TIDAL LAGOON SWANSEA BAY

The Proposed Tidal Lagoon Swansea Bay Generating Station

Marine and Coastal Access Act 2009
Application for a marine licence
to undertake marine energy works and to dredge and dispose of dredged material

VOLUME M3

ENVIRONMENTAL STATEMENT: NON-TECHNICAL SUMMARY

February 2014

www.tidallagoonswanseabay.com

NON-TECHNICAL SUMMARY

THIS DOCUMENT

This document relates to the Tidal Lagoon Swansea Bay energy generation project (the Project). It is the Non-Technical Summary (NTS) of the Environmental Statement (ES). The ES has been prepared by Tidal Lagoon (Swansea Bay) plc (TLSB) to provide information about the Project as part of the application process for a development consent order (DCO) under the Planning Act 2008. The ES reports on the full findings of the Environmental Impact Assessment (EIA), which assesses the potential effects of the Project on the local and wider environment, and includes measures to reduce effects and provide benefits. The ES is submitted with the application for a DCO to authorise construction and operation of the Project (further details on the application and consenting process are provided below).

INTRODUCTION TO THE PROJECT

TLSB is proposing to construct and operate a tidal energy lagoon, located in Swansea Bay, South Wales (Figure 1). The red line boundary of the Project, encompassing all the elements proposed, and the maximum extent of land over which powers are sought, is also shown in Figure 1. The tidal lagoon will generate renewable energy in the form of electricity using the large tidal range (the difference between high and low water) which is a distinguishing feature of the Bay. The Lagoon will have a nominal rated capacity of 240 Megawatts (MW), generating 400GWh net annual output. This is enough electricity for approximately 121,000 homes: more than Swansea's annual domestic electricity use (109,000 households); c.70 percent of Swansea Bay's annual domestic electricity use (Swansea, Neath & Port Talbot, 173,000 households); or c.9 percent of Wales' annual domestic electricity use (based on 1,369,000 households).

In addition to generating electricity, the Project aims to provide visitor facilities and other amenities including art, education, mariculture and sporting/ recreational facilities. The seawall is expected to be open to the public during daylight hours for walking, running, cycling, fishing etc, though access will be controlled in extreme weather.

An integral part of the Project is the provision of an enclosed water sports venue capable of providing a safe body of water for local, regional, national and international events. The new rock armour of the Lagoon seawall, which will extend some distance offshore, will provide good opportunities for habitat creation both above and below the water level. In addition, opportunities will be available for both able-bodied and disabled recreational fishermen, with the provision of safe and formal fishing locations, as well as informal opportunities for walkers, runners and cyclists.

The Project is entirely privately funded. The development phase is funded by private individuals and green entrepreneurs, as well as a public share offer held in June 2013. The construction phase will be funded by major institutional investors and a further public share offer.

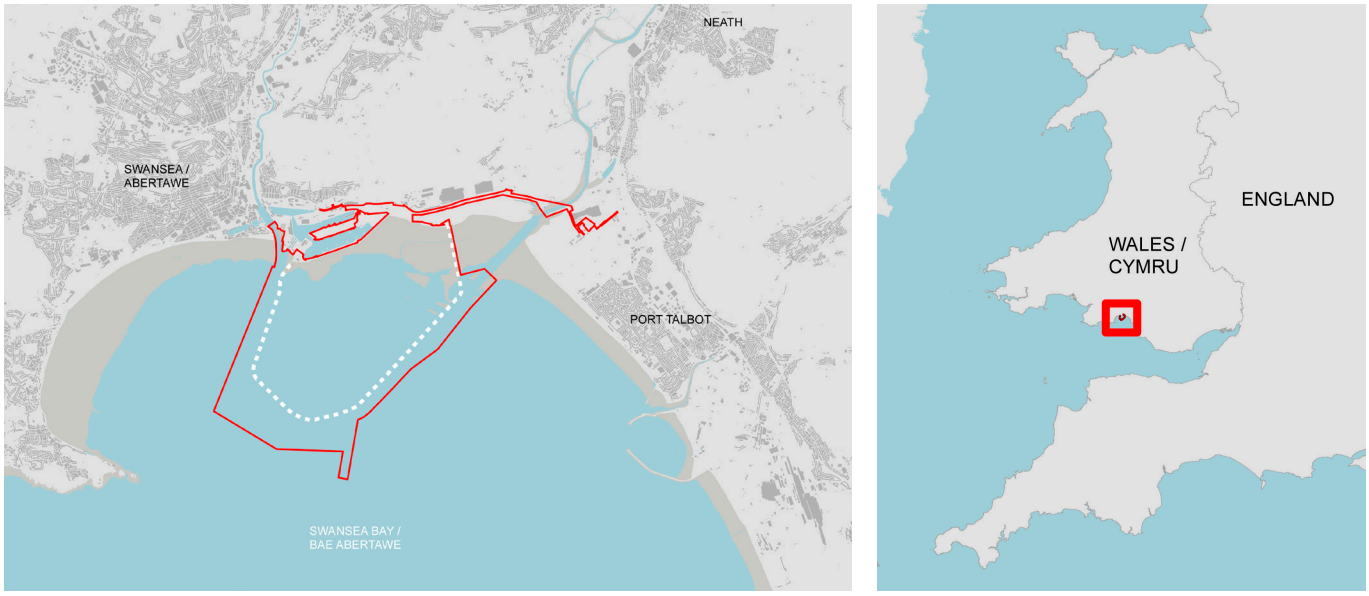

Figure 1: Location of the proposed tidal lagoon

CONSENTING PROCESS

As the Project is an offshore electricity generating station with a capacity in excess of 100MW, it is classed as a nationally significant infrastructure project (NSIP) under the Planning Act 2008 (PA 2008). Construction of such a project requires that a development consent order (DCO) is made by the appropriate Secretary of State, in this case the Secretary of State for Energy and Climate Change, via an application to the Planning Inspectorate under PA 2008.

The DCO for the Project will include a number of consents formerly required separately for a project of this type. Section 33 of PA 2008 dispenses with the need for separate planning permission or deemed planning permission under the Town and Country Planning Act 1990 (TCPA 1990) and consents under Section 36 of the Electricity Act 1989. Any additional permissions required under TCPA 1990 will be sought following the grant of development consent, as such elements would not form an integral part of the Project as authorised by the DCO.

The DCO will authorise construction and operation of the generating station itself, and its component parts. These include both offshore and onshore elements of the Project, including the integral electrical grid connection works.

As the Project lies within Welsh waters, an application for a marine licence will be made to the appropriate licensing authority, under the Marine and Coastal Access Act 2009, in this case, the Marine Licensing Team within Natural Resources Wales (NRW). The requirement for a marine licence (ML) is broadly defined by works taking place in the offshore environment that affect the seabed or the movement of materials relating to it. In order to deliver the Project, TLSB will be carrying out licensable activities, including the construction of marine energy works and dredging and disposal of dredged material.

An application for a marine licence will be submitted concurrently with the application for the DCO. Given the nature of the two regulatory regimes, elements of the offshore Project that are subject to the DCO application are also subject to a separate marine licence application.

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Figure 2: Overview of the Project elements

OVERVIEW OF THE PROJECT

The Project is situated at Swansea Port, approximately 2.2km southeast of Swansea city centre. The Project straddles the administrative areas of the City and County of Swansea Council (CCSC) and Neath Port Talbot County Borough Council (NPTCBC). The main onshore development lies within the Port area, immediately south of Fabian Way (A483) which is the main trunk road from Junction 42 of the M4 into Swansea.

The onshore development area (Figure 2) provides an indication of where the structures associated with the Project will be located, with the grid connection route highlighted in yellow. Immediately west of the site, adjacent to the boundary, is the mouth of the River Tawe and to the east of the site, is the River Neath.

The Lagoon will enclose part of Swansea Bay, from the eastern side of the River Tawe (western landfall) to the eastern edge of the new Swansea University Bay Campus (SUBC - previously known as the Science and Innovation Campus, and currently under construction) (eastern landfall). The seawalls impounding the Lagoon will extend approximately 1.5km directly offshore from SUBC, adjacent to Crymlyn Burrows Site of Special Scientific Interest (SSSI). The seawalls will then extend in a southwest direction along the western boundary of the training wall of the River Neath Channel. A turbine and sluice gate housing structure will be located in the south west of the Lagoon, at an oblique angle to the dredged channel of the River Tawe. The seawall will then extend north towards Swansea Port, close to the mouth of the River Tawe, parallel but offset by 100m from the dredged channel for the River Tawe and Port of Swansea. In total, this will form an approximately 9.5km-long, U-shaped, seawall which will impound approximately 11.5km² of the seabed, foreshore and intertidal area of Swansea Bay.

The seawall will have a sediment core held in place by a casing of sediment-filled geotextile tubes, known as Geotubes®. Dredged or imported gravels could be used as an alternative to Geotubes®. The outside of the structure will be covered in rock armour of various sizes, depending on its level of exposure (Figure 3). The sand used to form the walls will be taken from within the Lagoon footprint. Rock armour will then be brought in by sea (from a UK source) to provide the outer protection. The crest of the seawall will include provision of an access road which will be used for the operation and maintenance of the Lagoon as well as for visitors.

