Proposed Tidal Lagoon Development

in Swansea Bay, South Wales

Environmental Impact Assessment

Scoping Report

October 2012

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1. Introduction

1.1 Objective of Report

1.1.1 This report has been prepared by Tidal Lagoon Swansea Bay Ltd to assist in the process of identifying an appropriate scope of an Environmental Impact Assessment (EIA) in support of applications for consents for a tidal lagoon renewable energy generation scheme in Swansea Bay, South Wales (Figure 1.1). The proposed tidal lagoon will have an installed capacity of 250-350MW, capable of generating over 400,000MWh/year[1]. This is enough to supply well over 100,000 homes, or the equivalent to Swansea city's domestic electricity use[2].

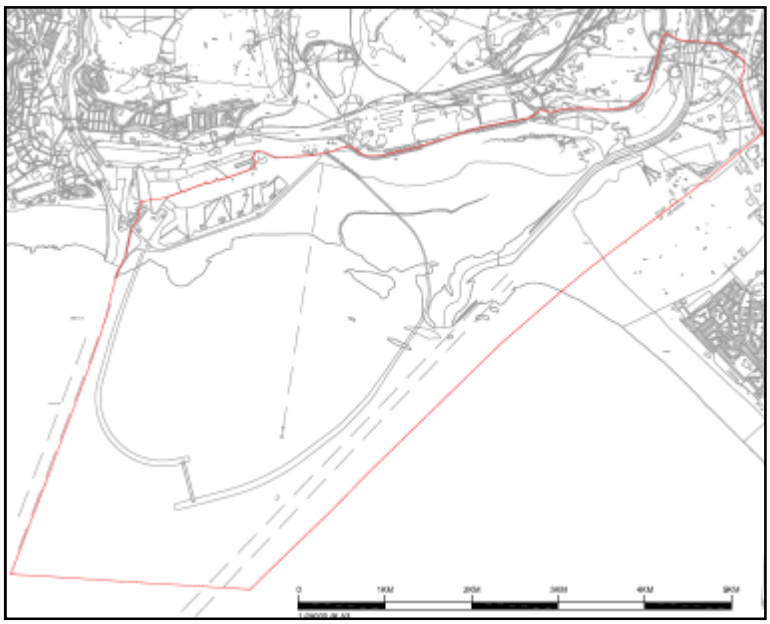

Figure 1.1 Proposed Location of Anticipated Main Tidal Lagoon Works

1.1.2 Figure 1.1 (also shown in Appendix 1.1) shows the anticipated location of the main works comprised in the project. This includes both on and off-shore elements. The final location for the project is anticipated to lie within the area shown and will also make provision for working areas etc.

1.1.3 In 2006 a scoping report was prepared by Tidal Electric Ltd (TEL) for an earlier Lagoon project at the same general location. The 2006 report had a limited circulation among key stakeholders before that project was put on hold. Although similar to the 2006 scoping report, this document incorporates feedback to the earlier project, responds to design reviews, incorporates additional consultation responses and provides updated and more extensive baseline information on which to base an on-going, comprehensive consultation process.

1.1.4 The offshore study area referred to throughout this report broadly encompasses Swansea Bay as defined from Mumbles Head to Port Talbot and as far offshore as the 10m depth contour. For specific subject areas e.g. coastal processes and seascape/landscape assessment the study area has been extended. The onshore study area will be subject-specific, but can generally be defined by a radius of 15km from the lagoon location.

[1] Subject to further energy modelling and final design

[2] Based on latest available domestic electricity usage figures for the area (2007)

1.2 Legislation, Consents and Need for an Environmental Impact Assessment

1.2.1 The Planning Act 2008 made significant changes to the planning system for major infrastructure projects. As the proposed Swansea Bay Tidal Lagoon is an offshore generating station of more than 100MW it falls within the classification under the 2008 Act of a Nationally Significant Infrastructure Project (NSIP). An application will therefore be made to the Planning Inspectorate (PINS) for the grant of development consent under a development consent order (DCO) by the Secretary of State for Energy and Climate Change.

1.2.2 The DCO will embrace a number of separate consents formerly required for a project of this type. A formal Environmental Impact Assessment (EIA) will be required as part of the application for a DCO and an Environmental Statement (ES) documenting the findings of the EIA process will be prepared in accordance with the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009 and the Marine Works (Environmental Impact Assessment) Regulations 2007.

1.2.3 Section 33 of the Planning Act 2008 dispenses with the need for separate planning permission and consents under Section 36 or 37 of the Electricity Act 1989 and the Town and Country Planning Act (TCPA) 1990. However, the proposal lies within Welsh waters and therefore a marine license is required for construction and dredging from the Welsh Government Marine Consents Unit (MCU) under the Marine and Coastal Access Act (MCAA) 2009. From April 2011, the MCAA 2009 replaces the need for licences under the Food and Environment Protection Act (FEPA) 1985 and the Coast Protection Act (CPA) 1949. It is proposed that a single EIA process and ES will be prepared embracing as many statutory consents as possible.

1.2.4 The DCO will provide for the generating station itself with its component parts. These include the offshore and most onshore aspects of the project, including the integral electrical grid connection works, which will form part of the application for development. Onshore elements of the project which are not categorised as 'associated development' will be applied for under the Town and Country Planning Act 1990 to the relevant local authority, in this case with the City and County of Swansea (CCS).

