

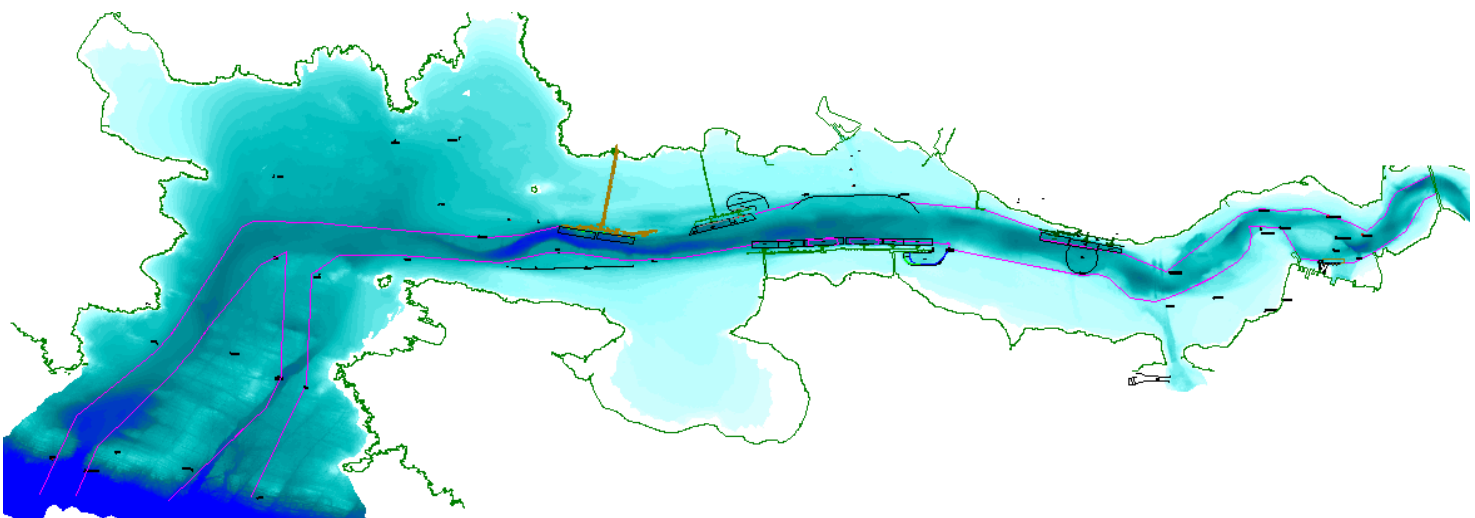


**MILFORD HAVEN PORT AUTHORITY**

**DREDGING  
STRATEGY DOCUMENT**

**Revision 3**

**October 2021**





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## Document Register

Document Name	Date Issued	Issued to	Issued by
MHPA Maintenance Dredging Strategy Document 1 <sup>st</sup> Draft April 2008.doc	08/05/2008	Dave Levell	Martin Maloney
MHPA Maintenance Dredging Strategy Document 2 <sup>nd</sup> Draft June 2008.doc	11/06/2008	Dave Levell	Martin Maloney
MHPA Maintenance Dredging Strategy Document. Final 3 <sup>rd</sup> July 2008	03/07/2008	Dave Levell, 4 hard copies for distribution and one CD	Martin Maloney
MHPA Maintenance Dredging Strategy Document. Final 3 <sup>rd</sup> July 2008	08/09/2008	MFA. One hard copy with licence application	Martin Maloney
MHPA Maintenance Dredging Strategy Document. Final 3 <sup>rd</sup> July 2008	18/09/2008	MFA. 12 copies on CD in pdf format	Martin Maloney
MHPA Dredging Strategy Document April 2009	20/04/2009	MHPA (AB,MCA, BH, DL)	Martin Maloney
MHPA Dredging Strategy Document March 2011. Rev1 1 <sup>st</sup> Draft	04/03/2011		Martin Maloney
MHPA Dredging Strategy Document July 2016. Revision 2	04/08/2016	NRW and MHPA (JM)	Martin Maloney
MHPA Dredging Strategy Document Oct 2021. Revision 3	19/10/2021		Martin Maloney



## **1. Introduction**

This is the 3<sup>rd</sup> revision of the 'Dredging Strategy Document' for Milford Haven. The original was provided to the Marine and Fisheries Agency in September 2008 as 'Maintenance Dredging Strategy Document' and was subsequently revised in March 2011 in connection with the new disposal licence application at that time and was renamed 'Dredging Strategy Document'. That document was provided to the Marine Consents Unit of the Welsh Assembly Government along with the 2011 license application. The document was again revised in August 2016 to support the renewal of the maintenance dredging disposal license.

The purpose of this document is to establish a baseline of dredging related information that can be used to inform relevant authorities on the history of dredging within Milford Haven as well as setting out the anticipated maintenance dredging requirements within the Haven, (10 years period from 2022 to 2032). It is intended that this document be used in connection with sea disposal applications under the Marine & Coastal Act for the sea disposal of all dredging risings from within the Milford Haven waterway.

Although this document is predominantly focused on maintenance dredging activities it is also intended that it be used in conjunction with any future capital dredging works that may be required, as such any reference to dredging should be taken to mean maintenance or capital dredging works, unless otherwise stated.

It is the aim of Milford Haven Port Authority (MHPA), on behalf of all relevant bodies, to manage all dredging operations within Milford Haven in a responsible manner and to give due consideration to the conservation objectives of the Pembrokeshire Marine Special Area of Conservation (Pembrokeshire Marine SAC). To achieve this, MHPA has formulated a strategic approach to dredging, which provides the necessary framework for this to be achieved. The basis of this strategic approach includes the following activities:

- i) Production of this Dredging Strategy Document.
- ii) Formulation of a formal Dredging Liaison Group of key participants.
- iii) Establishment of a regular survey regime to monitor sedimentation.
- iv) Formulation of a suitable GIS system for archiving information.
- v) Production of dredging related Appropriate Assessments as required.
- vi) Regular liaison with other relevant bodies regarding dredging matters.
- vii) Undertake environmental monitoring where considered necessary.
- viii) To update the strategy as new knowledge becomes available.
- ix) Obtain the necessary NRW licences and adhere to their conditions.
- x) Appoint only responsible dredging contractors on all dredging works.
- xi) Develop a 'Best Practice' approach to dredging and disposal activities.

In line with these aims, MHPA applied for and obtained a long-term (5year 2011-2016) disposal licence covering the known maintenance dredging requirements of those bodies participating in a group approach to maintenance dredging. These areas all fall within the jurisdiction of MHPA (See Figure 1 located at the end of this document). That license was renewed



in 2017 for an additional 5 years up March 2022. It must be pointed out that there is no obligation on any individual marine operator to participate in this strategic approach to dredging; some may choose to operate independently from it. However, any dredging application will need formal approval from MHPA to undertake dredging works and as such will fall under the umbrella of the framework created by this strategy document. MHPA desires to incorporate as many bodies as possible into the strategy. To date, no bodies have opted to operate outside of the framework offered by MHPA.

MHPA have applied for a renewal of the maintenance dredging disposal licence, valid for 10 years from 2022 to 2032, for the maximum permitted deposition volume of 250,000m<sup>3</sup> in any one 12 month period at sites LU169 and also LU168. The maximum total quantity licensed for disposal at the sites during the validity of the licence will therefore be 10 x 250,000m<sup>3</sup> = 2,500,000m<sup>3</sup>. However, the actual quantity of maintenance material dredged over the 10year period will be considerably less than this, as set out later in this document. The reason for this apparently large annual quantity is that MHPA wishes to retain flexibility within the dredging strategy to enable at least two large dredge campaigns to be carried out at some point during the 10-year validity of the licence. It is very likely that some years will require no disposal at all, as has happened historically. It is anticipated that the overall requirements can be refined on an ongoing basis to enable more precise information for all new disposal license applications.

The need for a Dredging Strategy came about partly as a desire to support and provide direction on dredging, and related matters, within the Management Scheme for the Pembrokeshire Marine Special Area of Conservation (SAC) and also as a result of discussions between MHPA, the then MCU and CCW (now both part of NRW) regarding longer-term strategic planning requirements for offshore disposal arrangements.

Milford Haven is located within the Pembrokeshire Marine SAC (See Figure 2 located at the end of this document) and any new plans or projects within the waterway are subject to specific regulation under the **Habitats Directive** 92/43/EEC of 21 May 1992 on the Conservation of Natural Habitats and of Wild Fauna and Flora (the 'Habitats Directive'), as transposed by the Conservation of Habitats and Species Regulations 2017 (as amended) and retained in UK law following the UK's withdrawal from the European Union by the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 (the 'Habitats Regulations'). One of the key factors concerning the designation of the Pembrokeshire SAC, and the operation of major industrialised port facilities within its limits, was the acknowledgement that those activities that existed, or took place before the designation of the SAC, are considered to be 'ongoing projects'. The operation of the port, with the attendant maintenance dredging requirements, is an ongoing activity that was in place at the time of designation, and its impacts on the SAC features were acknowledged at the time of designation of the Site. The SAC Management Scheme states that unless otherwise qualified, the reference point for degradation of the conservation objectives is the date of submission of the site as a candidate SAC, (1997). In circumstances where degradation was already identified as being unacceptably high, the conservation



objectives seek to restore the features to a reduced, acceptable level of degradation. One such activity that will continue to take place is the maintenance dredging of those areas that were created and maintained by mechanical dredging activities prior to the designation of the site.

The strategic approach to the maintenance dredging needs of Milford Haven is, for the sake of prudence only, being considered as a new plan and as such is subject to Appropriate Assessment (AA). As such an Appropriate Assessment has been produced in association with this document. The AA is periodically revised as the needs arise.

The Pembrokeshire Marine SAC was formally included on the European Register on the 27<sup>th</sup> June 2005. For the purpose of this Dredging Strategy Document 'designation' is taken to be at the point in time at which the site was submitted as a candidate SAC, which was October 1997. (The site was originally proposed as a candidate SAC under the "Pembrokeshire Islands SAC" in 1995). Any project or plan that was in existence prior to this date is accepted as being ongoing and is therefore subject to the same legislative framework under the Habitats Directive.

This document will set out those areas, within MHPA's limits, that have been dredged in the past and may require some form of dredging to maintain navigable depths, the safe operation of the port and its associated facilities. This includes maintenance dredging and capital dredging.

It is not the purpose of this document to go into details regarding the legislation governing the SAC or to go into depth regarding the history of surveys, research and other studies covering a wide range of disciplines. Suffice to say that the Milford Haven Waterway is, arguably, one of the most widely studied coastal waterways within the UK. Of particular value are the three major review documents produced by Hobbs and Morgan (1992), Bent (2000) and Warwick (2006). A new detailed study of the seabed sediments in the entire Milford Haven waterway was commissioned by the Milford Haven Waterway Environmental Surveillance Group in 2012. A brief background of the key matters of these documents has been included in this document in order to set out the basic foundations on which the present-day approach to dredging and dredge disposal in Milford Haven is based. Much of the research documentation and review material can be obtained via the Milford Haven Waterway Environmental Surveillance Group, which maintain a data archive.

## **2. Brief Dredging History within Milford Haven**

Milford Haven is a natural deep-water harbour located in South West Wales. It is one of the premier ports in the UK, servicing a large proportion of the hydrocarbon needs of the UK and beyond.

Milford Haven has been used as a key strategic port for hundreds of years, both for fishing and for military purposes. In the early 1950s, the leading oil companies at the time identified Milford Haven as being a prime location for the development of deep water facilities to receive crude oil carriers and the development of a major oil port. Until that time, only vessels up to 100,000



tonnes could safely navigate the natural deep-water channel. The Milford Haven Conservancy Board, later to become the Milford Haven Port Authority, was created by an Act of Parliament in 1958 (Milford Haven Conservancy Act, 1958 and subsequent acts).

Phase I of the channel improvement program commenced in 1965. That development involved the deepening, by dredging, of the natural deep water entrance to the Haven close to St Anne's Head. The work involved the removal of approximately 310,000m<sup>3</sup> of seabed material, consisting of rock, gravel and sand. The dredged material was all deposited at the disposal site just outside of the Haven referred to as LU170 (See Figure 3 located at the end of the document).

Phase II of the channel improvements commenced in 1970 and involved the widening of the natural entrance channel at St Anne's Head and also the straightening of the channel by the removal of some of the deep channel meanders within the Haven, predominantly in the vicinity of the ESSO terminal (now South Hook LNG). The second phase of dredging resulted in the removal of approximately 1.1million m<sup>3</sup> of material. The material was also all deposited at the site just outside the Haven referred to as LU170. The two dredging campaigns permitted the safe navigation of the deep water channel by vessels up to 250,000tonnes.

The oil-related industrial activity continued to expand following the construction of the first wartime oil storage facility at Llanreath, and post-war oil storage and jetty at East Llanion. The Angle Bay oil terminal, tank farm, and oil pipeline to the BP refinery at Llandarcy were commenced in the late 1950s. The main construction activities, which have involved dredging within Milford Haven can be summarised as follows:

- 1888 Milford Docks Constructed
- 1939 Newton Noyes Jetty Constructed
- 1960 ESSO Refinery Opened, (closure 1983)
- 1961 BP Terminal opened, (closure 1985, Texaco take over berths)
- 1962 MHPA Jetty Construction
- 1964 Texaco Refinery Opened (Now Chevron)
- 1967 Phase I Channel Improvements Commenced
- 1968 Gulf Refinery Opened, (Now Semlogistics and formerly Petroplus)
- 1969 Phase II Channel Improvements Commenced
- 1970 Phase I Channel Improvements Completed.
- 1971 CEGB Power Station Commissioned, (closed 1997)
- 1971 Pipeline from Gulf Oil to Pembroke Powerstation Constructed
- 1971 Phase II Channel Improvements Completed
- 1972 Texaco to ESSO branch pipeline constructed across Haven
- 1973 Amoco Refinery opened, - (Now Puma formerly Elf, TFE, Total & Murco.)
- 1974 ESSO Expansion Berths 3 & 4 Construction
- 1979 RoRo Terminal Pembroke Dock (B&I)
- 1985 Westfield Pill (Neyland) Marina
- 1986 Port of Pembroke Construction
- 1988 Irish Ferries Pembroke Dock Expansion



1990 West Lanion Pill Dredging  
1993 Coshaston Pill Channel Dredging  
1998 PDFT RoRo Link Span Terminal Upgrade Completed  
2006 South Hook Channel Widening  
2006 Wear Spit Channel Widening  
2008 Semlogistics Berth 3 Deepening  
2009 Construction of new Pembroke Power Station (PPS) commenced  
2010 Re-dredging of PPS intake and outfall channels commenced.

The locations of the above projects and their approximate areas of impact are shown in Figure 4 (located at the end of this document).

No significant construction activity has taken place in the Haven since 2010.

The Milford Haven waterway has comparatively low natural suspended sediment loading within the water column, (typically in the range of 10-50 mg/l.). Significant areas of intertidal and sublittoral fine sediments occur within the numerous inlets and bays throughout the waterway. Compared to most of the turbid waters of the east-coast estuaries and ports, the requirement for routine maintenance dredging, due to siltation, within the lower industrialised waterway is low.

Since the original capital dredging activities associated with the above projects were completed, many areas have been subject to natural sedimentation. The removal of these sediments, by maintenance dredging, has been required periodically in order to restore the required navigation depths. The rate of sedimentation within the Haven varies greatly depending on the location. Historical records have been used wherever possible to acquire an indication of the sedimentation rates in specific areas. These records consist of documentation, disposal returns or archived Hydrographic surveys. The tables in the Appendix show the volumes of material dredged throughout the Milford Haven waterway on a year on year basis covering the period from 1985 to October 2021.

### **3. Brief History of Pembrokeshire Marine SAC Designation**

*(Source Pembrokeshire Marine Special Area of Conservation Management Scheme, Dec 2007)*

*“Special Areas of Conservation designated under the Habitats Directive, and Special Protection Areas (SPAs) designated under the complementary Birds Directive to protect wild birds, collectively form a network of protected sites across Europe called Natura 2000. SACs and SPAs cover both terrestrial and marine environments. Where they include the sea or the foreshore, they can also be referred to as “European Marine Sites”. There are over 60 SACs within the UK that are marine or have a marine element. Sizes of sites vary, as do the number of habitats and species for which the sites have been chosen. It is important that any management of a European Marine Site gives due regard to the conservation requirements of other adjacent or nearby Natura 2000 sites.*

*The seas around Pembrokeshire have long been recognised for their marine conservation importance. The area around Skomer was designated a Marine Nature*



*Reserve (MNR) in 1991. It remains Wales's only Marine Nature Reserve. Formerly, since 1976, it was one of the UK's first voluntary marine reserves.*

*The Pembrokeshire Marine SAC site was proposed in 1995 (then called Pembrokeshire Islands) for its reefs, estuaries, shallow inlets and bays and for its grey seal population. In 1997 the site was submitted to the EC and so became known as a candidate site. It is important to note that UK government and the National Assembly for Wales's policy ensured that candidate sites should be protected as though they were already designated.*

*In 1999, the lists of candidate SACs from each European Union member state within the Atlantic biogeographical region, including the UK, were reviewed at meetings convened by the European Commission. Following this review, the UK along with a number of other member states was asked by the EC to submit further sites, and to identify additional features of interest on existing sites.*

*The EC considered that the UK list of sites did not sufficiently cover about half of the many different habitat types and species listed in Annexes I and II of the Directive as requiring SACs, and that therefore additional sites for a number of habitat types and species should be identified by the UK. They also wished to see all Annex I/II habitats and species with a significant presence on existing sites listed as interest features of those sites.*

*The process of identifying the additional sites, and the additional habitats and species (often referred to as the 'moderation process') started in November 1999 and was completed by the end of 2000. Moderation requirements specifically relevant to this site were to:*

- *modify the existing candidate SAC site to include additional habitats and species from Annex I and II of the Habitats Directive,*
- *change site boundaries to better encompass existing features or to accommodate new features.*

*The moderation process resulted in a boundary extension to include the south-east Pembrokeshire coast, additional features being identified and a name change from "Pembrokeshire Islands" to "Pembrokeshire Marine". The list of proposed sites in Wales was agreed following discussion between Countryside Council for Wales (CCW) specialists and colleagues in the conservation agencies in England, Scotland and Northern Ireland and the UK Joint Nature Conservation Committee (JNCC) to ensure consistency across the UK. Following this there were discussions with the National Assembly for Wales and UK government departments to help ensure that the proposed revisions to the UK site list met the requirements of the European Commission.*

*In 2003 further amendments were made to the boundary in order to ensure consistency with UK conservation designations, in particular Sites of Special Scientific Interest (SSSI's). Pembrokeshire Marine, along with all other candidate SACs in Wales, was formally designated in December 2004."*

#### **4. Brief History of Milford Haven Offshore Disposal Sites**

Up until 1994 the majority of dredged material, both maintenance and capital, had been deposited at a licensed disposal site just outside Milford Haven, site LU170 (See Figure 3 at end of document). Since dredging first took place in Milford Haven several million cubic metres of material have been deposited at this site. The materials deposited covered a wide spectrum of soil



classification ranging from rock fragments from blasting, through gravels and sands to silts and clays.

Reports of unusually high turbidity around the Skomer Marine Nature Reserve (SMNR) in 1989, 1991 and 1992 culminated with the licensing body at that time (MAFF) suspending the use of site LU170 in 1994, pending the results of a detailed investigation into the potential impacts of dredge spoil disposal on the SMNR.

An initial study was carried out by ABPmer, in connection with the CEGB Pembroke Power Station proposal to burn Orimulsion. This study looked at the existing site LU170 and two other sites. The report concluded that Site F, later to be designated as site LU168, located 17km South of St Anne's Head, was the most suitable site for the disposal of the 1.65million cubic metres of capital dredge material associated with the development of the Orimulsion import terminal facility. CCW raised concerns about the findings of this report due to the low level of field validation data and also because the conclusions were inconsistent with CCW's field observations.

In 1997 a further study was commissioned by MHPA to consider the suitability of site LU168 for the disposal of dredged material. Environmental Tracing Systems Ltd (ETS) carried out the study. The conclusion was that LU168 was not suitable for the disposal of significant quantities of fine maintenance dredged sediment. As a result of these findings, MHPA instructed ETS to investigate a new disposal site. Following initial consultations, the site of the new investigation was chosen to be Site 1 (Later designated as LU169). The investigation showed that the disposal of fine dredged material at this location was unlikely to result in any significant impact on the Pembrokeshire Marine SAC and SMNR.

The licensing of site LU169 was granted with a precautionary note requiring additional investigation to be carried out during subsequent disposal operations. As a result, an additional tracer investigation was carried out during maintenance dredging in 2002.