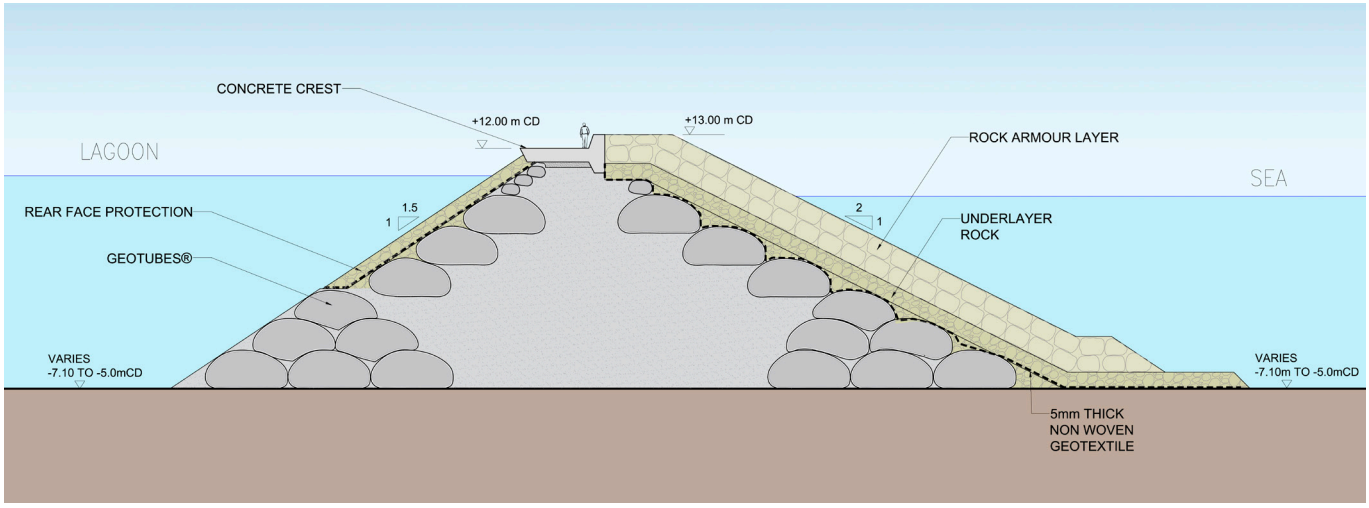

Figure 3: Example cross-section through lagoon seawall

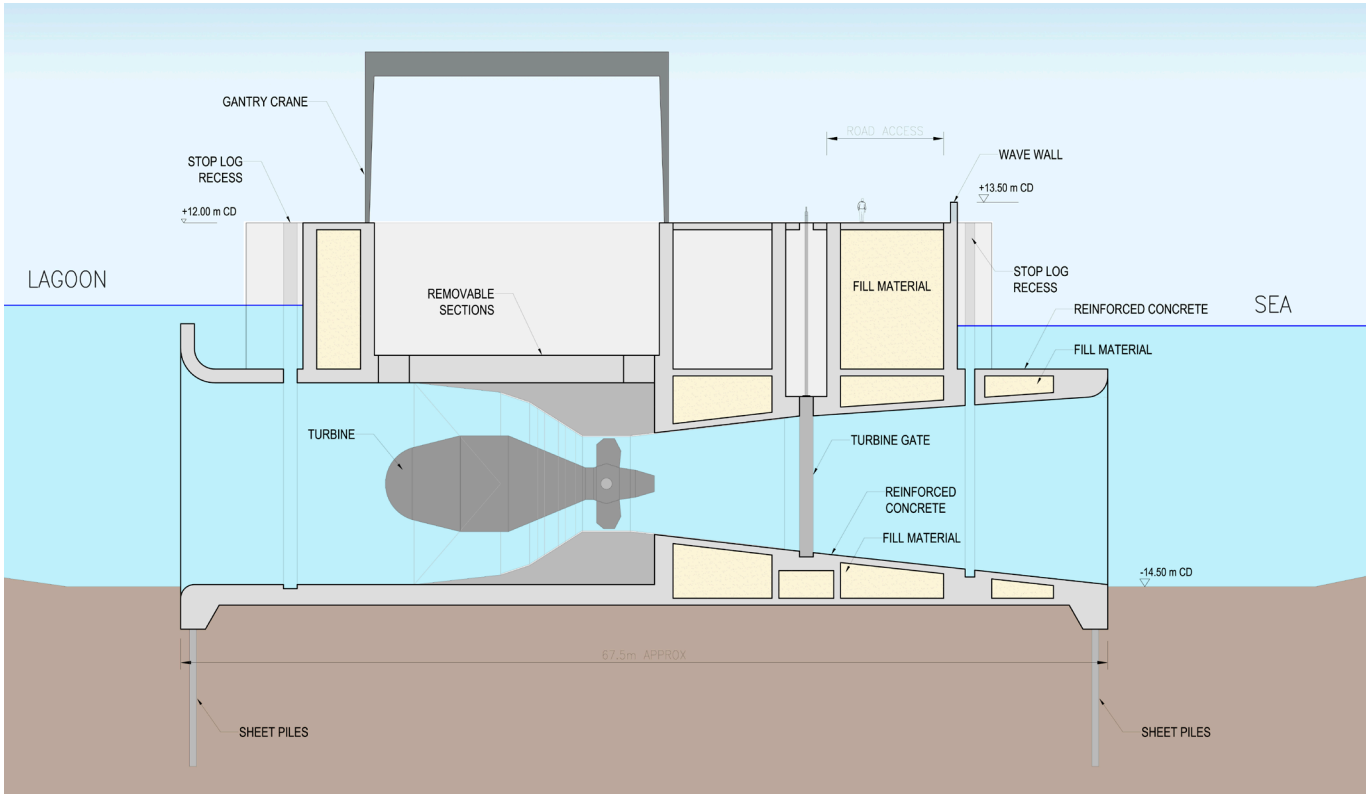

Figure 4: Cross-section of turbine housing structure

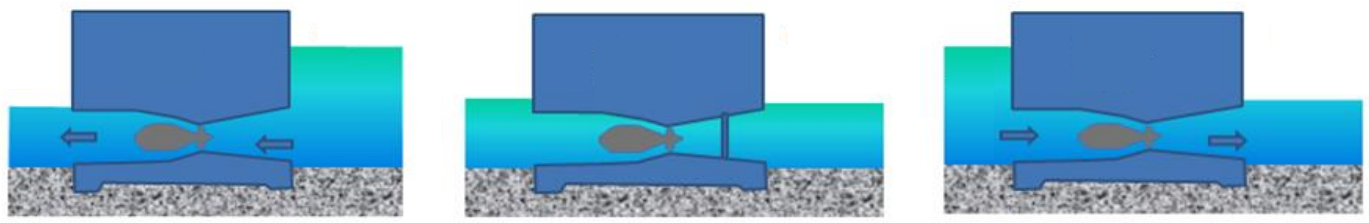

Figure 5: Illustration of water flow between the sea and the Lagoon

The hydro (water) turbines located within the turbine and sluice gate housing will be bi-directional, meaning they are able to generate power with flows of water in both directions (i.e. on both incoming and outgoing tides). There will be up to 16 turbines, each one around 7m in diameter, and all located permanently underwater (Figure 4). There will also be up to ten sluice gates; these are large gates which will be underwater and able to let seawater in and out of the Lagoon, and so controlling the water passing through the turbines, as required.

To generate electricity, as the sea starts to rise (flood tide) from low tide level, water is prevented from entering the Lagoon for an average of 2.5 hours, which creates a difference in water levels known as 'head'. Once sufficient head has been reached, the water is allowed to flow into the Lagoon through the turbines, turning the runner (like a propeller) and generating electricity. This process is repeated on the ebb tide, where the water is prevented from leaving the Lagoon until there is sufficient head to start the process again (Figure 5).

Towards the end of the ebb or flood tide the sluice gates will be opened. This is to empty or fill the Lagoon as quickly as possible before low or high tide level. By doing this, it ensures that the Lagoon water level is as close to the outside sea level as possible, before the tide starts to rise or fall again. This is to maximise electricity generation and to keep the intertidal area as close as possible to that occurring naturally outside the Lagoon. An option to pump the seawater at the end of the tide is also being investigated to further equalise seawater levels.

This generation sequence will happen on both the flood and ebb tides, four times a day in total. Figure 6 illustrates this generating cycle.

The electricity generated by the Project will be exported to the National Electricity Transmission System (NETS) at the existing Baglan Bay substation by means of underground cables. The cables will be laid in the seawall and then alongside existing roads/paths, crossing the River Neath, and on to the substation. To cross the River Neath, the cable will either be laid in existing disused pipes, or in ducts formed by directional drilling.

At the end of the operational lifetime of the Project (anticipated to be some 120 years), it is considered that total removal of the Lagoon would cause significant detrimental effect to the rocky reef and sand ecosystems which will by then be well-established. It would also occasion complete loss of the recreational tourism facilities forming part of the Project. As such, there are two potential options for decommissioning:

- Replace, upgrade and extend the life of the power generating station; or
- Remove the turbines and sluice gates leaving the seawalls and housing structure in place and allowing continued leisure use of the impounded area.

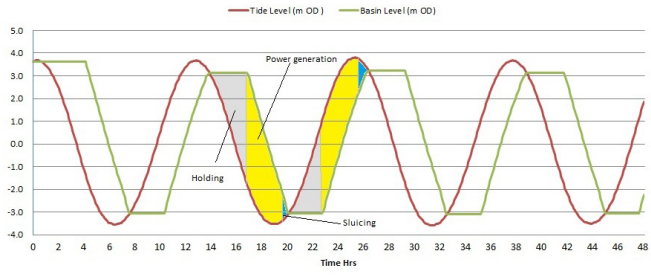

Figure 6: Indicative 48-hour operating cycle for the Lagoon

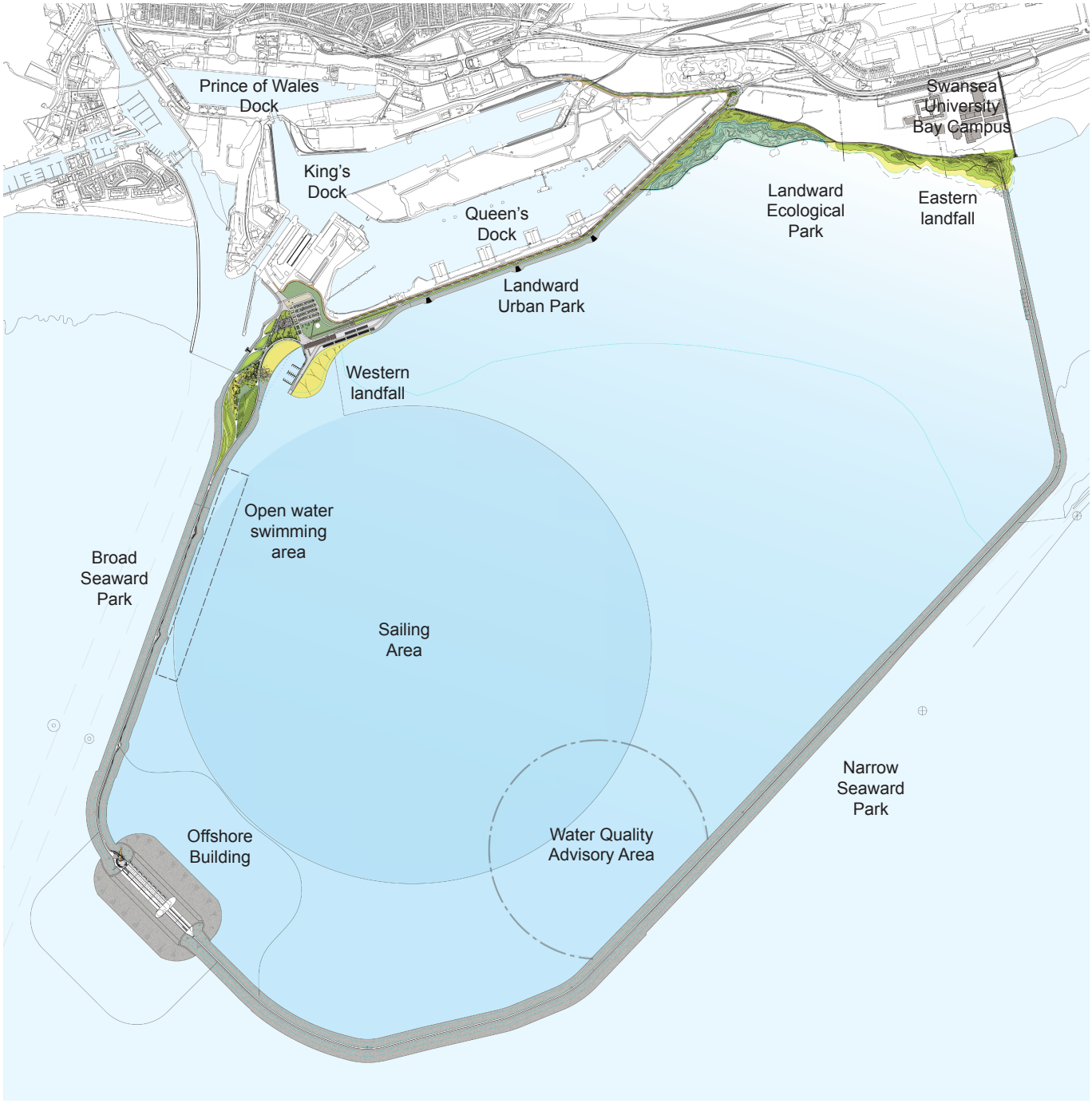

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Figure 7: Lagoon masterplan

DAY-TO-DAY RUNNING OF THE LAGOON

The Project includes operation and maintenance (O&M) facilities with integrated visitor and sporting/ recreational facilities, as well as other embedded amenities including art, education and mariculture. As such, safe access and appropriate parking for the Project is required. The needs of the Project have been encompassed in an overarching Masterplan, as shown in Figure 7, designed around three core areas, namely: the Offshore Building; the western landfall; and the eastern landfall. The Masterplan aims to link these three areas and the seawalls of the Lagoon to the land, while capturing the existing waterside environments associated with Swansea Port, the SUBC and existing brownfield land. As such, the public realm of the Project has been designed as a 'marine park' with four offshore and onshore character areas reflecting their context and use. These are: the Broad Seaward Park, Narrow Seaward Park, Landward Urban Park and Landward Ecological Park. A circular route around the four parks will provide better links for visitors to the Lagoon as well as O&M access.