1.2.5 Other consents or permissions required include:

i. A lease for use of the seabed from The Crown Estate;

ii. A lease for use of the intertidal area covered from The Somerset Trust;

iii. A European Protected Species (EPS) Licence – this may be required if species protected under the Conservation of Habitats and Species Regulations 2010, and the Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (as amended) (collectively known as the 'Habitat and Offshore Marine Regulations') are present. These licences are issued by the MCU for developments within 12nm of the coast.

iv. Consent from the Environment Agency may be required under the Water Resources Act 1991 (if discharging/draining water or erecting structures, e.g. cabling, in, over or under a water course that is part of a main river), to the extent that this is not included in the application for development consent.

1.3 Consultations

1.3.1 Before an application for a development consent is submitted, wide consultation with key stakeholders, the local community and interest groups is required. The Infrastructure Planning (Environmental Impact Assessment) Regulations (2009) also require that formal consultation is undertaken with the local authorities and statutory bodies during the preparation of the ES, before the application is made. The Welsh Government's Marine Consents Unit (MCU) and the UK Marine Management Organisation (MMO) will be consulted, together with the relevant local authorities with coastal and landward jurisdictions within which the proposed development footprint falls. In this way consultation will be achieved at both authority and community level. Consultation in respect of the application for development will include:

a) Section 42 (duty to consult) of the 2008 Act requires a programme of consultation with those 'prescribed bodies' set out in the Infrastructure Planning (Applications, Prescribed Forms and Procedures) Regulations 2009 and each local authority defined by Section 43 of the 2008 Act.

b) Section 47 (duty to consult the local community) of the Act requires the applicant to prepare a statement setting out how it proposes to consult with people living in the vicinity of the development and to consult with the relevant local authorities on that process. In this instance, the onshore infrastructure including grid connection will be located within the City and County of Swansea (CCS) and Neath Port Talbot County Borough (NPTCB). Carmarthenshire County Council (CCC) and Bridgend County Borough Council (BCBC) will also be consulted as these councils border the aforementioned.

1.3.2 The objective of the consultation will be to:

i. Provide information on the project to consultees and establish an understanding of stakeholders' views on the proposal;
ii. Identify the potential impacts and areas of concern and, where possible, identify mitigation measures and feed this back into the iterative design process and construction programming of the project, subsequently consulting again with stakeholders having taken their views on board (if appropriate);
iii. Understand the amount of existing knowledge and data that is available for the site and the study area, and
iv. Provide on-going feedback on the progress of the project.

1.3.3 For the EIA process, at the pre-scoping stage, informal consultation has been undertaken with a number of prospective statutory and non-statutory consultees including (in alphabetic order):

a) Associated British Ports (ABP)
b) Cadw
c) Countryside Council for Wales (CCW)
d) Dwr Cymru – Welsh Water (DCWW)
e) Environment Agency – Wales (EA-W)
f) Friends of the Earth – Cymru (FOE)
g) Glamorgan Gwent Archaeological Trust (GGAT)
h) Gower Marine Mammal Project
i) Marine Management Organisation (MMO)

j) National Grid
k) Neath Harbour Commissioners (NHC)
l) Royal Commission on the Ancient Historical Monuments of Wales (RCAHMW)
m) Royal Society for the Protection of Birds (RSPB)
n) The Crown Estate (TCE)
o) Welsh Assembly Government, Marine Consents Unit (MCU)
p) Western Power Distribution (WPD)

1.3.4 Further consultation will be undertaken during the EIA process. In addition, full stakeholder mapping has been undertaken as part of the project's communications strategy, to ensure sufficient community outreach and engagement over and above statutory requirements. Appendix 1.2 provides a more detailed list of consultees and the informal feedback from initial consultations.

1.4 Structure of this Scoping Report

1.4.1 The objective of this report is to identify the scope of the EIA that will be undertaken to evaluate the potential effects of the project on the surrounding area. Feedback and comments on this scoping document will be sought from key consultees through PINS and integrated into the EIA process.

1.4.2 The findings of the EIA will be reported successively in a Preliminary Environmental Impact report (PEIR) and in an Environmental Statement (ES) which will be provided in support of the application for development consent and other relevant applications. The results of the EIA will also be used to inform the detailed design of the project and, where appropriate, mitigation measures will be incorporated to minimise residual effects on the environment or measures identified to enhance beneficial effects. Appropriate monitoring will be identified during the EIA process. To facilitate initial feedback, this scoping report has been structured to:

i. Provide an overview of the proposed project.

ii. Describe the proposed structure of the ultimate Environmental Statement.

iii. Outline the content of the ES chapters. For each environmental subject area an overview of the existing environment is provided and the available existing baseline data is identified; the need and scope of further survey work is given, where appropriate; and the scope of the proposed assessment is outlined.

iv. Provide a summary of survey works associated with the EIA process.

2. THE PROJECT

2.1 General Description

2.1.1 It is proposed to design, construct and operate a tidal lagoon for the purpose of generating renewable energy. This will be achieved by harnessing the power of the high tidal range in Swansea Bay (where the maximum Spring tidal range reaches over 10m). The lagoon would be designed with an installed capacity of between 250-350 MW and is forecast to generate over 400,000 MWh per annum of renewable electricity. Such power generation is reliable and predictable as it uses energy derived from tidally driven water movement. This is a key consideration for managing future national electricity supply from a mix of technologies and will enable the electricity to be used as a 'base load' power source without the need to balance with fossil fuel-driven capacity on the grid.

