TIDAL LAGOON SWANSEA BAY

Environmental Statement
Chapter 23. Mitigation and Monitoring

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Contents

23.0 Mitigation and Monitoring

23.1 Introduction

23.1.0.1 The preceding, specialist chapters of this ES (Chapters 6 to 22) report assessments of potential impacts that the Project may have upon the receptors described in those chapters during the construction, operation and decommissioning phases. Where likely significant impacts were identified, mitigation measures and their methodologies have been proposed.

23.1.0.2 This Mitigation and Monitoring chapter provides a summary of those potential significant impacts that have been identified and the means by which they are to be addressed.

23.1.0.3 Council Directive 85/337/EEC of 27th June 1985 (as amended) on the assessment of the effects of certain public and private projects on the environment (the EIA Directive) describes the measures that Member States must take to ensure that the developer supplies all the necessary information. Article 5.2 of the EIA Directive states that the information a developer provides should include *a description of the measures envisaged in order to avoid, reduce and, if possible, remedy significant adverse effects.*

23.1.0.4 The Project has aimed since its inception to provide an opportunity for enhancement of the area's natural resources and amenities, without compromising their inherent value. As such, many measures that might have needed consideration at a later stage in the development, as *mitigation*, have already been incorporated into the development's design from the outset and as a result of an iterative process between the design team and the environmental assessment team.

23.1.0.5 For the purposes of this ES, mitigation is applied through three principal approaches:

i. mitigation incorporated during the design phase;

ii. mitigation for the construction phase;

iii. mitigation through operational site management;

23.1.0.6 Furthermore, the project will incorporate measures that provide additional opportunities for wildlife and people. These are discussed under the heading of *enhancement*.

23.1.0.7 *Monitoring* is planned as an important method for evaluating the outcomes of mitigation and enhancement measures. Within the environmental assessment chapters, proposals for monitoring have been briefly described. To further define the monitoring proposals an Adaptive Environmental Monitoring Plan (AEMP) has been prepared and this is discussed further below and presented in Appendix 23.1.

23.2 Mitigation incorporated during the design phase

23.2.0.1 As discussed above, minimising impacts on and offering enhancements to the environment have been of central importance to the Tidal Lagoon Swansea Bay project. Thus, design and environmental considerations have informed one another throughout the design phase. This has allowed the project to avoid or minimise negative, environmental effects and to exploit opportunities for environmental gain or enhancement. Table 23.1 lists the mitigation measures that have been implemented during the design phase.

23.3 Mitigation for the construction phase

23.3.0.1 The preparation of a construction environmental management plan (CEMP) will ensure that the required measures for mitigation are formally documented and part of the contract documentation given to the appointed construction contractor. This will ensure that mitigation measures proposed within this ES are implemented. Further details of the CEMP are given in Chapter 4 Project Description. The CEMP will define the procedures relevant to the site and construction activity but will continue to be developed throughout the detailed design state and throughout construction, in order to reflect any new findings.

23.3.0.2 An Environmental Liaison Officer (ELO) will be employed during the construction phase. The ELO will manage the environmental aspects of the Project and will have ongoing liaison with statutory and non-statutory organisations and adjacent landowners. The ELO will work with the appointed construction contractor with regard to the implementation of the environmental mitigation measures. Ultimately, responsibility for following these procedures will rest with TLSB and their appointed construction contractor. Table 23.1 lists the mitigation measures for the construction stage.

23.3.0.3 The development of a final CEMP and compliance with its terms is secured by a requirement attached to the draft DCO.

23.4 Mitigation through operational site management

23.4.0.1 Some of the measures listed in Table 23.1 are intended for implementation during the operational phase, and will be secured by Tidal Lagoon Swansea Bay's Operational Environmental Management Plan (OEMP) (see Chapter 4 Project Description). To facilitate this, the AEMP will review the available information from monitoring undertaken together with management processes in an iterative manner to improve future management. A carefully planned period for the management cycle will be defined within the final AEMP to present a clear timeframe after which both management advice and the management process will be reviewed and updated.

23.4.0.2 A warden will be employed to manage the environmental aspects of the Project during the operational phase. The warden will be responsible for monitoring or surveys and liaising with statutory and non-statutory consultees and adjacent landowners. As for the construction phase, ultimate responsibility for following these procedures will rest with TLSB, the owner and operator of the Project.

23.4.0.3 The development of a final OEMP and compliance with its terms is secured by a requirement attached to the draft DCO.

23.4.0.4 Table 23.1 also includes the mitigation for the operational phase of the Project.

23.5 Enhancement

23.5.0.1 Certain measures listed in Table 23.1 have been incorporated into the development in order to improve the outcomes secured by the Project. These enhancement measures include the creation of new habitat areas, which will be capable of supporting an increased number of species of plants, invertebrates and birds; opportunities for improved water quality, bringing opportunities for bathing and watersports; and a visitor centre to deliver information to local people and tourists and inspire interest in the project.

23.6 Monitoring

23.6.0.1 The monitoring of certain aspects of the mitigation and enhancement associated with the Project will be necessary in order that the residual effects can be judged. This also allows adjustments to be made, where necessary. The AEMP provides a framework for the monitoring of the Project. It addresses:

i. the baseline monitoring already completed and reported upon in this ES; and

ii. the monitoring planned as the project progresses through the pre-construction, construction and operational phases.

23.6.0.2 Due to the long lifespan of the Project (120 years), monitoring or surveys that are required during the decommissioning and post-decommissioning phases will be developed prior to the commencement of that process. This is secured by requirements attached to the draft DCO

23.6.0.3 Any monitoring or surveys that are programmed to take place pre-construction or during construction that will not be continued through to the operation phase are covered within the Construction Environmental Management Plan. Therefore, such surveys and monitoring are not covered within the AEMP, e.g. marine and terrestrial archaeology, land quality and hydrogeology (onshore site investigations).

23.6.0.4 The AEMP has been prepared in order to guide the monitoring of the effects of the Project at each stage of its progress. In the same way that results of the baseline monitoring carried out for the EIA process have informed this ES, the results of pre-construction and construction-phase monitoring will provide up-to-date baseline data for operational-phase monitoring. As the project evolves over its long lifespan, the AEMP will be updated and it is for this reason that it is an *adaptive* plan. The document will continue to be updated and refined to give the best possible understanding of the Project's environmental effects such that mitigation can be adjusted.

23.6.0.5 The AEMP has been prepared based on Cefas guidance for monitoring for construction and operation of offshore renewable energy projects *Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects (2012).* These guidelines provide for consideration of a variety of environmental topics, including those identified below. The guidance states that monitoring must be hypothesis driven with measureable outputs.

23.6.0.6 The AEMP describes the monitoring and surveys that are proposed for each of the following environmental topics:

i. Coastal processes
ii. Water quality
iii. Subtidal and intertidal benthic ecology
iv. Fish
v. Marine mammals
vi. Coastal birds
vii. Terrestrial ecology
viii. Marine noise

23.7 Reporting and dissemination of information

23.7.0.1 The findings of any surveys or monitoring undertaken will be reported on completion of the works or at various stages if the monitoring is carried out over a longer term. The findings will be analysed and reports produced documenting the results. The documents will be provided to relevant statutory organisations in a timely manner in line with any agreed reporting requirements set out in the final AEMP. The findings of the studies will be used to refine any mitigation measures or monitoring and as agreed with statutory organisations where appropriate.

23.7.0.2 The findings of studies undertaken through the construction and operation phases of the Project together with collaborations between TLSB and various consultancies and academic institutions may well lead to the publication of peer-reviewed, scientific articles, thereby increasing the collective knowledge of Swansea Bay's environment. The findings would also be applicable for the ongoing development of tidal range renewable energy projects which have been identified as a key element in meeting the UK's renewable energy targets in the Government's UK Marine Policy Statement (March, 2011).

23.8 Securing mitigation

23.8.0.1 Mitigation and enhancement for the Project is secured in a variety of ways. These include:

i. By limitations upon the development expressed in the text of the DCO or shown on drawings that are referred to in its text;
ii. In requirements (akin to planning conditions) attached to the DCO;
iii. In a development consent obligation ("DCOb") under s106 Town and Country Planning Act 1990; and
iv. Under conditions attached to the marine licence required for the project in respect of marine elements.