Figure 8: Illustration of the Offshore Building

The Offshore Building (Figure 8) will house the main O&M and visitor facilities (both adjacent to and forming part of the turbine housing structure). The building will be a maximum of three storeys high, permitting elevated views across the Lagoon. For health and safety reasons it is anticipated that public access would be limited, possibly seasonally or to daylight hours and to appropriate weather/sea conditions.

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Figure 9: Western landfall layout

The western landfall area (Figure 9) forms a destination location and the gateway to the western seawall, which extends as an attractive public realm towards the Offshore Building described above.

The western landfall will include the Western Landfall Building (Figure 10) which comprises a two-storey structure providing functional space for the O&M requirements of the Project. The building will also allow controlled access to the western seawall. In addition, water sports facilities and a visitor orientation and public information space will be provided to assist visitors to the Lagoon and Offshore Building.

The design of the eastern landfall facility (Figure 11) comprises an information wall and viewing platform stepped into the proposed dune and coastal grassland area. The facility will abut the eastern landfall access track and the final design is anticipated to be coordinated with SUBC as a combined facility providing information on the Project and Crymlyn Burrows SSSI, encouraging responsible behaviour for both Lagoon access and habitat protection and conservation. The facility will not be lit.

Figure 10: Western Landfall Building

The eastern landfall area, including the adjacent Landward Ecological Park, will be accessed via a track that will extend south of the SUBC. It will be secured with a locked gate, thereby limiting unauthorised vehicular access at all times. Only O&M, emergency and possibly SUBC vehicles will be given access. Students and staff at the SUBC will access the eastern landfall via the Campus. The gate, which will also allow pedestrian and cycle access, will be manually opened and closed every day by staff based at the western landfall offices. It will secure the seawall from access during hours of darkness and extreme weather.

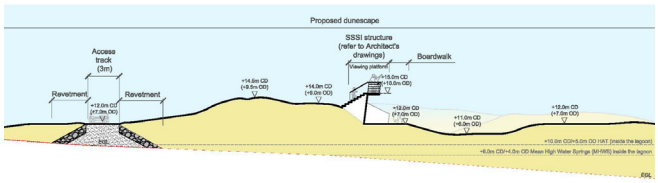

Figure 11: Eastern landfall viewing platform

The Landward Ecological Park (Figure 12) which forms part of the eastern landfall comprises areas of saltmarsh (5ha), coastal maritime grassland (3ha) and dunes (5.5ha). These areas will be formed partly in mitigation for lost habitat elsewhere, but also as enhancement proposals thereby adding ecological connectivity and value to the area. Overall, the proposal establishes a new waterfront road, lagoon-side public realm and attractive recreation areas at a level above the high tides, with limited lagoon-side parking and pedestrian access to intertidal areas at low tide. Public realm, landscape and habitat creation proposals at either end of this route integrate the western and eastern landfall points into their environment before extending into the Bay. The circular route around the Lagoon is provided for O&M and recreational purposes and includes a publicly-accessible cycle and footpath route.

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Figure 12: Landward Ecological Park

In addition to a circular pedestrian/cycle route around the Lagoon, appropriate transport access routes have been determined for the construction and operation phases. These routes take into consideration the needs of existing and future users, in particular the Port of Swansea and SUBC. The main vehicular access routes will be from Fabian Way, which runs east to west to the north of the Port. A new Project access road with combined footpath and cycleway will be constructed from Langdon Road, as shown on Figure 13. Vehicles will leave Fabian Way at the existing traffic signal controlled junction near the Park & Ride, turning left at the existing roundabout (which extends to link with the SA1 development) and then turning right to join the new road.

The new Project access road will run along the north side of the existing Port Road, before turning west along the south of Queen's Dock as shown on Figure 14. At this turning point, a new road alignment / Port security entrance will be created with the Port access remaining from Baldwin's Bridge junction. In addition, at this turning point, the foot and cycle path to/from the eastern landfall will link in.

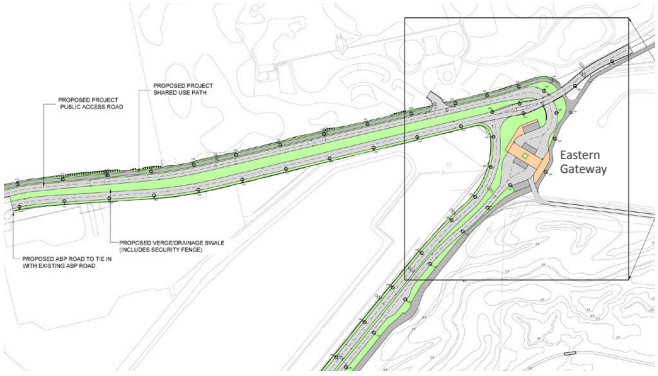

Figure 14: Access to the Lagoon and new Port security entrance

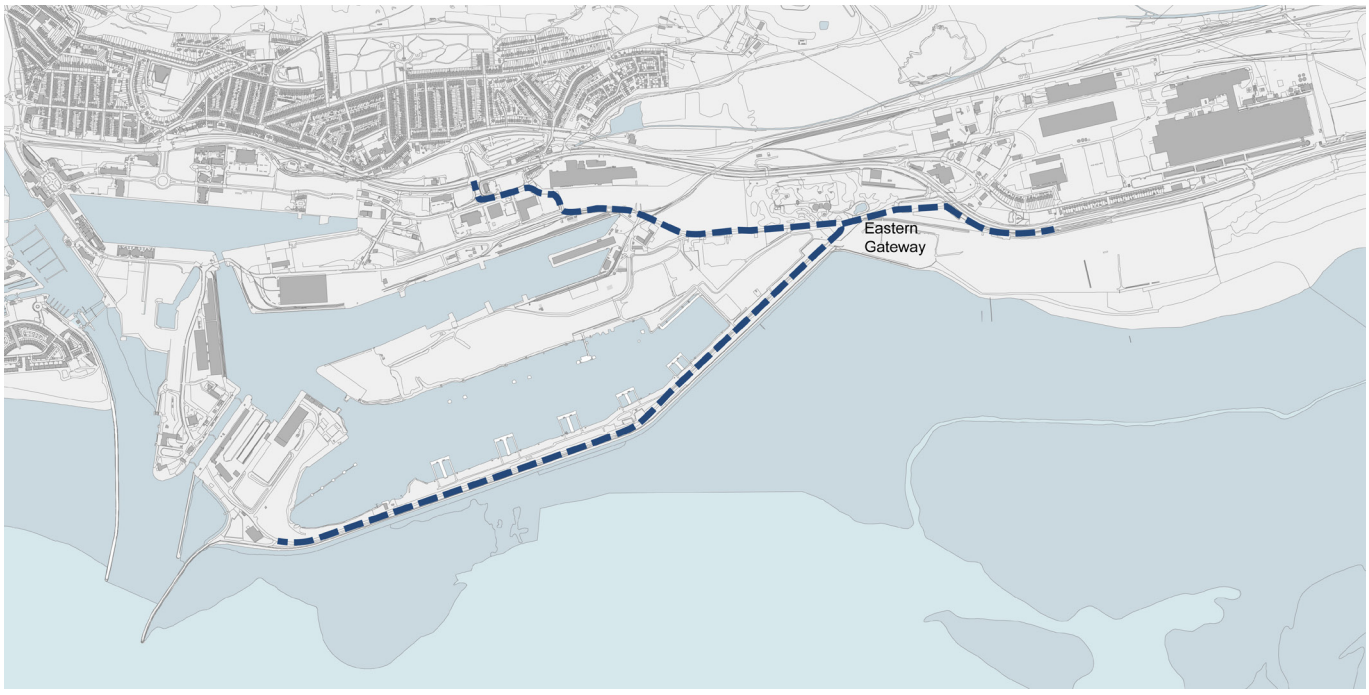

Figure 13: Access to the Lagoon from Fabian Way

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A shuttle bus is proposed linking the existing Park & Ride facility on Fabian Way, the western landfall, and the Offshore Building, subject to investigation of its viability. Facilities are also proposed on the western seawall to support a potential water shuttle service linking the existing pontoon on the west bank of the Tawe to the Lagoon facilities. These proposals support access to the Project from Fabian Way and Swansea Maritime Quarter respectively.

Conservation has also been vital to the design of the Project's onshore and offshore environments, both in terms of mitigation and enhancement. Figure 15 presents the key ecological features which are provided in the Project design. World War II archaeological features, comprising pill boxes and tank cubes, will be retained.