A summary report was produced by ETS covering both surveys. The report is titled 'Review of Dredge Spoil Grounds F (LU168) and 1 (LU169)' dated August 2004. The basic conclusions of the study were:

- 1) Site LU168 would be suitable for the disposal of material with a particle size  $>250\mu\text{m}$  (0.25mm). There is no restriction on the quantity of material that can be deposited at this site.
- 2) Site LU169 can accommodate the disposal of 250,000m<sup>3</sup> of fine-grained dredge material in any one-year without resulting in any significant impact on the SAC or Skomer Marine Nature Reserve (SMNR). Site LU169 is also suitable for the disposal of courser dredge material.

## **5. The Disposal Agreement**

During the consultation period for the disposal licence application made in connection with the 2006 maintenance dredging (Ref No 32714/05/0) and the



South Hook capital dredge (Ref No 32660/06/0), discussions were held between MHPA, DEFRA (now MMO) and CCW to agree on the timing and the maximum quantity of material that could be deposited within the designated disposal sites, LU168 (near site) and LU169 (far site). The main factual references referred to during the discussions were:

- i) The report produced by Environmental Tracing Systems Ltd (ETS) "Review of Dredge Spoil Grounds F (LU168) and 1 (LU169)" dated August 2004.
- ii) The report produced by Hebog Environmental "Milford Haven Maintenance Dredging Assessment: Biological & Sediment Characterisation" dated December 2005.

As discussed in the previous section, the ETS study was carried out in order to identify new disposal sites following the discovery that the depositing of fine sediments at the original site (LU170) had the potential to impact the Skomer Marine Nature Reserve. Site LU170 is located just outside the mouth of the Haven (See Figure 3 located at the end of this document). The study involved, amongst other things, placing tracers within the hopper of dredgers working within Milford Haven in 1997, 1998 and 2002. The artificial fluorescent tracer particles, which were mixed within the dredge material deposited at the disposal sites were tracked and quantified by specialist sampling and detection equipment.

The Hebog study was commissioned by MHPA in order to comply with conditions set down in the 2002 Maintenance dredging FEPA disposal licence. The dredging at that time was for the Texaco (now Valero) and Petroplus (now VPOT & Dragon LNG) berths. The licence stated that a monitoring survey should be undertaken to establish the effects of maintenance dredging on the biology and sediment characteristics within the vicinity of the dredging operations at the two sites.

The 2006 maintenance dredging licence was awarded on the understanding that MHPA would look into the establishment of a long-term Dredging Strategy, which would facilitate the issuing of longer-term disposal licences, and incorporates all the maintenance dredging offshore disposal needs of Milford Haven. The aim of the strategy document being to set out the dredging needs of Milford Haven and to schedule the dredging requirements so as not to exceed the existing limitations established for the offshore disposal sites. Following the circulation of the initial Maintenance Dredging Strategy Document, in September 2008, consultations were carried out with CCW. CCW expressed the desire for the document to be expanded to cover all dredging needs within the Haven, be it maintenance or capital dredging. The subsequently revised documents have been expanded to include this additional requirement.

Maintenance dredging was carried out at Chevron and Pembroke Port in 2010. That dredging was carried out under an interim one year licence but within the original 5 year FEPA application, with the understanding that the 5-year strategic approach would be fully implemented and licences finalised



prior to the next maintenance dredging requirement in Milford Haven. The requirement was duly fulfilled and the first 5-year maintenance dredging disposal licence was issued on the 5<sup>th</sup> of September 2011 (11/48/ML). A new 5-year license was obtained from the Maine Licensing body of NRW in July 2016 and covered the period from March 2017 to March 2022 (DML1664). In October 2021 a new application was submitted for a new 10-year license to follow on from the expiry of the existing license in March of 2022.

## 6. **Appropriate Assessment**

Under the Habitats Directive, projects, plans or actions which have the potential to have a significant impact on the conservation objectives of any SAC, must go through the Appropriate Assessment procedure in order to determine whether the proposed plan or project, alone or in combination with other plans or projects, will affect the integrity of the site. If the Appropriate Assessment concludes that there is no likelihood of significant impact on the conservation objectives of the SAC, and does not adversely affect the integrity of the SAC, the project can usually go ahead. If on the other hand there are unavoidable potentially adverse effects, the project may not be permitted to progress unless there are considered to be imperative reasons of overriding public interest and, that compensation measures are put in place. The latter stage would involve the Secretary of State.

Appropriate Assessments have to be carried out by the relevant Competent Authorities. With regards to dredging activity, within Milford Haven's port limits, the Competent Authority is deemed to be MHPA. However, the offshore licensed disposal sites are outside the MHPA limits therefore the Competent Authority, with regard to the disposal of dredged materials, is deemed to be the Coastal Protection Act (CPA) licensing authority, which is now Natural Resources Wales (NRW) supported by CEFAS.

MHPA is seeking to obtain a renewal of the long-term (10-year) maintenance dredging licence for all those areas, operated by participating bodies, which are expected to require some form of maintenance dredging during this licensed period. To help streamline the process of the licensing of maintenance dredging programmes, within English ports, the adoption of a Conservation Assessment Protocol (formerly referred to as the Maintenance Dredging Protocol) has been put in place. The Protocol has not been formally adopted in Wales. However, the basic principles have been mirrored. It is intended that this document will meet the requirement of the Protocol should it be adopted by NRW. It should be noted that the Environment Agency (EA), as part of the programme of measures associated with the Water Framework Directive, has also developed a framework for navigational dredging and disposal of dredged sediments in transitional and coastal waters. This was progressed between EA, DEFRA, and sector representatives and led to the issue of best practice guidelines. The document '*Clearing the Waters. A user guide for marine dredging activities*', has been considered by MHPA with regard to the AA in conjunction with this Dredging Strategy Document.

Any Capital dredging carried after October 1997 has been subject to Appropriate Assessment, as will any maintenance dredging of any new capital dredge areas. Capital Dredging has been defined, by the regulators,



as the dredging of any part of the seabed that has not been dredged before, or has not been dredged during the preceding 10-years. This arbitrary delineation has been proven<sup>1</sup> to be unfounded and therefore MHPA considers that Capital Dredging is the dredging of virgin seabed that has 'never' been dredged before. Any dredging in areas that have previously been dredged but not for more than 10 years will be defined as Infrequent Maintenance Dredging. Any dredging in areas that have been dredged with the previous 10 years will remain defined as Maintenance Dredging. This means that there are in essence only two definitions; Capital Dredging of virgin seabed and Maintenance Dredging or previously impacted seabed.

## 7. Licensed Offshore Disposal Sites

The locations of the disposal sites, as provided by the relevant licensing authorities, are defined by the following co-ordinates, which are given relative to **WGS84 datum** (GPS):

**Site LU168** is a polygon defined by the following limits:

51° 31.10' North 005° 10.75' West  
51° 31.10' North 005° 13.50' West  
51° 32.20' North 005° 13.50' West  
51° 32.20' North 005° 12.25' West

Since 2002 this site has only been used for the disposal of sediments with a D50 particle size >250µm. This site is located approximately 17km from the entrance to Milford Haven and is 20km SE of the Skomer MNR. (See Figure 3 located at the end of this document).

**Site LU169** 51° 35.0' North 005° 37.0' West

Within a circle of radius 0.5Nm centred on the above co-ordinates.

Site LU169 has been used for the disposal of dredge material during previous maintenance and capital dredging campaigns. The centre of the disposal site is located approximately 34km SW from the entrance of the Milford Haven and is situated 6.5km outside the southern boundary of the Pembrokeshire Marine SAC site. (See Figure 3 at end of document)

## 8. Methods of Dredging

There are several methods of dredging used in the marine industry. Most dredging plant can be used for maintenance or capital dredging. However, the choice of plant is dependent on environmental conditions such as material hardness, site exposure, disposal methods and the quantity of material to be dredged etc.

Where the material is characterised as soft, such as unconsolidated silts, sand or gravels, the most cost-effective and efficient method of dredging is usually with a Trailer Suction Hopper Dredger (TSHD). This is generally the

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<sup>1</sup> Murco - Maintenance or Capital dredging Report 2012\_10\_10



case for maintenance material but can also be the most appropriate tool for the capital dredging of such material.

Where the material is consolidated or characterised as hard or stiff, then other dredging methodologies may be required, such as a backhoe or cutter suction dredger. Where very hard rock has to be removed the material may have to be 'pre-treated' before being made suitable to be dredged by one of the other methods mentioned earlier. This may involve impact fracturing or even explosives, as used in the capital works during the initial channel widening and deepening in the early 1970s.

As maintenance dredging involves the removal of sediment deposits, following dredging of virgin material, they are generally unconsolidated in nature, which - subject to access - typically makes them suitable for removal using a Trailer Suction Hopper Dredger (TSHD) or a Grab Dredger. Some shallow areas or locations with restricted access may not be suitable for the use of a TSHD, in which case a different method may have to be adopted to raise the material from the seabed. These other methods could involve the use of a backhoe dredger, grab dredger, cutter suction dredger or material relocation using a Plough to a location where it can be accessed and removed by one of the other dredging methods referred to above.

Infrequent maintenance dredging (over 10 years since last dredged) will usually involve soft or fine sediments that will have had a longer period to consolidate. This may make the material slightly more resistant to dredging using a TSHD but it is expected that most materials that deposit following an original capital dredge will be able to be dredged using a TSHD or grab dredger. If the material proves resistant to these methods one of the other types of dredging plant discussed above will be able to dredge the material. Discussion in this document concerning the dredging of Maintenance material is also applicable to the dredging of Infrequent Maintenance material.

There are three distinct elements to any dredging operation with marine disposal, these are:

- A) The raising of marine deposits from the seabed.
- B) The transportation of the dredged material, by ship, to the offshore disposal sites via the Milford Haven Estuary
- C) The disposal of the material at sea by emptying the hopper.

### **8.1. Trailer Suction Hopper Dredger**

The majority of maintenance dredging activity, and some capital dredging, carried out in Milford Haven has historically been undertaken using Trailer Suction Hopper Dredgers (TSHD). The sediment is raised to the surface by suction. The suction plant is contained within a dedicated vessel. A pipe is lowered through the water column into the sediments. Suction is then created in the pipe by the rapid rotation of an impeller drawing sediments and water into the pipe. The mixture of sediment and water then passes through the pump and into the hopper of the vessel via a sequence of sealed pipes. If the material is resistant to removal by suction alone then water jets may be employed at the lower end of the pipe to fluidise the sediment as the suction head passes over it. The vessel will travel over the area to be dredged at a



very slow speed, typically less than 2 knots. As the vessel progresses, the suction head passes over the area requiring dredging producing a trench in the sediment. Successive passes over the area result in the total removal of all sediments above a specific level. The dredge master monitors the depth of the suction head at all times to ensure that the required level is not unduly exceeded.

The dredged sediment is raised to the surface by hydraulic action and stored within the hopper of the vessel. Once the vessel is full of a mixture of sediments and water the dredging process may continue in order to increase the sediment to water ratio in the hopper. This is achieved by allowing the surface water, in the hopper, to overflow through a dedicated weir system within the hopper. The optimum period of the overflow will depend on the particle size and density of the material being dredged. Where soft mud and silt are being dredged there is usually very little to be gained by extended periods of hopper overflow, as the dredging action puts a high proportion of the fine sediments into suspension, creating dense slurry, from which the solids will not settle out of suspension during the dredging operation. If overflow is permitted when dredging fine silts the hopper load will not increase significantly, as the density of the material overflowing will be similar to the density of the material being dredged from the seabed. This is not the case when dredging sands and gravels, which typically contains a low percentage of finer material. The use of the overflow when dredging coarse material can safely be permitted for some considerable time without causing significant impact on water turbidity levels, as the sand settles to the bottom of the hopper and only the supernatant water flows out of the overflow weir. The use of overflowing, or weiring as it is sometimes called, when dredging sands and gravels results in a more economic and efficient dredging operation as the load is maximised prior to the vessel departing to the disposal site. This is a very important consideration in Milford Haven as the offshore disposal sites are a significant distance from the port (LU169 = 35km). To transport a hopper load that contains a high proportion of water is very inefficient, both environmentally and economically. By maximising the load the CO<sup>2</sup> emissions associated with each m<sup>3</sup> of dredged material is minimised. The trade-off between local turbidity, the overall environmental impact of the whole process and the financial cost all have to be taken into account when formulating a 'best practice' approach to dredging.

Once the hopper is full, dredging stops and the suction pipe is raised to the surface and stowed on the deck of the vessel. The vessel sails to the designated disposal site under its own power. When the disposal vessel has reached the designated licensed disposal site the doors at the bottom of the hopper are opened and the contents of the hopper are discharged. Once the hopper is empty and flushed clean, the vessel closes its bottom doors and returns to the dredging site on a reciprocal course.



Plate 1. The TSHD “Pinta” working in Pembroke Dock in 2016

## 8.2. Backhoe Dredger.

The excavating module of a backhoe dredger is almost identical to a tracked hydraulic excavator used on land. The main differences, apart from being mounted on a pontoon, are that they are usually relatively large machines often with the boom and stick extended to cope with the greater digging depth as required in many maritime applications. The largest machines can dredge 30m below water level and dig with a 40m<sup>3</sup> bucket in soft soils.

The dredged material is loaded, by the excavator, into dedicated barges. The barges can be either self-propelled or ‘dumb’. In the latter case, a tug is required to tow the barge to the disposal site (as used by Dragon LNG for their pile risings in 2007). Once the material is loaded into the hopper the disposal process is the same as for the TSHD.

Backhoe dredgers are not often used for maintenance dredging, as they tend to be more expensive to operate. However, there are circumstances where it can be cost-effective to use them. The maintenance dredging of the then Semlogistics berths and mooring dolphin approached (now VPOT and DragonLNG) were dredged using a large backhoe dredger in the winter of 2007/08 and again in 2015/16. Dedicated split hopper barges were used to transport the excavated material to the disposal site. More than one barge is usually required due to the very long distance from the dredge site to the offshore disposal site, LU169. One hopper barge is usually being loaded whilst another is transiting to and from the disposal site. The cycle time of each barge is approximately 6-hours. The reason that a backhoe was used at this location in 2007/08 was mainly that the maintenance dredging was carried out at the same time that capital works were required to deepen Berth No3



and that the deepening work required excavation using a large backhoe. A backhoe was also used in 2015/16 to dredge material from the inaccessible areas between the berths and the mooring dolphins at Semlogistics and also close to the fender piles at the Pembroke Dock Ferry Terminal (PDFT), which are both areas that a TSHD cannot easily access.

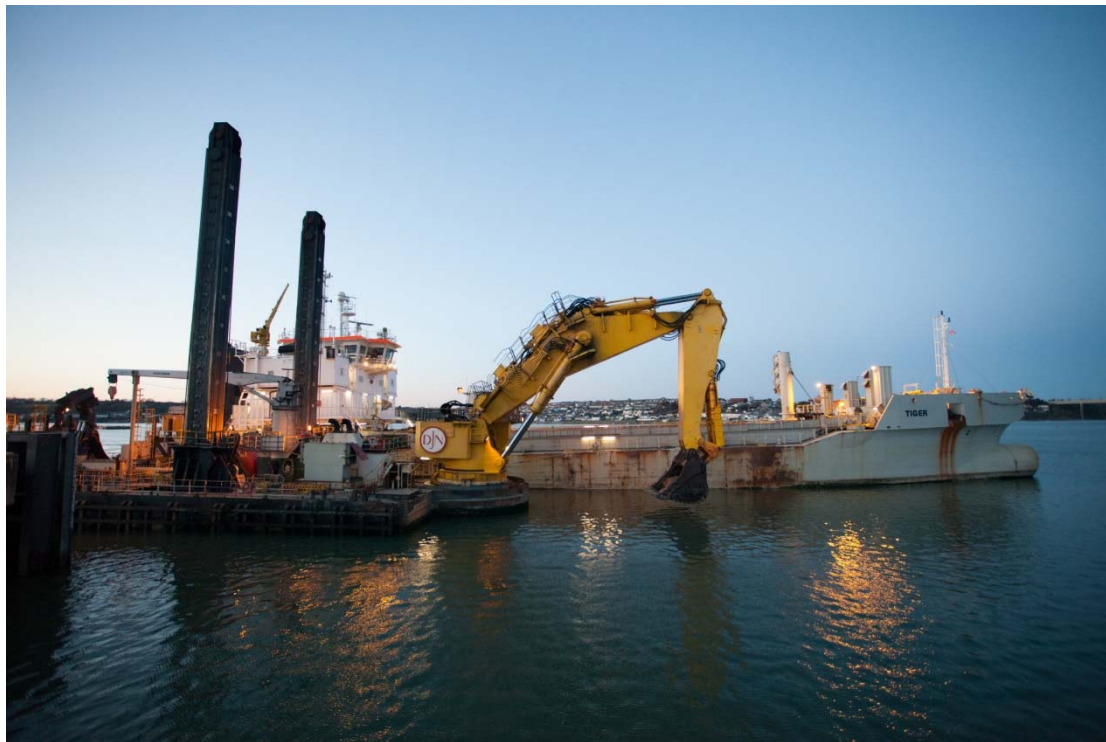


Plate 2. *The Backhoe dredger “Mimar Sinan” loading dredged material into the split hopper barge “Tiger” at the PDFT Milford Haven in February 2016.*

This same method of dredging was also used for the ‘capital’ dredging required in association with the new Pembroke Power Station development. Although, at the time, the regulators classified this particular dredging as ‘capital’ dredging it was in fact infrequent maintenance dredging. Due to the closure, and subsequent demolition of the old power station, maintenance dredging had not been carried out for over 10-years and hence was classified as ‘capital’ works by the regulator. The main reason that a backhoe was considered the most suitable plant for that particular dredging was due to the shallow nature of the site. Backhoe dredgers and their associated barges generally have much shallower draught limitations compared to a TSHD and are therefore less prone to tidal restrictions. Maintenance dredging of the outer portion on the intake approach channel of the power station was successfully carried out by a shallow draught TSHD in January 2016 (See Plate 3).



Plate 3. TSHD 'Pinta' dredging in Powerstation intake channel in January 2016.

There are occasions with confined areas where it is not possible to fit both the backhoe and the associated hopper barge into the area to be dredged. Where this occurs it is sometimes necessary to relocate material with the backhoe by placing the dredged material back on the seabed further out from the confined area where it is re-dredged and placed into the hopper barge once it can fit alongside the backhoe.

### 8.3. Cutter Suction Dredger.

A cutter suction dredger (CSD) incorporates a rotating crown cutter head at the end of a suction pipe. The cutter head is used to slice (cut) the material from the seabed and thereafter it is pulled up through the suction pipe using the same process as a TSHD. The main difference between the CSD and other methods of dredging is that the dredged material is transported via a pipeline directly to the disposal site, either elsewhere at sea or more commonly to a reclamation or disposal area on land. On occasion, the dredged mixture can be loaded into barges for disposal elsewhere but this is generally considered to be inefficient due to the relatively high percentage of transportation water required to maintain a steady flow of slurry through the pipeline.

This method of dredging is not suitable for the vast majority of dredging in Milford Haven. However, it is used at Neyland Marina to maintain a navigable depth. This method of dredging is only practicable at Neyland as the marina operators have a dedicated disposal site located just outside the entrance to Westfield Pill in the main haven. The dredged slurry is transported from the dredger to the disposal site in one continuous pipeline. The rate at which material can be deposited at the disposal site is strictly defined in the disposal licence for that operation. No other parties are permitted to use this dedicated disposal site at present.

It is possible that a CSD may be used for dredging in Milford Haven in the future as it is a method of dredging that is well suited to dredging in shallow areas, such as Pembroke Power Station or the VPOT/Dragon and Valero



mooring dolphin approaches. In these cases, the material will either be pumped via pipeline to a shore disposal site or to a dedicated hopper barge for offshore disposal.

Cutter suction dredgers come in various sizes, the largest of which are capable of cutting and transporting solid rock. They are particularly efficient at transporting material short distances (<2km) from a dredge/winning site to the disposal/reclamation area, as the excavation is almost continuous and does not require the interruption to the dredging process as that associated with a TSHD. Longer pipeline lengths/distances can be achieved with an auxiliary in-line booster pump(s).