Table 23.1 Summary of mitigation and enhancement measures

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
	Chapter 6: Coastal Processes, Sediment Transport and Contamination			
6.1	Localised coastal process effect	• High level coastal process modelling was undertaken during early stages of project development which demonstrated that a land attached design was preferable to an offshore design (Chapter 3, Site Selection and Option Appraisal).	Design	Complete
6.2	Extent/degree of coastal processes effect	• High level coastal process modelling was used to develop placement of lagoon seawalls in design layout J(2) (Chapter 3, Site Selection and Option Appraisal).	Design	Complete
6.3	Sediment quality	• Geotechnical Investigation (GI) survey to identify sediment composition across lagoon footprint to determine sediments suitability for use within lagoon wall and those required for disposal.	Design	Complete
6.5	Re-suspension of historic contamination	• Geotechnical Investigation (GI) survey to identify sediment quality at sites proposed for construction works.	Pre-construction	Pre-commencement Condition to be discharged by NRW Marine Licensing Team (MLT).
6.6	Suspended sediment and disposal offshore site	• Micro-siting of turbine and sluice gate housing to reduce potential quantity of material for disposal off site (as discussed in Chapter 4, Table 4.1).	Design	DCO Requirement/ML Condition
6.7	Potential impacts on sandy beaches at Blackpill SSSI and within the lagoon.	• Coastal landscaping of beach within lagoon footprint adjacent to SUBC. Profile will ensure integration of the lagoon foreshore into the adjacent dune system and will smooth aeolian	Operation	Monitoring and mitigation to be secured by DCO Requirement imposing OEMP and AEMP. ML Condition.

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
		effects from the eastern wall landfall. Monitoring of beach profiles and intervention in terms of beach nourishment activities to supply an alternative supply of sand, if necessary.		
6.8	Changes in sedimentation in the navigational channel to Swansea and Neath Docks	• Implement of additional dredging in navigation channels if necessary. Review/liaise with Ports with respect to existing monitoring and additional survey where necessary to monitor potential change in sedimentation within navigation channel to inform the need for maintenance dredging during construction and operation (see Appendix 23.1 AEMP).	Construction and Operation	Monitoring measures to be Secured by AEMP. Dredging to be secured in OEMP.
	Chapter 7: Marine Water Quality			
7.1	Localised effect on Aberafan Designated Bathing Water	• Positioning of turbine/sluices gate housing in south to west orientation to minimise impact on Aberafan Bathing waters (Chapter 3, Site Selection and Option Appraisal).	Design	Complete
7.2	Localised effect on Swansea Designated Bathing Waters	• Positioning of turbine/sluices gate housing in south to west orientation to minimise impact on Swansea Bathing waters (Chapter 3, Site Selection and Option Appraisal).	Design	Complete
7.3	Spill and incidents during offshore construction affecting water quality	• Marine Contingency Plan to minimise potential spills/incidents during construction and to identify action measures to deal with potential incidents.	Construction	Contingency and monitoring integrated into the CEMP, secured by DCO Requirement
7.4	Spill and incidents during onshore construction affecting water quality	• Plan to minimise potential spills/incidents during construction which may affect local water quality and to identify action measures to deal with potential incidents.	Construction	Contingency and monitoring integrated into CEMP, secured by DCO Requirement.

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
7.5	Reduced water quality due to disturbance of contaminated sediment	• GI study to identify dredging areas with appropriate sediment quality and nature to avoid high quantities of suspended materials during dredging and construction of sea walls. • Targeting of sediments for use in sea wall construction and cofferdam to reduce re-suspension of metals.	Design Construction	Pre-commencement DCO Requirement/ML Condition Pre-commencement DCO Requirement/ML Condition to be discharged by NRW (MLT).
7.6	Storm water discharge from outfall having potential to intermittently reduce water quality in the lagoon for water contact sports.	• UV disinfection of storm water/extension of outfall required if maximum usability of impounded waters to be achieved in operational phase.	Design	DCO Requirement as part of Water Quality Strategy
		• Development of Water Quality Strategy (WQS) as part of the OEMP to include an advanced warning system between DCWW and TLSB with respect to potential performance issues at the WWTW which may affect lagoon water quality. • Development of WQS which provides information on water quality within different areas of the Lagoon. Information will be provided on a water quality advisory zone (500m) around outfall demarked on plans located at appropriate positions around the lagoon including within Western Landfall Building, Offshore Building and eastern landfall. • Identification of beach swimming area and sea swimming area in WQS which are demarked on plans located at appropriate positions around the lagoon including within Western Landfall and Building, Offshore Building and eastern landfall. • Water quality monitoring within the lagoon to confirm assumptions of WQS (see AEMP).	Operation	DCO Requirement/OEMP

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
	Chapter 8: Intertidal and Subtidal Benthic Ecology			
8.1	Habitat loss	• Avoiding designated habitats where possible at the project planning and design phase, and making sure that appropriate weight is attached to designated sites, to protected species and habitats, and other species of principal importance for the conservation of biodiversity.	Design	
		• Environmental briefing of construction workers to advise on sensitive habitats and minimise extent of effect. • No unplanned works or tracking across Crymlyn Burrows SSSI intertidal area. All works within intertidal area of SSSI to be agreed in advance with NRW(A).	Construction	Education and tracking limitations to be included in the CEMP secured by DCO Requirement.
8.2	Change in the levels of suspended sediment and potential release of contaminants	• Where possible micro-siting of cofferdam to an area of more coarse sediment reduces the need for disposal and significance of this impact.	Design	Siting of Cofferdam to be approved pursuant to DCO Requirement/ML Condition
		• Adoption of good practice and available guidelines (including CIRIA publications and Pollution Prevention Guidance 5).	Construction	Guidelines incorporated in the CEMP and secured by DCO Requirement.
8.3	Changes in habitat extent and suitability resulting in impact on Sabellaria (Section 42 species)	• Translocation of the honeycomb worm, *Sabellaria alveolata*. In conjunction with SEACAMS - Pre-construction survey to identify Sabellaria suitable for translocation and donor site suitable for temporary receipt. • Translocation of *Sabellaria* or *Sabellaria* casts to encourage for future settlement once construction works complete to range of sites around the lagoon wall (inside and outside).	Pre-construction, construction and operation.	Pre-commencement DCO Requirement (applicable only to specific works) for survey and translocation scheme. DCO Requirement also to secure other habitat enhancement measures as described.

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
		• Monitoring of *Sabellaria* translocation work (see monitoring report (AEMP)). • Provision of rock pools and features similar to bio-blocks to provide a bio-diversity offset on the rock armour. • Provision of rock pools and features similar to bio-blocks to provide a bio-diversity offset on the rock armour.		Operational monitoring to form part of AEMP.
8.4	Impact on native oyster within lagoon footprint (mitigation and enhancement)	• Development of a 10 year programme in conjunction with SEACAMS to facilitate the reintroduction of the native oyster (Appendix 8.3).	Currently on-going	10 year reintroduction programme subject DCOb.
		• Oyster dredge trawls will be undertaken prior to construction works commencing in the proposed dredge areas, footprint of seawall and turbine/sluice gate housing to collect any native oysters that may be present. • Native oysters to be translocated to Centre for Sustainable Aquatic Research (CSAR) at Swansea University whilst construction works are ongoing, where their spawning behaviour and spat development will be monitored (Appendix 8.3).	Pre-construction	Pre-commencement requirement to survey dredging area. Requirement for TLSB to undertake translocation in conjunction with CSAR. Secured by DCO Requirement
		• Reintroduction of native oysters to Swansea Bay through spatting ponds. • Assessment of alternative cultch material to encourage settlement of oyster spats within the Bay.	Operation	Operational monitoring to be included in AEMP.