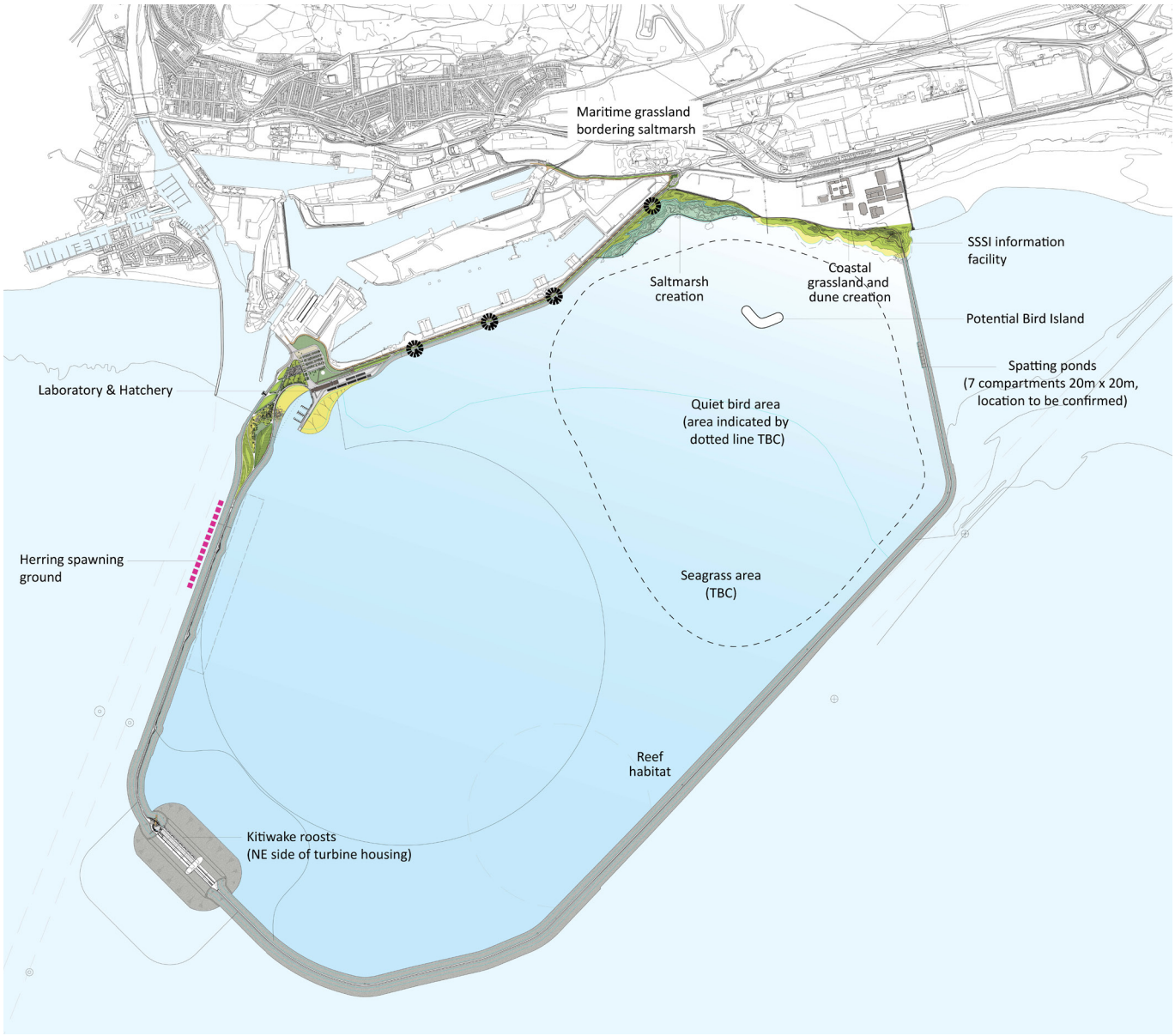

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Figure 15: Key ecological proposals

SITE SELECTION AND OPTION APPRAISAL

The Project aims to achieve a balance between optimum tidal energy output, an appropriate scale, and maximising opportunities for additional benefits to the local area. As noted above, Swansea Bay has a naturally high tidal range which makes it suitable for this form of renewable energy. It also has a gently-sloping intertidal area suitable for construction of the Lagoon seawall. Finally, the location adjacent to Swansea Port provides great opportunities for regeneration and connectivity, meaning that all of these key ambitions are achievable.

Over the last two years, approximately 20 lagoon design layouts and multiple turbine configurations have been considered in TLSB's efforts to find the best solution with regard to energy generation, environmental impact and cost viability. The resulting preferred layout is as shown in Figure 2. The onshore elements have also undergone significant development such that the overall Masterplan encompasses O&M requirements (necessary for the operation of the energy generation facility) as well as related recreational opportunities and environmental mitigation and enhancement.

PLANNING AND POLICY CONTEXT

A review of relevant national, regional and local planning policy has been undertaken, which showed strong support for new energy development, and new renewable (and marine renewable) energy development in particular. Overall, when determining any application for renewable energy development, a balancing exercise must be undertaken to weigh the wider benefits of renewable energy against local impacts. This balancing exercise must be carried out in the context of local, Welsh, UK and European policy, as well as obligations relating to combating climate change, delivering energy security and promoting renewable energy.

COASTAL PROCESSES, SEDIMENT TRANSPORT AND CONTAMINATION

Swansea Bay can be described as a shallow tidal embayment to the north of the Central Bristol Channel. Over time, the Bay has formed through wave action and tidal inundation between Mumbles Head in the west and Porthcawl Point in the east. There are important and measurable differences in the physical (tidal, wave and sediment) characteristics across the study area, and between the more exposed Bristol Channel and the more sheltered Swansea Bay.

The Project is located within Swansea Bay and experiences a very large tidal range (termed hyper-tidal). The Project is also exposed to relatively large waves originating from the North Atlantic and propagating along the Bristol Channel. Locally, some of these waves may pass around Mumbles Head and enter Swansea Bay. Wave heights are significantly smaller than those found within the Central Bristol Channel. Across much of the outer regions of the Bay, seabed sediment is mainly made up of coarse-grained material (coarse sand and gravel), whilst closer to the shore (and particularly over the shallow intertidal area) the seabed is mainly comprised of finer-grained sediment.

An initial feasibility study was carried out in order to inform some of the decisions on the Lagoon layout considered in the subsequent detailed assessment. This study has also been used to help define the near-field and far-field study areas for the detailed EIA. The results of these initial assessments (based on emerging designs for the Lagoon) suggested that potential effects on tidal characteristics (water levels and currents) are limited in magnitude and predominantly contained in extent to Swansea Bay itself. Similarly, effects on local wave behaviour were also limited in both magnitude and extent with the Lagoon structure providing shelter to sections of the shoreline behind it, depending on the prevailing wind and wave conditions. The EIA studies subsequently sought to confirm these findings using a more detailed approach to the assessment, as described below.

A number of Project-specific surveys were carried out to collect data for use in the EIA studies. These included geophysical, metocean and benthic surveys, with additional data from existing sources also considered to help define the 'baseline' (existing) environment. Further data has also been collected on sediment quality (contamination) across the study area, including areas from which sediment is to be extracted to form the Lagoon seawalls. The data has been collected from the sediment surface and at depth and has subsequently been used in the Coastal Processes assessment of both sediment transport effects and contamination across the study area.

A detailed modelling study has been carried out to allow the Project to develop a more detailed understanding of potential changes to the marine physical environment as a result of the final design of the Project. Data collected for the Project, as described above, has been used to calibrate and validate a purpose-built set of detailed numerical models of the study area. The assessment of potential EIA effects of the development has been informed through the conceptual understanding of the baseline environment and the outputs of the numerical modelling tools. In this way, potential effects on hydrodynamics, waves, sediment transport and morphology across the study area have been assessed, with specific reference to the identified receptors. As a result, an extensive range of issues has been considered, including potential effects on the existing Ports of Swansea, Neath and Port Talbot as well as designated sites including Crymlyn Burrows and Blackpill SSSIs and Kenfig Special Area of Conservation (SAC).

The coastal processes assessment has considered potential effects over the lifetime of the Project, including during each of the construction, operation and decommissioning phases. The assessment has considered potential effects on coastal processes, sediment transport and contamination over both the near-field and far-field regions of the study area.

The assessment has identified that a number of potential impacts to coastal process receptors within Swansea Bay (and further afield in the Central Bristol Channel) could occur as a result of the Project. These findings are summarised below, in general terms, with further detail on potential effect presented within the ES.

During the construction phase of the Project, there is the potential for increased suspended sediment concentrations (SSC), and subsequent deposition, within Swansea Bay, resulting from the dredging and construction activity. The predicted increases tend to be greatest in magnitude closest to the location of the construction activity, although increased SSC values are shown to be relatively short-lived before returning to within peak natural background levels. The dynamic nature of Swansea Bay results in the majority of the material that settles out of suspension being re-suspended during the next tidal cycle, before subsequent dispersal (under tidal influence) across the wider area. As a result, by the end of a full spring-neap cycle, the predicted increased deposition is limited in both magnitude and extent.

During the construction and operations phase of the Project there is expected to be changes to the hydrodynamic and wave conditions across the Bay, with associated effects on sediment transport. Inside the Lagoon, the power generation activity requires water levels to be held at High Water (HW) and Low Water (LW), in order to build up a head difference in water levels across the turbine array. As a result, the levels of HW and LW inside the Lagoon are predicted to change during the operation phase, with HW levels being lowered and LW levels being raised. Associated flow speeds inside the Lagoon are also expected to change, with increased speeds (compared to the baseline) being observed in the lee of the turbines and sluice gates (during the flood tide) and decreased speeds across the shallow subtidal and intertidal region (towards the back of the Lagoon) as a result of the sheltering effects of the Lagoon walls.

During the operation phase, outside the Lagoon, small changes to HW and LW levels are predicted within the western part of the Bay (as a result of the constriction of flow between the Lagoon and Mumbles Head). In this area, HW levels are predicted to reduce slightly (around 1-2cm), whilst LW levels are predicted to increase slightly. Across the remainder of the Bay, no changes to water levels are predicted. Associated flow speeds outside the Lagoon are also predicted to change. Across the western part of the Bay, mean flow speeds are predicted to reduce slightly (compared to the baseline). Conversely, increased flows are predicted in the lee of the turbine array (during the ebb tide) and around the 'corners' of the eastern Lagoon wall.

With regard to the potential effects on wave conditions, inside the Lagoon the sheltering effects of the seawalls result in a large reduction in wave height, with the only waves inside the Lagoon being generated by the prevailing wind conditions and across the fetch length available within the seawalls (supporting leisure uses within the Lagoon). Outside the Lagoon, the seawalls act to shelter different parts of the Bay, depending upon the prevailing wind and wave conditions. For instance, for waves approaching from the dominant south-westerly direction, the coastline in the lee of the Lagoon (the region fronting Crymlyn Burrows) will be offered a degree of shelter; conversely, for waves approaching from the less-dominant south-easterly direction, the north-west part of the Bay will similarly be offered a degree of shelter.

There is a potential for waves to reflect off the Lagoon walls, leading to increased wave heights along the coast. The potential effects are condition-specific, with south-westerly waves reflecting off the Lagoon walls and increasing wave heights in the south-western part of the Bay (along the Mumbles coastline). When considering the south-easterly waves, reflection off the Lagoon wall results in increased wave heights at a small section of coast to the north of Port Talbot. Under both scenarios, the predicted increase in wave height is not considered to increase flood risk from tidal sources.

The hydrodynamic and wave conditions act to control the transport of sediment into and around the Bay. Potential effects of the Project have been assessed for both finer (mud) and coarser (sand and gravel) sediment. During the operational phase, there is a potential for changes in deposition of fine material within the Lagoon. Directly in the lee of the turbines and sluice gates, the higher flows experienced over the flood tide act to maintain material in suspension, thus reducing the potential for deposition. Across the upper subtidal and lower intertidal regions of the Lagoon, the reduced tidal flows and calmer wave conditions (compared to the baseline, as a result of sheltering by the Lagoon walls) result in a predicted increase in deposition of fine material. Outside the Lagoon, the reduced flows in the western part of the Bay result in a predicted increase in the deposition of fine material across parts of the shallow subtidal region although this will reach an equilibrium, around which the natural changes will occur.

With regard to coarser material, inside the Lagoon a similar change is predicted to that described for the finer sediment. In the lee of the turbine array, the increased flows have the potential to reduce deposition, with lower flows towards the back of the Lagoon resulting in the potential for increased deposition. Outside of the Lagoon, the Lagoon is predicted to interrupt the transport of sand from the area around the Neath Delta, in a westward direction towards the western part of the Bay. This is predicted to result in a build-up of sand material along the outside of the eastern Lagoon wall. Furthermore, the Lagoon is also predicted to stop the intermittent supply of sand material into the western part of the Bay from the Neath region (although sand can still reach this part of the Bay from offshore sources). Analysis of long terms beach profiles data for this region show a general trend for slight accretion over time. As a result of the reduction in intermittent sand transport, it is considered that this slight accretion is likely to reduce following construction of the Lagoon, leading to a more stable profile in the future.

