PEMBROKE DOCK INFRASTRUCTURE PROJECT

Water Framework Directive Assessment Report

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1 INTRODUCTION

1.1.1 EU Directive 2000/60/EC, better known as the Water Framework Directive (WFD), established a framework for community action in the field of water policy. The WFD came into force in 2000 and required EU Member States to ensure that all inland and coastal waters achieve 'good' water quality status by 2015. The aims of the WFD are for Member States to:

1. Implement the necessary measures to prevent deterioration of the status of all bodies of surface water.
2. Protect, enhance and restore all bodies of surface water, subject to the application of subparagraph (iii) for artificial and heavily modified bodies of water, with the aim of achieving good surface water status by 2015.
3. Protect and enhance all artificial and heavily modified bodies of water, with the aim of achieving good ecological potential and good surface water chemical status by 2015.
4. Implement the necessary measures in accordance with Article 16 (1) and (8), with the aim of progressively reducing pollution from priority substances and ceasing or phasing out emissions, discharges and losses of priority hazardous substances.

1.1.2 The WFD 2000/60/EC was transposed into United Kingdom (UK) law by the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 (as amended). These Regulations were revoked in April 2017 by the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. The legislative framework sets out the legal requirements to protect and improve the water environment and sets out environmental objectives that must be met for all water bodies. The foundation of this is an ecosystem-based approach that requires measures to be taken to encourage the sustainable use of water and to protect and improve surface waters (including rivers, lakes, transitional and coastal waters), and groundwater bodies, with the aim of achieving good status.

1.1.3 In Wales, regard to the Environment (Wales) Act 2016 and the Well-being of Future Generations (Wales) Act 2015 is also to be considered. The overarching aims of the Environment Act is to enable Wales' resources to be managed in a more proactive, sustainable and joined up way. The Well-being of Future Generations Act requires 44 public bodies in Wales to work in a sustainable way and consider the impact their work can have for people living in Wales, now and in the future.

1.1.4 The WFD must also be considered in the planning and licensing of all new activities in water bodies (rivers, estuarine and coastal waters). Natural Resources Wales (NRW) is the competent authority in Wales for delivering the aim of the WFD, which is for all water bodies to achieve "good status". "Good status" comprises two parts. The first is "good ecological status", or "good ecological potential" for water bodies. The second is "good chemical status". "Good ecological status/potential" includes biological, hydromorphological and physicochemical quality elements and specific pollutants. "Good chemical status" concerns a series of priority substances, including a number of priority hazardous substances. The WFD also requires that relevant protected area objectives are achieved.

1.1.5 Milford Haven Port Authority (MHPA) have commissioned RPS to support them with their environmental permitting and consenting requirements for the Pembroke Dock Infrastructure (PDI) project which seeks to improve existing facilities at Pembroke Port, Pembroke Dock, Pembrokeshire, SA72 6TD. A full description of the proposed development is included in Chapter 2 (Project Description) of the Environmental Statement (ES). The proposed masterplan is included as Figure *1.1*

1.1.6 As part of RPS's support to MHPA, RPS has been requested to undertake an assessment in accordance with the WFD.

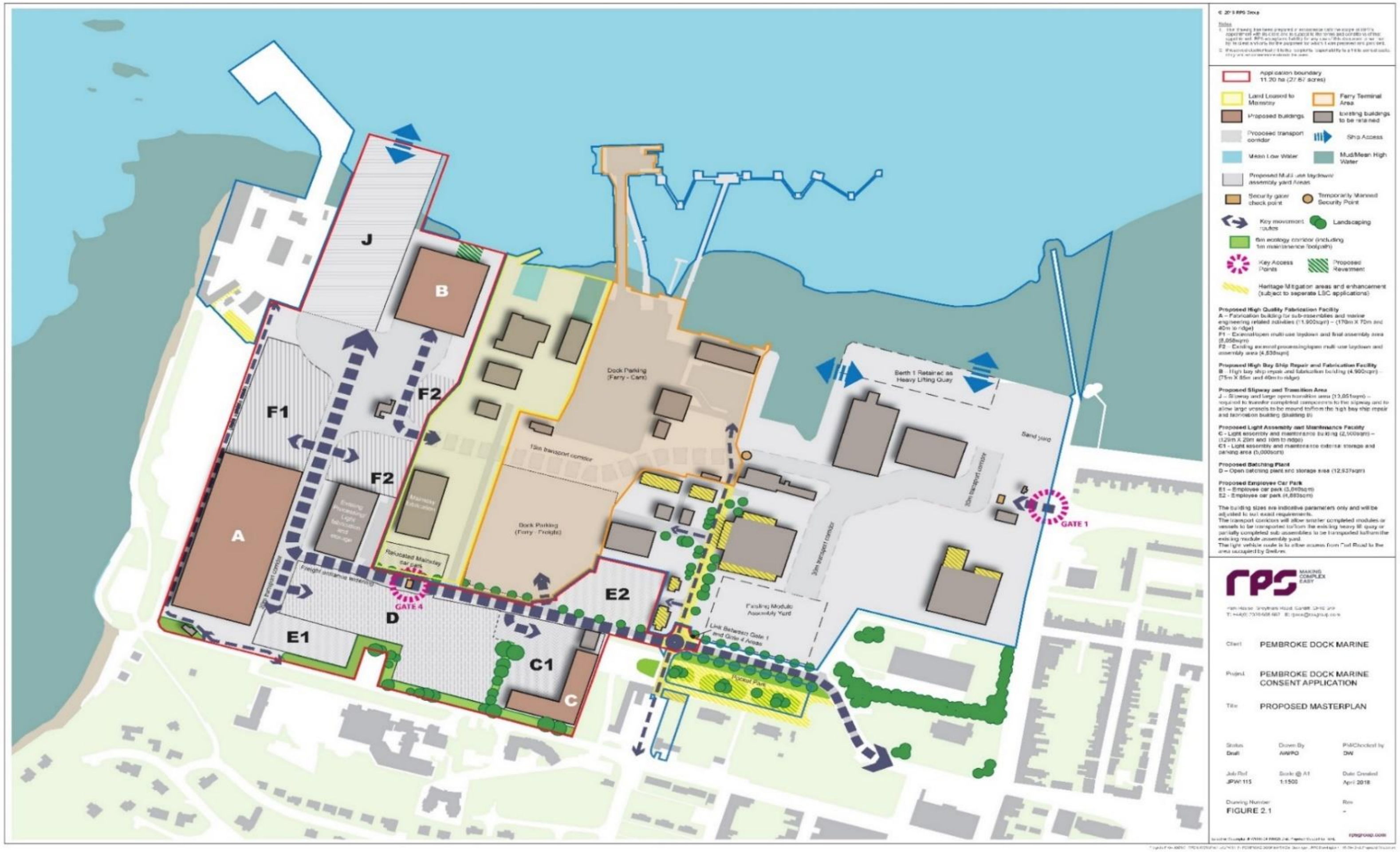
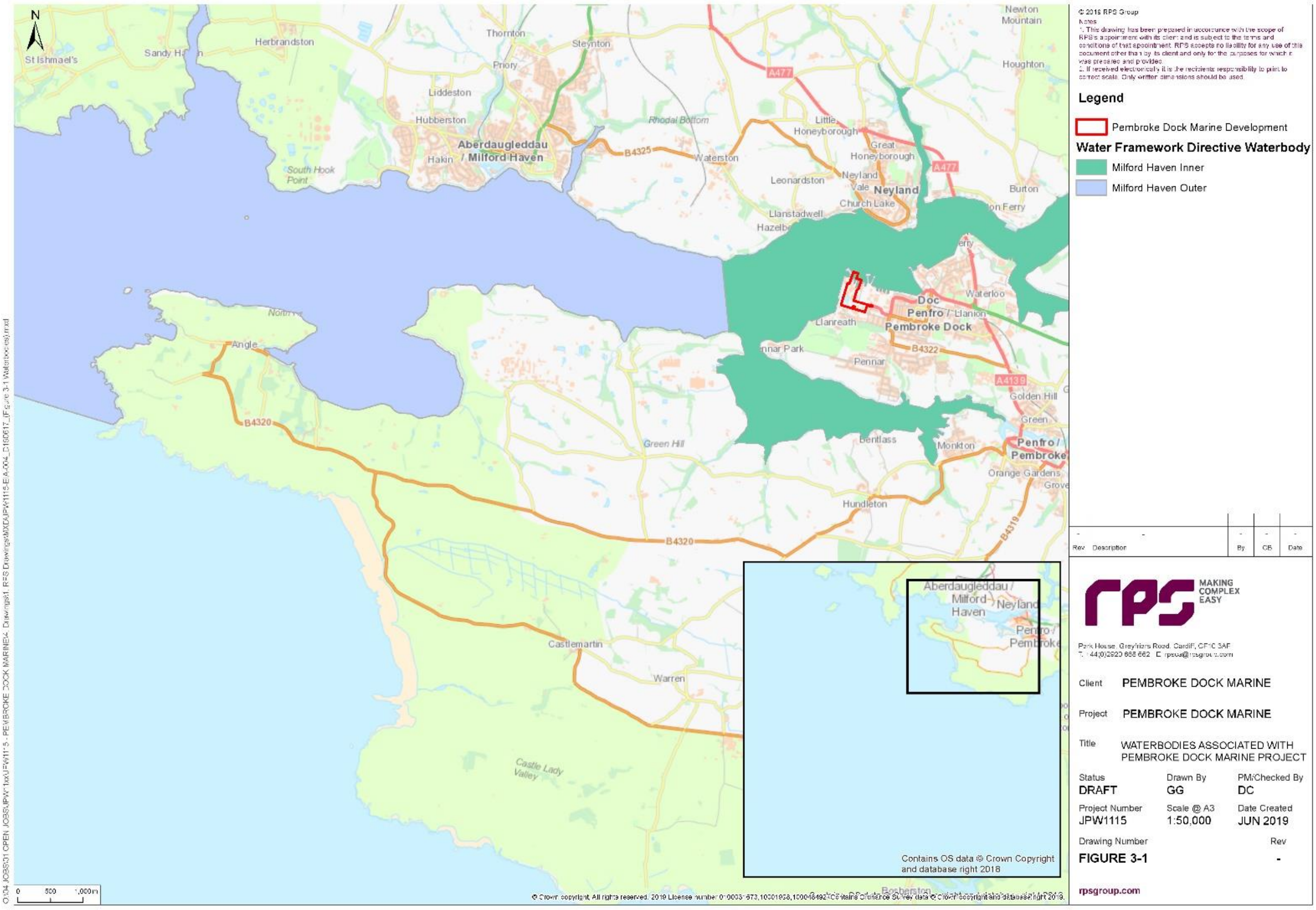


Figure 1.1: Proposed master plan for Pembroke Port Infrastructure project.

2 WFD BODIES

The proposed development has the potential to impact on two WFD water bodies either directly or indirectly; transitional water body Milford Haven Inner and coastal waterbody Milford Haven Outer. Milford Haven Inner is located within the project footprint; and Milford Haven Outer is located approximately 2 km to the west of the project footprint (



2.1.1 Figure *2.1*).

2.1.2 A baseline description of the biological, physio-chemical and hydromorphological quality elements, as presented in the WFD (2000/60/EC) are provided in Table 2.1 and Table 2.2 for Milford Haven Inner and Milford Haven Outer; respectively.

2.1.3 The Milford Haven Inner waterbody current overall status to meet its objectives is 'Moderate', with ecological status as 'Moderate (very certain)' and Chemical Status as 'Fail'. The reason for failing to meet good ecological status is due to high levels of dissolved inorganic nitrogen and macroalgae. The reasons for the chemical status of fail are currently not specified and mitigation measures are currently not in place (WWW, 2018).

2.1.4 Justification for not achieving good status by 2015 is because mitigation measures are not in place as they are disproportionately expensive (WWW, 2018).

2.1.5 As such the target objective for this waterbody is an overall status of 'Good' by 2027.

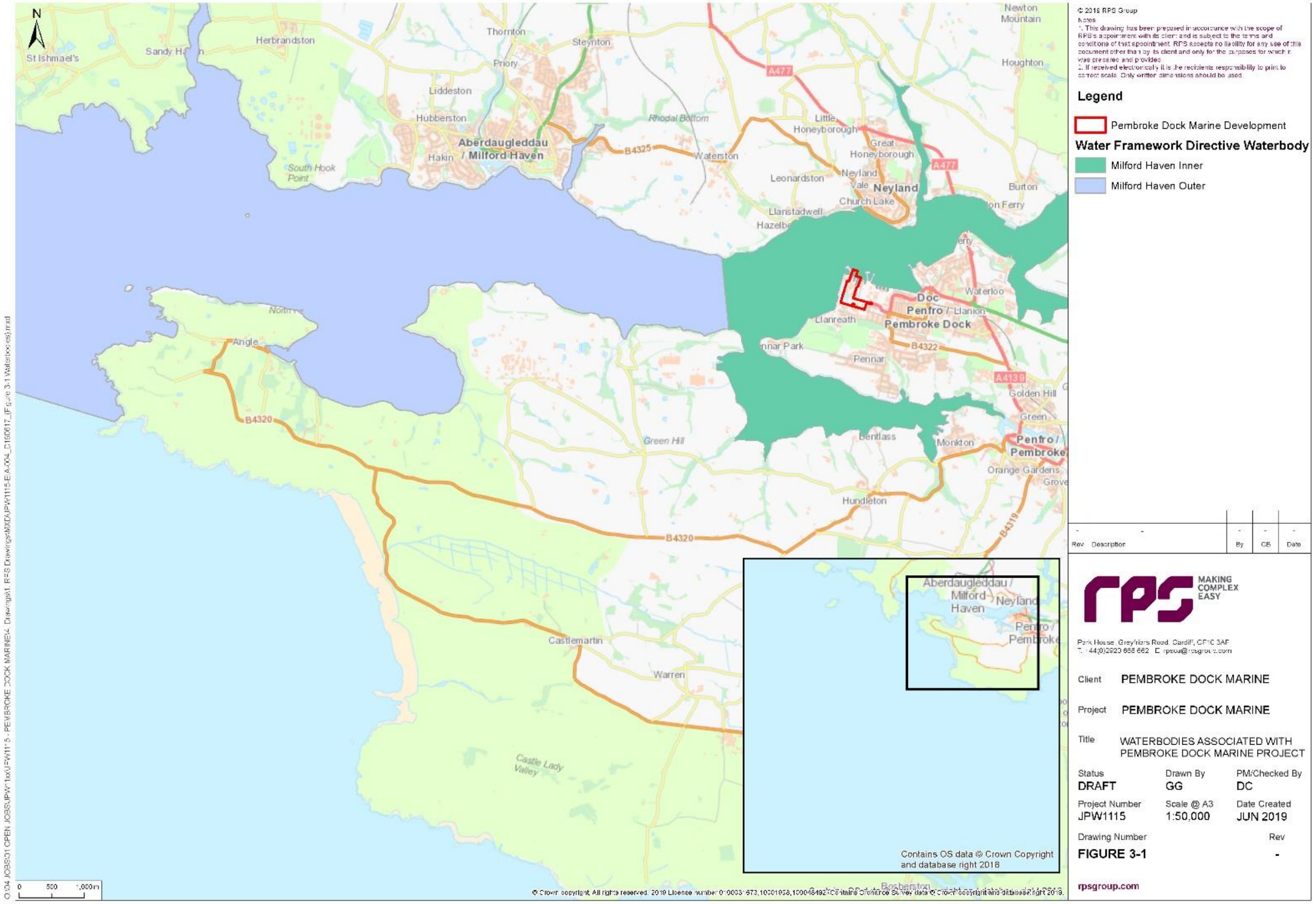


Figure 2.1: WFD Waterbodies associated with the Pembroke Dock Infrastructure Project.