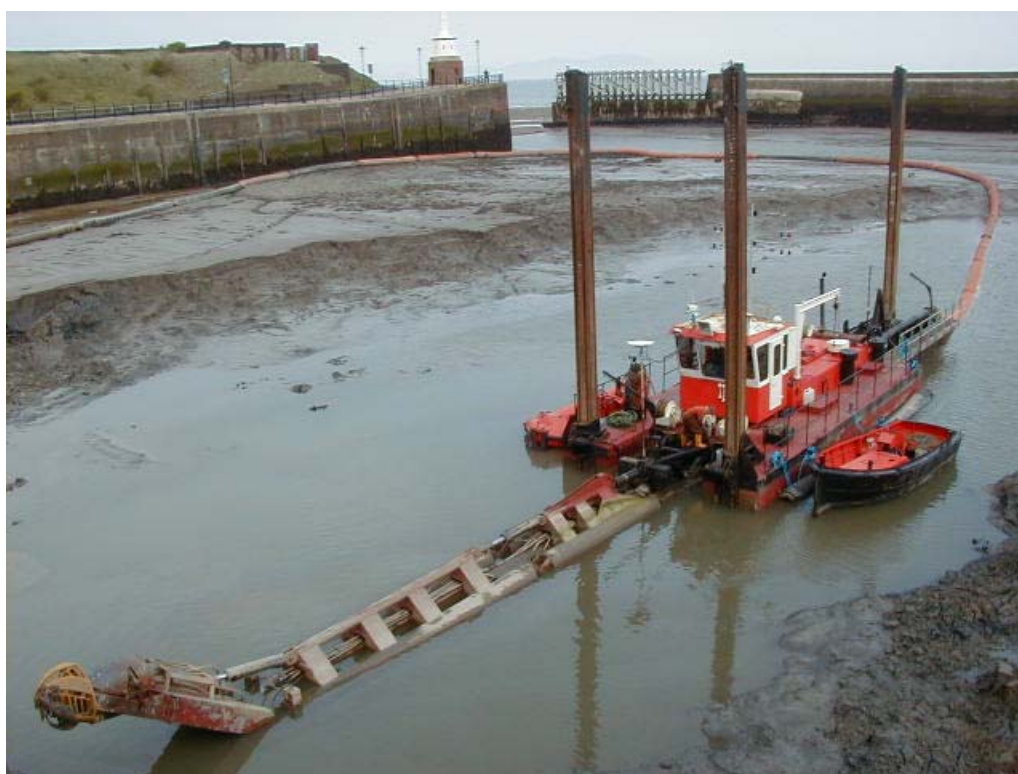


Plate 4. A small Cutter Suction Dredger working in a shallow channel. The discharge pipe can be seen trailing out behind the vessel.

Due to the suction orifice being located within the cutter head crown the vast majority of disturbed material is sucked up into the discharge pipe. With the correct operation, the release of suspended sediments into the local environment can be kept to a minimum.

#### 8.4. Grab (or clamshell) Dredger

Grab dredgers usually consist of a wire operated crane fitted with a clamshell type bucket. Often the vessel, on which the crane is mounted, also includes a hopper into which the dredged material is loaded. This enables the vessel to both dredge and transport the dredged material to the disposal site. Grab dredgers can be used in silt, loose sand, some types of clay, gravel, cobbles and occasionally broken rock. They are not particularly effective in fine silts, unless cohesive, because soft fluid material tends to run and spill from the bucket, especially in strong currents.



One advantage of grab dredgers is their ability to dredge in fairly deep water and also their ability to carry out spot dredging, either to remove isolated areas above the design level or to remove material that is located close to dock walls and in corners that may be inaccessible or difficult for other types of dredging plant to access. Subject to the type of material dredged, they have moderate to low production rates. Grab dredgers are generally stationary while dredging and are fixed at the excavation site using anchors, or spuds.



Plate 5. Grab hopper dredger “Cherry Sand” working inside a dock

The above grab hopper dredger was used in Pembroke Dock in June 2020 to remove sediments that had accumulated within Berth2. Some of the material to be removed was located at the inner end of the berth, which was very difficult for another dredger type to access.

### **8.5. Ploughing.**

A TSHD dredging spread often includes a ‘Plough Vessel’ (or Bed Leveller), which can be used to relocate sediment from inaccessible areas to a location where the TSHD can access it. A plough consists of an open bottom steel box with a blade on the front edge. The plough is lowered to the required depth and is then pulled, by the tug, over the desired area. The blade cuts into any shoal material, which has to be unconsolidated, and then catches it in the box part of the structure as it passes over the seabed. As the box has an open bottom, the material will fall out of the bottom as soon as the water depth increases beyond the depth that the plough is set at, creating a level bed in the area, hence the alternative name for this type of plant, ‘Bed Leveller’. This approach means that the material is only re-located a short distance from the shoal area as the plough does not have the ability to carry material, it can only drag it. By careful control of the plough depth, the impact on the seabed can be minimised and there is no need for the over dredging required by other more aggressive forms of dredging such as TSHD, Backhoe, Cutter Suction or Grab.



This method is often used close to jetty structures, or very shallow areas. For example, ploughing has been used extensively in the mooring dolphin approaches at Semlogistics (now VPOT), as the bed level in front of the mooring dolphins is less than 2.5m below Chart Datum (BCD) and is therefore inaccessible to all but the shallowest of TSHD. Historically ploughs have been used to pull the maintenance material into deeper water where the TSHD can then dredge it. Another area where ploughing has been used is in the approach channel to Milford Dock. The channel has been kept clear for many years by using a plough to relocate material into deeper water on Milford Shelf. This relocated material is then dredged during the next normal maintenance dredging campaign in the area. This same principle has been used in Pembroke Dock to relocate high spots, in the berth pockets, into deeper areas. This remedial relocation of material can successfully maximise available water depth while extending the period required between dredge campaigns.

Another important use of a plough vessel, in isolation, is the relocation of material from shallow areas into deeper areas within the close proximity of the shoal point, without subsequent re-dredging by other plant. This is a particularly effective way of re-establishing the safe navigation depths without the need to transport the material to a disposal site. The material is physically dragged from the shoal spot into deeper water where it is permitted to settle back onto the seabed. This method of dredging is usually only suitable for use where a small quantity of material needs to be removed, as production is generally very slow.

The above method of plough dredging was used in 2006 to move a small quantity of 'capital' material from the South side of the Channel in the area between the VPOT turning circle and the entrance to Pennar Gut. It is referred to in documentation as the 'Dragon Channel Widening'. This small quantity of material (<500m<sup>3</sup>) had to be removed in order to provide sufficient water to enable the Pembroke-Rosslare ferry to pass the Dragon LNG facility when there is a gas vessel moored alongside the berth. It had originally been intended to remove this material by using a TSHD and disposing of it at sea, but it was decided to attempt to relocate it using a plough first as the material was made up of soft sediments and some gravel/weathered rock. This approach proved successful. The environmental advantage of this method is that the material, and associated benthos is not necessarily lost, it is merely relocated in the same vicinity all be it highly disturbed. There will be a disturbance to the organisms on the seabed in the deeper water where the dredged material falls out of the plough.



Plate 6. A plough vessel pulling material from the toe line of a berth face to a location where the TSHD can access it.

## 9. Use of Dredged Material.

When dredged material is disposed of in any manner other than disposal it is classified as being put to 'beneficial use'. The 'use' of the material depends greatly on the chemical make-up and particle size of the material. In general, marine silts have very little 'use' and are therefore returned to the marine environment at designated disposal sites. Fine-grained silts are not suitable for use as engineering fill as the settlement and drainage properties usually render them unsuitable. The very high water content of the dredged sediment, combined with the poor drainage characteristics makes it impractical to transport the material by land-based plant and in addition, the low nutrient levels make it unsuitable to use as a top dressing on agricultural land. Dredged marine silts can be used for salt marsh replenishment or even establishment; however there are no requirements for this in, or close to, Milford Haven.

Coarse grained sediments, such as sand and gravel, do have other 'beneficial' uses. These include aggregates for the construction industry, engineering fill material and beach replenishment, amongst others. There are only two maintenance dredging areas within Milford Haven that have a significant coarse-grained particle size. These are Thorn Island and Mill Bay. UK Dredging carried out investigations in 1997 to assess the suitability of the material for other uses. The conclusion of the investigation was that neither site contained material that had any identifiable use and hence had no economic value, either due to fine particle sizes, as in the case of Thorn Island, or due to very high shell content, as was the case with the material at Mill Bay. It was identified that the particle size of the material at Mill Bay was  $>250\mu\text{m}$ , which meant that, under the original agreement with MMO, it was



suitable for disposal at site LU168 (Near site). The sediment samples are analysed and assessed with this in mind every 3 years.

In summary, the potential for the beneficial use of the maintenance dredging spoil from Milford Haven has been investigated and no suitable use has been identified. As a matter of course, the disposal options will be reviewed on a regular basis, as the disposal of material at LU169 is very expensive both in economic cost and also carbon footprint<sup>2</sup>, as a result of the long sailing distance to the site. If a more economic and environmentally sound alternative is identified the disposal options will be reviewed.

The disposal of any new capital material will be looked at in the same light. It is a requirement of the licensing process that alternative uses be investigated prior to the sea disposal option being utilised, this is referred to as the 'Waste Hierarchy'. All dredging operations, maintenance or capital, are therefore assessed to establish if there are other more suitable disposal options e.g. The drilled pile risings from the Dragon LNG refurbishment were assessed to see if they could be used as fill material on the site. However, the small volume, particle size variance and timing of the operation resulted in no suitable use being found. This material was however suitably course-grained and was deposited at the near site LU168. The capital dredging associated with both the Semlogiostic's Berth 3 deepening (2007/8) and the Pembroke Power Station dredging (2010/11) required the removal of material that was predominantly silt and therefore had no identifiable beneficial use. The material from both of these projects was deposited at LU169.

There are several useful reference document<sup>3</sup> on beneficial use of dredge material. These have been produced in order to promote a more sustainable approach to the re-purposing of dredged materials as oppose to sea disposal. This links into the waste hierarchy<sup>4</sup> has been produced by the '

#### **10. Impacts of Maintenance Dredging and Associated Monitoring**

The physical removal of material from the seabed, during maintenance dredging activities, will inherently have an impact on any organism within the sediments being removed. This direct impact on the seabed, in areas that were maintained by dredging before the designation of the SAC, is considered to be an ongoing activity that was in existence prior to SAC site designation. This means that the activity does not constitute a change or deterioration of the site integrity.

During the dredging process, there is the potential for indirect impacts on the surrounding environment. The primary process by which indirect impacts can occur, during maintenance dredging, is the potential for elevated turbidity levels as a result of re-suspended sediments being released into the surrounding water body. This in turn can lead to raised nutrient levels and

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<sup>2</sup> [http://randd.defra.gov.uk/Document.aspx?Document=ME1104\\_9384\\_TRP.pdf](http://randd.defra.gov.uk/Document.aspx?Document=ME1104_9384_TRP.pdf)

<sup>3</sup> MMO (2019). Use of dredge material in the north east; north west; south east and south west marine plan areas. A report produced for the Marine Management Organisation, MMO Project No: 1190, June 2019, 58pp Environment Agency (UK), 2010, Technical Report "on the beneficial use of marine sediments from capital and maintenance dredging in land-based projects". Waste and Resources Action Programme (WRAP).

CEDA (2019). "Sustainable Management of the Beneficial Use of Sediments." Information Paper

<sup>4</sup> Defra – Guidance on applying the Waste Hierarchy, June 2011



higher biological oxygen demand (BOD). This impact is considered to be inherent in the physical dredging process. However, MHPA has taken steps to minimise the potential for elevated turbidity levels as a result of maintenance dredging activities that have fallen under their direct supervision within the Haven. These mitigation measures are described in the following paragraphs.

There are three key areas where the dredging process may result in raised turbidity levels:

- i) During the physical dredging process.
- ii) During the transportation of material from the dredge site to the disposal site.
- iii) During the Disposal activity.

### **10.1. The Physical Dredging Process**

The physical dredging activity can result in raised turbidity levels in several ways. With regard to dredging by TSHD, the most significant is hopper overflow, which has been discussed previously in section 8.1. There is also draghead disturbance at the seabed/water interface. In shallow water, there is also potential for disturbance by propeller wash from the vessels own propulsion system as it manoeuvres.

Draghead disturbance, from a TSHD, is generally localised and is minor in nature. It is caused as a result of the physical contact of the draghead on the seabed as it is drawn across the dredge area. Water jets are sometimes required, in the draghead, to fluidise the sediments, which can improve the fluid transport properties of the dredged material up and through the dredge pipe. The seabed disturbance caused by the water jets is drawn into the draghead by the suction action of the impeller pump and should not result in any significant additional impacts on the surrounding turbidity levels. When dredging predominantly coarse-grained material the draghead impact will be negligible.

Elevated turbidity levels caused by the dredger's propeller wash will only be of potential impact when the dredger is working in very shallow water and the propulsion system is close to the seabed. Where this could represent a potential concern is for the maintenance dredging of Valero Berths 4&5, Pembroke Port, the mooring dolphin approach at VPOT and also at the Pembroke Power Station intake channel. MHPA have reduced the potential impact of this by requiring, within dredging contracts, that dredging in shallow areas should be avoided at low tide when the clearance between the hull of the dredger and the seabed will be at a minimum.

The use of CSD disposing back into the sea can result in significantly elevated turbidity levels as a result of the fluidised material being released into a mobile water body. The resultant turbidity from this process will generally stay close to the seabed if the discharge point is on, or close to, the seabed. This form of dredging and disposal has been used for several years at Neyland Marina, where a small CSD dredger deposits soft sediments from the marina, via its pump and pipeline, to a designated disposal site, in deep



water in the main Haven just outside the Marina entrance. (Note: The dredging and disposal activity of Neyland Marina is regulated by NRW and NRW is the Competent Authority governing the disposal process). In an effort to minimise localised impacts at the discharge point the disposal licence regulates the amount of material dredged/discharged on each tide. The timing is also restricted so as to minimise impacts at sensitive times of the year. This dredging activity has always been carried out independently from MHPA's other dredging activities and is likely to carry on in this manner for the foreseeable future. However, the operators of Neyland Marina are represented in the Milford Haven Dredging Liaison Group and their dredging activities are now included in related discussions.

Ploughing can also cause elevated turbidity levels as a result of the ploughs interaction with the seabed material. However, there is limited fluidisation during the ploughing process so turbidity levels are likely to be localised and restricted to the nearby environment unless carried out in an area with strong current velocities. This is unlikely in Milford Haven as the areas of high flow velocities are not areas of high sedimentation and hence do not require any dredging intervention.

Backhoe and grab dredgers will also cause localised raised turbidity levels as the loaded bucket or grab is lifted through the water column. As there is very little fluidisation of the sediments, contained within the bucket during this process, the raised turbidity levels tend to be localised and minor in nature.

The Hebog study conducted during the maintenance dredging of Texaco (now Valero) and Petroplus (now VPOT/Dragon) in 2002, recorded that the sediment plume created by the dredger, at the Texaco site, could be identified for approximately 1.5km upstream on a spring flood tide. Observation at the Petroplus site indicated that, on a spring flood tide, the sediment plume stayed close to the shore and was only visible for a distance of approximately 500m up current. It is not expected that this kind of plume will be created in future dredging activities as MHPA have taken steps to mitigate against the potential for this impact by contractually restricting hopper overflow. This ensures that the majority of the dredged mixture will remain in the hopper of the vessel. Excess water will not be released unless water densities are below a specified density (nominally 1.07t/m<sup>3</sup>) and this will usually be restricted to 'light mixture overboard' (LMO). This means that the dredge pump can be kept running when the suction head is not in contact with the seabed, this improves dredging efficiency and also means that the hopper is not filled with undue amounts of unnecessary 'clear' water. The adoption of this restriction has significantly reduced the creation of sediment plumes within the Milford Haven waterway. This restriction will remain under review as more scientific information becomes available regarding the impact, or lack of impact, as a result of short term intermittent elevated suspended sediment levels and associated deposition.

Sediment plume monitoring undertaken on behalf of MHPA during the 2006 and 2010 dredging, using a turbidity meter and associated water samples, showed that turbidity levels were 10-30mg/l higher than background levels at a point approximately 100m downstream of dredging operations. Turbidity



levels at 500m downstream of the dredging operation were 5-10mg/l higher than background levels. The dredging methods during both dredging campaigns adopted the restricted hopper overflow policy mentioned above. This small scale localised and short-lived elevation in turbidity levels is not considered to result in any significant impact on the features of the SAC and is well below natural variations that take place during inclement weather.

Sediment plume monitoring was also carried out during the maintenance and capital dredging at Semlogistic (now VPOT/Dragon) during the winter of 2007/2008. This dredging was carried out using a large backhoe dredger loading into split hopper barges. The results of the turbidity monitoring showed that suspended sediment levels remained relatively low and localised throughout the dredging campaign with no moderate or high levels recorded throughout the campaign duration of 3 months.

The 'capital' dredging of Pembroke Power Station (2007/8) also required monitoring to be carried out during the backhoe dredging operations. The results of this monitoring showed that suspended sediment levels were generally low with only occasional short-lived localised elevated levels close to the dredge site.

If dredging is carried out using TSHD methods the actual dredging activity will consist of discreet periods of dredging followed by much longer periods of no or low activity, as the TSHD travels to the offshore disposal site to deposit the dredged material. The loading cycle will last approximately one hour and the deposit cycle will last approximately 5-6 hours, based on the use of site LU169. Physical TSHD dredging will therefore only be conducted for approximately 4 hours in any 24hour period. If dredging is carried out using a backhoe dredger loading to barges, then the dredging activity will progress almost continuously but with a much smaller zone of impact at any one time, as the backhoe dredger will focus its activity in small discreet areas that are within reach of the excavator's arm at any one time. Due to the low levels of fluidisation, there will be lower levels of turbidity.

In shallow areas, such as the VPOT mooring dolphin approaches, the maintenance material may be re-located to deeper water by the backhoe or a plough vessel, for subsequent removal by a TSHD, or alternatively loaded directly into barges by backhoe dredging. Ploughing in shallow waters may result in raised turbidity levels, as there is the potential for combined interaction between the plough blade and the vessel's own propeller wash. The Hebog report of 2002 showed that this method of two-phase dredging did not result in any significant long-term effects on dredging-disturbed macrobenthic communities. It is likely that most future maintenance dredging campaigns will include the use of plough vessels.

Dredging has the potential to release nutrients and other contaminant hydrocarbons and heavy metals, which may be present in the sediment. Nutrients can become available for use by algae, which can grow in the water column, or over benthic substrate. Excessive growth of algae, particularly algal mats, can result in the ecological deterioration of marine and estuarine habitats and harm dependant species. Results based on data obtained



between 1996 and 1998 and summarised by MHWESG (1999) indicate that although hypereutrophication was present in the Haven there was little evidence of eutrophication.

Changes in oxygenation are likely to occur in the water column, as a result of increased biological oxygen demand (BOD) and chemical oxygen demand (COD) resulting from organic material and other chemicals being dispersed by the dredging process. This will also apply to benthic habitats, although the additional mechanism of reduced diffusion of oxygen through settled sediments will also apply to benthic habitats and species.

### **10.2. Transportation of Dredged Material**

There is potential for material to leak from the hopper of the transportation vessel while in transit to the disposal site. MHPA require that all vessels transporting dredged material to the disposal site have properly functioning hopper door seals. Under the dredging contracts, the contractor may be required to demonstrate that the hopper seals are functioning correctly prior to any dredging work taking place.

Given the very exposed nature of the disposal sites, it is possible that during rough sea conditions some dredged material may overspill the top of the hopper. This will usually only represent a small percentage of the hopper contents and will be from the top of the hopper where sediment concentrations will be at a minimum. Should circumstances prevail such that over spilling occurs, the vessel will be underway, which will result in a wide dispersion of the material resulting in high dilution and hence very low levels of resultant turbidity. The risk of any impact as a result of inadvertent hopper overspill is considered to be negligible.

### **10.3. Raised Turbidity Levels at Disposal**

The disposal of the dredged material at the offshore disposal sites will result in raised turbidity levels at the site, especially if the material is silty in nature. This is to be expected, and the locations of the disposal sites have been chosen so as to minimise the potential for any significant impact on the Pembrokeshire Marine SAC.

The findings of the ETS studies for disposal site LU169 suggested that fine silts deposited will be re-suspended during periods of high current flow or storm conditions. The fate of these sediments was tracked, during the above surveys, as discussed earlier in this document. It must be noted that the disposal site is designed to be a dispersive site, which means that it is not expected that anything other than the coarser fractions will be retained within the site for any extended period.

### **10.4. Macrobenthic Community Recovery Rates**

A review of dredging works in coastal areas worldwide showed that the rates of recovery of benthic communities following dredging in various habitats varied greatly (Nedwell & Elliot 1998; Newell, Seiderer & Hitchcock 1998). Knowledge of the population dynamics of the organisms that comprise the benthic community allows some estimates of the likely time-course of



recolonisation and recovery of benthic communities following cessation of dredging.

Recovery rates were most rapid in highly disturbed sediments in estuaries that are dominated by opportunistic species, (r-strategists). In general, recovery times increase in stable gravel and sand habitats dominated by long-lived components with complex biological interactions controlling community structure, (K-strategists).

The natural population of benthic organisms that inhabits mobile sands and sandy gravels comprises 'opportunistic' species that are well adapted for rapid recolonisation in deposits that are disturbed. In coarse stable deposits, however, the community is more complex and comprises 'equilibrium' components that have a slow rate of colonisation and growth.

