualifying features

Internationally Important Populations of Regularly Occurring Annex 1 Species	
Species	Breeding Population
Sandwich Tern	441 pairs (4.0% of British breeding population) (2008-2014)
Common Tern	492 pairs (4.8% of British breeding population) (2008-2014)
Little Tern	63 pairs (3.3% of British population) (2008-2014)

4.7.2 High tide surveys

The abundance of waterbirds using Lymington and its environs at high water is described by WeBS 'Core Count' data. These Core Counts are carried out during high tide periods by volunteer surveyors. The results therefore describe the abundance of birds when they are aggregating at roosting locations or on inland sites. Locally, two broad survey areas are covered by these surveys. These are referred to as the 'Hurst to Lymington' and 'Pylewell' count sectors as shown on Figure 17. They cover the outer Lymington Estuary, but also much of the wider coastline from Hurst Spit to Tanners Lane.

The latest available WeBS Core Count data from these high tide surveys covers the period up to June 2021. At this time, the latest available monthly survey data (as provided by BTO) is more complete for the Hurst to Lymington frontage that for Pylewell. For Hurst to Lymington, there is a complete set of monthly data for each of the winters from 2016/17 to 2020/21. For Pylewell, the latest data extends to the 2019/20 winter. To summarise the latest survey results, the annual peak abundance of individual key species is shown in Table 12 for the 'Hurst to Lymington' sector, and Table 13 for the 'Pylewell' area.



Copyright British Trust for Ornithology[27]

Figure 17 Location of BTO Wetland Bird Survey (WeBS) 'Core Count' sectors

Table 12. Annual peak counts of key species in 'Pylewell' sector at high water

Species	2016/17	2017/18	2018/19	2019/20	Peak Average (2016/17-2019/20)
Avocet			20		5
Bar-tailed Godwit	1	8	9		5
Black-headed Gull		20	500	130	163
Black-tailed Godwit	2		3		1
Brent Goose (Dark-bellied)	270	300	350	200	280
Canada Goose	11	24	23	2	15
Common Gull		1	1		1
Cormorant	4	12	13	23	13

27 Obtained from BTO WeBS data site: https://www.bto.org/our-science/projects/wetland-bird-survey/data

Species	2016/17	2017/18	2018/19	2019/20	Peak Average (2016/17-2019/20)
Curlew	20	27	35	30	28
Dunlin	700	1000	600	450	688
Eider (except Shetland)	10	33	1	11	14
Great Black-backed Gull	3	3	5	2	3
Great Crested Grebe	3	7	4	1	4
Great Northern Diver		1		1	1
Greenshank	1	3	1	1	2
Grey Heron	1	1	1	2	1
Grey Plover	60	90	30	50	58
Greylag Goose (British/Irish)			60		15
Herring Gull	3	7	9	6	6
Kingfisher	1	1			1
Knot	250	100	50		100
Lapwing		5			1
Little Egret	4	4	5	7	5
Mallard			7	14	5
Mediterranean Gull	2	5	13	4	6
Mute Swan	6	1	0	1	2
Oystercatcher	13	9	15	8	11
Pintail	28	50	60	40	45
Red-breasted Merganser	10	11	3	3	7
Redshank	8	19	30	25	21
Ringed Plover	30	30	3	5	17
Shelduck	18	8	14	9	12
Spoonbill	6	6	10		6
Teal	13	50	70		33
Turnstone	28	50	2	22	26
Wigeon	590	350	400	230	393
Avocet			20		5
Bar-tailed Godwit	1	8	9		5

Source: BTO, WeBS data 2016/17 to 2019/20

Table 13. Annual peak counts of key species in ''Hurst to Lymington' sector at high water

Species	2016/17	2017/18	2018/19	2019/20	2020/21	Peak Average (2015/16-2020/21)
Avocet	11	16	24	25	29	19
Barnacle Goose	2	0	3	3	9	2
Bar-tailed Godwit	9	8	3	33	12	13
Black-headed Gull	0	250	0	0	0	63
Black-tailed Godwit	478	355	670	563	220	517
Brent Goose (Dark-bellied)	1,085	1,273	1,942	1,426	1,395	1,432

Species	2016/17	2017/18	2018/19	2019/20	2020/21	Peak Average (2015/16-2020/21)
Common Gull	11	3	3	2	2	5
Common Sandpiper	7	1	0	0	0	2
Common Scoter	1	0	1	0	0	1
Common Tern	1	1	0	0	0	1
Coot	160	125	83	143	97	128
Cormorant	23	17	26	18	18	21
Curlew	185	200	185	224	213	199
Curlew Sandpiper	9	0	0	0	1	2
Dunlin	2,480	2,500	2,750	2,000	2,440	2,433
Eider (except Shetland)	13	18	29	8	6	17
Gadwall	34	20	32	87	52	43
Golden Plover	250	300	400	650	470	400
Goldeneye	7	7	8	6	1	7
Great Black-backed Gull	5	6	7	14	7	8
Great Crested Grebe	8	14	17	15	26	14
Great Northern Diver	1	1	0	0	1	1
Greenshank	18	20	17	15	11	18
Grey Heron	6	7	6	5	6	6
Grey Plover	160	244	143	81	153	157
Greylag Goose	2	0	0	1	5	1
Herring Gull	29	30	50	68	32	44
Kingfisher	2	3	2	3	3	3
Knot	450	320	350	32	180	288
Lapwing	1,205	712	1,070	778	985	941
Lesser Black-backed Gull	3	3	1	0	0	2
Little Egret	29	25	29	22	53	26
Little Grebe	38	35	24	31	17	32
Little Ringed Plover	0	0	1	0	0	0
Little Stint	3	0	0	0	4	1
Long-tailed Duck	0	0	2	1	0	1
Mallard	326	244	388	233	186	298
Mediterranean Gull	4	4	2	2	3	3
Moorhen	10	8	10	10	6	10
Mute Swan	44	46	62	41	47	48
Oystercatcher	303	187	160	186	196	209
Pintail	248	407	303	212	550	293
Pochard	9	0	11	1	1	5
Purple Sandpiper	0	0	0	1	0	0
Red-breasted Merganser	32	17	19	16	20	21
Red-necked Grebe	0	2	0	0	0	1
Redshank	410	250	265	191	273	279

Species	2016/17	2017/18	2018/19	2019/20	2020/21	Peak Average (2015/16-2020/21)
Red-throated Diver	0	0	2	0	0	1
Ringed Plover	150	300	113	80	177	161
Ruff	3	5	13	12	7	8
Sanderling	0	0	2	0	0	1
Sandwich Tern	3	2	0	0	3	1
Scaup	0	0	1	0	0	0
Shag	1	0	0	0	0	0
Shelduck	148	187	165	192	160	173
Shoveler	110	137	162	210	140	155
Slavonian Grebe	1	1	0	2	0	1
Smew	0	0	0	0	3	0
Snipe	33	9	7	9	76	15
Spoonbill	2	6	2	10	6	5
Spotted Redshank	8	8	9	10	6	9
Teal	1,530	1,055	1,140	1,300	692	1,256
Tufted Duck	41	41	55	50	42	47
Turnstone	141	150	150	103	164	136
Water Rail	2	3	1	1	2	2
Whimbrel	0	0	0	1	0	0
Wigeon	1,760	1,267	1,660	1,015	1,245	1,426
Cells shaded green indicate 5-year averages greater than the National Threshold[28].						

Source: BTO, WeBS data 2016/17 to 2019/20

During these most recent winter periods, 75 and 38 bird species were respectively recorded at the Hurst to Lymington and Pylewell sections. The overall peak mean number of waterbirds across all winters is 1,989 at Pylewell and 12,073 at Hurst to Lymington. The diversity and abundance of species is greater across Hurst to Lymington, because it is a larger area that covers a much boarder range of coastal and landside wetland habitats (including the LNR) ,than the Pylewell count section.

These abundance values equate to around 4 % and 24 % respectively of the total wintering waterbird assemblage value that is cited within the Solent and Southampton SPA designation (see Table 10). Some of the main species recorded across both areas include Black-headed Gull, Brent Goose, Dunlin, Knot, Pintail and Wigeon. Ringed Plover and Teal are also present at both, so all four of the overwintering bird species that are individually cited in the Solent and Southampton Water SPA (see Table 10) are recorded in these sections.

Across the Hurst to Lymington area, the following species were present at nationally important levels: Black tailed Godwit, Brent Goose, Greenshank, Pintail and Spotted Redshank. These species are highlighted in green in Table 13.

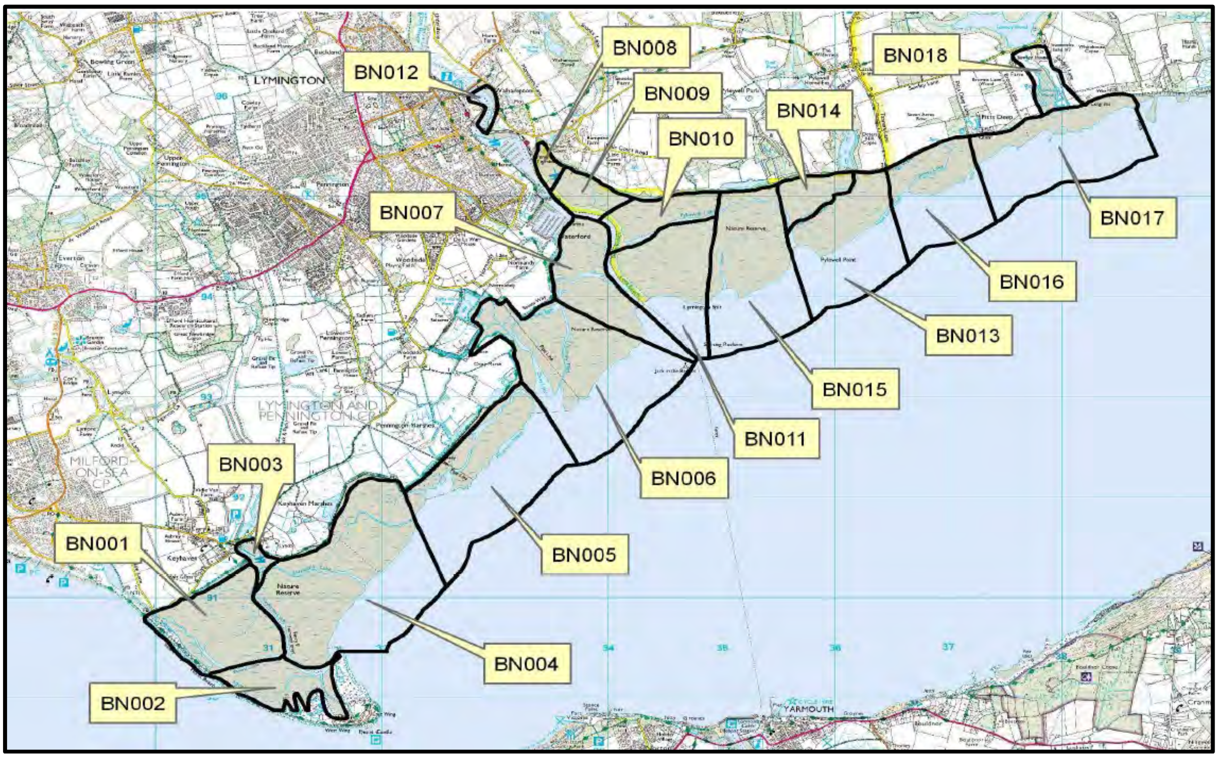
[28] The thresholds levels are available at: Species Threshold Levels (https://www.bto.org/volunteer-surveys/webs/data/species-threshold-levels). The thresholds are set as 1% of the biogeographic population (internationally important) or national population (nationally important).

Also occurring in the Hurst to Lymington sector at nationally important levels (simply because they are present at all) are Spoonbill, which evidently now regularly occur on the site (peak average five over five winters). Some other species that are abundant, even if they do not exceed thresholds of national importance due to larger aggregations elsewhere in the country, include Avocet, Curlew, Lapwing, Redshank, Ringed Plover, Shelduck, Teal and Turnstone in the Hurst to Lymington section and Grey Plover (peak average 58 over four winters) on the Pylewell section.

4.7.3 Low water surveys

The abundance and distribution of waterbirds across intertidal environments of the Lymington Estuary and its environs is described in occasional WeBS 'Low Tide' surveys. Under the WeBS programme, these surveys are carried out less frequently than the Core Counts because they require more intensive survey effort. They are also typically done between November and February (compared to monthly and through the year for WeBS Core Counts).

These surveys extend across a single large area that is referred to as the 'North-west Solent' count sector. This area covers the coastline from Hurst Spit to the promontory east of Sowley, but it is also divided into subsections for different field recorders to cover. Image 17 shows the area that is covered, and the individual subsection that are surveyed within it.



Source BTO WeBS data site

Image 17. Location of BTO WeBS low tide count sectors

Eight such low tide surveys have been undertaken over the last three decades which cover the outer Lymington Estuary in whole or in part since the early 1990s. The surveys undertaken in 2004/5, 2010/11 and 2012/13 winters were reviewed within the preceding baseline document (Black & Veatch, 2017a). The most recent low water count which covered the Lymington Estuary was undertaken during the 2018/2019 winter. The data from these surveys were obtained from the BTO.

The summary results from the 2018/19 winter surveys are shown in Table 14. This describes the monthly peak abundance, the monthly average peak and the average density of birds as they are distributed across the survey area. The most abundant species across the foreshore during the 2018/19 low water survey period were Dunlin, Dark-bellied Brent Geese, Knot, Wigeon, Black-tailed Godwit and Teal. The peak counts of these species were 5,690; 1,304; 596; 696; 273 and 330 respectively.

The total abundance (as the sum of the peaks for each species) was 10,392. As with the high water counts, this is around 20% of the total wintering waterbird assemblage value that is cited within the Solent and Southampton SPA designation. And, as expected, all four of the overwintering bird species that are individually cited in the Solent and Southampton Water SPA (see Table 10) are again recorded in these low water surveys.

Table 14. WeBS Low tide counts on the North-West Solent during the 2018/19 winter

Species	Month Peak	Month Average	Average Density
Brent Goose (Dark-bellied	1,304	1,023	1.16
Canada Goose	120	60	8.57
Mute Swan	78	46	6.57
Shelduck	113	61	0.14
Wigeon	696	433	0.78
Mallard	78	61	0.10
Pintail	82	37	0.09
Teal	330	177	0.58
Eider	1	1	0.01
Red-breasted Merganser	20	12	0.06
Coot	1	1	1.00
Little Grebe	5	3	3.00
Great Crested Grebe	21	14	0.06
Oystercatcher	157	124	0.22
Avocet	15	11	0.09
Lapwing	4	2	0.03
Golden Plover	8	4	0.67
Grey Plover	160	116	0.27
Ringed Plover	55	35	0.12
Curlew	105	84	0.22
Bar-tailed Godwit	11	9	0.03
Black-tailed Godwit	273	203	0.79
Turnstone	81	53	0.11
Knot	596	440	2.49
Dunlin	5,690	4,277	7.68
Snipe	1	1	0.03
Redshank	177	149	0.29
Spotted Redshank	5	4	0.05
Greenshank	3	3	0.02
Black-headed Gull	125	93	(0.72)
Mediterranean Gull	2	1	(<0.01)
Common Gull	1	1	(0.02)
Great Black-backed Gull	15	10	(0.02)
Herring Gull	16	12	(0.06)
Cormorant	21	16	0.03
Spoonbill	1	1	0.02

Species	Month Peak	Month Average	Average Density
Grey Heron	1	1	0.02
Little Egret	17	16	0.04
Kingfisher	1	1	0.14

The individual count sections which cover Lymington Estuary particularly, as shown in Image 17, are sector numbers are BN007, BN008, BN009, BN010 and BN011. These sites were also individually reviewed for the previous baseline (Black & Veatch, 2017a). Of these however, only BN007 was surveyed during the 2018/19 winter.

Image 18 illustrates the coverage and shows the subsections that were, and were not, surveyed. This image also describes the comparative distribution of Wigeon during the 2012/13 and 2018/19 surveys.

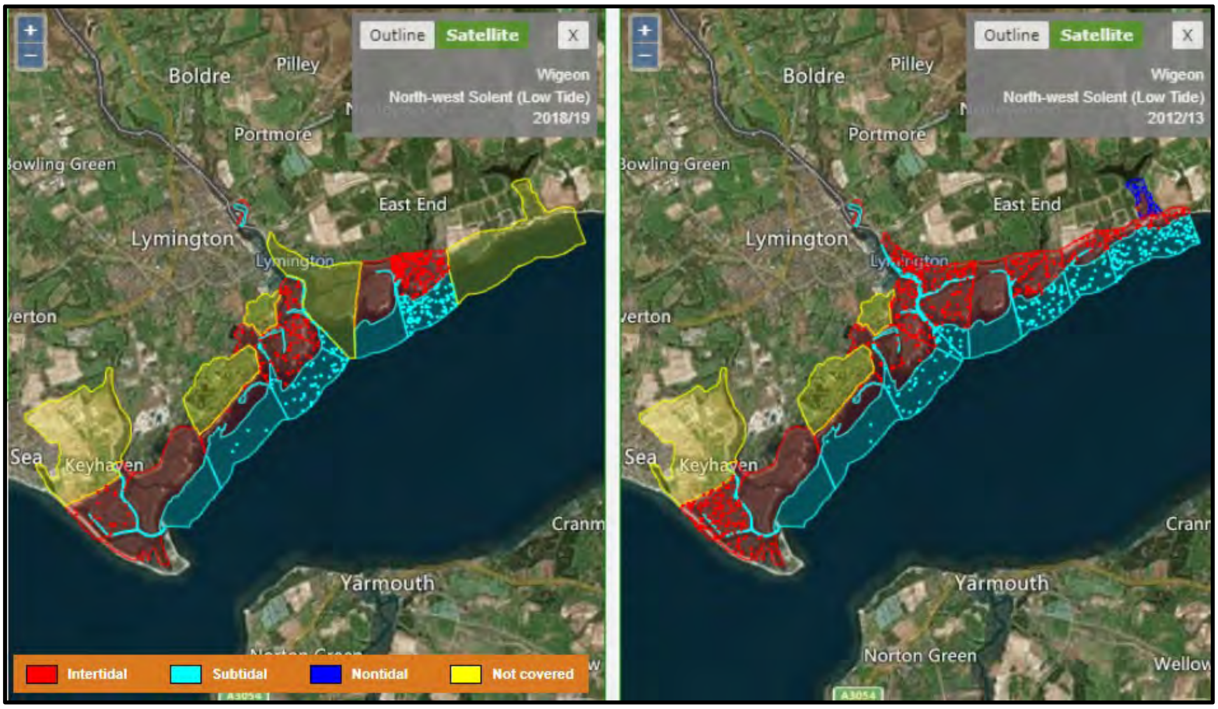


Image 18. Distribution of Wigeon for 2012/13 (right) and 2018/19 (left) low tide surveys

For this baseline review therefore the results taken only from Section BN007 in 2018/19 are compared with the findings from previous surveys. These results are shown in Table 15 and they show that the waterbird populations are compatible with past surveys. The characteristic species are the same as in past years. There is also a notable occurrence in 2018/19 of one individual Spoonbill that has not been recorded previously.

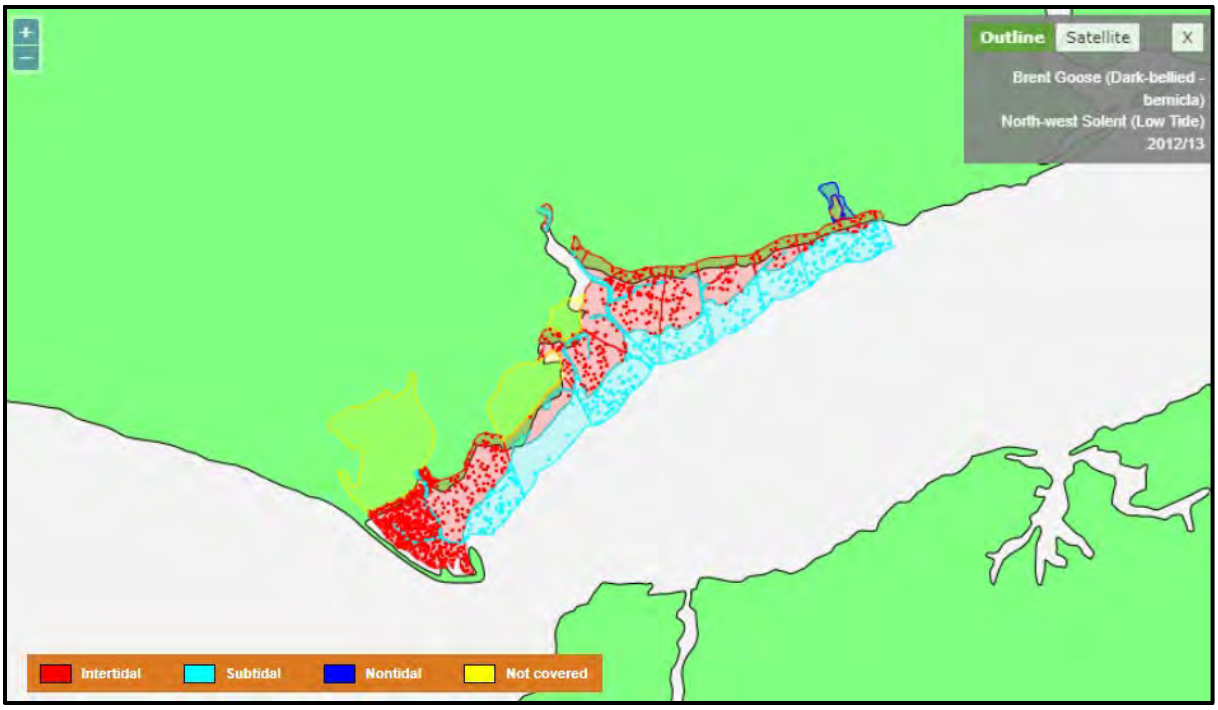
As many of the subsections were not surveyed in 2018/19, care needs to be taken when making any between-year comparisons based on these data. While fully recognising these limitations, the abundance and distribution of the species Dark-bellied Brent Goose was considered further as one indicative illustration of the data and the findings. The abundance of Brent Goose in 2018/19 (peak count of 1,304 birds and an average density of 1.16) was compared with previous surveys and found to be broadly consistent with past records.

29 BTO WeBS: https://www.bto.org/our-science/projects/wetland-bird-survey/data

To illustrate this, the abundance and average density of this species in each low water survey since 1992/93 winter were are as follows[30].

- **2012/13 survey**: peak count 2,760 (average density 1.18);
- **2010/11 survey**: peak count 3,827 (average density 1.68);
- **2009/10 survey**: peak count 956 (average density 0.84);
- **2008/09 survey**: peak count 2,495 (average density 2.14);
- **2004/05 survey**: peak count 2,026 (average density 0.78);
- **1997/98 survey**: peak count 2,095 (average density 1.66); and
- **1992/93 survey**: peak count 5,418 (average density 2.07).

The BTO maps also provide useful descriptions of distributions of different species across habitat types and count sections. They show, for example, how Dark-bellied Brent Goose, is a regularly occurring species throughout the survey area during the low tide surveys (see Image 19 which shows the distribution from the 2012/13 surveys). They are only rarely occurring in the Pennington part of the foreshore (count Section BN0005 as shown on Image 17), which is a reflection of the fact that the amount of remaining intertidal habitat is now comparatively low in this section.



Copyright British Trust for Ornithology (from BTO WeBS data site)

Image 19. Distribution of Dark bellied Brent Goose for 2012/13 WeBS low tide survey

30 The average density is the best between-survey comparative indicator because the count areas that are covered can vary between years (see Image 18 for an illustration of this).

Table 15. Average winter bird counts at low tide in BTO areas BN007

Species	Preferred Habitats	2004/05	2010/11	2012/13	2018/19
Bar-tailed Godwit	Intertidal		1	2	2
Black-tailed Godwit	Intertidal & non-tidal	3	3	0	2
Brent Goose (Dark-bellied)	All habitats		130	26	220
Cormorant	All habitats			1	1
Curlew	Intertidal & non-tidal	8	4	21	10
Dunlin	Intertidal	217	193	465	850
Golden Plover	Intertidal & non-tidal	4		1	
Goldeneye	Sub-tidal			1	
Great Crested Grebe	Sub-tidal			1	
Greenshank	Intertidal & non-tidal				1
Grey Plover	Intertidal	7	13	31	8
Knot	Intertidal			3	2
Lapwing	Intertidal & non-tidal			11	
Little Egret	Intertidal & non-tidal	2	2	3	1
Mallard	All habitats	1		7	7
Oystercatcher	Intertidal	17	7	9	20
Pintail	All habitats				11
Red-breasted Merganser	Sub-tidal			3	
Redshank	Intertidal & non-tidal	27	4	13	16
Ringed Plover	Intertidal		3	1	10
Shelduck	All habitats	7	8	1	12
Shoveler	All habitats		2	3	
Slavonian Grebe	Sub-tidal			1	
Spoonbill	Intertidal & non-tidal				1
Teal	All habitats	16	33	74	55
Turnstone	Intertidal	4	5	3	1
Wigeon	All habitats		33	82	60

4.7.4 Breeding surveys

As noted in Section 4.7.1, the abundance and distribution of nesting birds and the degree of success experienced by breeding water birds, are regularly examined by HCC. This HCC monitoring work covers the marshes from Hurst to Sowley (Figure 18 shows the key survey locations which correspond to the main saltmarsh complexes).

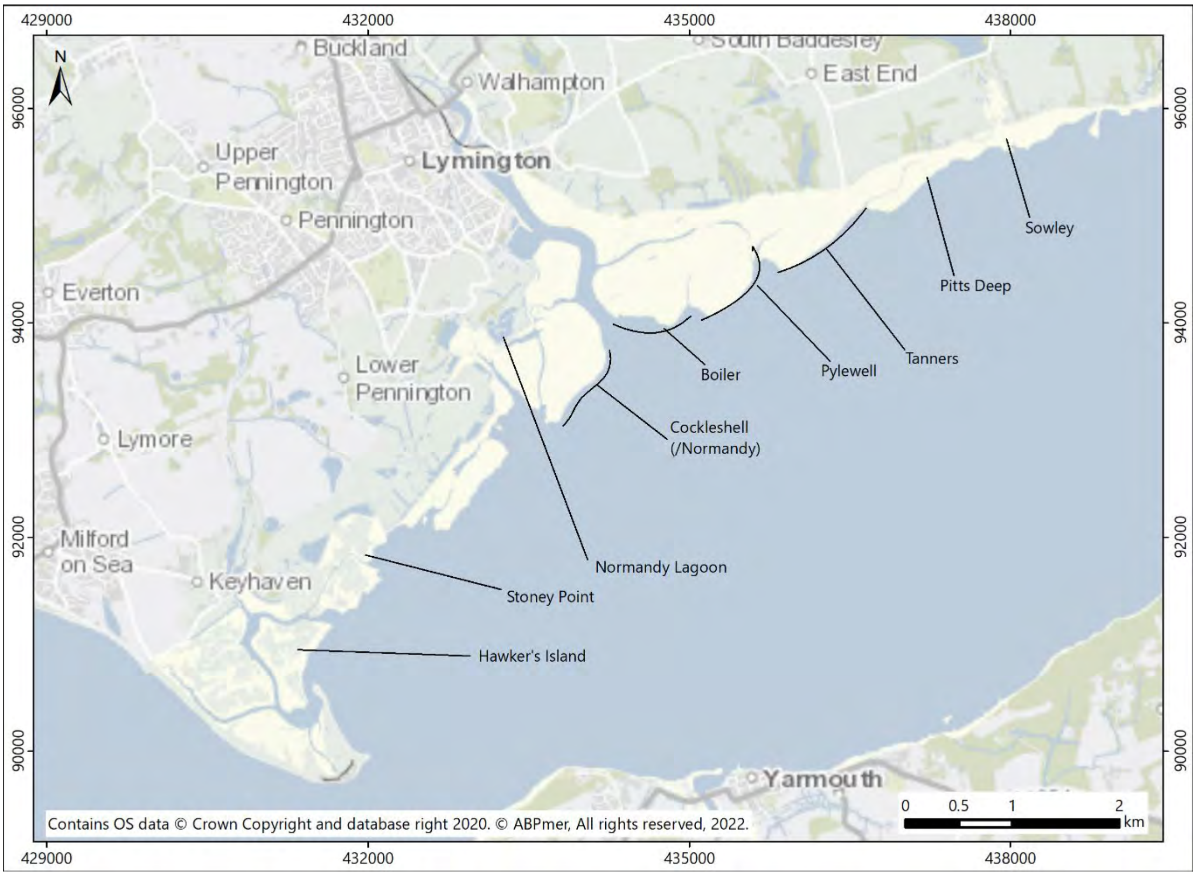


Figure 18. Saltmarshes and Normandy lagoon covered by HCC breeding bird surveys

This work has shown that the Boiler Marsh, just to the east of Lymington Estuary, is the most important for breeding birds. In particular, the eastern part of this marsh (called Pylewell for the breeding bird surveys as shown on Figure 18) is the most valuable section of this island marsh.

A main reason why this area is the most valuable is because large parts of it are still relatively high in the tidal frame. These slightly higher lying areas have low levels of tidal inundation during the summer months and exhibit dense coverage with marsh plants. To illustrate this, Image 20 shows three nests in close proximity on a dense growth of Sea Purslane, as recorded during a site visit in May 2022.

On Boiler Marsh (including the Pylewell count area), 1,850 active Black-headed Gull nests were recorded in May 2021, along with 20 nesting pairs of Mediterranean Gull, around 25 pairs of Common Tern, and a potentially late-arriving Roseate Tern. By comparison, marsh areas to the west of the survey areas (further towards Keyhaven particularly) used to have more nesting birds, but are now too low in the tidal frame to act as valuable breeding sites.

The Boiler Marsh area is also valuable because it is relatively inaccessible to predators. This was evidenced in 2021, when there was substantial predation of nesting birds on the Normandy/Cockleshell marshes. The Normandy/Cockleshell marshes that lie just to the west of the Lymington Estuary entrance (see Image 17) are also relatively high in the tidal frame in several areas and are therefore potentially valuable for breeding birds.

In May 2021, the shingle ridge on Normandy/Cockleshell supported the largest recorded Sandwich Tern colony the Western Solent (315 active nests). There were also 55 nesting pairs of Mediterranean Gull, around 42 pairs of Common Tern and 2,430 active Black-headed Gull nests. However, the Sandwich Tern and Mediterranean Gull colonies on these marsh islands were lost through predation (probably by fox(es) based on analysis of selected carcasses) (HCC, pers comm).

As described in previous baseline review (Black & Veatch, 2017a), a more localised and bespoke study of breeding birds in the outer Lymington Estuary was also undertaken to inform the Lymington Harbour Protection EIA (Black & Veatch, 2008). The findings from this work complement the broader patterns observed from the HCC monitoring.

For these Lymington Harbour Protection surveys, a local ornithologist provided information on the presence of breeding birds across the outer estuary. This again showed that the Boiler Marsh site was the most valuable and that the other locations had limited value, which corresponds to the broader HCC survey observations.

Despite the major challenge posed by predation, there were notable successes in 2021. The initially large number of Sandwich Terns before the predation event was encouraging, and the initial increase of Mediterranean Gull in this area (again before predation) also suggests a continued expansions of this species' breeding range following increases recently observed in the Eastern Solent. There were also breeding successes on Boiler Marsh and on the Normandy lagoons in the LNR, for Common and Little Tern and other species.

Source: ABPmer 5 May 2022

Image 20. Black-headed Gull nests on Boiler Marsh within dense patch of Sea Purslane

During 2021 and 2022, a few management measures have also been implemented to protect breeding birds. For example, electrified fencing has been added around the Normandy Lagoons, and signs have been put in place on the Boiler/Pylewell, Hawker's Island, Stony Point and Cockleshell marshes to discourage visitors from landing. Also, the formerly licensed egg collection on the marshes has been stopped.

These measures and recent survey findings are encouraging, but it is also recognised that the ongoing erosion of the marshes at Lymington (especially those to the east of the estuary, which have the most value in the North West Solent area) represents an ongoing threat to the viability of breeding bird species in the area.