Table 2.1: Milford Haven Inner waterbody WFD Features and Objectives

Water body[1]	Description, notes or more information
WFD water body name	Milford Haven Inner
Water body ID	GB531006114100
River basin district name	Western Wales
Catchment	Cleddau and Pembrokeshire Coastal Rivers TraC
Water body type (estuarine or coastal)	Transitional
Water body total area (km^2)	21.02
Overall waterbody status (2015)	Moderate
Ecological status	Moderate
Chemical status	Fail
Target water body status and deadline	Good 2027
Hydromorphology status of waterbody	Supports Good
Heavily modified waterbody and for what use	No
Phytoplankton Status	High
History of Harmful Algae	Not monitored
Angiosperm Status	High
Invertebrates status	Good
Macroalgae status	Moderate
Fish status	Good
WFD protected areas within 2km	Yes

[1] Water body information was extracted from Water Watch Wales website.
https://magic.defra.gov.uk provides additional information on habitats and protected areas.

2.1.6 The Milford Haven Outer waterbody current overall status to meet its objectives is 'Moderate', with ecological status as 'Moderate (very certain)' and Chemical Status as 'Good'. The reason for failing to meet good ecological status is due to high levels of dissolved inorganic nitrogen. Justification for not achieving good status by 2015 is because mitigation measures are not in place as they are disproportionately expensive. Current justification for not meeting the overall status objective of 'Good' is that proposed mitigation measures are disproportionately expensive or technically not feasible (WWW, 2018).

2.1.7 As such the target objective for this waterbody is an overall status of 'Good' by 2027.

Table 2.2: Milford Haven Outer waterbody WFD Features and Objectives

Water body[1]	Description, notes or more information
WFD water body name	Milford Haven Outer
Water body ID	GB641008220000
River basin district name	Western Wales
Catchment	Not Applicable
Water body type (estuarine or coastal)	Coastal
Water body total area (km^2)	35.39
Overall water body status (2015)	Good

Ecological status	Moderate
Chemical status	Good
Target water body status and deadline	Good 2027
Hydromorphology status of water body	Supports Good
Heavily modified water body and for what use	No
Phytoplankton status	High
History of Harmful Algae	Not monitored
Angiosperm status	Good
Invertebrates status	Not monitored
Macroalgae status	Good
Fish status	Not monitored
WFD protected areas within 2km	Yes

[1] *Water body information was extracted from Water Watch Wales website. Magic maps provide additional information on habitats and protected areas.*

3 WFD ASSESSMENT PROCESS

3.1.1 A WFD assessment can comprise of up to three stages. All stages may not require completion dependent on the outcomes of each stage. The stages are:

- Stage 1: Screening – excludes any activities that do not need to go through the scoping or impact assessment stages.
- Stage 2: Scoping – identifies the receptors that are potentially at risk from your activity and need impact assessment.
- Stage3: Impact assessment – considers the potential impacts of your activity, identifies ways to avoid or minimise impacts, and shows if your activity may cause deterioration of the waterbody status or jeopardise the water body achieving good status.

3.1.2 This WFD Assessment Report has been developed in accordance with NRW guidance note OGN 072 (NRW, 2018a). Tables provided in the Scoping Section (Section 5) are based on the 'Clearing the Waters for All' guidance (EA, 2017) although they incorporate OGN 72 guidance information where appropriate.

4 SCREENING

4.1.1 The aim of the screening stage is to ensure that only those activities that may cause deterioration or prevent a water body from meeting its objectives are assessed further. The screening stage excludes any low risk activities that do not require a WFD scoping assessment to be undertaken and therefore associated impact assessment.

4.1.2 According to the Table 5 Appendix 4 of the NRW OG072 guidance document (NRW, 2018a), detailed assessment is required for the proposed development as a number of the activities described in the project description (ES Chapter 2) do not fall into any of the listed categories of activities where assessment is not required (NRW, 2018a).

5 SCOPING

5.1.1 Scoping assists with identifying elements within water bodies which may be impacted as a result of the activity, these will then progress to detailed compliance assessment. As part of scoping, the focus is on identifying components of the activity or project that have the potential to cause an impact and the quality elements potentially impacted (NRW, 2018a). A scoping assessment should be undertaken for each water body potentially affected by the project. Water bodies can be scoped out at this stage if it can be robustly demonstrated that there will be no impacts.

5.1.2 Scoping was completed for proposed activities against the receptors and criteria provided in the NRW OGN072 guidance note (NRW, 2018a) for two waterbodies, Milford Haven Inner and Milford Haven Outer, that were identified as being potentially impacted by the proposed development. Receptors that project activities were assessed against included:

- Hydromorphology;
- Water quality;
- Biology: Benthic habitats;
- Biology: Fish;
- Priority Species;
- Protected areas; and
- Invasive non-native species.

5.1.3 Results of the scoping assessment are provided in Appendix A. A summary of the scoping results is provided below in Table 6-1. Two waterbodies, Milford Haven Inner and Milford Haven Outer were initially identified as part of the scoping exercise. However, Milford Haven Outer waterbody located 2 km from the project was scoped out from further assessment as it was identified the waterbody status and objectives would not be affected by the project.

Table 5.1: Summary of Results from Scoping Assessment

Receptor	Waterbody	Potential risk to receptor?	Note the risk issue(s) for impact assessment
Hydromorphology	Milford Haven Inner	Yes	Some change to the physical form of the seabed is predicted causing change to intertidal zone and some depth variation
	Milford Haven Outer	No	The project will not affect the physical form or cause changes to sediment transport within the waterbody, depth or intertidal zone structure
Biology	Milford Haven Inner	Yes	Biological Quality Elements: fish, benthic invertebrates, macroalgae and angiosperm receptors have been taken forward for further assessment.
	Milford Haven Outer	No	Due to the distance the waterbody is from the project, impacts to identified biological quality elements and associated descriptors have been scoped out from further assessment
Fish	Milford Haven Inner	Yes	The project has the potential to restrict migratory fish movement from sediment plumes that will be generated during dredging activities. Underwater noise effects during dredging activities and preparation of the slipway have the potential to cause disturbance effects to fish behaviour. Potential for release of contaminants during dredging and dewatering activities has the potential to cause toxicity effects to fish eggs or larvae.
	Milford Haven Outer	No	Based on previous studies as described for water quality dredging activities will unlikely result in sediment plumes which could impact on fish behaviour and cause toxicity effects due to mobilisation of contaminants within the waterbody due to the distance from the project. Underwater noise effects from dredging will unlikely reach fish populations associated with water body as modelling (Appendix 6.2 of the ES has shown effects to be within 1km of the project footprint.
Water quality	Milford Haven Inner	Yes	Clarity of water could be affected from generation of sediment plumes during dredging over a continuous period of 14 days. Contaminant concentrations analysed from collected sediment samples within the dredge footprint exceed Cefas Action Level 1 concentrations for metals. Therefore, potential for release of contaminants into water column following disturbance.
	Milford Haven Outer	No	Existing studies indicate that sediment plume migration from dredging activities will not extend into waterbody located 2 km from the project. Studies have shown on an ebb tide plumes can migrate up to 1.5km. No effects to water quality are therefore predicted to this waterbody
Protected areas	Milford Haven Inner	Yes	Within 2 km of the project footprint the following protected areas are found: Pembrokeshire Marine SAC (27 m from project footprint)

Receptor	Waterbody	Potential risk to receptor?	Note the risk issue(s) for impact assessment
			Shellfish waters (1770 m from project footprint)
	Milford Haven Outer	No	The qualifying features associated with protected areas will unlikely be affected by the project due to the distance the project is to the waterbody as described above.
Priority Habitats and Species	Milford Haven Inner	Yes	Several listed migratory and non-migratory fish species and harbour porpoise and listed habitats exist within the waterbody. Sediment plumes generated during dredging activities could cause a barrier which may effect migratory fish movement within identified waterbody by creating a physical barrier. Underwater noise effects during dredging activities and preparation of the slipway have the potential to cause disturbance effects to fish and harbour porpoise behaviour. Potential for release of contaminants during dredging and dewatering activities has the potential to cause toxicity to fish eggs or larvae. Dredging activities have the potential to impact listed habitats through smothering effects from the deposition of dredge material outside the dredge footprint following resuspension and migration from the point of disturbance. Barge vessel movements during dredge disposal could increase collision risk associated with harbour porpoise movements Accidental spill events could impact on priority species and habitat during construction and operation
	Milford Haven Outer	No	Due to the distance the waterbody is from the project, impacts to identified priority habitats and species have been scoped out from further assessment.
Invasive non-native species Biology	Milford Haven Outer	No	The project will not affect the physical form or cause changes to sediment transport within the waterbody, depth or intertidal zone structure
	Milford Haven Inner	Yes	Biological Quality Elements: fish, benthic invertebrates and macroalgae receptors have been taken forward for further assessment.

6 DETAILED COMPLIANCE ASSESSMENT

6.1.1 This section considers the potential impacts of an activity, identifies ways to avoid or minimise impacts, and concludes if the activity may prevent any quality element within any waterbody achieving good status/potential or may cause deterioration.

6.1.2 Receptors or features identified as part of the scoping stage have been brought through for detailed assessment. Listed priority species and habitats have been included as part of Sections 6.10, 6.11 and 6.12. To address impacts on identified protected areas and in particular Special Areas of Conservation (SACs) within the two waterbodies Section 6.13 provides a summary of and reference to the Report to Inform Appropriate Assessment (RIAA) which forms part of the Habitat Regulations Assessment (HRA) – see Appendix 6.3 of the ES, and the overall Marine Licence application to NRW.

6.2 Hydromorphology

Baseline Description

6.2.1 The Milford Haven Waterway (MHW) is a deep macro-tidal ria estuary believed to have been created by the flooding of the Daugleddau river valley during the sea level rise at the end of the last Ice Age (Halcrow, 2012). The MHW main tidal channel is deep, with a typical depth of 20 m between the mouth and the Cleddau Bridge and a typical depth of 10 m upstream of the Cleddau Bridge to the confluence at Lawrenny Quay (Halcrow, 2012).

6.2.2 The topography of the seabed within the site is dominated by rugged, mainly igneous, but also sandstone and limestone, rocky reefs. Many areas of the seabed rise to considerable heights above the surrounding seabed, some forming islands and islets. Sandbanks formed in the lee of rocky reefs. Between the elevated areas of seabed are extensive undulating areas of rock, such as west of the Dale peninsula, and plains and gentle slopes of sediments.

6.2.3 The mean tidal range within the MHW varies from 6.3 m during spring tides and 2.7 m during neap tides. The tides in the MHW flow east during flood periods and west on the ebb with highest tidal currents found within the central channel of the MHW. Maximum tidal flows are 1.5 knots approximately three hours before high-water (HW) on a spring tide with the tidal flow in an easterly direction. On neap tides, maximum tidal flows of up to 0.7 knots are observed approximately 2.5 hours before HW.

6.2.4 The wave and tidal regime in the immediate vicinity of Pembroke Port is affected by local geological and hydrodynamic processes. Pembroke Port is situated on the outside meander of the Daugleddau river and where the river opens up into the MHW. Carrs Rock, immediately to the west of Carr Jetty, at the western boundary of Pembroke Port, is a submerged bedrock feature deflecting tidal currents, Hobbs Point, present to the east of Pembroke Port, is a headland providing shelter in its lee. Both geological features force the tidal currents to the northern side of the MHW and away from Pembroke Port, resulting in a relatively low energy environment, evidenced by the mudflats present to the east of Pembroke Port.

Impacts to Seabed Morphology from Dredging Activities

6.2.5 Sediments removed from the dredge footprint will be disposed offshore at a licensed disposal ground. Sediments within the dredge footprint are considered typical of the sediments that are found in low energy environments within MHW, comprising gravel, sand, silt and clay fractions. Should sediment particles become mobilised and migrate outside the project footprint following disturbance they will settle in areas of that typically experience high rates of sediment deposition and will be similar to the soft sediment substrates that already exist (Germano and Associates, 2013). Low levels of sediment deposition (2-4 mm) are predicted given the small dredge volume calculated. This will ensure that seabed morphology will not change within the waterbody and the objectives for the Milford Haven Inner waterbody will not be affected by the project.

Impacts to Hydromorphology from Physical Presence of Infrastructure

6.2.6 The project will slightly increase the depth (maximum depth of 6 m) in the intertidal and shallow subtidal area of Pembroke Port, primarily in the vicinity of the redesigned slipway, where an area of hardstanding between the two existing slipways will be removed and the two slipways will be replaced by a single, larger slipway in the intertidal, extending into the shallow subtidal. In addition, the Graving Dock will be infilled, although this will be entirely within the boundary of the existing Graving Dock so there will be no extension of the frontage of the dock walls.