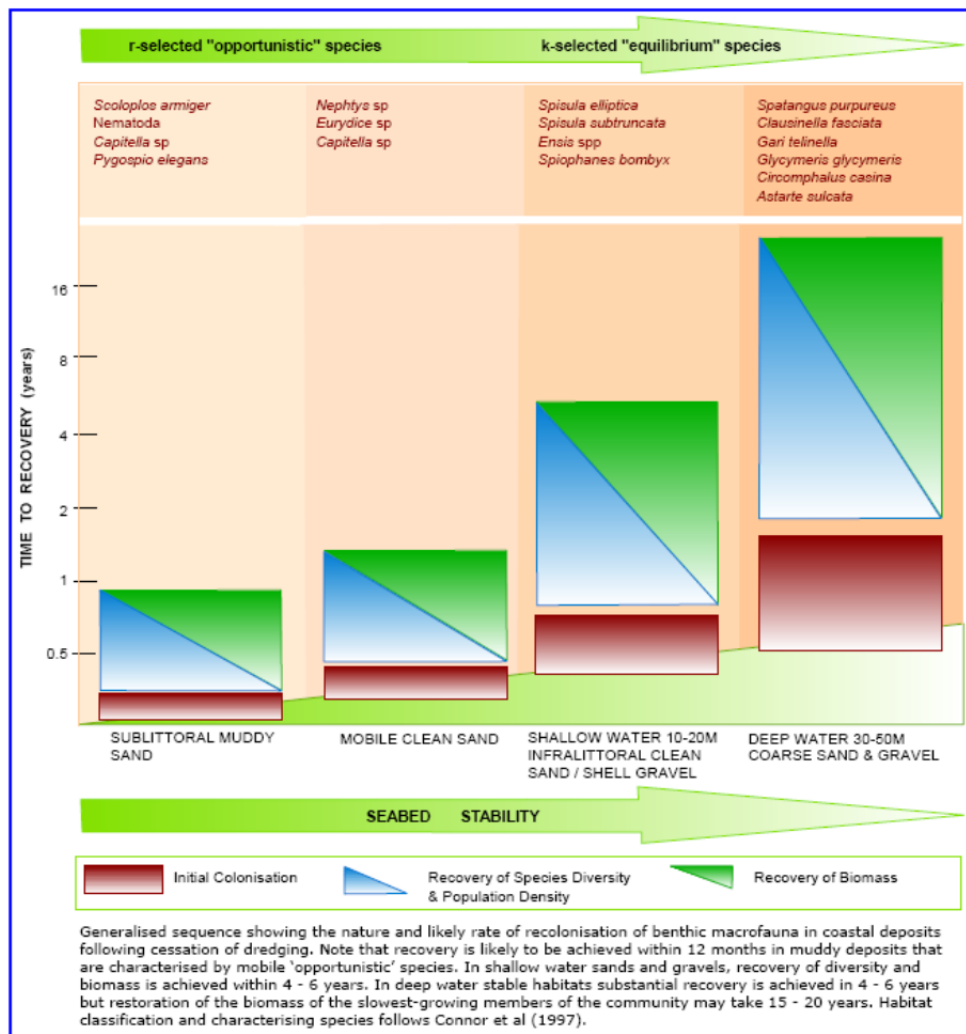


Figure 5 From: IMPACTS OF OVERBOARD SCREENING ON SEABED & ASSOCIATED BENTHIC BIOLOGICAL COMMUNITY STRUCTURE IN RELATION TO MARINE AGGREGATE EXTRACTION Sustainable Land-Won & Marine Dredged Aggregate Minerals Programme. SAMP.1.022, MESL, March 2004

The Hebog Environmental report on the full monitoring study undertaken as part of the 2002 maintenance dredging license requirements concludes that biological recovery appears to be relatively rapid with almost all sites having returned to at least 80% of their baseline values for diversity, abundance and biomass within 3 years. Physical recovery of most sites also appears to be



rapid, although some coarsening of sediment structure has occurred in a number of cases. Chemical contamination of sediments appears low. On the basis of the Hebog, Maintenance Dredging assessment it appears unlikely that maintenance dredging at these jetties, taken in isolation, will have a significant long-term impact on the nature of the benthic communities present.

The results highlight the tolerance of the benthic community in their study area to disturbance and suggest that regular disturbance is a factor in determining the macrobenthic community type present.

Most estuarine benthic fauna are likely to be transitional between r-selected opportunists and K-selected equilibrium species (McCall, 1976; Rees and Dare, 1993; Holt *et al.* 1995) recovery times following the dredging disturbance is likely to be quicker than if occurring in areas dominated by K-strategists.

Richard Warwick (2006) conducted an extensive review and analysis of Milford Haven macrobenthic data generated from a wide range of studies from 1974 -2005.

One of his general conclusions was that all the Milford Haven subtidal studies have higher than average values of average taxonomic distinctness compared with the UK sites in the NMMP study, suggesting that the biodiversity is not degraded in comparison with other coastal areas.

Warwick further expanded the analysis of the macrobenthic dataset from the Hebog Dredging monitoring studies 2002 – 2004 and his conclusions are particularly pertinent to the Maintenance Dredging Strategy.

Several multivariate analyses were conducted, the combined Multi-Dimensional Scaling (MDS) for the station mean abundances, within and adjacent to the berthing boxes of the Texaco [*now Valero*] and Petroplus [*now VPOT*] terminal jetties, for the pre-dredge survey in March 2002 and post-dredge surveys in April 2003 and April 2004 shows no obvious difference in the station relationships between years (Fig. 6). However, there are clear differences between impacted (dredged) and control (undredged) sites: Fig. 7 shows the impacted sites (except for station 7 in 2003 and 2004) clustered to the left of the configuration. A two-way crossed ANOSIM (control/impacted and years) reveals a strong and highly significant difference between the impacted and control stations, and no differences between years. This suggests that the differences do not result from the immediate effects of the 2003 dredging activity, but from the historical dredging activity from which the stations have not recovered.

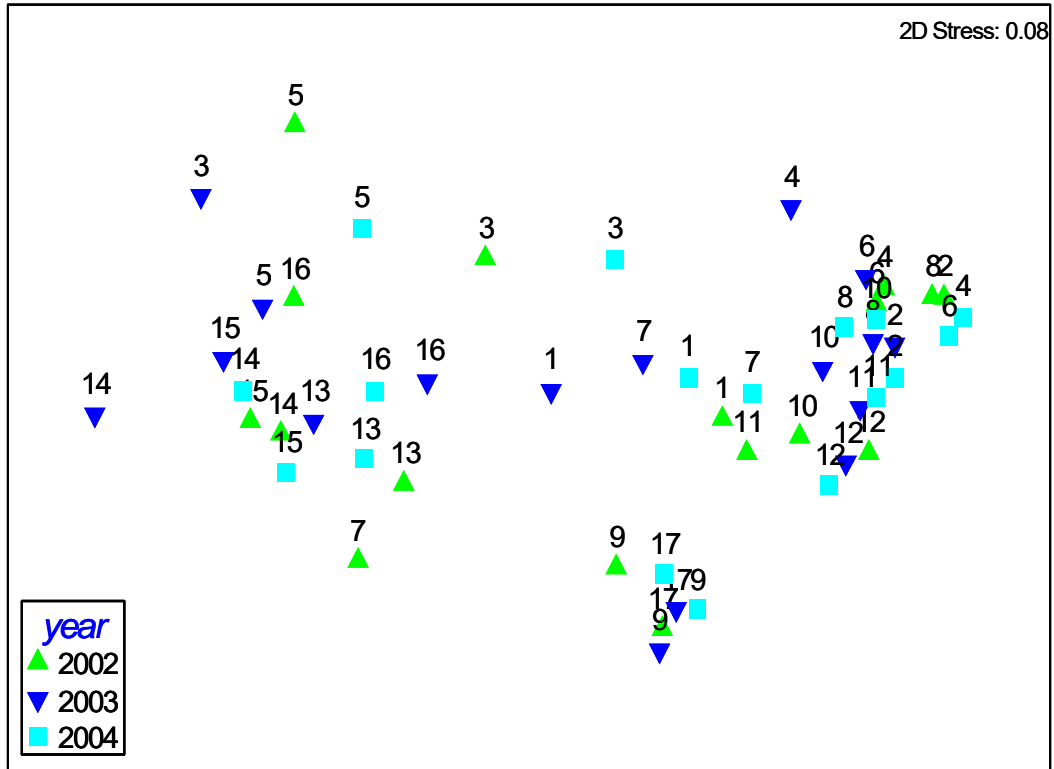


Figure 6. Combined MDS for all stations (labels) and years (symbols) for the Hebog Environmental survey.

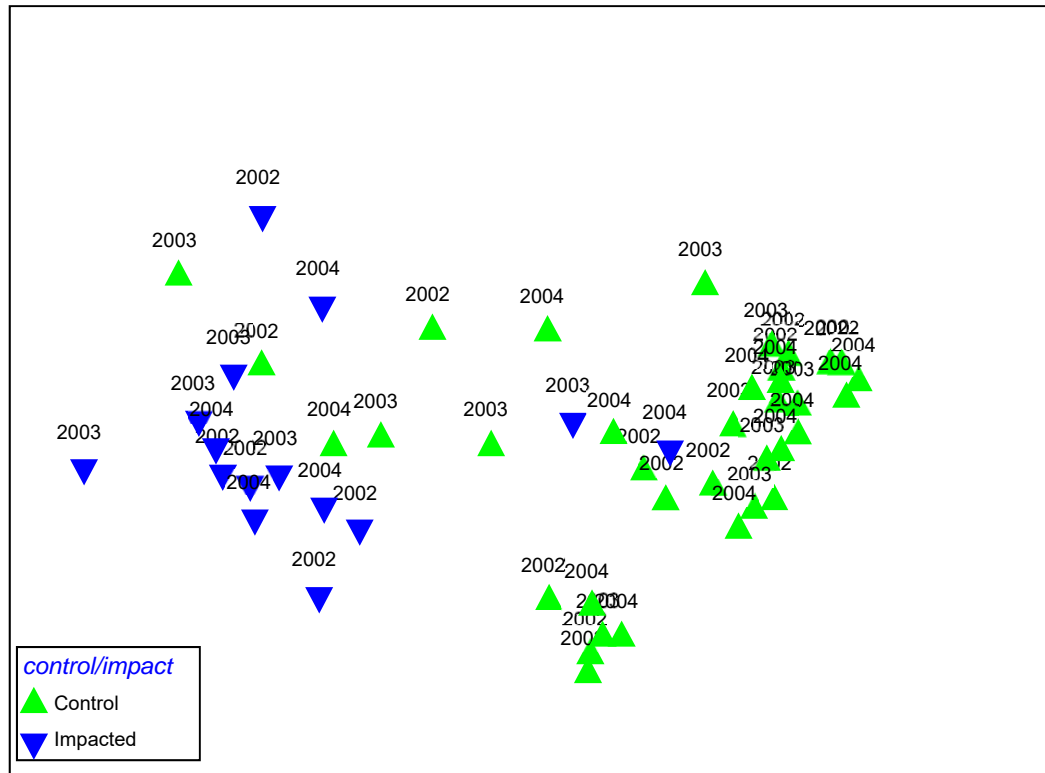


Figure 7. Combined MDS for all years (labels) and control/impacted status (symbols) for the Hebog Environmental survey.



The important point with respect to the Pembrokeshire Marine SAC is that the macrobenthic communities encountered within the areas of long-term, albeit intermittent, disturbance as a consequence of Maintenance Dredging are likely to be different from the non-disturbed communities, and are likely to have been so prior to the SAC designation in 1997.

### **10.5. Monitoring**

Following the initial studies associated with the investigations of the disposal site, by ETS, there has been no formal requirement for any additional monitoring to be carried out in association with the disposal activity. However during the consultations between MHPA, DEFRA and CCW, in association with the 2006 disposal Licences, CCW raised concerns that there was potential for silts deposited at LU169 to be re-suspended and ultimately re-deposited in St Brides Bay. As a result, MHPA agreed to undertake a limited amount of Benthic and particle size sampling. The specification for this sampling was provided by CCW. It was initially intended to undertake 2 surveys, one prior to the commencement of disposal activities in 2006 and another following completion of dredging. The first survey was carried out in January 2006 and was intended to form the pre-dredge survey. However, a delay in the issuing of the disposal licences meant that the dredging was delayed until the summer, as a result MHPA decided to repeat the benthic survey in June 2006 immediately prior to the commencement of dredging activities. The post dredge benthic sampling was conducted in March 2007 as MHPA took the opportunity of the equipment being on-site to extend the scope of the sampling to include the discrete sampling of the Capital dredge sites at South Hook and Dragon. The results of this benthic monitoring are discussed in an overview report produced by Warwick (2007).

In order to further understand the processes taking place in St Brides Bay MHPA decided to extend the program to include an additional sampling survey during the summer of 2008. This confirmed the initial findings that there was no identifiable impact of the disposal activities on St Brides and the monitoring programme was curtailed.

It was found during the dredge related monitoring that the preventative methods imposed by MHPA significantly reduced the amount of re-suspended sediments released into the local marine environment. The turbidity levels recorded were very unlikely to have resulted in any significant adverse impacts on the features of the SAC. For this reason, no dedicated dredge campaign water quality monitoring has been implemented since 2010. The degree and extent of any environmental monitoring will be subject to review prior to each planned dredging activity based on the scale, method and location of the dredging activities.



## 11. The Strategic Approach

Milford Haven Port Authority intends to maintain the long-term maintenance dredging regime that will prevent a situation from arising whereby the volume of material deposited at the offshore disposal site LU169 exceeds the presently recommended maximum quantity of 250,000m<sup>3</sup> in any one year. The focus is on the forthcoming 5-year period up to 2027. However, it is the intention to extend the long-term planning of the maintenance dredging requirements beyond this date to include the full 10-year period of the new license applied for (2022-2032) if possible.

### 11.1. Maintenance Dredging Requirements

There are three key considerations when formulating a schedule for the dredging requirements of Milford Haven. The first is the operational and safety requirements of the various marine operators, the second is the sedimentation rates of each of the areas within the Haven that require maintenance dredging, and the third is any restrictions on the dredging/disposal activities as laid down by the licensing authority.

The following sites are those that are considered to require regular or periodic maintenance dredging and also qualify as existing 'projects or plans' under the Natura 2000 regulatory framework (including its post Brexit UK replacement - any references to Natura 2000 in the 2017 Regulations and in guidance now refers to the new national site network) i.e. in existence prior to designation circa 1997. The location of these sites is shown on Figure 4a (located at the end of this document).

- Mill Bay – West Channel
- Thorn Island – Angle , South Channel
- Valero – Berths and Approaches
- Milford Shelf
- Milford Docks Approach Channel
- Dragon LNG
- Semlogistics (including turning circle)
- Pembroke Powerstation Inlet and RoRo approach
- Pembroke Port
- Pembroke Dock Ferry Terminal RoRo facility
- Neyland Marina

There are also areas within the navigable waterways that have been dredged in the past but to date have experienced either very slow sedimentation or have been self-cleaning. It is possible that these areas may require some form of Infrequent Maintenance dredging in the future and should therefore be included in the overall strategy. These areas are:

- St Anne's Head entrance channel.
- Approach channel from Watwick Point to the South Hook jetty.
- South Hook LNG facility.
- South Hook Channel
- Puma facility.
- MHPA pilot jetty.



- Pembroke Power Station outfall channel.
- Dockyard Bank and Car Jetty channel.
- Newton Noyes Pier.
- West Llanion
- Cosheston Pill.

These areas have generally not required much in the way of maintenance dredging for at least 10 years and any future dredging requirement is classed by MHPA as Infrequent Maintenance. However, all of these areas have been dredged in the past and the seabed communities are likely to have been changed as a result.

Two such areas that were re-dredged are the cooling water channels associated with the new Pembroke Power Station in 2010/11. This dredging was classified, at that time, as capital dredging by the regulators, not because the works involved removal of virgin seabed material, but because it had not been maintained for more than 10 years. The outfall channel has proved to be self-cleaning to date but the cooling water inlet channel will require periodic maintenance dredging, as carried out in 2016. Both of which were predicted in the previous versions of this document.

RWE has joined the Milford Haven Dredging Liaison Group so that future maintenance requirements will be programmed into the overall strategic approach.

## **11.2. Operational Safety**

Engineers determined the depth of the water required at any given location within Milford Haven during the original design stage of each facility. Some of the variables that would have been considered at the design stage would have included, the size and draught of vessels, tidal variation, environmental factors (current, waves, wind etc) as well as the local geological conditions and overall cost constraints of the development. Once the optimum design had been established, based on the required criteria, the facility would have been constructed to meet the specification. From an ongoing maintenance dredging point of view the design levels required, and associated water depths, are critical for both planning and safety. If the minimum depth requirements are not maintained then there will either be a risk of the vessel grounding, with the possible associated risk of a pollution incident, or the draught of the vessels arriving or leaving the facility will need to be reduced by decreasing the cargo of the vessel. Both of these options have an economic impact, but grounding also runs the risk of a serious environmental impact. The 'Milford Haven Port Authority Standard Operating Procedures' state that all vessels must have an under-keel clearance of 10% of the vessels draught at all times when underway reducing to 5% when the vessel is moored alongside at a berth. MHPA periodically review under-keel clearances throughout the navigable channels of Milford Haven. The results of any such review may impact the dredging requirements and are, therefore, an integral part of the dredging strategy, the purpose being to match the maintenance required with the navigational safety needs.



In general, the berth pockets, at any of the jetties, are dredged to a deeper depth than the associated approach channel to the particular jetty. This is to allow for the height difference between the vessel arriving at high water and the water depth required for the fully laden vessel moored at the berth at low water.

Each area of the Haven has an advertised declared depth, e.g. the main approach channel, seaward of Thorn Island, has an original design depth of 16.8m below Chart Datum. This means that the water depth in the channel should never be less than 16.8m, even on the lowest of spring tides. At all other times, the available water depth for navigation will be 16.8m + Tide Height. Vessels of greater draught than this can still be safely navigated within the channel, as long as there is sufficient tidal height to accommodate the additional depth requirement. For inbound vessels there must also be sufficient depth in the allotted berth pocket to accommodate the vessel as the tide level falls.

MHPA have powers under the Milford Haven Conservancy Act 1983 (Section 19 'Powers with respect to dredging etc') to dredge material as required from any area within the Port Authorities limits. MHPA also have the powers to prohibit or impose conditions or restrictions on any dredging activity proposed within port limits, Section 19(3)b. The disposal of the dredged material is subject to restrictions as set out in Section 19 sub-clause 1a, hence the need for a disposal licence for all material being deposited below the mean high water spring tide level. Any material deposited above the mean low water line may be subject to local government planning permission or regulations under the Waste Directive.

MHPA consider the safe navigation of all vessels within the MHPA limits is of paramount importance. By maintaining the navigable water depth the risk of vessels grounding, while within the designated channel or berth limits is minimised.

### **11.3. Sedimentation Depth and Accretion**

An extremely important consideration when planning dredging activities is not just the volume of material to be dredged, from a particular area, but also the thickness of the material to be dredged. It is far more efficient for a dredger to remove a thick layer of sediment than it is to remove a thin layer. The removal of a thick layer of sediment will result in higher concentrations of material being transported into the hopper of the dredger. When dredging a thin layer of sediment the water concentration will be higher, which will result in not only a lower production rate but will also result in there being less dredged material in the hopper, once it is full, subject to overflow. This is particularly relevant in Milford Haven as the practice of overflowing the hopper to increase cargo concentrations is presently restricted. The efficiency of the dredging operation will not only have a direct impact on the cost of the dredging but will also affect the environmental impact of the dredging activity, in that lower efficiency will result in a longer duration to complete the required works with an associated increase in fuel consumed to complete the required works.



The thickness of sediments within any one area will vary considerably. For example; in sheltered areas or the berth pocket it is common for there to be a relatively rapid loss of depth at the toe lines of the berth pocket (the interface between the base of the pocket and the bottom of the side slopes) but a much slower loss of depth in the centre of the berth pocket, where vessel movements will limit the ability of sediments to settle. For example, the approach to the mooring dolphins at Semlogistics experiences a loss of depth of approximately 2cm per month but the berth pockets experience a considerably slower rate of sedimentation. A better understanding of the rate of loss of depth in all areas is continuously ongoing using the annual bathymetric surveys.

Information obtained from recent bathymetric surveys has enabled sedimentation rates to be calculated more accurately than had been possible using historical information, previously. This has in turn enabled sediment depths to be predicted and it is envisaged will ultimately allow the optimum dredge interval to be identified. This will all help the future programming of dredging activity within Milford Haven.