4.8 Sediment quality

4.8.1 Action level standards

Sediment quality is described in terms of a range of chemical parameters that can be associated with sediment due to their low solubilities in water. The following chemical parameters are measured:

- Heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc) and other metals (aluminium, boron, iron, manganese, selenium, silver and vanadium);
- Organotins (tributyltin (TBT) and dibutyltin (DBT));
- Total petroleum hydrocarbons (TPH);
- Polyaromatic hydrocarbons (PAHs) (USEPA 16);
- Polychlorinated biphenyls (PCBs) including 25 congeners;
- Ammonia; and
- Sulphide.

In contrast to water quality, the UK does not have set environmental quality standards (EQSs) for *in situ* sediment quality. The only requirement is for 'no deterioration' in the EC Dangerous Substances List 1 parameters. Whilst there are no sediment quality EQSs, the significance of contamination in sediment for disposal at sea are evaluated using the Centre for Environment, Fisheries and Aquaculture Science (Cefas) Action Level (AL) system. ALs are not statutory contamination concentrations but are used as part of a 'weight of evidence' approach adopted for determining licences for the disposal of dredged material at sea[31].

These values are generally used in conjunction with a range of other assessment methodologies (e.g. bioassays, comparison with historic data, knowledge of site environmental conditions, physical characteristics of disposal material, etc.). ALs do not therefore define fixed 'pass' or 'fail' criteria, but can provide a trigger for additional assessment.

In general, contamination levels in dredged material that are below AL 1 are unlikely to influence a licensing decision. In contrast, contamination levels above AL 2 are considered unsuitable for disposal at sea, and as a result may have an impact on other waste streams (i.e. moving to landfill) and require consideration under other waste related licensing and regulation. Contamination levels between AL 1 and AL 2 requires further consideration and testing before a decision can be made. For an explanation of how the Action Level values were established, refer to Defra (2003)..

[31] In 2020, Defra carried out a review of the action levels. A report by Cefas (2020) for Defra proposed revised levels. A series of consultation/workshops have since been held over the last two years to discuss these proposals. However, the updated action levels have not yet been officially adopted. Therefore, the established and existing action levels have been used for this baseline review.

4.8.2 Quality of Lymington sediments

Sediment quality analysis in Lymington Harbour was carried out by Cefas as part of the MMO marine licensing procedure for disposal of maintenance dredged material at Hurst Fort (Licence L/2014/00396/1). The most recent sediment quality survey was undertaken in December 2019. This was conducted in under sample plan SAM/2019/00043 and in fulfilment of Condition 5.2.2 on Marine Licence L/2014/00396/2. The results were subsequently provided to the MMO, prepared in consultation with Cefas.

The sampling regime and analysis was undertaken in accordance with the sample plan. The samples were collected from eight stations (4492707 to 4492714) across Lymington Estuary and harbour areas. The sediment samples were then analysed by MMO-approved laboratories for the following physical and chemical parameters:

- Particle size analysis (PSA);
- Trace metals: Arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc;
- Organotins: Dibutyltin (DBT) and tributyltin (TBT); and
- Total hydrocarbon content (THC).

The sample site locations are shown in Figure 19. The contaminants concentrations are presented in Table 16 and the PSA analysis results are presented in Table 17.

Figure 19 Location of the sediment quality sampling sites (December 2019)

Table 16. Trace metal contamination in samples from Lymington (December 2019)

Sample Ref No.	Site/Sample Name	Contaminant										
		Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	Dibutyltin (DBT)	Tributyltin (TBT)	Total Hydrocarbon Content (THC)
Unit of measurement		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Cefas Action Level AL1		20	0.4	40	40	0.3	20	50	130	0.1	0.1	100
Cefas Action Level AL2		100	5	400	400	3	200		800	1	1	-
4492707	Town Quay and Moorings	21	0.2	59	44	0.1	25	40	130	0.0063	0.01	220
4492708	Railside & main channel	20	0.17	64	40	0.1	27	33	120	0.0084	0.012	200
4492709	Fortuna Area	19	0.14	61	31	0.089	24	28	94	<LOD	0.0072	120
4492710	Horn Reach main channel	72	0.13	58	27	0.083	24	27	90	<LOD	0.0067	97
4492711	Horn Reach moorings & channel margins	19	0.13	57	27	0.089	24	26	90	<LOD	0.0055	100
4492712	Harbour Master & Dan Bran Pontoon	18	0.12	59	28	0.086	24	26	88	<LOD	0.0051	98
4492713	Lymington Marina (Berthon)	20	0.14	61	34	0.1	24	29	100	0.0065	0.0088	170
4492714	Lymington Yacht Haven	19	0.16	56	27	0.082	23	26	87	<LOD	0.0055	100
Key	Below AL 1											
	> AL 1, < AL 2											
	Above AL 2											

Table 17. Particle size analysis (PSA) results from sediment samples December 2021

Sample Ref No.	Site/Sample Name	Visual Appearance	Particle Size Distribution (%)		
			Gravel (>2 mm)	Sand (2 mm - >63 µm)	Silt (≤63 µm)
4492707	Town Quay and Moorings	Slightly gravelly sandy mud	0.02	8.91	91.09
4492708	Railside & main channel	Gravelly mud	8.72	8.83	82.50
4492709	Fortuna Area	Slightly gravelly sandy mud	0.01	10.50	89.49
4492710	Horn Reach main channel	Slightly gravelly sandy mud	0.01	11.47	88.57
4492711	Horn Reach moorings & channel margins	Slightly gravelly sandy mud	0.03	9.94	90.08
4492712	Harbour Master & Dan Bran Pontoon	Slightly gravelly sandy mud	0.06	7.97	91.99
4492713	Lymington Marina (Berthon)	Slightly gravelly sandy mud	0.17	10.61	89.22
4492714	Lymington Yacht Haven	Slightly gravelly sandy mud.	0	10.20	89.83

In summary, the levels of sediment contamination in the Lymington Estuary are low, based on this latest 2019 sample data. The majority of contaminants are below Cefas AL 1, and none of the sediment samples exceeded AL 1 for cadmium, mercury, lead, zinc or organotins. There were exceedances of AL 1 for chromium and nickel across all eight samples, but no exceedances of AL 2 for these metals.

The highest level of contamination was in the sample from 'Town Quay and Moorings'. This is the furthest upstream site, and the one that lies closest to potential anthropogenic sources of pollution such as surface runoff. The sample taken from this site exceeded AL 1 for arsenic, chromium, copper, nickel, and total hydrocarbon content.

The results are very similar to those recorded previously for the 2014 surveys, when arsenic and nickel slightly exceeded AL 1 in all locations, while lead slightly exceeded the AL 1 level at the 'Town Quay and Moorings' location (Black & Veatch 2017a).

Particle size analysis confirms that these sediments are predominantly silt, with a gravel fraction. This material will be dredged and will be suitable for recharge. All but one sample remained below 1 % Gravel (>2 mm), with only the sample taken from 'Railside and main channel' containing 8.7 % gravel. The Sand (2 mm to 63 µm) portion of the samples never exceeded 17 %, with the greatest sand portion belonging to Sample 4492710, taken from the 'Horn Reach main channel'. Finally, the Silt fraction (<63 µm) contained proportions in the region of 80 % in all samples, with the greatest being observed to be 87.35 %, at the 'Harbour Master and Dan Bran Pontoon' site.

4.9 Water quality

Water quality is important for benthic infauna, and hence the feeding resource for waterfowl can be impacted because of poor water quality. The water quality conditions within Lymington Estuary and the implications of maintenance dredging activities are outlined in the stand-alone Water Framework Directive (WFD) Compliance assessment (Binnies, 2021). This is included as Appendix C.

As noted in Section 3.6, the WFD assessment includes details of the waterbodies that could be affected (see also Figure 6) and assesses the impacts of maintenance dredging on these waterbodies as well as the European/Ramsar sites. The WFD assessment also sets out the applicable EC Directives[32] which trigger a requirement for monitoring. These listed are as follows.

- EC Water Framework Directive (WFD) (2000/60/EC) - this is the driver for water quality monitoring which is required to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater. The WFD outlines that all aquatic ecosystems should meet 'good status' by 2027;
- EC Bathing Water Directives (76/160/EEC and 2006/7/EC) - sets stringent water quality standards in order to preserve, protect and improve the quality of the environment and to protect human health;
- EC Shellfish Waters Directive (2006/113/EEC) - this sets standards in terms of faecal coliforms in shellfish waters and flesh which allows for the classification of harvesting areas;
- EC Urban Waste Water Treatment Directive (91/271/EEC as amended by 98/15/EC) - the objective is to protect the environment from the adverse effects of sewage discharges. It sets treatment levels on the basis of sizes of sewage discharges and the sensitivity of waters receiving the discharges;
- EC Dangerous Substances Directive (67/548/EEC) - this Directive controls the levels of dangerous substances going into inland, coastal and territorial waters. Dangerous substances are toxic substances that pose the greatest threat to the environment and human health; and
- EC Nitrates Directive (91/676/EEC) - sets a threshold of 50 mgl-1 for the identification of vulnerable waters in order to protect all waters against pollution by nitrates from agricultural sources.

Further detail about the WFD requirements and that of other relevant legislation is also outlined in Section 4.10.

The dredging areas are located within two WFD estuarine and coastal waterbodies (Lymington Transitional waterbody and the Solent coastal waterbody). The WFD assessment finds that the effects of dredging and sediment disposal, are temporary in nature and localised in extent, with implementation of the proposed mitigation measures. Thus, no significant adverse environmental effects or negative consequence on the status of WFD elements at the waterbody level have been assessed.

The WFD assessment concludes that continued maintenance dredging and disposal complies with the objectives of the WFD, and the works are not anticipated to cause a deterioration to the current overall WFD status of Lymington (Transitional) waterbody or Solent (Coastal) waterbody, or to adversely affect the features of the Protected Areas.

[32] Where EU Directives are referred to, it is again recognised here that the requirements for adhering to EU-derived domestic has been maintained in UK law following EU withdrawal.

4.10 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.

4.10.1 National legislation

Dredge and disposal operations are regulated in England by the 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. 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 10 years is exempted from the requirements of a marine licence.

4.10.2 Habitats Regulations

Under Regulation 63 of the Habitats Regulations[33], 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 Regulation 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 (i.e. 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.

[33] Modified by the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 on 31 January 2020.

4.10.3 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 MCZ 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, in 2019, 41 new sites (and 12 additional features) were designated, including one site within the scope of this MDP; the Yarmouth to Cowes MCZ. The third phase essentially completed the UK Blue Belt and thus contribution to the ecologically coherent network in the Solent in terms of the representation of species and habitats[34].

Once designated, public authorities have certain obligations to support the achievement of MCZ 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 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.

Two MCZs lie within a few kilometres of the Lymington Estuary, although outside the study area,. These two sites are The Needles MCZ and the Yarmouth to Cowes MCZ. Their location is shown in Figure 2.

The Yarmouth to Cowes MCZ lies around 4 km from the entrance to Lymington Estuary and was designated relatively recently, in 2019. It is protected because it contains a wide variety of habitats that support ecologically important species and features[35]. The habitats and species include the following: peat and clay exposures in the region; the Bouldnor Cliff geological feature; a clay outcropping in Thorness Bay with distinct piddock species, native oysters throughout the area; rock reeflike structures and a range of other fine/mixed sediment habitats.

The Needles site lies around 6 km from the entrance to Lymington Estuary and close to the Hurst Fort disposal ground. This MCZ was designated in 2016. It covers a 11 km^2 (Defra, 2016) stretch of Solent adjacent to the northwest side of the Isle of Wight to just south of the Needles, and includes a series of sheltered bays. The site protects seagrass beds in both Totland and Colwell Bays, as well as native oysters[36].

It is a condition within the extant marine licence for dredging and disposal activities at Lymington (L/2014/00396/2) that dredge sediment is only deposited at Hurst during the first four hours of an ebbtide. This is to minimise the risk of the sediment being transported into, and potentially smothering, the designated shellfish beds.

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34 https://www.gov.uk/government/collections/marine-conservation-zone-designations-in-england (Accessed June 2022).

35 The Defra factsheet for the Yarmouth to Cowes MCZ is available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/915531/mcz-yarmouth-cowes-2019.pdf

36 The Defra factsheet for the Needles MCZ is available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/492458/mcz-the-needles-factsheet.pdf

4.10.4 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 Baseline Document are cited above. 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.

The WFD is implemented in England and Wales through the Water Environment (WFD) (England and Wales) Regulations 2017 (commonly termed the Water Framework Regulations)[37]. Under the 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). Lymington Harbour is located within the South East River Basin District which is reported in the South East RBMP.

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 Lymington Harbour. 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[38]. This was followed when undertaking the 2021 WFD) Compliance assessment by Binnies, which is included as Appendix C.

4.10.5 Environment Act 2021

The Environment Act became law in November 2021. It provides the Government with powers to set new binding targets, including for air quality, water, biodiversity, and waste reduction. It also will include targets, tools and polices that are designed to reverse the decline in biodiversity in fulfilment of objectives within the Government's 25-year plan.

To help achieve these ambitions, the Act includes targets for achieving biodiversity net gain (BNG) as part of future developments. This will require all planning permissions granted in England (with a few exemptions) to deliver at least 10% biodiversity net gain from November 2023. BNG will be measured using Defra's biodiversity metric and habitats will need to be secured for at least 30 years. Alongside delivering net gain there are also the elements/requirements for:

- A strengthened legal duty for public bodies to conserve and enhance biodiversity;
- New biodiversity reporting requirements for local authorities; and
- Mandatory spatial strategies for nature: Local Nature Recovery Strategies (LNRS).

The Act also establishes a new environmental watchdog, the Office for Environmental Protection (OEP) that was legally created in November 2021. The OEP is responsible for England and Northern Ireland, with its role being to protect and improve the environment by holding government and other public authorities to account.

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

38 https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters (Accessed June 2022).

5 Appropriate Assessment Information

5.1 Introduction

Maintenance dredging in Lymington Estuary is required to ensure the continuation of navigation, harbour activities and marine industries based on and around the Harbour. The LHC have a statutory conservancy duty to maintain safety of navigation in the harbour.

This baseline document has been prepared to assist regulators and advisors with decisions about the effects of maintenance dredging in Lymington Estuary and inform marine licensing procedures and applications. Specifically, it has been prepared to inform decisions to be taken by competent authorities under the Habitats Regulations about the 'likely significant effects' effects of ongoing and future maintenance dredging on internationally protected nature conservation sites. To aid these decisions, and provide relevant information for Appropriate Assessment as required, this section outlines the impacts associated with dredging in relation to the relevant designated sites.

This report is a revision to the previous baseline document (Black & Veatch, 2017a). It extends and updates the baseline with newly available details. It covers maintenance of the mooring areas in the inner harbour, as week as maintenance of the navigable channel in the lower river (downstream of the wave screens). In general, the assessment information is common to all areas but, where necessary, it is specific to particular maintenance areas.

5.2 Potential impacts on SAC features

5.2.1 Introduction

The interest features of the Solent Maritime SAC[39] that could potentially be affected by maintenance dredging include:

- Spartina swards (*Spartinion maritimae*);
- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*);
- Mudflats and sandflats not covered by seawater at low tide; and
- *Salicornia* and other annuals colonising mud and sand.

In the Lymington Channel, the seaward boundary of the Solent Maritime SAC is set at the CD tidal elevation. The required maintenance dredging activities only remove sediment from the subtidal zone of the mooring areas. These areas do not include intertidal areas above CD (see Figure 2). Therefore, there are no direct effects on the SAC interest features listed above.

It is also notable that maintenance dredging in this estuary is performed by backhoe dredging. This is a highly accurate method and is noted as being particularly beneficial when working in environmentally sensitive areas (UK Marine SACs Project, 2001).

[39] In past assessments, the Solent and Isle of Wight Lagoons SAC has also been noted. Given the distance of the lagoons from the proposed dredging and disposal areas, and the lack of interaction between the nearest lagoons and open water, no significant impacts are likely on any of the interest features of the Solent and Isle of Wight Lagoons SAC. This site was therefore 'scoped out' of the assessment on this occasion.

Although there are no direct habitat effects, there is the potential for these intertidal SAC interest features to be indirectly affected by changes in the morphology and functioning of the estuary through the removal or redistribution of sediment within the system. Therefore, further consideration is given below (Sections 5.2.2 to 5.2.3) to the potential for indirect effects on the SAC. As with previous assessments (Black & Veatch; 2013a, 2013b, 2017 and ABPmer, 2009), this section concludes that that there will be no reduction in intertidal extent and no significant impacts on interest features of the Solent Maritime SAC or on the overall the integrity of this site.

As part of this review, Section 5.2.4 also summarises the notable measures taken at Lymington to manage the sediment resource in the estuary. In addition, the impacts to the nearby section of the Solent and Isle of Wight Lagoons SAC are also considered in Section 5.2.5.

5.2.2 Changes in estuary morphology

As outlined in the preceding baseline review (Black & Veatch, 2017a), the estuary is in a process of change and habitat loss (as described in Section 4.5), and the ability of such ecosystems to sustain themselves into the future is a key part of their integrity. There is little opportunity for the intertidal habitats at Lymington to adapt within the current designated boundaries. In addition, removal of a large volume of sediment each year, sediment that may have created new habitats in a more natural system, potentially reduces the opportunities for the estuary to attempt to sustain itself as time goes on.

An earlier assessment of estuary processes and maintenance dredging in Lymington Harbour (ABPmer, 2002), also examined the possible effect of dredging on saltmarsh erosion in Lymington Harbour. It concluded, in relation to loss of saltmarsh, that "*it appears unlikely that the lateral erosion is due to any reduction in sediment caused by dredging*." The same report informed the English Nature conclusion that, subject to certain restrictions on timing of dredging, "*that the project is not likely to have a significant effect on the interest features of the international sites in this area and therefore raises no objections to the works going ahead*".

This English Nature view, expressed in 2002, was in line with their Site Management Statement (produced on designation of the site) which stated in two areas (Section 6 (b) and Section 8 (2)) that "*As the site has been notified with dredging as an on-going operation, the continuation of current management practices is very unlikely to present a problem as far as English Nature are concerned*".

Although there is a source-pathway-sink link between the saltmarshes and the mooring areas, there is no such link from the mooring areas to the saltmarsh. If the material presently removed from the "*sediment traps*" (i.e. the marinas and dredged mooring areas), were to be left in the system, it could not be naturally eroded on a state of the tide that could transport it to potential areas of deposition in the lower estuary, as the tide would have to be falling. Suspended sediment is not deposited on the ebb tide, due to the strong currents. However, it is possible that some of the sediment currently removed by dredging could settle on intertidal areas in the vicinity of the dredged area. The areas that could reasonably be expected to benefit from increased intertidal deposition (such as would occur if maintenance dredging were to cease), are generally outside the internationally designated sites. The exception is the area above the wave screen, opposite Lymington Yacht Haven, which has been stable since the construction of the wave screens.

In addition to the dredging of mooring areas, active maintenance of the lower river channel was consented in October 2013 (L2013/00301/3) and first undertaken in phases during the winters of 2013/14 to 2016/17. The dredging was required because the margins of the channel were not being maintained by the movement of boat traffic and monitoring had shown that an accretion trend is continuing.

Consent to maintain the channel is now included in the maintenance dredge Marine Licence L/2014/00396/2, which was reissued as a variation in September 2017. This permits the disposal of maintenance dredged sediment from the Lymington Harbour Maintenance Dredge Area at Hurst Fort and the Lymington Saltmarsh Recharge Site. As with other dredging in the estuary, this is undertaken by back-hoe dredger.

In consenting the initial dredging in 2013, the MMO concluded that the activity of maintaining by dredging the margins of the navigation channel was not considered to cause a Likely Significant effect on the features of the SAC (Black & Veatch, 2017a). The continuing accretion trend supports the conclusion that there has been no impact on the geomorphology or functioning of the estuary.

The baseline review in Section 4.2 has further confirmed that, where changes are taking place in Lymington Estuary, these are mainly a function of natural processes. There was also no indication from a recent review of the bathymetric and topographic data that dredging was having any detectable effect in intertidal areas of the estuary (ABPmer, 2022).

5.2.3 Effects from sediment resuspension and movement

Disturbance of sediment during these dredging operations causes temporary low-level impacts on water quality (i.e. elevated levels of suspended sediment). This disturbed sediment will gradually settle back onto the bed following the completion of maintenance dredging works. No significant impacts have been observed, or are likely to occur, to any of the intertidal interest features of the Solent Maritime SAC from these temporary changes to water quality. Impacts associated with remobilisation of contaminated sediments are also considered in Section 5.3.2.

Much of the disturbed sediment will stay within the system and gradually settle back onto the bed in a different location. This is especially true in the upstream mooring areas, where disturbed sediment will predominantly stay locally and gradually settle back onto the bed. Low concentrations of suspended sediment that are carried by the ebb current into the river channel will be lost from the estuary and will not pose a threat to intertidal habitats or flora (Black & Veatch, 2017a).

Similarly, sediment resuspended during maintenance of the lower river navigation channel will be lost on the ebb tide, but on the flood tide it is likely to be transported into the mooring areas. Small quantities may settle on the intertidal areas under appropriate tidal conditions. Concentrations will again be low, and the habitats are highly tolerant of any changes arising and effects will be insignificant.

5.2.4 Sediment management and restoration

In recent years, new projects have been developed to determine how to better manage the sediment resource and declining habitats in the estuary. The Lymington River Reedbeds WLMP in 2009-2012, for example, explored opportunities for sustainable evolution of the estuary and its habitats outside current boundaries (Jacobs, 2013). The project helped to develop ways of using dredged sediment to help sustain habitats rather than exporting it out of the estuary, such as the Lymington Saltmarsh Recharge by Bottom Placement (Black & Veatch, 2017c).

In subsequent years further work has been, and is being, done to explore how dredged sediment can be used beneficially within the system. This includes the Solent Forum BUDS project (ABPmer, 2018; 2020b) and initiatives being pursued by the LHC. As described in Section 2.5, the LHC are continuing to place sediment at Boiler Marsh every winter in order to protect that habitat.

In addition, the Solent Forum is now seeking a marine licence to carry out a similar bottom placement at two other sites in the outer Lymington Estuary. The LHC are, furthermore, seeking a marine licence to place some of the newly deposited materials at Boiler Marsh onto the higher part of the habitats to further enhance and protect this SAC-designated feature.

These new and proposed beneficial use initiatives are innovative. There currently are no directly equivalent projects being carried out elsewhere in the UK. These projects are therefore demonstrating what can be achieved with dredge sediment, and providing new and valuable lessons about sediment management practices and the ecological effects and benefits of such projects. These are lessons that are valuable for Lymington and the Solent, but also more widely across the UK and internationally.

5.2.5 Solent and Isle of Wight Lagoons SAC

This Solent and Isle of Wight Lagoons SAC supports a series of coastal lagoons that include the Pennington-Keyhaven lagoons (part of the wider Lymington to Keyhaven Local Nature Reserve) behind the sea wall to the west of Lymington Estuary. This part of the SAC comprises a network of ponds and ditches behind the fronting bund. A system of sluices and tidal flaps around the reserve are used to control flooding and water flow across the reserve.

The potential effects on dredging operations on this SAC was considered in the preceding baseline review (Black and Veatch, 2017a). Natural England also highlighted the need to consider the effects on this SAC in their comments on a draft copy of this current assessment (see Appendix A).

It is concluded, here, that no significant impacts on these lagoons are likely to arise from the ongoing dredging commitments. This is reflected in the absence of such effects on the morphology and water quality of the much closer Solent Maritime SAC (as described above). In addition, and as described by Black and Veatch (2017a), the distance of these lagoons from the proposed dredging and the isolation of the nearest ones behind the sea wall also means that the proposed subtidal channel dredging will have no adverse impacts on the interest features of this SAC.

5.3 Potential impacts on SPA and Ramsar features

The interest features of the Solent and Southampton Water SPA and Solent and Dorset Coast SPA sites that could potentially be affected by maintenance dredging include:

- Populations of over-wintering birds; and
- Populations of breeding birds.

The individual interest features of these SPAs are shown in Section 4.7.1 and in Table 10 and 11. The interest features of the SPAs and Ramsar area (including the habitats which support bird species) and the relevant conversation objectives are set out in Appendix B.

As described in Section 5.2, there will be no significant changes to the SAC designated intertidal habitats. Therefore, the extent and quality of bird foraging habitats and prey items will not be adversely significantly affected. Impacts via these pathways are therefore not considered further for this assessment.

There is the additional possibility, however, that birds could be disturbed by dredging activities or from changes to water quality from the maintenance dredging. These impact pathways are reviewed in the following section. As with previous assessments (Black & Veatch; 2013a, 2017a), this section concludes that that there will be no significant impacts on interest features of the SPAs or Ramsar areas or on the overall the integrity of this sites.

5.3.1 Disturbance from dredging activities

The presence of dredging vessels and the associated increases in noise levels during dredging campaigns has the potential to affect bird populations. This would apply to overwintering species rather than breeding birds. Breeding birds, including foraging Terns, will not be significantly affected because the maintenance dredging and disposal occurs in the winter months and outside of the breeding season.

The main nesting sites are also not close to the maintenance dredging areas. As described in Section 4.7.4, the main intertidal breeding sites are on the higher elevation marshes, and particularly on Boiler Marsh. The bottom placement of sediment at the Boiler Marsh beneficial use sites is relatively close to the main breeding areas. However, this occurs with the dredging in winter and, as outlined in the HRA for that activity (Black & Veatch, 2013c), does not happen in the nesting season. The placement does not directly affect breeding habitat and instead this activity has a net benefit because it protects the SPA-designated saltmarsh and its function as nesting bird habitat in the short to medium term (Black & Veatch, 2013c; ABPmer, 2022).

Any disturbance to overwintering foraging birds from dredging activities will also be insignificant, given the location and nature of the activities involved. Any such disturbance to birds from the noise of the excavators or the hopper barges are unlikely to be significant, as the proposed works will take place against a background of a busy harbour with regular ferry sailings, recreational boating and the operations of the fishing fleet.

Backhoe dredging is already undertaken within the harbour and the lower river on a regular basis as part of the regular maintenance dredging operations and it is widely recognised that birds habituate to the noise of a dredger in operation. In the event that birds are disturbed from the commencement of activities, feeding and roosting nearby recommences relatively soon after the dredging operation has started. Dredging works will be undertaken during daylight hours and no flood lights will be required, but barges may travel to deposit sediment after dark as part of normal navigational activities (Black & Veatch, 2017a).

5.3.2 Increased suspended sediment and contamination

Increases in levels of suspended sediment during maintenance dredging have the potential to affect interest features of the Solent and Southampton Water SPA and Ramsar site through the remobilisation of contaminated sediments within the estuary which could potentially impact waterfowl prey species. Solent and Dorset Coast SPA species would not be expected to be affected as activities will only take place in winter.

As noted previously, backhoe dredging as used in Lymington. This is a comparatively accurate technique with a low with overspill rate. It is particularly suited for working in environmentally sensitive areas (UK Marine SACs Project, 2001). The operation itself is relatively slow, and the impact on turbidity and plume formation is low compared to other dredging methods, such as cutter suction or trailer dredgers (CIRIA, 2000).

As described in Section 5.2.3, there is disturbance of mud subtidal habitat (below chart datum) during the dredging process. This occurs both inside the SPA at the lower river dredging areas and outside in the mooring areas. Dredging of the mooring areas is undertaken in a regime with low hydrodynamic energy and therefore dispersion of material suspended in the dredging operation is limited and will not impact on the SPA. On the ebb tide, some could be carried at low concentrations into the SPA. Similarly, sediment resuspended within the SPA, during navigation channel dredging, will be lost on the estuary on the ebb tide, but on the flood tide it is likely to be transported into the mooring areas.

Small quantities of sediment may settle on the intertidal areas in favourable conditions (especially calm conditions and high tide). Concentrations will be low and will be beneficial to the intertidal habitats, in the same way as formal sediment recharge. Sediment from the lower river will be quickly dispersed by the high energy hydrodynamic regime of the Solent.

The level of contamination in the sediment is also low (see Section 4.8). In large part, this is to be expected because the sediment being dredged from annual maintenance dredging has settled on the bed very recently and not been subject to historic contamination. The low level of contamination is confirmed by regular analyses of sediment samples from the maintenance dredging sites. It is therefore considered unlikely that maintenance dredging has had any impact on the habitats and species of the SPA, or on the integrity of the European Marine Sites, through remobilisation of contaminated sediments.

Sediment samples will continue to be collected and tested for contaminants at an approved laboratory as part of the MMO marine licence conditions. It is unlikely that any impacts from contaminated sediments would be likely in the future.

5.4 In-combination effects

As part of the Appropriate Assessment process, it is necessary is to consider whether the maintenance dredging activities could have 'in combination' impacts with other plans and projects. The plans and projects in Lymington are outlined in Section 4.4.3. As described, these developments have been minor and have been permitted through appropriate marine licensing. No major new proposals are proposed in the area, apart from saltmarsh enhancement work. For example, there are no defined shoreline management proposals at this time (although proposals are expected to emerge through the Hurst to Lymington Strategy (see Section 3.8) over the coming years). Therefore, no significant in-combination impacts are anticipated between maintenance dredging and other plans or projects.

5.5 Future evolution and sea level rise

In the future, the mouth of the estuary will continue to widen, and lateral retreat of the exposed outer marshes will continue. A long-term decline in habitat extent is forecast, with a loss of saltmarsh by the 2050s. These changes are evidently influenced by limited availability of sediment in the estuary due to long term changes in the sediment supply. This has been linked to a reduced supply from eroding cliffs, together with an increase of extensive coastal defences, limiting the level of erosion and input to background sediment supply. Furthermore, due to the ebb-dominance of the Solent, fine-grained suspended sediments are transported offshore. This exacerbates the lack of sediment supply feeding the saltmarshes and results in at times quite rapid rates of erosion..

While widespread lateral erosion of the marshes is taking place, Ke and Collins (1993) reported that the marsh surfaces were continuing to accrete vertically at rates of 2 to 5 mm year^{-1}. However, this is dependent on an adequate supply of sediment and the rates of accretion remain uncertain. They are difficult to record accurately because they will vary greatly across the habitat. They are also not of a scale that can be readily recorded with available LiDAR data (ABPmer, 2020b).

In addition to the uncertainties about accretion rates, it is also uncertain how much effect other physical and ecological contributory factors are having have on the ongoing loss of saltmarshes (see Section 4.3.2). Even if the marshes are accreting, it is not likely to be at a rate which will enable them to keep pace with ongoing relative sea level rise[40], which is considered to be accelerating.

40 During the period 1980 to 2011 relative sea level has risen at a rate of 3.1 ± 0.7 mm year^{-1} at Southampton (Wahl *et al.*, 2013). This rate was derived from analysis of tide gauge records and corresponds to a total sea-level rise of between approximately 0.08 and 0.1 m during this time.

The primary source of climate change information is the UK Climate Change Impacts Programme (UKCIP) and the most recent predictions are from UKCP18 (Palmer *et al.,* 2018). To determine future sea level rise, the industry-recognised climate change scenario for planning purposes is termed the 'Representative Concentration Pathways (RCPs) 8.5, 95%ile likelihood[41].

The RCP 8.5 value is based on the most severe Green House Gas (GHG) concentration pathway but observational evidence of sea level rise indicates that we are currently following this trajectory. On this trajectory the sea level rise predictions for Lymington (Palmer *et al*., 2018) indicate an increase of 1.01 m by 2100, above present day (2022) levels. Future revisions of this Baseline Document will need to take into account the new UKCP18 information on sea level rise when it becomes available.

It may also be that the marshes are settling and compacting, which would counter any benefits from accretion. It is furthermore important to recognise the influence of the lunar nodal cycle. This cycle causes the tidal range to vary by up to around 4 % over an 18.6-year cycle (which last reached its maximum in 2015). With an average spring tidal range of 2.4 m, this could thus influence water levels by ± 0.1 m (ABPmer, 2020b).

Ongoing marsh losses are therefore likely to be exacerbated by sea level rise, although sediment management and restoration measures at Lymington (as described in Sections 2.5 and 5.2.4) are helping to address these issues and slow the decay of these habitats.