6.2.7 The area of footprint of the project that extends into the inner Milford Haven Waterbody represents 0.01 km^2 or 0.05% of the waterbody.

6.2.8 It is therefore not expected that the proposed development will result in significant changes to the hydrodynamic regime of the waterbody due to the low energy conditions that already exist within the area. Any changes to the hydrodynamic regime will therefore be small and localised and not affect the WFD objectives of Milford Haven Inner waterbody being achieved.

6.3 Water Quality

Baseline Description

Salinity

6.3.1 There is a complex, dynamic salinity regime with in Milford Haven Inner waterbody. Data suggests that salinity remains relatively constant between 34.5-35‰ although some data indicates that salinity within the haven itself is more variable, falling to 33.5‰ during winter months and rising to 36‰ in summer months (NRW, 2018).

Dissolved Oxygen

6.3.2 Available data suggests water column dissolved oxygen is generally 100% saturation though recent survey data suggests that parts of MHW suffer levels as low as 86% (NRW, 2018).

Suspended Sediment Concentrations

6.3.3 There is limited natural sediment input from offshore areas (storm events, tidal excursion) and the rivers (bank erosion) that flow into the MHW, with anthropogenic factors identified as the primary source of sediment disturbance. Chronic sediment disturbance and re-suspension occur due to the continual development and industry throughout the MHW and land based anthropogenic activities from the catchment. Demolition of disused jetty structures, runoff from land disturbance and agriculture, pile-driving for construction, propeller wash and bow-waves of tankers, tugs, ferries, cargo and fishing vessels, by shellfish and bait-digging, and small vessel mooring have been found to be sources of sediment re-suspension. A major anthropogenic ongoing cause of sediment re-suspension within the MHW is likely to be periodic dredging as part of the capital and maintenance dredging operations by MHPA. Sediments re-suspended affect water transparency and therefore influence biotic processes.

6.3.4 Near Pembroke Port, the suspended sediment concentrations (SSC) as measured by turbidity and water transparency were found to be dependent on biogenic and anthropogenic factors. Turbidity data recorded in 2012 found that values ranged between a minimum of 2.3 formazin turbidity units (FTU) and a maximum of 19 FTU with a mean value over the period of 9.5 FTU. Turbidity peak values were recorded in spring and may have coincided with phytoplankton blooms, with lower values recorded during summer months potentially due to low rainfall and decreasing current speeds. Water transparency, determined by a Secchi disk, is dependent on particulate matter and dissolved substances in the water. Recorded values between 2009 and 2011 ranged from 1.2 m to 3.1 m.

Nutrients and Contaminants

6.3.5 Nutrient and contaminant levels are variable throughout the Milford Haven Inner and Outer waterbodies. Highly dynamic water movement maintains levels of many contaminants below detectable limits although low level chronic hydrocarbon residues are present in sediment sink areas in MHW (Little *et al.,* 2015). Coastal waters are considered to have raised levels of nutrients as a consequence of diffuse agricultural sources as measured by the recent Surveying the Waterway Environment for Pollution (SWEPT) project (awaiting publication). MHW has high levels of nutrients although comparison to background levels for open coasts suggest they are comparable (NRW, 2018b). Water column contaminant concentrations and fluxes are poorly known. Available data suggest that these too are comparable with typical inshore background levels found in the Pembrokeshire (NRW, 2018b).

Sediment Quality

Physical Characteristics

6.3.6 Sediments within the proposed development site comprise mud and sand fractions. From four samples collected within the slipway and Graving Dock dredge areas, mud consisted of 74% with sand fractions constituting remaining 26%. These results are typical of the sediments found in low energy environments within MHW which are characterised by low tidal currents and reduced wave action.

Contaminants

6.3.7 Sediment quality has been monitored in MHW since 1978 for hydrocarbons and heavy metals, following the Sea Empress spill occurring at the mouth in 1996. Data from 2007 to 2010 found that most of the SSCs, including PAH concentrations, have generally decreased. Long-term average hydrocarbon concentrations are marginally elevated over near-shore coastal background levels. Elevated metal concentrations have been observed in the central industrialised section of the waterway and in known or inferred sediment sink areas attributed to chronic anthropogenic inputs such as propeller wash and bow-waves of tankers, tugs, ferries, cargo and fishing vessels, by shellfish and bait-digging, and by small vessel mooring. Contaminant levels in many of the estuarine inlets of MHW are above levels known to have adverse effects on biota (e.g. Cosheston Pill, Angle, and Carew/Creswell).

6.3.8 NRW monitor the water quality status of the Milford Haven Waterway through the Water Framework Directive (NRW, 2020). The proposed dredge area is located within the Milford Haven inner transitional water body whereby a risk assessment for metals, organotins, and PAHs has been undertaken. Metals, including Cadmium, Copper, Iron, Lead, Manganese, Nickel and Zinc have been identified as 'not at risk' of contamination, with the exception of Mercury classed as 'at risk' of contamination. Organotins were assessed as 'probably not at risk'. The risk of PAH contamination to the Milford Have inner transitional waterbody were assessed as 'not at risk'. Additionally, the NRW have classified the transitional waterbody as of a 'moderate' status and hypernutrified compared to WFD nutrient standards, as a result there is localised evidence of impacts from excessive macroalgal growth on eelgrass and saltmarsh habitats. These nutrients have been identified to have likely originated from point and diffuse discharge sources (NRW, 2018c).

6.3.9 Sediment samples were collected during two sampling campaigns as detailed in Appendix 6.1: Marine Environment Baseline Report to assist with understanding physicochemical properties of sediments proposed to be dredged. Samples were analysed by a laboratory for a suite of contaminants and the results compared against AL1 (Cefas Action Level 1) and AL2 (Cefas Action Level 2) criteria. Cefas Action Levels are guideline criteria used as part of a weight of evidence approach to decision-making on the disposal of dredged material to sea. Contaminant levels found in dredged material below AL1 are of no concern and are unlikely to influence the licensing decision. However, dredged material with contaminant levels above AL2 are generally considered unsuitable for at sea disposal. Dredged material with contaminant levels between AL1 and AL2 requires further consideration and testing before a decision can be made.

6.4 Sediment contamination data from 15 samples located within areas proposed to be dredged indicate concentrations marginally above AL1 for all heavy metals (specifically, copper, lead, mercury and zinc) within the slipway footprint, although predominantly within surface sediments to a depth of 0.5 m. One site displayed concentrations of above AL2 for copper and lead with another site displaying concentrations above AL2 for zinc. Both samples were collected from surface sediments within the dredge area. Within the Graving Dock area, sediments displayed metal concentrations generally below AL1 except for chromium, nickel and zinc which were above AL1.

6.5 Organotin concentrations were found to be below the AL1 for samples collected except for surface samples collected at site 1 during 2018 sampling event and SBH304 collected during 2020 sampling event. Site 1 were found to exceed AL1 for Dibutyltin and AL2 for Tributyltin while site SBH304 was found to exceed AL1 for TBT.

6.6 Total Petroleum Hydrocarbon (TPH) concentrations were generally found to be above detection limits at all sites but were considered comparable to concentrations within the MHW ranging from <1 mg/kg to 75 mg/kg across all sites. However one site STP403 recorded an outlier concentration of 6600 mg/kg. No ALs exist for TPH.

6.7 PAH and PCB concentrations were below adopted guideline criteria for all sites from samples collected during 2018. However the 2020 sampling event generally recorded elevated PAH concentrations across all sites, i.e. above AL1; there is no AL2 for PAH compounds. The most contaminated site for PAH concentrations was the surface sample collected at STP403 which displayed concentrations over 1000 µg/kg for eight PAH compounds. AL1 guideline criteria is 100 µg/kg.

6.8 Organochlorine Pesticide (OCP) concentrations were generally below limit of detection for all samples collected at sample depths below 1.0 m except for Dichlorodiphenyltrichloroethane (DDT) which displayed concentrations for mid and deep samples at sites SBH301, SBH303 and SBH304. All surface samples displayed concentrations above the limit of detection for several OCP compounds. AL1 guideline criteria for DDT was exceeded at sites SBH302, SBH304 and SPT403.

6.9 Sediment contaminant data indicated elevated levels above Cefas AL1 guideline criteria for heavy metals, PAHs, PCBs generally within surface sediments across the dredge footprint. AL2 was exceeded at a surface sample at one site for copper and lead during 2020. Contaminant concentrations in 2020 were generally higher than those identified in the 2018 sampling campaign and also when compared with background concentrations particularly within surface sediments.

Sediment Plume Generation during Dredging Activities

Suspended Sediment Concentrations (SSCs)

6.9.1 Capital dredging of the slipway footprint to allow for installation of the mega-slipway and removal of sediments within the Graving Dock will result in a total dredge volume of up to 45,840 m^3 of substrate. Sediments within the slipway footprint above mean low water spring (MLWS) along with material from the Graving Dock following installation of a temporary cofferdam at the entrance will be removed in dry conditions by land based excavation equipment. This means that the soft sediments above this level will not be released into the water column, leaving only the materials below MLWS to be considered as material to be dredged in the 'wet' using marine based equipment.

6.9.2 The volume of non-rock material to be dredged below MLWS is 8,904 m^3 and comprises of the following material types and volumes (as per results from a detailed ground investigation, Causeway Geotech, 2020):

- Silt and Clay - 3,551 m^3;
- Coarse Sand - 680 m^3;
- Gravel - 315 m^3;
- Gravel / Clay Bound Mudstone - 2,499 m^3; and
- Mudstone - 1,859 m^3.

6.9.3 All dredge material located below MLWS will be removed by backhoe dredge and will be re-used for other aspects of the development, notably as infill material of the timber pond.

6.9.4 During dredging, dependent on the type of material and localised hydrodynamic regime, sediments become mobilised into the water column and migrate away from the point of disturbance before settlement outside the dredge footprint.

6.9.5 To determine the fate of sediments to be released during dredging an estimate of the spill volume was calculated based on Aarninkhof *et al*. (2018) and Becker *et al*., (2015) was undertaken. For a backhoe dredge Aarninkhof *et al*. (2018) predicts a sediment volume of 3.5% release of the total dredge volume while Becker *et al*. 2015 states a sediment release of between 1-5% of the total dredge volume. For the purposes of this sediment plume assessment a conservative spill volume of 5% was assumed.

6.9.6 The fate of three types of sediment fractions was assessed, gravel, sand and silt during dredging flood and ebb spring tides.

6.9.7 For gravel fractions a total volume of 16 m^3 will be released. Based on the maximum current velocities a typically sized gravel particle would be transported 2 m from its origin.

6.9.8 For coarse sand the coarsest sand (which is the same as finest gravel) would be carried 10 m on peak ebb and 2 m on peak flood. The finest of the sand fraction may take up to 0.5 hours to settle out, which may extend the plume 700 m during peak ebb flows and 180 m during peak flood flows. Under typical current speeds, a sand particle would be transported 260 m and 100 m respectively.

6.9.9 If it is assumed all sand has this grading and the dredging is carried out over the course of at least one tide, the area affected would be circa 9400 m^2. The average deposition depth from 34 m^3 of sand is 3.6 mm, most of which is located within the dredge area. If fine sand fractions are assumed, the deposition depth is 1.1 mm. This indicates that the sand fraction is not likely to impact on areas beyond the immediate vicinity of disturbance and where settlement takes place it is of limited magnitude

6.9.10 For silt fractions an average silt particle of 0.03 mm diameter would settle from mean sea level to the bed in around 1.3 hours with no stimulus. When exposed to maximum spring currents the transport may be 1800 m on ebb and 500 m on the flood. However, peak currents only last for a fraction of the tide, therefore with average current speeds this is reduced to 690 m and 260 m for ebb and flood tides, respectively. It should also be noted, excursion to the east would bring particles in lower current speeds with reduced dispersion whilst to the west the reverse is true as the strong channel currents would be encountered.

6.9.11 If the dredging operation is undertaken over the course of both ebb and flood tides the settlement area under these conditions would be circa 66,000 m^2 with an associated sedimentation depth of 2 mm. It is anticipated that the dredging works will be undertaken over a 2 day period, i.e. circa 16 hours. Then the release rate of silt would be 11 m^3/hour with a settling period of 1.3 hours and the plume may consist of 14.1 m^3 of the silt fraction. If the plume is assumed to be of the dimensions shown above, i.e. extending 260 m to the east of the site and 690 m to the west and diminishing in height within the water column with increased distance, then the average excess suspended sediment concentration would be circa 200 mg/l during and for a limited period following the dredging works.

6.9.12 Elevated suspended sediment levels would be experienced in the locality of the site due to the silt fraction, similar to those experienced during a storm event (Little *et al*. 2009). However, beyond 500 m from the site, the large tidal currents would provide increased dispersion and the finer material would be indiscernible from background levels (Little *et al*. 2009).

6.9.13 In conclusion, the water quality of the Milford Haven Inner waterbody will not deteriorate and the water quality objectives will not be affected from temporary increase in SSC during dredging activities.

Contaminants

6.9.14 Capital dredging associated with the slipway and within the Graving Dock will remove up to 45,840 m^3 of substrate. All material from both areas will be removed in dry conditions except for 8,904 m^3 of material located within the slipway footprint below MLWS, which reduces the potential for release of sediments and therefore contaminants into the water column. Effect on sensitive receptors may arise where contaminated sediments are re-suspended into the water column and potentially dispersed over a wider area via currents or tidal movement.

6.9.15 Sediment contaminant data indicated elevated levels above Cefas AL1 guideline criteria for heavy metals, PAHs, PCBs and OCPs generally within surface sediments across the dredge footprint. AL2 was exceeded at a surface sample at one site for copper and lead during 2020. Contaminant concentrations in 2020 were generally higher than those identified in 2018 sampling campaign and also when compared with background concentrations particularly within surface sediments.

6.9.16 The contaminant concentrations associated with sediments within the proposed dredge area for the slipway, identified across the two sampling events, were typically found to be elevated compared with levels found in the wider MHW.

6.9.17 While surface sediments exceed adopted guideline criteria thresholds for heavy metals, PAHs, PCBs, the proposed dredge volume of sediments that will be exposed to the receiving environment from the slipway area is considered small. Removal of the material by backhoe excavator compared with dredging methods that disturb much larger volumes of sediments (e.g. Cutter Suction Dredge) will limit exposure of fine sediment to the water column and therefore the potential for contaminant elutriation. In addition, the majority of surface sediments that displayed elevated concentration of contaminants will be dredged in the dry limiting the exposure of contaminants to the receiving environment.