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
8.5	Discharges and spillages into marine environment	• Adoption of good practice to ensure that substances released into the marine environment are minimal. • Bunding and/or storage facilities will be installed to contain and prevent the release into the marine environment of fuel, oils and chemicals associated with the plant, and refuelling and construction/ maintenance equipment.	Construction	CEMP including published guidelines and best available practice (BAP) techniques to be adhered to during construction.
8.6	Temporary deterioration in water quality during construction	• Targeting of sediments approved by CEFAS for use in Geotubes® and sediment bund option for construction of the turbine/sluice gate housing to reduce re-suspension of metals. • Use of Geotubes® for wall construction and for containment of finer silts within central wall cavity to minimise reduction in water quality during works.	Design/construction	Pre-commencement requirement discharged by NRW in agreement with CEFAS.
8.7	Introduction of invasive non-native species (INNS)	• Implementation of standard marine protection measures to minimise potential introduction or spread of INNS, where possible. • Following appropriate legislation and guidance as well as the implementation of best practice will limit the introduction and spread of non-native species (eg. the Green Blue[1] and Royal Yachting Association (RYA)[2]).	Construction Operation	Best available practice and compliance with international conventions applicable to vessels to be contained in the CEMP and secured by DCO Requirement

[1] http://www.thegreenblue.org.uk/boat_users/antifoul_and_invasive_species.aspx
[2] http://www.rya.org.uk/infoadvice/planningenvironment/advice/Pages/AdviceonAntifouling.aspx;

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
		• Lagoon warden with remit which includes contribution to working groups focused on the restoration and enhancement of intertidal habitats within Swansea Bay.	Operation	Lagoon warden will be part of the operation of the Lagoon provided for in OEMP and secured by DCO Requirement.
8.8	Enhancement	• Provision of hatchery for the potential for introduction of lobster or native fish species. • Encouragement of saltmarsh habitat within strategic area of lagoon. • Investigation of opportunities for encouragement of seagrass within lagoon, once lagoon operational. • Investigation of opportunities for use of concepts such as bioreefs in eastern intertidal area of lagoon. • Development of a 10 year programme in conjunction with SEACAMS to facilitate the reintroduction of the native oyster (Appendix 8.3). • Reintroduction of native oysters to Swansea Bay through spatting ponds. • Assessment of alternative cultch material to encourage settlement of oyster spats.	Design	Secured by DCO Requirement and DCOb
	Chapter 9: Recreational and Commercial Fisheries			
9.1	Impact on shellfish and Fish – Suspended sediment and deposition	• Use of appropriate geotextile lining to minimise the release of fine sediment into the water column.	Design	
		• Seafloor disturbance limited to redline area of (use of buoys and distribution of worker awareness information) • Adherence to best practice guidance (Marine Minerals Guidance 1: Extraction by dredging from the English seabed ODPM 2002) and other industry standards.	Construction	Measures to be included in CEMP secured by DCO Requirement.

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
		• Selection of dredging equipment by the contractor will be appropriate to the depths and material types to be dredged and to minimise the creation of plumes. • Disposal of the dredge spoil not used for seawall construction will be undertaken at Swansea Bay licensed outer disposal grounds, thereby presenting minimal risk of impact to sites outside the development area. • Preventing on-board screening or minimising material passing through spillways when outside the dredging area to reduce the spread of the sediment plume.		
9.2	Impact through contaminated sediments	• Use of appropriate geotextile lining to minimise the release of fine sediment into the water column and, if appropriate, containment of any finer silts within central wall cavity to minimise reduction in water quality during works. • Targeting of sediments approved by CEFAS for re-use in seawall construction and any temporary sediment bund for construction of turbine/sluice gate housing to reduce re-suspension of metals.	Design/construction	Pre-commencement DCO Requirement to seek approval of sediment for reuse in Project form NRW in consultation with CEFAS.
9.3	Increases in underwater noise and vibration	• Use of vibro piling techniques where possible. • If percussion/impact piling required due to ground conditions use of 'soft-start' piling procedures will be used, which alert fish to the works before the full noise level is generated.	Design/construction	Piling methodology to be secured by DCO Requirement/ML Condition

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
9.4	Potential effect on migratory and other fish accessing River Neath during directional drill of cable.	• Timing of works under river to avoid migratory period of vibration sensitive Shad. • Siting of drill compound at suitable distance from waters edge • Implementation of standard pollution control measures during works as identified in CEMP.	Construction	Timing of works form part of the CEMP secured DCO Requirement
9.5	Loss of habitat and habitat modification (eg lithophilic spawners such as herring)	• Where possible construction of western landfall and offshore cofferdam dredging in year 1 not to commence until end March/beginning April to allow herring to spawn.	Construction	Timing of works form part of the CEMP secured by DCO Requirement
		• Introduce spawning material (recycled from within Lagoon work areas where possible) at the base of the seawall for use by fish which utilise substrate to spawn (e.g. herring). Where possible media to be placed at the foot of the western lagoon wall by the end of August in Year 1 so that it will be available for herring to use for September spawning run • Consider placement of appropriate spawning media at other various locations around the lagoon wall with different degree of wave exposure. • Design of seawall adapted to increase heterogeneity and potential for fish spawning for instance use of rough, natural rock surface	Design/construction	Scheme for fish spawning enhancements to be secured by DCO Requirement
9.6	Physiological and behavioural impacts of electromagnetic fields on electrosensitive and magnetosensitive fish	• Electrical cables from the turbines to be buried within the lagoon seawall, above water level. • Cables beneath Neath will be drilled to appropriate depth (10m) and/or screened.	Design	DCO provision/DCO Requirement

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
9.7	Damage to fish during drainage of the temporary cofferdam	• The use of fish-friendly pumps to be used where appropriate to minimise bodily damage and provision of netting to ensure no fish in area. • If appropriate netting to be carried out prior to dewatering in order to remove any trapped fish within the structure. • Shellfish would be removed from the temporary cofferdam in advance of works. Fish rescue would be undertaken, if necessary, of fish remaining within cofferdam during latter stage of dewatering.	Design	DCO Requirement/CEMP secured by DCO Requirement
9.8	Potential loss of native oysters within footprint	• Oyster dredge trawls will be undertaken prior to construction works commencing in the proposed dredge areas, footprint of seawall and turbine/sluice gate housing to collect any native oysters that may be present. • Native oysters to be translocated to Centre for Sustainable Aquatic Research (CSAR) at Swansea University whilst construction works are ongoing, where their spawning behaviour and spat development will be monitored. (Appendix 8.3).	Pre-construction	Pre-commencement DCO Requirement to survey dredging area. Requirement for TLSB to undertake translocation in conjunction with CSAR. Scheme to be secured by DCO Requirement
9.9	Loss of commercial fishing grounds	• Provision of facilities for the potential for introduction of lobster or native fish species.	Design	Scheme to be secured by DCOb/DCO Requirement
9.10	Injury or mortality of fish from contact with turbines	• Use of behavioural fish guidance systems, e.g acoustic fish deterrents in proximity to the intake of the lagoon to discourage the movement of fish through the turbines. Deterrent will be turned off when sluicing occurring. • The deterrents will be developed in conjunction with the marine mammal requirements (10.2).	Design/operation	Scheme to be secured by DCO Requirement

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
9.11	Loss of recreational fishing grounds	• Minimise the size of the exclusion zones, where possible, thus allowing recreational fishermen to transit more freely across the bay during the construction phase of the project.	Construction	Exclusion zones to be included in CEMP
		• Design of seawall to encourage range of fish species. • Opportunities for shore-based anglers to fish within deeper water. • Fishing platforms included in the design of the lagoon seawall. • Angling opportunities: platforms with disabled access - the lagoon seawall will allow disabled anglers new opportunities to fish with relative ease, in appropriate weather conditions.	Design	Secured by DCO Requirement
9.12	Impact on anadromous fish and rod catch – piling and loss of foraging habitat	• Use of Good Practice Guidelines for piling and dredging (outlined in [9.1] above) • Minimised sediment plume during construction.	Construction	Good practice measures implemented in CEMP secured by DCO Requirement.
9.13	Increases in light emissions.	• Design of illumination would be directional and would be centred on landward elements and walkways. • The illumination of the water surface, especially outside the lagoon, would be avoided where possible. • The use of white mercury vapour lamps will be avoided.	Design	Lighting strategy to be secured by DCO Requirement
9.14	Waterborne noise and vibration from recreational activities.	• Recreational activities within the Lagoon will be encouraged in designated areas, with quieter areas identified in other areas.		OEMP secured by DCO Requirement