41 The Environment Agency recommends using this RCP 8.5 and '95th percentile (upper end) allowance in planning for more severe climate impacts.

6 Discussion and Recommendations

6.1 Summary

The maintenance dredging activities in Lymington Harbour occur close to, or within, the boundary of the Solent and Southampton Water SPA, Ramsar wetland, the Solent and Dorset Coast SPA, and the Solent Maritime SAC. This updated assessment evaluated the impacts on these designated sites. It concludes, in keeping with the findings from past reviews, that the effects of dredging and sediment disposal in Lymington Harbour will not adversely affect the integrity of designated European sites[42]. Similarly, no negative effects on the status of WFD elements at the waterbody level are anticipated. In respect to the features of each site, the following conclusions are reached:

- **Solent Maritime SAC:** No significant impacts are expected from the dredging activities on the intertidal habitat interested features of the Solent Maritime SAC. The dredging occurs in subtidal areas, so intertidal habitat will not be directly affected and there will be no significant indirect reduction in the extent of the intertidal habitats from the dredging.
- **Solent and Southampton Water SPA and Ramsar:** Overwintering and breeding waterbirds are interest features of the Solent and Southampton Water SPA and Ramsar area. The maintenance dredging takes place in winter, so does not affect birds during the spring and summer nesting season. The dredging works will not cause significant disturbance to overwintering birds because of the nature and location of the activities. Furthermore, those wintering birds that use the estuary are tolerant of, and habituated to, ongoing vessel movements in a busy harbour. There will also be no loss of foraging or nesting habitat for birds, as there will be no net loss of intertidal extent (as described in the preceding point for SAC-designated habitat). The beneficial re-use / placement of sediment at Boiler Marsh is beneficial because it is helping to delay the loss of the most valuable nesting saltmarsh in the local area.
- **Solent and Dorset Coast SPA:** Breeding and foraging tern species which are protected within this designated area will not be adversely affected by the dredging activities. As noted on the preceding point (in relation to the Solent and Southampton Water SPA and Ramsar site), a key consideration is that dredging takes place in winter, so does not affect birds during the spring and summer nesting season.
- **Lymington (Transitional) waterbody or Solent (Coastal) waterbody:** The WFD Assessment for maintenance dredging and disposal (Binnies, 2021) concluded that the activity complies with the objectives of the WFD and the works will not cause a deterioration to the current overall WFD status of the Lymington (Transitional) waterbody or Solent (Coastal) waterbody, or adversely affect the features of the Protected Areas. Furthermore, dredging and disposal is unlikely to prevent the WFD waterbodies from achieving their future status objectives, including Protected Area objectives.

As described in previous assessments, it is valuable to consider what would happen if maintenance dredging were to cease. This would, in the short term, lead to maintained areas silting to regime levels, with a consequent significant adverse impact on commercial and leisure activity and safety of navigation. The mechanism for siltation is considered to be a combination of sediment carried into the estuary in suspension on a flood tide and the re-suspension of intertidal mud deposits by wave action on a rising tide.

[42] As noted in Section 5.2, in past assessments, the Solent and Isle of Wight Lagoons SAC has also been noted; this site was 'scoped out' of the assessment on this occasion; see Section 5.2 footnote for rationale.

This process results in material being carried into quiescent waters in the inner harbour. There would then no natural mechanism for this material to be re-suspended and deposited in the outer harbour. The areas that could reasonably be expected to benefit from the cessation of maintenance dredging, in the form of increased intertidal deposition, are generally outside the European sites. In a more natural estuary, there would be significantly more sediment available for new habitats to form as it adapts to sea level rise. Opportunities for this are very limited given the current very modified form of the estuary.. Nevertheless, the estuary's intertidal habitats are likely to benefit from opportunities to return dredged sediment to the estuary, where possible.

6.2 Recommendations

In accordance with the maintenance protocol, and as proposed in past baseline documents, it is recommended that this baseline is updated periodically to incorporate new information as it becomes available (e.g. on sea level rise). It is LHC policy to do this on five yearly cycle, and the next update would be in 2027.

By adopting this five-yearly review programme, substantial revisions to the baseline are not generally required. However, it is important to capture any changes to the dredging requirements that might occur, as well as any new information about the changing environment or the effects and value of ongoing beneficial use disposal operations.

Over the coming years, new information will be obtained to describe the conditions in the estuary. This will include, as it has in this report, bathymetric data of the estuary, and bird counts data from the WeBS monitoring programmes. Future baseline documents will also need to highlight legislative and relevant policy changes, including those continuing to emerge from the Environment Act (2021), such as delivering Biodiversity Net Gain or the development of Local Nature Recovery Strategies (LNRS), where these apply to Lymington Harbour. Future baseline reviews will also need to highlight any new developments that result from the local costal defence strategy.

The other main change over the coming years is expected to be the increasing delivery of more beneficial use alternatives to the offshore disposal of dredge sediment. On average around 28,000 wet tonnes of sediment are dredged and exported out of the estuary each year, and over the past decade several beneficial use projects have been delivered in Lymington Harbour, to restore and protect intertidal habitats. As a result, Lymington Harbour has become a valuable site for showing what can be achieved, as well as illustrating the technical issues, costs and benefits of such projects.

At present, it is not practical to dispose of all maintenance dredge arisings in this manner; however, the potential for using more dredging materials to facilitate more of these schemes will continue to be considered, given the potential benefits of creating intertidal habitat. It is very likely that more opportunities for more habitat restoration and enhancement schemes will be pursued over the next few years. This is because the LHC, as well as the Solent Forum, are continuing to actively explore methods for beneficially using more of this sediment in the future. Current proposals in development include:

- Translocation sediment from the Boiler Marsh deposit grounds onto the higher marsh areas, to increase marsh vegetation, improve the resilience of Boiler Marsh as a whole, and allow for more sediment to be deposited in this over time; and
- Additional Bottom Placement projects to improve the resilience of saltmarshes at Cockleshell and Pylewell.

As the owners of the baseline document, consultee and a Competent Authority, the LHC has the opportunity to maintain an archive of consultation and study documents that can be referenced in future revisions.

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8 Abbreviations/Acronyms

AD	Anno Domini
AEOI	Adverse Effect on the Integrity
AIS	Automatic Identification Systems
AL	Action Level
BMT	BMT Group Ltd
BNG	Biodiversity Net Gain
BTO	British Trust for Ornithology
BUDS	Beneficial Use of Dredge Sediment in the Solent
CCO	Channel Coastal Observatory
CD	Chart Datum
CEDA	Central Dredging Association
Cefas	Centre for the Environment, Fisheries and Aquaculture Science
CIRIA	Construction Industry Research and Information Association
COVID	Coronavirus
DBT	Dibutyltin
Defra	Department for Environment, Food & Rural Affairs
DETR	Department of the Environment, Transport and the Regions
EC	European Commission
EEC	European Economic Community
EIA	Environmental Impact Assessment
EMP	Environment Management Panel
EMS	European Marine Site
EQS	Environmental Quality Standard
EU	European Union
FEPA	Food and Environment Protection Act
GHG	Green House Gas
ha	Hectare(s)
HAT	Highest Astronomic Tide
HCC	Hampshire County Council
HELCOM	The Baltic Marine Environment Protection Commission (Helsinki Commission)
HIWWT	Hampshire and Isle of Wight Wildlife Trust
HMSO	Her Majesty's Stationery Office
HMWB	Heavily Modified Water Body
HRA	Habitat Regulations Assessment
INNS	Invasive Non Native Species
JNCC	Joint Nature Conservation Committee
LAT	Lowest Astronomic Tide
LHC	Lymington Harbour Commissioners
LiDAR	Light Detection And Ranging
LNR	Local Nature Reserve
LNRS	Local Nature Recovery Strategies
LOD	Limit of Detection
MCAA	Marine and Coastal Access Act
MCZ	Marine Conservation Zone
MDP	Maintenance Dredge Protocol
MHWN	Mean High Water Neaps
MHWS	Mean High Water Springs
MLW	Mean Low Water

MLWN	Mean Low Water Neaps
MLWS	Mean Low Water Springs
MMO	Marine Management Organisation
MPA	Marine Protected Area
MTL	Mean Tide Level
NFDC	New Forest District Council
OD	Ordnance Datum
OEP	Office for Environmental Protection
PAHs	Polyaromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PIANC	Permanent International Association of Navigation Congresses
ppm	Parts Per Million
PSA	Particle Size Analysis
Ramsar	Wetland of international importance under Wetlands Convention (Ramsar, Iran, 1971)
RBMP	River Basin Management Plans
RCP	Representative Concentration Pathways
ReMEDIES	Reducing and Mitigating Erosion and Disturbance Impacts affecting the Seabed
SAC	Special Area of Conservation
SCOPAC	Standing Conference on Problems Associated with the Coastline
SDCP	Solent Dynamic Coast Project
SEMS	Solent European Marine Site
SPA	Special Protection Area
SRT	Self-Regulating Tide
SSSI	Sites of Special Scientific interest
TBT	Tributyltin
THC	Total Hydrocarbon Content
TPH	Total Petroleum Hydrocarbons
UK	United Kingdom
UKCP	UK Climate Projections
UKCIP	UK Climate Change Impacts Programme
USEPA	United States Environmental Protection Agency
WeBS	Wetland Bird Survey
WFD	Water Framework Directive
WLMP	Water Level Management Plan

Cardinal points/directions are used unless otherwise stated.

SI units are used unless otherwise stated.

Appendices





Innovative Thinking - Sustainable Solutions

A Natural England Advice

A draft copy of this baseline document was issued to Natural England for comment. A copy of the letter received in response (dated 15 December 2022) is included below.

Date: 15 December 2022
Our ref: 410426

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BY EMAIL ONLY

Dear Colin

Update to Baseline Document for Maintenance Dredging in Lymington Harbour

Solent and Southampton Water Special Protection Area/Ramsar (SPA/Ramsar)
Solent and Dorset Coast SPA
Solent Maritim Special Area of Conservation (SAC)
Solent and Isle of Wight Lagoons SAC

Thank you for your consultation on the above dated 15 November 2022. Natural England welcomes the proactive approach taken by Lymington Harbour Commissioners (LHC) to ensure that the Baseline Document is kept both up to date but also reflects the wider changes to maintenance dredging in the harbour and the beneficial re-use schemes which have taken place since the document was originally produced in 2011.

Natural England continues to support the production (including reviews) of Maintenance Dredge Protocols (MDP) as industry best practice, providing a foundation for consistent and informed decision making by all competent authorities. The MDP provides a strategic approach to considering the impacts of maintenance dredge activity within a defined port or estuary and can support demonstration of compliance with The Conservation of Habitats and Species Regulations 2017 as amended (The Habitats Regulations). It also negates the need to produce an environmental assessment for individual consent applications, thereby providing efficiencies through the consenting process. This enables a clear baseline and audit trail for compliance with the Habitats Regulations to support dredging activities (and any potential marine licence applications as required) for all statutory harbour authorities in the area.

Following receiving the document titled 'LHC_Maintenance_Baseline_ABPmerR3937_14Oct22lrt' from ABPmer on behalf of LHC, Natural England has reviewed the Appropriate Assessment Information (Section 5) within the Updated Baseline Document for Maintenance Dredging in Lymington Harbour. A full review would require use of our Discretionary Advice Service. If you wish to use this please follow the instructions on the request form and please state clearly the advice that you require from us. Once you have submitted your request to our Consultations team, we will be in touch.

We confirm that **Natural England agrees with the conclusions within the appropriate assessment information (section 5) of the updated baseline document and agrees with the assessment of the impact of maintenance dredge activities in Lymington Harbour and to the surrounding Special Areas of Conservation and Special Protection Areas.** In particular, Natural England note the incorporation of the Solent and Dorset Coast SPA and support the assessment of the impacts associated with this site.

On this basis, Natural England will be supportive of any future Marine Licence applications for maintenance dredging within Lymington Harbour as long as they are in line with the revised Baseline Document.

Natural England have the following minor comments/recommendations:

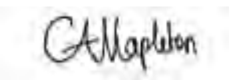
- Section 5.2 (Potential impacts on SAC features) has been updated to no longer assess the potential impacts upon the Solent and Isle of Wight Lagoons SAC. It is Natural England's view that whilst the works will have minimal interaction with the features of the SAC, the coastal lagoons support species that have very critical habitat tolerances and are highly vulnerable to changes in hydrological regime and sediment disturbance. As the works take place adjacent to the SAC and for completeness of the assessment, Natural England recommends LHC continue to include the Solent and Isle of Wight Lagoons SAC moving forwards.
- LHC confirm that they will continue to update the Maintenance Dredge Baseline Document in line with future legislative changes. Natural England welcomes this and would be happy to continue to support this process in the future.

We stress that this letter does not constitute Natural England's assent or advice for the purposes of section 28H of the Wildlife and Countryside Act 1981 (as amended). When more details of the proposed operations become available and before carrying them out, the operating authority, having considered its general duty under section 28G(2) of the Wildlife and Countryside Act 1981 (as amended), is required to give notice to Natural England. The operating authority is required to carry out the works in accordance with the provisions of section 28H of the Wildlife and Countryside Act 1981 (as amended) as the proposed works are within or adjacent to the SSSIs found within the designated sites listed above.

Finally we would like to thank you for completing the Update to the Maintenance Dredge Protocol and for continuing to work with Natural England.

For any queries relating to the content of this letter please contact me using the details provided below.

Yours sincerely



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B Conservation Objectives

Table B1 provides details of the conservation objectives for each of the following four European/Ramsar sites:

- Solent and Dorset Coast SPA;
- Solent Maritime SAC;
- Solent and Southampton Water SPA; and
- Solent and Southampton Water Ramsar site.

Table B1. Interest features and conservation objectives of the European/Ramsar sites

Site	Features	Conservation Objectives
Solent and Dorset Coast SPA	▪ A191 *Sterna sandvicensis* Sandwich Tern (Breeding) ▪ A193 *Sterna hirundo*; Common Tern (Breeding) ▪ A195 *Sternula albifrons*; Little Tern (Breeding)	With regard to the SPA and the individual species and/or assemblage of species for which the site has been classified and subject to natural change; ▪ Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring: o The extent and distribution of the habitats of the qualifying features; o The structure and function of the habitats of the qualifying features; o The supporting processes on which the habitats of the qualifying features rely; o The population of each of the qualifying features; and o The distribution of the qualifying features within the site.
Solent Maritime SAC	▪ H1110. Sandbanks which are slightly covered by sea water all the time ▪ H1130. Estuaries ▪ H1140. Mudflats and sandflats not covered by seawater at low tide; Intertidal mudflats and sandflats ▪ H1150. Coastal lagoons* ▪ H1210. Annual vegetation of drift lines ▪ H1220. Perennial vegetation of stony banks; Coastal shingle vegetation outside the reach of waves ▪ H1310. Salicornia and other annuals colonising mud and sand; Glasswort and other annuals colonising mud and sand ▪ H1320. Spartina swards (*Spartinion maritimae*); Cord-grass swards ▪ H1330. Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) ▪ H2120. Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes"); Shifting dunes with marram ▪ S1016. *Vertigo moulinsiana*; Desmoulin`s whorl snail	With regard to the SAC and the individual species and habitats for which the site has been designated and subject to natural change; ▪ Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring: o The extent and distribution of qualifying natural habitats and habitats of qualifying species; o The structure and function (including typical species) of qualifying natural habitats; o The structure and function of the habitats of qualifying species; o The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; o The populations of qualifying species; and o The distribution of qualifying species within the site.

Site	Features	Conservation Objectives
Solent and Southampton Water SPA	▪ A046a *Branta bernicla bernicla*; Dark-bellied Brent Goose (Non-breeding) ▪ A052 *Anas crecca*; Eurasian Teal (Non-breeding) ▪ A137 *Charadrius hiaticula*; Ringed Plover (Non-breeding) ▪ A156 *Limosa limosa islandica*; Black-tailed Godwit (Non-breeding) ▪ A176 *Larus melanocephalus*; Mediterranean Gull (Breeding) ▪ A191 *Sterna sandvicensis*; Sandwich Tern (Breeding) ▪ A192 *Sterna dougallii*; Roseate Tern (Breeding) ▪ A193 *Sterna hirundo*; Common Tern (Breeding) ▪ A195 *Sterna albifrons*; Little Tern (Breeding) ▪ Waterbird assemblage	With regard to the SPA and the individual species and/or assemblage of species for which the site has been classified and subject to natural change; ▪ Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring: o The extent and distribution of the habitats of the qualifying features; o The structure and function of the habitats of the qualifying features; o The supporting processes on which the habitats of the qualifying features rely; o The population of each of the qualifying features; and o The distribution of the qualifying features within the site.
Solent and Southampton Water Ramsar site	**Ramsar Criterion 1 :** The site is one of the few major sheltered channels between a substantial island and mainland in European waters, exhibiting an unusual strong double tidal flow and has long periods of slack water at high and low tide. It includes many wetland habitats characteristic of the biogeographic region: saline lagoons, saltmarshes, estuaries, intertidal flats, shallow coastal waters, grazing marshes, reedbeds, coastal woodland and rocky boulder reefs. **Ramsar Criterion 2 ;**The site supports an important assemblage of rare plants and invertebrates. At least 33 British Red Data Book invertebrates and at least eight British Red Data Book plants are represented on site. **Ramsar Criterion 5:** Assemblages of international importance: Species with peak counts in winter: 51343 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: ▪ Ringed Plover , *Charadrius hiaticula*, Species with peak counts in winter: ▪ Dark-bellied Brent Goose, *Branta bernicla bernicla*, ▪ Eurasian Teal , *Anas crecca* ▪ Black-tailed Godwit , *Limosa limosa islandica*	See conservation objectives for Solent and Southampton Water SPA.

* Denotes a priority natural habitat or species.

Source: JNCC (1998); Natural England (2018a; 2018b; 2019; 2020)

C Water Framework Assessment

Water Framework Directive Compliance Assessment for the Lymington maintenance dredge produced to accompany Marine Licence application dredging and disposal activities (Binnies, 2021).

WATER FRAMEWORK DIRECTIVE COMPLIANCE ASSESSMENT

In support of a Marine Licence Application (Dredging and Disposal Activities)

Project no. 123038-3301

Prepared for:

Lymington Harbour Commissioners

26th May 2021

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WATER FRAMEWORK DIRECTIVE COMPLIANCE ASSESSMENT

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INTRODUCTION

1.1 Background

In 2017, Black & Veatch Ltd. (*now Binnies UK Ltd.*) were appointed by Lymington Harbour Commissioners to apply for a Marine Licence for the continuation and extension of maintenance dredging within Lymington Harbour, which was successfully granted.

This Water Framework Directive (WFD) Compliance Assessment is being undertaken as a requirement of the continuation of the Marine Licence (L/2014/00396/2), with the condition (5.2.3) that this document (part of the 2017 Baseline Document for Maintenance Dredging in Lymington Harbour (Black & Veatch, 2017)), must be reviewed by the year 2021 when the next RBMP cycle and classification results are available.

The new RBMP (cycle 3) has been delayed until 2022, however the Environment Agency has confirmed this review can be carried out within RBMP cycle 2 data.

1.2 Site Context

Lymington Estuary is located on the western arm of the Solent, in the lee of the Isle of Wight and Hurst Spit. The twentieth Century saw the harbour evolve into a major leisure boating centre with moorings for around 1,700 yachts. The river also supports a small commercial fishing fleet and ferry operation, carrying over 1.1 million passengers and approximately 350,000 vehicles per year.

The dredging area is located within two WFD estuarine and coastal waterbodies (Lymington Transitional waterbody and the Solent coastal waterbody). The area lies in several designated sites; however it is important to note that maintenance dredging has been carried out in the majority of harbours in the UK for many years, and in many cases, including Lymington, the Natura 2000 sites were designated with these operations already taking place. The designated sites are:

- The Solent Maritime Special Area of Conservation (SAC);
- The Solent & Southampton Water Special Protection Area (SPA);
- The Hurst Castle & Lymington River Site of Special Scientific Interest (SSSI);
- Lymington and Sowley Shellfish Waters

The designated sites which are within 2km of the dredging area are:

- The Solent & Isle of Wight Lagoons SAC, lies approximately 0.5km west of the dredging site;
- The Solent & Dorset Coast Special Protection Area (SPA) is situated approximately 1km from the site;
- Pennington Shellfish Waters.

The designated sites which are within 2km of the disposal areas are:

- The Solent Maritime Special Area of Conservation (SAC);
- The Solent & Southampton Water Special Protection Area (SPA);
- Lymington and Sowley Shellfish Waters;

- Pennington Shellfish Waters;
- Totland (IoW) Shellfish Waters (Hurst Fort);
- Colwell Bay (IoW) Bathing Waters (Hurst Fort).

1.3 Scope of WFD Assessment Report

The scope of this report is to summarise and update the findings of a preliminary WFD Compliance Assessment, highlighting the waterbody screening, baseline conditions and the scoping process to determine potential effects on WFD elements, and consideration of any WFD 'mitigation measures' which could be put 'in place' or prevented from being 'in place' as a result of the works being undertaken within Lymington Harbour. The methodology adopted for this WFD assessment is provided in Section 2.

This document provides Marine Management Organisation (MMO) with the necessary information to make an informed decision as to whether the development meets obligations under the European WFD (Directive 2000/60/EC)[1], to prevent deterioration in the overall status of waterbodies, and also to enable waterbodies to achieve their WFD objectives for 'Good Ecological Potential/Status'.

The Environment Agency makes periodic assessments of the quality of rivers across England and Wales in order to report trends over time and satisfy legislative requirements. Data is then compared against Environmental Quality Standards (EQS), which are designed to protect the environment and human health. Within the study area, there are several applicable EC (European Commission) Directives which trigger a requirement for monitoring, which are described below.

- EC Water Framework Directive (WFD) (2000/60/EC) - this is the driver for water quality monitoring which is required to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater. The WFD outlines that all aquatic ecosystems should meet 'Good Ecology Status / Good Ecological Potential' by 2027.
- EC Bathing Water Directives (76/160/EEC and 2006/7/EC) - sets stringent water quality standards in order to preserve, protect and improve the quality of the environment and to protect human health.
- EC Shellfish Waters Directive (2006/113/EC) - this establishes standards, in terms of faecal coliforms in shellfish waters and flesh which allows for the classification of harvesting areas.
- EC Urban Waste Water Treatment Directive (91/271/EEC, as amended by 98/15/EC) - the objective is to protect the environment from the adverse effects of sewage discharges. It sets treatment levels on the basis of sizes of sewage discharges and the sensitivity of waters receiving the discharges.

[1] The Water Framework Directive (WFD) originates from the EU but has been retained in UK law following the UK's exit from the European Union. Retained EU law is a legal concept describing EU-derived rights and legislation preserved by the UK following Brexit. It is a defined term under the European Union (Withdrawal) Act 2018 (EU(W)A 2018), and the collective term given to the body of EU-derived laws the UK preserves and converts into domestic UK law, effective on the repeal of the European Communities Act 1972.

- EC Dangerous Substances Directive (67/548/EEC) - this Directive controls the levels of dangerous substances going into inland, coastal and territorial waters. Dangerous substances are toxic substances that pose the greatest threat to the environment and human health.
- EC Nitrates Directive (91/676/EEC) - sets a threshold of 50mgl^{-1} for the identification of vulnerable waters in order to protect all waters against pollution by nitrates from agricultural sources.

Estuarine Water Quality

The European Water Framework Directive (WFD) (2000/60/EC) is implemented in England and Wales by the Water Environment (WFD) (England and Wales) Regulations 2017 (known as 'The Regulations')[1].

The WFD aims to protect and enhance waterbodies within Europe, and extends to cover estuaries, rivers, groundwater, man-made docks, lakes, canals, and coastal waters out to one nautical mile. Within each water body, the WFD sets overall, ecological and chemical objectives. The overall objective for all natural water bodies is to attain a current status of 'Good', which can comprise 'Good Ecological Status (GES)' and 'Chemical Status' and for all Artificial or Heavily Modified Water Bodies (A/HMWB) there is a requirement to meet 'Good Ecological Potential (GEP)'.

River Basin Management Plans (RBMPs) set out measures required to achieve the aims of the WFD, and a deadline has been set within River Basin Management (RBMP) for these water bodies to achieve the required status, unless alternative arrangements (e.g. exemptions due to costs and feasibility) can be justified (Environment Agency, 2012b, 2012b). The RBMP WFD cycle of assessments take place every six years and therefore objectives which are not met by 2015 may roll on to 2021 cycle, and so on to 2027. The second cycle 2015 RBMPs were signed off in February 2016. The third cycle which was initially due to be released in 2021 is still under review and not expected to be finalised until 2022 (Environment Agency, 2021).

The Environment Agency are the Competent Authority responsible for delivering the WFD objectives, and as a Public Body, they must have regard for the RBMP in undertaking Flood and Coastal Erosion Risk Management (FCERM) duties. The RBMP also identifies Protected Area designations for water bodies; these may include Habitats Directive (1992/43/EC), Birds Directive (2009/147/EEC), Bathing Water Directive (2006/7/EEC), Shellfish Waters Directive (2006/113/EC), Urban Waste Water Treatment (1991/271/EEC) and Nitrates Directives (1991/676/EEC). If these are located within the 'zone of influence' of potential impacts, then these may also require consideration within the WFD Compliance Assessment.

Lymington Harbour is covered by the South East River Basin Management Plan (RBMP) (Environment Agency, 2016). The RBMP provides the baseline information for undertaking the overall assessment and also sets out details of the current status, objectives of each water body and protected area designations within Annexes to the main RBMP.

The only waterbodies that will be directly affected by maintenance dredging and disposal is the Lymington transitional waterbody (GB520704202100) and the Solent coastal waterbody (GB650705150000) (see Table 2). Other WFD waterbodies nearby include Lymington River waterbody (GB107042011220), upstream of the dredging activity, the Dorset/Hampshire coastal waterbody (GB620705550000), the South West Hants Solent Group groundwater body (GB40702G504000), and the Southwest Hants Barton Group groundwater body (GB40702G504000).

1.4 Assessment methodology

The methodology adopted for this WFD Compliance Assessment has been derived from the Environment Agency's 'Water Framework Directive Assessment: Estuarine and Coastal Waters' 2016 Guidance (Environment Agency, 2016); replacing the previous revised 2012 guidance called 'Clearing the waters. Marine dredging and the Water Framework Directive' (Environment Agency, 2012).

This guidance was designed primarily to consider the effects of dredging and disposal activities on WFD waterbodies and quality elements, and screening tables have been completed for this WFD Compliance Assessment and are provided in Appendix B. The steps of this WFD Compliance Assessment consider dredging and disposal activities, and include:

Step 1 - Screening: This involves identifying WFD waterbodies, based on their location within, upstream and downstream of the works which could be affected, and excludes any activities that don't need to go through the scoping or impact assessment stages.

Waterbodies (groundwater, river, coastal and transitional) were identified based on the Environment Agency's Catchment Data Explorer website, which details the reasons for designation as heavily modified or artificial, current overall status of the waterbody, ecological and chemical status, classification data for individual biological quality elements, supporting hydro-morphological and physico-chemical quality elements (if available) and whether there are any Protected Area designations present.

Waterbodies identified are either 'screened in' or 'screened out' of further assessment by determining whether the proposed works have the potential for any non-temporary effects on the waterbody.

The 2016 guidance (Environment Agency, 2016) states a list of activities which can be excluded from scoping, which include:

- A fast-tracked or accelerated marine licence activity that meets specific conditions;
- Maintaining pumps at pumping stations;

- Removing blockages or obstacles like litter or debris within 10m of an existing structure to maintain flow;
- Replacing or removing existing pipes, cables or services crossing over a waterbody – but not including any new structure or supports, or new bed reinforcement; or
- 'Over water' replacement or repairs to, for example bridge, pier and jetty surfaces – if you minimise bank or bed disturbance.

Step 2 - Scoping: This stage identifies the receptors which are potentially at risk from the activity and will consequently require Impact Assessment. These receptors are based on the waterbody's quality elements and are listed below:

- Hydromorphology – physical characteristics of estuaries and coasts, including size, shape and structure of the waterbody, and the flow and quantity of water and sediment;
- Biology: Habitats – this is taken into account if:
  - the footprint of the activity (1.5 times the area when the activity is dredging) is ≥0.5km^2,
  - 1% or more of the waterbody's area,
  - within 500m of any higher sensitivity habitat; and/or
  - 1% or more of any lower sensitivity habitat.

  For WFD assessment purposes, the higher and lower sensitivity habitats are listed in

  Table 1 below.
- Biology: Fish – this is only considered if the activity:
  - is in an estuary and could affect fish in the estuary;
  - is outside the estuary but could delay or prevent fish from entering the estuary;
  - could affect fish migrating through the estuary to freshwater;
  - could impact normal fish behaviour (e.g. movement, migration, or spawning) due to noise/vibration, a physical barrier, a significant chemical change or change to depth/flow of water.
- Water quality – this should be included in the Impact Assessment if the activity:
  - could affect water clarity, temperature, salinity, oxygen levels, nutrients or microbial patterns continuously for longer than a spring neap tidal cycle (approximately 14 days);
  - is in a water body with a phytoplankton status of moderate, poor or bad;
  - is in a water body with a history of harmful algae.
- Protected areas – if this activity is within 2km of any WFD protected area, these will be included in the Impact Assessment. WFD protected areas include:
  - Special Areas of Conservation (SAC)
  - Special Protection Areas (SPA)
  - Shellfish Waters
  - Bathing Waters
  - Nutrient Sensitive Areas

- Invasive Non-Native Species (INNS) – if there is any risk that the activity could introduce or spread INNS to a waterbody, such as:
  - using materials or equipment that have come from, had use in or travelled through other waterbodies;
  - carrying out activities which help to spread existing INNS, to the immediate waterbody or other waterbodies.

Table 1: Higher and lower sensitivity habitats which are listed in the WFD 2016 guidance (Environment Agency, 2016)

Higher sensitivity habitats	Lower sensitivity habitats
Chalk reef	Cobbles, gravel and shingle
Clam, cockle and oyster beds	Intertidal soft sediments like sand and mud
Intertidal seagrass	Rocky shore
Maerl beds	Subtidal boulder fields
Mussel beds, including blue and horse mussel	Subtidal rocky reef
Polychaete reef	Subtidal soft sediments like sand and mud
Saltmarsh	
Subtidal kelp beds	
Subtidal seagrass	

Completion of the scoping tables set out in the 2016 WFD assessment guidance (Environment Agency, 2016) to determine which WFD parameters should be 'scoped in' or 'scoped out' for further assessment and are based on multiple factors.

Any WFD quality elements which have been identified as requiring consideration for a particular waterbody and in relation to a known impact are scoped in and taken forward to Step 3. The scoping tables can be found in Appendix B.

Step 3 - Impact Assessment: This stage considers impacts and mitigation. An Impact Assessment must be carried out for each receptor during scoping as being at risk from the activity. This step should determine whether there is a likelihood of a non-temporary effect (i.e. permanent or significant enough over a six-year period) to potentially cause deterioration in the status at the waterbody level.

As the activity may create pressures on the marine environment, the JNCC marine pressures-activities matrix is used to identify whether the activity may affect the receptors. If there's no pathway linking the pressure to the receptor, there can be no impact and it is therefore not necessary to carry out any further assessment of that receptor. Referring to the outcomes of the various steps, an overall conclusion will be drawn on whether a non-temporary effect on the status at the waterbody level will occur.

The tables showing the marine-pressures activity matrix for dredging and disposal are shown in Appendix C.

1.5 Data Sources

Data used to inform this assessment have been derived from the following:

- European Marine Observation and Data Network ('EMODnet') [online]. Available from: http://www.emodnet.eu (note: this website will soon mover under the Europa.eu domain).