2.2 Positioning of the Tidal Lagoon

2.2.1 Swansea Bay is a large industrial embayment with a long history linked to the coal, steel and fishing industries. Nowadays, the main industrial activity is centred on Port Talbot, with some lower volume of activity at the ports of Swansea and Neath, and many areas of the old industrial seafront are being regenerated. In addition to this, there is wider recreational use of the Bay focused at designated bathing beaches as well within the embayment as a whole. As such, the positioning of a lagoon within the area requires careful consideration and accommodation of other existing uses. A number of key drivers were important when selecting the site within the Bay, namely:

2.2.2 ***Beach profile and depth of water:*** In order to minimise various environmental and economic impacts shallower water depth is preferred for lagoon development. Shallow waters with gentle beach slopes are found at a number of areas in the Bay including off the Swansea Dock and between Mumbles Headland and Singleton Park. The preferred area chosen is off Swansea Docks, where the seabed is gently sloping for a good distance offshore.

2.2.3 ***Beach quality***: As shallow water depth is preferred, this tends to occur nearer to the shore and, as such, the impact on existing beach uses could be marked. Within Swansea Bay there are two designated bathing beaches (Aberafan Sands and Swansea Bay), and it was essential that these were avoided. The site selected for the lagoon is on an intertidal area which is not a designated bathing area and which is backed by the Swansea dockland.

2.2.4 ***Landfall***: The use of an industrial landfall point would have significant benefits in terms of minimising impacts during construction, assisting with transport logistics and providing a potential grid connection option. As such the choice of Swansea docks is an ideal location for a landfall.

2.2.5 ***Navigation***: Positioning the lagoon such that it did not interfere with the operation of the ports was a key factor. The location between, but not affecting, the dredged approach channels of the ports of Swansea and Neath was selected to minimise disruption to shipping.

2.2.6 ***Turbine depth***: The marine turbines required for power generation have to be positioned in sufficiently deep water to be permanently submerged; on current turbine dimensions this requires 7m of permanent depth below Chart Datum. This can be achieved at the proposed location on its outer reaches.

2.2.7 As discussed above, there are other users of the potentially affected "waters", which need to be accommodated within the design. The potential effects of the lagoon on these users and waters will be assessed within the EIA. Mitigation measures would be proposed where necessary to minimise any potential effects. Of particular note is the presence of the main outfall for the Swansea Waste Water Treatment Works (WwTW) which would discharge its effluent into the proposed lagoon. The integrity of the outfall and its effects on the surrounding water quality and beaches can be accommodated through specific engineering design, construction and operational consideration. These will be discussed with DCWW, as well as the Environment Agency Wales (EA-W) who issue and monitor the Environmental Permit for the discharge from the outfall.

2.3 Overview of Tidal Lagoon Project

2.3.1 The proposed tidal lagoon will comprise an impounding "breakwater or seawall" of around 9.5km in length. This will impound a tidally driven area of water approximately 9.3km^2. The location of the lagoon has been chosen to use shallower water depths, thereby minimising the overall height of the seawalls and the materials required for construction. These suitable shallower waters are between the dredged navigation channels for Swansea and Neath Ports, which is away from Swansea Bay's designated bathing beaches.

2.3.2 The landward face of the seawall to the lagoon will be set such that the top 3m will be visible at Mean High Water Springs (MHWS), and approximately 12m wall height will be visible at Mean Low Water Springs (MLWS). Both figures are subject to final designs incorporating Health & Safety requirements that permit public access to the wall. In context, the existing Eastern Breakwater into Swansea Port is approximately 10.5m above chart datum. There will be additional structures on top of the seawall, which will be taller and these are discussed in the following section. The seawall represents the largest component of the project with respect to environmental effect. Further details of its construction can be found in Section 2.4. Any opportunities to reduce the structure's environmental footprint (and, where appropriate, costs) through engineering solutions will be continually investigated during the detailed design and EIA process.

2.3.3 Turbines will be set in a single turbine caisson section at one of the deepest points along the wall. The turbine housings will be located on the seaward side of the seawall at around 5-7m below Lowest Astronomical Tide (LAT). These housing will comprise reinforced concrete caissons, which will be built in a line about 400m long and will have a width of about 30m. Within these, a series of hydro turbines will be positioned, with runner diameters of 3-4m. These will generate electricity as water flows both into and out of the lagoon with the rise and fall of the tide. The area within the lagoon will remain subject to the full, natural tidal range, though delayed in time from the tidal cycle experienced outside the lagoon walls. A basic schematic illustration of a tidal lagoon's operation is given in Figure 2.1. In reality, the electricity generation period would commence shortly after high tide, rather than waiting until there is a significant head of water (the difference between lagoon level and external sea level) as is implied in the illustration below.