6.9.18 To determine the extent of potential release of contaminants as sediments are released during dredging activities, the dilution potential of released contamination can be inferred from the Sediment Plume Migration Assessment described above. In the sediment plume migration assessment the silt was assumed to be neutrally buoyant therefore even if the contaminant is not bound with the sediment the dilution will be of a similar magnitude. Consideration of typical silt particles associated with the dredging cycle, resulted in an average sediment concentration of around 200 mg/l which represents a dilution factor of 7,500 in relation to any contaminants bound to these particles. ELSID software was used to determine the likely dilution factor over a range of tidal conditions. The analysis showed that for the majority of the time (>85%) dilution factor is above 10 times and for more than half the time (≈55%) it is in excess of 50 times (further details on this are provided in paragraphs 6.128 – 6.134 of Chapter 6 of the EIA document).

6.9.19 Based on the highest contaminant concentrations identified within the dredge footprint and the lowest dilution factor (i.e. dilution factor of 8 identified during a flood tide which would occur <15% of the time during a flood tide event) concentrations would typically be below adopted AL1 guideline criteria within the mixing zone (10s of metres). For example a maximum copper concentration of 527 mg/l would be reduced to 65 mg/l slightly above AL1 and a PAH concentration of 2,920 mg/l would be reduced to 365 mg/l. By applying another dilution factor of 8 on top would reduce to below AL1 criteria within 10s of metres outside the mixing zone following initial dilution within the mixing zone. This assumes that all contamination would become elutriated into the water column following disturbance which is highly unlikely as the majority of contaminants are likely to remain bound to fine sediments.

6.9.20 Other potential sources of contaminant release during construction are from dewatering discharge activities associated with the Timber Pond. The water in the Timber Pond has been found to contain low contaminant levels and have similar physical properties to that of saline water from the surrounding MHW. Generally, contaminant concentrations were below levels of detection. Metal concentrations were above levels of detection but were relatively low (See Appendix B for laboratory analysis results data). The dewatering of the marine water that remains within the Graving Dock following installation of the cofferdam will not cause increase in contaminants in the receiving water column following discharge as care will be taken to ensure that sediment is not entrained in pump-out water.

6.9.21 There is therefore not predicted to be any effect on water quality from dewatering discharges and there will therefore be no implications for the objectives of the Milford Haven Inner waterbody.

Accidental Spill Events during Construction

6.9.22 There is the potential for the accidental release of pollutants into the marine environment during construction works, as a result of accidental spillage or leakage for example. Pollution may include diesel oil, leachates from cements and/or grouts used in construction.

6.9.23 The proposed development will include standard measures to control pollution during construction and these would be set out in a Construction Environmental Management Plan (CEMP). Adherence to these measures, standard best practice guidance and Environment Agency Pollution Prevention Guidelines would significantly reduce the likelihood of an accidental pollution incident occurring and impacting the waters of Milford Haven Inner and Outer waterbodies. Appropriate measures would include: designating areas for refuelling; storage of chemicals in secure designated areas in line with appropriate regulations and guidelines; double skinning of any tanks and pipes containing hazardous substances; and storage of hazardous substances in impervious bunds.

6.9.24 In the unlikely event that pollutants did enter the Milford Haven waterbodies they would likely be largely contained due to the low flow currents likely within the port area (defined as the area of MHW adjacent to the site located between the Carr Jetty and Ferry Terminal) which will assist with facilitating clean-up. In the unlikely event that pollutants were to enter the wider MHW during the construction phase they would be rapidly dispersed on the surface and in the water column and subject to twice daily tidal flushing, and so any effects on water quality would be limited. , In addition the applicant is highly trained and regularly exercised in the containment and cleanup of pollution given its role a port authority and its responsibility to the operation of the port and its users. With the measures adopted as part of the project in place, deterioration of the water quality within the Milford Haven Inner waterbody would not occur and the achievement of objectives not affected.

6.10 Biology: Habitats

Baseline Description

Intertidal Habitats

6.10.1 A detailed baseline assessment of the intertidal habitats associated with Milford Haven Inner waterbody are provided in Chapter 6, Section 6.3 (intertidal habitats) of the ES.

6.10.2 In summary, the following intertidal habitats have been identified within Milford Haven Inner waterbody:

- Intertidal mudflats (Welsh BAP priority listed);
- Sandy muddy shores;
- Moderately or low exposed rocky shore; and
- Seagrass beds (Welsh BAP priority listed).

6.10.3 The intertidal habitat in the immediate vicinity of Pembroke Port located within the Milford Haven Inner waterbody is littoral mud and low energy littoral rock.

Subtidal Habitats

6.10.4 A detailed baseline assessment of the intertidal habitats associated with Milford Haven Inner waterbody are provided in Section 6.3 (subtidal habitats) of the ES.

6.10.5 In summary, the following intertidal habitats have been identified within Milford Haven Inner waterbody:

- Mixed sediments (Welsh BAP priority listed);
- Rocky reef; and
- Seagrass beds (Welsh BAP priority listed).

6.10.6 The subtidal substrate near to Pembroke Port is mixed with varying proportions of silt/clay, fine sand, course sand and shells and cobble and rocky reef.

Physical Presence of the Project

6.10.7 Capital dredging of the slipway area and infilling of the Graving Dock will remove intertidal and subtidal benthic habitat within the project footprint. Maximum habitat loss around the slipway will constitute an area of 4,100 m^2, whilst dredging and infilling of the Graving Dock will remove 3,304 m^2 of habitat within the Milford Haven Inner waterbody.

6.10.8 Within the project footprint, both intertidal and subtidal sand and mud habitat will be removed. Both types of habitat whilst listed as priority habitats are extensive throughout the Milford Haven Inner waterbody and therefore the removal of this small area of habitat will not cause the extent of the habitat to significantly change or cause deterioration of this feature. The WFD objectives for the Milford Haven Inner waterbody will therefore not be affected by the project.

Increases in Suspended Sediment and Sediment Deposition from Sediment Plume Generation during Dredging Activities

6.10.9 Increases in suspended sediments and turbidity levels from dredging can, under certain conditions, have adverse effects on the marine flora and fauna. Increased SSC described above in Section 6.3 can affect filter feeding organisms through clogging and damaging feeding and breathing apparatus (Frid & Caswell, 2017) and impact on the photosynthetic rates through light attenuation as a consequence of increased SSC. Sediment disturbance will cause some sediment deposition outside the slipway dredge footprint potentially resulting in the smothering of benthic species and habitats.

6.10.10 Sediment deposition as sediment particles fall out of suspension are however predicted to be low. Previous dredging activities within Milford Haven waterbodies have identified deposition levels of between 1.2 mm and 4.3 mm (Little *et al.,* 2015). As outlined in paragraph **Error! Reference source not found.** above, the volume of sediment expected to be mobilised in the dredge footprint and dispersed in the wider area is small (i.e. volume of between 169 m^3 and 394 m^3 of fine material). Benthic communities occurring within the vicinity of Pembroke Port are likely to be tolerant to some degree to reduced light levels and smothering from sediment deposition due to the existing activities in the area such as propeller wash from vessel movements and maintenance dredging.

Intertidal Benthic Communities

6.10.11 Changes in light penetration are not relevant to the intertidal *Hediste diversicolor* and *Limecola* biotope (LS.LMu.MEst.HedMac) as the component species live in the sediment and are likely to be adapted to increased SSC (Tillin and Rayment, 2016). The LS.LMu.MEst.HedMac is also representative of Annex I 'Mudflats and sandflats not covered by seawater at low tide' benthic communities in the wider MHW. Similarly, characterising species of littoral mud, such as the Cirratulid polychaetes and cockles *Cerastoderma edule*, within Pembroke Port are considered to be resilient to increases in SSC and sediment deposition and there may even be some benefits if the dredged material releases additional organic matter into the marine environment, which may increase food availability for suspension feeders (Tillin and Marshall, 2016). Therefore, the littoral sand and mud habitat in the vicinity of the proposed development are considered to be of low sensitivity to increases in SSC and sediment deposition and therefore will not deteriorate as a consequence of the proposed dredging activities.

6.10.12 Littoral rock communities may be more vulnerable to increases in SSC and sediment deposition as their component species are characterised by algae and epifaunal suspension feeders. In turbid waters, light penetration would be decreased, inhibiting the photosynthetic activity of algae and potentially slowing growth rate. Sediment deposition can also slow growth if fine particulates cover the algae fronds. Suspension feeders may be vulnerable where particles interfere with their feeding and respiration rate. A characterising biotope of littoral rock - LR.HLR.FT.FserTX – is considered to be of medium sensitivity to increases in SSC and sediment deposition (D'Avack and Marshall, 2006). LR.LLR.F.Asc.X is not considered to be sensitive as the key species are likely to be tolerant of changes in the SSC (Perry, 2015). Given that the proposed dredging will be undertaken over a short period of time it is highly unlikely that increased SSC concentrations will extend over a sufficient period of time to cause an adverse effect. It is therefore not expected that a deterioration in this habitat will be observed and the objectives of the Milford Haven waterbodies affected.

6.10.13 Intertidal benthic communities on moderately exposed littoral rock are represented by the *Semibalanus balanoides* biotopes (e.g. LR.HLR.MusB.Sem). Whilst organic matter in SSC may provide additional food resources to filter feeders in this biotope, there is potential for increased scour and abrasion to affect vulnerable organisms and may lead to reduced spat settlement rates. However, due to the resilience of the key species, which have high reproduction and recruitment rates, no adverse effects to this habitat are predicted (Tilin and Hill, 2016).

6.10.14 Eelgrass communities, such as the LS.LMS.ZOS.Znol biotope, found to the east of the dredge footprint at Hobbs Point (1,100 m to the east) is likely to be sensitive to this impact since water clarity is vital for the growth and functioning of this photosynthetic plant. However, eelgrass communities are likely to survive short-term increases in turbidity and sediment deposition predicted from dredging activities and sensitivity would only be high if the plants at Hobbs Point experienced continuous burial (D'Avack *et al.*, 2015). This level of deposition is not, however, predicted from the sediment plume assessment undertaken, with sediment plume predicted to extend to a maximum of 500 m on a flood tide.

6.10.15 Given the low levels of suspended sediment and associated deposition predicted and temporary nature of the activity, deterioration of intertidal benthic habitats are not predicted and the achievement of the objectives of the Milford Haven Inner waterbody will not be hindered by the project.

Subtidal Benthic Communities

6.10.16 Subtidal communities within the vicinity of Pembroke Port will also be tolerant to changes in SSC and sediment deposition. Characterising polychaete species such as *Melinna palmata* and *Chaetozone gibber* have high growth rates and short life spans. Communities in the subtidal zone typify a deposit-feeding community, although disturbance from smothering effects from deposition of sediments recovery is unlikely and therefore the community is not predicted to be affected by the project from sediment deposition (De-Bastos, 2016).

6.10.17 In the wider MHW the subtidal mixed sediment is also characterised by polychaete worms, with amphipods and bivalves also abundant. As described above the polychaetes in the community are deposit feeders and therefore are unlikely to be affected by changes in the light penetration in the water column and would recover rapidly following changes to food availability. Suspension feeders such as *Abra alba*, may be vulnerable to increases in SSC if feeding apparatus becomes clogged, however, this species can also switch to surface deposit feeding if necessary and therefore is considered to be tolerant to increases in SSC (Budd, 2007) and is therefore not predicted to deteriorate as a consequence of the project.

6.10.18 Algae communities and benthic epifauna of subtidal rock habitat may have low resilience to the effects of increased SSC as reduced light availability can inhibit photosynthesis and limit the depth range at which algae grow. An increase in sediment deposition could provide a physical barrier to spat settlement and smother sessile epibenthos. *Sabellaria spinulosa*, a characteristic species of subtidal reefs found within the MHW, has high resilience to smothering and whilst there may be some curtailment of feeding and growth, recovery is likely to occur almost immediately following cessation of the impact (Jackson and Hiscock, 2008). Subtidal reef habitat is therefore predicted to not be affected by the project on a long-term basis from increases in SSC and sediment deposition from dredging activities.

6.10.19 Given the low levels of suspended sediment predicted and temporary nature of the activity, no deterioration of subtidal benthic habitats is predicted, or the overall waterbody objectives expected to be affected or restricted from being achieved in the long term.

Release of Contaminants during Dredging, Disposal and Dewatering

Intertidal Benthic Communities

6.10.20 In the wider MHW the sediment contaminant levels are elevated due to the high levels of industrial use in this area, with tankers, refineries, ports and harbours within the estuary (Little *et al.* 2015). The 'Mudflats and sandflats not covered by seawater at low tide' habitat within the

Milford Haven Inner waterbody is represented by the *Hediste diversicolor* biotope. *Hediste diversicolor* has been found living in estuarine environments with high levels of copper and its resistance to toxicity is likely to depend on its ability to detoxify the metal and store it in the tissues (Tillin and Rayment, 2016). Other estuarine species such as polychaetes are also resilient to heavy metals whilst bivalves, such as *Cerastoderma edule*, may decline in abundance if concentrations exceed a critical level (Tillin and Marshall, 2016). Given the tolerance of the community to existing high levels of contaminants and the low levels of contamination expected impacts to this habitat are not predicted (Section 6.3).

6.10.21 Reef habitat within the identified waterbody may experience a shift in community structure of component species due to elevations in contaminants although the release of contaminants at any identifiable concentrations from the proposed dredging activities is considered to be unlikely. Any disturbance to limpets and barnacles on reef habitat is likely to result in rapid re-colonisation although this will depend on processes such as larval supply and recruitment between populations. Given the tolerance of the community to existing high levels of contaminants and the low levels of contamination expected, impacts to this habitat are not predicted (Section 6.3).