As no additional mitigation measures, other than those already incorporated into the overall Lagoon design, have been identified that will reduce the potential coastal processes effects of the Project, a monitoring plan is being developed. Where necessary measures such as beach nourishment with sand, and maintenance dredging can be implemented.

WATER QUALITY

Swansea Bay offers many recreational activities including two designated bathing waters (Aberafan and Swansea Bay) and many more along the adjacent Gower coastline. The Gower beaches have consistently achieved the highest water quality standards for bathing waters, but performance of the Aberafan and Swansea bathing waters since 2007 has been reduced, in large part due to wet summers, and higher quantities of storm water runoff entering Swansea Bay. Dŵr Cymru Welsh Water (DCWW) is currently undertaking extensive improvement works in Swansea, with the aim of achieving improvement in water quality by 2015. The area is also designated as shellfish waters and there are a number of designated shellfish beds in the Bay.

All waterbodies are designated under the Water Framework Directive (WFD) with Swansea Bay classified as a Heavily Modified Water Body, at risk from diffuse pollution (surface water run-off from land) and morphological alterations. However, the Bay is not considered to be presently at risk from point source pollution, although further improvements are required to meet bathing water standards under the revised Bathing Waters Directive. As such, maintaining water quality during the construction and operation of the Project is very important.

The Lagoon itself should not contribute any pollutant load to the marine waters, but the presence of a large structure in the centre of Swansea Bay will change local tidal circulation patterns and this could affect water quality. The existing long sea outfall from nearby Swansea Waste Water Treatment Works (WWTW) extends into the Lagoon. The Lagoon will therefore affect effluent dispersion from the outfall, and effluent will be trapped in the Lagoon impoundment during the ebb tide. In addition, water quality from the Tawe and Neath estuaries and other discharges into the Bay have been considered.

The effects of the Lagoon on water quality have been minimised by careful design of the Lagoon shape and turbine/sluice location. The assessment of water quality impacts is based on the application of the established Swansea Bay Coastal Model. This model has been extensively updated and re-validated for this assessment. Pollutant inputs from over 170 sources derived from up-to-date comprehensive data sets are included in the model. The models have been applied to predict the circulation (hydrodynamics) and pollutant transport (advection and dispersion) in Swansea Bay. The coastal modelling is supported by hydrological and sewer network models to determine corresponding background and storm (wet weather) discharges from rivers, WWTW and storm water overflows.

The effects of the Lagoon on water quality are generally positive, causing a small net improvement in water quality at a number of locations in Swansea Bay, particularly at the Swansea Bay and Aberafan bathing waters. These improvements are mainly the result of changes to the River Tawe plume and enhanced mixing with offshore waters. Changes in shellfish water quality are predicted to be small, with potential improvement in some areas. The Project does not present a significant risk of changing the current WFD class in the Swansea Bay water body or adjacent water bodies.

Microbiological water quality within the Lagoon would be slightly improved. However, the potential effects on use of the Lagoon for contact water sports all year round was considered further in the context of storm discharges from the WWTW long sea outfall. In dry weather, the flows discharged from the outfall are ultra-violet (UV) disinfected with relatively low levels of bacteria, and the tidal movements through the turbines ensure water is not impounded in the Lagoon for long. This would permit the Lagoon to be used for watersports, although with some limitations on bathing and swimming. However, in very wet weather, screened storm water can be released through the outfall, affecting water quality in the Lagoon and the wider Bay. At these times, without mitigation (additional measures), the reduction in Lagoon water quality may be enough to preclude its use for water contact sports for periods after heavy rainfall. To mitigate this it is proposed to either install UV disinfection treatment of the storm water (as used at Cog Moors WWTW in Cardiff) to improve effluent quality to at least 'Sufficient' class (minimum standard for safe swimming) under the revised Bathing Waters Directive, or to extend the long sea outfall so that it discharges approximately 1.5km outside the Lagoon wall. Both options improve water quality within the Lagoon but they have a limited effect on water quality in Swansea Bay as a whole, and almost no effect on water quality at the designated bathing waters.

Overall, the impacts of the Project on water quality in Swansea Bay are considered small, and in many cases positive. Existing bathing, shellfish and WFD classes would not be expected to change as a result of the Project. Water quality within the Lagoon would be improved by installing UV disinfection to storm water discharges or extending the outfall, although this would have relatively little impact outside of the Lagoon.

INTERTIDAL AND SUBTIDAL BENTHIC ECOLOGY

A detailed assessment of the marine plants and animals (ecology) on the beach (Photo 1) and on the seabed within Swansea Bay has been undertaken. Although the Project site does not overlap any ecologically protected sites designated for marine features, there are two sites that support birds which feed in the intertidal areas namely: Blackpill SSSI and Crymlyn Burrows SSSI. In addition to this, there are a number of important ecological features within Swansea Bay as a whole. These include the honeycomb worm (Sabellaria alveolata), hydroid rockpools, piddocks in clay with mussels, piddocks in peat with red algae, mudflats, sands and gravels and the native oyster (Ostrea edulis).

To gain a better understanding of which plants and animals are within the Project footprint and wider Bay area, and where they are located, walkover surveys of the beach and offshore boat surveys have been undertaken. The results of the surveys confirmed that the honeycomb worm is both within the Lagoon footprint, where it is bordered by mixed substrate and large expanses of sand flats, and also across the wider Swansea beach. Towards the western end of the Bay, sand flats dominate with distinct areas of the honeycomb worm, piddock habitat and mixed substrate. The once extensive mussel beds which were present some 10 years ago appear to have mostly gone, and the native oyster is present in the Bay in low numbers.

Photo 1: Example of beach in Swansea Bay

A detailed assessment of the potential effects on marine plants and animals during the construction, operational and decommissioning phases of the Project has been undertaken. The potential effects that have been identified primarily relate to a loss and change in available habitat extent and a change in both the physical processes and water quality. These may occur through changes in availability or quality of habitat; release of existing or new contaminants; localised smothering of habitats or species; changes in suspended sediment concentrations; changes in biological communities; and introduction of non-native species.

The main adverse impacts on marine ecology arising from the Project relate to important ecological features, in particular the honeycomb worm, hydroid rockpools, mudflats, sands and gravels. During construction, the greatest impacts on these protected features are the localised smothering events that will occur during this phase of the Project. During operation, there will be a large change in habitat extent and suitability and also the potential spread and introduction of non-native species. The Project will also result in a minor benefit to certain marine features, such as macroalgae and mussels, through the introduction of new intertidal and subtidal rocky habitat.

Mitigation measures have been identified in order to minimise any potential impacts to acceptable levels. These include translocating the honeycomb worm, investigating opportunities to encourage their growth and settlement, and enhancing the design of the Lagoon wall to promote ecological diversity. In addition, opportunities to encourage the reintroduction of native oyster are being progressed as part of a long-term plan during the operation of the Project. In terms of the potential risk of introducing non-native species, the Project will adhere to best practice mitigation measures and the relevant legislation and guidance. The extent and quality of protected intertidal habitat features and non-native species will also be monitored to validate the results of the impact assessment and determine the success of the mitigation measures.

FISH INCLUDING RECREATIONAL AND COMMERCIAL FISHERIES

Recreational, commercial and migratory fisheries are an important consideration within Swansea Bay and the wider area. To understand the environment without the Project, a review of existing fisheries information and a number of field surveys have been conducted. The field surveys carried out in 2013 indicated that species caught were consistent with the results gathered through the desktop study. A total of 55 species were caught and the fish population was shown to be dominated by pelagic species including sprat and herring, with common demersal species including bass, whiting, dogfish, gobies, juvenile and adult flatfish (dab and plaice), as well as rays.

The area surrounding the Bay is rich in fish and shellfish, including species of commercial and/or conservation value, as expected for the Bristol Channel. Migratory fish (fish which travel back and forth between water bodies during their lifetime), such as Atlantic salmon, allis shad and twaite shad, European eel, river lamprey and sea lamprey, are of high conservation value and move past the Swansea Bay area and into the Bristol Channel to a number of internationally designated sites upstream. Rivers flowing into Swansea Bay also host good numbers of salmon and migratory brown trout stocks, which have been identified as being of national importance, and European eel. There are also a number of regionally important fish and shellfish stocks, including bass, dab, herring, plaice, sole, rays and other elasmobranchs. A number of species are commercially valuable in the area, these include: bass, mullet, rays, sole, plaice, edible crab, spider crab, whelk and lobster. Other shellfish, such as mussel, are also harvested within the Bay.

During construction there would be the potential to affect fish and shellfish populations temporarily and locally through effects such as underwater construction noise and as increased suspended sediment levels, although control measures will be implemented to reduce these where possible. The Lagoon will not physically block access to the mouths of any rivers; however, the possible effect of the Project on migratory fish has been investigated. Detailed computer modelling has been undertaken for key migratory and marine fish species, including behaviour modelling (the likelihood of the various fish species coming into the Lagoon area and passing through the turbines and sluices) and entrainment modelling (the effect on any fish that pass through the turbines, taking into consideration design elements including shear stress and turbulence). Ten different representative fish species were modelled including their relevant life stages, where appropriate. Overall the size of the turbines (7m in diameter) and low rotation speeds (approx. 67 rpm) mean that there will be large gaps through which fish can pass and the risk to fish populations and runs of migratory fish will be very low (the majority of effects being less than 2 percent mortality without mitigation). Furthermore, the use of sluice gates will allow free passage of fish in and out of the Lagoon in the latter part of the tidal cycle.

Herring are known to spawn in the Bay and some presently spawn within the Lagoon area. Suitable spawning substrates will be provided along the outer Lagoon wall to create alternative herring spawning locations.

There will be some disruption to local commercial fishermen, especially to any who pot within the Project area. During operation, the Lagoon would not be accessible to any fishing vessels which currently use this area of the Bay and therefore this would result in a loss of fishing grounds within the Lagoon footprint.

Where other potentially significant adverse effects have been identified, suitable mitigation will be provided, for example acoustic fish deterrents may be used to further lower the numbers of fish entrained through the turbines. Post-construction monitoring will also be carried out to check that any effects remain within expected design limits.

The Lagoon walls can be expected to act as an artificial reef and will provide new sea fishing opportunities. TLSB also proposes contributing to fishery enhancement measures nearby.

MARINE MAMMALS

A detailed assessment of the potential impacts of the Project on marine mammals and turtles has been undertaken. To gain an understanding of the occurrence and distribution of these species throughout the relevant study area, a number of recent data sources have been reviewed. The marine mammals which occur most frequently, and in the highest numbers within the wider Swansea Bay area, are the harbour porpoise and grey seal (Photo 2). Although a number of other species such as common dolphin are recorded in the Bristol Channel, these are rarely sighted around Swansea Bay.

Photo 2: Grey seal

A detailed assessment of the potential effects on marine mammals during the construction, operation and decommissioning phases of the Project has been undertaken. The cumulative effects of the Project alone and in-combination with other plans, projects and activities has also been assessed. During the construction phase, potential adverse impacts include collision risk, visual disturbance and noise/vibration disturbance, and the implications of changes in water quality, compared to baseline conditions. The processes involved in operating and maintaining the Project over its lifetime will lead to potential adverse impacts, including changes to feeding habitat, turbine collision risk, barrier effects upon movement, noise disturbance and electromagnetic fields and these have all been assessed.