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
9.15	Enhancement	• Development of a 10 year programme in conjunction with SEACAMS to facilitate the reintroduction of the native oyster (Appendix 8.3). • Funding of ongoing study and monitoring of fish movements, artificial reef structures, limestone and rock pools located on the sea walls. • Establishment of a fisheries reference group with parties including NRW, CCSC and key representatives from the Angling Trust and those associated with the Tawe, along with engineering and environmental input from TLSBS team, to investigate opportunities to enhance the Fish Pass on the Tawe Barrage. A financial or in kind contribution for the provision of engineering and environmental design expertise to such an exercise; and subject to a design being produced which demonstrates a material benefit to performance of the existing Tawe Barrage fish pass in terms of the numbers of fish passing over the fish pass and securing match funding for such improvements, funding for provision of an improved fish pass. • Creation of a laboratory and hatchery area forming part the Western Landfall Building.		10 year reintroduction programme subject DCOb
	Chapter 10: Marine Mammals			
10.1	Noise disturbance during construction	• Use of low-noise piling techniques such as Vibro piling where possible. • Collection of additional baseline data using 2 C-PODs to inform CEMP and Adaptive Environmental Monitoring Plan (AEMP).	Design Pre construction	Piling and Monitoring strategy to be secured by CEMP/AEMP imposed by DCO Requirement

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
		• Procedures will incorporated into the CEMP to allow for transition from vibro-piling to percussive piling during hours of darkness or poor visibility. • If possible percussive piling works will commence within 20mins of cessation of vibro-piling. If 20 minutes have elapsed the following procedures will be followed for the transition to and percussive piling only. • Establishment of a 'mitigation zone' of radius 500m around the piling site, prior to any piling. • Within this mitigation zone, detection would be undertaken by a Marine Mammal Observer (MMO) and acoustically using appropriate Passive Acoustic Monitoring (PAM) equipment. • Both the observers and equipment will be deployed at least 20 minutes before percussive piling is due to commence. • Percussive piling would not commence if marine mammals are detected within the mitigation zone or until 20 minutes after the last visual or acoustic detection. • The MMO/ PAM operative should track any marine mammals detected and ensure that they are satisfied that the animals have left the mitigation zone before they advise the crew to commence percussive piling activities. • Percussive piling will commence using an agreed soft start procedure (the gradual increase of piling power, incrementally, until full operational power is achieved). The soft-start procedure will vary	Construction	Monitoring, soft start and timing procedures to be included in piling strategy secured by DCO Requirement and ML Condition.

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
		according to hammer and pile design and other factors.		
10.2	Collision risk during Construction	• Work vessels will avoid speeds above 6knots where possible when moving around site. JNCC guidance on reducing the risk to marine mammals of corkscrew injuries (linked to vessels that used ducted propellers) will be followed.	Construction	CEMP secured by DCO Requirement
10.3	Collision risk during operations	• AEMP to be imposed • The findings of further data collection (Point 10.1) will inform the AEMP • The Lagoon Warden will undertake routine surveillance for carcases. They will liase with the UK Cetacean Strandings Investigation Programme (CSIP) concerning existing shoreline surveillance which covers key areas which are predicted to be hotspots for strandings, based on local advice and hydrodynamic modelling. Integration of the Lagoon programme would be developed and run in coordination with the CSIP. • If necessary post-mortem evaluation of carcass of stranded animals would be carried out to assess cause of death. • Development of specific acoustic deterrents triggered if marine mammal is detected within 50 metres of a turbine. The deterrents will be developed in conjunction with the fish requirements (Point 9.10). • Monitoring to ensure the effectiveness of acoustic deterrents (see AEMP).	Operation	Monitoring and mitigation to be contained in AEMP and to be used to inform measures through OEMP. Secured by DCO Requirement

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
10.4	Animals becoming trapped within the lagoon	• Capture-and-release would be used if a marine mammal manages to access the lagoon through a sluice gate. • The Lagoon Warden would liaise with BDMLR, RSPCA Llys Nini, RSPCA Cymru and NRW concerning a capture and release monitoring programme. This would include communication routes and access arrangements.	Operation	Capture and release procedure to be dealt with in the OEMP, secured by DCO Requirement.
	Chapter 11: Coastal Birds			
11.1	Disturbance to coastal birds in foraging and roosting construction	• Where practical the main seawall construction to be in phases moving around the site thereby leaving areas with lower levels of disturbance. • Timing of main lagoon seawall construction works aimed for outside winter bird movement where possible (Oct to March). • Removal of existing structures (e.g. eastern breakwater/seawall) outside bird breeding season, where possible, or areas to be checked for nests prior to demolition.	Design/construction	Timing of works to be secured by CEMP and under DCO Requirement
	Disturbance to coastal birds in foraging and roosting operation	• Provision of low disturbance areas within internal lagoon areas and along lagoon seawall areas to maintain availability of low-disturbance, foraging habitat. • Provision of disturbance free kittiwake roosts on north east facing wall of turbine house away from down lighting. Investigate other opportunities for siting of ledges. • Provision of saltmarsh providing suitable foraging habitat	Design	Bird enhancement strategy to be secured by DCO Requirement

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
		• Increased fish diversity on outer wall and provision of herring spawning will minimise impact on prey species loss.		
11.2	Blackpill SSSI, Crymlyn Burrows impacts during construction and operation	• An artificial roost eg island within the quiet zone at the north-eastern end of the lagoon. Factors to be considered include being located >300m from lagoon walls to ensure a clear field of vision for birds whilst roosting. The artificial roost would be designed for use by species associated with Blackpill SSSI species including Sanderling and Ringed Plover. Note: an artificial high tide roost island was created for the Cardiff Bay Barrage and use by Dunlin, Redshank and Curlew. This has been documented as becoming a favoured roosting location on spring tides (Toomer & Clark, 1992 and Rehfisch et al. 1993). • Provision of disturbance free areas within the Lagoon.	Design/operation	Bird enhancement/mitigation strategy to be secured by DCO Requirement
11.3	Enhancement of habitats and foraging areas	• Use of concepts such as bioreefs in the eastern intertidal area of lagoon to encourage general levels of biodiversity including prey species of coastal bird species • Provision of saltmarsh habitat provides additional habitat for some coastal bird species including Little Egret and Redshank.	Design	Bird enhancement strategy to be secured by DCO Requirement

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
	Chapter 12: Terrestrial Ecology			
12.1	Impacts on SSSI in construction and operation (including impacts on Fabian Way conservation verge and sand dune outside of protected sites)	• Creation of artificial dune-scape at the base of existing coastal defences in the north east edge of the lagoon which will also provide a source of sand for redistribution towards Crymlyn Burrows by wind action.	Design	Scheme for creation of dune habitat to be secured by scheme under DCO Requirement.
		• Use of existing track for access to eastern section of SSSI. • Pre-construction treatment of any invasive species. • Minimal size of construction easement area. • Seasonal timing of construction works during autumn/winter, where possible. Minimising time spent in sensitive habitats. • Use of membranes or protection mats for top and subsoil storage. Minimising the amount of time spoil is stored and reinstated. • Cable route – trench to take place immediately adjacent to existing track (where applicable) and where possible trench width minimised (approx 70cm wide) to reduce temporary loss of habitat in the absence of other constraints including existing services. • Reinstatement through spread of subsoil followed by spread of topsoil to allow for natural re-colonisation by vegetation.	Construction	Requirement in the CEMP to remove any invasive species if found. CEMP includes provision for other restrictions in relation to habitat protection during construction. To be secured by DCO requirement.