6.10.22 The potential for release of contaminants is however low risk as discussed in Section 6.3. Sources for potential contamination include dredging and dewatering will be a single short-term temporary event, rather than an ongoing activity. In addition, the potential for release of high concentrations of contaminants is low given the low volumes of sediment to be dredged and high dilution factors identified. Therefore, no deterioration of the status of subtidal benthic habitats is predicted or the overall waterbody objectives expected to be affected or restricted from being achieved in the long term

Subtidal Benthic Communities

6.10.23 The subtidal communities within the vicinity of Pembroke Port are likely to be tolerant of increases in sediment contaminants as they exist already in a moderately disturbed environment. The characterising species are infaunal polychaetes, including *Melinna palmata* and *Chaetozone gibber* and amphipods *Ampelisca diadema* and *Photis longicaudata* are highly unlikely to become exposed to contaminants given the small volume of sediments to be dredged. These species tend to have a high reproductive capacity and therefore recovery is likely following a disturbance event. Given the tolerance of the community to existing high levels of contaminants and the low levels of contamination expected, impacts to this habitat are not predicted (Section 6.3).

6.10.24 Subtidal mixed sediment is also characterised by polychaete worms, with amphipods and bivalves also abundant. Contamination is ubiquitous throughout the waterbody and therefore communities will be tolerant to small increases in levels of pollutants. Like the polychaetes and amphipods, bivalves will vary in their tolerance to contaminants depending on the nature of the chemical. Mercury is likely to be the most toxic heavy metal to *A. alba* with lead less toxic (Budd, 2007). Hydrocarbons are considered to be the least problematic for bivalves in terms of contaminants although high levels may cause decreased respiration rates and a decrease in feeding rate (Budd, 2007). Recovery rates are considered to be high for the component species of subtidal mixed sediment and therefore no impacts are predicted from release of contaminants.

6.10.25 The potential for release of contaminants is however low risk as discussed in Section 6.3. Sources for potential contamination include dredging and dewatering will be a single short-term temporary event, rather than an ongoing activity. In addition, the potential for release of high concentrations of contaminants is low given the low levels of sediment to be dredged and high dilution factors identified. Therefore, no deterioration of the status of subtidal benthic habitats is predicted nor will the overall waterbody objectives be hindered by the project in the long term.

Accidental Release of Pollutants during Construction

6.10.26 An assessment was completed to assess the potential impacts of an accidental spill event on benthic habitats in Chapter 6 of the ES (Section 6.5 -Accidental Release of Pollutants during Construction). In conclusion, with appropriate mitigation and management plans in place, the risk of accidental spills will be minimised and therefore there will be no deterioration of subtidal benthic habitats within the waterbody or the overall status.

6.11 Biology: Fish

Baseline Description

6.11.1 A detailed baseline assessment of the fish assemblages associated with Milford Haven Inner waterbody is provided in Chapter 6 of the ES (Section 6.3 - Fish and Shellfish Ecology).

6.11.2 The fish assemblages of the Milford Haven Inner waterbody are typical of an estuarine environment. Gobies *Pomatoschistus spp*. are the most abundant species group with sand smelt *Atherina presbyter* and bass *Dicentrachus labrax* also occurring in relatively high numbers. Three species of thick-lipped mullet were also regularly recorded within the MHW. Otter trawls conducted for the Pembroke Power Station, approximately 2.5 km from the proposed development, recorded 19 species of fish including elasmobranchs, (thornback ray *Raja clavata*, lesser spotted dogfish *Scyliohinus caniculus*), demersal flat fish (plaice *Pleuronectes platessa*) and abundant gobies.

6.11.3 Several species of diadromous fish migrate through the estuary between seawater and freshwater, these include Atlantic salmon, sea trout and European eel, sea lamprey Petromyzon marinus, river lamprey *Lampetra fluviatilis*, allis shad *Alosa alosa* and twaite shad *Alosa fallax*.

6.11.4 The Milford Haven Inner waterbody coincides with spawning habitat for sandeel, plaice and sole, as mapped by Ellis *et al.* (2012). The sheltered estuarine conditions also provide a safe environment for juvenile fish and therefore are considered an important nursery area for sandeel, plaice, sole, whiting, herring, mackerel, spotted ray, thornback ray and tope shark (Ellis *et al.*, 2012).

6.11.5 Fish species that are mentioned above and listed as priority species under Section 7 of the Environment (Wales) Act 2016 include:

- Sand-eel (*Ammodytes marinus*);
- Tope shark (*Galeorhinus galeus*);
- Herring (*Clupea harengus*);
- Whiting (*Merlangius merlangus*);
- Thornback ray (*Raja clavate*);
- Mackerel (*Scomber scombrus*);
- Sole (*Solea solea*);
- Plaice (*Pleuronectes platessa*);
- Allis shad (*Alosa alosa*);
- Twaite shad (*Alosa fallax*);
- European eel (*Anguilla anguilla*);
- River lamprey (*Lampetra fluviatilis*);
- Smelt (*Osmerus eperlanus*);
- Sea lamprey (*Petromyzon marinus*);
- Atlantic salmon (*Salmo salar*); and
- Brown/Sea trout (*Salmo trutta*).

Sediment Plume Generation during Dredging Activities

6.11.6 Fish are sensitive to increases in SSC, both directly, through physiological and behavioural disruption, and indirectly, through habitat modification (e.g. smothering of spawning/nursery habitats). Increased SSC can impair foraging, increase mortality, affect growth, reproduction and survival at all trophic levels. However, there is also evidence to indicate that high sediment loads, and associated turbidity found in natural ecosystems can create feeding opportunities for some species such as demersal fish (Henley *et al*., 2000).

6.11.7 As mobile species, fish are likely to exhibit avoidance reactions and move away from the vicinity of adverse sediment conditions, particularly if refuge conditions are present (Sigler *et al.,* 1984; Bash *et al.,* 2001). Demersal fish species including plaice and thornback ray live partially buried in sediment on the sea floor and therefore are unlikely to be sensitive to increases in sediment deposition. Therefore, most individuals could tolerate or avoid any unfavourable discharges of particulate matter (Robertson *et al.,* 2006).

6.11.8 Excessive fine sediment (in suspension or deposited) can have damaging effects on all life stages of fish and particularly on fish eggs and larvae/fry (Robertson *et al*., 2006). Juvenile fish are more likely to be affected by habitat disturbances such as increased SSC than adult fish due to the decreased mobility of juvenile fish which makes them less able to avoid impacts. This could therefore have implications for spawning/nursery habitats.

6.11.9 Fish are also known to tolerate high levels of SSC and migrating fish species, such as salmonids, are commonly known to migrate through high SSC in estuaries (Salmon and Trout Association, 2015). In addition, migratory fish species, such as *Salmo salar*, often have an acute sense of smell which helps to direct them to their home grounds to spawn and therefore are not relying on visual cues to navigate (Heard, 2007).

6.11.10 Given the proposed dredging activities are predicted to temporary, of short duration and a low volume of sediments are predicted to be mobilised (Section 6.3), the impacts on fish from SSC and sediment deposition are predicted to be negligible and no deterioration of the status of this quality element is predicted nor will the achievement of waterbody overall objectives be hindered in the long term by the project.

Underwater Noise Emissions during Construction Activities

6.11.11 A detailed assessment was undertaken in Chapter 6 of the ES (Section 6.5 - Underwater Noise Emissions during Construction Activities) including modelling, which is presented in Appendix 6.2 of the ES, to assess the impacts of underwater noise emissions from dredging activities on fish populations. Model outputs were compared to adopted guideline criteria from Popper *et al.* (2014).

6.11.12 Based on modelling undertaken using the threshold criteria adopted, no injury to all fish species is predicted from non-impulsive noise source such as dredging. Some recoverable injury may be for some fish species such as gadoids and eels if dredging operation continued for 48 hours and fish remained within a few meters of the source for this period, which is highly unlikely given the high motility of fish who will move away from the noise source. All other fish species considered to be at low risk during non-impulsive noise such as vessel movements and dredging activities.

6.11.13 Behavioural effects in response to construction related underwater noise include a wide variety of responses including startle responses (also known as C-turn responses), strong avoidance behaviour, changes in swimming or schooling behaviour or changes of position in the water column. These may occur within the near (i.e. 10s of metres) to far field (i.e. 1000s of metres) based on Popper *et al.* (2014), depending on the source of noise. Criteria adopted from Washington State Department of Transport Biological Assessment Preparation for Transport Projects Advanced Training Manual (WSDOT, 2011) indicates behavioural effects from non-impulsive noise sources behavioural response is predicted within 19 m for vessel movements and 5 m for dredging.

6.11.14 Potential behavioural effects including barrier effects to migratory fish are possible given the narrow morphology of the MHW and may cause restrictions to the movement of migratory species. Modelling has predicted disturbance effects up to a intermediate distances for dredging activities. Therefore, if dredging is undertaken during the species migration periods some disturbance is likely across the width of the MHW. While disturbance effects could include restriction to migration, sound levels will highly unlikely result in a barrier to fish migrating within the MHW. At some point across the width of the MHW sound levels will be sufficient level for migratory fish species to pass.

6.11.15 Given that proposed effects are considered to be short term there will be no deterioration on the objectives of the waterbodies identified in the long-term.

Potential for Contaminant Release during Dredging

6.11.16 The sensitivity of fish to contaminants that could be released during the project will vary depending on a range of factors including species and life stage. Due to their increased mobility, adult fish (including migratory fish species) are less likely to be affected by marine pollution although are still susceptible to potential long-term effects. For example, effects of mercury bioaccumulation have been examined for subtidal fish (i.e., flounder, dab, whiting, plaice) and a positive correlation between fish size and mercury bioaccumulation was found (Baeyens *et al.*, 2003).

6.11.17 Fish eggs and larvae are likely to be particularly sensitive, with potentially toxic effects of pollutants on fish eggs and larvae (Westernhagen, 1988). Effects of re-suspension of sediment bound contaminants (e.g. heavy metals and hydrocarbon pollution) on fish eggs and larvae are likely to include abnormal development, delayed hatching and reduced hatching success (Bunn *et al.,* 2000). There are however, no spawning grounds for migratory fish in the vicinity of the Pembroke Port, therefore, it is only migrating adults/juveniles which have the potential to be affected.

6.11.18 The potential for release of contaminants is however considered low risk as discussed in Section 6.3. Sources for potential contamination include dredging and dewatering will be a single short-term temporary event, rather than an ongoing activity. In addition, the potential for release of high contaminant concentrations is low given the small volumes of sediment which will be dredged and high dilution factors identified. Therefore, no deterioration of the status of this quality element is predicted nor will the achievement of the waterbody overall objectives be hindered in the long term by the project.

Accidental Spill Events during Construction

6.11.19 An assessment was completed to assess the potential impacts of an accidental spill event on fish in Chapter 6 of the ES (Section 6.5 - Accidental Release of Pollutants during Construction). In conclusion, with appropriate mitigation and management plans in place there will be a minimal risk of accidental spillage and therefore there will be no deterioration of the status of this quality element is predicted or the waterbody overall objectives are expected to be affected or restricted from being achieved in the long term.

6.12 Biology: Marine Mammals (Priority Species)

Baseline Description

6.12.1 A detailed baseline assessment of the marine mammal species associated with Milford Haven Inner waterbody is provided in Chapter 6 of the ES (Section 6.3 - Marine Mammals). Marine mammals likely to be found within the MHW include harbour porpoise *Phocoena phocoena*, bottlenose dolphin *Tursiops truncates* and otter *Lutra lutra*.

6.12.2 Harbour porpoise and bottlenose dolphin are likely to occur within the lower reaches of the estuary with very few venturing as far up as Pembroke Port.

6.12.3 Higher levels of otter activity have previously been recorded within the MHW and therefore otter are likely to occur in the vicinity of the Pembroke Port.

6.12.4 The following provides a summary of the impacts considered, the assessment undertaken and the conclusions.

Collision Risk during Construction Activities

6.12.5 The ES (Chapter 6, Section 6.5) concluded no significant effect on marine mammal populations due to (i) the low speed of vessels, (ii) the short duration of the project construction and (iii) baseline levels of vessel activity in the MHW, which suggests species are adapted to vessel movements. As a result, there is no deterioration of this quality element.

Underwater Noise Emissions during Construction Activities

6.12.6 The ES (Chapter 6, Section 6.5) concluded no significant effect on marine mammal populations from underwater noise emissions associated with dredging and vessel movements due to i) low risk to injury, ii) localised disturbance effects, (iii) low numbers of species identified within MHW. As a result, there is no deterioration of this quality element.

6.13 Protected Areas

6.13.1 Within 2 km of the project footprint the following WFD protected areas are found:

- Shellfish waters (1,75 km from project footprint); and
- Pembrokeshire Marine SAC (27 m from project footprint).

Shellfish Waters

Baseline Description

6.13.2 The Milford Haven Cleddau designated shellfish waters are located 1.75 km from Pembroke Port within the Milford Haven Inner waterbody. Within the protected area shellfish populations include native oyster *Ostrea edulis*. Wild stocks of mussels *Mytilus* spp. are present in patches on raised beds or on rocks between Cleddau Bridge, Picton point Coedcanlas and Sprinkle Pill. Cockle beds are also found at Coedcanlas, Sprinkle Pill and east of Lawrenny Quay. Pacific oyster *Crassostrea gigas* were also formally cultured with operations ceasing ten years ago. As consequence these are now found naturally in the waterbody mainly within the Creswell/ Carew side channel and adjacent reaches of the main Cleddau channel up to Carron Pill (Cefas, 2012).

Increases in Suspended Sediment and Sediment Deposition from Sediment Plume Generation during Dredging Activities

6.13.3 Designated shellfish waters are important to preserving the quality of the shellfish that are harvested for human consumption. An increase in SSC could temporarily affect the clarity of the water and affect the component species. In order to comply with the directive, any discharge must not cause the suspended solid content of the water column to increase by 30%. The designated shellfish waters lie 1.7 km to the east of the site and it is very unlikely that SSC will increase by 30% in this area as a result from construction activities for any period of time, due to the low volumes of sediment to be dredged and the relatively sheltered conditions in the vicinity of Pembroke Port, which will reduce the potential for widespread dispersal of suspended sediments. Therefore, deterioration of the objectives of the protected area is not expected.

Release of Contaminants during Construction Activities

6.13.4 As shellfish feeding mechanism is by filtering food items from the water, contaminants can accumulate in their tissues and potentially cause chronic and acute effects. Given the distance the designated site boundary is from the proposed development, the potential for toxic effects from contaminants is low. Any release of contaminants during dredging and dewatering through plume generation will be short term and localised (Section 6.2) and therefore unlikely to extend 1.7 km from the dredge location. In addition, sediment plumes that are generated during dredging will be diluted relatively quickly given the increased flushing associated with the waterbody.