The main adverse impacts arising from the Project on marine mammals is percussive piling noise during construction (if required), and collision risk with turbines and barrier effects during operation. All of these impacts have been assessed, at likely worst case, as moderate adverse without mitigation.

In order to minimise any potential impacts to acceptable levels, several mitigation measures are proposed. So far as underwater noise during construction is concerned, these include using vibratory piling techniques as far as is practical and, if any percussive piling is necessary, following the Joint Nature Conservation Committee piling protocol and soft start procedures. In terms of collision risk, an appropriate turbine collision monitoring programme is being developed, together with acoustic deterrents and potential additional monitoring. A capture and release protocol is also being developed to mitigate for potential barrier effects.

COASTAL BIRDS

Coastal birds, in particular over-wintering birds, are an important feature of Swansea Bay. An assessment has been undertaken of the potential effects of the Project upon the coastal bird assemblage that utilises Swansea Bay, and sites designated for their bird interest, including Blackpill SSSI, located in the west of the Bay.

A review of existing literature and records has been undertaken, including records from the British Trust for Ornithology (BTO) and Gower Ornithological Society (GOS). Targeted bird surveys during high and low tides were carried out between 2011 and 2013 to supplement the more extensive long-term records that existed to establish a baseline. The surveys covered an area between Mumbles Pier and the River Tawe (western area) and the River Tawe to the River Neath (eastern area). Surveys were conducted in winter periods (September-March) in the eastern and western areas, with further summer surveys (April-August) conducted in the eastern area, as agreed with Natural Resources Wales (NRW).

Photo 3: Sanderling

Photo 4: Ringed plover

During the wintering months, surveys identified a total of 31 coastal bird species during the low tide surveys and 29 species in the high tide surveys. Sanderling (Photo 3) was the only species regularly recorded during field surveys in nationally important numbers, although GOS records indicated nationally important numbers of Great Crested Grebe using Swansea Bay. Three species including Ringed Plover (Photo 4), Oystercatcher and Dunlin were considered to occur in regionally important numbers. Three regular high tide roost sites were identified, one in Blackpill SSSI and two in Crymlyn Burrows SSSI. During the summer surveys a total of 22 bird species were recorded utilising the eastern area. The numbers of non-breeding bird species were much reduced compared to the wintering records, with only Sanderling recorded in nationally important figures on one occasion. During the surveys, passage bird species were recorded, including Common Sandpiper and Whimbrel. The field surveys confirmed use of the Bay by a similar assemblage of bird species to those recorded during long term data sets.

The Project will result in the loss of intertidal and enclosure of subtidal habitat which is utilised by a variety of coastal bird species for foraging, roosting and loafing. In particular, construction works are likely to result in some displacement of coastal bird species using habitat for foraging or roosting within or adjacent to the Project footprint. During operation, recreational activities have the potential to also disturb birds using the Lagoon whilst the fish diversity (prey species) within the Lagoon will alter as a result of sonic deterrents. There will be no direct impacts on sites designated for their bird interest. Alternative foraging and roosting habitat is available within the Bay and as such it is considered that the Project will

have no significant adverse effect on intertidal bird feeding areas or the high tide roosts. No significant residual adverse impact on Blackpill SSSI or Crymlyn Burrows SSSI is expected. The Project has the potential to have a minor adverse effect on the Great Crested Grebe population that utilises the Lagoon footprint through disturbance and changes to favoured available prey species within the Lagoon, although alternative foraging and loafing habitats are available to birds within Swansea Bay.

A range of measures will be implemented to mitigate potential impacts including: a construction programme that is conducted outside the main wintering bird period (October-March); phased / zoned development; provision of a delineated 'quiet zone' for birds; creation of an artificial high tide roost; access restrictions or screening to parts of the Lagoon wall to create visual barriers between walkways and key roosting habitat; as well as provision of spawning media for fish (prey species for divers and grebes).

Mitigation measures will minimise the effect of habitat loss and disturbance incurred as a result of the Project, in addition to providing resources ensuring continued use of the site by coastal bird species. In the long term, as birds become habituated to the presence of the structure and as new habitats develop, a residual impact of the Project on coastal birds is not considered likely. Monitoring of bird assemblages during and post construction will be implemented to ascertain continued bird species utilisation of the Swansea Bay area and the success of mitigation measures.

TERRESTRIAL ECOLOGY

The potential impacts of the Project on ecological receptors, including terrestrial birds, were considered by investigating existing baseline conditions, followed by prediction and assessment of likely impacts. Mitigation measures designed to alleviate potential impacts, in addition to enhancement measures, have been proposed. The ecological impact assessment was carried out in line with the CIEEM Guidelines for Ecological Impact Assessment (2006).

Five statutory designated sites were identified within 5km of the Project: Crymlyn Bog/Cors Crymlyn SAC, Ramsar wetland, and SSSI (circa <200m north); Pant-y-Sais SSSI and Local Nature Reserve (LNR) (circa 1.5km north-east); Crymlyn Bog and Pant-y-Sais National Nature Reserve (NNR) (circa 850m north); Crymlyn Burrows SSSI (circa <100m east); and Blackpill SSSI (circa 3km west). Four further SSSIs remote from the Project area, notified for their geological interest, were also identified. The closest coastal sites with a geomorphological connection with the Severn Estuary/ Bristol Channel include: Kenfig SAC, SSSI, NNR and LNR (circa 12.5km south-east); and Oxwich Bay SSSI and NNR (circa 14km west). Non-statutory sites in proximity to the Project include the Fabian Way (A483) Conservation Verge, Red Jacket Fen Wildlife Trust Reserve and Spontex Dunes Site of Importance for Nature Conservation (SINC) designated by the CCSC.

Baseline surveys included a Phase 1 habitat survey; a rapid National Vegetation Classification (NVC) assessment of coastal habitats associated with Swansea Bay (Photo 5); and faunal surveys including breeding birds, bats, reptiles, invertebrates and mammals including otter.

Photo 5: Coastal grassland in lea of the Port seawall

No impacts to sites of international nature conservation importance were identified. Direct but temporary impact to Crymlyn Burrows SSSI and the Fabian Way Conservation Verge will result from cable installation. Changes in coastal processes will result in indirect effects on Blackpill SSSI and Crymlyn Burrows SSSI.

Potential impacts on ecological receptors within the Project footprint include habitat loss and disturbance of protected or otherwise notable species. Construction and operation of the Project will result in permanent land-take where new infrastructure is required, as well as temporary land-take associated with construction infrastructure. Existing coastal grassland habitat will be lost from the docks estate. Cable installation will temporarily affect Crymlyn Burrows SSSI and Fabian Way Conservation Verge. Mitigation measures to address loss of coastal grassland include habitat translocation and creation measures resulting in at least like-for-like replacement. Mitigation for cable installation includes seasonal timing, use of existing tracks, minimisation of the construction corridor and use of ground protection matting. For protected or otherwise notable species, winter clearance of scrub, a capture and translocation programme for reptiles, and minimisation of light spill is likely to result in an insignificant impact.

The physical presence of the completed Lagoon within Swansea Bay will alter existing local coastal processes. Modelling results predict sand accretion fronting Crymlyn Burrows SSSI, with formation of dune habitat likely at the outer edge of the Lagoon near its landfall at the western edge of the SSSI. Wind flow at the western end of the SSSI will also be locally modified (<1-200m). At Blackpill SSSI, the blocking of intermittent transport of sandy material from the east to western part of the Bay is likely to lead to a more stable beach profile in the future. These potential effects are not considered likely to significantly impact the integrity of the SSSIs.

Enhancement measures including the creation of an area of saltmarsh and artificial sand dune habitat within the proposed Lagoon footprint have the potential to contribute to the conservation of these habitats of Principal Importance for Biodiversity as listed under Section 42 of the Natural Environment and Rural Communities Act (2006).

SEASCAPE AND LANDSCAPE VISUAL IMPACT ASSESSMENT (SLVIA)

The SLVIA assessed the likely effects that the Project would have on the character and visual amenity of the seascape and landscape within a 15km study area. The methodology was especially developed for the assessment and is in accordance with best practice guidance.

During construction of the Project, there will be no significant change in seascape or landscape character from within the majority of the study area. This is due, to the existing industrial/maritime character of the landscape/seascape in which most of the construction work will be undertaken and the short term nature of this work.

During operation, effects on seascape and landscape character are predicted to be direct and significant from locations within or immediately adjacent to the Project boundary. This includes Swansea Port and Crymlyn Burrows, plus Swansea Gate Business Park. However, overall effects on seascape and landscape character within the study area are predominately predicted to be indirect and not significant.

Cumulative effects on seascape and landscape character are predicted to be significant from locations within or immediately adjacent to the development boundary. To the east of the Lagoon seawalls within Crymlyn Burrows, the increase in perceptible development may lead to a noticeable change in character.

During the construction phase of the Project, significant effects on visual amenity will predominantly occur from locations within the development site boundary and locations immediately surrounding it. The construction of the Lagoon seawall will be a prominent feature, although any works will be viewed against a backdrop of existing development and in conjunction with existing ships within Swansea Bay. The significance of effects on visual amenity will diminish with distance, as construction activity will predominantly be viewed as part of the wider seascape/landscape.

Significant effects on visual amenity during operation will be restricted to locations in close proximity to the Project boundary, and from elevated locations that overlook the Bay. From viewpoints located away from the immediate surroundings of the Project, effects on visual amenity are not predicted to be significant. The Project will be incorporated into the view without changing the characteristics that currently define them. At night the Offshore Building will be the most visible feature of the Project and will be most noticeable from locations in close proximity to the Project. Lighting of other elements of the Project are predominantly low level, and will therefore not be prominent. Lighting of the Project will be viewed predominantly against the existing lights of the urban areas that surround the Bay, all of which will reduce night time effects.

Cumulative effects are considered to be significant from locations within the immediate surroundings of the Project boundary. From all other locations, cumulative effects are considered not to be significant, as development is a key existing feature that defines many of the views within the study area.

It is predicted that there will be no significant effects on visual amenity from the statutory and non-statutory landscape designations, due to the limited views of the Project from within their boundaries. From national trails/long distance routes and cycle routes, significant effects will be primarily restricted to a short section of the Wales Coast Path that extends from West Pier, at Swansea Port to Mumbles Head.

NAVIGATION

The Project is situated between the approach channels of the River Neath (leading to the Port of Neath and Monkstone Cruising and Sailing Club Marina) and the River Tawe (leading to the Port of Swansea and Swansea Marina). The Port of Port Talbot is located to the southeast of the Project. Baseline surveys of shipping movements in the vicinity of the Project were undertaken and these studies confirmed that shipping and navigation are of key importance in the area and thus the effects of the Project on these aspects have been assessed.

The Project has been designed based on discussions with Neath and Swansea Port Authorities to ensure that navigation will not be affected. As a result, the Lagoon seawalls have been positioned along each respective approach channel based on their input. For the Tawe channel, the Lagoon seawall will tie into the existing Swansea Port seawall, and then continue, running parallel to the dredged channel but positioned 100m away (to the east). For the Neath channel, the Lagoon seawall will run along the side of the channel such that it extends the existing northern “training” wall (a wall which was built in the Victorian times to “train” or channel the flows of the river Neath). The end of the Neath channel will also be widened slightly to the south.