- Environment Agency Catchment Data Explorer [online]. Available from: http://environment.data.gov.uk/catchment-planning/WaterBody/GB520704202100 [date accessed: 16/04/21]

- JNCC (2017) Solent Maritime SAC citation [online]. Available from: http://jncc.defra.gov.uk/protectedsites/sacselection/sac.asp?EUCode=UK0030059 [date accessed: 16/04/21]

- JNCC (2017) Annex II Species Desmoulin's whorl snail (*Vertigo moulinsiana*) citation [online]. Available from: http://jncc.defra.gov.uk/ProtectedSites/SACselection/species.asp?FeatureIntCode=s1016 [date accessed: 16/04/21]

- JNCC (2017) Solent and Isle of Wight Lagoons SAC citation [online]. Available from: http://jncc.defra.gov.uk/protectedsites/sacselection/sac.asp?EUCode=UK0017073 [date accessed: 16/04/21]

- JNCC Marine pressures-activities matrix [online]. Available from: http://jncc.defra.gov.uk/default.aspx?page=7136 [date accessed: 16/04/21]

- Magic Map (Defra) [online]. Available from: https://magic.defra.gov.uk/MagicMap.aspx [date accessed: 12/04/21]

- Natural England (2016) Solent and Dorset Coast potential Special Protection Area citation [online]. Available from: https://www.gov.uk/government/consultations/solent-and-dorset-coast-potential-special-protection-area-comment-on-proposals [date accessed: 16/04/21]

- Ramsar (2007) Solent and Southampton Water Ramsar Site citation [online]. Available from: https://rsis.ramsar.org/ris/965 [date accessed: 16/04/21]

- Natural England (2021) SSSI sites in Lymington. [online]. Available from: https://designatedsites.naturalengland.org.uk/SiteDetail.aspx?SiteCode=S1001019 [date accessed: 16/04/21]

2. PREVIOUS WFD ASSESSMENT FOR MAINTENANCE DREDGING

(a) Background

Dredging in Lymington Harbour has already been subject to a WFD Compliance Assessment in 2011 and 2017, within the previous and current *Baseline Documents for Maintenance Dredging in Lymington Harbour* (Black & Veatch, 2011, 2017).

Natural England lent its support to the previous and current Baseline Documents and agreed with its conclusions. The Environment Agency has also been consulted on the Baseline Document in relation to the WFD Compliance Assessment of dredging activities, and its advice has informed this WFD Compliance Assessment.

(b) Measures to reduce the impact of dredging

The next stage in the previous WFD Compliance Assessment was to evaluate whether there were any other measures which could reduce the impact of maintenance dredging on the environment. In sheltered, confined waters, such as the maintained areas within Lymington Harbour, maintenance dredging is undertaken by either backhoe, or backacter, or cutter suction dredging, as described in the baseline document.

The choice of dredging method is normally dictated by the disposal route, site conditions, and type and quantity of dredged material. Backhoe dredging is the preferred method for loading barges for disposal at sea (Hurst Fort) and cutter suction being more appropriate for pumping ashore (as in saltmarsh restoration, beach recharge or land reclamation).

The disposal site at Hurst Fort is not located within any site of nature conservation and has been located there in order to avoid impacts to sensitive areas, with disposal restricted to the first four hours of ebb tides so the material is taken out to sea quickly. Therefore, it was not considered that the maintenance dredging activities could be modified in order to improve the elements for which the waterbodies were failing.

The latest RBMP cycle 2019 (cycle 2) classified the overall WFD waterbody status of both Lymington Transitional and Solent Coastal waterbodies as 'Moderate', as well as both of moderate ecological potential, which is the same as in RBMP 2009 (cycle 1) and 2016 (cycle 2), indicating that the maintenance dredging has had little effect on the WFD status of these waterbodies.

Additional chemical parameters within the waterbodies have been measured in 2019 cycle 2, which show as 'Fails', specifically for 'Polybrominated diphenyl ethers (PBDE)' and 'Mercury and its compounds'.

These parameters were not measured in previous years, so a direct comparison cannot be made, which means these contaminants were likely to have been present within the waterbodies pre-2019. These "fails" were also present in all three waterbodies (Lymington River, Lymington transitional, and Solent), therefore is of a much larger scale and are likely to not be influenced by the dredging and disposal activities.

PBDEs are a group of man-made organobromine compounds. They have been widely used as flame retardants in a range of products including electrical and electronic equipment, textiles and foams. The persistent and bioaccumulative properties of PBDEs, along with their potential adverse effects on aquatic life and humans have led to commercially supplied variations of these compounds being designated priority hazardous substances and ubiquitous persistent, bioaccumulative and toxic compounds under the Water Framework Directive (WFD) in the related Environmental Quality Standards Directive (EQSD) (2008/105/EC amended by 2013/39/EU).

There are currently national and international measures in place to prevent the use of PBDEs in products. However, there are a wide range of old consumer products used in homes and businesses which contain PBDEs. Releases occur during use and disposal of these products and they continue to enter waste-water treatment works (WwTWs). This then continues to spread via sewage sludge and surface water run-off (Environment Agency, 2019a).

Mercury is a naturally occurring metallic element, but much of the mercury found in the environment today arises from past industrial activity.

Mercury can occur in various chemical forms which differ in their degree of toxicity and bioavailability. The change from one form to another occurs in water and sediment through biological processes. Methylmercury is the most toxic and bioavailable form.

Historically, mercury has had many industrial and domestic uses which are now banned or severely restricted in favour of safer alternatives. It has been used in electrical equipment such as thermostats and batteries, cosmetics, wood preservatives, textile treatment agents and as an antifouling agent on boat hulls. A major use of mercury has been in mercury amalgam dental fillings, although this is now declining. Liquid mercury has been used for many years in measuring devices such as thermometers, barometers and blood pressure monitors (Environment Agency, 2019b).

Mercury and its compounds are classed as Water Framework Directive priority hazardous substances under the Environmental Quality Standards Directive (EQSD; Directive 2008/105/EC amended by Directive 2013/39/EU) because they readily bioaccumulate, are highly toxic and persistent. It is found in measurable concentrations in fish and mussels at all locations sampled as part of the Environment Agency biota monitoring programme (Environment Agency, 2019b).

The conclusion of the initial WFD Compliance Assessment for maintenance dredging is that the activity complied with the objectives of the WFD and was deemed to be compliant with the relevant standards and objectives of other relevant EU legislation (Black & Veatch, 2017).

With regards to the waterbody failures of elevated levels of PBDEs and Mercury and its compounds, the issue extends beyond the zone of influence for potential impacts associated with dredging and disposal activities, to the nearby waterbodies (Lymington River, Lymington Transitional and the Solent). This supports the finding that the contaminants are from sources other than dredging and disposal activities, therefore it is highly likely that these said activities are not contributing to these failures.

3. RESULTS

The results of the WFD Assessment are provided below and are based upon the latest WFD Estuarine and Coastal Guidance (Environment Agency, 2016).

3.1 Step 1: Screening

WFD waterbodies were determined as relevant based on their geographical location and their connectivity to the waterbody where the dredging will take place. The high-level screening process identified six water bodies close the dredging area (Table 2; Appendix A, Figure 1).

As the extended maintenance dredging area will be taking place in both waterbodies, Lymington transitional waterbody (ID GB520704202100) and the Solent coastal waterbody (ID GB650705150000), these were screened in for further assessment. As the dredging footprint size (and therefore location) has changed, both waterbodies are screened in for all quality elements at this stage (i.e. hydromorphological, biological, water quality, WFD protected areas and INNS) and details of these can be found in the scoping tables in Appendix B.

Lymington River waterbody, Dorset/Hampshire coastal waterbody, South West Hants Solent groundwater body, and South West Hants Barton Group groundwater body are also nearby, however they are not anticipated to be affected by the maintenance dredging or disposal, and therefore these are screened out of further assessment (see Table 2 for reasoning).

3.2.1 Collation of baseline data

Baseline data has been collected from the Environment Agency's online Catchment Data Explorer system (http://environment.data.gov.uk/catchment-planning/; accessed on 05/04/2021) for all biological, chemical and supporting elements for Lymington transitional water body and for the Solent coastal water body. Current WFD overall status data are shown in Table 3 and Table 4.

In terms of benthic habitats and invertebrate fauna, data obtained from the European Marine Observation and Data Network ('EMODnet')[2], indicates that the benthic habitats present in the dredging area comprise 'infralittoral sandy mud' (A5.33), and 'infralittoral fine mud' (A5.34) in the upper and mid-sections; and 'infralittoral sandy mud' (A5.33) in the lower section of the dredging area in the Solent coastal waterbody. These sediments are characterised as containing various invertebrate fauna including the polychaete worms *Nephtys hombergii*, *Arenicola marina* and *Capitella capitata*; the bivalve molluscs *Limecola balthica*, *Abra alba*, and *Mytilus* sp.; the sponge *Haliclona oculata*; the bryozoan *Flustra foliacea*, and the gammarid shrimp *Ampelisca* spp; and colonial ascidians are also present.

With regards to the disposal sites, the saltmarsh recharge disposal area is a tidal creek made up of 'infralittoral sandy mud' (A5.33), with similar faunal characteristics of the dredging area. The benthic habitat at Hurst Fort consists of 'Circalittoral coarse

[2] http://www.emodnet-seabedhabitats.eu/

sediment' (A5.14) and 'Deep circalittoral coarse sediment' (A5.15), which is typical in tidal channels of marine inlets, along exposed coasts and offshore. This habitat, as with shallower coarse sediments, may be characterised by robust infaunal polychaetes, mobile crustacea and bivalves.

Table 2: Identification of WFD waterbodies[3] and confirmation of assessment requirements

Water body name and type	Water body ID	A/HMWB Designation	RBMP overall status (2019 Cycle 2)	Screen for detailed WFD Assessment	Reasoning
Lymington (Transitional)	GB520704202100	HMWB	Moderate Status	**IN**	The activities will be undertaken within the Lymington transitional water body (GB520704202100), so there is potential for direct and indirect effects on biological quality and supporting elements. This waterbody has therefore been screened in for further assessment.
Solent (Coastal)	GB650705150000	HMWB with coastal and flood protection	Moderate Status	**IN**	A small section of the maintenance dredging area also falls within the Solent coastal water body (GB650705150000), as well as the Hurst Fort disposal ground and the Saltmarsh recharge beneficial reuse disposal area (see Appendix A, Figure 1). When the lower river maintenance dredging takes place, the majority of the disturbed material will be transported eastwards on the flood tide by the Solent tidal stream, however, there is still potential for direct and indirect effects on biological quality and supporting elements, due to disturbance of sediment, underwater noise and increased turbidity.
Lymington River (River)	GB107042011220	HMWB	Moderate	**OUT**	The Lymington River has a self-regulating tidal gate at its tidal limit. This gate allows saline water to pass into the Lymington River waterbody, where previously it has been restricted by the Causeway. The tidal gate remains open at all times except high tide, when it is closed to provide flood defence. Although there is exchange between the Lymington transitional and Lymington River water bodies, it is unlikely that any significant quantity of sediment from the dredging and alternative disposal activity will reach the Lymington River on the flood tide, therefore this water body has been discounted from any further assessment.

[3] *Source - RBMP Cycle 2 Map* – Environment Agency Catchment Data Explorer, *accessed 10th April 2021.*

Water body name and type	Water body ID	A/HMWB Designation	RBMP overall status (2019 Cycle 2)	Screen for detailed WFD Assessment	Reasoning
Dorset/Hampshire (Coastal)	GB620705550000	No	Moderate	**OUT**	Although the Dorset/Hampshire coastal water body is connected to the Solent water body, it is over 5km from the disposal site. Due to the distance from the works and the fact that the it is outside of the main Solent tidal stream, there will not be any impact on this coastal water body and this water body has been discounted from any further assessment.
South West Hants Barton Group (Groundwater body)	GB40702G503500	N/A	Good	**OUT**	The South West Hants Barton Groundwater body is restricted to the terrestrial area. As the dredging and disposal activity will be restricted to the subtidal area there will not be any impact on the groundwater body and therefore this waterbody has been discounted from any further assessment.
South West Hants Solent Group (Groundwater body)	GB40702G504000	N/A	Good	**OUT**	The South West Hants Solent Groundwater body is restricted to the terrestrial area. As the dredging and disposal activity will be restricted to the river and subtidal area, there will not be any impact on the groundwater body and therefore this water body has been discounted from any further assessment.

Table 3: Baseline WFD classification data for screened in water bodies[4]

Waterbody	Description, notes or more information
WFD waterbody name	Lymington
Waterbody ID	GB520704202100
River basin district name	South East
Waterbody type (estuarine or coastal)	Estuarine
Waterbody total area (ha)	245.2
Overall waterbody status (2019)	Moderate
Ecological status (2019 Cycle 2)	Moderate
Chemical status (2019 Cycle 2)	Fail
Chemical failures	Polybrominated diphenyl ethers (PBDE); Mercury and Its Compounds
Target waterbody status and deadline	Moderate by 2015 (and retain this overall status)
Hydromorphology status of waterbody	Supports Good
Heavily modified waterbody and for what use	- Coastal protection - Flood protection
Higher sensitivity habitats present	- Saltmarsh (92.6ha)
Lower sensitivity habitats present	- Intertidal soft sediment (141.1ha) - Rocky shore (0.07ha)
Phytoplankton status (2019 Cycle 2)	No data
History of harmful algae	Not Monitored
WFD protected areas within 2km	- Solent Maritime SAC - Solent and Isle of Wight Lagoons SAC - Solent and Southampton Water SPA Shellfish Waters: - Lymington and Sowley - Pennington

[4] *Source – Environment Agency Waterbody Summary Reports for Lymington (Transitional) provided for 2019 Cycle 2, accessed on 10th April 2021*

Table 4: Baseline WFD classification data for screened in water bodies[5]

Waterbody	Description, notes or more information
WFD waterbody name	Solent
Waterbody ID	GB650705150000
River basin district name	South East
Waterbody type (estuarine or coastal)	Coastal
Waterbody total area (ha)	25,958.1
Overall waterbody status (2015)	Moderate
Ecological status (2019 Cycle 2)	Moderate
Chemical status (2019 Cycle 2)	Fail
Chemical failures	Polybrominated diphenyl ethers (PBDE); Mercury and Its Compounds
Target waterbody status and deadline	Moderate by 2015 (and retain this overall status)
Hydromorphology status of waterbody	No data
Heavily modified waterbody and for what use	- Coastal protection - Flood protection - Navigation, ports and harbours
Higher sensitivity habitats present	- Saltmarsh (92.6ha) - Intertidal seagrasses (141.34ha) - Subtidal kelp beds (115.7ha) - Chalk reef (3,308.8ha) - Mussel beds including blue and horse mussels (0.8ha)
Lower sensitivity habitats present	- Intertidal soft sediments (sand and mud) (1,496.9ha) - Subtidal soft sediments (sand and mud) (11,772.3ha) - Subtidal rocky reef (460.8ha) - Rocky shore (80.1ha) - Cobbles, gravel and shingle (129.5ha)
Phytoplankton status	Good
History of harmful algae	No

[5] *Source – Environment Agency Waterbody Summary Report for Solent (Coastal) provided for 2019 Cycle 2, accessed on 10th April 2021*

WFD protected areas within 2km of dredging area	- Solent Maritime SAC - Solent and Isle of Wight Lagoons SAC - Solent and Southampton Water SPA Shellfish Waters: - Lymington and Sowley - Pennington
WFD protected areas within 2km of Hurst Fort disposal area	- Solent Maritime SAC - Solent and Southampton Water SPA Shellfish Waters: - Yarmouth, Isle of Wight - Pennington - Totland, Isle of Wight Bathing Waters: - Colwell Bay, Isle of Wight
WFD protected areas within 2km of Saltmarsh recharge disposal area	- Solent Maritime SAC - Solent and Southampton Water SPA Shellfish Waters: - Lymington and Sowley - Pennington

3.2 Step 2: Scoping

The WFD elements that require further consideration are shown in Table 6, which include the quality elements listed in Section 1.4 (Assessment Methodology).

The full scoping tables can be found in Appendix B, and a summary table of which quality elements have been scoped in for each waterbody are below (Table 5).

Table 5: Summary table of scoping results in Lymington transitional (dredging only) and Solent coastal (dredging and disposal)

Lymington (Transitional)		
Dredging		
Receptor	**Potential risk to receptor?**	**Note the risk issue(s) for impact assessment**
Hydromorphology	Could significantly impact the hydromorphology of any waterbody	A large proportion of the waterbody is subject to maintenance dredging.
Biology: habitats	Footprint is 1% or more of the waterbody's area and over 0.5 km^2	22.9% of the waterbody (0.56 km^2) will be subject to maintenance dredging.
	Within 500m of any higher sensitivity habitat	Less than 100m away from the Saltmarsh habitat.
Biology: fish	Is in an estuary and could affect fish in the estuary, outside the estuary but could delay or prevent fish entering it, or could affect fish migrating through the estuary	Large area of waterbody being dredged which is an estuary; therefore, this may prevent fish entering it while maintenance dredging is taking place.
	Could impact on normal fish behaviour like movement, migration or spawning (for example creating a physical barrier, noise, chemical change or a change in depth or flow)	Large area of waterbody being dredged; therefore, this may impact fish movement and behaviour.
Water quality	Could affect water clarity, temperature, salinity, oxygen levels, nutrients or microbial patterns continuously for longer than a spring neap tidal cycle (about 14 days)	Maintenance dredging will take place over a number of days; therefore, the water clarity may be affected.
	The chemicals are on the Environmental Quality Standards Directive (EQSD) list	Release of chemicals during maintenance dredging due to sediment disturbance.

	It disturbs sediment with contaminants above Cefas Action Level 1.	Release of contaminants during maintenance dredging due to sediment disturbance.
Protected areas	WFD protected areas within 2km of dredging area	- Solent Maritime SAC - Solent and Isle of Wight Lagoons SAC - Solent and Southampton Water SPA - Solent and Southampton Water Ramsar Site - Lymington and Sowley Shellfish Waters - Pennington Shellfish Waters
Solent (Coastal)		
Dredging		
Receptor	**Potential risk to receptor?**	**Note the risk issue(s) for impact assessment**
Hydromorphology	Is in a waterbody that is heavily modified for the same use as your activity	Yes – heavily modified for 'Navigation, ports and harbours.'
Biology: habitats	Within 500m of any higher sensitivity habitat	Under 100m from the Saltmarsh habitat.
Water Quality	Could affect water clarity, temperature, salinity, oxygen levels, nutrients or microbial patterns continuously for longer than a spring neap tidal cycle (about 14 days)	Maintenance dredging will take place over several days; therefore, the water clarity may be affected.
	The chemicals are on the Environmental Quality Standards Directive (EQSD) list	Release of chemicals during maintenance dredging due to sediment disturbance.

	It disturbs sediment with contaminants above Cefas Action Level 1.	Release of contaminants during maintenance dredging due to sediment disturbance.
Protected areas	WFD protected areas within 2km of dredging area	- Solent Maritime SAC - Solent and Isle of Wight Lagoons SAC - Solent and Southampton Water SPA - Solent and Southampton Water Ramsar Site - Lymington and Sowley Shellfish Waters - Pennington Shellfish Waters
Disposal		
Receptor	**Potential risk to receptor?**	**Note the risk issue(s) for impact assessment**
Hydromorphology	Is in a waterbody that is heavily modified for the same use as your activity	Yes – heavily modified for Coastal protection
Biology: habitats	Within 500m of any higher sensitivity habitat	Under 100m from the Saltmarsh habitat.
Biology: Fish	Could impact on normal fish behaviour like movement, migration or spawning (for example creating a physical barrier, noise, chemical change or a change in depth or flow)	Saltmarsh recharge disposal area is in a tidal creek which could provide a nursery area for fish.

Water Quality	Could affect water clarity, temperature, salinity, oxygen levels, nutrients or microbial patterns continuously for longer than a spring neap tidal cycle (about 14 days)	Disposal will take place over a number of days; therefore, the water clarity may be affected.
	The chemicals are on the Environmental Quality Standards Directive (EQSD) list.	Release of chemicals during sediment disposal due to sediment disturbance.
	It disturbs sediment with contaminants above Cefas Action Level 1.	Release of contaminants during sediment disposal due to sediment disturbance.
Protected areas	WFD protected areas within 2km of Hurst Fort disposal area	- Solent Maritime SAC - Solent and Southampton Water SPA Shellfish Waters: - Yarmouth, Isle of Wight - Pennington - Totland, Isle of Wight Bathing Waters: - Colwell Bay, Isle of Wight
	WFD protected areas within 2km of Saltmarsh recharge disposal area	- Solent Maritime SAC - Solent and Southampton Water SPA Shellfish Waters: - Lymington and Sowley - Pennington

3.3 Step 3: Impact Assessment of Effects on WFD

A high level assessment of potential causal links and effects identified from completion of the screening and scoping tables for Lymington transitional and Solent coastal water bodies are shown in Table 6 and Table 7. It should be noted that this preliminary assessment assumes that the mitigation measures described in these tables during dredging and disposal will be adopted and thereby minimise any potential adverse effects.

The assessments for both the Lymington Transitional waterbody (Table 6) and the Solent Coastal waterbody (Table 7) indicate that, with implementation of the proposed mitigation measures, the potential direct and indirect effects on WFD elements will be temporary, negligible or minor, and localised in extent.

Table 6: Impact Assessment of potential effects on scoped-in quality elements and actions for WFD compliance of the Lymington Transitional Waterbody

WFD Quality Elements	Assessment of effects on quality elements	Actions for WFD Compliance (including proposed mitigation during design and implementation of works)
Biology – Habitats and Fish		
Aquatic flora (Macroalgae/Angiosperms incl. Seagrass)	Dredging will involve the removal of sediment which is currently in the subtidal zone of the designated main navigation channel, and has the potential to lead to the direct loss/disturbance of aquatic flora and following the mobilisation of sediments and contaminants into the water column, which may result in a localised reduction in water quality, including reduction in light penetration as well as productivity and growth rates in plants. As the works will be short-term and therefore temporary in nature, and considering maintenance dredging has already been undertaken a number of times previously, which would have already disturbed any established aquatic vegetation in the past, it is anticipated that effects will be no greater than minor adverse and therefore not significant on aquatic flora. Thus, no adverse effects are anticipated on this WFD element at the water body level.	Measures proposed include best practice to minimise sediment mobilisation during dredging e.g. use of barge mounted backhoe dredger. Dredging to be undertaken within clearly identified zones.
Benthic invertebrates	The potential impacts and subsequent effects include i) direct loss/displacement of benthic habitats and associated invertebrates within the footprint of the dredged area ii) sediment deposition and subsequent smothering of benthic communities and iii) pollution impacts leading to subsequent toxicological effects in benthic communities. Considering the temporary nature of the works and the employment of non-dispersive dredging methods, the effects are anticipated to be localised, short-term and temporary. Following the cessation of dredging, recolonisation by benthic invertebrates from undisturbed areas is anticipated to occur. It should also be noted that the site has already undergone maintenance and capital dredging several times in the past, and therefore the communities which are present will already have experienced some degree of disturbance. Consequently, effects are considered to be no greater than minor in scale and therefore not significant on benthic invertebrates. Thus, no significant effects are anticipated on this WFD biological element at the water body level.	Measures proposed include best practice to minimise sediment mobilisation during dredging e.g. use of barge mounted backhoe dredger. Dredging to be undertaken within clearly identified zones. Consideration to timing of events for the works to be undertaken (e.g. carry out during ebb tides to ensure less disturbance of sediment).
Fish	The works have the potential to lead to a number of effects during dredging, some of these include i) Temporary increases in underwater noise (e.g. from dredging and movement of vessels) ii) Loss/disturbance of spawning/nursery areas iii) Increase in suspended sediments in the water column, as well as increases in turbidity iv) Pollution leading to toxicological and behavioural effects in species. The dredging area is a busy channel, it is expected that the fish will already be accustomed to a certain level of disturbance, however, further mitigation will also be implemented to reduce disturbance including liaising with the MMO during the Marine Licencing process to agree appropriate timings of dredging. Effects are considered to be no greater than temporary and minor, therefore not significant. In terms of loss/disturbance to spawning/nursery areas, the development site is not located within a particular fish spawning / nursery area hotspot and the proposed works will only affect a small area of channel, leaving larger suitable habitat areas intact, the effects are considered to be no greater than minor adverse. For the effects of underwater noise on fish, with the implementation of the proposed measures, the effects are anticipated to be minor and temporary. Thus, no significant effects are anticipated on this WFD biological element at the water body level.	None required for WFD compliance at the water body scale, however other mitigation will be followed: - Liaison with MMO to ensure the timing of dredging works minimises disturbance.

Hydromorphology		
Tidal regime - Wave exposure	Dredging for the approach channel may slightly modify wave patterns by refraction, but the effects are considered to be negligible as the increase in depth relative to the existing conditions is small. Furthermore, due to the short-term temporary nature of dredging and adoption of non-dispersive methods, as well as the fact that maintenance dredging has been undertaken previously here, with no reports of adverse effects on the intertidal zone structure. Consequently, no significant effects anticipated on this WFD supporting element at the water body level.	None required for WFD compliance
WFD Quality Elements	**Assessment of effects on quality elements**	**Actions for WFD Compliance (including proposed mitigation during design and implementation of works)**
Water Quality		
Transparency	The dredging works has the potential to lead to increases in suspended sediments, a subsequent increase in turbidity and a reduction in light penetration. However, a series of measures will be implemented to minimise these effects. As there is an absence of severe wave action and weak tidal currents in the harbour, it will serve to minimise potential adverse effects on sediment resuspension. Moreover, the communities within Lymington Harbour are likely to be tolerant to high levels of suspended solids. Maintenance dredging, shipping activities and disturbance around the Lymington Harbour area have been ongoing for many years and the benthic invertebrate communities present will reflect this pattern of activity and their recovery will be relatively rapid (ABPmer, 1999). Consequently, effects are considered to be no greater than minor in scale and therefore not significant on benthic invertebrates. Thus, no significant effects are anticipated on this WFD biological element at the water body level.	None required for WFD compliance with WFD at the water body scale, however other mitigation will be followed: - No working on sensitive operations during adverse weather conditions. - Liaison with MMO to ensure the timing of dredging works minimises disturbance.
Nutrient conditions (e.g. nitrogen)	The dredging site is not highlighted as being a particular nutrient hot spot and is not located with NVZ's, therefore potential significant adverse effects arising from the temporary disturbance of sediments is considered unlikely to lead to significantly elevated nutrient levels in the water column. Thus, no significant adverse effects are expected at the water body level.	None are required for WFD compliance.
Chemicals identified on the Environmental Quality Standards Directive (EQSD) list	Sediment quality analysis was carried out in Lymington Harbour in 2014 by Cefas, and in 2019 by NLS, as part of the MMO marine licensing procedure for the disposal of maintenance dredged material at Hurst Fort (Licence L/2014/00396/1) and for discharge of condition 5.2.2 on (Licence L/2014/00396/2), respectively) (see Appendix E; Table E-1 and E-2). These were carried out in order to assess the nature and degree of any chemical contamination present. Results on both counts demonstrated that the dredged material was acceptable for disposal at sea and for beneficial reuse, and as maintenance dredging and disposal have been carried out for a number of years in Lymington Harbour with no detrimental impacts to the area, it is anticipated that there will be no significant effects on this WFD supporting element at the waterbody level.	None are required for WFD compliance.

Sediments with contaminants above Cefas Environmental Action Level (EAL) 1	Sediment quality analysis was carried out in several sites in Lymington Harbour in 2014 by Cefas, and in 2019 by NLS as part of the MMO marine licensing procedure for the disposal of maintenance dredged material at Hurst Fort (Licence L/2014/00396/1) and for discharge of condition 5.2.2 on (Licence L/2014/00396/2), respectively) (see Appendix E; Table E-1 and E-2). This was carried out in order to assess the nature and degree of any chemical contamination present. 2019 sediment samples were collected to measure trace heavy metal and organotin concentrations. The data indicated that concentrations of trace heavy metals and organotins in the sediment fall well below Cefas EAL 2 (Appendix F) and are also below the PELs set out in the Canadian guidelines. Arsenic exceeds EAL 1 in two locations (Horn Reach and Town Quay and Moorings), which are not in close proximity to the disposal sites. Nickel slightly exceeds EAL 1 in all sampling locations. Cadmium, copper, mercury, zinc, DBT and TBT fall below EAL (Cefas EALs are shown in Appendix F). Overall, there is little difference in metal concentrations between the five locations sampled and between the 2014 and 2019 data. The PAH results in the 2014 dataset showed elevated levels above Cefas EAL 1 for fluoranthene and perylene in five samples; for pyrene in four samples; for benzo(b)fluoranthene, diben(ah)anthracene and ideno(1,2,3-cd)pyrene in two samples; and benz(a)anthracene, benzo(a)pyrene and C3-naphthalenes in one sample. The results are below the levels occurring in the wider area though, and overall, the results demonstrated that the material is acceptable for disposal at sea and for beneficial reuse. Furthermore, as maintenance dredging and disposal have been carried out for several years here with no detrimental impacts, it is anticipated that there will be no significant effects on this WFD supporting element at the waterbody level.	None are required for WFD compliance.
WFD Quality Elements	Assessment of effects on quality elements	Actions for WFD Compliance (including proposed mitigation during design and implementation of works)
Protected Sites (within 2km distance)		
Shellfish waters	The Lymington transitional water body does not contain any designated Shellfish Waters; however, the boundary of the Lymington and Sowley Shellfish waters lies approximately 250 metres downstream (see Figure A-2, 5.Appendix A:). Dredging will not be undertaken within areas classified as shellfish waters, but it will take place within classified bivalve mollusc harvesting areas. It is considered unlikely that the dredging site is located within a prime spot for mollusc harvesting, especially as this site has previously undergone maintenance dredging on several occasions. Nevertheless, there is potential for dredging to lead to i) an increase in suspended sediments and turbidity ii) mobilisation of contaminants into the water column iii) reduction in oxygen levels and iv) deposition of these sediments into the potential mollusc harvesting areas. This may lead to adverse effects in shellfish including the clogging of filter feeding and breathing mechanisms from suspended sediments and potential toxicological and physiological effects. However, as the works will be short-term and therefore temporary only lasting for the duration of dredging, with fairly near-field effects anticipated, no significant adverse effects are anticipated on mollusc harvesting areas.	- Measures proposed include best practice to minimise sediment mobilisation during dredging e.g. use of barge mounted backhoe dredger. - Dredging to be undertaken within clearly identified zones.

Special Areas of Conservation (Natura 2000 sites)	There is the potential for effects on the Solent Maritime SAC, the Solent & Isle of Wight Lagoons SAC, and the Solent and Southampton Water SPA, due to the proximity of the proposed dredging works. However, the small scale and timing are such that any effects associated with resuspension of sediment will be localised and are not expected to affect any of the qualifying habitats of the SAC[6] directly or indirectly (e.g. through siltation/smothering of re-suspended sediments). The qualifying Annex II species[7] is a snail, and highly unlikely to be found in the region of the dredging area, as the channel environment is not suitable habitat for Desmoulin's whorl snail, which are typically found in reed-grasses or sedges on calcareous wetland sites, therefore this species is not likely to be affected by the dredging activity. Thus, the proposed works are not anticipated to lead to significant adverse effects on this SAC at the water body scale. Interest features of the Solent and Isle of Wight Lagoons SAC are represented over a range of locations. The nearest lagoon system to the dredging is the Pennington-Keyhaven lagoons, which comprise a network of ponds and ditches behind the sea defence bund. The other lagoons are remote from Lymington, at Gosport, Bembridge and Langstone Harbour. Given the distance of these lagoons from the proposed dredging and the isolation of the nearest ones behind the sea wall, the proposed subtidal channel dredging will have no impact on any of the interest features of the Solent and Isle of Wight Lagoons SAC.	None required for compliance with WFD.

[6] Annex I qualifying habitats include Estuaries, Spartina swards, Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*), sandbanks slightly covered by seawater at all times, mudflats and sandflats not covered by seawater at low tide, coastal lagoons , annual vegetation of drift lines , perennial vegetation of stony banks , *Salicornia* and other annuals colonising mud and sand, and shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes').
[7] Annex II species include (Desmoulin's whorl snail (*Vertigo moulinsiana*).