Pembrokeshire Marine SAC

6.13.5 The Pembrokeshire Marine SAC has several qualifying Annex I habitat and Annex II species features which are offered protection under the Habitats Directive. Annex I habitats include:

- Estuaries;
- Reefs;
- Mudflats and sandflats not covered by seawater at low tide.

6.13.6 Annex II species list include:

- Grey Seal *Halichoerus grypus*;
- Sea Lamprey *Petromyzon marinus*;
- River lamprey *Lampetra fluviatilis*;
- Allis shad *Alosa alosa*;
- Twaite shad *Alosa fallax*; and
- European otter *Lutra lutra*.

6.13.7 To assess the potential effects of the project on these features a Report to Inform Appropriate Assessment (RIAA) was undertaken and is included as Appendix 6.3 to the ES.

6.13.8 Potential likely significant effects (LSE) which were identified in the RIAA included impacts from underwater noise emissions generated by the dredge vessel and construction vessels, accidental pollution events and liquid discharges in the form of sediment plumes during dredging during construction phase.

6.13.9 It was concluded that all potential effects would not result in an adverse effect on the integrity of the SAC when taking the conservation objectives of the relevant features into consideration.

This was due to construction activities being temporary and the short term, intermittent and reversable nature of the impacts associated with construction, as well as the relatively low sensitivity of the relevant features to the impacts predicted.

6.14 Cumulative Impacts

6.14.1 Other developments (projects/plans) that could result in cumulative effects in-combination with the proposed development on features of the designated sites identified have been summarised in Table 6.1. Their locations are shown in Figure 6.1

Table 6.1: Projects and Activities Considered for Assessment of Cumulative Effects.

Project (Developer)	Spatial Overlap	Temporal Overlap	Description and proposed development activities	Further Assessment required?	Justification
Dredging and disposal sites	In bold font presented in description column	Yes	DML1743 – Dredge and disposal from Neyland Marina, 2017-2020 (Neyland Yacht Haven ltd.), **no spatial overlap**;	Yes	Sediment plumes generated from placement of material in identified disposal ground and dredging activities may present potential cumulative effects with proposed development activities. There may also be a potential for cumulative impact from increased underwater noise from dredging and disposal activities.

DML1646 – Milford Haven maintenance dredging, 2017-2022 (MHPA). Annual volume 5500 m3, **spatial** **overlap**, see

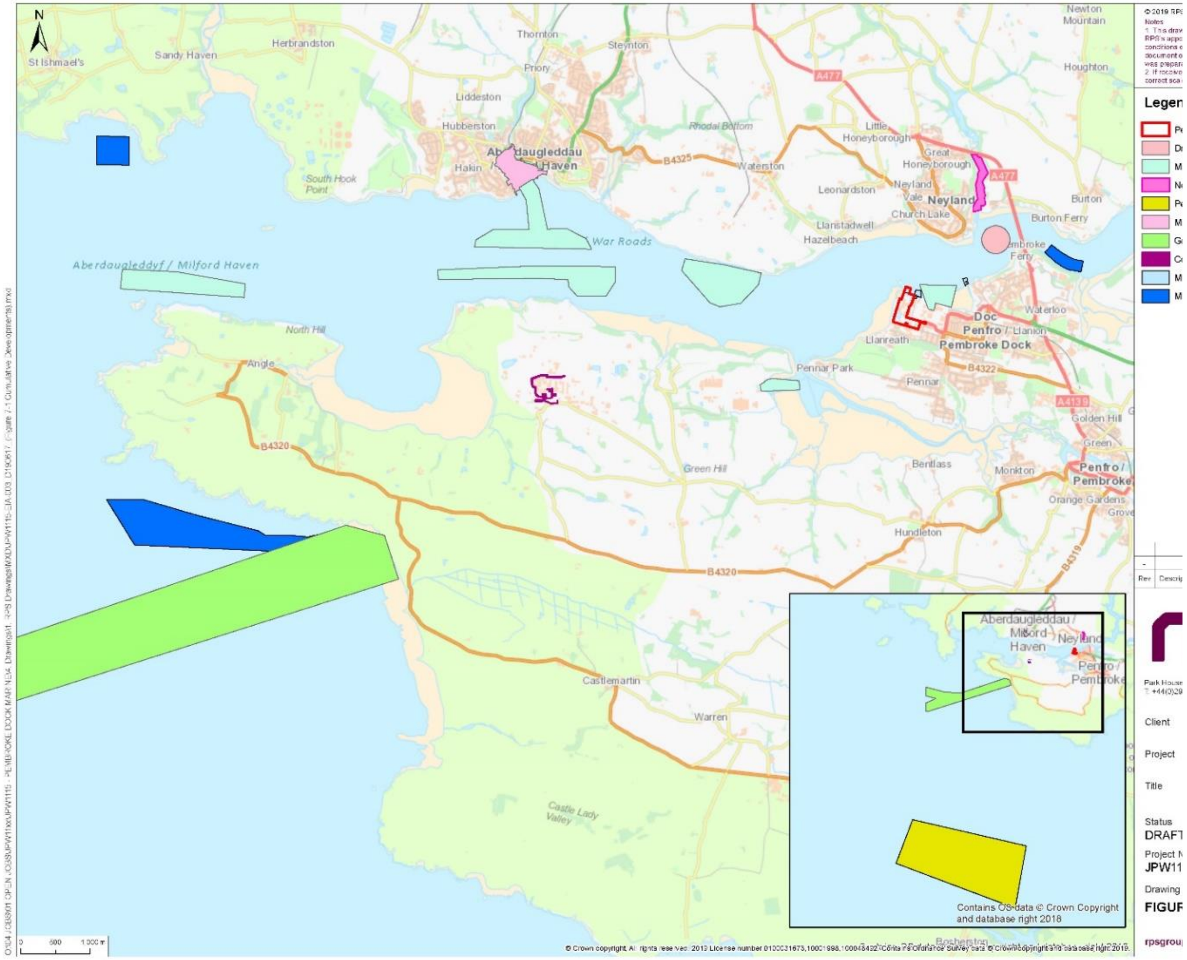


Figure *6.1*;

Project (Developer)	Spatial Overlap	Temporal Overlap	Description and proposed development activities	Further Assessment required?	Justification
			RML1462 - Dredging a 32 m x 20 m approach channel in relation to the construction of a new lock structure in relation to the proposed Martello Quays sites, 2017-2022 (The Conygar Investment Company plc). Annual volume 9500 m^3, **no spatial overla**p.		
Deployment of scientific equipment and marker buoys (University College of Swansea) - DEML1845	No	Yes	Deposition and subsequent removal of marker buoys with environmental monitoring and mid-water settlement plates, 2018-2019	No	No spatial overlap and impact pathway identified.
Martello Quay (Martello Quays Ltd.) - LPA Ref: 07/0020/CA	Yes	No	Planning permission was approved by Pembrokeshire County Council (PCC) in February 2008. The project includes up to 260 marina berths and associated car parking; marine workshops and a chandlery; 450 houses and apartments; a new public promenade; shops; a pub and restaurant; a hotel; and a five-screen multiplex cinema.	No	There is a high level of uncertainty with regards to timescales, EIA and project construction works, considering no progress has been made since the permission was granted in 2008 . As a result, this project has been scoped out.

Project (Developer)	Spatial Overlap	Temporal Overlap	Description and proposed development activities	Further Assessment required?	Justification
Marine Energy Test Area Phase 1 (Pembrokeshire Coastal Forum)	Yes	Yes	The project will provide five testing sites located within Pembroke Ports to support testing and monitoring of marine energy components and subassemblies. Testing activities includes mob and demob of vessels, deployment and monitoring of components/subassemblies. Components and sub assemblies will be deployed to the seabed, on the surface or within water column.	Yes	Testing and monitoring activities are likely to undertaken during construction and operation phase of the proposed development. There is also potential for cumulative impacts on identified marine receptors
Marine Energy Test Area Phase 2 (Pembrokeshire Coastal Forum)	Yes	Yes	The project will provide three testing sites located within MHW to support testing and monitoring of marine energy devices. Testing activities includes mobilisation and demobilisation of vessels, deployment wave and tidal energy devices. Devices will be deployed to the seabed, on the surface or within water column.	Yes	Testing activities are likely to be undertaken during construction and operation phase of the proposed development. There is also potential for cumulative

Project (Developer)	Spatial Overlap	Temporal Overlap	Description and proposed development activities	Further Assessment required?	Justification
					impacts on identified marine receptors
Pembrokeshire Wave Energy Demonstration Zone (Wave Hub Ltd.)	No	Yes	The project entails the development of 90 km^2 of seabed with water depths of approximately 50 metres and a wave resource of approximately 19 kW/m; to support the demonstration of wave arrays with a generating capacity of up to 30MW for each project. Consent for this project could be achieved in 2022, infrastructure could be built by 2024 and the first technology could be installed in 2025.	No	There is no spatial overlap with the proposed development (see Figure 6-1).
Mixed used development (MHPA) - LPA reference: 14/0158/PA	No	Yes	Demolition of several existing buildings and the mixed-use redevelopment of Milford Waterfront comprising up to 26,266 m^2 of commercial, hotel, leisure, retail and fishery related floorspace. Up to 190 residential properties, up to 70 additional marina berths, replacement boat yards, landscaping, public realm enhancements, access and ancillary works. A decision on this application is yet to be made by PCC.	Yes	Given the distance from the project and likely impact pathways. There is potential for cumulative impacts to affects the marine environment.
Cable Interconnector (Greenlink) - Welsh Government reference: qA1296053	No	Yes	The project is a 500MW subsea electricity interconnector linking the power markets in Ireland and Great Britain and is planned for commissioning in 2023. As an EU Project of Common Interest, it is one of Europe's most important energy infrastructure projects. The interconnector is planned to make landfall at Freshwater West Beach to the south of the mouth of the MHW. A marine licence application has been submitted in 2018, which is pending decision, for marine Ground Investigations for the Interconnector.	No	There is no spatial overlap with the proposed development.

Project (Developer)	Spatial Overlap	Temporal Overlap	Description and proposed development activities	Further Assessment required?	Justification
Ground investigations - RML1827					
Combined Heat and Power (CHP) Cogeneration Unit at Pembroke Refinery Welsh Government reference: qA1312073	No	Yes	The project is to provide the refinery's electrical power and support its steam demands. Valero has configured the project to efficiently generate electricity whilst using the waste heat arising from this combustion process to produce super-heated steam for use within the refinery. The use of waste heat and the production of steam usefully increases the overall efficiency of the electrical generation plant.	No	There is no spatial overlap with the proposed development and no impact pathway to identified marine receptors.

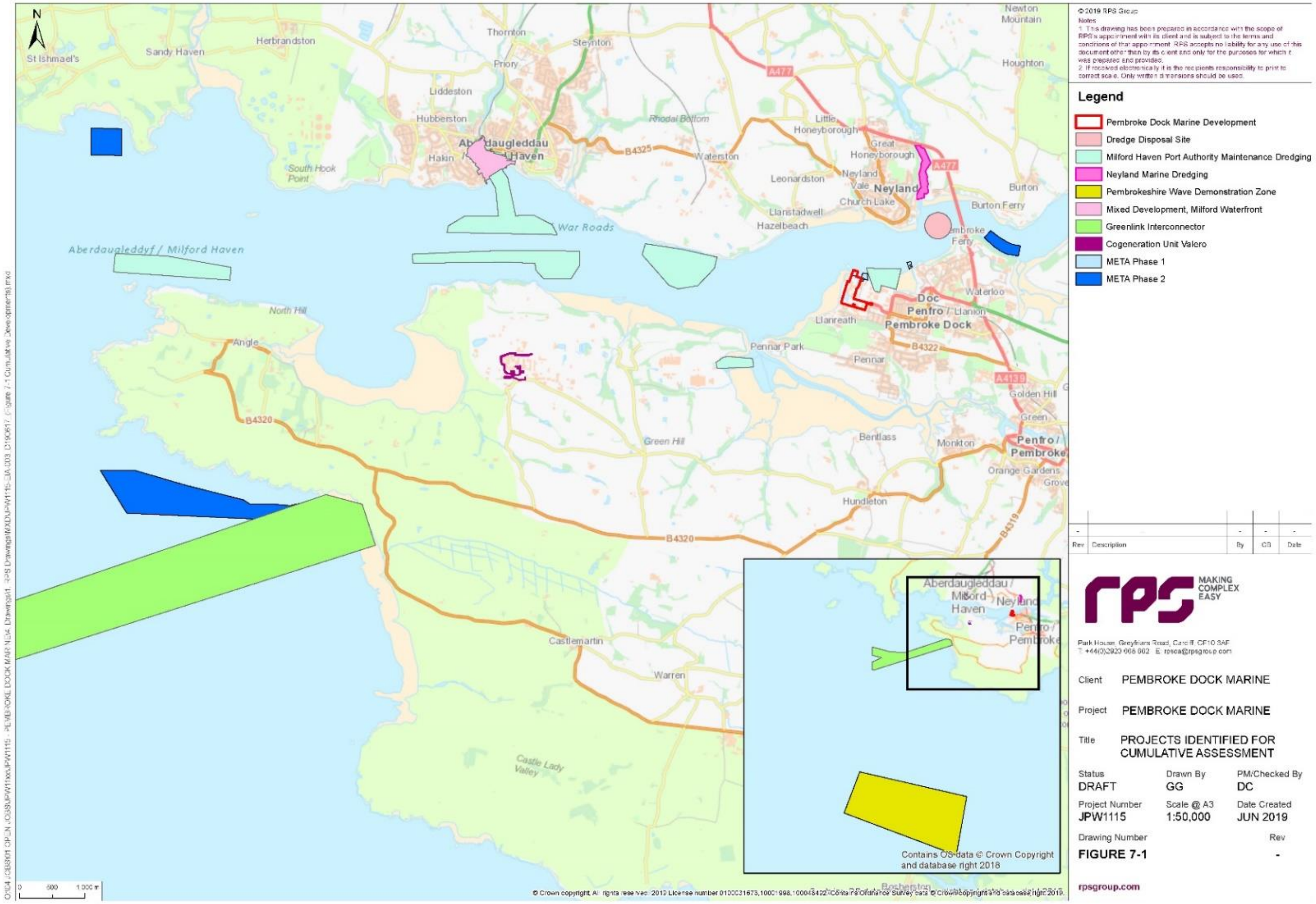


Figure 6.1: Location of Projects and Activities that have been considered for Cumulative Impact Assessment

6.14.2 The following projects and their associated activities have been taken forward for cumulative assessment:

- Dredging and disposal sites associated with Neyland Marina development and MHPA maintenance dredging activities;
- Marine Energy Test Area (META) Phase 1 and Phase 2; and
- Mixed used development, Milford Haven.