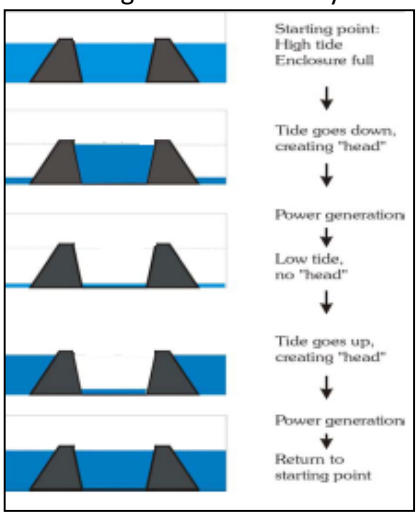

Figure 2.1 Schematic of Tidal Lagoon Operation

2.3.4 Access requirements via the seawall will be based upon the space required to install or remove the turbine units by gantry crane. This gives an overall plan dimension for the turbine caisson section of approximately 400m x 20m.

2.3.5 The figure below shows a schematic of a turbine caisson. Included in the design is a sluice gate with an overhead gantry which will sit approximately 8m above the seawall. The sluice gate will allow for quick equalisation of water levels at low and high water, with potential additional use of pumping at high water to maximise the head (i.e. amount of water available for electricity generation) created within the lagoon. At high water levels the sluice gate will be winched out of the water for a period of about 1.5 hours.

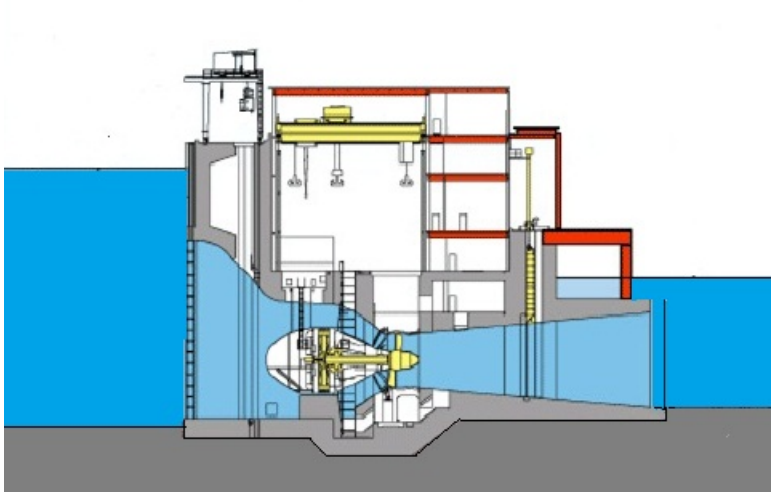

Figure 2.2 Schematic of Caisson and Turbine

2.3.6 It is currently anticipated that the electricity generated by the turbines offshore will be stepped-up to 132 kV prior to being exported by cable to the shore and then onwards to a suitable grid connection point. This step-up is required to minimise energy losses during transmission. Figure 2.3 shows the cable route option to Baglan substation which is the preferred option currently being proposed at this stage of the project. The final connection point will be subject to National Grid offer once an application is accepted. Due to the size of installed capacity and output, a grid connection will be taken direct to National Grid's 275kV circuit, with a possible alternative being a 400kV connection. Whichever option is

taken forward will be given sufficient powers to be included in the application for development consent and arrangements with National Grid, the relevant local planning authority and other landowners/interested parties. Within the EIA the final grid connection option will be confirmed and assessed.

Figure 2.3 Possible Grid Connection Option for the Lagoon

2.3.7 Associated with the lagoon it will be necessary to have operation and control facilities to manage the generating station. At this stage it is anticipated that the primary facility will be housed onshore, probably close to the landfall of the eastern seawall, with smaller control facilities housed at a location at or near the turbine caissons. The onshore facility, which is an integral part of the generating station, would house permanent control staff and is likely to include:

a) Maintenance workshop and Spares store;

b) Parking and garaging for 2-4 operations and maintenance (O&M) vehicles (pick-up truck and van), plus additional staff parking;

c) Boat storage (rib boat for maintenance inspections/rubbish clearance etc);

d) Control room (staffed by two operators 24/7, from a team working a five-shift pattern);

e) Welfare facilities for shift workers (mess room/kitchen/showers/toilets);

f) Office accommodation (for five-man maintenance team working standard hours Mon-Fri, but on call for emergencies 24/7); and

g) Requirement for a slipway/jetty access point off the wall into permanent water i.e. at the low water mark (this could be shared with proposed leisure facilities).

2.3.8 Restricted access measures at both landfall points of lagoon seawalls will be included in the design. The onshore building would also control the access points to the lagoon seawalls, particularly for use during adverse weather conditions as an example.

2.3.9 In addition to this, located adjacent to the O&M facilities it is proposed that there will be visitors' facilities. The exact details of these will be determined during the EIA process and could include:

i. Watersports and activities facilities – potentially incorporating a clubhouse, toilets/changing facilities, café, boat or equipment storage units, additional slipways – one inside and one outside the lagoon;

ii. Cycle hire points for public equipment use;

iii. Parking provision, public transport pick-up/drop-off and landscaped circulation space suitable for 70-100k visitors per year; and

iv. Safe, secure visitor access between the two seawall landfall points so a complete circuit can be made.

2.3.10 Finally, to ensure continuity of the proposed development with its surrounding environment and to enhance its ability to catalyse regeneration, it is proposed to provide a bridge link to the SA1 development at the western end of the docks and beyond into the city; this will form a spatial link to the University Science and Innovation Campus development to the east of the docks.