Table 7: Impact Assessment of potential effects on scoped-in quality elements and actions for WFD compliance of the Solent Coastal Waterbody

WFD Quality Elements	Assessment of effects on quality elements	Actions for WFD Compliance (including proposed mitigation during design and implementation of works)
Biology – Habitats and Fish		
Aquatic flora (Macroalgae/Angiosperms incl. Seagrass)	Dredging will involve the removal of sediment which is currently in the subtidal zone of the designated main navigation channel, and has the potential to lead to the direct loss/disturbance of aquatic flora and following the mobilisation of sediments and contaminants into the water column, which may result in a localised reduction in water quality, including reduction in light penetration as well as productivity and growth rates in plants. As the works will be short-term and therefore temporary in nature, as well as less than 1% of the total waterbody area, and considering maintenance dredging has already been undertaken a number of times previously, which would have already disturbed any established aquatic vegetation in the past, it is anticipated that effects will be no greater than minor adverse and therefore not significant on aquatic flora. Thus, no adverse effects are anticipated on this WFD element at the waterbody level.	Measures proposed include best practice to minimise sediment mobilisation during dredging e.g. use of barge mounted backhoe dredger. Dredging to be undertaken within clearly identified zones.
	Saltmarsh recharge disposal area: The disposal will take place within the subtidal area with the aim of the sediment creating a 'reef' on the sea floor to protect the adjacent saltmarsh. It is expected that natural tidal movement may also wash some sediment onto the saltmarsh. Given the fact that sediment is not being directly placed on the saltmarsh and the limited extent and temporary nature of the impacts, it is unlikely that this WFD parameter will be adversely affected by the works. The saltmarsh recharge trial which took place from 2014 to 2017 went well and benthic habitat surveys carried out by Natural England demonstrated that there had been no adverse impacts on the saltmarsh area following three dumping campaigns (Black & Veatch, 2017b). There may be a temporary impact on suspended sediment concentrations in the vicinity of the site, although this has clearly not affected the growth of the saltmarsh. In the long-term the bottom dumping scheme will act to retain sediment within the estuary system, with the aim of conserving the intertidal saltmarsh habitat, therefore no adverse effects are anticipated on this WFD element at the water body level. Hurst Fort: This disposal site is not located within any site of nature conservation and has been sited here in order to avoid impacts to sensitive areas with dumping restricted to the first four hours of ebb tides to take the material out to sea, thus no adverse effects are anticipated on this WFD element at the water body level.	Disposal to take place during ebb tide.
Benthic invertebrates	The potential impacts and subsequent effects include i) direct loss/displacement of benthic habitats and associated invertebrates within the footprint of the dredged area ii) sediment deposition and subsequent smothering of benthic communities and iii) pollution impacts leading to subsequent toxicological effects in benthic communities. Considering the temporary nature of the works and the employment of non-dispersive dredging methods, the effects are anticipated to be localised, short-term and temporary. Following the cessation of dredging, recolonisation by benthic invertebrates from undisturbed areas is anticipated to occur. It should also be noted that the site has already undergone maintenance and capital dredging several times in the past, and therefore the communities which are present will already have experienced some degree of disturbance. Consequently, effects are considered to be no greater than minor in scale and therefore not significant on benthic invertebrates. Thus, no significant effects are anticipated on this WFD biological element at the water body level.	Measures proposed include best practice to minimise sediment mobilisation during dredging e.g. use of barge mounted backhoe dredger. Dredging to be undertaken within clearly identified zones. Consideration to timing of events for the works to be undertaken (e.g. carry out during ebb tides to ensure less disturbance of sediment).

WFD Quality Elements	Assessment of effects on quality elements	Actions for WFD Compliance (including proposed mitigation during design and implementation of works)
	The smothering of benthic invertebrates within the disposal footprint in both areas is unavoidable. The loss of benthic invertebrates cannot be mitigated for, but the loss will be on a localised scale and the area of the coastal bed that will be affected is very small in comparison to the size of the waterbody. Giving consideration to the scale, and nature of the disposal activities, it was determined that any impacts on benthic invertebrate populations are likely to be localised, temporary and insignificant. Also, the sediment recharge will have beneficial effects on the saltmarsh and the associated invertebrates, therefore it is expected that the disposal area will become re-established relatively quickly with benthic invertebrates.	None required for WFD compliance at the water body scale
Hydromorphology		
Tidal regime - Wave exposure	Dredging for the approach channel may slightly modify wave patterns by refraction, but the effects are considered to be negligible as the increase in depth relative to the existing conditions is small. Consequently, no significant effects anticipated on this WFD supporting element at the waterbody level.	None required for WFD compliance
	The location of the saltmarsh recharge disposal area is within a sheltered site and outside of the main Solent tidal stream. The amount of sediment to be disposed and the area over which it will be disposed is also limited (less than 0.005% of the water body) and therefore will not affect dominant currents at waterbody level.	None required for WFD compliance
Water Quality		
Chemicals on the Environmental Quality Standards Directive (EQSD) list	Sediment quality analysis was carried out in several sites in Lymington Harbour in 2014 by Cefas, and in 2019 by NLS as part of the MMO marine licensing procedure for the disposal of maintenance dredged material at Hurst Fort (Licence L/2014/00396/1) and for discharge of condition 5.2.2 on (Licence L/2014/00396/2), respectively) (see Appendix E; Table E-1 and E-2). This was carried out in order to assess the nature and degree of any chemical contamination present. Results demonstrated that the material is acceptable for disposal at sea and for beneficial reuse, and as maintenance dredging and disposal have been carried out for a number of years here with no detrimental impacts, it is anticipated that there will be no significant effects on this WFD supporting element at the waterbody level.	None required for WFD compliance

Sediment with contaminants above Cefas Environmental Action Level (EAL) 1	Sediment quality analysis was carried out in several sites in Lymington Harbour in 2014 by Cefas, and in 2019 by NLS as part of the MMO marine licensing procedure for the disposal of maintenance dredged material at Hurst Fort (Licence L/2014/00396/1) and for discharge of condition 5.2.2 on (Licence L/2014/00396/2), respectively) (see Appendix E; Table E-1 and E-2). This was carried out in order to assess the nature and degree of any chemical contamination present. 2019 sediment samples were collected to measure trace heavy metal and organotin concentrations. The data indicated that concentrations of trace heavy metals and organotins in the sediment fall well below Cefas EAL 2 and are also below the PELs set out in the Canadian guidelines. Arsenic exceeds EAL 1 in two locations (Horn Reach and Town Quay and Moorings), which are not in close proximity to the disposal sites. Nickel slightly exceeds EAL 1 in all sampling locations. Cadmium, copper, mercury, zinc, DBT and TBT fall below EAL (Cefas EALs are shown in Appendix F). Overall, there is little difference in metal concentrations between the five locations sampled and between the 2014 and 2019 data. The PAH results in the 2014 dataset showed elevated levels above Cefas EAL 1 for fluoranthene and perylene in five samples; for pyrene in four samples; for benzo(b)fluoranthene, diben(ah)anthracene and ideno(1,2,3-cd)pyrene in two samples; and benz(a)anthracene, benzo(a)pyrene and C3-naphthalenes in one sample. The results are below the levels occurring in the wider area though, and overall, the results demonstrated that the material is acceptable for disposal at sea and for beneficial reuse. Furthermore, as maintenance dredging and disposal have been carried out for several years here with no detrimental impacts, it is anticipated that there will be no significant effects on this WFD supporting element at the waterbody level.	None required for WFD compliance
WFD Quality Elements	**Assessment of effects on quality elements**	**Actions for WFD Compliance (including proposed mitigation during design and implementation of works)**
Protected Sites (within 2km distance)		
Shellfish Waters	The Solent Coastal waterbody contains several designated Shellfish Waters; the ones within a 2km distance from the dredging area and saltmarsh recharge disposal area are Lymington and Sowley, and Pennington. Additionally, Hurst Fort disposal area is 1.8km northeast from the boundary of Totland Shellfish Waters, off the northwest coast of Isle of Wight. Neither dredging nor disposal will be undertaken within areas classified as shellfish waters, but it will take place within classified bivalve mollusc harvesting areas. It is considered unlikely that the dredging site is located within a prime spot for mollusc harvesting, especially as this site has previously undergone maintenance dredging on several occasions. Nevertheless, there is potential for dredging to lead to i) an increase in suspended sediments and turbidity ii) mobilisation of contaminants into the water column iii) reduction in oxygen levels and iv) deposition of these sediments into the potential mollusc harvesting areas. This may lead to adverse effects in shellfish including the clogging of filter feeding and breathing mechanisms from suspended sediments and potential toxicological and physiological effects. However, as the works will be short-term and therefore temporary only lasting for the duration of dredging, with fairly near-field effects anticipated, no significant adverse effects are anticipated on mollusc harvesting areas.	- Measures proposed include best practice to minimise sediment mobilisation during dredging e.g. use of barge mounted backhoe dredger. - Dredging to be undertaken within clearly identified zones.
Bathing Waters	Hurst Fort disposal area is situated 1.7km north from the Colwell Bay Bathing Water site on the northwest coast of the Isle of Wight (see Figure A.2 in 5.Appendix A:). As the effects of the sediment disposal are anticipated to be fairly localised, affecting less than 0.5% of the waterbody, and due to the short-term temporary nature of the works, no significant adverse effects are anticipated on the bathing water.	None required for WFD compliance

Special Areas of Conservation (Natura 2000 sites)	There is the potential for effects on the Solent Maritime SAC, the Solent & Isle of Wight Lagoons SAC, and the Solent and Southampton Water SPA, due to the proximity of the proposed dredging works. However, the small scale and timing are such that any effects associated with resuspension of sediment will be localised and are not expected to affect any of the qualifying habitats of the SAC[8] directly or indirectly (e.g. through siltation/smothering of re-suspended sediments). The qualifying Annex II species[9] is a snail, and highly unlikely to be found in the region of the dredging area, as the channel environment is not suitable habitat for Desmoulin's whorl snail, which are typically found in reed-grasses or sedges on calcareous wetland sites, therefore this species is not likely to be affected by the dredging activity. Thus, the proposed works are not anticipated to lead to significant adverse effects on this SAC at the waterbody scale. Interest features of the Solent and Isle of Wight Lagoons SAC are represented over a range of locations. The nearest lagoon system to the dredging is the Pennington-Keyhaven lagoons, which comprise a network of ponds and ditches behind the sea defence bund. The other lagoons are remote from Lymington, at Gosport, Bembridge and Langstone Harbour. Given the distance of these lagoons from the proposed dredging and the isolation of the nearest ones behind the sea wall, the proposed subtidal channel dredging will have no impact on any of the interest features of the Solent and Isle of Wight Lagoons SAC.	None required for compliance with WFD.

[8] Annex I qualifying habitats include Estuaries, Spartina swards, Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*), sandbanks slightly covered by seawater at all times, mudflats and sandflats not covered by seawater at low tide, coastal lagoons , annual vegetation of drift lines , perennial vegetation of stony banks , *Salicornia* and other annuals colonising mud and sand, and shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes').
[9] Annex II species include (Desmoulin's whorl snail (*Vertigo moulinsiana*).

4. CONCLUSIONS

This assessment demonstrates that effects generated as a result of dredging and sediment disposal, are likely to be temporary in nature and localised in extent, with implementation of the proposed mitigation measures. Thus, no significant adverse effects are anticipated to occur, nor will there be any negative effects on the status of WFD elements at the waterbody level.

Lymington Harbour Commissioners have powers to dredge under Section 29 of the 1951 Pier and Harbour Order (Lymington) Confirmation Act. A Marine Licence (issued by the MMO) will be required for the extension of the maintenance dredging area.

There are numerous designated areas within, and close to, Lymington Harbour. The proposed dredging and disposal activities fall within the boundary of the Solent and Southampton Water SPA, and the Solent Maritime SAC. The sites are also close to the boundary of the Solent and Isle of Wight Lagoons SAC, three designated Shellfish Waters, and a Bathing Waters site. Potential impacts on these designated sites have been considered in respect to the features of each site.

It is not anticipated for there to be any significant impacts from the proposed dredging on features of the Solent Maritime SAC, as there will be no reduction in the area of the intertidal zone and therefore no impacts on mudflat or saltmarsh.

Given the distance of the lagoons from the proposed dredging and disposal areas and the lack of interaction between the nearest lagoons and open water, no significant impacts are likely on any of the interest features of the Solent and Isle of Wight Lagoons SAC.

With respect to the potential for disturbance to birds which are features of the Solent and Southampton Water SPA, analysis of previous bird surveys undertaken for Lymington Harbour Commissioners have been considered (Black & Veatch, 2017). This evidence has suggested that the proposed dredging works will not cause disturbance to birds beyond that of regular activities which are carried out in the Approach Channel.

With regards to the 2019 RBMP waterbody failures of elevated levels of PBDEs and Mercury (and its compounds), the issue extends beyond the zone of influence for potential impacts associated with dredging and disposal activities, to the nearby waterbodies (Lymington River, Lymington Transitional and the Solent). This supports the finding that the contaminants are from sources other than dredging and disposal activities, therefore it is highly likely that dredging and disposal activities are not contributing to these failures.

The conclusion of the WFD Assessment for maintenance dredging and disposal is that the continued activity currently complies with the objectives of the WFD and the works are not anticipated to cause a deterioration to the current overall WFD status of Lymington (Transitional) waterbody or Solent (Coastal) waterbody, or to adversely affect the features of the Protected Areas. Furthermore, the waterbody chemical failures in both scoped-in waterbodies (Lymington transitional and the Solent) are unlikely to be caused by the dredging and disposal activities and are considered unlikely to prevent the WFD waterbodies from achieving their future status objectives, including Protected Area objectives as required for other EU legislation.

5. REFERENCES

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APPENDIX A: FIGURES

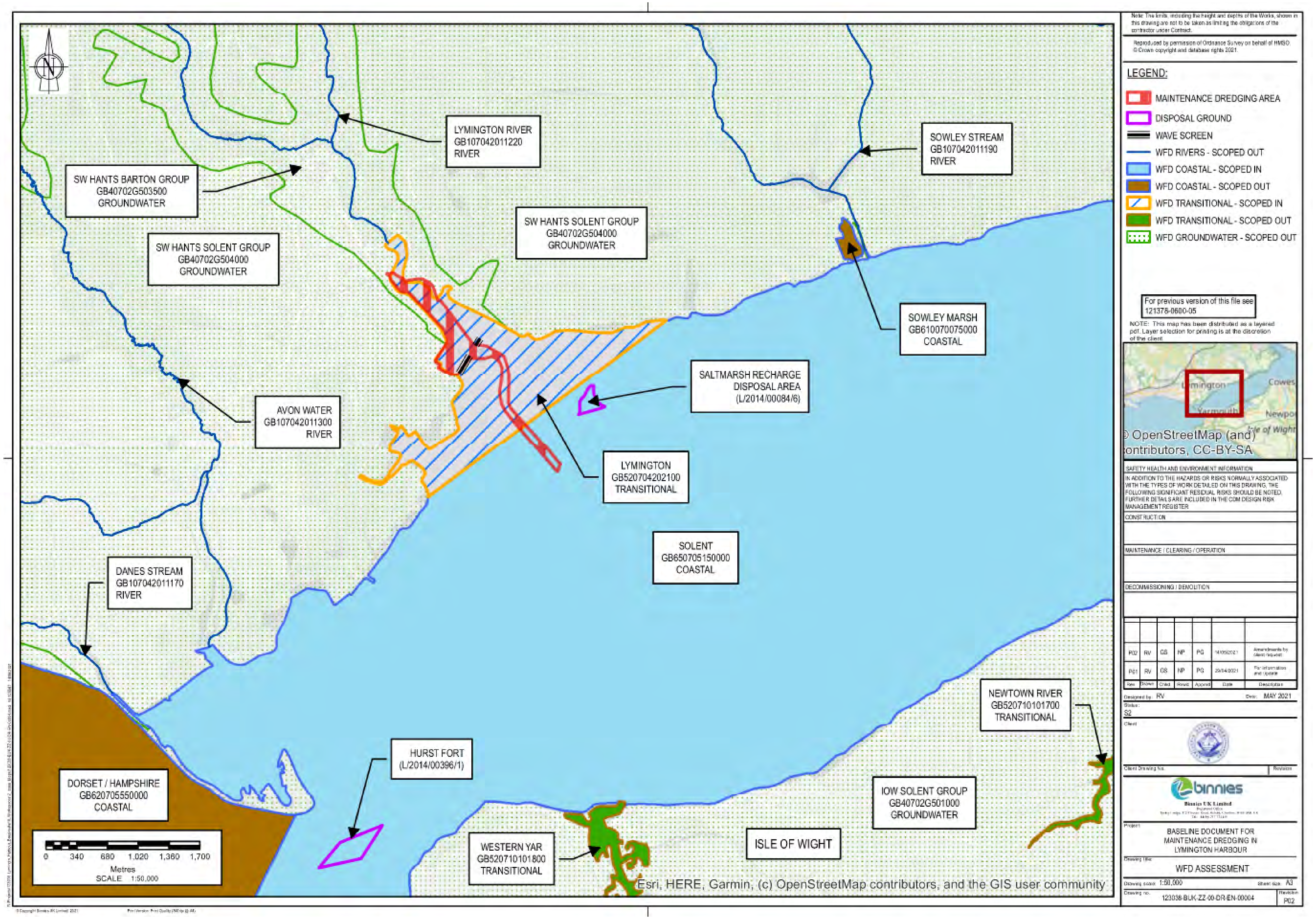

Figure A.1 **WFD Waterbodies (Scoped in and out) in the vicinity of the dredging and disposal activities.**

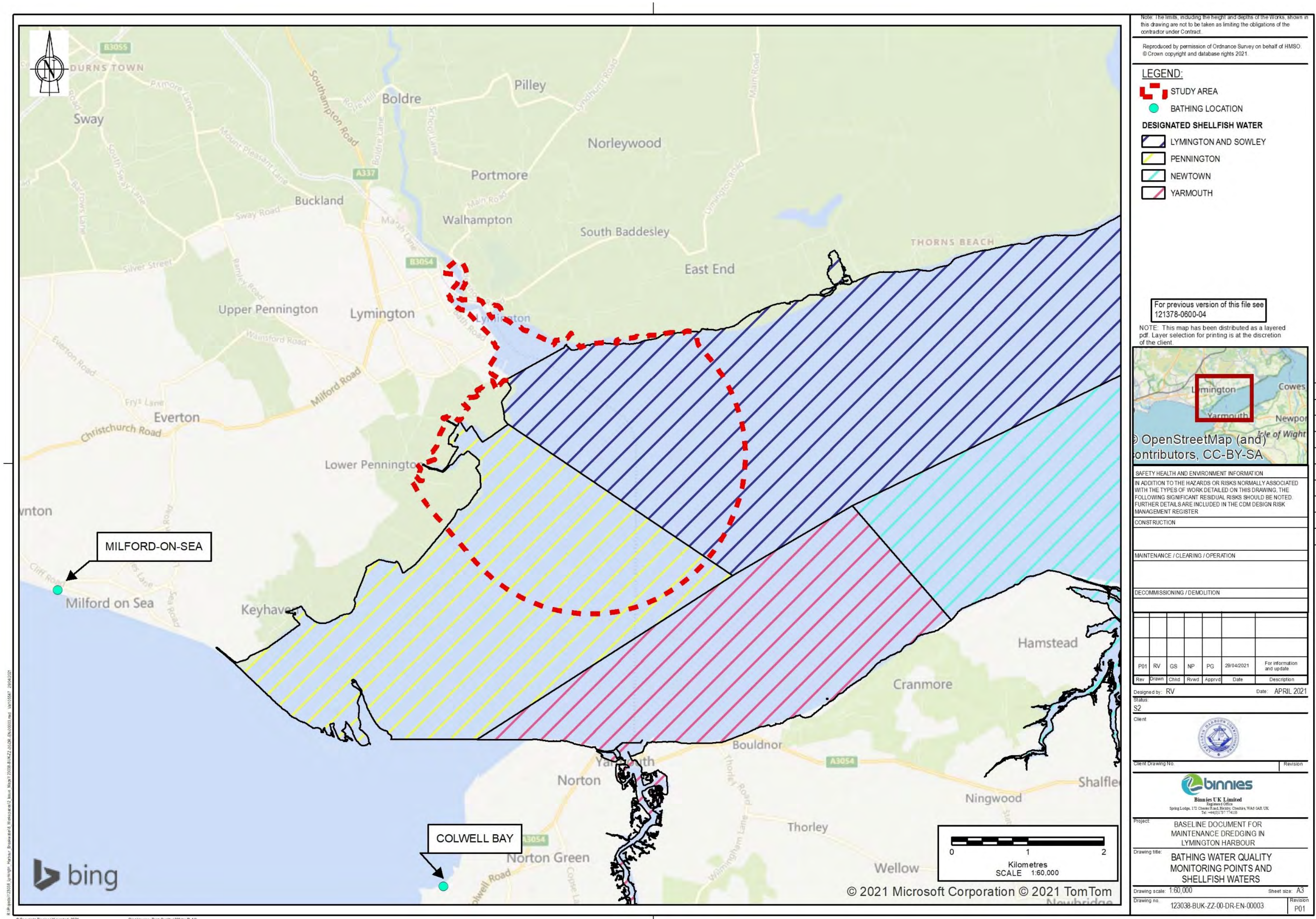

Figure A.2 Shellfish Waters and Bathing Waters close to the dredging and disposal areas

APPENDIX B: SCOPING TABLES

Table B.1 Scoping table for the dredging and disposal sites within Lymington (transitional) waterbody (GB20704202100) - HYDROMORPHOLOGY

Lymington (Transitional)			
DREDGING			
Consider if dredging:	**Yes**	**No**	**Hydromorphology risk issue(s)**
Could impact on the hydromorphology (e.g. morphology or tidal patterns) of a waterbody at high status	Requires impact assessment	Impact assessment not required	No nearby waterbodies at high status.
Could significantly impact the hydromorphology of any waterbody	Requires impact assessment	Impact assessment not required	Yes – 22.9% of the waterbody will be subject to maintenance dredging.
Is in a waterbody that is heavily modified for the same use as your activity	Requires impact assessment	Impact assessment not required	No - heavily modified for 'coastal protection'.

Table B.2 Scoping table for the dredging and disposal sites within the Solent (coastal) waterbody (GB650705150000) - HYDROMORPHOLOGY

DREDGING			
Consider if dredging:	**Yes**	**No**	**Hydromorphology risk issue(s)**
Could impact on the hydromorphology (for example morphology or tidal patterns) of a waterbody at high status	Requires impact assessment	Impact assessment not required	No nearby waterbodies at high status.
Could significantly impact the hydromorphology of any waterbody	Requires impact assessment	Impact assessment not required	No – only 0.03% of the waterbody's area will be subject to maintenance dredging.
Is in a waterbody that is heavily modified for the same use as your activity	Requires impact assessment	Impact assessment not required	Yes – heavily modified for 'coastal protection' and 'Navigation, ports and harbours'.
DISPOSAL			
Consider if your disposal:	**Yes**	**No**	**Hydromorphology risk issue(s)**
Could impact on the hydromorphology (for example morphology or tidal patterns) of a waterbody at high status	Requires impact assessment	Impact assessment not required	
Could significantly impact the hydromorphology of any waterbody	Requires impact assessment	Impact assessment not required	Hurst Fort disposal area – only 0.05% of the waterbody's area will be subject to sediment disposal. Saltmarsh recharge disposal area - only 0.02% of the waterbody's area will be subject to sediment disposal, which has a beneficial use to protect the saltmarsh area.

Is in a waterbody that is heavily modified for the same use as your activity	Requires impact assessment	Impact assessment not required	Yes, heavily modified for 'coastal protection'.

Table B.3 Scoping table for the dredging and disposal sites within Lymington (transitional) waterbody (GB20704202100) - BIOLOGY - HABITATS

DREDGING			
Consider if the footprint of maintenance dredging is:	**Yes**	**No**	**Biology habitats risk issue(s)**
$0.5km^2$ or larger	Yes to one or more – requires impact assessment	No to all – impact assessment not required	$0.37km^2$ footprint within the waterbody (x 1.5 = $0.56km^2$)
1% or more of the waterbody's area			15.3% of the waterbody's area (x 1.5 = 22.9%)
Within 500m of any higher sensitivity habitat			Yes <100m from Saltmarsh habitat
1% or more of any lower sensitivity habitat			No

Table B.4 Scoping table for the dredging and disposal sites within the Solent (coastal) waterbody (GB650705150000) – BIOLOGY - HABITATS

DREDGING			
Consider if the footprint of maintenance dredging is:	**Yes**	**No**	**Biology habitats risk issue(s)**
$0.5km^2$ or larger	Yes to one or more – requires impact assessment	No to all – impact assessment not required	$0.048km^2$ within the waterbody (x 1.5 = $0.072km^2$)
1% or more of the waterbody's area			0.02% of the waterbody's area (x 1.5 = 0.03%)
Within 500m of any higher sensitivity habitat			Yes <100m from Saltmarsh habitat
1% or more of any lower sensitivity habitat			No
DISPOSAL			
Consider if the footprint of disposal area is:	**Yes**	**No**	**Biology habitats risk issue(s)**
$0.5km^2$ or larger	Yes to one or more – requires impact assessment	No to all – impact assessment not required	No
1% or more of the waterbody's area			Hurst Fort disposal area – 0.05% of the waterbody's area Saltmarsh recharge disposal area – 0.02% of the waterbody's area
Within 500m of any higher sensitivity habitat			Yes <100m from Saltmarsh habitat
1% or more of any lower sensitivity habitat			No

Table B.5 Scoping table for the dredging and disposal sites within Lymington (transitional) waterbody (GB20704202100) - BIOLOGY – FISH

DREDGING			
Consider if the maintenance dredging:	**Yes**	**No**	**Biology fish risk issue(s)**
Is in an estuary and could affect fish in the estuary, outside the estuary but could delay or prevent fish entering it, or could affect fish migrating through the estuary	Continue with questions	Go to next section	Large area of waterbody being dredged which is an estuary; therefore, this may prevent fish entering it while maintenance dredging is taking place.
Could impact on normal fish behaviour like movement, migration or spawning (for example creating a physical barrier, noise, chemical change or a change in depth or flow)	Requires impact assessment	Impact assessment not required	Large area of waterbody being dredged, therefore this may impact fish movement and behaviour.
Could cause entrainment or impingement of fish	Requires impact assessment	Impact assessment not required	

Table B.6 Scoping table for the dredging and disposal sites within the Solent (coastal) waterbody (GB650705150000) – BIOLOGY – FISH

DREDGING			
Consider if the maintenance dredging:	**Yes**	**No**	**Biology fish risk issue(s)**
Is in an estuary and could affect fish in the estuary, outside the estuary but could delay or prevent fish entering it or could affect fish migrating through the estuary	Continue with questions	Go to next section	
Could impact on normal fish behaviour like movement, migration or spawning (for example creating a physical barrier, noise, chemical change or a change in depth or flow)	Requires impact assessment	Impact assessment not required	
Could cause entrainment or impingement of fish	Requires impact assessment	Impact assessment not required	
DISPOSAL			
Consider if the disposal:	**Yes**	**No**	**Biology fish risk issue(s)**
Is in an estuary and could affect fish in the estuary, outside the estuary but could delay or prevent fish entering it or could affect fish migrating through the estuary	Continue with questions	Go to next section	No
Could impact on normal fish behaviour like movement, migration or spawning (for example creating a physical barrier, noise, chemical change or a change in depth or flow)	Requires impact assessment	Impact assessment not required	The saltmarsh recharge site is a tidal creek which can provide a nursery area for fish.

Could cause entrainment or impingement of fish	Requires impact assessment	Impact assessment not required	No

Table B.7 Scoping table for the dredging and disposal sites within Lymington (transitional) waterbody (GB20704202100) – WATER QUALITY

DREDGING			
Consider if the maintenance dredging:	**Yes**	**No**	**Water quality risk issue(s)**
Could affect water clarity, temperature, salinity, oxygen levels, nutrients or microbial patterns continuously for longer than a spring neap tidal cycle (about 14 days)	Requires impact assessment	Impact assessment not required	Maintenance dredging will take place over a number of days; therefore the water clarity may be affected.
Is in a waterbody with a phytoplankton status of moderate, poor or bad	Requires impact assessment	Impact assessment not required	No
Is in a waterbody with a history of harmful algae	Requires impact assessment	Impact assessment not required	No
If the maintenance dredging uses or releases chemicals (e.g. through sediment disturbance) consider if:	**Yes**	**No**	**Water quality risk issue(s)**
The chemicals are on the Environmental Quality Standards Directive (EQSD) list	Requires impact assessment	Impact assessment not required	Release of chemicals during maintenance dredging due to sediment disturbance.
It disturbs sediment with contaminants above Cefas Action Level 1	Requires impact assessment	Impact assessment not required	Release of contaminants during maintenance dredging due to sediment disturbance.
If your activity has a mixing zone (e.g. discharge pipeline or outfall) consider if:	**Yes**	**No**	**Water quality risk issue(s)**
The chemicals released are on the Environmental Quality Standards Directive (EQSD) list	Requires impact assessment	Impact assessment not required	No mixing zone

Table B.8 Scoping table for the dredging and disposal sites within the Solent (coastal) waterbody (GB650705150000) – WATER QUALITY

DREDGING			
Consider if the maintenance dredging:	**Yes**	**No**	**Water quality risk issue(s)**
Could affect water clarity, temperature, salinity, oxygen levels, nutrients or microbial patterns continuously for longer than a spring neap tidal cycle (about 14 days)	Requires impact assessment	Impact assessment not required	Maintenance dredging will take place over a number of days; therefore the water clarity may be affected.
Is in a waterbody with a phytoplankton status of moderate, poor or bad	Requires impact assessment	Impact assessment not required	No
Is in a waterbody with a history of harmful algae	Requires impact assessment	Impact assessment not required	No
If your activity uses or releases chemicals (e.g. through sediment disturbance) consider if:	**Yes**	**No**	**Water quality risk issue(s)**
The chemicals are on the Environmental Quality Standards Directive (EQSD) list	Requires impact assessment	Impact assessment not required	Release of chemicals during maintenance dredging due to sediment disturbance.
It disturbs sediment with contaminants above Cefas Action Level 1	Requires impact assessment	Impact assessment not required	Release of contaminants during maintenance dredging due to sediment disturbance.
If your activity has a mixing zone (like a discharge pipeline or outfall) consider if:	**Yes**	**No**	**Water quality risk issue(s)**

The chemicals released are on the Environmental Quality Standards Directive (EQSD) list	Requires impact assessment5	Impact assessment not required	No mixing zone
DISPOSAL			
Consider if the maintenance dredging:	**Yes**	**No**	**Water quality risk issue(s)**
Could affect water clarity, temperature, salinity, oxygen levels, nutrients or microbial patterns continuously for longer than a spring neap tidal cycle (about 14 days)	Requires impact assessment	Impact assessment not required	Sediment disposal will take place over a number of days; therefore the water clarity may be affected.
Is in a waterbody with a phytoplankton status of moderate, poor or bad	Requires impact assessment	Impact assessment not required	No
Is in a waterbody with a history of harmful algae	Requires impact assessment	Impact assessment not required	No
If your activity uses or releases chemicals (e.g. through sediment disturbance) consider if:	**Yes**	**No**	**Water quality risk issue(s)**
The chemicals are on the Environmental Quality Standards Directive (EQSD) list	Requires impact assessment	Impact assessment not required	Release of chemicals during disposal of dredged material due to sediment disturbance.
It disturbs sediment with contaminants above Cefas Action Level 1	Requires impact assessment	Impact assessment not required	Release of contaminants during disposal of dredged material due to sediment disturbance.
If your activity has a mixing zone (e.g. discharge pipeline or outfall) consider if:	**Yes**	**No**	**Water quality risk issue(s)**

The chemicals released are on the Environmental Quality Standards Directive (EQSD) list	Requires impact assessment5	Impact assessment not required	No mixing zone

Table B.9 Scoping table for the dredging and disposal sites within Lymington (transitional) waterbody (GB20704202100) – WFD PROTECTED AREAS

DREDGING			
Consider if your activity is:	**Yes**	**No**	**Protected areas risk issue(s)**
Within 2km of any WFD protected area	Requires impact assessment	Impact assessment not required	- Solent Maritime SAC - Solent and Isle of Wight Lagoons SAC - Solent and Southampton Water SPA - Solent and Southampton Water Ramsar Site - Lymington and Sowley Shellfish Waters - Pennington Shellfish Waters