6.14.3 The potential impact pathways assessed in Sections **Error! Reference source not found.** to 6.13 (inclusive) have been considered, and the cumulative assessment undertaken is presented below.

6.14.4 Where a potential impact pathway has been screened out of further consideration for the proposed development on its own, or the assessment for the proposed development concluded no impact, no cumulative assessment has been undertaken. These include:

- Collision risk of vessels on marine mammals;
- Accidental release of pollutants on all ecological receptors;
- SSC and sediment deposition during dredging on benthic habitats, fish and shellfish;
- Release of contaminants during dredging and dewatering on all ecological receptors; and
- Introduction of invasive and non-native species.

Water Quality

6.14.5 Proposed development activities may cause localised increases in suspended sediments during dredging and dewatering activities. Increases in suspended sediment concentrations associated with the cumulative projects identified have the potential to spatially and temporally overlap with proposed development activities, resulting in further increases in suspended sediments within the Pembroke Port jurisdiction. The waterbody regularly experiences elevations in suspended sediments as part of construction development, maintenance dredging and from vessel activity. The duration of dredging and disposal activities vary depending on the volume and method of dredging. This can cause sediment plumes to extend for several kilometres dependent on the velocity of tidal currents in the MHW (Little *et al.,* 2009). There is therefore an existing high baseline level of suspended sediment within the MHW. It is considered likely that suspended sediment concentrations will rapidly return to background concentrations as sediments either fall out of suspension or become widely dispersed within the waterbody.

6.14.6 For projects where larger volumes of suspended sediments are predicted such as MHPA annual maintenance dredging (362,500 tonnes; see

6.14.7 Figure *6.1*) and Neyland Marina maintenance dredging (5,500 tonnes), consent has already been granted. While detailed information on the impact significance associated with the increases in suspended sediments is scarce for Neyland Marina, it is assumed consent has been awarded based on sufficient mitigation, and management has been adopted to ensure proposed works are compliant with environmental legislation. Similarly, maintenance dredging and disposal activities undertaken by MHPA and Neyland Yacht Haven ltd, which are substantially smaller in terms of sediment volumes to be dredged, are also expected to be managed appropriately in accordance with licence conditions, resulting in reduced environmental impacts.

6.14.8 Given the spatial overlap associated with proposed development and the identified cumulative projects, increases in suspended sediments could occur. These may be minor should projects temporally overlap, although increases will be temporary as concentrations return to background levels on cessation of dredging and disposal. Therefore, should project activities occur where timescales overlap, the potential cumulative impacts of increased suspended will not cause deterioration of the water quality within the Milford Haven waterbodies and the achievement of objectives would not be affected.

Biology: Habitats

6.14.9 There may be a minor loss of small areas of soft sediment habitat associated with the proposed development, in particular from dredging of the slipway and infilling of the Graving Dock. Similar types of habitat may be lost from META Phase 2 as part of the vessel anchoring and component subassembly deployment and due to MHPA maintenance dredging. Maintenance dredging activities will remove sediments that have accumulated since the previous dredging event, so these habitats will have been previously disturbed and modified. Similarly, placement of dredge sediments within the disposal ground will also experience habitat loss/disturbance from the most recent disposal event. Any habitat loss from META Phase 2 will also be temporary and reversible, with full recovery of the seabed expected once devices are removed from the seabed following testing. Given that these areas are small and will have previously been disturbed the cumulative effect from these activities on benthic habitat loss are considered negligible.

6.14.10 The potential reduction in habitat associated with third party projects is considered negligible compared with the prevalence of these types of habitat throughout the MHW. In addition, these habitats experience a high level of disturbance, therefore potential impacts of additional disturbance are not considered to cause deterioration to the Milford Haven waterbodies and restrict objectives from being achieved.

Biology Fish

6.14.11 Activities associated with identified cumulative projects may cause an increase in underwater noise from a range of sources including construction vessels and plant, barges and dredge vessels. The underwater noise emissions associated with the proposed development will be from vessels and operation of dredge plant and equipment.

6.14.12 Cumulative underwater noise may cause some avoidance by species of fish in the short term. However, no injury or long-term effects are predicted as any animals present within the area are likely to demonstrate some degree of habituation due to already raised levels of underwater noise from existing port and industrial operations. The cumulative disturbance area and/or the period in which disturbance effects are observed may increase, however recovery is likely to be rapid on cessation of activities.

Biology Marine Mammals (Priority Species)

6.14.13 Harbour porpoise and bottlenose dolphin are occasionally sighted in the MHW within the vicinity of Pembroke Port. Minor disturbance effects such as avoidance and masking of communication are predicted for the proposed development from vessel movements and dredging with the overall impact considered to be minor. Similar effects may also arise due to vessel and dredge activities from all cumulative projects identified. Potential effects may extend for a longer duration and a larger area if a temporal overlap is assumed.

7 CONCLUSIONS

7.1.1 The proposed development has been assessed in accordance with the WFD. As part of the scoping stage Milford Haven Inner waterbody had the potential to be impacted by the project. Milford Haven Outer waterbody located 2 km from the project was scoped out from further assessment as it was identified the waterbody status and objectives would not be affected by the project.

7.1.2 The project was assessed against the following WFD receptor groups in accordance with clearing water for all guidance:

- Water quality;
- Habitats;
- Fish;
- Marine mammals (priority species);
- Protected areas; and
- Cumulative impacts.

7.1.3 Following completion of the assessment it was identified that each receptor group would not deteriorate, or the objectives of the waterbody be restricted from being achieved as a consequence of proposed project activities.

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A SCOPING TABLES FOR PROPOSED PROJECT

8.1.1 The scoping assessment for the project has been undertaken in accordance with NRW guidance note OGN072. Findings from the assessment have been undertaken with respect to two identified water bodies that could be potentially affected by the project:

- Milford Haven Inner is located within the project footprint; and
- Milford Haven outer is located approximately 2km to the west of the project footprint.

Your activity	Description, notes or more information
Applicant name	Milford Haven Port Authority
Application reference number (where applicable)	Not applicable
Name of activity	Pembroke Dock Infrastructure project
Brief description of activity	250 m length of AU 25 sheet piles will be installed using an excavator mounted vibro-hammer finished with impact driver Capital dredging associated with the slipway and within the Graving Dock will remove up to 45,840 m^3 of substrate. All material from both areas will be removed in dry conditions except for 8,904 m^3 of material located within the slipway footprint below MLWS, which reduces the potential for release of sediments and therefore contaminants into the water column. Dewatering and infilling of existing Graving Dock area and timber treatment pond including dredging and disposal of 8000 m^3 of sediment material. Creation of open space laydown in brownfield areas within the curtilage of the dockyard. Demolition of some other buildings which are no longer fit for purpose.
Location of activity (central point XY coordinates or national grid reference)	X: 195835 Y: 203799
Footprint of activity (ha)	10.72 ha
Timings of activity (including start and finish dates)	12 months
Extent of activity (for example size, scale frequency, expected volumes of output or discharge)	45,840 m^3 of dredging to be undertaken over a period of 3 weeks. Dewatering of the timber treatment pond as well as the Graving Dock area. The Graving Dock discharge water will be marine following installation a cofferdam while the water within the timber treatment pond has been characterised.

Use or release of chemicals (state which ones)	Some potential for release of contaminants from disturbance of sediments during dredging and release of discharge during dewatering of the timber treatment pond.

Specific Risk Information

8.1.2 Potential risks of the project activities were considered for each of the following receptors: hydromorphology, biology (fish), water quality, priority habitats, priority species, invasive non-native species (INNS) and protected areas within each identified waterbody. Cumulative impacts have also been assessed.

Section 1: Hydromorphology

8.1.3 Consider if hydromorphology is at risk from your activity.

8.1.4 Use the water body summary table to find out the hydromorphology status of the water body, if it is classed as heavily modified and for what use.

Consider if your activity:	Yes	No	Hydromorphology risk issue(s) to Milford Haven Inner Waterbody	Hydromorphology risk issue(s) to Milford Haven Outer Waterbody
Changes the physical form or alters the process of sediment transport (erosion, deposition or transfer)	Requires impact assessment	Impact assessment not required	Yes; requires impact assessment. Some change to the physical form of the seabed	No; impact assessment not required. The project will not affect the physical form or cause changes to sediment transport within the waterbody.
Have a significant impact on the hydromorphology conditions of a waterbody, for example changes to: depth variation, the seabed and intertidal zone structure, tidal patterns, for example dominant currents, freshwater flow and wave exposure.	Requires impact assessment	Impact assessment not required	Yes; requires impact assessment. The proposed project increase in depth profile adjacent to the existing slipway area. The Graving Dock area will be infilled causing change to the bathymetry within the intertidal and subtidal area.	No; impact assessment not required. The project is not located within the waterbody any and will therefore not cause change to depth, the seabed or intertidal zone structure.

Consider if your activity:	Yes	No	Hydromorphology risk issue(s) to Milford Haven Inner Waterbody	Hydromorphology risk issue(s) to Milford Haven Outer Waterbody
Has a physical footprint greater than 1% of the area of a surface water body or greater than 0.5km², then it should be scoped in for hydromorphology	Requires impact assessment	Impact assessment not required	No; impact assessment not required. The physical footprint of the project will comprise of <1% of the area of both identified waterbodies and constitutes and area of 0.1 Km^2.	No; impact assessment not required. The physical footprint of the project is located outside the waterbody and therefore will not impact on waterbody
Is in a water body that is heavily modified for the same use as your activity	Requires impact assessment	Impact assessment not required	No; impact assessment not required. Both identified waterbodies are not considered as heavily modified in accordance with extracted data.	No; impact assessment not required. Both identified waterbodies are not considered as heavily modified in accordance with extracted data.

Section 2: Water Quality

8.1.5 A scoping assessment has been undertaken on water quality and how physicochemical parameters could be affected by the project is provided in the table below:

Consider if your activity:	Yes	No	Water quality risk issue(s) to Milford Haven Inner Waterbody	Water quality risk issue(s) to Milford Haven Outer Waterbody
Could affect water clarity, temperature, salinity, oxygen levels, nutrients or microbial patterns continuously for longer than a spring neap tidal cycle (about 14 days)	Requires impact assessment	Impact assessment not required	Yes. Dredging activities scheduled to be undertaken for a period of three weeks will generate sediment plumes that will potentially cause reduction in water clarity.	No. Impact assessment not required Existing studies indicate that sediment plume migration from dredging activities will not extend into waterbody located 2 km from the project. Studies have shown on an ebb tide plumes can migrate up to 1.5km.
Is in a water body with a phytoplankton status of moderate, poor or bad	Requires impact assessment	Impact assessment not required	No; impact assessment not required. Waterbody is classified as high.	No; impact assessment not required. Waterbody is classified as high

Is in a water body with a history of harmful algae	Requires impact assessment	Impact assessment not required	No; impact assessment not required. Not previously monitored.	No; impact assessment not required. Not previously monitored

8.1.6 Potential for release or disturbance of chemicals has been considered in the table below:

If your activity uses or releases chemicals (for example through sediment disturbance or building works) consider if:	**Yes**	**No**	**Water quality risk issue(s) to Milford Haven Inner Waterbody**	**Water quality risk issue(s) to Milford Haven Outer Waterbody**
The chemicals are on the Environmental Quality Standards Directive (EQSD) list	Requires impact assessment	Impact assessment not required	Yes; requires impact assessment. Potential for release of chemicals listed following disturbance of sediments during dredging activities. Potential for accidental hydrocarbon contaminant release during construction activities.	No; impact assessment not required. Dredging footprint and disposal ground located 2 km from nearest boundary to MHO waterbody. No impact is therefore predicted from release of contaminants.
It disturbs sediment with contaminants above Cefas Action Level 1	Requires impact assessment	Impact assessment not required	Yes; requires impact assessment. Sediment samples collected within dredge area returned contaminant concentrations above Cefas Action Level 1.	No; impact assessment not required. Mobilisation of sediments within the dredge footprint unlikely to cause deterioration in water quality within the waterbody due to distance of the waterbody from the project and the likely extent of sediment plume migration described above.
If your activity has a mixing zone (like a discharge pipeline or outfall) consider if:	Yes	No	Water quality risk issue(s) to Milford Haven Inner Waterbody	Water quality risk issue(s) to Milford Haven Outer Waterbody
The chemicals released are on the Environmental Quality Standards Directive (EQSD) list	Requires impact assessment	Impact assessment not required	No; impact assessment not required. The project will not have a mixing zone associated with the activity and therefore no chemicals listed on Environmental Quality Standards Directive (EQSD) list that will be released as part of the project activities.	No; impact assessment not required. The project will not have a mixing zone associated with the activity and therefore no chemicals listed on Environmental Quality Standards Directive (EQSD) list that will be released as part of the project activities.

Section 3: Biology

8.1.7 Annex V of the Directive sets out Biological Quality Elements (BQEs) which are used to classify ecological status using five classes from high to bad including elements such as fish, invertebrates or algae.

Quality Element	Pressure Description
Phytoplankton	Nutrient enrichment
Macroalgae	Nutrient enrichment, hazardous chemicals
Angiosperms	Nutrient enrichment, morphological alterations
Benthic invertebrates	Organic pollution, hazardous chemicals and some morphological alterations
Fish (transitional only)	Organic enrichment (dissolved oxygen), habitat destruction

8.1.8 Following consideration of the proposed project activities and the pressure descriptions for each receptor, **benthic invertebrates, macroalgae and angiosperm** receptors associated with the Milford Have Inner waterbody have not been taken forward for further assessment. The project will not cause nutrient enrichment of the waterbody that could potentially impact on phytoplankton.