2.3.11 In addition to this it is proposed to have a visitor centre building offshore, located near and integrated with the turbine housing area approximately 5km out along the lagoon wall. The exact appearance and facilities within this building are still to be determined but they are likely to include:

a) Architecturally significant design/appearance, with the objective of creating an iconic building;

b) Lobby;

c) Café/restaurant/toilets;

d) Permanent renewable energy exhibition space(s);

e) Interactive physical exhibitions for education and interest;

f) Multi-use exhibition/function space; and

g) Navigational lighting as required.

2.3.12 In terms of potential visual effects this is discussed further in Section 3.3.

2.4 Overview of Tidal Lagoon Construction

2.4.1 The landward connection of the seawalls will allow the import of materials and the movement of construction workers to and from the site. The presence of a permanent connection to the shore would also open up tourism, recreation or educational opportunities for the Lagoon during its lifetime.

2.4.2 The proposed construction period will span 24 months. The seawall will be built with a sand and gravel core using geotextile tubing to encase dredged sediment fill. Selected appropriate dredged material from within the footprint of the lagoon will be used to fill the geotextile tubes and these will be laid on the seabed without further foundation requirement. Sand-filled geotextile tubes have been used around the world in a range of coastal and structural applications as breakwaters, groynes and perimeter dykes for large scale land reclamation projects. One comparable precedent project is the 12km Incheon Bridge project in Korea, where a very similar design of sand breakwater was constructed in 9m tides on a soft seabed, forming the foundation for a highway bridge over the estuary. The sand and gravel core will then be overlaid with rubble and rock armour (Figure 2.4) to protect against degradation. All materials for construction will be sourced as appropriate to maximise environmental and economic benefits, for example reducing their carbon footprint and optimising local supply chain opportunities.

2.4.3 The source for import of external rock armour for the lagoon walls has yet been finalised, although a number of options are currently being reviewed. It is appreciated that the anticipated volume of rock to be imported is significant and could in itself cause localised impacts. For the purposes of EIA it will be assumed that the rock will be sourced from an existing operational site, and that any potential effects and required mitigation (e.g. noise, dust, ecology etc) would be addressed under the permits in relation to that site. Notwithstanding this, the transport of rock to the lagoon has the potential to have a localised effect on the Swansea Bay area. There are three options for transport: road, rail or sea. Whichever option is identified, the potential effect of the transport of rock on the local access routes would be addressed within appropriate chapters of the EIA.

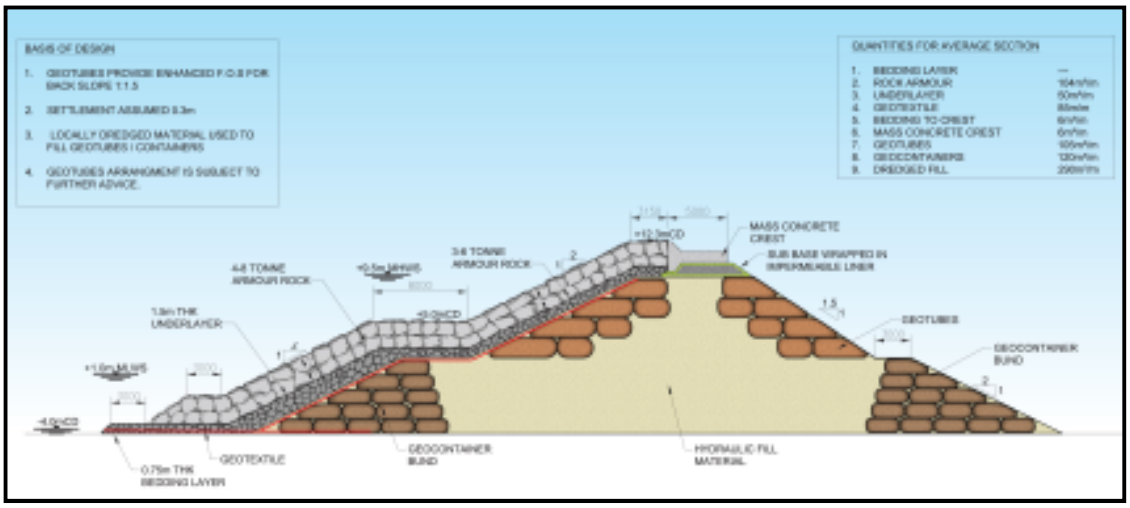

Figure 2.4 Indicative Perimeter Wall Cross Section (source: Atkins, 2012)

2.4.4 With turbines located on the seaward side of the lagoon, in deeper water, there will be seabed preparation requirements for the installation of turbine caissons. This process will involve the installation of a cofferdam structure and some removal of soft material to lay solid foundations. The concrete caissons will then either be constructed onshore through use of dry docks and placed in situ, or built within the cofferdam which allows for all-year construction by isolating the construction area and reducing weather risk. The reinforced concrete turbine houses have been designed as pre-fabricated modules and piling may be required to support the turbine housings when in place, due to the wave impact exposure at that point on the design. A temporary onshore construction compound will be required for the caissons and turbine housing. This will be located on a brownfield site in Swansea docks and discussions are being held with ABP to identify the most appropriate location.

2.4.5 Mechanical and electrical installation would follow construction of the turbine house. It is anticipated that equipment would be either shipped to the site and offloaded using conventional, barge-mounted cranes, or transported to site via the landward connection of perimeter wall.

2.4.6 As is a standard requirement of the MCAA licence (formerly FEPA and CPA) surveys will be undertaken pre and post construction to ensure that there is no unwanted debris left on the seabed and that all rock armouring is correctly positioned.