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
		• Monitoring of the artificial dune-scape in north eastern area of lagoon to determine the need for further beach nourishment through wind driven sand losses.	Operation	Monitoring included in OEMP. Beach nourishment measures to be included as part of AEMP measures in the OEMP. To be secured by DCO Requirement.
12.2	Impacts on Blackpill SSSI reduction in sand supply during construction	• Beach nourishment activities to supply additional source of sand to habitat subject to results of monitoring.	Operation	Beach nourishment scheme to be secured by DCO requirement.
12.3	Eastern lagoon wall landfall and Crymlyn Burrows SSSI	• Creation of an artificial sandy beach within the Lagoon at its eastern landfall. The feature has a number of objectives including provision of a sand source at the south-western corner of the SSSI, provision of alternative recreational zone to draw visitors away from the SSSI and an aesthetic function to facilitate landscape integration. Periodic beach nourishment activities when required would replace sand lost from it, due to wind transport. The requirement for beach nourishment is not considered likely in the short to medium term and if required is likely to originate from commercial supplies such as sand dredged from the Bristol Channel or material dredged more locally (such as the Neath Channel);	Design	Scheme for provision of beach to be secured by DCO Requirement.
		• Beach landscaping and design of beach on western side of eastern lagoon landfall to reduce wind effect of wall.	Design	Scheme for provision of beach to be secured by DCO Requirement.
		• Vegetation management to create areas of bare sand as well as physical intervention to create blow-outs in area.	Operation	Vegetation management to be secured by DCO Requirement

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
		• Restoration of dune slack habitat through removal of scrub and woodland, as well as accumulated topsoil, if appropriate for grid connection works through SSSI. • Non-intervention management regime with regard to clearance of strandline natural litter to encourage invertebrates.	Construction	Working width corridor included in limits of deviation in the red line.
		• Public access restrictions to sensitive habitat and signing away from SSSI. • Landward access at the eastern lagoon arm, for visitors and students, will be from the west along a pathway / cycle track created to provide a haul route during the construction phase. Access between the SUBC and western end of the SSSI will be restricted by fencing. The nearest parking to the eastern landfall will be at the southern edge of the docks. Access between the Project and the SSSI (at the coast) will not be restricted, however; the alignment of the access track, distance from parking areas, and provision of an artificial beach as well as other facilities is expected to focus visitor pressure to managed areas within control of the Project. An information board would be provided setting out particular sensitivities for instance, nesting / roosting birds. Access to the lagoon wall will be restricted by security fencing and a gate limiting access during severe weather conditions and at night.	Design/Operation	Provision for visitor management included in OEMP. Access management, provision of eastern landfall visitor orientation and signage to be secured by DCOb.

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
12.4	Impact of cable route through Crymlyn SSSI	• Minimise working width of cable route corridor through SSSI, where appropriate. • Siting of laydown areas in agreement with NRW(A) - where appropriate clearance of agreed scrub vegetation within dune slacks. • Scrub clearance outside bird breeding season or pre check by ornithologist if inside breeding season (March - August). • Spraying of Goldenrod in working corridor and any stands adjacent to cable route. • Environmental liaison officer supervising any cable works within SSSI.	Construction	Pre-commencement DCO Requirement for approval of cable corridor width and laydown areas. Management of works to minimise impacts to be included in the CEMP.
12.5	Loss of bare ground, ephemeral and short perennial vegetation	• Scheduling of works on the eastern bank of the Neath during autumn/winter (September to March) where possible in order to avoid destruction of annual plants before they have the opportunity to set seed. • Storage and reuse of substrate (docks estate) supporting Rock Sea-lavender in artificial rocky shore habitat creation areas of lagoon seawalls. Habitat with the potential to support Rock Sea-lavender will be formed on appropriate areas of the tidal lagoon seawalls.	Design/construction	Timing of works to be included in CEMP secured by DCO Requirement. Reuse of soils, etc, also secured in CEMP
12.6	Loss of sand dunes outside designated sites	• Creation of an artificial dune front, using material dredged from within the lagoon footprint, to tie in existing habitat with the new lagoon wall. The tie in point will connect with existing sea defences fronting the SUBC. The artificial dune front will increase the area of dune habitat (by in excess of 3ha) and will be made of material capable of	Design	Scheme for creation of dune habitat to be secured by scheme under DCO Requirement

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
		colonisation by sand dune species. • Management to reduce impact through public access (such as use of boardwalks for access		
12.7	Loss of coastal grasslands	• Retention of habitat strips at least 3m wide associated with the grassland in the lea of the sea wall towards the south-east of Queens Dock (1.55ha retained); • Grassland creation along the landward side of new saltmarsh following removal of the existing sea wall (1.04ha). Colonisation of existing rock armoured sea defences will also be encouraged through infilling of large gaps with aggregate and localised topping with sandy spoil / topsoil; • Creation of a dedicated coastal grassland plot to the seaward edge at the south-eastern end of the docks estate (creating approximately 3 ha of coastal grassland habitat with a transition to saltmarsh habitat as well as connectivity to dune habitat towards the east); • Creation of grassland habitat at the periphery of parking bays at the western end of the project. • Translocation of grassland turves and reuse of topsoil from areas of species-rich sward to encourage the establishment of coastal grassland habitat in the newly created areas with plants of local provenance.	Construction	Creation of habitats to be included as works in DCO and provision to be secured by DCO Requirement. Provision of saltmarsh to be secured by DCOb.
12.8	Artificial Rocky Shore Habitat	• Translocation of robust plants (such as Golden-samphire) or substrates containing target species	Construction	Scheme for creation of rocky shore habitat to be secured by scheme under DCO

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
		seeds (such as Rock Sea-lavender) to holding areas where they can be relocated to newly created habitats on lagoon walls; • Creation of purpose-designed artificial rocky shore habitat on new lagoon walls. These will comprise shelves of compacted aggregate mixed with fines on internal parts of the lagoon wall. In addition, similar features will be created on less exposed sections of the external lagoon wall. At least 5km of such habitat will be created along new lagoon walls.		Requirement
12.9	Disturbance, injury or mortality of breeding birds	• Scrub cover or rank grassland to be removed / cut outside of the breeding bird season (end of February to end of August);	Before construction	Pre-commencement CEMP under DCO Requirement.
		• Pre-construction checks in areas with residual potential for nesting birds. • Following the cessation of construction activities, reinstatement /site clearance will be undertaken to provide bare and open areas (devoid of clutter) with potential to support ground nesting birds.	Construction	CEMP includes provision for management of scrub removal in high risk areas, to be secured by DCO Requirement
		• Restriction of access to sensitive habitats	Operation	Restriction of areas in CEMP.
		• Provision of Kittiwake ledges on north eastern face of turbine housing (not under any direct lighting). Locations for further ledges will be reviewed at other suitable locations around the lagoon wall. • Routine winter maintenance of ledges maybe required to ensure ledge remain in good repair.	Design	Bird enhancement strategy to be secured by DCO Requirement

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
12.10	Disturbance, injury or mortality of reptiles	• Where possible, habitat retention, demarcation and protection (reptile fencing and visibility fencing) designed to facilitate in-situ protection of reptiles in part of the grassland verge to the south-east of Queens Dock; • Habitat manipulation to reduce reptiles cover (scrub removal and grass strimming to 10-15cm) in areas identified for clearance; • Provision of artificial refugia (100-200 tins per hectare) within areas identified for clearance; • Reptile capture and translocation programme; • Clearance under the supervision of an ecologist; • Provision of features such as rock piles within grassland habitat creation areas at the south-eastern edge of Swansea Docks in order to encourage re-colonisation of reptiles from contiguous habitat to the east; • Removal of temporary reptile fencing as soon as localised construction works have finished to allow reptiles to re-colonise new habitat.	Construction	Measures included in CEMP. Monitoring of impacts during construction included in CEMP. CEMP secured by DCO Requirement
12.11	Disturbance, injury or mortality of Invertebrates	• Retention of grassland habitat plots in order to ensure presence of food plants for colonisation in addition to adult, eggs or pupae of invertebrates; • Reuse of grassland turves or topsoil to encourage re-establishment of diverse grassland plots; • Using infertile substrates in habitat creation areas to encourage colonisation by a diverse assemblage of plants more likely to support a diverse invertebrate fauna.	Construction	Management measures to be included in CEMP secured by DCO Requirement.

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
12.12	Disturbance, injury or mortality of otters	• Use of directional lighting at construction compounds in order to avoid light spill onto open water of the docks; • Exclusion fencing to high risk areas and provision of alternative access routes for otter. • ensuring access between the docks and coastline is maintained at all times and that barriers that could impede movement of Otter are not created. • Sympathetic security lighting regime during operation. • Passage through security fencing between the docks estate and Project will be maintained during operation to ensure interconnectivity. • Access to the foreshore for Otters will be increased in the operational phase of the Project due to the removal of the sea wall. • Control of dogs within Lagoon area.	Construction Operation	Measures included in CEMP and OEMP secured by DCO Requirement. Lighting design secured by DCO Requirement. OEMP to secure other measures.
12.13	Disturbance of bats	• Sympathetic lighting regime during construction and operation. • Lagoon wall should provide replacement flight line and foraging habitat for bats.	Construction, operation	Measures included in CEMP and OEMP secured by DCO Requirement.
12.14	Colonisation of invasive species	• Pre-construction treatment programme or mechanical removal and disposal during construction. • Identification and demarcation of invasive species infestations; • Implementation of an invasive species construction management plan aimed at setting out a strategy to avoid their spread;	Construction	Measures included in CEMP secured by DCO Requirement.