Table B.10 Scoping table for the dredging and disposal sites within the Solent (coastal) waterbody (GB650705150000) – WFD PROTECTED AREAS

DREDGING			
Consider if your activity is:	**Yes**	**No**	**Protected areas risk issue(s)**
Within 2km of any WFD protected area	Requires impact assessment	Impact assessment not required	- Solent Maritime SAC - Solent and Isle of Wight Lagoons SAC - Solent and Southampton Water SPA - Solent and Southampton Water Ramsar Site - Lymington and Sowley Shellfish Waters - Pennington Shellfish Waters
DISPOSAL			
Consider if your activity is:	**Yes**	**No**	**Protected areas risk issue(s)**
Within 2km of any WFD protected area	Requires impact assessment	Impact assessment not required	- Solent Maritime SAC - Solent and Isle of Wight Lagoons SAC - Solent and Southampton Water SPA - Solent and Southampton Water Ramsar Site - Lymington and Sowley Shellfish Waters - Pennington Shellfish Waters

Table B.11 Scoping table for the dredging and disposal sites within Lymington (transitional) waterbody (GB20704202100) - INVASIVE NON-NATIVE SPECIES (INNS)

DREDGING			
Consider if dredging could:	**Yes**	**No**	**INNS risk issue(s)**
Introduce or spread INNS	Requires impact assessment	Impact assessment not required	

Table B.12 Scoping table for the dredging and disposal sites within the Solent (coastal) waterbody (GB650705150000) - INVASIVE NON-NATIVE SPECIES (INNS)

DREDGING			
Consider if dredging could:	**Yes**	**No**	**INNS risk issue(s)**
Introduce or spread INNS	Requires impact assessment	Impact assessment not required	
DISPOSAL			
Consider if disposal could:	**Yes**	**No**	**INNS risk issue(s)**
Introduce or spread INNS	Requires impact assessment	Impact assessment not required	

APPENDIX C: JNCC MARINE PRESSURES-ACTIVITIES MATRIX TABLE

Activity	Sub-activity	Pressure Theme	Pressure	Pressure Level	Evidence	Confidence
Extraction – navigational dredging (capital & maintenance)	Dredging (non-living resources)	Hydrological changes (inshore/ local)	Water flow (tidal current) changes - local	Sub-activity results in pressure but no evidence available with respect to the specified benchmark	Dredging activities can cause localised change to the hydrodynamic flow in an area. The magnitude and type of effect will be related to the overall size of the excavation compared to the overall size of the system (ABP Research & Consultancy Ltd, 1999).	High
Extraction – navigational dredging (capital & maintenance)	Dredging (non-living resources)	Pollution and other chemical changes	Non-synthetic compound contamination - overall		Dredging operations imply the removal of sediments, and their transport and relocation. During these activities, sediments can enhance their capacity to mobilize contaminants, which means there is an environmental impact that should be taken into account.	High
Extraction – navigational dredging (capital & maintenance)	Dredging (non-living resources)	Pollution and other chemical changes	Non-synthetic compound contamination - Transition elements & organo-metals		Dredging operations imply the removal of sediments, and their transport and relocation. During these activities, sediments can enhance their capacity to mobilize contaminants, which means there is an environmental impact that should be taken into account.	High
Extraction – navigational dredging (capital & maintenance)	Dredging (non-living resources)	Pollution and other chemical changes	Non-synthetic compound contamination - Hydrocarbon & PAH Contamination		Dredging operations imply the removal of sediments, and their transport and relocation. During these activities, sediments can enhance their capacity to mobilize contaminants, which means there is an environmental impact that should be taken into account.	High

Extraction – navigational dredging (capital & maintenance)	Dredging (non-living resources)	Pollution and other chemical changes	Synthetic compound contamination	Sub-activity results in pressure but no evidence available with respect to the specified benchmark	Dredging operations imply the removal of sediments, and their transport and relocation. During these activities, sediments can enhance their capacity to mobilize contaminants, which means there is an environmental impact that should be taken into account.	High
Extraction – navigational dredging (capital & maintenance)	Dredging (non-living resources)	Pollution and other chemical changes	Radionuclide contamination		Aside from nuclear accidents, marine inputs of radionuclides are now restricted to the relatively small number of discharges from nuclear power stations and reprocessing plants, which are rigorously controlled by various national or international agencies.	Medium
Extraction – navigational dredging (capital & maintenance)	Dredging (non-living resources)	Pollution and other chemical changes	De-oxygenation		Abstract from Lohrer and Wetz (2003): Dredging is one type of large-scale, anthropogenic disturbance in marine soft-sediment habitats. The impacts of dredging have usually been studied with regards to (1) disturbance-recovery of benthic populations and communities.	High

Extraction – navigational dredging (capital & maintenance)	Dredging (non-living resources)	Pollution and other chemical changes	Nutrient enrichment	Sub-activity results in pressure but no evidence available with respect to the specified benchmark	Abstract from Lohrer and Wetz (2003): Dredging is one type of large-scale, anthropogenic disturbance in marine soft-sediment habitats. The impacts of dredging have usually been studied with regards to (1) disturbance-recovery of benthic populations and communities.	High
Extraction – navigational dredging (capital & maintenance)	Dredging (non-living resources)	Pollution and other chemical changes	Organic enrichment		Abstract from Lohrer and Wetz (2003): Dredging is one type of large-scale, anthropogenic disturbance in marine soft-sediment habitats. The impacts of dredging have usually been studied with regards to (1) disturbance-recovery of benthic populations and communities.	High
Extraction – navigational dredging (capital & maintenance)	Dredging (non-living resources)	Physical damage	Habitat structure changes - removal of substratum (extraction)		Decreased diversity in benthic communities as a consequence of dredging and filling is reported for many regions of the world (Rosenburg, 1977). The depth of material removed during maintenance dredging varies greatly depending on the location*... (*please note that this sentence was not complete on the JNCC matrix).	High

Extraction – navigational dredging (capital & maintenance)	Dredging (non-living resources)	Physical damage	Penetration and/or disturbance of the substrate below the surface of the seabed - (Overall abrasion)	Sub-activity results in pressure but no evidence available with respect to the specified benchmark	Both aggregate extraction and navigational dredging cause abrasion, a physical pressure that can affect a number of different ecosystem characteristics (ODEMM, 2011). The depth of material removed during maintenance dredging varies greatly depending on the location*. (*please note that this sentence was not complete on the JNCC matrix).	High
Extraction – navigational dredging (capital & maintenance)	Dredging (non-living resources)	Physical damage	Penetration and/or disturbance of the substrate below the surface of the seabed - Surface		Both aggregate extraction and navigational dredging cause abrasion, a physical pressure that can affect a number of different ecosystem characteristics (ODEMM, 2011). The depth of material removed during maintenance dredging varies greatly depending on the location*. (*please note that this sentence was not complete on the JNCC matrix).	High
Extraction – navigational dredging (capital & maintenance)	Dredging (non-living resources)	Physical damage	Penetration and/or disturbance of the substrate below the surface of the seabed - Subsurface		Both aggregate extraction and navigational dredging cause abrasion, a physical pressure that can affect a number of different ecosystem characteristics (ODEMM, 2011). The depth of material removed during maintenance dredging varies greatly depending on the location*. (*please note that this sentence was not complete on the JNCC matrix).	High
Extraction – navigational dredging (capital & maintenance)	Dredging (non-living resources)	Physical damage	Changes in suspended solids		The magnitude and spatial extent of the suspended sediment field around any dredging operation is a function of the type of dredge used, the physical and biological characteristics of the material being dredged (e.g., density, grain size, organic content).	High

Extraction – navigational dredging (capital & maintenance)	Dredging (non-living resources)	Physical damage	Siltation rate changes		Dredging may cause local deposition of sediment in the area surrounding the dredge site. This sediment includes material disturbed at the drag head of the dredger and also some of sandy material from the it's overflow.	High
Extraction – navigational dredging (capital & maintenance)	Dredging (non-living resources)	Other physical pressures	Underwater noise changes	Sub-activity results in pressure but no evidence available with respect to the specified benchmark	Potential effects of underwater noise produced by dredging operations on a variety of organisms have emerged as a concern of environmental agencies. For example, it has been hypothesized that dredging-induced noise could block or delay the migrations of fish*. (*please note that this sentence was not complete on the JNCC matrix).	High
Extraction – navigational dredging (capital & maintenance)	Dredging (non-living resources)	Biological pressures	Removal of non-target species		Essentially the impact of dredging activities mainly relates to the physical removal of substratum and associated organisms from the seabed along the path of the dredge head (Newell *et al.* 1998).	High
Dredge & spoil disposal	Disposal	Pollution and other chemical changes	Non-synthetic compound contamination - overall		Only harbour sediment that meets quality criteria expressed in the form of threshold levels for trace metals, mineral oil (petroleum hydrocarbons), polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs) and organochlorine pesticides is permitted.	High

Dredge & spoil disposal	Disposal	Pollution and other chemical changes	Non-synthetic compound contamination - Transition elements & organo-metals		Only harbour sediment that meets quality criteria expressed in the form of threshold levels for trace metals, mineral oil (petroleum hydrocarbons), polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs) and organochlorine pesticides is permitted.	High
Dredge & spoil disposal	Disposal	Pollution and other chemical changes	Non-synthetic compound contamination - Hydrocarbon & PAH Contamination		Only harbour sediment that meets quality criteria expressed in the form of threshold levels for trace metals, mineral oil (petroleum hydrocarbons), polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs) and organochlorine pesticides is permitted.	High
Dredge & spoil disposal	Disposal	Pollution and other chemical changes	Synthetic compound contamination	Sub-activity results in pressure but no evidence available with respect to the specified benchmark	Only harbour sediment that meets quality criteria expressed in the form of threshold levels for trace metals, mineral oil (petroleum hydrocarbons), polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs) and organochlorine pesticides is permitted.	High
Dredge & spoil disposal	Disposal	Pollution and other chemical changes	Radionuclide contamination		Aside from nuclear accidents, marine inputs of radionuclides are now restricted to the relatively small number of discharges from nuclear power stations and reprocessing plants, which are rigorously controlled by various national or international agencies.	Medium
Dredge & spoil disposal	Disposal	Pollution and other chemical changes	De-oxygenation		In well mixed open water disposal sites, oxygen depletion or eutrophication is not likely, and nutrient analysis may not be required (PIANC, 1998).	Medium

Dredge & spoil disposal	Disposal	Pollution and other chemical changes	Nutrient enrichment		The disturbance axis reflects a shift from undisturbed assemblages with a large proportion of production contributed by large *K* strategists towards disturbed ones where much of the production is contributed by polychaetes and macrofaunal nematodes.	Medium
Dredge & spoil disposal	Disposal	Pollution and other chemical changes	Organic enrichment		The disturbance axis reflects a shift from undisturbed assemblages with a large proportion of production contributed by large *K* strategists towards disturbed ones where much of the production is contributed by polychaetes and macrofaunal nematodes.	Medium
Dredge & spoil disposal	Disposal	Physical damage	Habitat structure changes - removal of substratum (extraction)		Material from capital dredging can be used as part of land claim projects which results in the loss of saline habitat.	High
Dredge & spoil disposal	Disposal	Physical damage	Changes in suspended solids	Sub-activity results in pressure but no evidence available with respect to the specified benchmark	At this disposal site, solid wastes are dumped within an area dedicated to waste disposal and a large quantity of suspended solids (SS) are generated (Kawagoshi et al. 1999).	High
Dredge & spoil disposal	Disposal	Physical damage	Siltation rate changes		Dredged material descends like a dense jet for at least the first 100m of its descent. In most cases it will hit the bottom within this phase. The proportion depends upon the mechanical properties of the sediment.	High

APPENDIX D: MITIGATION MEASURES TABLE

Water body Name	Mitigation measure	Status
Lymington	Indirect / offsite mitigation (offsetting measures)	Not in place
	Operational and structural changes to locks, sluices, weirs, beach control, etc.	Not in place
	Preserve and where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone	Not in place
	Managed realignment of flood defence	Not in place
	Removal of hard bank reinforcement / revetment, or replacement with soft engineering solution	Not in place
	Remove obsolete structure	Not in place
Solent	Manage disturbance	In place
	Site selection (dredged material disposal) (e.g. avoid sensitive sites)	In place
	Sediment management	In place
	Indirect / offsite mitigation (offsetting measures)	In place
	Preserve and where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone	Not in place
	Removal of hard bank reinforcement / revetment, or replacement with soft engineering solution	Not in place

APPENDIX E: SEDIMENT QUALITY ANALYSIS RESULTS

Table E-1: Metal concentration of sediment samples within Lymington Harbour (sampled 16/08/2014)

Measured as mg/kg dry weight; *<LOD = below 0.002

Metal concentration (dry weight, mg/kg)	Location				
	Yacht Haven	Horn Reach	Town Quay & Moorings	Lymington Marina	Fortuna Area
Arsenic	20.28	20.16	24.36	23.62	27.04
Cadmium	0.16	0.16	0.25	0.19	0.18
Chromium	0.16	0.16	0.25	0.19	0.18
Copper	31.26	28.95	95.59	47.27	42.52
Mercury	0.08	0.07	0.23	0.11	0.10
Nickel	24.36	24.90	31.74	29.71	31.00
Lead	29.37	28.39	50.75	37.00	35.49
Zinc	97.81	95.61	196.00	127.50	122.70
Dibutyl Tin (DBT)	<LOD*	<LOD*	<LOD*	<LOD*	<LOD*
Tributyl Tin (TBT)	0.016	0.010	0.090	0.020	0.020

Table E-2: Metal concentration of sediment samples within Lymington Harbour (sampled 03/12/2019)

Measured as mg/kg dry weight; *<LOD = below 0.003

Metal concentration (dry weight, mg/kg)	Location							
	Yacht Haven	Horn Reach main channel	Horn Reach Mooring & Main Channel	Town Quay & Moorings	Lymington Marina	Fortuna Area	Railside & Main Channel	Harbour Master & Dan Bran Pontoon
Arsenic	19.00	72.00	19.00	21.00	20.00	19.00	20.00	18.00
Cadmium	0.16	0.13	0.13	0.20	0.14	0.14	0.17	0.12
Chromium	56.00	58.00	57.00	59.00	61.00	61.00	64.00	59.00
Copper	27.00	27.00	27.00	44.00	34.00	31.00	40.00	28.00
Mercury	0.08	0.08	0.09	0.10	0.10	0.09	0.10	0.09
Nickel	23.00	24.00	24.00	25.00	24.00	24.00	27.00	24.00
Lead	26.00	27.00	26.00	40.00	29.00	28.00	33.00	26.00
Zinc	87.00	90.00	90.00	130.00	100.00	94.00	120.00	88.00
Dibutyl Tin (DBT)	<LOD*	<LOD*	<LOD*	0.0063	0.0065	<LOD*	0.0084	<LOD*
Tributyl Tin (TBT)	0.0055	0.0067	0.0055	0.01	0.0088	0.0072	0.012	0.0051

APPENDIX F: CEFAS GUIDELINE EALS FOR THE DISPOSAL OF DREDGED MATERIAL

	Action Level 1	**Action Level 2**
Contaminant /Compound	**mg/kg Dry Weight (ppm)**	**mg/kg Dry Weight (ppm)**
Arsenic	20	100
Mercury	0.3	3
Cadmium	0.4	5
Chromium	40	400
Copper	40	400
Nickel	20	200
Lead	50	500
Zinc	130	800
Organotins (TBT DBT MBT)	0.1	1

EAL = Environmental Action levels
Source: https://www.gov.uk/guidance/marine-licensing-sediment-analysis-and-sample-plans

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D Habitats Regulations Assessment

D.1 Introduction

The Solent Forum partnership is seeking to designate two alternative/beneficial use dredge disposal sites in the outer Lymington Estuary. These are sites where dredged sediment from harbours in the Solent could be placed to supply sediment to the area. This will help to protect the saltmarshes and slow the rates at which they are eroding. It would prolong the life of these marshes and the surrounding mudflats and help maintain the benefits these habitats provide for biodiversity, water quality and harbour protection.

These two proposed sediment recharge sites lie either side of the entrance to Lymington Estuary. They are referred to here as 'Pylewell' and 'Cockleshell' and are shown on Figure 3 of the main report.

A Marine Licence will be required from the MMO to permit the placement of sediment at these two sites. This HRA has been prepared to support the Marine Licence Application.

D.1.1 Project description

Details about the proposed beneficial use sites, including the project aims, are provided in **Section 2 of the main report.**

In summary, at the two proposed beneficial use sites, sediment would be bottom placed from hopper barges in the same way that sediment is now being placed at Boiler Marsh by LHC. From the practical lessons that have been learned at Boiler Marsh, this would supply sediment to these areas, lead to the creation of a protective bund for the habitats behind and could become a source of sediment for further marsh raising.

It is expected that dredged sediment from a range of sources could be placed at these sites. This could include sediment from the harbours of Lymington, Yarmouth, Beaulieu, Cowes or, occasionally, even the Hamble. If licensed, the proposed beneficial use sites at Pylewell and Cockleshell would operate in the same way as an offshore disposal site. Each harbour would be responsible for ensuring that the dredge sediments are suitable for disposal at sea (under existing consenting regimes), and hence also placement at Pylewell or Cockleshell.

Having multiple possible sediment sources is not only novel for this type of inshore beneficial use location, it also means that it is not possible to know with certainty how much sediment could be placed at these locations or how regularly. That will be dependent upon the requirements of each harbour and their relevant consenting arrangements. It will be influenced by their dredge volumes, sediment type, sediment quality, dredging methods and the vessels they use to transport sediment.

Due to these uncertainties about project scale and to provide regulators and all interested parties with confidence in the approach taken, it is anticipated that this project will be carried out in a phased and adaptive manner. It would begin with trials and be followed by scaling up across the deposit sites over time, if possible and where agreed. Sediment would initially be placed towards the upper reaches of mudflat habitat (as high as existing bathymetry and vessel access allows) at spring tide high water. Over time and subject to monitoring and management advice the sediment could increasingly be placed at lower elevations within the defined zones.

Where a harbour is able or required to place some dredge sediment at Pylewell or Cockleshell then the total volume that can be placed is likely to still be affected by the bed elevations at the disposal locations. Any disposal will need to coincide with high tide and the placement sites will be influenced by the vessel draught. For the purposes of consenting and this HRA though, it is assumed that up to 29,000 wet tonnes (approximately 20,000 m^3) could be placed annually across the two sites.

D.2 Need for an HRA

The intertidal areas where the proposed disposal and intertidal restoration work will take place within the boundaries of the Solent Maritime Special Area of Conservation (SAC) and the Solent and Southampton Water Special Protection Area (SPA) and Ramsar site. The site also lies close to the Solent and Isle of Wight Lagoons SAC, as well as the Solent and Dorset Coast SPA.

The ecology and nature conservation of these European/Ramsar sites are protected, in England and Wales, under the UK Habitats Regulations. The original 1994 Habitats Regulations transposed into national law the requirements of the EU Habitats Directive. These were then consolidated and updated by the Conservation of Habitats and Species Regulations of 2010 and then 2017.

The latter legislation (The Conservation of Habitats and Species Regulations 2017 (as amended)) continues to have effect in domestic law under the European Union (Withdrawal) Act 2018, which repealed the European Communities Act 1972 while also maintaining EU-derived domestic legislation in national law. The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 then later made some minor changes to this legislation to accommodate it into UK law.

The Habitats Regulations provide for the protection of European designated sites including SACs and SPAs. In addition, Natural England (2013) advise that these regulations apply to Ramsar sites (designated under the 1971 Ramsar Convention for their internationally important wetlands), candidate SACs (cSAC), potential SPAs (pSPA), and proposed and existing European offshore marine sites.

As the proposed beneficial use sites have the potential to directly and/or indirectly affect European/Ramsar sites, the MMO (as the Competent Authority) is required to take account of the Habitats Regulations and, where needed, produce an Appropriate Assessment (AA). Regulation 63 of the Habitats Regulations states that:

"A competent authority, before deciding to undertake, or give any consent, permission, or other authorisation for a plan or project which:

a) is likely to have significant effect on a European site or a European offshore marine site (either alone or in combination with other plans or projects); and
b) is not directly connected with or necessary to the management of the site must make an appropriate assessment of the implications for the site in view of that site's conservation objectives".

D.3 Need for an Appropriate Assessment

The stages of an HRA process are described in Image D1. There are three main stages as follows:

- **Stage 1 (Screening):** determine whether the proposed activity takes place within or close to a European/Ramsar site and is either directly connected with or necessary to the management of European/Ramsar site;

- **Stage 2 (Test of LSE):** determine whether the project is likely to have a significant effect on any European/Ramsar Site; and
- **Stage 3 (Appropriate Assessment):** if it is concluded that the work is likely to have a significant effect, then produce an AA which determines whether the project could or will adversely affect the integrity of any European/Ramsar site.

In this case the Stage 1 and Stage 2 apply to this proposal and a Stage 3 Appropriate Assessment (AA) is required and information for this is provided in the next section.

This is firstly because the proposed activity will take place within or close to a European/Ramsar site. So the Stage 1 test applies.

At Stage 2, as shown in Image D1, the decision as to whether a 'Stage 3' AA is required is based on an assessment of LSE. LSE is a 'coarse filter' judgement or a statement that the anticipated effects of the proposal will be more than trivial (i.e. that the anticipated changes resulting from a proposal have the potential to impact on an interest feature of a European/Ramsar site). If a project (or plan) could have an LSE on a European/Ramsar site, it does not automatically follow that an impact will occur. The decision of LSE is purely an indication of the need for an AA.

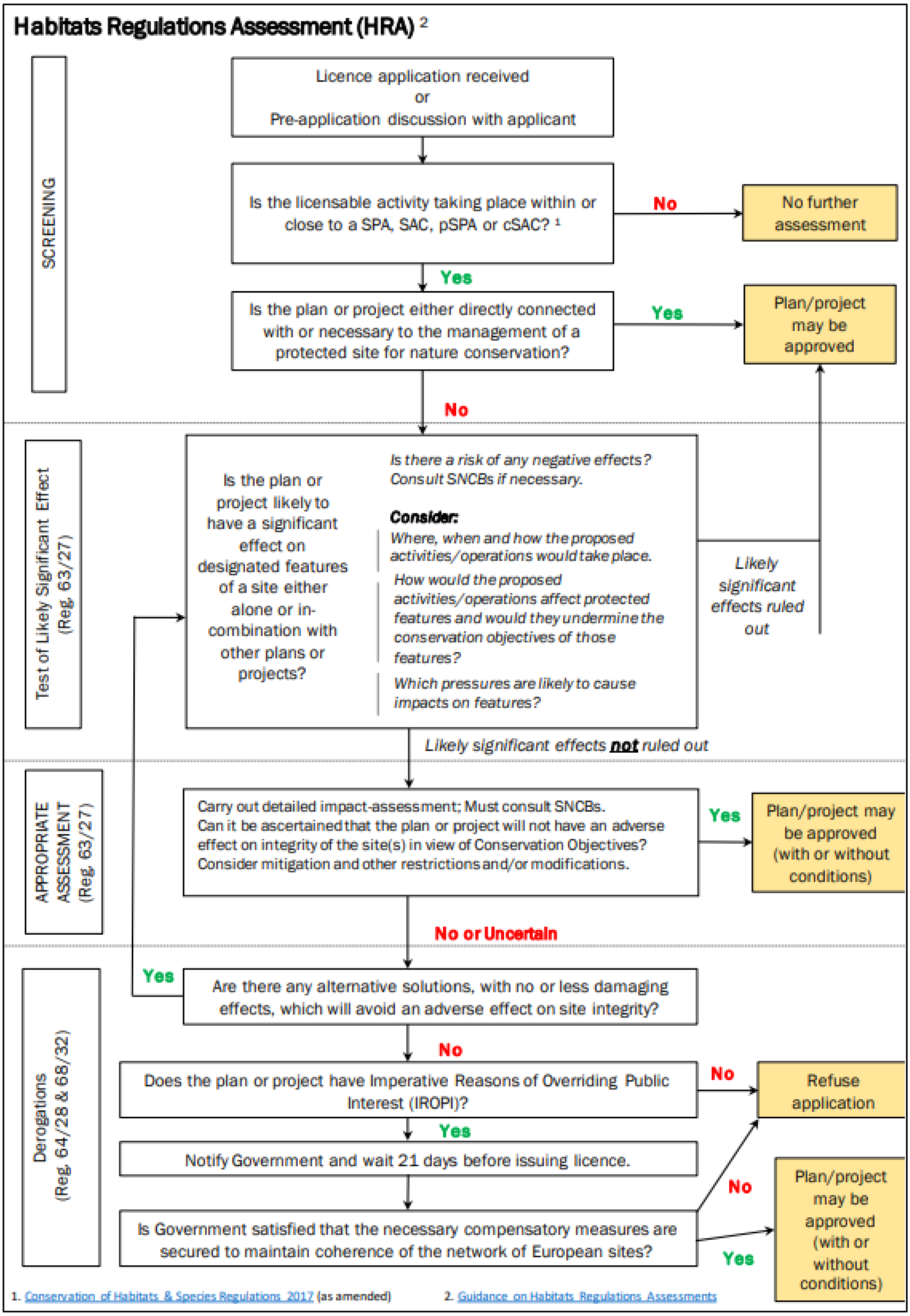
Having taken the advice from Natural England on other beneficial use placement and habitat restoration projects, it is judged that this project is 'likely to have a significant effect' on a designated site or that such an effect cannot be excluded. It is also not seen as an activity that is 'directly connected with or necessary to the management' of the designated sites[22]. Therefore, an AA is needed as per Stage 3 of the HRA process.

The Solent Maritime SAC, the Solent and Dorset Coast SPA, and the Solent and Southampton Water SPA and Ramsar sites have been screened into the AA. The Solent and Isle of Wight Lagoons SAC has been screened out as there is not considered the potential for an LSE because the lagoons are behind embankments and a sufficient distance away to not be affected by potential water quality impacts (which could only affect the lagoons through open two-way sluices).

In an AA, it is necessary to determine whether the project or plan would have an adverse effect on the integrity (AEOI) of the European/Ramsar site(s) in view of the site(s)'s conservation objectives. The integrity of a site has been defined as the coherence of its ecological structure and function, across its whole area that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was classified (Department of the Environment, Transport and the Regions (DETR), 1994).

Where it cannot be demonstrated that a project will not have an AEOI, or there is insufficient certainty of an avoidance of an adverse effect, the activities can only proceed if it can be demonstrated that there are no more suitable (less damaging) alternatives, and that there are Imperative Reasons of Over-riding Public Interest (IROPI) sufficient to justify the proposed project. In certain circumstances, the Secretary of State may be required to ensure that adequate compensation, usually in the form of replacement habitat, is provided to protect the overall coherence of the Natura 2000 network (i.e. European sites).

22 While the proposed project is not formally defined as being for the conservation management of the designated sites, it is fundamentally being pursued to enhance habitats and enhance the nature conservation value of the area. This includes protecting and improving areas used by breeding and roosting waterbirds that are interest features of the designated site. The proposed intertidal habitat restoration initiative will also advance habitat creation ideas identified under the Site Improvement Plan for the Solent European Marine site (Natural England, 2014) and will inform aspirations for the wider management for the Solent European site.



Source: Natural England (2023)

Image D1. **Summary of the key stages comprising an HRA**

The decision on whether integrity is affected will be made by the Competent Authority (in this case, the MMO), in consultation with Natural England. To assist the MMO with their review under Habitats Regulations, this shadow Habitats Regulations Assessment (HRA) has been prepared to accompany this proposal and the Marine Licence Application to the MMO.

To avoid too much unnecessary repetition of text this shadow HRA has been prepared as a 'signposting document'. **It refers in bold to sections of the main report where information can be found, or it summarises the key information from the main report**.

D.4 Information for Appropriate Assessment

The habitats and species that are qualifying interest features of the European/Ramsar sites at or near the proposed beneficial use disposal sites **are described in Section 4.6.1 of the main report**. They are also tabulated with conservation objectives **in Appendix B of the MDP baseline report (in Appendix C).** The potential for adverse effects from the proposed beneficial use sites on the interest features of European/Ramsar sites that were identified are **reviewed in Sections 4.4.2, 4.5.2, 4.6.2, 4.7.2 and 4.8.2 of the main report**. This supporting information should be referred to when preparing the AA but, to further assist, the potential impacts and key issues are summarised below.

D.4.1 Changes to habitat

The smothering of benthic invertebrates within the footprint of the proposed beneficial use disposal sites will be on a very localised scale and the area of the seabed that will be affected will be very small for each deposit load from the smaller split hopper barges that would be using these sites. The total area covered by the proposed beneficial use sites (9.2 ha at Pylewell and 7.3 ha at Cockleshell) is also small in the context of the SAC intertidal mudflat feature (Pylewell: 0.18 %; Cockleshell: 0.14 %), and the Solent and Southampton Water SPA and Ramsar site (Pylewell: 0.17%; Cockleshell: 0.14%).

The proposed beneficial use disposal sites will result in a slight raising of habitat in the tidal frame and a potential short to medium term change in the extent or type of habitat (i.e., from lower intertidal mudflat to higher intertidal mudflat). Based on recent precedents at Boiler Marsh, it is expected that the proposed beneficial use disposal sites will become re-established relatively quickly with benthic invertebrates between dredge and disposal campaigns (Binnies UK Ltd, 2021).

The sediment recharge will have beneficial effects on the adjacent vulnerable saltmarsh habitats and associated invertebrates. The regular placements at the proposed beneficial use disposal sites will act as 'sacrificial bund' feature that will be protecting parts of the inner marsh and helping to retain sediment in the area. The placement of material at the proposed beneficial use disposal sites will help to slow marsh decay and the rate of marsh fracturing (ABPmer, 2020). In addition, placing material from Lymington Harbour at these sites will help to add or retain more sediment within the local sedimentary system rather than disposing of this material at more distant licensed sea disposal sites.

A small proportion of the material that is placed on the seabed at the proposed beneficial use sites will be dispersed and re-deposited locally to the site. Dispersion of material will be limited given the placement activities will take place as high up on the shore as possible. Sedimentation away from the proposed beneficial use disposal sites is unlikely to be measurable; and will be short-lived and transient in nature, likely to be redistributed by natural physical processes and ongoing activities.

The mudflat benthic fauna recorded in the area of the proposed beneficial use disposal sites comprise species that are capable of rapidly recolonising disturbed habitats. These species are also considered to be commonly occurring in the wider area, and tolerant to some sediment deposition. Benthic communities are, therefore, considered to have a low sensitivity to minor fluctuations in sedimentation. Any minor deposition outside of the immediate proposed beneficial use disposal sites is considered unlikely to cause significant smothering effects and recoverability is expected to be high.

The proposed beneficial use disposal sites are not expected to cause significant changes to physical processes (e.g., water levels, flow rates, accretion and erosion patterns). Therefore, indirect changes to seabed habitat extent and quality as a result of the works will be negligible.

In the context of the site's conservation objectives, the condition of natural habitat, the supporting habitat of bird interest features, 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 qualifying natural habitats and supporting habitats (and associated species) or a change to the structure and function (including typical species) of this habitat. There is also not expected to be any discernible change in the supporting processes on which qualifying natural habitats and the habitats of the bird interest features rely. Overall, the changes to habitat and associated benthic communities are considered to result in **no potential for an AEOI on the habitat and bird interest features of the Solent Maritime SAC, Solent and Southampton Water SPA/Ramsar site, and Solent and Dorset Coast SPA**.

D.4.2 Increased suspended sediment levels

The retention and persistence of LHC's regular and cumulative deposits at Boiler Marsh over periods of months and years suggests that this is likely to also occur at the proposed beneficial use sites at Pylewell and Cockleshell. In terms of sediment suspension, the fine sediment comprising the potential dredge material sources will generally be contained within the bulk of the dredged material and will primarily move as a cohesive mass from the hopper to the seabed. Increased SSC will be greatest at the immediate site of the disposal.