2.4.7 Finally, appropriate lighting and safety warning systems to ensure safe navigation in the vicinity of the lagoon will be a fundamental part of the project. The specific requirements for this will be determined through consultation with Trinity House Lighthouse Service and other appropriate stakeholders.

2.5 Operation and Maintenance

2.5.1 The proposed lagoon will have a nominal design life of 50 years, but has the potential to continue operation for over twice this, subject to periodic maintenance and occasional replacement of mechanical structures which will be planned into the cost profile of the development.

2.5.2 The intent will be to operate the tidal lagoon from the land-based operations and maintenance control room onshore. Systems will be incorporated to alert operatives should operational parameters be at risk of exceeding specified limits designed to ensure safety. Each turbine unit will have the ability to shut down independently of the others in emergency situations. Remote surveillance will include systems such as use of CCTV to ensure trash screens, which prevent ingestion of debris by the turbines, do not become blocked by debris.

2.5.3 Further, there will be a regime of maintenance that is likely to include:

a) Frequent (e.g. weekly) general inspections;
b) Monthly to quarterly more detailed manual inspections;
c) Annual maintenance inspection of the turbine house and perimeter wall, examining structure condition;
d) Annual inspection of electrical equipment (fans, pumps and battery/charger systems);
e) Annual inspection and maintenance of turbine and generator seals, lubricants and mechanical clearances;
f) More intermittent (likely to be every three to five years) inspection of other electrical equipment such as switchgear and control/relay equipment; and
g) A major outage of each unit for detailed inspection is likely to be required every 4 years.

2.5.4 Security systems will also be in place to protect against inappropriate interference by unauthorised persons.

2.6 Decommissioning

2.6.1 With the simple, but robustly designed, nature of the lagoon the expected operational life of the project will be in the region of 100 years. Following the expiration of that period, alternative options for the lagoon would be considered. This could include, for instance, continued use for power generation, inundation, use for marine recreational facilities or removal of the whole or part structure from site.

2.6.2 Within the ES an overview of the likely decommissioning will be provided within the project description. If the option for removal is considered likely, for the purpose of the assessment it would be assumed that the temporary effects in terms of noise disturbance, water quality changes, traffic impacts etc during the decommissioning phase will be similar, if not shorter in duration, to those of the construction phase. In terms of coastal processes and the potential changes in hydrodynamics within the Bay, it is assumed that the situation would be similar to the broad steps in constructing the lagoon, depending on the decommissioning approach ultimately adopted. As such the assessment of construction impacts and any mitigation identified in that regard would provide a baseline assessment for the decommissioning of the project. Whilst it is acknowledged that the baseline conditions will have changed during the intervening 50+ years and this must be taken into consideration at the time of decommissioning, this approach is considered sufficient for the purposes of EIA at this point.

3. STRUCTURE OF THE ENVIRONMENTAL STATEMENT

3.1 Overview of the Environmental Statement

3.1.1 The preliminary chapters of the Environmental Statement (ES) will set the scene for the project. They will provide an overview of the proposed renewable energy project including details of both the offshore and onshore components. The various applications to be supported by the final ES would be identified.

3.1.2 An overview will also be given of the iterative process that has been undertaken in terms of considering alternatives location sites and design options. The design evolution will continue throughout the EIA process, with mitigation measures being incorporated where appropriate. Finally, the introductory chapters will go on to provide a description of the principal elements of its construction and operation/maintenance phases, along with an overview of the anticipated decommissioning.

3.1.3 The main body of the Environmental Statement will be prepared in stand-alone chapters to present a complete picture of assessment and effects for each individual environmental subject area. Assessments will be undertaken for the construction and operation/maintenance phase of the project. Within the ES, it is proposed to provide a brief overview of the anticipated effects of decommissioning.

3.1.4 The following environmental subject areas, which will be included in the ES, have been determined through preliminary consultations and from guidance documentation:

i. Coastal, Sediment Transport and Contamination;
ii. Marine Water Quality Assessment;
iii. Intertidal and Subtidal Benthic Ecology;
iv. Fish, including Recreational and Commercial Fisheries;
v. Marine Mammals;
vi. Coastal Birds;
vii. Navigation (commercial and recreational) and Marine Transport Assessment;
viii. Terrestrial Ecology;
ix. Seascape and Visual Assessment;
x. Marine and Terrestrial Archaeology and Historic Landscape;
xi. Marine and Terrestrial Noise Assessment;
xii. Onshore Transport Assessment and Air Quality;
xiii. Economy, Tourism and Recreation; and
xiv. Information for a Habitats Regulation Assessment.

3.1.5 Each environmental subject area will report an assessment of the environmental impacts of the proposed development, and will evaluate the potential impacts that may occur. Although there will be slight variation between chapters, in general each will include the:

a) Overview of chapter and relevant policy and/or legislation;
b) Assessment methodology;
c) Description of baseline conditions including findings of any site specific surveys;
d) Detailed assessment of the effects of construction and operation/maintenance. Including an overview of anticipated decommissioning effects.
e) Mitigation and enhancement measures, so far as appropriate, and residual impacts.
f) Monitoring; and
g) A conclusion presenting significant aspects, both positive and negative.