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
		• Site monitoring under Adaptive Environmental Monitoring Plan. • Creation and implementation of an invasive species management plan.	Operation	Monitoring and adaptive management included in OEMP, informed by AEMP.
12.15	Enhancement	• Creation of approximately 5 hectares in size of Saltmarsh and created from dredged spoil arising from construction of the lagoon. • A Lagoon warden with a remit which includes coordination of ecological monitoring and management of relevant ecological habitats will be based at the laboratory in the Western Landfall Building. The Warden will also liaison with local ecological groups, other landowners and Statutory Nature Conservation Bodies, for the area.		Secured by DCOb and OEMP.
	Chapter 13: Landscape/Seascape			
13.1	Impacts of lighting	• Development of appropriate lighting to keep lagoon within Swansea Bay setting.	Design	Lighting design to be secured by DCO Requirement
	Chapter 14: Navigation			
14.1	Increased vessel to vessel collision risk with work vessels or with displaced vessels during construction.	• Notices to mariners should be produced well in advance of the establishment of the exclusion zones.	Pre-construction	Notice period to be included and enforced in CEMP, and operated in consultation with relevant harbour and navigation authorities.
14.2	Additional vessel to structure allision risk during construction.	• Additional Aids to Navigation (AtoN) • Work procedures and planning with respect to other users in the bay • Promulgation of information • Notice to Mariners (NtoM)	Construction pre-commencement	Measures to be secured in consultation with relevant port and navigation authorities. Work procedures, planning

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
		• Safety vessel on site during construction • Appropriate safety zones during construction • Dolphin piles on outside of cofferdam during construction.	requirement	and safety zones to form part of CEMP. Safety vessel function to be required as part of CEMP. Provision of vessel to form requirement in DCO.
14.3	Displacement of pilot vessels/tugs during construction	• Change location of pilot boarding station (to south) to increase distance between pilot boarding station and lagoon wall	Construction	Provision of replacement pilot station to be secured by DCO Requirement
14.4	Increased vessel to vessel collision risk – especially for vessels in the channel coming out of Swansea during operation	• Works vessel co-ordination with other users in the Bay • Safety vessel during major maintenance	Operation	Notice to Mariners procedure to form part of OEMP Safety vessel provision to be secured in OEMP. Any required provision of safety vessel to be secured by DCO Requirement.
14.5	Vessel to structure allision risk during operation	• Lighting and marking of lagoon • Promulgation of information • Aids to navigation • Procedures for adverse weather • Safety zone around turbine housing (dolphin piles and booms outside and floating booms inside) • Maintenance dredging of channels where necessary	Operation	Lighting of the lagoon and maintenance dredging to be secured by terms of DCO. Requirements regarding lighting maintenance dredging and safety zone to be included in the DCO . Lighting, safety zone and maintenance dredging procedure to be form part of the OEMP.

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
14.6	Vessel to structure allision risk for recreational vessels during operation	• As above, with the addition of: • Coordination with event's organisers to ensure the provision of site support vessels during events and other busy periods	Operation	DCO/OEMP to set requirements and procedure for the operation of any membered boat club or sporting event holder to provide support vessels.
14.7	Change to transit routes for fishing and recreation vessels	• Promulgation of information to specific persons	Construction and operation	Requirement to provide notice of changes to routes upon operation included in DCO.
14.8	Impact on persons in the water after falling from vessel	• Marked exclusion area around turbines • Extensive promulgation of information • Additional aids to navigation • Quick response emergency shutdown procedure for turbines from manned facility on turbine housing • Enforcement of life jackets for sporting activities in the lagoon impoundment.	Operation	Requirements regarding safety/exclusion zone and use of life jackets to be included in the OEMP secured by DCO Requirement. Emergency shutdown procedure and safety procedures to be included in the OEMP secured by DCO Requirement.
14.9	Wave reflection	• Wall design ensures that wave reflection will not be a significant issue	Operation	Incorporated in Project design
14.10	Impact on search and rescue operations and vessels emergency plans	• The Lagoon has been designed to incorporate the requirements of all on and offshore first responders e.g. in the width of the access track on the seawall and provision of slipway. • Implementation of Emergency Response Co-operation Plan (ERCoP) • Coordination with event's organisers and	Operation	ERCoP to be secured as part of OEMP in consultation with HM Coastguard Implementation of boat club and event organisers as

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
		membered boat club to ensure the provision of site support vessels during events and other busy periods		above.
14.11	Impact on pilot boarding station and displacement of pilot vessels/tugs during operation	• As with construction impact above	Operation	Provision of replacement pilot station to be secured by DCO Requirement
14.12	Impact of lagoon lighting during operation	• Lighting designed with consideration given to shipping and navigation	Operation	Requirements regarding lighting to be included in the DCO.
14.13	Water Shuttle	• Provision of a jetty on the western lagoon wall to facilitate a water shuttle serving the Project from the west bank of the River Tawe and/or Mumbles.	Operation	DCO Requirement
	Chapter 15: Onshore Transport			
15.1	Increased cycle and pedestrian access to the Lagoon and surrounding areas	• Project designed to provide enhancement of local amenities and appropriate highway signage • Provision of bus stop(s) at the western landfall of the lagoon to enable bus service departures and arrivals. • Provision of a shuttle bus service to the Project from the Park & Ride facility on Fabian Way subject to investigation of its viability; • Provision of bicycle racks at the western landfall of the lagoon. • Provision of a jetty on the western bank of the River Tawe on the western seawall to facilitate a water shuttle serving the Project from the west bank of the River Tawe and/or Mumbles.	Design /Operation	DCOb.

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
15.2	Impacts of increased road traffic during construction	• Close control of construction traffic entering and leaving the site. • Delivery and spoil removal via designated routes in agreement with relevant bodies • Deliveries phased in a "just in time" approach to minimise site traffic • Planning of access and egress of construction traffic to minimise impact on local network (in particular during peak times) • Construction staff encouraged to use sustainable transport, car sharing and minivans will be used to transit from car parks to construction site to minimise impact on the local roads and within the site • Pedestrian access where possible segregated from vehicular traffic at all times	Construction	Measures included and enforced in Construction Phase Travel Plan (CPTP). CPTP to be approved by NPTCBC and CCSC. Pre-commencement DCO Requirement.
15.3	Impacts of increased road traffic during operation	• Measures to encourage the use of sustainable modes of transport i.e. public, cycle, pedestrian. • Appointment of a travel plan co-ordinator to manage travel to site • Measures to minimise journeys by car	Operation	Measures to be included and enforced in Operational Phase Travel Plan (OPTP). OPTP to be approved by NPTCBC and CCSC. Pre-commencement DCO Requirement.
15.4	Transport impacts during major events	• Major Event Travel Plan (METP) to be prepared and implemented by event organisers • METP to include details of: • Definition of what constitutes a major event; • Expected number of competitors and spectators, including mode of travel; • Management of vehicular and pedestrian access,	Operation	DCO Requirement for NPTCBC and CCSC to approve METP prior to first major event.

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
		including details of off-site parking, • any temporary Park & Ride facilities, drop off and pick up arrangements, etc.; • Details of any temporary road closures or Traffic Management required; • Car and coach parking arrangements; • Details of police liaison; and • Access signage and advertising strategy.		
	Chapter 16: Air Quality			
16.1	Impacts on air quality during construction	• A Construction Environmental Management Plan (CEMP) will be prepared for the site and agreed with CCSC and NPTCBC before any on-site works begin.	Before construction	Air quality measures to be secured in CEMP under DCO Requirement.
16.2	Impacts from construction vehicle emissions	• Use of catalytic converters and other emissions control devices and regular maintenance of vehicle engines. • On-road vehicles to comply with national and EU emissions standards. • Where possible, all vehicles will switch off engines when not in use, i.e. minimise idling vehicles.	Construction	Air quality measures to be secured in CEMP under DCO Requirement.