Dispersion of material will be limited given the placement activities will take place as high up on the highest tides and as high on the shore as possible, predominantly at the times of low or even slack tidal flows, to help maximise its retention. In practice, the sediment will be placed between around 1.1 mCD and 1.7 mCD (0.9 to 0.3 below ODN). The maximum water depths at the sites during the periods of bottom placement will, therefore, be in the order of 2 m. Due to the nature of the vessels used, placement will not occur during high wave activity, again minimising the disturbance of the sediment to the water column.

Any changes to SSC will be temporary, intermittent and short-lived, lasting the period of the proposed disposal activities associated with the maintenance dredge campaigns of nearby harbours and marinas. Furthermore, any changes will be largely limited to the immediate vicinity of the proposed beneficial use disposal sites. Thus, in physical terms, any plumes resulting from placement of material at the proposed beneficial use disposal sites are expected to have a minimal and very localised effect on water and sediment quality. Benthic species in the area are considered to be well adapted to survival under fluctuating conditions. The benthic community present within and adjacent to the proposed sites is, therefore, expected to be tolerant to the predicted changes in water and sediment quality. In other words, they are not sensitive to the magnitude of changes in water quality that are predicted.

Fish and shellfish within the West Solent are considered to be well adapted to living in an area with variable and often high suspended sediment loads. The predicted changes in SSC will not result in significant displacement or a barrier to the movements of fish. Furthermore, fish 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 enables them to move freely to avoid areas of adverse conditions and to use other prey resources.

Overall, the disposal activities are predicted to have negligible effects on the benthic and fish prey species of these birds. These changes are therefore unlikely to be harmful to waterbirds.

In the context of the site's conservation objectives, the condition of qualifying species interest features as a viable component of the European/Ramsar sites and the availability of prey for species interest features will be maintained. In other words, there is not expected to be any discernible change in the overall structure and function (including typical species) of qualifying natural habitats or the populations or distribution of qualifying species interest features or their prey. Overall, the changes in SSC are considered to result in **no potential for an AEOI on the habitat and bird interest features of the Solent Maritime SAC, the Solent and Southampton Water SPA/Ramsar site, or the Solent and Dorset Coast SPA,**.

D.4.3 Remobilisation of contaminated sediments

As dredged sediment is moved and re-distributed, there is the potential for sediment-bound contaminants to be released into the water column. The levels of contaminants present in the potential dredge material sources are considered to be relatively low, mostly below, or marginally exceeding, Cefas AL 1. The deposits are unlikely to cause a measurable change in water and sediment quality given that the proposed bottom placement method of disposal is aimed at retaining as much sediment as possible at the proposed beneficial use disposal sites and minimising the potential resuspension and dispersion of sediment. Furthermore, the disposal of dredge material is controlled by the MMO evaluation process for licensing disposals at sea.

The potential changes to levels of chemical contaminants in the water and the potential redistribution of sediment-bound chemical contaminants are assessed as negligible. Overall, these localised changes will be temporary and considered unlikely to be of a concentration that will be harmful to benthic habitats or bird interest features and their prey. Furthermore, standard practice pollution prevention guidelines will be followed to minimise the risk of accidental spillages and the risk of introduction of contaminants throughout the disposal process.

In the context of the site's conservation objectives, the condition of qualifying species interest features as a viable component of the European/Ramsar sites and the availability of prey for species interest features will be maintained. In other words, there is not expected to be any discernible change in the overall structure and function (including typical species) of qualifying natural habitats or the populations or distribution of qualifying species interest features or their prey. Overall, the changes in the levels of toxic contamination are considered to result in **no potential for an AEOI on the habitat and bird interest features of the Solent Maritime SAC and Solent and Southampton Water SPA/Ramsar site, or the Solent and Dorset Coast SPA**.

D.4.4 Potential for disturbance to waterbirds

The operation of the split hopper barge above a deposit location or its presence in the areas is not expected to cause significant bird disturbance. Any local waterbird populations are expected to be tolerant of vessel movements and disposal activities to some degree (given the regular activities in the adjacent Lymington Estuary), but also will readily habituate to these activities, which will not involve any loud sudden impact noises.

Any birds that use the areas surrounding the proposed disposal sites in winter could potentially be affected by the presence of a split hopper barge. As noted in **Section 4.8.1 of the main report**, the high water 'Pylewell' count sector, which extends across the eastern side of Lymington channel and all of Boiler and Pylewell marsh, supports 1,989 birds on average and around 4 % of the Solent and Southampton Water SPA overwintering population. The 'Hurst to Lymington' count sector, which extends across the western side of the Lymington Channel to Hurst Spit and covers the Cockleshell site, supports 12,073 birds on average and around 24 % of the Solent and Southampton Water SPA overwintering population.

The levels of potential disturbances will be lower than that experienced during the preceding Wightlink recharge which involved more regular activities and a team of contractors on site. The level of disturbance during the Wightlink recharge did not give rise to any significant effects. Furthermore, many past recharge projects at Lymington and other sites have been done in winter without signs of significant adverse impacts. This precedent exists because beneficial reuse of dredged sediment often has to be done in winter when the dredge material is available.

In order to minimise any potential adverse effects on waterbirds, cold weather working conditions will be adhered to on the occasion(s) when work might be undertaken in winter (e.g., October to March).

In the context of the site's conservation objectives, there will be no significant disturbance or displacement of bird interest features or their prey. In other words, there is not expected to be any discernible change in the overall populations or distribution of qualifying species interest features or their prey. Overall, the levels of airborne noise and visual disturbance from the proposed works are considered to result in **no potential for an AEOI on the bird interest features of the Solent Maritime SAC and Southampton Water and Solent SPA/Ramsar site or the Solent and Dorset Coast SPA**.

D.4.5 In-combination effects

As part of the Appropriate Assessment process, it is necessary to consider whether the proposed activities could have in combination impacts with other plans and projects. In combination impacts refer to effects which may or may not interact with each other, but which could affect the same interest feature(s).

In considering these effects it is firstly relevant that any potential adverse effects on European/Ramsar sites and features from the proposed beneficial use disposal sites at Pylewell and Cockleshell will be temporary, localised and insignificant to minor adverse at worse in their own right. These temporary effects will be required to deliver a net minor to moderate benefit from the project overall.

Secondly, no major new projects are proposed for the area, apart from saltmarsh enhancement works that can be considered in this context. For example, there are no defined shoreline management proposals at this time (although proposals are expected to emerge through the Hurst to Lymington Strategy over the coming years). The situation regrading other plans and projects in Lymington are outlined in **Section 4.4.3 of the MDP baseline report (in Appendix C)**.

The main project interaction going forward will be disposal and habitat restoration activities at Boiler Marsh by LHC with Land and Water Services Ltd. These activities will supply additional dredge material to an area which is progressively exporting sediment, and this will come from other harbours in the Solent as and when appropriate. These placements are also being pursued to achieve a net benefit to the habitats in the area.

These Boiler Marsh projects together with the proposed beneficial use sites at Pylewell and Cockleshell will provide benefits to the European/Ramsar sites. Therefore, the proposed works are considered to result in **no potential for an AEOI on European/Ramsar sites and features either alone or in-combination with other plans and projects**.

Over time, and if this project is consented, it may lead to more ambitious projects that cause more fundamental changes. However, these are not proposed, planned or envisioned at this time. Any such larger projects, if they were to be enacted, would probably only be progressed for other to deliver broader and more substantial coastal defence or conservation management measures.

D.5 Conclusions

This assessment indicates that the proposed beneficial use disposal sites will not have an AEOI on the interest features or conservation objectives of European/Ramsar sites either alone and/or in-combination with other plans and projects. This is based on the nature, scale, location and timing of the proposed activities as well as the evidence relating to relevant impact pathways.

Additional confidence in this conclusion is provided by the embedded mitigation measures. This includes:

- Adoption of an adaptive management strategy overseen by stakeholders including Natural England that includes regular monitoring and review;
- Adhering to cold weather working conditions on the occasion(s) when work might be undertaken in winter (e.g., October to March).

Fundamentally this project is being undertaken to improve the resilience of, and achieve net benefits for, intertidal habitats and the overwintering and breeding birds that rely on them. It will benefit interest features of the European/Ramsar sites in their own right while also providing lessons about how more such beneficial use initiatives might be done to achieve even greater gains in the future.

In this respect it will be helpful in the future to re-evaluate whether such projects should formally be defined as conservation measures. That is because this will influence the scope of and need for HRAs for such beneficial activities. If there are further positive outcomes from this latest beneficial use project, as there have been from past ones, then it would be useful to do so especially if this will facilitate delivering more such projects and the licensing of them.

Any such broad policy ambitions are outside the scope of this assessment. For now, and for this proposed project, it is recognised that the assessment conclusions need to be reached by the MMO in consultation with Natural England based on the information provided here.

E Water Framework Directive Compliance Assessment

E.1 Project Overview

The Lymington Estuary is located in the western arm of the Solent, in the lee of the Isle of Wight and Hurst Spit (see Figure E1). The town of Lymington has a long history of port activities dating back to at least 1200 AD. The area was a thriving port in the 17th Century when extensive coastal salt workings allowed the export of salt to America. Then over the 20th Century the harbour evolved into a major leisure boating centre with moorings for around 1,700 yachts. The river now also supports a small commercial fishing fleet and a car and passenger ferry service to the Isle of Wight making around 8,700 trips per annum.

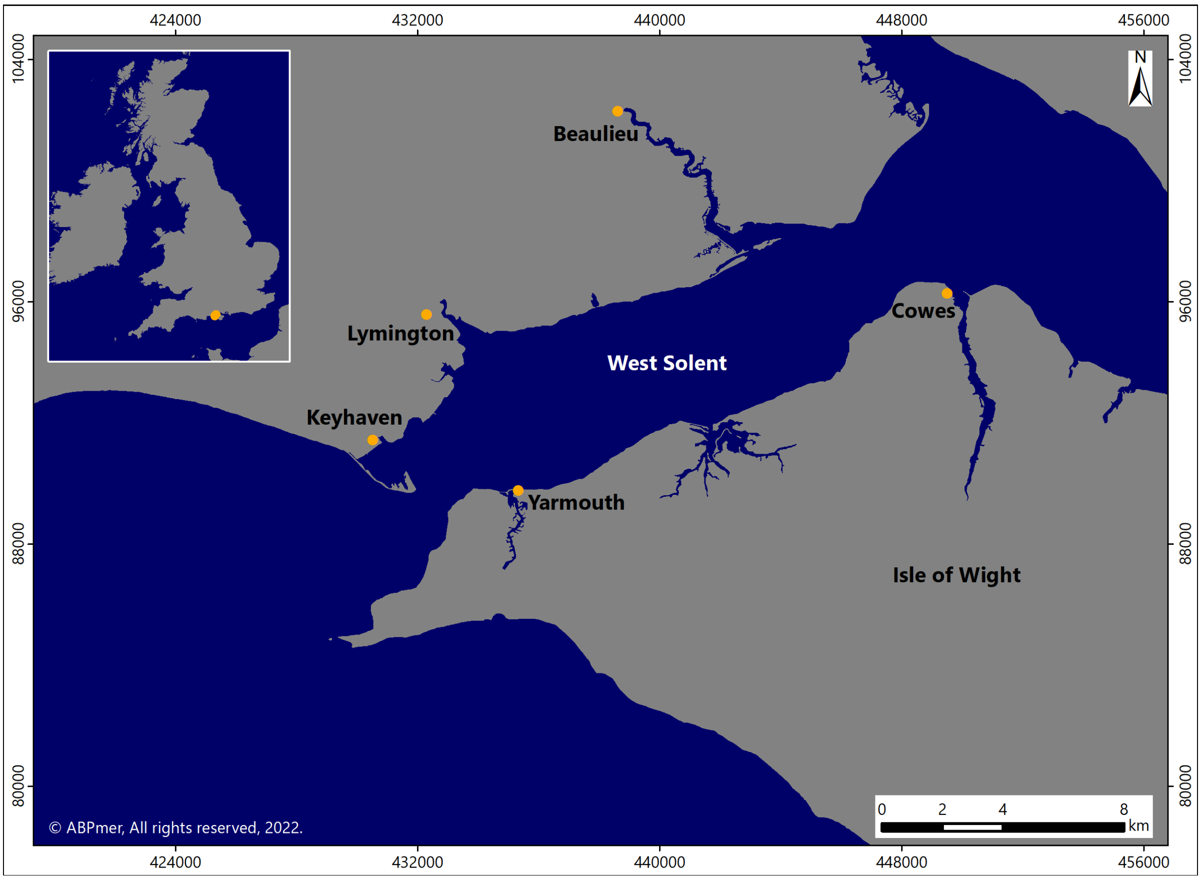


Figure E1. Location of Lymington town and harbours of the western Solent

This harbour is accessed from the Solent via a winding approach channel between saltmarshes and intertidal mudflats. In the summer months, this channel is especially busy with ferries and recreational craft (ABPmer, 2023a and Black & Veatch, 2017a). To ensure effective and safe navigation of the Lymington estuary, the Lymington Harbour Commissioners (LHC) regularly dredge the approaches and berthing areas in line with Marine Licence L/2014/00396/2.

At Lymington, instead of solely placing dredge arisings at a licensed subtidal disposal ground at Hurst Fort, 'alternative use' projects have also been successfully undertaken in recent years. These projects include the ongoing beneficial use 'bottom placement' work at Boiler Marsh (by LHC, under an ongoing Marine Licence), as well as two past projects where sediment was pumped onto higher elevations at Yacht Haven Marsh and at Boiler Marsh.

The Solent Forum partnership are now proposing to designate two alternative/beneficial use dredge disposal sites in the outer Lymington Estuary at Pylewell and Cockleshell. This Water Framework Directive (WFD) Compliance Assessment has been prepared, in accordance with the Water Environment Regulations (WER), to inform these new proposals by Solent Forum, and the related Marine Licence Application. Further detail on the proposed project is provided in Section E.3.1 of this WFD Compliance Assessment.

E.2 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) (as amended). These Regulations were revoked and replaced in April 2017 by the Water Environment (WFD) (England and Wales) Regulations 2017[23].

The overall objective of the WFD is to achieve good status (GS) in all inland, transitional, coastal and ground waters by 2021, 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 one nautical mile 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 sustainable 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 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 (DO) and salinity) and hydromorphological (e.g. hydrological regime) quality of the body of water, 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.

[23] After the UK left the EU, the main provisions of the WFD were retained in English law through the Floods and Water (Amendment etc.) (EU Exit) Regulations 2019 (HMSO, 2019c). .

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 Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (as amended), transpose the PSD into English law alongside any updates as a result of the European Union (Withdrawal Agreement) Act 2020.

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 the 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 interim water body classification results via the Environment Agency Catchment Data Explorer (http://environment.data.gov.uk/catchment-planning). The latest updates to RBMPs took place in December 2022, and this third stage of the RBMP approach to water body management covers the period from 2022 to 2027.

The proposed new beneficial use deposit sites at Pylewell and Cockleshell are located in the South East River Basin District. This is reported in the South East RBMP.

Consideration of WFD requirements is necessary for works 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 the proposed beneficial use sites to impact WFD water bodies, specifically referring to the following environmental objectives, as set out in Section 13 (subsections 1 to 7) of the Water Framework Regulations:

- **For surface water bodies**, the objectives are to:
  (a) Prevent deterioration of the status of each body of surface water;
  (b) Protect, enhance and restore each body of surface water (other than an artificial or heavily modified water body) with the aim of achieving good ecological status and (…) good surface water chemical status, if not already achieved (…);
  (c) Protect and enhance each artificial or heavily modified water body with the aim of achieving good ecological potential and (…) good surface water chemical status, if not already achieved (…); and
  (d) Aim progressively to reduce pollution from priority substances and aim to cease or phase out emissions, discharges and losses of priority hazardous substances.
- **For shellfish water protected areas**, in addition to the [above] objectives (…) for the surface water bodies in which they are located, the objectives are such objectives as are necessary or desirable to improve or protect the shellfish water protected area in order to support shellfish life and growth and to contribute to the high quality of shellfish products suitable for human consumption as the appropriate authority may direct.
- **For groundwater bodies**, the objectives are to:
  (a) Prevent deterioration of the status of each body of groundwater;

(b) Prevent or limit the input of pollutants into groundwater;
(c) Protect, enhance and restore each body of groundwater, and ensure a balance between abstraction and recharge of groundwater, with the aim of achieving good groundwater chemical status and good groundwater quantitative statusy, if not already achieved (…); and
(d) Reverse any significant and sustained upward trend in the concentration of any pollutant resulting from the impact of human activity in order to progressively reduce pollution of groundwater.

- **For each protected area**, other than a shellfish water protected area, the objective is to achieve compliance with any standards and objectives required by or under [the retained EU law] under which the area or body is protected:
  (a) By 22 December 2021, if not already achieved, or
  (b) If different, by any date for compliance set in [the relevant retained EU law].

Where two or more objectives set under this regulation apply to the same body of water, or the same part of a body of water, the most stringent objective applies.

The Environment Agency (2023) has published guidance ("Clearing the Waters for All") regarding how to assess the impact of activities in transitional and coastal waters for the WFD. The guidance sets out the following three discrete stages to WFD assessments:

- **Screening**: excludes any activities that do not need to go through the scoping or impact assessment stages (Section E.3);
- **Scoping**: identifies the receptors that are potentially at risk from an activity and need impact assessment (Section E.4); and
- **Impact Assessment**: considers the potential impacts of an activity, identifies ways to avoid or minimise impacts, and indicates if an activity may cause deterioration or jeopardise the water body achieving GS (Section E.5).

The Lymington Harbour Maintenance Baseline Document (including in Appendix C) was recently updated in conjunction with a separate licence condition for the Harbour Authority, and further provides a range of environmental information relevant to the WFD.

E.3 Screening

E.3.1 Project description

Details about the proposed beneficial use sites, including the project aims, are provided in **Section 2 of the main report.**

In summary, the Solent Forum partnership is seeking to designate two alternative/beneficial use dredge disposal sites in the outer Lymington Estuary. These are sites where dredged sediment from harbours in the Solent could be placed to supply sediment to the area. This will help to protect the saltmarshes and slow the rates at which they are eroding. It would prolong the life of these marshes and the surrounding mudflats and help maintain the benefits these habitats provide for biodiversity, water quality and harbour protection.

These two proposed sediment recharge sites lie either side of the entrance to Lymington Estuary. They are referred to here as 'Pylewell' and 'Cockleshell' and are shown on Figure E2.

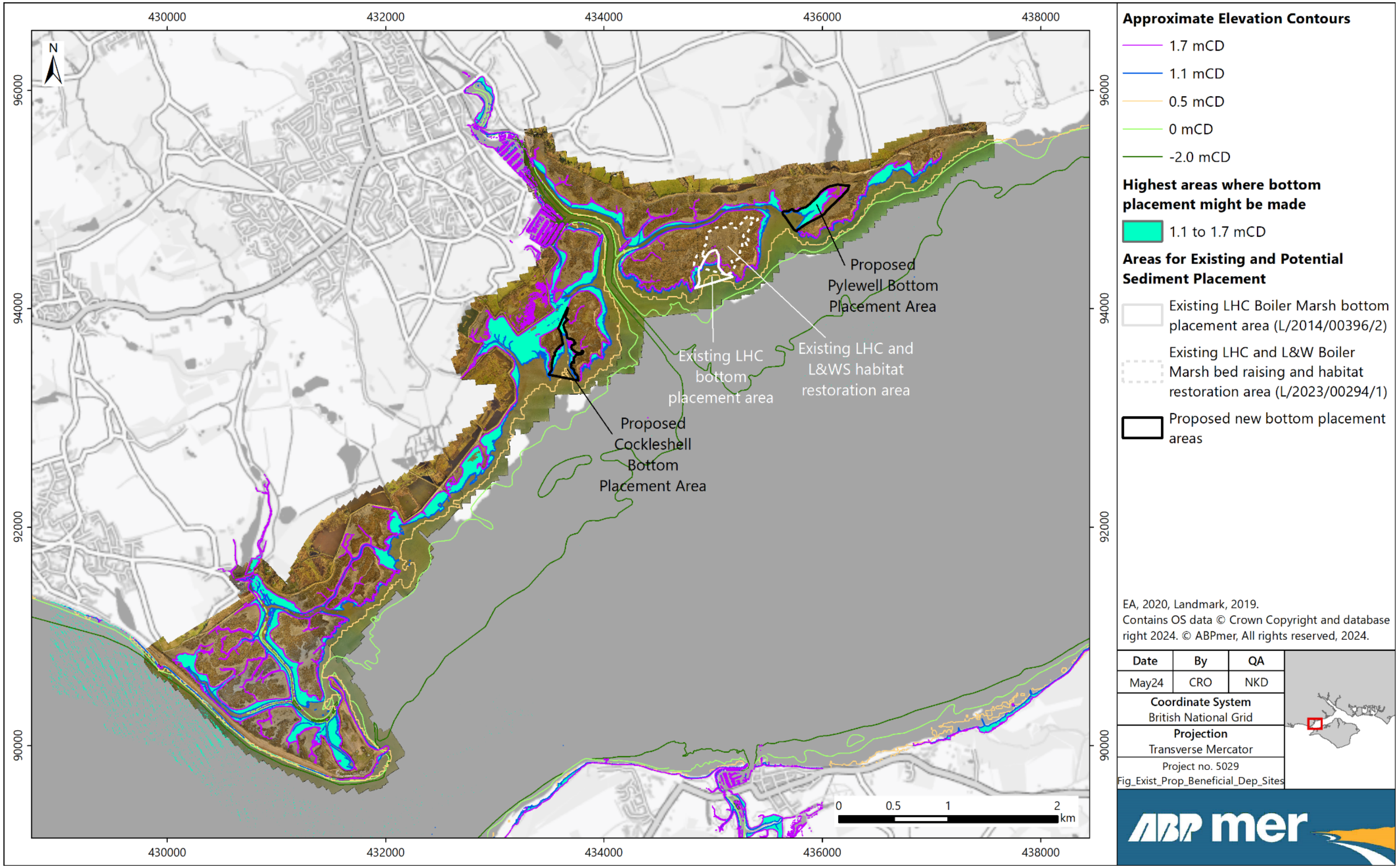


Figure E2. **Location of existing and proposed placement sites with bed elevation contours**

At the two proposed beneficial use sites, sediment would be bottom placed from hopper barges in the same way that sediment is now being placed at Boiler Marsh by LHC. From the practical lessons that have been learned at Boiler Marsh, this would supply sediment to these areas, lead to the creation of a protective bund for the habitats behind and could become a source of sediment for further marsh raising.

It is expected that dredged sediment from a range of sources could be placed at these sites. This could include sediment from the harbours of Lymington, Yarmouth, Beaulieu, Cowes or, occasionally, even the Hamble. If licensed, the proposed beneficial use sites at Pylewell and Cockleshell would operate in the same way as an offshore disposal site. Each harbour would be responsible for ensuring that the dredge sediments are suitable for disposal at sea (under existing consenting regimes), and hence also placement at Pylewell or Cockleshell.

Having multiple possible sediment sources is not only novel for this type of inshore beneficial use location, it also means that it is not possible to know with certainty how much sediment could be placed at these locations or how regularly. That will be dependent upon the requirements of each harbour and their relevant consenting arrangements. It will be influenced by their dredge volumes, sediment type, sediment quality, dredging methods and the vessels they use to transport sediment.

Due to these uncertainties about project scale and to provide regulators and all interested parties with confidence in the approach taken, it is anticipated that this project will be carried out in a phased and adaptive manner. It would begin with trials and be followed by scaling up across the deposit sites over time, if possible and where agreed. Sediment would initially be placed towards the upper reaches of mudflat habitat (as high as existing bathymetry and vessel access allows) at spring tide high water. Over time and subject to monitoring and management advice the sediment could increasingly be placed at lower elevations within the defined zones.

Where a harbour is able or required to place some dredge sediment at Pylewell or Cockleshell then the total volume that can be placed is likely to still be affected by the bed elevations at the disposal locations. Any disposal will need to coincide with high tide and the placement sites will be influenced by the vessel draught. For the purposes of consenting and this HRA though, it is assumed that up to 29,000 wet tonnes (approximately 20,000 m^3) could be placed annually across the two sites.

E.3.2 Potentially affected water bodies

To determine which waterbodies would potentially be affected by the proposed beneficial use disposal sites, all the surface and groundwater water bodies that could theoretically be affected by the proposals were recorded. On this basis, the following water bodies were initially screened in:

- Lymington transitional water body (ID: GB520704202100);
- Solent coastal water body (ID: GB650705150000);
- Lymington River water body (ID: GB107042011220);
- SW Hants Solent Group groundwater water body (ID: GB40702G504000); and
- SW Hants Barton Group groundwater water body (ID: GB40702G503500).

Figure E3 shows the location of the proposed beneficial use sites and surrounding WFD water bodies.

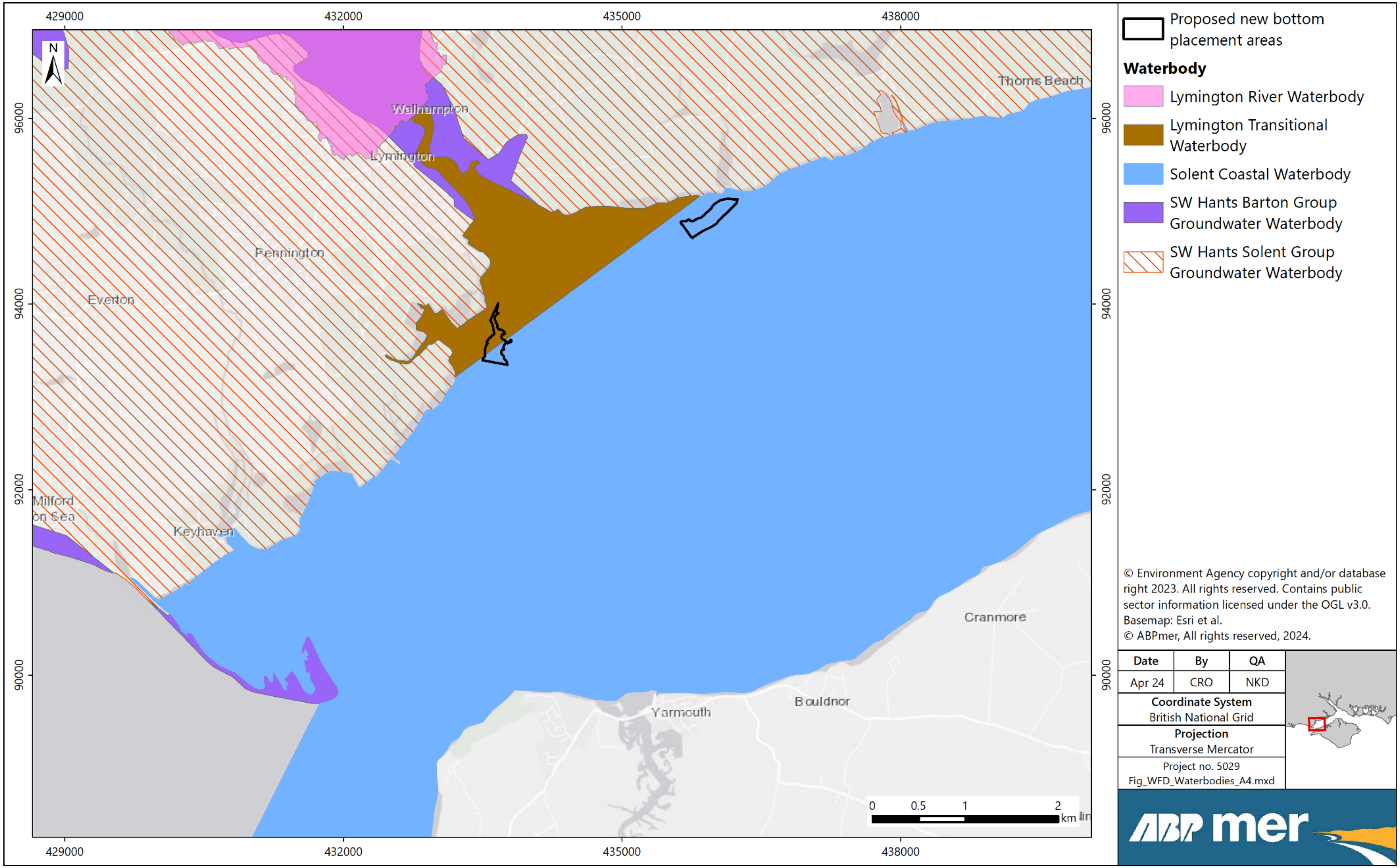


Figure E3. Waterbodies as well as dredging and disposal sites in the Western Solent

Based on the location and scale of the proposed beneficial use sites, no significant non-temporary effect on the Lymington River water body is expected. Similarly, given the nature of the activities (i.e., operation of two new dredge disposal site), the project will not have a significant non-temporary effect on the SW Hants Solent Group or SW Hants Barton Group groundwater bodies which lie beneath most of the terrestrial extent of the Lymington estuary. Therefore, groundwater water bodies have been screened out of the assessment and are not discussed further as the new disposal sites and their operation are unlikely to result in any adverse effects (e.g. saline intrusion).

The proposed beneficial use disposal sites are located within the Solent coastal water body and Lymington transitional water body. These waterbodies are therefore screened into the assessment. Table E1 provides a status summary for these water bodies based on 2022 ecological status classification and 2019 chemical status classification. Both these water bodies are currently failing to achieve good status (GS); both water bodies have a chemical status of fail, while both have an ecological status of moderate.

Table E1. Lymington and Solent waterbody summary details

Water Body Name	Lymington	Solent
Water Body ID	GB520704202100	GB650705150000
Water Body Type	Transitional	Coastal
Water Body Area	2.495 km^2	259.936 km^2
Hydromorphological Designation	HMWB	HMWB
Protected Area Designations	Birds Directive Habitats Directive Shellfish Water Directive	Bathing Water Directive Birds Directive Habitats Directive Nitrates Directive Shellfish Water Directive Urban Waste Water Treatment Directive
Ecological Status/Potential	Moderate	Moderate
Chemical Status	Fail	Fail
Parameters Not at Good Status	Mitigation measures assessment (moderate or less) Mercury and its compounds (fail) Polybrominated diphenyl ethers (PBDE) (fail)	Angiosperms - saltmarsh (moderate) Dissolved inorganic nitrogen (moderate) Mercury and its compounds (fail) Polybrominated diphenyl ethers (PBDE) (fail)
Higher Sensitivity Habitats	Saltmarsh (92.60 ha)	Chalk reef (3308.84 ha) Intertidal seagrass (141.24 ha) Mussel beds, including blue and horse mussel (0.80 ha) Saltmarsh (132.87 ha) Subtidal kelp beds (111.65 ha) Subtidal seagrass (186.05 ha)
Lower Sensitivity Habitats	Intertidal soft sediments (141.11 ha) Rocky shore (0.07 ha)	Cobbles, gravel, and shingle (129.48 ha) Intertidal soft sediment (1496.88 ha) Rocky shore (80.05 ha) Subtidal rocky reef (460.77 ha) Subtidal soft sediments (11772.25 ha)
Phytoplankton Status	Not monitored	Good
History of Harmful Algae	Not monitored	No

The Lymington transitional water body is currently at moderate ecological potential (2022) and failing chemical status (2019). Moderate ecological potential is due to the 'Mitigation measures assessment'. Chemical status is failing to achieve good status due to priority hazardous substances 'mercury and its compounds' and 'polybrominated diphenyl ethers (PBDE)'.

The Solent coastal water body is currently at moderate ecological potential (2022) with a failing chemical status (2019). Moderate ecological potential is due to the biological quality element 'Angiosperms' (saltmarsh) and the physico-chemical quality element 'Dissolved inorganic nitrogen' being classified as moderate. In 2019, the chemical status failed to achieve good status due to priority hazardous substances 'mercury and its compounds' and 'polybrominated diphenyl ethers (PBDE)'.

E.3.3 Protected areas

The WFD requires that activities are also in compliance with other relevant legislation, such as the Conservation of Habitats and Species Regulations 2017 (as amended), Bathing Water Regulations 2013 (as amended), Nitrate Pollution Prevention Regulations 2015 (as amended), Urban Waste Water Treatment (England and Wales) Regulations 1994 (as amended), and the provisions of the Shellfish Water Protected Areas (England and Wales) Directions 2016 (as amended).