3.2 Assessment Criteria

3.2.1 To assess the impacts of the proposed development on the various environmental receptors, the appropriate guidelines for the specific environmental subject area will be followed. Where no specific guidelines are available, a generic method will be employed which is based on the Institute for Ecology and Environmental Management (2010). These will be adapted by the specialist consultant where necessary for the environmental subject area. So far as possible a consistent scale will be used throughout.

3.2.2 For each subject area:

i. The ***value*** of the receiving receptor (site/feature/species) will be determined;
ii. The ***magnitude*** of the potential impact on the receptor will be identified; and
iii. An overall ***predicted impact significance*** will be given.

3.2.3 The value of each receptor will be based on evaluation methods identified in the various guidelines. Table 3.1 shows an example of how the nature conservation value of a variety of sites/features/species can be determined.

Table 3.1 Potential Value of Ecological Receptors (Adapted from IEEM, 2010)

Level of Value	Examples
International (Very High)	• An internationally designated site or candidate site (SPA, pSPA, SAC, cSAC, pSAC, Ramsar site, etc) or an area which the country agency has determined meets the published selection criteria for such designation, irrespective of whether or not it has yet been notified. • Internationally significant and viable areas of a habitat type listed in Annex 1 of the Habitats Directive. • Regularly occurring, globally threatened species (i.e. IUCN Red listed) or species listed on Annex 1 of the Berne Convention. • Regularly occurring populations of internationally important species that are rare or threatened in the UK or of uncertain conservation status. • A regularly occurring, nationally significant population/number of any internationally important species.
National (High)	• A nationally designated site (SSSI, NNR, MNR) or a discrete area, which the country conservation agency has determined meets the published selection criteria for national designation (e.g. SSSI selection guidelines) irrespective of whether or not it has yet been notified. UKBAP habitats and species.
Regional/ County (Medium)	• Viable areas of key habitat identified in the Regional/County BAP or smaller areas of such habitat which are essential to maintain the viability of a larger whole; • Viable areas of key habitat identified as being of Regional value in the appropriate Natural Area profile; • Any regularly occurring significant population that is listed in a Local Red Data Book. • Significant populations of a regionally/county important species.
District / Borough (Low)	• Areas of habitat identified in a sub-County (District/Borough) BAP or in the relevant Natural Area profile; • District sites that the designating authority has determined meet the published ecological selection criteria for designation, including Local Nature Reserves selected on District/Borough ecological criteria (District sites, where they exist, will often have been identified in local plans); • Sites/features that are scarce within the District/Borough or which appreciably enrich the District/Borough habitat resource;
Parish/Local (Negligible)	• Areas of habitat considered to appreciably enrich the habitat resource within the context of the Parish, e.g. species-rich hedgerows. • No site designation. • Species present are common and widespread.

N.B. Where species or habitats occur in more than one category above, the highest value is applied.

3.2.4 The potential impact on the receptor is assessed giving consideration to the following aspects:

i. **Positive or negative** - Is the impact likely to be good or bad for the feature/species?
ii. **Magnitude** - what size' or 'amount' of an impact is there?
iii. **Extent -** The extent of the impact i.e. that is the full area over which the impact occurs.
iv. **Duration -** The duration over which the impact is expected to last prior to recovery or replacement of the feature.
v. **Reversibility -** Is it an irreversible (permanent) impact from which recovery is not possible or is it a reversible (temporary) impact from which spontaneous recovery is possible?
vi. **Timing and frequency** - Some changes may only cause an impact if they happen to coincide with critical life-stages or seasons. The frequency of how often the activity/impact will happen.

3.2.5 The magnitude of the potential impact is then assessed for each receptor using the categories set out in Table 3.2 below.

Table 3.2 Assessing the Magnitude of Each Impact on an Ecological Receptor

Impact description	Criteria
Major Negative	The change is likely to cause a permanent adverse effect on the integrity of an ecological receptor. The proposed development will have effects which would adversely impact on the integrity of a site (at regional to international level).
Moderate Negative	The proposed development will not adversely impact upon the integrity of a site, but the effect on the site is likely to be significant in terms of its ecological objectives (e.g. key attributes of a site will be altered, but not so much as to result in a change in the site's evaluation). The proposed development will have permanent and severe impacts upon undesignated habitats of county importance. The proposed development will result in changes in the distribution of a legally protected species, but not affect its population status or conservation status but the population will become more vulnerable.
Minor Negative	Neither of the above applies, although some negative impact to a designated site or undesignated habitat of regional / county importance is evident. The proposed development will have permanent and severe impacts upon undesignated habitats of local / negligible importance. The proposed development will have an adverse affect on a legally protected species but with no significant reduction in conservation status.
Neutral	Although it is not always possible to state categorically that there will be no impact on a receptor the term neutral will be used where the level of exposure is considered to be less than the tolerance of the receptor, therefore an impact is unlikely. Or there will be no impact at all on that habitat or species/faunal group.
Positive	The change is likely to benefit the receptor in terms of its conservation status, but not so far as to achieve favourable conservation status.

3.2.6 Based on the value of the receptor and the predicted magnitude of the potential impact, the significance of an impact can then be determined according to Table 3.3. Residual impact is the significance of impact considered after mitigation measures have been taken into account.