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
16.3	Impacts of construction dust and vehicle tracks	• No bonfires. • Site layout will be planned; machinery and dust-causing activities will be located away from sensitive receptors, where possible. • Reduce speeds of vehicles tracking across un-made surfaces. • Use of water as a dust suppressant, where appropriate during dry weather. • Minimise drop heights for a delivery of aggregates • Regular vehicle cleaning and covered loads. • Cleaning of mud tracked onto main highways if necessary.	Design/construction	Air quality measures to be secured in CEMP under DCO Requirement.
	Chapter 17: Hydrology and Flood Risk			
17.1	Release of suspended sediments	• No permanent works proposed within Queens or Kings Docks. • Dockside works will employ standard, good practice construction measures. • Standard construction site management measures employed to prevent or minimise this. • Cut-off ditches and/or geotextile silt-fences installed around excavations or exposed ground and stockpiles where required.	Construction	Measures to be included in CEMP secured by DCO Requirement.
17.2	Build-up of dust and mud	• Site access points regularly cleaned.	Construction	Measures to be included in CEMP secured by DCO Requirement.
17.3	Construction silt combining with run-off	• Earth movement controlled to reduce risk.	Construction	Measures to be included in CEMP secured by DCO Requirement.

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
17.4	General pollution	• Development of a Pollution Prevention Plan as part of the CEMP. • An Emergency Spill Response Plan (ESRP) would be produced as part of the EMP, which site staff must have read and understood. • On-site provision would be made to contain a serious spill or leak through the use of bunding and absorbent material.	Construction	Measures to be included in CEMP secured by DCO Requirement.
17.5	Mud on roads producing sediment-rich run-off	• Properly contained wheel-wash facilities, where required, to minimise mud on the roads.	Construction	Measures to be included in CEMP secured by DCO Requirement.
17.6	Unmanaged surface water run-off, ground water seepage and de-watering during construction	• Silty water abstracted during excavations would be discharged to settlement tanks • Cleaned run-off can then be discharged to an appropriate location (Queen's Dock or Lower Tawe) via temporary soakaways or pipes. • Discharge agreements will be decided with the ABP (as landowner, along with any other such parties), NRW and, where there are implications for the foul drainage network, DCWW prior to commencement of works.	Construction	Measures to be included in CEMP secured by DCO Requirement.
17.7	Leakage of oils and hydrocarbons Plant and machinery waste polluting drainage system	• Oils and hydrocarbons to be stored in designated locations with specific measures to prevent leakage and release of their contents, including the siting of storage areas away from surface water drains and on an impermeable base with an impermeable bund that has no outflow and is of adequate capacity to contain 110% of the contents.	Construction	Measures to be included in CEMP secured by DCO Requirement.

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
		• Valves and trigger guns to be protected from vandalism and kept locked when not in use. • Wherever possible, plant and machinery to be kept away from drainage system • Drip trays beneath oil tanks, engines, gearboxes and hydraulics. • Drip trays checked and emptied regularly by a licensed waste disposal operator. • ESRP alongside on-site provision for the containment of spills.	Construction	Measures to be included in CEMP secured by DCO Requirement. DCO Requirement to agree the need for oil interceptors/sediment traps with DCWW and NRW prior to any surface water run-off into the drainage system.
17.8	Concrete entering the drainage system	• Batching plant on-site within the Port environs	Design	Location of batching plant to be approved by relevant planning authorities
		• Wherever possible, mixing and handling of wet concrete on-site would be undertaken in designated, impermeable areas, away from any drainage channels, surface water or tidal waters. • A designated, impermeable area would be used for any washing down or equipment cleaning associated with concrete or cementing processes. • Wastewater would be discharged to an agreed point.	Construction	Measures to be included in CEMP secured by DCO Requirement. Requirement to agree any discharge points with relevant planning authorities.

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
17.9	Disturbance of contaminated land Pollution from contaminated excavated materials	• GI conducted prior to the Project. • Where contaminated land is disturbed, scheme of remediation works will be developed and agreed with NRW • Stockpiling of possibly contaminated, excavated materials and appropriate management, such as positioning away from any drainage systems and subsequent covering to prevent run-off or infiltration of contaminants into the ground, will minimise the risk of pollution of water bodies. • Where possible, the use of driven piles, rather than cast-in-place or bored piles provides little potential for the pollution of water. If using the latter methods, the potential risk of contamination posed to underlying aquifers can be mitigated through measures, such as the use of pile casing and isolating and sealing features from surface water. • Depending on the results of the risk assessment process and proposed Terrestrial Ground Investigation, contaminated hotspots present within the made ground underneath the area of the Project may be removed, treated or isolated prior to development.	Construction	Pre-commencement requirement to conduct GI and agree any actions with the relevant planning authorities in consultation with RW Measures to be included in CEMP secured by DCO Requirement.

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
17.10	Disturbance of existing drainage network	• All existing utilities will be identified and marked prior to works commencing. • Exposed, disused drainage piping, such as abandoned overflows, will be isolated from surface water run-off and decommissioned. • Any damages to the drainage network, if present, will be immediately repaired. • An Emergency Action Plan will be implemented	Construction	Pre-commencement requirement to identify all utilities. Requirement to isolate and decommission disused drainage; repair any damages. Emergency action plan included in CEMP secured by DCO Requirement.
17.11	Disturbance to groundwater particularly in relation to excavations for foundations	• Where complete cut-off is provided, then groundwater can be controlled on excavation using normal pumping equipment. • If partial cut-off is considered, dewatering systems using sump trenches or well points directing groundwater from the excavation can be used instead. • Measures, such as cut-off trenches, can be put in place to prevent potentially polluted run-off from the project entering the excavation. • Uncontaminated water arising from excavations will need to be disposed of to an appropriate location, e.g. Queen's Dock or Lower Tawe, subject to appropriate discharge consent from NRW or approval from ABP, if uncontaminated and following the removal of silt via settlement ponds or alternative measures.	Construction	Cut off and partial cut-off procedures included in CEMP secured by DCO Requirement. Discharge addressed by powers conferred by article in DCO.

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
17.12	Temporary, minor increase in water demand	• Water supply will be provided by DCWW and will require a Building Water Supply licence. • Water-efficient fixtures and fittings will be used in temporary office facilities. • Re-use of water during the construction phase will minimise water consumption.	Construction Design	Pre-commencement DCO requirement to have Building Water Supply Licence in place. Water use limitation measures to be included in the CEMP.
17.13	Generation of foul and sewerage waste	• Wastewater will be kept separate from surface water runoff. • Volume can be reduced by use of water-efficient fixtures and fittings and re-use of water in construction activities, where applicable. • Foul water will be drained to the private sewer network, where existing, and then connected to public sewerage subject to agreement with DCWW for subsequent connection to the DCWW network.	Construction Design	Discharge addressed by powers conferred by article in DCO.
17.14	Creation of preferential pathways for contaminated runoff to reach deeper groundwater	• Investigations/survey to minimise potential risks through: old boreholes; disused drainage networks on site from earlier developments; or part-demolished sections of existing site drainage.	Design	Pre-commencement DCO requirement
		• Use of geotextile bunding to isolate and minimise the ingress of surface water runoff to non-decommissioned boreholes or exposed surface water drainage pipes. • Decommissioning of surface water drainage networks and exposed boreholes to the satisfaction of NRW. • Pile casing during piling and isolation of the area around the piling from surface water until piling is complete	Construction	Measures to be included in the CEMP secured by DCO Requirement DCO Requirement to secure decommissioning surface water drainage networks/exposed boreholes prior to commencement of works.