Section 4: Fish

8.1.9 A scoping assessment has been undertaken on whether fish could be potentially affected by the project and the results are provided in the table below:

Consider if your activity:	Yes	No	Biology fish risk issue(s) to Milford Haven Inner Waterbody	Biology fish risk issue(s) to Milford Haven Outer Waterbody
Could impact on normal fish behaviour like movement, migration or spawning (for example creating a physical barrier, noise, chemical change or a change in depth or flow)	Requires impact assessment	Impact assessment not required	Yes; requires impact assessment. Sediment plumes generated during dredging activities could cause a barrier which may effect migratory fish movement within identified waterbody by creating a physical barrier. Underwater noise effects during dredging activities and preparation of the slipway have the potential to cause disturbance effects to fish behaviour.	No, impact assessment not required. As described above dredging activities will unlikely result in sediment plumes which could impact on fish behaviour and cause toxicity effects due to mobilisation of contaminants within the waterbody due to the distance from the project. Underwater noise effects from dredging will unlikely reach fish populations associated with water body

Consider if your activity:	Yes	No	Biology fish risk issue(s) to Milford Haven Inner Waterbody	Biology fish risk issue(s) to Milford Haven Outer Waterbody
			Potential for release of contaminants during dredging and dewatering activities has the potential to cause toxicity to fish eggs or larvae.	as modelling has shown effects to be within 1km of the project footprint.
Could cause mechanical injury or death to fish through: Entrainment, e.g. fish being drawn into cooling water systems or turbines Impingement, e.g. fish trapped against debris screens	Requires impact assessment	Impact assessment not required	No; impact assessment not required. There are no intakes associated with the project that could cause entrainment or impingement to fish within the waterbody.	No; impact assessment not required. The project is not located within the waterbody and therefore no mechanical injury is predicted to fish within the waterbody.
Is in a transitional water body and could affect fish or is outside of the transitional water body but could impact upon migratory fish	Requires impact assessment	Impact assessment not required	Yes; requires impact assessment. Project footprint is located within the Milford Haven Inner waterbody which is characterised as transitional	Yes; requires impact assessment. Project could potentially impact migratory fish associated with the waterbody.

Section 5: WFD Protected Areas

8.1.10 An assessment of the following WFD protected areas have been considered at risk if they are located within located 2 km of the project footprint:

- Special Areas of Conservation (SAC)
- Special Protection Areas (SPA)
- shellfish waters
- bathing waters
- nutrient sensitive areas

Consider if your activity is:	Yes	No	Protected areas risk issue(s)
Within 2 km of any WFD protected area	Requires impact assessment	Impact assessment not required	Within 2 km of the project footprint the following WFD protected areas are found: Pembrokeshire Marine SAC (180 m from project footprint) Shellfish waters (1770 m from project footprint) No other WFD protected areas are located within 2km of the project footprint.

Section 6: Priority Habitats and Species

8.1.11 An assessment of whether the project to cause impacts on priority habitats and species under Environment (Wales) Act 2016.

Consider if:	Yes	No	Priority species and habitat risk associated with Milford Haven Inner Waterbody	Priority species and habitat risk associated with Milford Haven Outer Waterbody
There are priority species and habitats within identified waterbody	Go to next question	No further scoping is required	Yes. Several listed migratory and non-migratory fish species and harbour porpoise exist within the waterbody. Several listed habitats also occur	Yes. Several listed migratory and non-migratory fish species and harbour porpoise exist within the waterbody. several listed habitats also occur
Consider if the project could:				
Impact on identified priority species	Requires impact assessment	Impact assessment not required	Yes; requires impact assessment. Sediment plumes generated during dredging activities could cause a barrier which may effect migratory fish movement within identified waterbody by creating a physical barrier. Underwater noise effects during dredging activities and preparation of the slipway have the potential to cause disturbance effects to fish, and harbour porpoise and bottlenose dolphin behaviour. Potential for release of contaminants during dredging and dewatering activities has the potential to cause toxicity to fish eggs or larvae. Barge vessel movements during dredge disposal could increase collision risk associated with harbour porpoise and bottlenose dolphin movements Accidental spill events could impact on priority species during construction and operation.	No, impact assessment not required. As described above dredging activities will unlikely result in sediment plumes which could impact on fish behaviour within the waterbody dur to the distance from the project. Underwater noise effects from dredging will unlikely reach fish populations associated with water body as modelling (Appendix 6.2 of the ES) has shown effects to be within 1km of the project footprint, dredging activities and preparation of the slipway have the potential to cause disturbance effects to fish behaviour. Potential for release of contaminants during dredging and dewatering activities is unlikely to cause toxicity to fish eggs or larvae within the waterbody due to distance of the waterbody to the project.
Impact on identified priority habitats	Requires impact assessment	Impact assessment not required	Yes; requires impact assessment. Removal of listed habitats within the project footprint.	No. Impact assessment not required Existing studies indicate that sediment plume migration from dredging activities will not extend into waterbody

Consider if:	Yes	No	Priority species and habitat risk associated with Milford Haven Inner Waterbody	Priority species and habitat risk associated with Milford Haven Outer Waterbody
			Dredging activities have the potential to impact listed habitats through smothering effects from the deposition of dredge material outside the dredge footprint following resuspension and migration from the point of disturbance. Accidental spill events could impact on priority habitats during construction and operation	located 2 km from the project. Studies have shown on an ebb tide plumes can migrate up to 1.5km. Accidental spill events could are unlikely to result in effects to priority habitats due to the low volumes predicted to be used during the project. Any spills will be contained within localised areas following implementation of proposed mitigation specified in Section 6.4 of the ES.

Section 7: Invasive Non-native Species (INNS)

8.1.12 An assessment was undertaken to determine whether the project could introduce or spread INNS.

8.1.13 Risks of introducing or spreading INNS include:

- materials or equipment that have come from, had use in or travelled through other water bodies
- activities that help spread existing INNS, either within the immediate water body or other water bodies

Consider if your activity could:	Yes	No	INNS risk issue(s)
Introduce or spread INNS	Requires impact assessment	Impact assessment not required	No; impact assessment not required. The proposed project plant equipment will be based onshore or with the support of a barge that will be transported to site from within the waterbodies.

B Laboratory Analysis Results for Timber Pond

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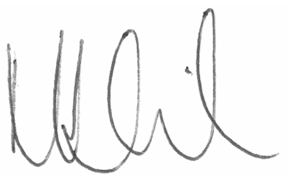
Certificate of Analysis

Report No.: 18-77741-1

Issue No.: **1**
Date of Issue **24/12/2018**

Customer Details:	RPS Energy - Chepstow Marine, Riverside Court, Beaufort Park, Chepstow, Monmouthshire, NP16 5UH
Customer Contact:	Nicola Simpson
Customer Order No.:	REQUEST
Customer Reference:	JER1262
Quotation Reference:	181107/04
Description:	1 water sample
Date Received:	15/11/2018
Date Started:	20/11/2018
Date Completed:	24/12/2018
Test Methods:	Details available on request (refer to SOP code against relevant result/s)
Notes:	None



Approved By: **Matthew Hickson, Laboratory Manager**

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Results Summary

Report No.: 18-77741-1

Customer Reference: JER1262

Customer Order No: REQUEST

					Customer Sample No	WATER 1
					RPS Sample No	384576
					Sample Type	WATER
					Sampling Date	08/11/2018
Determinand	**CAS No**	**Codes**	**SOP**	**Units**	**RL**	
aliphatic hydrocarbons C05-C06		US	in house	ug/l	0.1	< 0.10
aliphatic hydrocarbons C06-C08		US	in house	ug/l	0.1	< 0.10
aliphatic hydrocarbons C08-C10		US	in house	ug/l	0.1	< 0.10
aliphatic hydrocarbons C10-C12		NS	in house	ug/l	1	< 1.00
aliphatic hydrocarbons C12-C16		NS	in house	ug/l	1	< 1.00
aliphatic hydrocarbons C16-C21		NS	in house	ug/l	1	< 1.00
aliphatic hydrocarbons C21-C35		NS	in house	ug/l	1	< 1.00
aromatic hydrocarbons C05-C07		US	in house	ug/l	0.1	< 0.10
aromatic hydrocarbons C07-C08		US	in house	ug/l	0.1	< 0.10
aromatic hydrocarbons C08-C10		US	in house	ug/l	0.1	< 0.10
aromatic hydrocarbons C10-C12		NS	in house	ug/l	1	< 1.00
aromatic hydrocarbons C12-C16		NS	in house	ug/l	1	< 1.00
aromatic hydrocarbons C16-C21		NS	in house	ug/l	1	< 1.00
aromatic hydrocarbons C21-C35		NS	in house	ug/l	1	< 1.00
silver	7440-22-4	NS	in house	ug/l	1	2
arsenic	7440-38-2	US	in house	ug/l	0.16	4.1
beryllium	7440-41-7	NS	in house	ug/l	0.1	< 0.1
cadmium	7440-43-9	NS	in house	ug/l	0.03	0.05
chromium	7440-47-3	NS	in house	ug/l	0.25	1
copper	7440-50-8	NS	in house	ug/l	2	2.9
mercury	7439-97-6	NS	in house	ug/l	0.01	0.03
nickel	7440-02-0	NS	in house	ug/l	0.5	< 1
lead	7439-92-1	NS	in house	ug/l	0.09	1.4
antimony	7440-36-0	NS	in house	ug/l	0.17	1.0
selenium	7782-49-2	NS	in house	ug/l	0.25	11.0
total petroleum hydrocarbons by GCMS		NS	in house	ug/l	10	< 10.0
total suspended solids		NS	in house	mg/l	5	35.0
thallium	7440-28-0	NS	in house	ug/l	0.08	1.20
zinc	7440-66-6	NS	in house	ug/l	1.25	16.0
acenaphthene	83-32-9	N	in house	ug/l	0.02	< 0.02
acenaphthylene	208-96-8	N	in house	ug/l	0.02	< 0.02
anthracene	120-12-7	N	in house	ug/l	0.02	< 0.02
benzo(a)anthracene	56-55-3	N	in house	ug/l	0.02	< 0.02
benzo(a)pyrene	50-32-8	N	in house	ug/l	0.02	< 0.02
benzo(b)fluoranthene	205-99-2	N	in house	ug/l	0.02	< 0.02
benzo(g,h,i)perylene	191-24-2	N	in house	ug/l	0.02	< 0.02
benzo(k)fluoranthene	207-08-9	N	in house	ug/l	0.02	< 0.02

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Results Summary

Report No.: 18-77741-1

Customer Reference: JER1262

Customer Order No: REQUEST

					Customer Sample No	**WATER 1**
					RPS Sample No	384576
					Sample Type	**WATER**
					Sampling Date	08/11/2018
Determinand	**CAS No**	**Codes**	**SOP**	**Units**	**RL**	
chrysene	218-01-9	N	in house	ug/l	0.02	< 0.02
dibutyltin (DBT)	1002-53-5	N	in house	ng/l as cation	5	< 5
dibenzo(a,h)anthracene	53-70-3	N	in house	ug/l	0.02	< 0.02
fluoranthene	206-44-0	N	in house	ug/l	0.02	< 0.02
fluorene	86-73-7	N	in house	ug/l	0.02	< 0.02
indeno(1,2,3-c,d)pyrene	193-39-5	N	in house	ug/l	0.02	< 0.02
naphthalene	91-20-3	N	in house	ug/l	0.02	< 0.02
phenanthrene	85-01-8	N	in house	ug/l	0.02	< 0.02
pyrene	129-00-0	N	in house	ug/l	0.02	< 0.02
tributyltin (TBT)	56573-85-4	N	in house	ng/l as cation	5	< 5
triphenyltin (TPT)	668-34-8	N	in house	ng/l as cation	20	< 20
total PAHs		N	in house	ug/l	0.2	< 0.20
pH		N	in house	pH units	0	7.8

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Report No.: 18-77741-1
Customer Reference: JER1262
Customer Order No: REQUEST

Comments

RPS Sample Number	Customer Number	Sample Comments
384576	WATER 1	Samples for Naphthalene,Phenanthrene, Fluoranthene and Pyrene were blank corrected due to blank contamination. Due to this, they were reported as <0.02ug/l (NH)

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Deviating Samples

Report No.: 18-77741-1
Customer Reference: JER1262
Customer Order No: REQUEST

Our policy on Deviating Samples and reference list of Holding Times applied can be supplied on request. These have been implemented in accordance with UKAS Policy on Deviating Samples (TPS63).
RPS is not responsible for the integrity of samples as received, unless RPS personnel performed the sampling, and it is possible that samples submitted may be declared to be deviating.
Where applicable the analysis method remains UKAS accredited, however results reported for a deviating sample may be invalid. The reason for a sample being declared to be deviating is indicated below.
Where no sampling date was supplied, samples have been declared to be deviating. However, if a date of sampling can be supplied, the results may be reissued with the deviating sample status removed.
Where the sample container used was unsuitable, the appropriate Holding Time was exceeded, or the sample is flagged as deviating for some other reason, re-sampling/re-submisson may be required.

RPS No.	Customer No.	Customer ID	Date Sampled	Containers Received	Deviating Sample	Reason for Sample Deviation
384576	WATER 1		08/11/2018	1 litre amber glass bottle	No	Holding time has been exceeded

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Report Information

Key to Report Codes

U	UKAS Accredited
F	UKAS Flexible Scope
M	MCERTS Accredited
N	Not accredited
O	Marine Management Organisation (MMO) Validated
S	Subcontracted to approved laboratory
US	Subcontracted to approved laboratory UKAS Accredited for the test
MS	Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test
SI	Subcontracted to internal RPS Group laboratory
USI	Subcontracted to internal RPS Group laboratory UKAS Accredited for the test
MSI	Subcontracted to internal RPS Group laboratory MCERTS/UKAS Accredited for the test
I/S (in results)	Insufficient Sample
U/S (in results)	Unsuitable Sample
S/C (in results)	See Comments
ND (in results)	Not Detected
DW (in units)	Results are expressed on a dry weight basis

Sample Retention and Disposal

Samples will generally* be retained for the following times prior to disposal:

Perishables, e.g. foodstuffs	1 month (if frozen) from the issue date of this report
Waters	2 weeks from the issue date of this report
Other Liquids	1 month from the issue date of this report
Solids (including Soils)	1 month from the issue date of this report

*Sample retention may be subject to agreement with the customer for particular projects