#### **11.4. Specific Dredge Areas and Their Sedimentation Regime**

Ideally, sedimentation rates would be calculated from comparisons of accurate bathymetric survey information. Unfortunately a lack of 'reliable' historic bathymetric survey data in some areas, prior to 2009, made it impossible to calculate accurate sedimentation rates by this method. However, since 2009, annual surveys of most of the maintenance dredge areas, have been carried out and this has removed this previous level of uncertainty regarding tidal corrections and associated seabed levels.

A good example of the reliability of the historic survey information was Mill Bay on the West side of the main approach channel close to St Anne's Head. There have been numerous surveys of Mill Bay over the years, but it was established in 2006, that there can be a significant tidal gradient between this part of the Haven and the primary tide gauge used for water level measurement, which is located at the Pilot Jetty at Hakin. It is estimated that the gradient, between these two locations, can be as much as 0.3m on a large spring tide. This means that there will have been some degree of inaccuracy in any surveys when reduced to Chart Datum using tidal data from this Pilot Jetty gauge, as was the practice until 2009.

The advent of Real Time Kinematic Differential Global Positioning Systems (RTK DGPS) has helped to identify and quantify this naturally occurring variance. Surveys carried out in 2009 and 2010 adopted this method of height control and this heighting method has been adopted for all bathymetric surveys since. This approach will minimise this potential source of vertical inaccuracy. Unfortunately, this variation in survey uncertainty has made it impossible to calculate reliable sedimentation rates at Mill Bay using historical survey information prior to the 2009 survey.

Additional tide gauges have also recently been installed by MHPA elsewhere in Milford Haven to improve the knowledge base with regard to tidal gradients within the waterway. This ongoing investment in knowledge of the Milford



Haven waterway will progressively provide more reliable and accurate information.

Where suitable bathymetric survey information has not been identified an assessment of the future dredging needs has been derived from the historical information included in the Appendix. The source of this information is from the dredging disposal returns made to DEFRA by the vessel carrying out the disposal operations. It is a requirement of all disposal licences that returns are made to the regulator (NRW) detailing the quantity of material deposited at the disposal sites.

Confusion sometimes occurs between the use of tonnes and cubic meters as the method of quoting quantities. The disposal returns ask for quantities to be quoted in tonnes. However, dredging contracts are usually based on cubic meters of material removed. In order to convert from cubic meters to tonnes the in-situ density of the material being dredged needs to be known. Accurate values are not always known, which means that the conversion from tonnes to cubic metres, and vice versa, may result in some degree of discrepancies. For the purpose of this document, all quantities have been quoted in cubic metres (m<sup>3</sup>). Conversions have been made using assumed in-situ densities of 1.5t/m<sup>3</sup> for silt, and 1.8t/m<sup>3</sup> for sand.

The tables in the Appendix show the year-on-year dredged volumes from 1985 to October 2021. Volumes prior to 2006 have generally been obtained from disposal returns. Volumes after and including the 2006 dredging have been derived from survey information. For the sake of clarity, some relatively recent capital dredge volumes have also been included, but these will not necessarily form part of the future maintenance requirement under this strategy, as any maintenance requirements of these additional areas will be subject to their own individual licence application and associated Appropriate Assessment.

It is important to note that maintenance dredging usually takes account of some future element of sedimentation when deciding what level to dredge to. i.e. if dredging were to be carried out exactly to the design levels then within a very short space of time, following the completion of the dredging, natural sedimentation will result in levels that are above the required design level. For this reason, dredging usually takes place to a lower level than is required for the design in order to allow some capacity for natural sedimentation. The ongoing increase in knowledge of the sedimentation rates within the Haven will allow the dredging requirement to be better targeted. As the understanding improves it will be fed back into the Strategy to provide an increasingly efficient dredging program.

The following sections discuss the sedimentation rates in all of the known and potential maintenance dredge areas within Milford Haven. Charts have been produced for each area showing the annual rate of depth loss using the available survey information. The following is an example of one of the plots covering Valero Berths 4&5 and the associated turning area. The available survey data has also been used to calculate volumetric variations at each site.

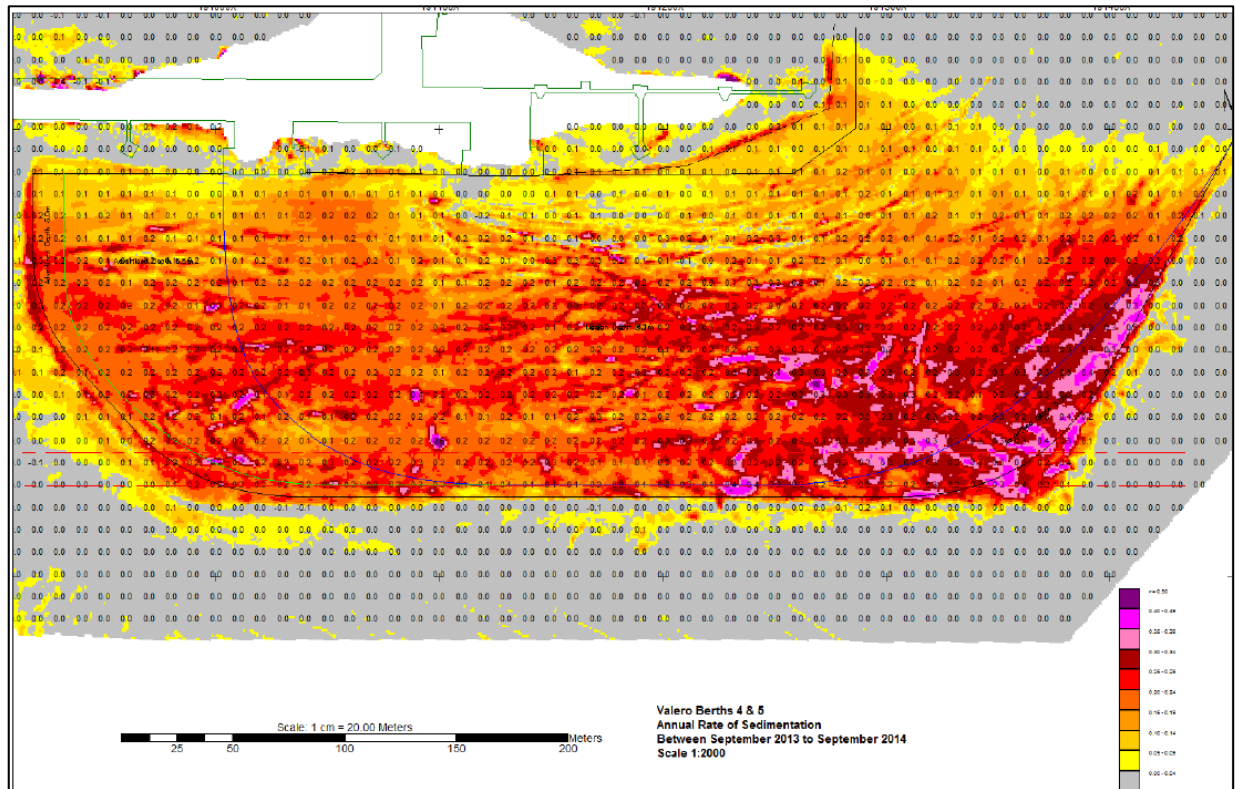


Figure 8. Sedimentation 2013-2014 plot of Valero Berths 4&5

#### 11.4.1. Mill Bay

Sedimentation rates at Mill Bay were originally calculated using the 2006 post dredge survey, which was carried out using single beam echo sounding (SBES) bathymetric methods with RTK height control and the 2009 and 2010 multibeam echo sounding (MBES) surveys, both of which used RTK heighting methods. Since 2009 all surveys have been carried out using MBES methods with RTK height control.

During the period 2006 to 2009, it was found that the maximum loss of depth equated to approximately 0.2m/year. This represents an annual accumulation of approximately 10,000m<sup>3</sup>/year. More recent and more accurate multibeam surveys have indicated that the average rate of sedimentation from 2011 to 2015 was approximately 11,500m<sup>3</sup>. There had been a number of significant severe stormy periods during this time frame, which may have increased the rate of sedimentation in this area. Since 2015 the sedimentation rate at Mill Bay has reduced significantly, with accretions of only 1,007m<sup>3</sup> seen between the 2020 and 2021 surveys. It is considered that this area has now reached its natural stable profile. However, the bed levels are now significantly above the design depth of -16.8mCD but this has not impacted significantly on shipping movements as the draught of vessels entering and leaving the haven have reduced in recent years, but this might not always be the case.

#### 11.4.2. Thorn Island

The original analysis of the sedimentation rates at Thorn Island was carried out using the same survey data sets as used for Mill Bay, namely SBES Post



Dredge 2006 and the 2009 and 2010 MBES surveys. The sedimentation rate during that period was calculated to be approximately 4,500m<sup>3</sup>/annum.

Analysis of the multibeam data between the post dredge survey of 2011 and the pre-dredge survey of 2015 indicates that the average accumulation was slightly less than that calculated from the 2006-2009 period. The average rate of accumulation between 2011 and 2015 was approximately 3,350m<sup>3</sup>/year.

The average annual rate of accumulation between 2015 and 2020 was 3,792m<sup>3</sup>. The rate of accretion has slowed since the dredging carried out in 2015. The net accumulation between the 2018 and 2019 surveys was 6,731m<sup>3</sup> but between the 2019 and 2020 surveys, the net accumulation had reduced to 3,032m<sup>3</sup>. This reduction is probably representative of the area progressing towards its level of equilibrium.

The rate of loss of depth at Thorn Island has been calculated to be as much as 0.3m per year.

#### **11.4.3. South Hook LNG facility**

The initial analysis of the sedimentation rates at South Hook LNG was carried out using a seabed clearance MBES survey from 2008 and two MBES surveys carried out by MHPA in 2009 and 2010. Additional multibeam surveys have been carried out in this area since that time with the most recent being in 2020. The variation in depth in this area has been very small and it is difficult to identify any significant pattern. It is however evident that there is very little sedimentation within the vicinity of the South Hook jetties. This is in line with historical information, as dredging was very rarely required at these berths when operated by ESSO.

The fact that the present LNG vessels have a maximum draught that is considerably less than the available water depth suggests that dredging will not be required at the South Hook LNG facility within the foreseeable future. However it is possible that infrequent maintenance dredging will be necessary at some point in the more distant future.

#### **11.4.4. South Hook Channel**

The analysis of sedimentation rates at the South Hook channel widening has been carried out using similar data to that used for Mill Bay apart from the 2006 post dredge survey data which was height corrected using Tide Gauge observation and not RTK heighting.

The analysis shows that there has been very little sedimentation in this area since capital dredging was carried out in 2006. It was anticipated at the concept stage that sedimentation rates in this area would be minimal. This has proved to be the case to date. In fact, some of the original dredge marks remain visible in the 2020 data set, which suggests that there is little erosion or deposition activity in the area, where the channel was widened slightly.

There has however been a very small build-up of material above the 10mCD design level close to the edge of the channel. Given the small volume of material involved, it is anticipated that this material could be relocated using a



plough vessel, should one be available. Alternatively, this material could be dredged using a TSHD during a wider campaign.

Based on the survey information it is anticipated that some very small-scale remedial maintenance work will be required in this area every 10 years.

#### **11.4.5. Puma (previously Murco)**

The berths and turning area at the Puma marine facility do not suffer from high sedimentation rates. No dredging activity has been recorded since its original construction in the early 1970s, apart from occasional ploughing in the vicinity of the berths. Sedimentation does occur in Berths 1 and 2. However, the draught of vessels using the facility in recent years has been considerably less than used in these berths when it was originally constructed. This has allowed the operators of the facility to avoid the need for full-scale maintenance dredging. The available depth in the berth pockets of Berths 1 and 2 has been reducing progressively over the years. It is possible that in the future the seabed level may rise to a point where maintenance dredging will be required. Maintenance dredging may also be required should the pattern of trade using the facility require deeper draught vessels.

The rate of sedimentation at the Puma Berths has been measured using the available surveys and the maximum rate of loss of depth is of the order of 0.05-0.1m/year which equates to approximately 2,600m<sup>3</sup> per annum when including the side slopes of the berth pockets.

As the original deep berth pockets have not been maintained, the volume of material above the original design has been progressively increasing. The backlog volume stands at around 52,000m<sup>3</sup> above the design profile in 2020. If Puma required this material to be removed, MHPA would define it as Infrequent Maintenance Dredging due to the fact that the seabed has been heavily impacted in the past and has been further disturbed by ploughing activity, most recently in 2013. A separate disposal license application will be required to cover any dredging and subsequent disposal from the Puma berths as this facility is not presently included on the existing maintenance dredge license.

#### **11.4.6. Valero Sedimentation Rates**

The Valero facility consists of 8 berths ranging in design depths from -6.4mCD down to -20.7mCD. The sedimentation regime differs widely between the berths. The berths that suffer most from rapid loss of depth are Berths 1, 6 and 4&5.

The Valero Berths 4&5 and the associated approach and turning area suffer from one of the highest sedimentation rates within Milford Haven with up to 0.4m of sediment being deposited on the seabed annually. Due to this high rate of sedimentation, this area has historically required the highest frequency of maintenance dredging campaigns, typically every occurring every 2-3 years. However, the pandemic in 2020-21 meant that a planned maintenance campaign in this area was postponed.



Based on available survey information, the rate of sedimentation within Valero Berth 4&5 is up to 40m<sup>3</sup>/day (14,500m<sup>3</sup>/year 2011 to 2015). This area of the Haven is particularly prone to rapid siltation as silts are washed along the shallow Pwllcrochan Flats, which lie immediately upstream to the east of the Valero terminal on the southern side of the Haven, into the deepened basin area. Due to the deeper depth in the turning basin, the current velocities reduce significantly and the silt that is in suspension falls to the seabed. It is also likely that some silt material will be transported along the seabed in a fluid mud form as a result of wave and current action in the intertidal zone during windy conditions. Another contributing factor is that there is very little current flow in this area on the flood tide. This results in an extended period of fairly slack water following an ebb tide. This allows time for the suspended material to drop out of suspension and settle on the seabed, without being transported back upstream on the flood tide. It was anticipated that the rate of sedimentation in Berths 4&5 would not be linear but that it would be at its most rapid immediately following dredging and then slow as the seabed level rises. During the period between the 2012 post dredge survey and the 2015 pre-dredge survey, the average rate of loss of depth was up to 0.3m/annum. For a similar period between the 2016 post dredge survey and 2020 the average annual rate of accumulation was 10,500m<sup>3</sup>.

The rest of the Valero berths (1,2,3,6,7 & 8) experience a sedimentation rate of approximately 38m<sup>3</sup>/day in total, with the vast majority of this being in the deeper Berths 1 and 6. These two berths are located on the natural ebb tide flow path from the Berth 4&5 area and it is evident that they suffer from a similar sedimentation regime as found in Berths 4&5. The slower rate of sedimentation in the outside berths at Valero, combined with the fact that shallower draught vessels are the norm at present, means that dredging has not been required in these berths as frequently as in Berths 4&5. Dredging of the outer berths has historically been carried out every 5-8 years.

Analysis suggests that Valero will experience annual sedimentation of approximately 10,500<sup>3</sup>/year in Berths 4&5 and 6,200m<sup>3</sup>/year in berths 1-8, of which 6,000m<sup>3</sup> is in Berth 1 and 6. This provides a total annual sedimentation of approximately 16,700m<sup>3</sup>/year.

#### **11.4.7. Milford Shelf**

Milford Shelf is an area on the northern side of the main navigation channel opposite the Valero Berths. The original capital dredging was carried out to allow vessels to turn when arriving or leaving the Valero facility. The sedimentation rates in this area are generally very low. Dredging, using a TSHD, was carried out in 1998, 2006, 2011 and 2015. The volume of material dredged from this area in 2006 was approximately 31,000m<sup>3</sup>. However, in later years the volume removed was significantly less with only 1,200m<sup>3</sup> being dredged from the main basin area in 2015. The total volume of material that was above the design depth of -9.8mCD in 2020 was only 300m<sup>3</sup>. It is anticipated that dredging in this area will be required at similar intervals in the future. However, it is possible that interim ploughing activities may be employed to relocate sediments from the shoals into deeper water between TSHD campaigns.



#### 11.4.8. Milford Dock Approach Channel

Like Milford Shelf the sedimentation rate within the Milford Dock Approach Channel is low. The channel has been maintained in recent years by ploughing any accumulated sediment southwards into the deeper water of Milford Shelf. The material is then removed by TSHD during the periodic maintenance dredging of Milford Shelf. The last dedicated plough campaign was carried out in 2010. Ploughing was also carried out in 2007 again in 2008 during the maintenance dredging of Semlogistics. During 2012 some material was also removed with TSHD. The sedimentation rates within the wider approach channel area have been calculated to be in the region of 1,600m<sup>3</sup>/year based on the 2015 and 2020 monitoring surveys.

The sediment that accumulates in the Milford Dock Approach Channel could be dredged directly using a small, shallow draught TSHD. It is unlikely that a small TSHD will be used in this channel in isolation as it is unlikely to be an economic option. This approach may change in the future as a small TSHD will be suitable for maintenance requirements at Pembroke Power Station.

#### 11.4.9. Dragon LNG

The Dragon LNG Berth (formally Petroplus Berth No1) was substantially reconstructed when it was taken over by Dragon LNG. The whole structure was refurbished, which included new berthing and mooring piles. These were required to handle the new LNG vessels which are a different design to the oil tankers that used to use the berth. The draught of the new LNG vessels is less than the previous vessels using the berth, as such the design depth has been reduced from -14.1mCD to -13.8mCD. This has meant that the berth has been allowed to lose 0.3m of available depth without impacting the safe operation of the berth. This permitted sedimentation has distorted the figures slightly when compared to historical figures, which were calculated using the old design depth of -14.1mCD. Regardless of this, the sedimentation rates at the Dragon Berth are relatively low.

The Dragon facility was dredged in 2008 shortly before the planned arrival of the first LNG vessel and then again in 2015. On both occasions, the dredging was carried out at the same time as maintenance dredging at Semlogistics (now VPOT), which is located immediately to the East of the Dragon facility. In 2008 the bulk of the dredging was conducted using a large backhoe dredger as this was on site for the capital dredging of the Semlogistics Berth 3 deepening. However additional cleaning up was carried out using a TSHD following the departure of the backhoe dredger from site. A total volume of around 4,000m<sup>3</sup> was dredged from Dragon LNG during that campaign. In 2015 the majority of the dredging was carried out by a TSHD but inaccessible material close to the berth face was removed by a backhoe. The volume removed in 2015 was approximately 1,400m<sup>3</sup> as no dredging was carried out on the side slopes during this campaign.

The accretion pattern at Dragon LNG shows that the most rapid sedimentation takes place on the side slopes to the north of the berth pocket. This does not directly impact shipping activities. However, as the depth of material increases on the side slopes, there will be a tendency for sediments to migrate into the berth pocket over time. The slopes do not have to be



dredged on every campaign but will need to be periodically cleared. The deposition within the main berth pocket is relatively minor and can be removed most economically using a medium-size TSHD.

Based on the MBES survey information from 2015 to 2020 the rate of sedimentation over the area of interest at Dragon LNG is of the order of 850m<sup>3</sup>/year.

#### **11.4.10. VPOT**

The location of the VPOT berths (formerly Semlogistics), close to the shoreline on the northern side of the Haven, has resulted in there being long periods of virtually slack water in the area between the berths and the offset mooring dolphins. This has created ideal conditions for marine sediment to be deposited and has resulted in the highest sedimentation rate to be identified in any of the maintained areas of the Haven, up to 1m per annum. The mooring dolphin approaches were originally dredged to a depth of -6mCD but are now generally maintained to a depth of -2.5mCD. The reduction in required depth is probably due to the fact that small shallow draught rope runners now run mooring lines ashore, whereas the original design may have allowed for deeper draught tugs to carry out this task.

The mooring dolphin approach experiences a sedimentation rate of approximately 11m<sup>3</sup>/day with a similar quantity being deposited on the side slopes. The berth pockets on the other hand only have a sedimentation rate of approximately 7m<sup>3</sup>/day. This is probably due to the berth pockets being located in a stronger current flow that deters sedimentation. In addition, vessel activity may be responsible for preventing rapid accretion in the berth pockets. The build-up of sediments in the VPOT site between 2015 and 2020 equates to approximately 10,200m<sup>3</sup>/year.

Not all of the VPOT areas are dredged on each campaign, the mooring dolphin approaches were dredged in 1992, 2002, 2008 and 2015, but dredging of the berths alone was carried out in 2012, 2015 with additional ploughing in 2019. It had been the intention to dredge the berths and the mooring dolphin approaches in 2020. However, the COVID-19 pandemic resulted in the postponement of the intended dredging until 2022.