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
17.15	Increased flood risk	• SUDS-based drainage options will be incorporated into the design, where appropriate. • Rainwater harvesting techniques and water butts used, where possible, for proposed buildings. • Flood response plan – liaison with NRW – preparation of flood warning plan and flood warning area in CEMP and OEMP • Floor levels raised – freeboard allowance +0.5m	Design and operation	DCO Requirement for drainage strategy
17.16	Increase in demand for potable water and in disposal of wastewater	• Rainwater from roofs and other hard surfaces would potentially be harvested and stored on site for irrigation of landscaped areas. • Installation of water meters and water-efficient appliances and fittings.	Design enhancement	DCO Requirement
17.17	Contamination from in-situ materials	• Damp-proof membranes to be incorporated, where the Project involves the construction of foundations. Such construction would therefore lie within damp-proof membranes and will not be exposed to underground strata or groundwater. • All proposed drainage/service runs would be surrounded by appropriate, granular, bedding materials and located above the static level of any shallow groundwater.	Design	DCO Requirement for drainage strategy

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
17.18	General impacts on the environment and DCWW infrastructure	• Oil interceptors would be used to drain high-risk areas, as defined by the EA's Pollution Prevention Guidelines 3 (EA PPG3). • These typically include car parking areas that are larger than 800m^2 or areas that have more than 50 car parking spaces, as well as areas where goods vehicles are parked or manoeuvred.	Design	DCO Requirement for drainage strategy
17.19	Residual risk of spillage of contaminating material	• Operating measures, such as speed limits and road markings, and procedures during delivery or movement of materials. • The drainage system would also typically have cut-off measures that would allow a spill to be contained, so that it can be effectively controlled and managed without leading to off-site impacts. • An ESRP would be put in place and education/information on waste treatment/emergency events/spills, etc. will be provided to the staff.	Operation	DCO Requirement for drainage strategy
		• Commercial uses and landscaping maintenance on site would adhere to statutory and best practice waste regulations, and would have and adhere to safety protocols, plans and procedures, with respect to the storage and use of all fuels, chemicals and waste. • Storage of any chemicals required for use within the completed development, such as for landscaping and general site maintenance, would be in designated areas within buildings, with no direct pathway to the sewer system or water courses.	Operation	Measures included in OEMP.

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
	Chapter 18: Land quality			
18.1	General impacts	• Development and undertaking of targeted site investigation work to inform the construction of the western landfall building and boating centre. • Development of appropriate targeted mitigation strategy.	Construction	Pre-commencement DCO Requirement in relation to onshore buildings to undertake GIs and implement appropriate mitigation measures.
18.2	Health and safety impacts for construction staff	• Evaluation and implementation of appropriate measures to protect construction staff health	Construction	Safety measures to be included in the CEMP secured by DC Requirement.
18.3	Disposal of soil off-site	• Site materials will be re-used to level the project, where possible. • The procedure for managing the re-use of soils at the project will be documented in a Materials Management Plan.	Construction	Procedure for the management of off-site soils included in a Materials Management Plan and implemented as part of the CEMP secured by DCO Requirement.
		• Where surplus soil needs to be disposed of, it will be done at an appropriate, licensed landfill facility, in accordance with current Duty of Care responsibilities and other statutory requirements. • As required by the Landfill Directive, inert, non-hazardous and hazardous waste will require pre-treatment prior to disposal. • Prior to disposal, soil will need to be characterised following the methodology described in the Environment Agency publications 'Framework for the Classification of Contaminated Soils in	Construction	Measures included in CEMP secured by DCO Requirement

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
		Hazardous Wastes', version 1 and 'Guidelines on sampling and testing of wastes to meet landfill waste acceptance procedures' version 1.		
18.4	Accidental fuel and chemical spills	• Storage within bunded areas to contain chemical spillages during construction. • Emergency procedures to manage the eventuality of an accidental spill in line with regulatory guidance	Construction	Measures and procedures included in CEMP secured by DCO Requirement
18.5	Geotechnical considerations: made ground and superficial deposits	• GI to be carried out to establish the most appropriate foundations and other elements of onshore buildings	Design	Pre-commencement DCO Requirement to carry out GIs
18.6	Disturbance of ground gases	• The Phase 2 geotechnical investigation will include monitoring for the presence of ground gases, in accordance with existing standard (BS 8576:2013), and will be enforced by the local authority. • If required, ground gas mitigation measures will also be incorporated into the foundation design of the buildings.	Design	So far as required to be secured by DCO Requirement
18.7	Disturbance of unexploded ordnance during piling and deep excavation	• Explosive Ordnance Safety and Awareness Briefings for personnel conducting intrusive works. • Unexploded Ordnance Site Safety Instructions for site personnel. • Desktop study to review risk and presence of an Explosive Ordnance Disposal Engineer on site to supervise open excavations where appropriate. • Down-hole intrusive magnetometer surveys of all deep intrusive works and target investigation of suspect anomalies.	Construction	Measures included in CEMP secured by DCO Requirement.

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
	Chapter 19: Noise and Vibration			
19.1	Site preparation and construction noise	• Implementation of best practice for haulage contractors as per BS5228. • Screening of potentially noisy construction works; working hours; regular maintenance of construction equipment • Soft start procedures for percussive piling.	Construction	Measures included in CEMP secured by DCO Requirement.
	Chapter 20: Marine Archaeology			
20.1	Damage or disturbance of archaeological sites	• The observance of a development exclusion zone around the position of wreck 05 to ensure that no impact occurs. ▪ A watching brief during dredging will allow for the identification of those sites for which a significance rating was not possible (33, 37-39 and 43-55) and for the monitoring of activity in the vicinity of sites **24-35** and **27-31**. The watching brief will involve the implementation of a protocol for the reporting of material recovered from the dredge head, with provision for monitoring of dredging by a suitably qualified archaeologist where the discovery of material suggests the present of an archaeological site. The protocol will include provision for the recording and investigation of any recovered material, and for the assessment of any sites that are discovered during dredging.	Construction	Restriction in exclusion zone to be secured by DCO Requirement Watching brief to be included in the CEMP
		• Mitigation measures detailed in a written scheme of investigation (WSI).	Before construction	Pre-commencement DCO Requirement to have approved WSI in place.

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
	Chapter 21: Terrestrial Archaeology			
21.1	Damage or removal of archaeological objects	• Level 2 building recording exercise on the light on the eastern breakwater. If possible and practical, retention of Harbour Light (308200). Recording of light to mitigate against the impact of loss. • Retention of three standing pill boxes and gun emplacement plus approximately 3m buffer zone. • WWII gun emplacement - a series of small evaluation trench and the recording of any structural remains revealed below ground. • Archaeological watching brief for construction of cable route running through previously undisturbed ground. • Tank cubes and collapsed pill box located at the eastern end of the seawall may remain *in situ* or be relocated as a result of the Project.	Design	Any removal of structures subject to requirement to record their presence. WWII pill boxes to be incorporated in design as secured by DCO Requirement
	Chapter 22: Tourism and Recreation			
22.1	Impacts on the environment and amenities	• Use of lagoon for a range of water contact and other sporting activities. Key sports identified include sailing, rowing, open water swimming and triathlon. • Building of Offshore Building and Western Landfall Building and associated facilities. • Walking and cycling facilities. • Controlled public access will be provided to the seawall and lagoon, ensuring that access is prevented or managed during extreme weather conditions and that access is limited by duration and location during the hours of darkness.	Design/operation enhancement	WQS to be secured by AEMP, OEMP and DCO Requirement. Provision of building(s) and access secured by DCOb

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
		• Public access (as above) on and around the seawall to new areas for coastal and recreational sea fishing. • Provision of bus stop(s) at the western landfall of the lagoon to enable bus service departures and arrivals. • Provision of a shuttle bus service to the Project from the Park & Ride facility on Fabian Way subject to investigation of its viability; • Provision of bicycle racks at the western landfall of the lagoon. • Provision of a jetty on the western bank of the River Tawe on the western seawall to facilitate a water shuttle serving the Project from the west bank of the River Tawe and/or Mumbles.	Design/operation enhancement	Secured by DCOb.
		• A setting for art and educational programmes. • Cape Farewell was appointed TLSB's education and cultural partner in early 2012. • Educational programme and resource created by TLSB for schools and colleges of Swansea and Neath Port Talbot. The programme aims to help young people develop their skills and knowledge to allow them to make their own choices for the future environment.	Design/operation enhancement	Secured by DCOb.

	Potential impact	Mitigation/Enhancement	Stage of development when applied to the Project	Method of delivery (DCO Requirement, Marine Licence (ML) Condition, etc.)
22.4	Contribution to and mitigation/enhancement of wider ecological environment and local economy	• Encouragement of reintroduction of native oyster to Swansea Bay. • A lobster hatchery with introduction of lobster onto the seawall. • Local labour and procurement commitment (subject to legal requirements)	Design/operation enhancement	Secured by DCOb.

23.9 References

Cefas (May 2012) Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects, Cefas contract report: ME5403 – Module 15

HM Government (March 2011), UK Marine Policy Statement

Legislation

Council Directive 85/337/EEC of 27th June 1985 (as amended) on the assessment of the effects of certain public and private projects on the environment (the EIA Directive)