A Hazard Workshop (April 2013), attended by around 30 key maritime stakeholders, further identified potential shipping and navigation constraints and potential effects of the Project. This information was used during the design of the Project and in the assessment. A Navigational Risk Assessment drew on this workshop and studies of the current levels of risk, emergency response, incidents and marine traffic. These were used to make an assessment of potential impacts and the mitigation measures best suited to reduce them.

The main adverse effects of the Project are vessel-to-structure contact risk, displacement of pilot vessels, person in the water after falling from a vessel, effects on navigation due to wave reflection from the seawalls or water depths and changes to search and rescue operations. Mitigation measures will be implemented such as Additional Aids to Navigation, Notice to Mariners, movement of the pilot boarding station (in consultation with harbour authorities), appropriate safety zones around construction works and the turbine housing structure, consultation with emergency responders and emergency facilities incorporated into the Lagoon design, and seawall design to minimise wave reflection. With mitigation, impacts will be reduced to minor adverse, except for vessel-to-structure contact risk during operation where a moderate to minor adverse effect has been identified. Dolphin piles will be constructed at the extent of the safety zone around the turbine and sluice gate housing structure to reduce the likelihood of contact occurring. The application of these mitigation measures will reduce the risk to broadly acceptable for the impacts identified.

ONSHORE TRANSPORT

An assessment of the potential impacts to onshore traffic and transport resulting from the Project has been undertaken. In addition, an assessment of the likely impact of the Project together with other schemes in the surrounding area ('cumulative developments') has been carried out. The baseline environment was examined in relation to the surrounding highway network, public transport, cycling and pedestrian facilities within the vicinity of the Project. The assessment then considered the interaction between future development related movements and the baseline environment.

The Project is situated in the Port of Swansea. Fabian Way is an arterial road which forms part of the A483, connecting Swansea city centre with the M4 motorway at Junction 42. It is the main route into Swansea from the surrounding area and for traffic from further afield and runs adjacent to the Port. There are two junctions off Fabian Way providing access to the Port (the old Port access opposite the Park & Ride, and Baldwin's Crescent). There is no public access to the Port of Swansea at present. Bus services operate along Fabian Way and the Project can be accessed from bus stops at two locations. There is a cycle path running along the length of Fabian Way that forms a section of both National Cycle Network route 4 (NCN 4) and the Swansea to Glyncorrwg Loop. There is a Park & Ride facility located to the north of Fabian Way at the Langdon Road junction. The existing rail sidings to the north of Fabian Way are still in use, but the railway through the Port is not used and would require upgrading to become serviceable. The upgrade works required make using the railway impractical and so it has been assumed that all construction materials that cannot be imported by sea will be transported by road.

The implementation of a Construction Phase Travel Plan, including an access strategy for the Project, will help to minimise the impact of construction on all modes of transport. HGV movements along Fabian Way will be managed to ensure that deliveries are timed to avoid the commuter peak periods as far as possible. The impact of the Project on the local highway network is predicted to be of minor adverse significance. The impact on public transport during the construction phase is expected to be negligible. Impacts on pedestrian and cyclist amenity will also be minimised through the Construction Phase Travel Plan, and the impact is expected to be negligible.

For the operational phase of the Project, impacts on the local highway network are expected to be negligible during normal day-to-day use and also during weekends and holiday periods. An Operational Phase Travel Plan will be prepared and will set out measures to encourage the use of sustainable transport by both staff and visitors. The Project will include enhancements to pedestrian and cycle access to the Port area, opening up an area previously inaccessible to the public, and will provide new links along the waterfront to the site of the SUBC resulting in a major beneficial impact.

The Lagoon will be capable of holding major sporting events. These would require temporary measures to manage vehicle and spectator movements. A Major Event Travel Plan would be prepared well in advance of any major event in consultation with CCSC, NPTCBC and other stakeholders. Through measures included in the Major Event Travel Plan, and close liaison with all relevant bodies, it is anticipated that impacts on the local highway network and public transport can be limited to minor adverse significance.

With or without the Project, traffic generated by cumulative developments will result in a moderate adverse impact on the local highway network.

AIR QUALITY

The air quality assessment looks at the potential impacts linked to emissions (exhaust fumes) generated by increased road traffic as a result of the Project. It also examines the potential for dust generation during site preparation and construction works.

A review of baseline data has identified that the Project itself does not lie within an Air Quality Management Area (AQMA), which means that the air quality is good (it meets Air Quality Strategy objectives). However, there is an AQMA in Port Talbot, 6km to the southeast of the Lagoon, due to higher concentrations of fine particulate matter on land between the Tata Steel Works and the M4 motorway. There is also one AQMA within the City and County of Swansea area, approximately 3.3km west of the Project. The majority of construction materials will be brought to site by sea, and it is anticipated that the main traffic generated as a result of the Project is not anticipated to travel through either AQMA.

The change in concentrations of air pollutants as a result of additional road traffic movements during the construction and operation of the Project have been calculated for locations near Fabian Way. These locations include residential properties to the east and to the west of the site access point, which is the signal controlled Fabian Way/Langdon Road/ Park & Ride junction and also both Crymlyn Bog and Crymlyn Burrows. The baseline concentrations of the air pollutants nitrogen dioxide and fine particulate matter (PM10 and PM2.5) have been calculated for the current conditions and for the year 2018 without the Project. Pollutant concentrations are currently very good and achieve the Air Quality Strategy objective values by a wide margin. The concentration of these pollutants would continue to be good in 2018 both with and without the Project, as the size of calculated change in pollutant concentrations during the construction and operation of the Project would be small to imperceptible. Even when likely emissions

from other consented developments are included in the calculations, the cumulative changes in pollutant concentrations would be small to imperceptible at all sensitive locations. Changes in pollutant concentrations will therefore not have a significant effect on local air quality, nor on air quality in the Port Talbot or Swansea AQMAs.

A quantitative assessment of nitrogen deposition at Crymlyn Bog and Crymlyn Burrows has been undertaken for the construction and operational phases of the Project, together with cumulative effects with other developments, using the approach outlined in national guidelines. The results show that the impacts will be negligible and not considered to be significant.

Mitigation measures to be included in a management plan that will be adopted during the construction phase of the Project have been considered, and the assessment has concluded that they would be capable of controlling emissions at source. With the implementation of the management plan, there will be no significant adverse effects at any location outside the Project site. This means that not only will the transfer of dust from the construction works be controlled, but that the measures are also capable of controlling the potential occurrence of adverse effects on local businesses and residential properties. Overall, the effect of the Project on air quality will be negligible and, as such, is considered to be not significant with regard to local air quality.

HYDROLOGY AND FLOOD RISK

An assessment of the hydrological conditions and flood consequences has been undertaken for the site preparation, construction and operation of the Project.

During the construction phase, standard good practice construction practices will be used to control and minimise the effect on surface waters. This would include reducing potential contamination caused by the construction process, such as release of sediments into the sewers, spillage and leakage of oils and fuels, leakage of wet cement and concrete, and the disturbance of existing contamination and drainage. The overall likely impact of the Project during construction would be minor and temporary in nature with the implementation of the mitigation measures.

During the operational phase, possible surface water impacts are considerably less than during construction. Possible impacts have been identified as increased surface water runoff, increased foul water volume, and increased drinking water supply demands. Surface water will be managed through the use of Sustainable Drainage Systems (SuDS) where appropriate. Use of water efficient devices and rainwater harvesting for onshore development will minimise impacts on potable water demands and associated foul water discharges. All of these have been assessed as being insignificant, even with the cumulative effect of current and proposed developments.

In terms of potential flooding impact, hydraulic modelling results indicate that the Port area and onshore Project development will benefit from the presence of the Lagoon wall. Due to the rules governing the operation of the turbines, the quantity of water able to enter the Lagoon means that water levels inside the Lagoon are lower than those experienced outside of the Lagoon when comparing maximum water levels. In addition, there is a low

correlation between extreme wave heights and extreme water levels indicating that wave overtopping is unlikely to be associated with extreme water levels. As a precaution, a freeboard allowance of +0.5m should be added to finished floor levels for permanent buildings, both onshore and offshore. When considering the wider Swansea Bay, the effects of the Project on both water level and wave height have been assessed as insignificant.

LAND QUALITY

A robust desk study of land quality has taken place to identify key land contamination receptors and their sensitivity. The potential impacts of the Project have been assessed against the importance or sensitivity of the receptors. A walkover was also carried out to visually asses the land quality.

Most of the land along the foreshore of the Port of Swansea was reclaimed, many years ago, from the intertidal area to form the dock enclosure and is therefore comprised of 'made ground'. Queen's Dock was formerly an oil terminal with pipelines that ran to the Llandarcy Refinery and Baglan Bay chemical works. Pipelines are thought to remain in the ground from the Port boundary to the River Neath/Baglan Bay on approximately the same route to that proposed for the Project's grid connection to the NETS.

Parts of the onshore area have been subject to industrial use, in conjunction with the Port operations and associated industrial activities, for many years. Some areas with previously-identified land contamination have already been remediated by the landowners. Remediation works to the ground and groundwater are currently ongoing in other parts of the onshore area. The proposed onshore development areas of the Project avoid areas of known contamination, particularly those associated with former oil industry infrastructure. Prior to construction, further investigation will be undertaken, and any contaminated areas likely to be affected by the works will be avoided, or investigated, assessed and remediated as necessary.

Visual evidence of contamination of the groundwater was observed during the site walkover, with the localised presence of a surface sheen on groundwater seepages on the foreshore. This was interpreted as being due to both hydrocarbon contamination and the natural breakdown of hydrocarbon contaminants. The visual observation of sheens on the foreshore groundwater seepages appeared to be associated with areas that are currently undergoing remediation works to reduce the impact of oil-industry related contamination.

During the construction phase, potential impacts will be temporary in nature and controlled by standard operating procedures detailed within the Construction Environment Management Plan (CEMP) to ensure they are minimised. This covers potential contamination caused by the construction process and existing contamination. During the operational phase, land quality impacts will be negligible and limited to the storage and use of potential contaminants which will be controlled as detailed within the Operation Environment Management Plan (OEMP).

NOISE AND VIBRATION

An assessment of the potential noise and vibration effects of the Project has been undertaken for the marine and terrestrial environments. Background terrestrial (land) and marine (underwater) noise surveys have been undertaken to inform the EIA.

Baseline land noise surveys were undertaken at seven sites within the vicinity of the Project, extending from Swansea Marina on the western side of the River Tawe, eastwards to the southern end of Aberafan seafront. Existing noise data in the public domain collected for the CCSC and NPTCBC and the Welsh

Noise Map for the area were reviewed. Underwater marine noise measurements were collected from five points around the Project. On land, the baseline dominant noise sources are associated with vehicle movements, namely traffic on Fabian Way and around the industrial sites within Swansea Port. Offshore, the highest noise levels are associated with shipping accessing one of the three ports in the area (Swansea, Neath and Port Talbot).

The construction phase of the Project will generate the most noise and therefore could affect human and ecological receptors (including fish, birds and marine mammals). Generally, on land, noise impact from construction plant will not be significant due to the location of the principal noisy construction activities offshore. Noise associated with increased traffic during the construction phase will not result in adverse effects over the baseline noise levels, in part because construction materials will be brought primarily by sea, and due to the existing commercial / industrial nature of the adjacent port areas. Measures to control noise will be included within the CEMP.