The rapid rate of sedimentation in the Mooring dolphin approaches suggests that dredging should be carried out very regularly. However, this particular shallow area is very difficult to dredge, which in turn makes it expensive if it were to be dredged in isolation. To date, the berth operators have opted to manage their operations with periods of reduced depth until such time that other dredging works are required.

#### **11.4.11. Wear Spit (Dragon LNG Channel widening)**

In 2006 a very small amount of material needed to be removed from the south side of the navigation channel in the vicinity of Wear Spit to the east of the Semlogistics Berths. This was referred to at the time as 'Dragon LNG channel widening' as the material was removed to provide sufficient channel width for the Pembroke-Rosslare Ferry to pass the new LNG vessels at a safe distance. Although significant dredging had taken place historically in the



surrounding area this small area of the seabed was considered to be virgin seabed and was duly classified as Capital dredging. The original intention had been to dredge the material using a TSHD, during the 2006 maintenance campaign. However, an attempt to relocate the material using a plough proved to be successful. About 280m<sup>3</sup> of material was relocated to adjacent deeper water using this method.

The channel monitoring survey of 2012 showed there to be virtually no change in depth since the ploughing was carried out in 2006. The area will continue to be monitored to check for sediment accretion. Any sediment build-up in this area will consist of unconsolidated material and will represent an extremely small volume. As such, it is likely that any further dredging requirement will again be carried out using a plough so there will be no disposal activity.

#### **11.4.12. Pembroke Power Station Outfall**

Re-instatement of the power station outfall, by dredging, was carried out in the autumn of 2010. Due to the time period since this channel was originally dredged, circa 1970, the reinstatement was classified, by the regulators, as Capital dredging. At the time it was assessed that, once the power station was operational, the outfall channel would be self-cleaning. This was based on the fact that the original outfall channel did not require any maintenance dredging while the power station was operational. The original channel only silted up once the old power station ceased operation. This has proved to be the case and no significant accretion has taken place in the outfall channel since the commissioning of the power station in 2012.

#### **11.4.13. Pembroke Power Station Intake and Ro-o Approach**

The reinstatement of the power station intake and Ro-Ro approach channel was carried out in 2010-2011. As with the outfall mentioned above, the works were classified as Capital dredging even though the area had been maintained in the past, most recently in 2000, when a limited amount of dredging was carried out to allow scrap metal vessels to access the site during the demolition of the old power station.

Since the commissioning of the power station, regular surveys have been carried out by RWE and the sedimentation rates are now well documented. It was always predicted that some maintenance dredging would be required but the frequency was anticipated to be infrequent (3-5years) and the volume relatively small in comparison to other areas within Milford Haven. It has now been established that annual sedimentation is in the region of 6,300m<sup>3</sup>/annum over the area covering the Intake portal, Ro-Ro jetty and approach channel.

The frequency of maintenance dredging will be dependent on the rate of accumulation and the threshold that RWE set for minimum acceptable water depth. A partial dredge campaign was carried out in January 2016 to remove material from the seaward portion of the approach channel, as sedimentation had increased to a point whereby the flow velocities in the channel were getting close to permissible limits on lowest low water spring tides. Approximately 7,000m<sup>3</sup> of the total 34,200m<sup>3</sup> that existed above the design profile was



removed. As a result of this partial dredging campaign, it is anticipated that further dredging of the whole area would be required within 2-3 years.

It had been intended to dredge material from the intake channel in 2021. However, the COVID-19 pandemic resulted in the postponement of that particular campaign until 2022.

#### **11.4.14. Pembroke Port**

Identifying the rate of sedimentation in Pembroke Port is very difficult as different areas have been dredged at different times using different methods. In the past, some areas have been ploughed, which has relocated material from one area to another. Based on the survey data from 2015 to 2020 it is calculated that the average sedimentation rate within Pembroke Port is in the region of 7,800m<sup>3</sup> per annum.

The very nature of the location of the Port, out of the main current flows, means that the port is susceptible to sedimentation and the deepened berth pockets act as a sink for fluid sediments. The berth pockets, therefore, suffer the highest rate of loss of depth. The frequency of dredging depends very much on the trade expected to use the Port. As the berth pockets suffer the most rapid loss of depth any dredging requirement will be dictated by the draught of vessels arriving and leaving the berths. As a result of differential accumulation, it is likely that some interim ploughing may be required within the berth pockets between dredge campaigns. The plough will be used to re-distribute material within the berth pockets to maximise available depth for shipping.

Accretion does take place in the approach to the Port but not at the same rate as in the berth pockets. Should the approach need to be maintained between dredge campaigns this will probably be carried out using a plough. The plough will spread the accreted sediments into deeper waters in the vicinity of the Port.

Maintenance dredging has been carried out in Pembroke Port at fairly regular intervals, in 2002, 2010 and during the winter of 2015/16 when approximately 37,800m<sup>3</sup> were removed from the whole port area. Additional dredging was carried out in Berth 2 in 2020 when a grab hopper dredger was used to remove material from the southern extremity to provide sufficient quay length for an expected cargo vessel.

#### **11.4.15. Pembroke Dock Ferry Ro-Ro Terminal**

The Pembroke Ferry Terminal is situated in the main ebb current flow on the southern side of the Haven. This flow has proved to be sufficient to deter the accumulation of sediments in the berth pockets and the approach. Some accumulation does take place along the toe line of the berth pocket, which needs to be dredged every so often. This dredging has been carried out by either a plough vessel, a combination of plough and TSHD, or by a backhoe, as occurred in 2016. It is considered that most of the material accumulation is a result of sediment displacement by the ferry's propulsion systems.



The rate of accumulation above the design level in the Ro-Ro berth pocket is only of the order of 50m<sup>3</sup>/year. Although this is a very small quantity it still needs to be removed periodically in order to allow safe berthing of the Ferry.

#### **11.4.16. Dockyard Bank**

When the Pembroke Ferry Terminal was expanded, in 1998 to take the present large ferry, the approaches to the Ro-Ro jetty had to be widened by dredging to permit safe navigation of the larger vessel past the Dockyard Bank to the terminal. Analysis of the surveys since dredging took place shows that sedimentation in the areas dredged is very low. There are small patches that have shoaled to above the design level but they do not, at present, represent a navigation hazard and have not therefore been dredged. The bedform in these areas shows small sand waves, which suggests that the material is mobile. Should dredging be required in these areas then it is anticipated that the use of a plough to relocate material will be attempted first. Only if ploughing is unsuccessful will an alternative method be investigated. The prime alternative method will be the use of a TSHD whilst on site for other works in the Haven.

This dredging, if required, will be classed at Intermittent Maintenance Dredging by MHPA as the areas have been dredged in the recent past but more than 10 years ago. The areas have therefore been impacted by dredging and are not virgin seabed. This particular area is not presently included on the maintenance dredge license and will therefore be subject to a new application if sea disposal is required.

#### **11.5. Environmental Restrictions**

During consultations between MHPA, DEFRA and CCW for the 2006 dredging FEPA licences it was agreed that MHPA would endeavour not to carry out any dredging disposal activity during the sensitive marine spawning period in late spring to early summer, 1<sup>st</sup> April and 30 June, this is referred to as the 'closed period'. This restriction was subsequently removed, by DEFRA and MCU, from disposal licences between 2006 and 2010. However, in 2011 this restriction reappeared on MCU licences following MCU consultations with CCW. The reason for the fluctuation in opinion/advice is not known, however, MHPA is committed to minimising any disposal activity during the 'close season' if practical and possible.

As discussed earlier in this document, it has been agreed between all parties that the disposal of material at site LU169 will not exceed 250,000m<sup>3</sup> in any 12month period. For the purposes of this strategy, MHPA has defined a 'disposal' year to be from 1st July to 30<sup>th</sup> June the following year. Site LU169 is considered to be suitable for all dredged material including clay, silt, sand, gravel and rock.

There is no restriction on the quantity of material that can be deposited at LU168. However, this site is only considered suitable for the disposal of material with a particle size of >250µm (medium-grained sand and greater). It is worth noting that the ETS reports state that small quantities of finer sediment could be deposited at LU168 without any significant risk of impact



on the SAC or SMNR. There has been no definition of what 'smaller quantities' actually represents.

There has been a general consensus that the disposal of material on a one-off bulk dredging campaign should be avoided if possible. CCW had expressed the opinion that a 'little and often' approach would be preferable from an environmental viewpoint. This approach is contrary to the 'economies of scale approach', which has tended to be adopted in Milford Haven. This can clearly be seen with the 4-5 year peaks in volumes dredged in Table 2. The high cost of fuel has resulted in an increase in the cost of dredging. The availability of suitable dredging plant also makes it more difficult to obtain a dredger at short or even medium-term notice. It may well be the case that plant availability and elevated cost may render the 'little and often' approach unworkable. However, it is MHPA's desire to adopt a least environmental impact approach wherever possible. To this end, MHPA continues to investigate the possibility of adopting a longer-term dredging contract which will make allowance for more frequent smaller-scale maintenance dredge campaigns.

#### **11.6. Future Maintenance Dredging Requirements**

It can be seen from Table 2 in the Appendix that the total volume of material dredged in any one year, since 1985, has been less than the maximum permitted quantity of 250,000m<sup>3</sup>. This is inclusive of both capital dredging during that period and also material that was deposited at site LU168.

Table 2 shows the volumes of material dredged from all sites within Milford Haven. The yellow bars indicate the total quantity dredged, including any capital works. The blue bars show the volume of material that is considered to be 'maintenance' material. The red bars show the volume of Capital material dredged. It can be clearly seen that the vast majority of the material dredged within Milford Haven, since 1985, has been from those areas which were ongoing at the time of designation of the SAC. This graph also shows the 4-5 year cyclic nature of past dredge campaigns. The main reason for this peak of dredging requirements is not as a result of even sedimentation rates but primarily as a result of licence availability and economic efficiency. The cost of mobilising a dredger to Milford Haven is significant, if this can be shared between multiple facility operators then substantial financial and environmental savings can be made.

The majority of the material dredged from the maintenance areas will be fine-grained in nature (silt and fine-grained sand) and will generally be deposited at disposal site LU169. Material from Mill Bay is considered suitable for disposal site LU168, due to the courser nature of the sediments at that location. It is also considered by MHPA that the material from Thorn Island is also suitable for disposal at LU168 due to its sandy nature, However, the particle size falls below the present guidance size of 250µm.

In order to assess the worst-case scenario, the maximum volume dredged from all areas during the period since 1985 have been added together. This is shown in the far right-hand column on Table 1b in the Appendix. This shows that if circumstances so prevailed as to require all areas, that have required



maintenance dredging since 1985, to be dredged in one year to their maximum quantity ever dredged, then the total volume could equate to just under 387,000m<sup>3</sup>. If only taking those areas that are maintained prior to SAC designation then the maximum volume could be as much as 375,000m<sup>3</sup>. This is however very unlikely to occur. The maximum quantity deposited in any one year since 1985 was in 2006 when a total of 232,000m<sup>3</sup> was dredged, 32,000m<sup>3</sup> of which was capital material from the South Hook channel widening project and 42,300m<sup>3</sup> was deposited at disposal site LU168, leaving a maintenance quantity deposited at LU169 of only 157,700m<sup>3</sup>. The campaign carried out during the Winter of 2015/16 resulted in a total deposited volume of 205,026m<sup>3</sup> all of which was deposited at LU169, this is however split between 2015 and 2016 due to the timing but it was one continuous campaign lasting about 3months from December 2015 to early March 2016.

The main risk of there being a high annual disposal will be if Valero and VPOT wish to dredge at the same time. If Valero dredge all of their berths at the same time, as happened in 1997, 2006 and 2016, then this could account for up to 100,000m<sup>3</sup> depending on the interval between campaigns. VPOT undertook a thorough maintenance dredging campaign in 2008 and 2016, which involved the removal of approximately 70,000m<sup>3</sup> and 55,000m<sup>3</sup> respectfully. Even if these two major requirements are undertaken at the same time then this still remains within the maximum permitted quantity and leaves a surplus capacity to accommodate any other dredge requirements, such as Pembroke Power Station and Pembroke Dock. This surplus capacity could also include other capital dredging projects, which require approval.

The postponement of the planned dredging in 2020 and 2021, as a result of the COVID-19 pandemic, will have resulted in a larger accumulation of sediments in the areas to be dredged. Depending on which areas need to be dredged in 2022 it is possible that the amount of dredging may have to be restricted so as not to exceed the disposal limit. Table 3 in the appendix sets out a possible scenario where Valero may have to delay their dredging until 2023 in order for VPOT and PPS to dredge in 2022.

In order to provide a loose framework upon which to base the dredging requirements for the forthcoming 10 year period, Table 3 shows the estimated maintenance dredge requirement. As discussed elsewhere in this document, it is difficult to provide definitive requirements as economic and environmental conditions may dictate when dredging will be required. The detailed bathymetric surveys carried out since 2009 have continued to populate the knowledge base with regard to obtaining robust information upon which better forecasting can be based.

## **12. Dredging Liaison Group**

In 2006 MHPA established the Dredging Liaison Group and has been administering the group ever since. As discussed earlier, the aim of this group is to provide a platform on which the strategic approach to dredging can be discussed and planned. All facility operators are invited to the periodic meetings and are able to table their views and requirements through this forum. It also provides the framework for each user to take part in the whole process. The liaison group presently includes MHPA, South Hook LNG,



Puma, Valero, Milford Docks, Dragon LNG, VPOT, RWE, Port of Pembroke and Neyland Marina.

The first benefit of this group approach to dredging was demonstrated during the Pembroke Power Station capital dredging and the 2010 maintenance dredging, whereby the group agreed to defer some of the 2010 maintenance dredging in order to allow sufficient capacity at the disposal site for RWE to carry out their works in 2010/11. Without such a group approach the agreement on priorities could have been more contentious. The Dredging Liaison Group continues to provide an integrated platform for discussion and dissemination of dredging specific information and cooperation.

### **13. Hydrographic Survey**

In 2008 the need for regular bathymetric surveys was recognised. MHPA took action on this and since 2009 regular surveys have been carried out of all of the maintenance dredge areas on an annual basis. One central data repository has been established so that new information can be incorporated into relevant documents and charts.

Given the nature and sensitivity of the Milford Haven estuary it is essential that key areas are surveyed annually so that the future requirements can be accurately predicted at least 12 months, and sometimes 24 months, in advance. There is now over 12 years' worth of reliable survey data available on which sedimentation patterns can be assessed and predictions can be generated.

In line with the strategic approach, the dredging Liaison Group has agreed to continue with the annual Hydrographic survey of all maintenance dredge areas in Milford Haven.

### **14. Sediment Sampling**

As part of the disposal licence application process, there is a requirement to submit sediment samples to CEFAS for chemical analysis. The number of samples and the locations are usually determined by CEFAS based on the disposal application details. Sediment samples, associated with the 2017 multi-year term maintenance dredging disposal licence, were taken from seven locations that required maintenance dredging within the 5 year term of the license. These samples were analysed by CEFAS and were all found to be suitable for offshore disposal. The sampling has to be repeated every 3 years with the most recent samples being collected and analysed in 2021

The sediment samples are tested for heavy metal contamination as well as such as organotins (TBT and DBT), PCB's and PAH's. If any of the samples tested are found to be above the designated threshold levels, as set by the regulatory authority, then offshore disposal from that area may not be permitted. If this is the case then other disposal options for that particular material may have to be sought. There is now a significant historical database of sediment sampling results covering the maintenance dredge areas. To date, none of the testing carried out has found any contamination that would prevent sea disposal of the sediments.



The CEFAS guidelines comprise two Action Levels (AL), which are used as part of a weight-of-evidence approach to assessment on a case by case basis. In general, if contamination levels are below AL 1 then the materials are likely to be considered chemically 'clean'. Between AL 1 and 2, further testing may be required to identify any management techniques that may be required before sea disposal can be authorised. At levels above AL2, material may be considered too contaminated for sea disposal or require specialised dredging/disposal techniques.

An alternative or additional approach to assessing sediment quality is the use of the Interim Sediment Quality Guidelines (ISQGs) for the protection of marine aquatic ecosystems. English Nature has acknowledged the ISQGs as being appropriate for use in the UK given the lack of national standards. The ISQGs comprise two levels, the first (and lower level) being the ISQG, the level below which no effects would be expected on marine aquatic life. The second level is the Probable Effects Level (PEL) and sediments containing contamination at this level would be expected to cause effects in 50% of organisms. Between the two levels, a further assessment would be necessary to identify any necessary management actions in the same way as for CEFAS Action Levels.

Sediment sample analysis is usually valid for 3 years. Once the sample requirement has been defined by CEFAS then it will be necessary to submit additional samples for analysis prior to the three-year deadline. This is particularly important if a 5 or 10year disposal licence is obtained. The sampling is undertaken by MHPA as part of the overall strategic approach to dredging.

#### **14.1 Sediment Type Investigation**

A detailed map and dataset of sedimentary habitats in the Milford Haven Waterway were compiled for the Milford Haven Waterway Environmental Surveillance Group (MHWESG), from seafloor images collected in May 2012. This was the most comprehensive assessment of sediment distribution and benthic habitat composition available for the Milford Haven Waterway. The results included grain-size information, biological characteristics, and evidence of sediment transport conditions and effects of biological activity. In the context of the Milford Haven Waterway, an interpretative framework was developed that classified each of 559 stations within a 'facies distribution' map that included information on the location within the estuary and inferred sedimentary and biological processes. This framework groups the stations into classes with similar sediment transport conditions used to describe landscape-scale habitats and can be used to direct future monitoring activities within the Milford Haven Waterway.

Below are extracts from the report (*Sediment-Profile Imaging of Milford Haven Waterway, Wales, UK, May 2012*) showing the interpretation of the surface sediment types gathered during this comprehensive study. This information has been used to further inform the dredging strategy with regard to the conditions on the seafloor in the dredge areas.