Nature conservation designations

The Conservation of Habitats and Species Regulations 2017 (as amended) transpose the Habitats Directive (92/43/EEC) and Birds Directive (2009/147/EC) into English law[24]. Article 3 of the Habitats Directive (92/43/EEC as amended) requires the establishment of a network of important high-quality conservation sites known as Special Areas of Conservation (SAC) that will contribute to conserving habitats and species identified in Annexes I and II of the Directive. The listed habitat types and species are those considered to be most in need of conservation at a European level (excluding birds).

In accordance with Article 4 of the Birds Directive (2009/147/EC), Special Protection Areas (SPA) are strictly protected sites classified for rare and vulnerable birds (Annex I of the Directive), and for regularly occurring migratory species. Ramsar sites are wetlands of international importance designated under the Ramsar Convention (adopted in 1971 and came into force in 1975), providing a framework for the conservation and wise use of wetlands and their resources.

The nature conservation interests of the Lymington estuary, Solent Strait, and surrounding areas are of high importance with intertidal mudflats, and adjacent coastlines and estuaries having been designated as nationally and internationally protected sites. The following international nature conservation designations are located within 5 km of the proposed beneficial use sites:

- Solent & Southampton Water SPA and Ramsar Site;
- Solent & Isle of Wight Lagoons SAC;
- Solent Maritime SAC; and
- Solent and Dorset Coast SPA

The location of the proposed beneficial use sites in relation to the above designations is shown on Figure E4.

24 Conservation of Habitats and Species Regulations 2017 (as amended)) still has effect in domestic law under the European Union (Withdrawal) Act 2018, which repealed the European Communities Act 1972 while also maintaining EU-derived domestic legislation in national law. The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 then later made some minor changes to this legislation to accommodate it into UK law.

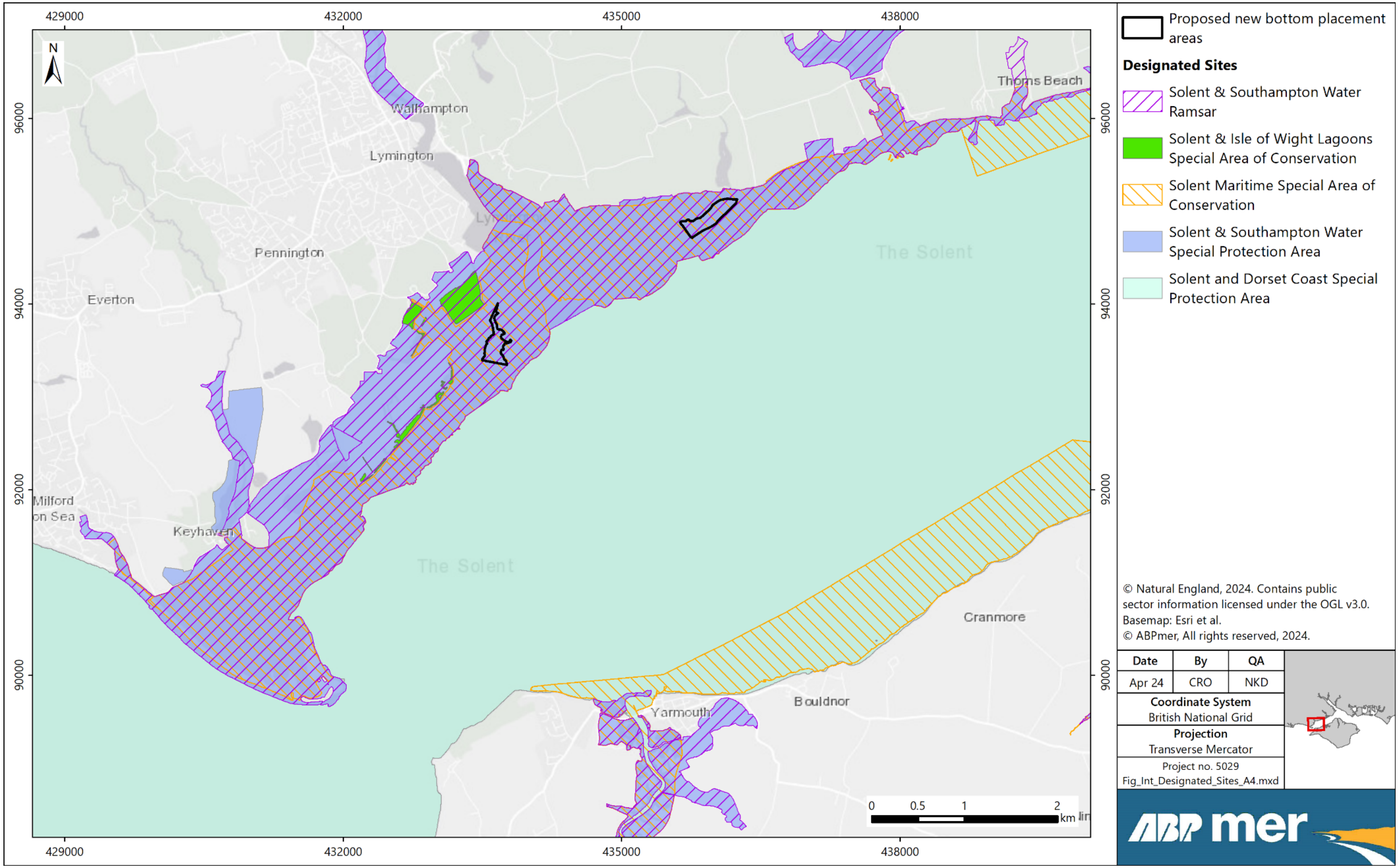


Figure E4. Location of international designations in relation to proposed beneficial use sites

Bathing Water 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 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 the UK Government's target under the revised Bathing Water Directive was to achieve a classification of 'sufficient' for all bathing waters by 2015, as described under the Bathing Water Regulations 2013[25] (as amended). 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.

There are no designated bathing waters within 5 km of the proposed beneficial use sites.

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 intravalvular liquid. The Directions 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).

- The proposed beneficial use disposal site at Pylewell is located within the Lymington and Sowley Shellfish Water Protected Area and the Cockleshell site is located within the Pennington Shellfish Water Protected Area.

Nitrates Directive

The Nitrates Directive (91/676/EEC), which is implemented in England by the Nitrate Pollution Prevention Regulations 2015 (as amended), 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.

The proposed beneficial use disposal sites at Pylewell and Cockleshell are located 1.5 km respectively from the nearest Nitrate Vulnerable Zone (NVZ) at Sowley Pond Eutrophic lake NVZ and Avon Water NVZ respectively, as designated under the Nitrates Directive. These NVZs are located on land, outside of the marine environment.

[25] From 31 January 2020, this is replaced by The Floods and Water (Amendment etc.) (EU Exit) Regulations 2019.

Urban Waste Water Treatment Directive

The Urban Waste Water Treatment (England and Wales) Regulations 1994 (as amended) transpose the Urban Waste Water Treatment Directive (91/271/EEC) into English law. It 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 UWWTD 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 UWWTD 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 no UWWTD designated sites within 2 km of the proposed beneficial use sites.

E.4 Scoping

The "Clearing the Water for All" guidance provides a scoping template to record findings and consider potential risks for several key receptors, specifically:

- Hydromorphology;
- Biology (habitats);
- Biology (fish);
- Water quality;
- Protected areas; and
- Invasive non-native species (INNS).

Each receptor is considered in the following sections and summarised in a table. Potential risks that have been scoped into the assessment are highlighted in red and considered within the impact assessment stage, while those scoped out of the assessment are highlighted in green.

E.4.1 Hydromorphology

Hydromorphology is the physical characteristics of estuaries and coasts, including the size, shape and structure of the water body and the flow and quantity of water and sediment. Table E2 presents a summary of hydromorphological considerations and associated risk issues for the proposed beneficial use sites. At least one hydromorphological consideration indicates that a risk could be associated with the proposed disposal activities. This receptor has, therefore, been scoped into the impact assessment (Section E.5).

Table E2. Hydromorphology scoping summary

Hydromorphology Considerations	Hydromorphology Risk Issue(s)	
	Lymington	Solent
Consider if your activity could impact on the hydromorphology (for example morphology or tidal patterns) of a water body at high status?	No (hydromorphology status 'supports good'). Impact assessment not required.	No (hydromorphology status 'not assessed'). Impact assessment not required.

Hydromorphology Considerations	Hydromorphology Risk Issue(s)	
	Lymington	Solent
Consider if your activity could significantly impact the hydromorphology of any water body?	Yes (potential changes to hydromorphology) Requires impact assessment.	Yes (potential changes to hydromorphology) Requires impact assessment.
Consider if your activity is in a water body that is heavily modified for the same use as your activity?	No (reason for hydromorphological designation is 'Coastal and Flood Protection'). Impact assessment not required.	No (reason for hydromorphological designation is 'Coastal and Flood Protection' and 'Navigation, ports and harbours'). Impact assessment not required.

E.4.2 Biology (habitats)

It is necessary to consider the impact of the physical footprint of an activity on nearby marine and coastal habitats. This specifically refers to habitats of higher sensitivity (e.g. intertidal seagrass, maerl and saltmarsh) and lower sensitivity (e.g. cobbles, gravel and shingle, subtidal rock reef and intertidal soft sediments like sand and mud). Table E3 presents a summary of biology (habitats) considerations and associated risk issues for the proposed beneficial use disposal sites. As the biology (habitats) considerations indicate that it is likely a risk could be associated with these works, this receptor has been scoped into the assessment (Section E.5).

Table E3. Biology (Habitats) scoping summary

Biology (Habitats) Considerations	Biology (Habitats) Risk Issue(s)	
	Lymington	Solent
Is the footprint of the activity 0.5 km² or larger?	No (beneficial use site at Cockleshell is 0.1 km² when multiplied by 1.5 times as per guidance for dredge operations). Impact assessment not required	No (beneficial use sites at Pylewell and Cockleshell works are 0.2 km² when multiplied by 1.5 times as per guidance for dredge operations). Impact assessment not required
Is the footprint of the activity 1% or more of the water body's area?	Yes (footprint over 1% of water body area). Requires impact assessment	No (footprint <1% of water body area). Impact assessment not required
Is the footprint of the activity within 500 m of any higher sensitivity habitat?	Yes (within 500 m of saltmarsh habitat due to nature of the proposal). Requires impact assessment	Yes (within 500 m of saltmarsh habitat due to nature of the proposal). Requires impact assessment.
Is the footprint of the activity 1% or more of any lower sensitivity habitat?	Yes (footprint of proposed beneficial use site at cockleshell is over 1% of intertidal soft sediments). Requires impact assessment.	Yes (footprint of proposed beneficial use sites at Pylewell and Cockleshell is over 1% of intertidal soft sediments). Requires impact assessment.

E.4.3 Biology (fish)

Activities occurring within an estuary could impact on normal fish behaviour such as movement, migration or spawning. Table E4 presents a summary of biology (fish) considerations and associated risk issues for the proposed beneficial use disposal sites. As there are biology (fish) considerations which indicate that a risk could be associated with these ongoing works, this receptor has been scoped into the assessment (Section E.5).

Table E4. Biology (fish) scoping summary

Biology (Fish) Considerations	Biology (Fish) Risk Issue(s)	
	Lymington	Solent
Consider if your activity is in an estuary and could affect fish in the estuary, outside the estuary but could delay or prevent fish entering it or could affect fish migrating through the estuary?	Yes. Guidance suggests "Continue with questions".	Yes. Guidance suggests "Continue with questions".
Consider if your activity could impact on normal fish behaviour like movement, migration or spawning (for example creating a physical barrier, noise, chemical change or a change in depth or flow)?	Yes (proposed disposal activities may lead to elevated underwater noise or increases in suspended sediment concentrations (SSC)). Requires impact assessment.	Yes (proposed disposal activities may lead to elevated underwater noise or increases in suspended sediment concentrations (SSC)). Requires impact assessment.
Consider if your activity could cause entrainment or impingement of fish?	No (entrainment risk not considered possible). Impact assessment not required.	No (entrainment risk not considered possible). Impact assessment not required.

E.4.4 Water quality

Consideration should be made regarding whether phytoplankton status and harmful algae could be affected by the proposed works, as well as identifying the potential risks of using, releasing or disturbing chemicals. Table E5 presents a summary of water quality considerations and associated risk issues for the proposed beneficial use disposal sites. As at least one water quality consideration indicates that a risk could be associated with these ongoing works, this receptor has been scoped into the impact assessment (Section E.5).

Table E5. Water quality (physical parameters) scoping summary

Water Quality Considerations	Water Quality Risk Issue(s)	
	Lymington	Solent
Consider if your activity could affect water clarity, temperature, salinity, oxygen levels, nutrients or microbial patterns continuously for longer than a spring neap tidal cycle (about 14 days)?	No (while the project duration exceeds 14 days, the potential to affect water quality is intermittent and unlikely to persist continuously for greater than 14 days). Impact assessment not required.	No (while the project duration exceeds 14 days, the potential to affect water quality is intermittent and unlikely to persist continuously for greater than 14 days). Impact assessment not required.

Water Quality Considerations	Water Quality Risk Issue(s)	
	Lymington	Solent
Consider if your activity is in a water body with a phytoplankton status of moderate, poor or bad?	No (phytoplankton status is currently not monitored). Impact assessment not required.	No (phytoplankton status is "good"). Impact assessment not required.
Consider if your activity is in a water body with a history of harmful algae?	No (history of harmful algae not monitored). Impact assessment not required.	No (waterbody has no history of harmful algae). Impact assessment not required.
If your activity uses or releases chemicals (for example through sediment disturbance or building works) consider if the chemicals are on the Environmental Quality Standards Directive (EQSD) list?	Yes (potential for contaminants in sediments to be disturbed during deposition). Requires impact assessment.	Yes (potential for contaminants in sediments to be disturbed during deposition). Requires impact assessment.
If your activity uses or releases chemicals (for example through sediment disturbance or building works) consider if it disturbs sediment with contaminants above Cefas Action Level 1?		
If your activity has a mixing zone (like a discharge pipeline or outfall) consider if the chemicals released are on the Environmental Quality Standards Directive (EQSD) list?	No (not applicable). Impact assessment not required.	No (not applicable). Impact assessment not required.

E.4.5 Protected areas

Consideration should be made regarding whether WFD protected areas are at risk from your activity, including SACs and SPAs (European sites), as well as bathing waters, shellfish waters and nutrient sensitive areas. Table E6 presents a summary of protected area considerations and associated risk issues for the proposed beneficial use disposal sites. As the protected areas considerations indicate that a risk could be associated with these ongoing works, this receptor has been scoped into the impact assessment (Section E.5).

Table E6. Protected areas scoping summary

Protected Area Considerations	Protected Area Risk Issue(s)	
	Lymington	Solent
Consider if your activity is within 2 km of any WFD protected area?	Yes (overlap with nature conservation designated sites, in proximity to Shellfish Water Protected Areas). Impact assessment required.	Yes (overlap with nature conservation designated sites, in proximity to Shellfish Water Protected Areas). Impact assessment required.

E.4.6 Invasive non-native species (INNS)

Consideration should be made regarding whether there is a risk the activity could introduce or spread INNS. Risks of introducing or spreading INNS include materials or equipment that have come from, had use in or travelled through other water bodies, as well as activities that help spread existing INNS, either within the immediate water body or other water bodies. Table E7 presents a summary of INNS considerations and associated risk issues for the proposed beneficial use disposal sites. As the INNS considerations indicate that a risk could be associated with these ongoing works, this receptor has been scoped into the impact assessment (Section E.5).

Table E7. Invasive non-native species scoping summary

INNS Considerations	INNS Risk Issue(s)	
	Lymington	Solent
Consider if your activity could introduce or spread INNS?	Yes (potential for introduction or spread of INNS). Requires impact assessment.	Yes (potential for introduction or spread of INNS). Requires impact assessment.

E.5 Impact Assessment

An impact assessment should be conducted for each receptor identified during the scoping stage as being at risk from an activity. The following receptors have been scoped into the impact assessment:

- Hydromorphology;
- Biology (habitats)
- Biology (fish);
- Water quality;
- Protected areas; and
- Invasive non-native species (INNS).

Each of these WFD parameters has been evaluated in order to determine whether the proposed beneficial use sites might cause deterioration in the status of the relevant water body (defined as a non-temporary effect on status at water body level), or an effect that prevents the water body from meeting its WFD objectives.

E.5.1 Hydromorphology

The bathymetric surveys that have been undertaken between 2019 and 2023 at the LHC's Boiler Marsh beneficial reuse site indicate that much of the sediment is remaining *in situ* at the placement site and that there is a progressive build-up of sediment (ABPmer, 2023a). One sign of this is that the locations where sediment is being placed have progressively been very slightly adjusted over time. As certain parts of the site become shallower and less accessible to the hopper barges, sediment is increasingly being placed slightly seaward, or to the east, of previous locations. The relative persistence of the material will have been helped by the manner in which the disposal work is being done, with deposits being placed on top of, or as close as possible to, previous ones.

Losses of sediment occurred between the winter disposal campaigns at Boiler Marsh, as would be expected to occur, but also from settlement and compaction of the placed material (ABPmer, 2023a). The extent of these losses varies between years and is influenced by the composition of the sediment and the deposit location.

In total, almost 60,000 m^3 have now been deposited on the site over the last nine winter campaigns (ABPmer, 2023a). A substantial amount of this material remains where it is placed, which has led to a gradual increase in the size of the raised mudflat feature over time. It is difficult to accurately measure the proportions of material that are either retained or exported because of the effects of sediment settlement and compaction. However, roughly half the deposited material remains during the winter campaigns, and this placed sediment then reduces in volume, through settlement and compaction, by about half as much again over the following summer. The ongoing and regular recharge placements have, therefore, been effective in creating a raised bed feature.

The placement of dredged sediment at the proposed beneficial use disposal sites at Pylewell and Cockleshell is expected to develop a similar raised feature at each of these sites. The continued regular placement of material will further help to maintain and potentially build up these features over time, although their size and persistence will be influenced by a range of factors, including the consolidation of the deposits, as well as the occurrence and nature of storm events.

The proposed beneficial use disposal sites have the potential to result in changes to hydrodynamics (e.g., water levels and flow rates). Any hydrodynamic changes that occur would happen slowly as the deposits accumulate at each proposed site, with greater effects occurring on completion of each maintenance dredge and disposal campaign.

The proposed beneficial use disposal sites will cause a change in the local estuary geometry which in turn will marginally decrease the estuary tidal volume and tidal prism. The proposed beneficial use disposal sites are within sheltered areas and outside of the main Solent tidal stream. The amount of sediment to be disposed and the area over which it will be disposed is also limited (9.2 ha at Pylewell and 7.3 ha at Cockleshell) and, therefore, will not affect dominant currents in the area (Binnies UK Ltd, 2021).

The scale of any changes in tidal volume and tidal prism are considered to be negligible and will not modify the way the tide propagates through the estuary to the area, in terms of the shape of the tidal curve, water levels and tidal range. Changes to flows following the proposed disposal activities will also be negligible in magnitude and extent and confined to the close proximity of the proposed beneficial use disposal sites, whereby elevated areas associated with the deposits encourage slightly enhanced local flow, but will not result in a change in the overall hydrodynamic working of the estuary. Considering the low existing flow speeds in the area (generally up to *circa* 0.3 m/s) and a minor decrease in overall estuary area during higher states of the tide, it is suggested that any decreases would be negligible in magnitude.

The proposed beneficial use disposal sites at Pylewell and Cockleshell are considered to result in a very localised and negligible change on hydrodynamics (e.g., water levels, flow rates, changes to tidal prism). The extent and magnitude of the changes will remain negligible in response to climate change and sea level rise.

Overall, the proposed beneficial use sites will not result in any significant changes to hydromorphology. The proposed disposal activities are, therefore, not expected to lead to a deterioration of the assessed hydromorphological elements within the Lymington transitional water body or the Solent coastal water body, nor prevent these water bodies from meeting their WFD objectives.

E.5.2 Biology (habitats)

Intertidal and subtidal mudflat

The bottom placement of dredged material at the proposed beneficial use disposal sites will result in localised physical disturbance and smothering of mudflat habitats and species where the material settles onto the seabed. Habitats within estuarine and coastal environments have highly fluctuating conditions including 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). Subtidal and intertidal habitats are, therefore, characterised by such perturbations and the biological communities of these environments are well adapted to survival under fluctuating conditions.

The smothering of benthic invertebrates within the footprint of the proposed beneficial use disposal sites is unavoidable. The smothering will be on a very localised scale and the area of the seabed that will be affected will be very small for each deposit load from the smaller split hopper barges that would be using these sites (Section 2.5.2). The total area covered by the proposed beneficial use sites (9.2 ha at Pylewell and 7.3 ha at Cockleshell) is also small in the context of the relevant Hurst Castle and Lymington River Estuary SSSI unit (4.7 % for Pylewell and 3.5 % for Cockleshell) and SAC intertidal mudflat feature (0.18 % for Pylewell and 0.14 % for Cockleshell).

The proposed beneficial use disposal sites will result in a slight raising of habitat in the tidal frame and a potential short to medium term change in the extent or type of habitat (i.e., from lower intertidal mudflat to higher intertidal mudflat). Also, the sediment recharge will have beneficial effects on the adjacent vulnerable saltmarsh habitats and associated invertebrates (see next Section 'Saltmarsh'). Based on recent precedents at Boiler Marsh, it is expected that the proposed beneficial use disposal sites will become re-established relatively quickly with benthic invertebrates between dredge and disposal campaigns (Binnies UK Ltd, 2021).

A small proportion of the material that is placed on the seabed at the proposed beneficial use sites will be dispersed and re-deposited locally to the site. Dispersion of material will be limited given the placement activities will take place as high up on the shore as possible. The small volume that is moved beyond the proposed sites is likely to be either dispersed widely in the outer estuary and Western Solent at very low concentrations or settle in the low flow areas of the tidal creeks and marshes. The scale of change is considered to be minor and of a similar magnitude to deposition resulting from natural change, vessel movements and ongoing maintenance dredging in the wider area. Sedimentation away from the proposed beneficial use disposal sites is unlikely to be measurable; and will be short-lived and transient in nature, likely to be redistributed by natural physical processes and ongoing activities.

The mudflat benthic fauna recorded in the area of the proposed beneficial use disposal sites comprise species that are capable of rapidly recolonising disturbed habitats. These species are also considered to be commonly occurring in the wider area, and tolerant to some sediment deposition. Benthic communities are, therefore, considered to have a low sensitivity to minor fluctuations in sedimentation, particularly in areas with muddy sediments and those located adjacent to regularly disturbed areas, such as the main approach channel into Lymington Harbour. Any minor deposition outside of the immediate proposed beneficial use disposal sites is considered unlikely to cause significant smothering effects and recoverability is expected to be high.

Saltmarsh

The proposed beneficial use disposal activities at Pylewell and Cockleshell will take place within the lower intertidal area with the aim of the sediment creating a raised area or 'reef' on the seabed to provide some protection from wave action to the adjacent eroding saltmarsh. The deposited material is not expected to remain in position in the long term but will be redistributed by wave action and tidal movement so that a proportion washes and settles on to the adjacent saltmarsh. The remainder may be effectively 'lost' from Lymington Harbour but will remain present in low concentrations as an enhanced suspended sediment source for the Solent saltmarshes as a whole (Black & Veatch, 2017a).

Given the fact that sediment is not being directly placed on the saltmarsh and the limited scale, extent and temporary nature of any resuspension and deposition, it is unlikely that saltmarsh habitat will be adversely affected by the proposed recharge activities at Pylewell and Cockleshell. The saltmarsh recharge trial which took place at Boiler Marsh from 2014 to 2017 went well and benthic habitat surveys carried out by Natural England demonstrated that there were no adverse impacts on the saltmarsh area following three deposit campaigns (Black & Veatch, 2017b; Binnies UK Ltd, 2021). The proposed beneficial use disposal sites may result in a temporary minor impact on SSC in the vicinity of the site (Section 4.4.2), however, based on the results of the recharge trial at Boiler Marsh, this did not affect the growth of the saltmarsh. Overall, therefore, no significant adverse effects are anticipated on the saltmarsh habitat.

In the long-term, the placement of material will act to retain sediment within the estuary system, with the aim of protecting the intertidal saltmarsh habitat and minimising or slowing down its current rate of loss from erosion. In this context, the proposed beneficial use disposal sites could help to re-supply sediment to the marshes at Pylewell and Cockleshell, and at least stall the progressive decline. Any measures which raise the bed levels up and/or slow the erosion of the outer marshes' edges have the potential to lead to marsh restoration. It is certainly known from past recharge work that, where dredged sediment is introduced to impoverished marsh surfaces, then marsh vegetation can develop/ or recover quickly (ABPmer, 2020).

Summary

Overall, the proposed beneficial use sites will not result in any significant adverse effects on habitats (there will be a net beneficial impact). The proposed works are, therefore, not expected to lead to a deterioration of the assessed habitat elements within the Lymington transitional water body or the Solent coastal water body, nor prevent these water bodies from meeting their WFD objectives.

E.5.3 Biology (fish)

Changes in water quality during dredge disposal activities could potentially impact fish species, by increasing SSC, resulting in changes to DO and releasing toxic contaminants bound in sediments.

Fish and shellfish within the West Solent 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 proposed new disposal and restoration sites and will be short-lived. The predicted changes in SSC will therefore not result in significant displacement or a barrier to migratory fish. Furthermore, fish, including migratory species, 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 enables them to move freely to avoid areas of adverse conditions and to use other prey resources.

Standard practice pollution prevention guidelines will also be followed to minimise the risk of accidental spillages and the risk of introduction of contaminants throughout the disposal process.

Elevated noise and vibration levels can potentially disturb fish by causing physiological damage and/or inducing adverse behavioural reactions and masking (Hawkins *et al.*, 2015). The ability to detect and localise the source of a sound is of considerable biological importance to many fish species and is often used to assess the suitability of a potential mate or during territorial displays and during predator prey interactions.

Information on underwater noise levels associated specifically with disposal of dredged material is limited. On this basis, noise levels associated with dredging activity more generally have been used to inform the assessment. Dredging noise impacts on fish are likely to be restricted to behavioural responses, which are predominantly limited to near and intermediate distances of several metres to tens of metres from the source (Popper *et al*., 2014). At Pylewell and Cockleshell, split hopper barges will be present only intermittently and the works will be short term. As the vessels are moving, fish are not physically constrained and will be able to move away from the source of noise and return once disposal and restoration activity has ceased. Noise levels at the proposed disposal sites and amounts of disturbance will thus be temporary and relatively low, and of a similar magnitude to underwater noise generated by existing vessel movements and ongoing maintenance dredging in the wider area.

Overall, the proposed beneficial use sites will not result in any adverse effects on fish. The proposed works are, therefore, not expected to lead to a deterioration of the assessed fish elements within the Lymington transitional water body or the Solent coastal water body, nor prevent these water bodies from meeting their WFD objectives.

E.5.4 Water quality

As sediment is disturbed and re-distributed into the water column, any sediment-bound contaminants may be partitioned from the solid phase (i.e., bound to sediments or suspended matter), to the dissolved or aqueous phase (i.e., dissolved in pore water or overlying water) (Luoma, 1983). The levels of contaminants present in the potential dredge material sources are considered to be relatively low, mostly below, or marginally exceeding, Cefas AL 1.

The material has been deemed acceptable for disposal at sea and continued maintenance dredge and disposal activities have been licensed. Furthermore, the deposits are unlikely to cause a measurable change in the levels of chemical contamination in the water at or around the site given that the proposed bottom placement method of disposal is aimed at retaining as much sediment as possible at the proposed beneficial use disposal sites and minimising the potential resuspension and dispersion of sediment. It is, therefore, unlikely that sediment quality criteria, as a result of the small proportion of contaminated material redistributed and deposited during the bottom placement of material at the proposed beneficial use disposal sites, will be exceeded elsewhere. Furthermore, the disposal of dredge material is controlled by the MMO evaluation process for licensing disposals at sea.

With regards to the 2019 failing levels of ‘mercury and its compounds’ and ‘polybrominated diphenyl ethers (PBDE)’ in the Solent coastal water body and Lymington transitional water body, the issue extends beyond the zone of influence for potential impacts associated with disposal activities. This supports the finding that the contaminants are from other sources and, therefore, it is highly likely that dredging and disposal activities are not contributing to these failures (Binnies UK Ltd, 2021).

Accidental spillages of oil and other substances have the potential to occur during the bottom placement activities at the proposed beneficial use disposal sites. Best practice pollution prevention guidelines (Defra and Environment Agency, 2016) will be followed to minimise the risk of accidental spillages and the risk of introduction of contaminants throughout the disposal process to minimise the risk of accidental spillages and the risk of introduction of contaminants.

Overall, the proposed beneficial use sites will not result in any adverse effects on water quality. The proposed sites are, therefore, not expected to lead to a deterioration of the assessed water quality elements within the Lymington transitional water body or the Solent coastal water body, nor prevent these water bodies from meeting their WFD objectives.

E.5.5 Protected areas

The proposed beneficial use sites lie within the boundaries of the following international designated sites:

- The Solent Maritime SAC;
- The Solent and Southampton Water SPA; and
- The Solent and Southampton Ramsar Site.

The site also lies close to the Solent and Isle of Wight Lagoons SAC, as well as the Solent and Dorset Coast SPA.

The potential impact pathways on these sites and interest features have been assessed in the Habitat Regulations Assessment (HRA) in Appendix D of the Environmental Appraisal (main report) in the context of the nature and scale of the proposed works. The geographic location of the project activities relative to the interest features and the sensitivities of the interest features to these environmental pressures/changes have also been taken into account. Based on available evidence in the HRA, there is considered to be no potential for an adverse effect on integrity (AEOI) of the interest features or conservation objectives of European sites either alone and/or in-combination with other plans and projects.

The proposed beneficial use disposal site at Pylewell is located within the Lymington and Sowley Shellfish Water Protected Area and the Cockleshell site is located within the Pennington Shellfish Water Protected Area. Any changes to SSC will be temporary, intermittent and short-lived, lasting the period of the proposed disposal activities associated with the maintenance dredge campaigns of nearby harbours and marinas. Furthermore, any changes will be largely limited to the immediate vicinity of the proposed beneficial use disposal sites. Thus, in physical terms, any plumes resulting from placement of material at the proposed beneficial use disposal sites are expected to have a minimal and very localised effect on water and sediment quality.

The potential changes to levels of chemical contaminants in the water and the potential redistribution of sediment-bound chemical contaminants are assessed as negligible. Furthermore, the sediment is unlikely to contain significant levels of bacterial coliforms. Therefore, effects on Shellfish Water Protected Areas are considered unlikely.

In conclusion, the proposed beneficial use disposal sites are not expected to lead to a deterioration of the assessed protected area designations, nor prevent the water bodies from meeting their WFD objectives.

E.5.6 Invasive non-native species

As with most activities which occur in the marine environment, there is potential risk that the proposed beneficial use disposal sites could result in the introduction or spread of INNS. Non-native species have the potential to be transported into the local area on the hulls of the vessels if they have operated in other water bodies, as well as ballast water which can transfer organisms from one water body to another. However, the vessels involved in the proposed beneficial use disposal activities will not be carrying ballast water and, therefore, there is no risk that non-native invasive species will be transported via this pathway during the proposed works. Furthermore, given the vessels undertaking the work are based in the Lymington Estuary, or wider Solent, the risk in terms of introducing or transferring INNS is considered to be minimal and, if necessary, can be managed through a risk-based Biosecurity Plan.

Consequently, the probability of the introduction and spread of INNS is considered low and it is not expected to lead to a deterioration in status of the Lymington transitional, or Solent coastal water bodies, nor prevent these water bodies from meeting future WFD objectives.

E.6 Conclusion

Based upon the information presented within this WFD compliance assessment, and considering the additional information presented in the Environmental Appraisal, it is concluded that the proposed beneficial use disposal sites are not likely to have a permanent (i.e. non-temporary) effect on the status of WFD parameters that are significant at water body level. Therefore, deterioration to the current status of the Lymington transitional water body or the Solent coastal water body is not predicted, nor a prevention of these water bodies achieving future WFD status objectives.

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