In terms of the marine environment, a comparison of noise levels from marine plant (suction dredgers) has been undertaken and compared with similar noise levels currently generated by shipping. It is intended that vibro-piling be used wherever possible, which generates much lower noise levels than impact piling. Vibro-piling would generate underwater noise levels similar to those from shipping. Impact piling would generate higher levels, so is only to be used when vibro-piling will not be practicable. To minimise impact on marine life, a 'soft start' procedure will be used for impact piling.

During operation, the recreational use of the Lagoon is expected to generate noise, especially during major events, although due to the distances involved to receivers, these are unlikely to cause significant impact. Major Event Travel Plans will be prepared for occasional infrequent large events and these, together with the OEMP, will include measures to control noise.

CULTURAL HERITAGE: MARINE ARCHAEOLOGY

The marine archaeology baseline considered the potential for shipwrecks and submerged prehistoric archaeology within the offshore and inter-tidal areas of the Project, and the potential for a range of other coastal activities within the inter-tidal zone. Overall, there is a very low level of known archaeology, but the assessment determined that there was potential for the presence of buried sites.

With regard to shipwrecks, there is a low level of data within the offshore area with most records being related to navigation markers and vessels that had sunk and then been salvaged. There is one known wooden shipwreck that lies within the inter-tidal zone in the vicinity of the eastern Lagoon seawall. The wreck is currently buried, but a target location for the wreck has been established by geophysical survey and the site will be avoided. The presence of this buried wreck is an indicator of the potential for further sites to lie buried within the seabed and inter-tidal sediments. This potential is considered to be low and would be addressed by a watching brief during construction.

There is no confirmed submerged prehistoric archaeology within the site. However, a palaeo-channel in the centre of the Lagoon has the potential to contain palaeo-environmental evidence, and peat deposits were recorded during the construction of the docks. The known location of these deposits either lies

away from the areas of direct impact, or are deeply buried. However, a watching brief during construction and the archaeological analysis of core samples have been recommended as the best way to mitigate any disturbance.

There is considerable evidence for coastal archaeology, such as fish-traps, to the west of Swansea docks. However, within the site of the Lagoon, the evidence is restricted to a small number of modern features that are probably, though not certainly fish-traps. The potential for further archaeology of this type to lie buried within the site would be addressed by a watching brief, with provision to sample and record any features that are encountered.

Overall, the scheme will have no significant impacts upon marine and inter-tidal archaeology, and mitigation will enable any currently unknown sites, discovered during the course of construction, to be addressed in an appropriate manner.

CULTURAL HERITAGE: TERRESTRIAL ARCHAEOLOGY

A baseline survey examining historic features was undertaken within a 1km study area of the Project. In addition, the study also considered effects on the historic setting of assets within a much wider area. No potential impacts in the wider study area were apparent.

Photo 6: Pill box

The most significant terrestrial historic environment assets are built elements at Queen's Dock which relate to military defensive structures dating from World War II, namely three pill boxes (Photo 5), four tank cubes and a gun emplacement. Although not currently statutorily protected, the individual structures are of high historic significance and retain significant group value. As a result, Cadw is currently minded to afford the remaining structures statutory protection through Scheduling.

The Project will have a negligible impact upon the pill boxes and tank cubes as it is intended that these are either retained in situ or suitably and sympathetically relocated, with any remains recorded. With a programme of archaeological evaluation to investigate the potential for the presence of below ground remains relating to the gun emplacement, the impact on this feature will be negligible. A programme of building recording will mitigate the removal of the Harbour Light, which was established in 1909 and is considered to be of low historic value. An archaeological watching brief will be undertaken along the length of the cable route where it crosses previously undisturbed ground where there is low potential for buried archaeological and palaeoenvironmental remains.

With the proposed mitigation, the Project is judged to have a negligible impact on the terrestrial cultural heritage resource.

ECONOMY, TOURISM AND RECREATION

Swansea, Neath, Port Talbot and its environs form a dynamic area, with numerous attractions and much recreational activity centred around the Bay and adjacent coastal area. Although there may be temporary disruption during construction, the location of the Project within Swansea Bay should minimise this. In addition, the Project looks to provide a number of direct and indirect jobs to the area during the construction and operation of the Lagoon, with the Welsh Economy Research Unit, Cardiff University, estimating that the Project will provide on average 1,850 jobs per year during the construction phase. It is predicted that there will be around 72 permanent jobs associated with the operation of the Lagoon and visitor facilities. A procurement strategy is currently being developed focused on maximising local procurement for aspects including training, employment and manufacture, through working with organisations such as the Welsh Government, local authorities, chambers of commerce and local further educational facilities. It is also predicted that the Project can have a catalytic effect in relation to a tidal lagoon industry, although this does not form part of the assessment contained in the ES.

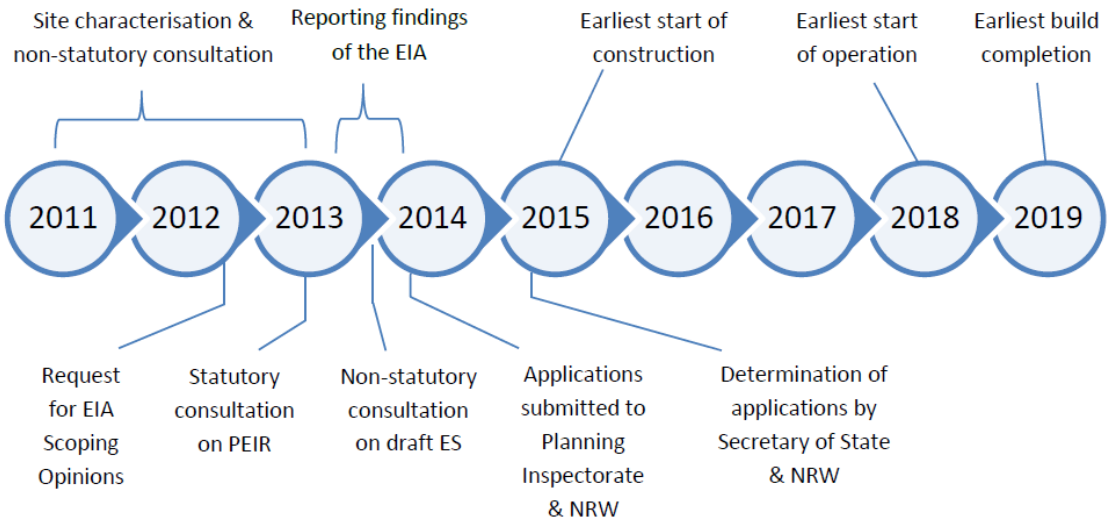
The Project also aims to contribute to the local and wider Swansea Bay area, with onshore and offshore facilities already described, such as the Offshore Building, the Western Landfall Building and the creation of beach areas and cycling/pedestrian routes. The new water sports facilities will provide opportunities for recreation, accommodating open water swimming, triathlon, sailing and coastal rowing in local, national and international event formats within the Lagoon. In terms of sporting events, these are anticipated to range from sailing competitions and training for a variety of classes of boat, to triathlon, swimming or running events once or twice a year, with between 2,000 and 8,000 visitors attending individual events. The design of the public realm and buildings provides for this anticipated demand and flexibility of layout to cater for peak demand for any activities at the Lagoon.

The new seawall itself will provide additional rocky habitat, which should attract a range of marine species including fish, which would be of benefit to recreational fisherman. Different mariculture opportunities are also being investigated to enhance the wider ecological environment, which could also benefit the local economy. Concepts include the encouragement of the re-introduction of the native oyster to Swansea Bay and a lobster hatchery with introduction of lobster onto the Lagoon wall. The Project will also provide a setting for art and educational programmes at all levels for Swansea Bay and beyond, as well as ongoing research opportunities. The Project involves the redevelopment of an area where public access is currently prohibited and the creation of attractive public realm areas and visitor facilities will mean that the Project will be a significant tourist and recreation attraction in its own right, with between 70,000-100,000 visitors a year anticipated.

PROGRAMME

The following diagram presents the phases through which the Project has progressed to date and the anticipated timescale to when the Project becomes operational generating electricity.

The ES proceeds on the basis of the outline construction programme shown below, which anticipates construction starting in 2015 and with the main construction lasting for about three years. The assessments contained in the ES are not materially sensitive to works commencing within the anticipated validity of the DCO (five years), or to an extension of a further year or two.



FURTHER INFORMATION

The draft Development Consent Order, Environmental Statement (and this Non-Technical Summary), the Consultation Report and the accompanying full suite of application documents are available to view (free of charge) on the Project website and the Planning Inspectorate's website following acceptance for consideration. If the application is accepted, the documents will also be available to view in hard copy at TLSB, Suite 6, J-Shed, King's Road, Swansea SA1 8PL, between the hours 1030 to 1700 Monday to Friday, and at the following locations and times:

- City & County of Swansea Civic Centre, Oystermouth Road, Swansea SA1 3SN. Opening hours: Monday-Thursday: 0830-1700, Friday: 0830-1630, Saturday: 1000-1500.
- Neath One Stop Shop, Civic Centre, Neath SA11 3QZ. Opening hours: Mon-Fri 0830-1700 (1630 on Fridays).
- Port Talbot Civic Centre, Port Talbot SA13 1PJ. Opening hours: Mon-Fri 0830-1700 (1630 on Fridays).
- Oystermouth Library, Dunns Lane, Mumbles, Swansea SA3 4AA. Opening hours: Mon-Thu 0900-1800; Fri 0900-1900; Sat: 0900-1700; Sun 1200-1600.

Following submission of the application for development consent, the Planning Inspectorate has 28 days to determine if the application is suitable for consideration. If accepted for consideration, there will be a further 28-day period during which the public can make representations on the Project for consideration during the subsequent examination. This representation can be made by post by requesting a form from the Planning Inspectorate, or on the Planning Inspectorate's website (http://www.planningportal.gov.uk/planning/planninginspectorate). This period will be advertised in the local press and on the Project website. Detailed guidance on how to make a representation, together with a full timetable of the planning process is available on the Planning Inspectorate's website.

TLSB will also be submitting an application for a marine licence, under the Marine and Coastal Access Act 2009, to the appropriate licensing authority, in this case the Marine Licensing Team at NRW. In order to deliver the Project, TLSB requires a licence for the construction of marine energy works and to dredge and dispose of dredged material. The marine licence application will be considered concurrently with the application for development consent.

The Project cannot go ahead without both consents.

The Project page on the Planning Inspectorate website can be viewed at:

http://infrastructure.planningportal.gov.uk/projects/wales/tidal-lagoon-swansea-bay/

For information about the planning process or to request a paper copy form during the periods defined above, phone the Planning Inspectorate on: 03034445000.

For information about the Project and TLSB's application, contact TLSB on:

- Call: 01792 274006
- Website: www.tidallagoonswanseabay.com
- Email: info@tidallagoonpower.com
- Write to: Tidal Lagoon Swansea Bay plc, Suite 6, J-Shed, King's Road, Swansea SA1 8PL

TLSB's registered office is at The Lypiatts, 15 Lansdown Road, Cheltenham, Gloucestershire GL50 2JA.

Please note: TLSB has submitted applications for a development consent order and marine license to the Planning Inspectorate and Natural Resources Wales respectively. This document forms a part of those applications. Consultation on the applications is managed by the Planning Inspectorate and Natural Resources Wales, not by TLSB. TLSB is happy to provide advice and support via the contact details above.