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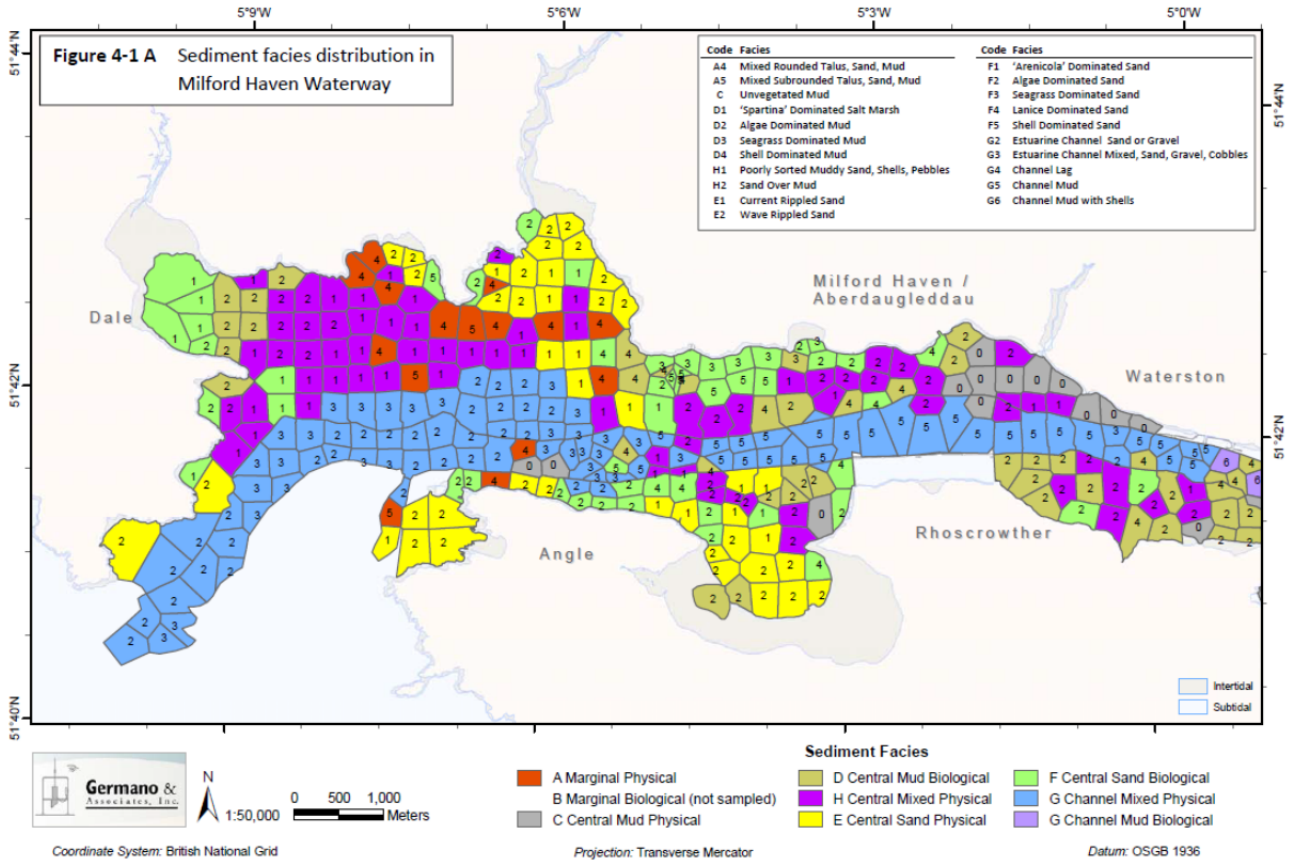


Figure 9. SPI sediment classification from May 2012 – Lower Estuary

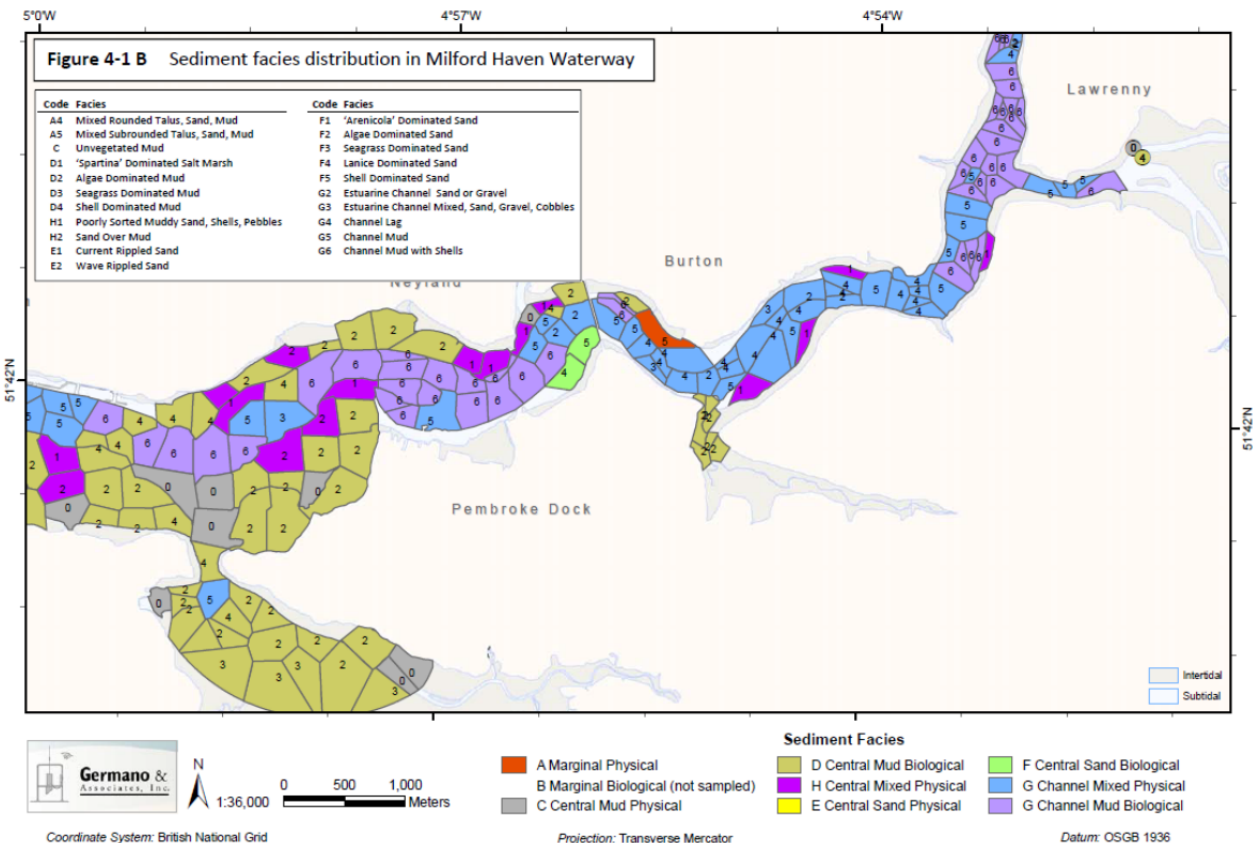


Figure 9. SPI sediment classification from May 2012 – Upper Estuary

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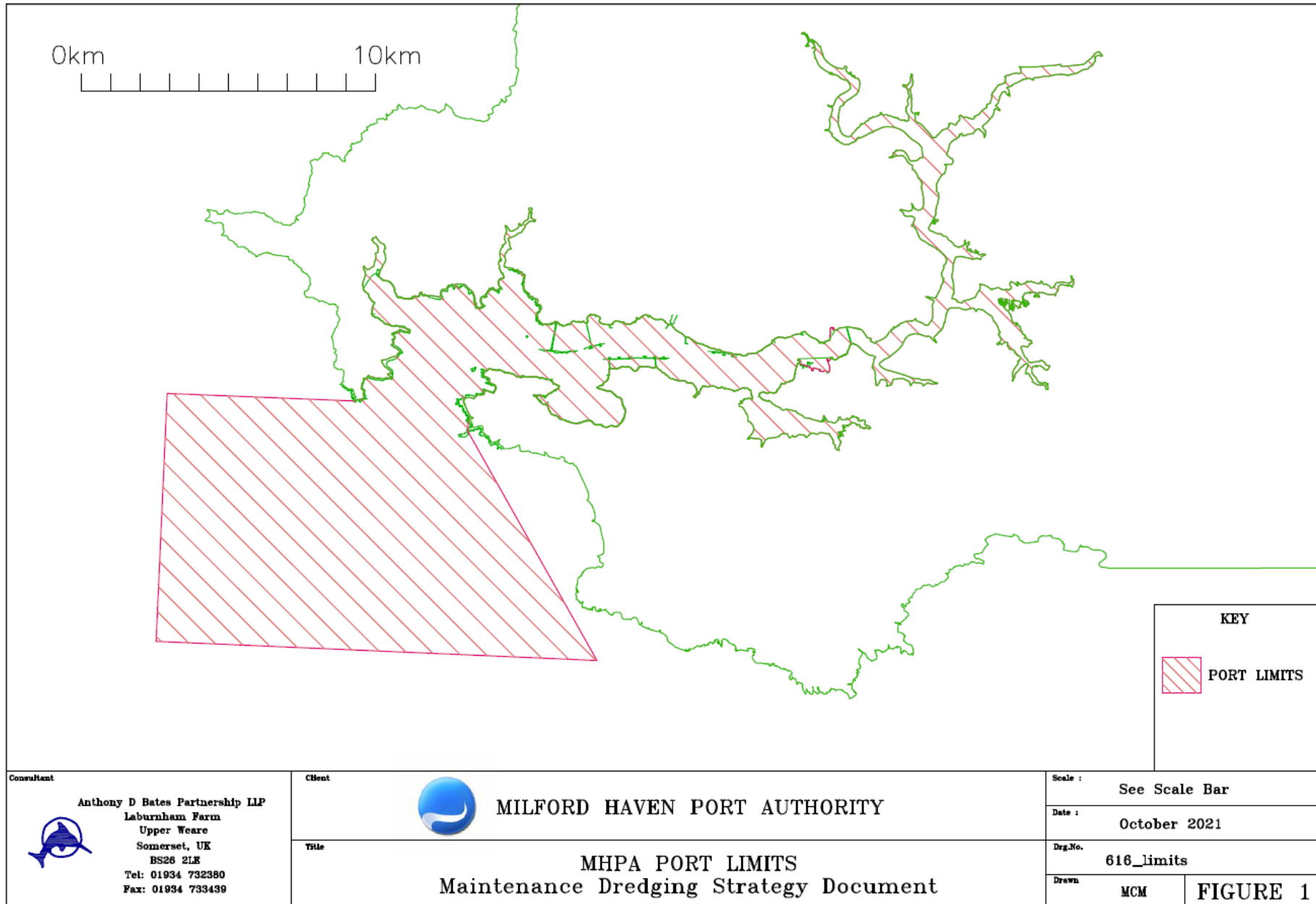


## FIGURES

Figure 1	MHPA Port Limits
Figure 2	Pembrokeshire Marine SAC Limits
Figure 3	Milford Haven Offshore Disposal Sites
Figure 4	Dredging History of Milford Haven
Figure 4a	Maintenance Dredge Areas

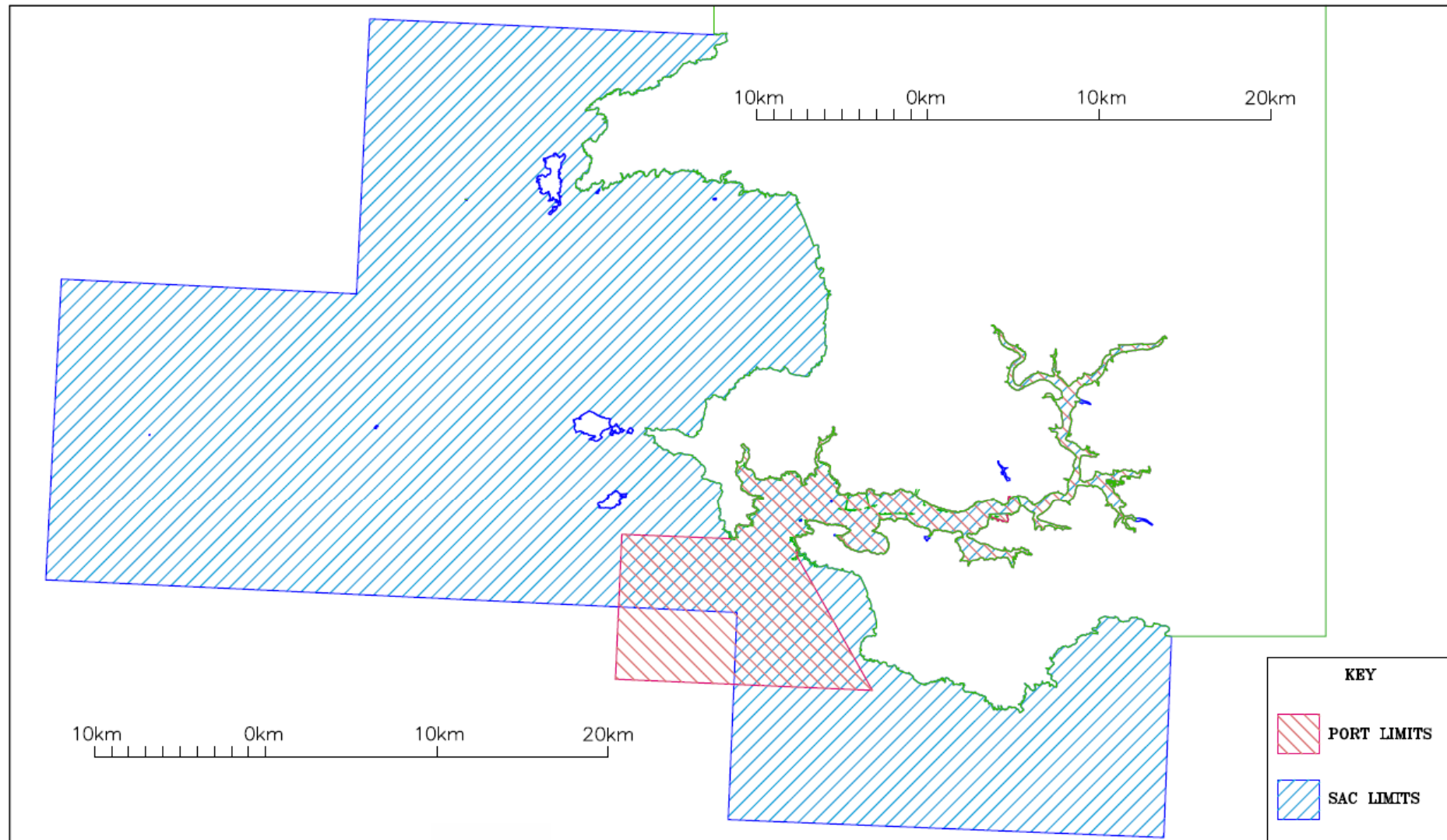


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# MILFORD HAVEN PORT AUTHORITY Dredging Strategy Document



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 MILFORD HAVEN PORT AUTHORITY

**Title**

PEMBROKESHIRE MARINE SAC LIMITS  
 With MHPA Limits Overlain

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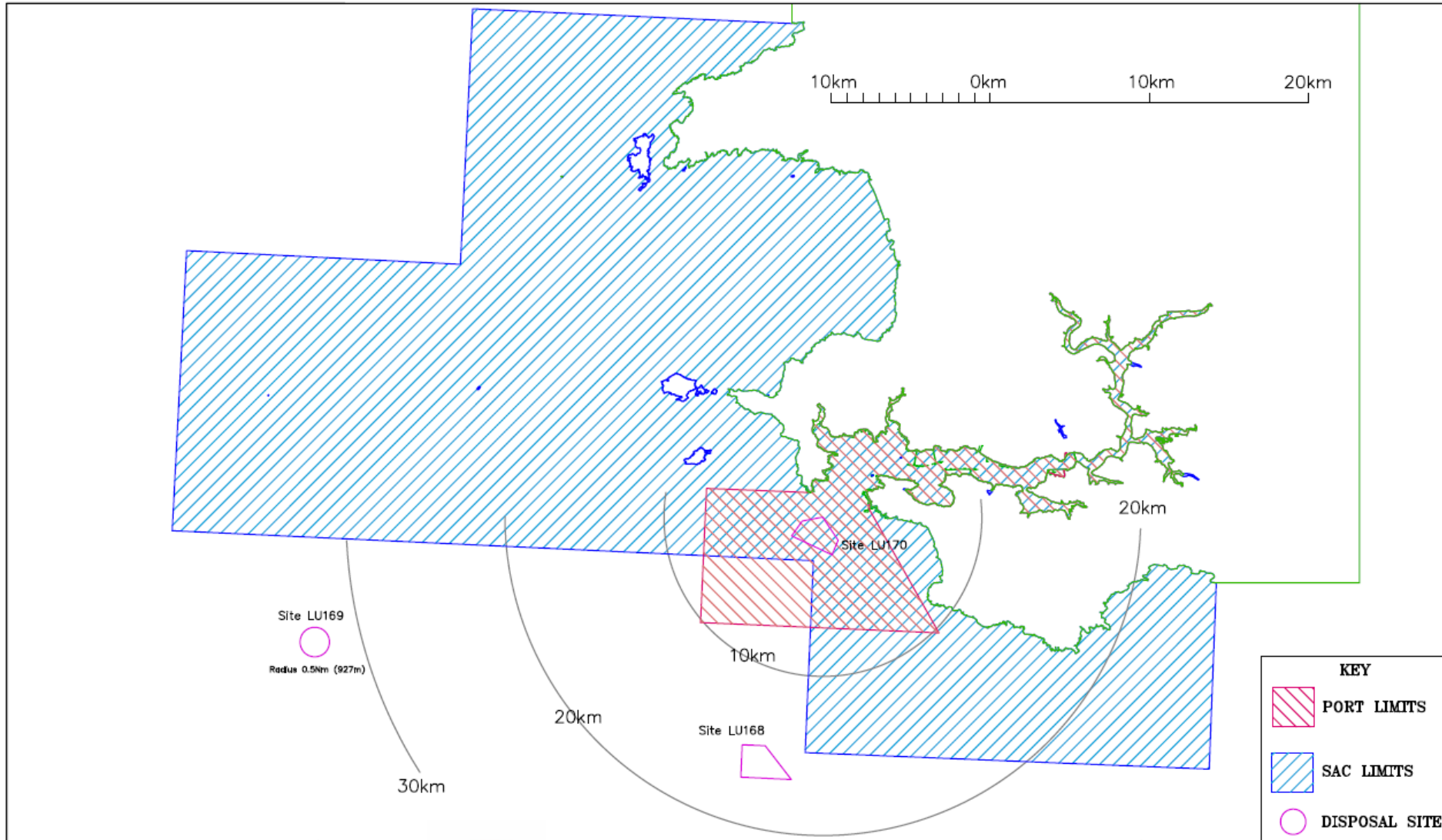
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**Drawn** MCM **FIGURE 2**



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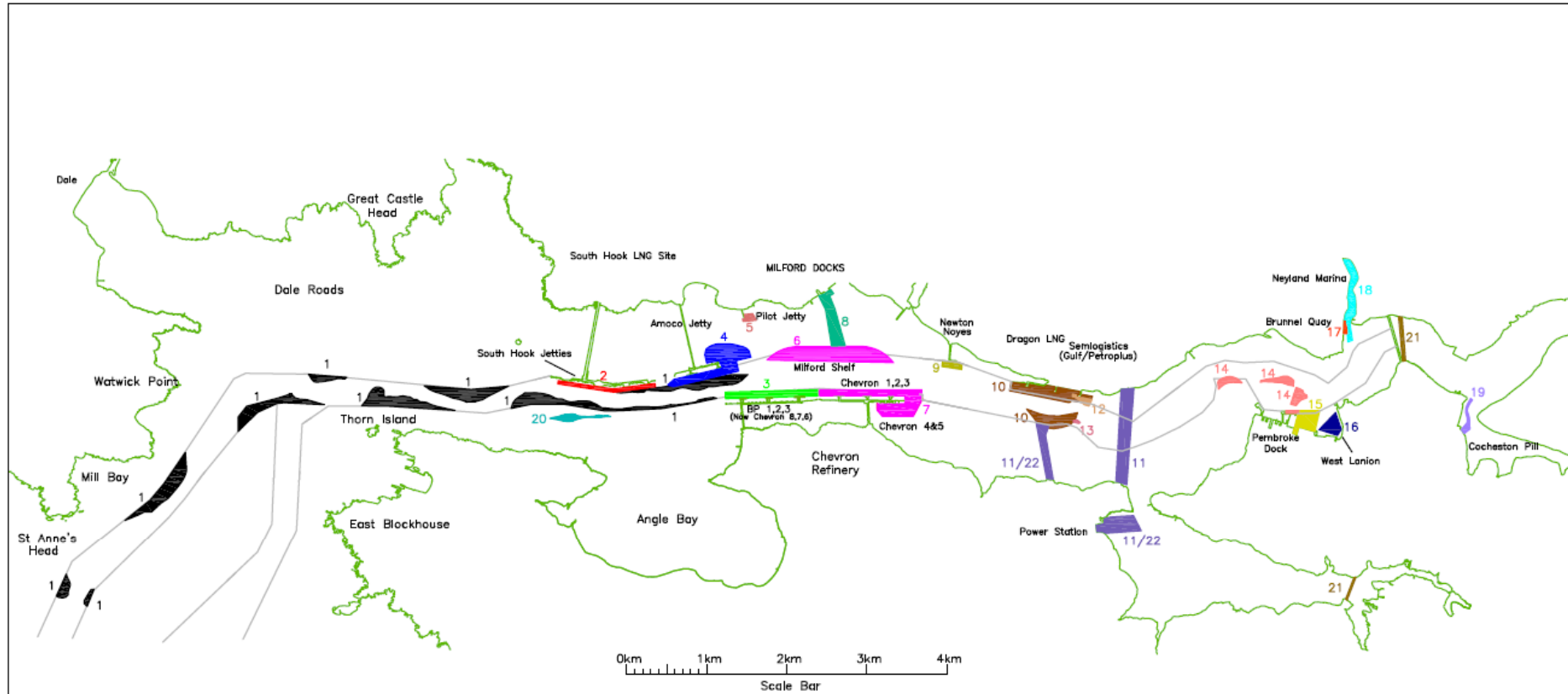
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 MILFORD HAVEN PORT AUTHORITY

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**Drawn** MCM **FIGURE 3**




# MILFORD HAVEN PORT AUTHORITY Dredging Strategy Document



1 Phase I & II Channel Widening 1967–1971	7 Texaco Jetty Construction 1964	13 Wear Spit Channel Widening 2006	19 Cosheston Pill Channel Dredging 1993
2 ESSO Berth Construction 1967 to 1971	8 Milford Dock Channel 1888	14 RoRo Terminal Upgrade 1998	20 South Hook Channel Widening 2006
3 BP Jetty Construction 1961	9 Newton Noyes Jetty Construction 1939	15 Pembroke Dock Construction 1986	21 Midland Oil Pipeline (1972)
4 Amoco Jetty Construction 1973	10 Gulf Oil Jetty Constuction 1968	16 West Lanion Pill Dredging 1990	22 Channels Re-instated (2010)
5 Pilot Jetty Construction 1962	11 Pembroke Power Station Construction 1971	17 Brunnel Quay Dredging 1986	
6 Turning Basin Milford Shelf 1964	12 Semlogistics Berth 3 Deepening 2007	18 Neyland Marina Construction 1985	

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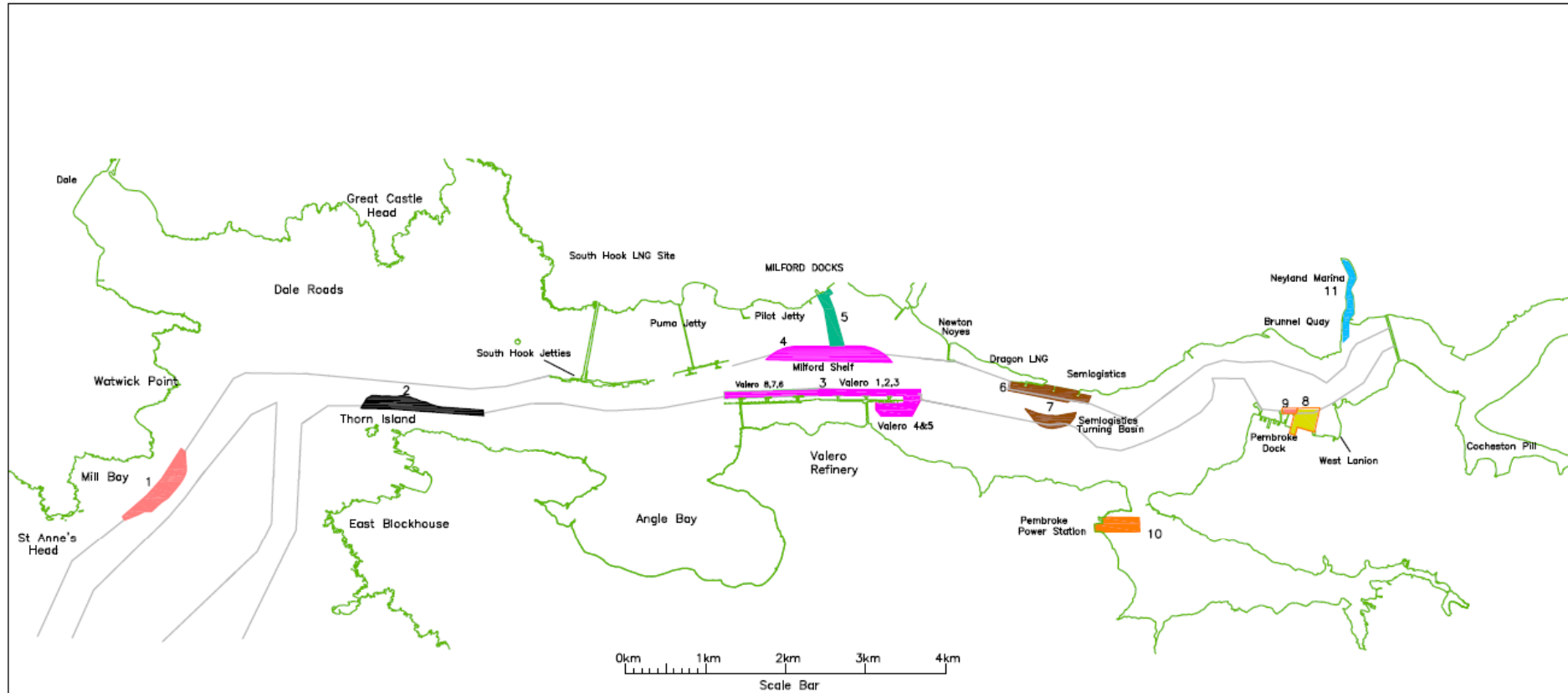
**Client**  

**MILFORD HAVEN PORT AUTHORITY**  
 Somerset, UK

**Title**  
**PROJECTS or PLANS in MILFORD HAVEN**


**Scale :** Use Scale Bar  
**Date :** October 2021  
**Dwg.No.:** 616 Dredging History  
**Drawn:** MCM **FIGURE 4**




# MILFORD HAVEN PORT AUTHORITY Dredging Strategy Document



1 Mill Bay	4 Milford Shelf	7 Semlogistics Berths 1, 2 & Turning Basin	10 Pembroke Power Station Intake
2 Thorn Island	5 Milford Docks Entrance Channel	8 Pembroke Port	11 Neyland Marine
3 Valero Berths 1-8 and Approaches	6 Dragon LNG Berth No1	9 Pembroke Ro-Ro Facility	

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**Title**  
 MAINTENANCE DREDGING IN MILFORD HAVEN

**Scale :** Use Scale Bar

**Date :** October 2021

**Dwg.No.** 616 Dredging Areas

**Drawn** MCM **FIGURE 4a**



## APPENDIX

### Tables

Table 1a	Disposal Records 1985 – 2002
Table 1b	Disposal Records 2003 – 2021
Table 2	Dredge Disposal Quantities (Graph)
Table 3	Provisional Dredging Requirement 2022-2031



## MILFORD HAVEN PORT AUTHORITY Dredging Strategy Document

### Table 1a - DREDGED QUANTITIES 1985 - 2002

Dredged Areas	Capital dredged	Last Dredged	1985	1986	1989	1990	1991	1992	1994	1997	1998	2002
Mill Bay	1970	2011	1000	0	0	0	0	0	1000	1000	0	0
Thorn Island	1972	2015	1500	0	0	0	0	0	1800	1000	0	0
South Hook Channel Widening	1972	Pre 1985	0	0	0	0	0	0	0	0	0	0
South Hook LNG Berths (formally ESSO)	1960	Pre 1985	0	0	0	0	0	0	0	0	0	0
Puma Berths	1973	Pre 1985	0	0	0	0	0	0	0	0	0	0
Valero Berths 1 to 8	1961/1964	2016	8000	0	0	0	0	0	0	37000	0	0
Valero Berths 4 & 5	1964	2016	25000	5000	32023	0	0	0	0	26000	6692	26700
Milford Shelf	1972	2016	0	3000	0	0	0	0	1000	1000	0	0
Milford Dock Approach	1888	2012	0	1175	0	0	0	0	0	0	0	0
Milford Docks	Unknown	Pre 1985	0	0	0	0	0	0	0	0	0	0
Newton Noyes Jetty	1939	1986	0	6000	0	0	0	0	0	0	0	0
Dragon LNG (formally Gulf & Petroplus)	1968	2016	0	1000	0	0	0	10000	0	0	0	1000
Semlogistics Berths 2 & 3 (formally Gulf & Petroplus)	1968	2016	17100	11000	0	0	0	94000	0	0	0	37400
Pembroke Powerstation outfall channel	1971	2010	0	0	0	0	0	0	0	0	0	0
Pembroke Powerstation cold water intake	1971	2016	0	0	0	7700	0	0	0	0	0	0
Pembroke Dock Ferry Terminal	1979	2016	500	0	0	0	0	0	0	0	10	0
Pembroke Dock	1986-1990	2016	2500	0	0	0	3400	0	5000	0	0	9440
Car Jetty	Unknown	1986	0	1808	0	0	0	0	0	0	0	0
Brunel Quay	Unknown	1986	0	1500	0	0	0	0	0	0	0	0
Neyland Marina (offshore disposal only)	1985	2011	0	0	0	0	0	0	0	0	0	0
Cosheston Pill	1994	1994	0	0	0	0	0	0	7400	0	0	0
West Llanion Pill	Unknown	1990	0	0	0	7000	0	0	0	0	0	0
Marine & Port Services Slipway	Unknown	1990	0	0	0	2400	0	0	0	0	0	0
			0	0	0	0	0	0	0	0	0	0
<b>Capital Dredging Post SAC Designation</b>			0	0	0	0	0	0	0	0	0	0
South Hook Channel Widening	2006		0	0	0	0	0	0	0	0	0	0
Semlogistics Berth 3 Deepening	2008		0	0	0	0	0	0	0	0	0	0
Pembroke Dock Channel Widening	1998		0	0	0	0	0	0	0	0	80000	0
Pembroke Powerstation outfall re-instatement	2010	2010	0	0	0	0	0	0	0	0	0	0
Pembroke Powerstation intake re-instatement	2010	2011	0	0	0	0	0	0	0	0	0	0
<b>TOTALS FOR YEAR</b>			<b>55600</b>	<b>30483</b>	<b>32023</b>	<b>17100</b>	<b>3400</b>	<b>104000</b>	<b>16200</b>	<b>66000</b>	<b>86702</b>	<b>74540</b>
<b>Maintenance Dredging Volume Only</b>			<b>55600</b>	<b>30483</b>	<b>32023</b>	<b>10100</b>	<b>3400</b>	<b>104000</b>	<b>8800</b>	<b>66000</b>	<b>6702</b>	<b>74540</b>
<b>Five Year Average (preceding 5 years)</b>			<b>0</b>	<b>0</b>	<b>23621</b>	<b>14521</b>	<b>9105</b>	<b>29905</b>	<b>25260</b>	<b>14960</b>	<b>16300</b>	<b>16248</b>
<b>5year Application Maintenance Dredge Sites Only</b>			<b>55600</b>	<b>21175</b>	<b>32023</b>	<b>7700</b>	<b>3400</b>	<b>104000</b>	<b>8800</b>	<b>66000</b>	<b>6702</b>	<b>74540</b>
<b>Five Year Average (preceding 5 years)</b>			<b>0</b>	<b>0</b>	<b>21760</b>	<b>12180</b>	<b>8625</b>	<b>29425</b>	<b>24780</b>	<b>14960</b>	<b>16300</b>	<b>16248</b>
<b>Capital Dredge Volume Only</b>			<b>0</b>	<b>0</b>	<b>0</b>	<b>7000</b>	<b>0</b>	<b>0</b>	<b>7400</b>	<b>0</b>	<b>80000</b>	<b>0</b>
<span style="color: red;">Red=Capital Dredging</span> <span style="color: blue;">Blue=Disposed at Site LU168</span> <span style="color: green;">Green=Disposal at Port Talbot</span> <span style="color: pink;">Pink=Capital Dredging with Disposal at Port Talbot</span>												
<span style="border: 1px solid black; padding: 2px;">Sites included in 5year Disposal License 2011 and 2017</span>												



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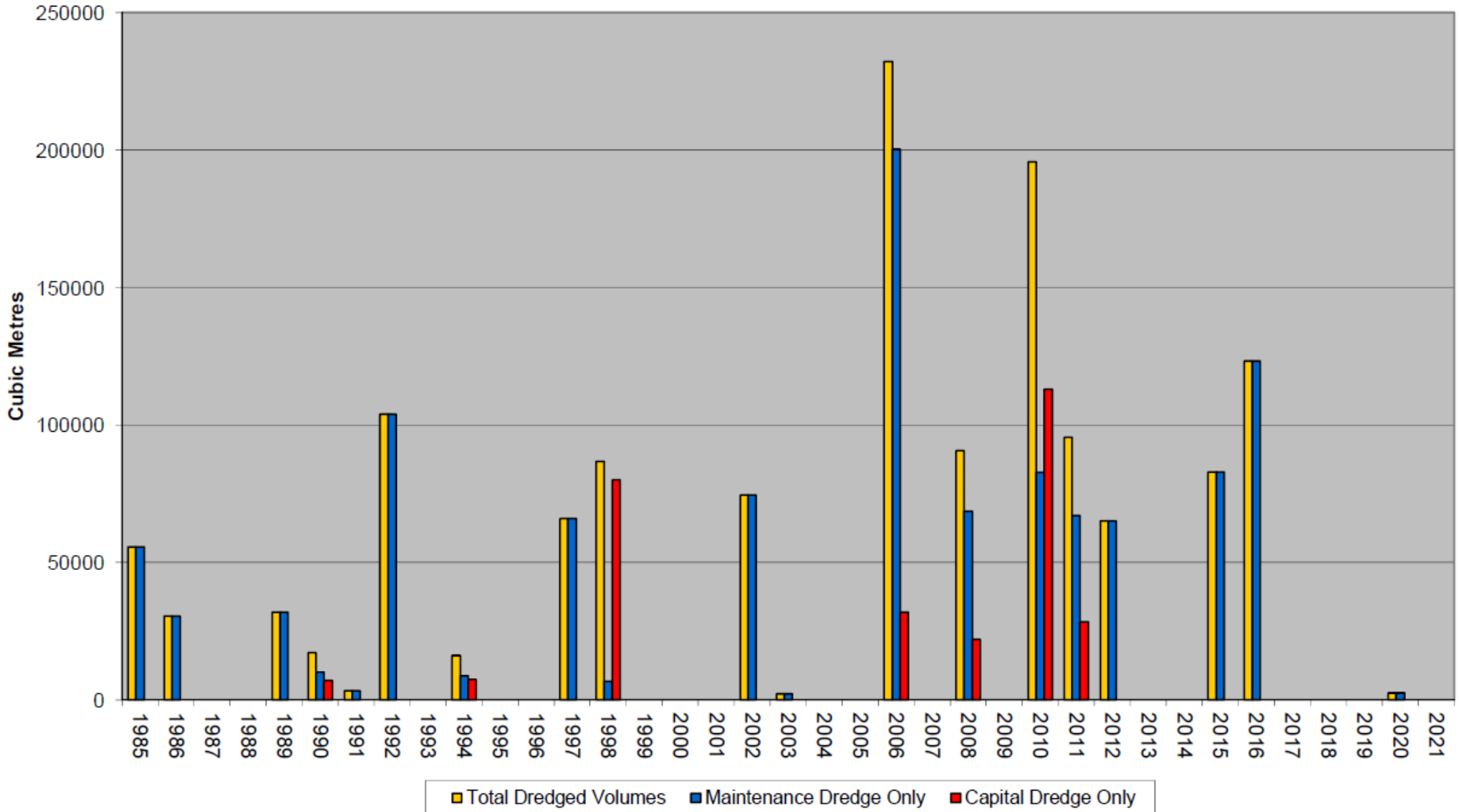
### Table 1b - DREDGED QUANTITIES 2003 - 2021

Dredged Areas	Capital dredged	Last Dredged	2003	2006	2008	2010	2011	2012	2015	2016	2020	Max Volume 1985 to 2021
Mill Bay	1970	2011	0	42350	0	0	39285	0	0	0	0	42350
Thorn Island	1972	2015	0	19584	0	0	26532	0	31945	0	0	31945
South Hook Channel Widening	1972	Pre 1985	0	0	0	0	0	0	0	0	0	0
South Hook LNG Berths (formally ESSO)	1960	Pre 1985	0	0	0	0	0	0	0	0	0	0
Puma Berths	1973	Pre 1985	0	0	0	0	0	0	0	0	0	0
Valero Berths 1 to 8	1961/1964	2016	0	71965	0	0	0	27069	10300	14832	0	71965
Valero Berths 4 & 5	1964	2016	1000	34308	0	45081	0	32941	14342	28855	0	45081
Milford Shelf	1972	2016	0	32132	0	0	1208	0	1200	2990	0	32132
Milford Dock Approach	1888	2012	0	0	0	0	0	1700	0	0	0	1700
Milford Docks	Unknown	Pre 1985	0	0	0	0	0	0	0	0	0	0
Newton Noyes Jetty	1939	1986	0	0	0	0	0	0	0	0	0	6000
Dragon LNG (formally Gulf & Petroplus)	1968	2016	0	0	5100	0	0	0	0	1436	0	10000
Semlogistics Berths 2 & 3 (formally Gulf & Petroplus)	1968	2016	1200	0	63500	0	0	3412	5841	48896	0	94000
Pembroke Powerstation outfall channel	1971	2010	0	0	0	0	0	0	0	0	0	0
Pembroke Powerstation cold water intake	1971	2016	0	0	0	0	0	0	0	7094	0	7700
Pembroke Dock Ferry Terminal	1979	2016	0	0	0	1068	0	0	0	725	0	1068
Pembroke Dock	1986-1990	2016	0	0	0	36572	0	0	19335	18458	2463	36572
Car Jetty	Unknown	1986	0	0	0	0	0	0	0	0	0	1808
Brunel Quay	Unknown	1986	0	0	0	0	0	0	0	0	0	1500
Neyland Marina (offshore disposal only)	1985	2011	0	0	0	0	0	0	0	0	0	0
Cosheston Pill	1994	1994	0	0	0	0	0	0	0	0	0	7400
West Llanion Pill	Unknown	1990	0	0	0	0	0	0	0	0	0	7000
Marine & Port Services Slipway	Unknown	1990	0	0	0	0	0	0	0	0	0	2400
	0	0	0	0	0	0	0	0	0	0	0	0
Capital Dredging Post SAC Designation	0	0	0	0	0	0	0	0	0	0	0	0
South Hook Channel Widening	2006	2006	0	31888	0	0	0	0	0	0	0	31888
Semlogistics Berth 3 Deepening	2008	2008	0	0	22000	0	0	0	0	0	0	22000
Pembroke Dock Channel Widening	1998	1998	0	0	0	0	0	0	0	0	0	80000
Pembroke Powerstation outfall re-instatemen	2010	2010	0	0	0	9143	0	0	0	0	0	9143
Pembroke Powerstation intake re-instatemen	2010	2011	0	0	0	103817	28430	0	0	0	0	103817
<b>TOTALS FOR YEAR</b>			2200	232227	90600	195681	95455	65122	82963	123286	2463	647469
												Average/yr
Maintenance Dredging Volume Only			2200	200339	68600	82721	67025	65122	82963	123286	2463	33872
Five Year Average (preceding 5 years)			15348	55416	53788	70332	43669	56694	43022	54274	25150	31169
												Average/yr
5year Application Maintenance Dredge Sites Only			2200	200339	68600	82721	67025	65122	82963	123286	2463	33506
Five Year Average (preceding 5 years)			15348	55416	53788	70332	43669	56694	43022	54274	25150	30950
Capital Dredge Volume Only			0	31,888	22,000	31,888	28,430	0	0	0	0	
<span style="color: red;">Red=Capital Dredging</span> <span style="color: blue;">Blue=Disposed at Site LU168</span> <span style="color: green;">Green=Disposal at Port Talbot</span> <span style="color: magenta;">Pink=Capital Dredging with Disposal at Port Talbot</span>												
Sites included in 5year Disposal Licence 2011 and 2017												



# MILFORD HAVEN PORT AUTHORITY Dredging Strategy Document

## Milford Haven Dredged Disposal Quantities Table 2





## MILFORD HAVEN PORT AUTHORITY Dredging Strategy Document

### Table 3 Provisional Dredging Requirement 2022 to 2031

Dredged Areas	Approximate Surface Area m <sup>2</sup>	Sediment Type*	Last Dredged	Approximate Annual Accretion	Provisional volumes to be dredged (m <sup>3</sup> )									
					2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Mill Bay	40000	C Sand	2011	6500		42000							45500	
Thorn Island	15000	M-F Sand	2016	3800		5000				15200			11400	
South Hook Channel Widening	7000	PS	2006	150										
South Hook LNG Berths	0	PS	Pre 1985	Negligible										
Puma Berths	0	Silt	Pre 1985	3900										
Valero Berths 1 to 8	30000	Silt	2016	7000		24000				28000				28000
Valero Berths 4 & 5	60000	Silt	2016	12000		50000				48000				48000
Milford Shelf	10000	Silt	2016	1050		3000				3150				3150
Milford Dock Approach	49000	Silt	2010	1600		3200				3200				4800
Milford Docks		N/A	Pre 1985	Not measured										
Dragon LNG	5000	PS	2016	1000		5000				4000				4000
VPOT Berths 2 & 3 and MD approach	35000	PS	2016	10200	45000	2500			40800					51000
Weir Spit 10m Channel widening	2400	PS	2006	Negligible										
Pembroke Power station outfall channel		Silt	2010	Negligible										
Pembroke Power station cold water intake	50000	Silt	2016	6500	32500				26000					32500
Pembroke Dock Ferry Terminal	2500	Gravel	2016	200		200				200				
Pembroke Dock	35000	Silt	2016	7900	7000	10000		2000		21700			15800	7900
Car Jetty		N/A	1986	Not measured										
Brunel Quay		N/A	1986	Not measured										
Neyland Marina (offshore disposal only)	32000	N/A	2011	Not measured										
Cosheston Pill		N/A	1994	Not measured										
West Llanion Pill		N/A	1990	Not measured										
Marine & Port Services Slipway		N/A	1990	Not measured										
Pembroke Dock Channel Widening	2000	N/A	1998	200		1000			1000					1000
<b>ESTIMATED TOTALS FOR YEAR to Site LU169 (m<sup>3</sup>)</b>				55500	84500	102900	0	2000	66800	123450	0	0	27200	179350
<b>ESTIMATED TOTALS FOR YEAR to Site LU168 (m<sup>3</sup>)</b>				6500	0	42000	0	0	0	0	0	0	45500	0
<b>ESTIMATED TOTAL DISPOSAL VOLUMES (m<sup>3</sup>)</b>				62000	84500	144900	0	2000	66800	123450	0	0	72700	179350

The above estimated program of dredging works is subject to change based on survey revisions, trade variations and plant availability

Red = Disposal at LU168

Blue = Ploughing

\* Sediment type based on D.M.Rostron 1982-198: C-Sand = Course Sand, M-F Sand = Medium to fine Sand, PS = Poorly sorted, N/A = Outside of sediment map area