Table 3.3 Impact Significance

Nature Conservation Value	Magnitude of Potential Impact				
	Major Negative	Moderate Negative	Minor Negative	Neutral	Positive
International/ Very High	Major Adverse	Major Adverse	Moderate to Minor Adverse	No Impact	Major - minor Beneficial
National/ High	Major Adverse	Major to Moderate Adverse	Minor Adverse	No Impact	Major - minor Beneficial
Regional/ Medium	Moderate Adverse	Moderate – Minor Adverse	Minor Adverse	No Impact	Moderate Beneficial
District/ Low	Minor Adverse	Minor Adverse	Insignificant	No Impact	Minor Beneficial
Local/Negligible	Minor/ Insignificant	Insignificant	Insignificant	No Impact	Insignificant

3.3 Cumulative Effects Assessment

3.3.1 EIA must consider the potential cumulative effects that a proposed development may have on the existing and reasonably foreseeable environment. Therefore, the cumulative effect of development will be considered within the relevant chapters of the ES.

3.3.2 Assessment of cumulative effects will ensure that the development is assessed in conjunction with other developments of similar nature in the local area that exist, that are approved but uncompleted, or the applications for which are under consideration. In the case of Swansea Lagoon, preliminary discussion with the Countryside Council for Wales, County and City of Swansea, Environment Agency and Neath Port Talbot County Borough Council has indicated that there a few projects which should be reviewed. These projects, their current planning status and the potential key issues that should be considered are identified in Table 3.4 below:

Table 3.4 Outline Cumulative Assessment Projects

Project and location	Current status	Potential issues to be considered
Swansea Bay Science and Innovation Campus - on shoreline adjacent to Crymlyn Burrows.	Planning permission granted. Construction timescale unknown.	Coastal processes effects and changes in flood risk. Direct/indirect socio economic or recreational impact.
Atlantic Array Wind Farm – off North Devon Coast approx 35km distant.	Outline programme - submit application Oct 2012: build 2015-2016. All survey data has been gathered, EIA in progress.	Construction noise impact on cetaceans, i.e. if construction of offshore wind farm falls at same time as lagoon, then cetaceans maybe displaced from wind farm site to Swansea Bay, resulting in potential cumulative impacts.
Navigational dredging adjacent to development and existing/proposed dredging in Bristol Channel.	On-going	Potential effect on navigation and potential combined effect on sediment deposition/ erosion in wider area. Consideration for additional maintenance requirement.
Port Talbot Harbour Redevelopment.	Potential future activities/ development which may have a cumulative effect. Details to be confirmed by NPTCBC.	To be confirmed during EIA.
Severn Barrage	Timescale unknown.	Limited details are currently available about this project and its timescales. It would be proposed that if the Severn Barrage project were taken forward then its EIA should include the Swansea Bay Tidal Lagoon in its cumulative assessment.

3.4 Assessment Study Areas

3.4.1 In terms of the marine study area for the assessment and cumulative effects, initial high level coastal process modelling has been undertaken to determine an appropriate area. The results of the high-level assessment suggest that there should be no far-field effects in the tidal regime area downstream in the Bristol Channel and upstream in the Severn Estuary. The modelling study also helped appraise the likely changes to waves and tides resulting from the lagoon. As might be expected the lagoon will have some direct influence on local tidal circulations in the immediate vicinity and will create a sheltering effect on waves arriving at the coast. These local changes are likely to modify sediment movements within the bay and around the lagoon to some degree, but there appears to be less change (smaller amount of areas involved and with lower magnitudes) outside the bay, with no major far-field effects and no apparent changes opposite Kenfig Special Area of Conservation. Full localised and wider effects will be investigated during the EIA process (see Section 4.6).

3.4.2 For the coastal process assessment the near field study area has been identified as the area between Mumbles Head in the west to Port Talbot in the east and out to the 10m contour. As discussed above it is not anticipated that the effects would be significantly further reaching, but this will be reviewed based on the final details of the lagoon and associated modelling output. As such the far field area is identified as stretching from Port Eynon in the west to Sker Point near Porthcawl in the east. The cumulative effects to be looked at in the coastal process section will primarily relate to the changes to coastal erosion and accretion processes.

3.4.3 For marine bacterial water quality there are a number of inputs to the area including the Swansea, Afan and Baglan long sea outfalls, Mumbles storm water outfall and inputs from the Rivers Tawe and Neath. The cumulative effects of these and other discharges will be looked at in terms of existing and potential future effects on local water quality. This is discussed further in Section 4.7.

3.4.4 With respect to the potential visual impact, the generally low nature of the lagoon structure means that the potential distance affected will be significantly reduced compared to, for instance, offshore wind turbines. For offshore wind farms which have total height of around 130m, a 30 to 40km radius study area is recommended best practice for impact assessments. This is extended to around 60km for the cumulative assessment with other wind farm developments. However, guidance acknowledges that this distance should be tailored to the nature of the development.

3.4.5 The proposed lagoon is on a different scale to offshore wind in particular with respect to height. With the generally low lying nature of the lagoon walls (c. 12m above low water) and the more enclosed shape of the Bay, significant views from beyond the headlands of Mumbles and Sker point/Porthcawl are not anticipated. However, in order to determine a worst case field of vision a Zone of Theoretical Visibility (ZTV) assessment has been undertaken with the maximum anticipated dimensions of the lagoon. The ZTV uses topographical information only and determines where a structure could be seen, assuming that there is no intervening buildings or vegetation.

3.4.6 The ZTV and its results are discussed in detail in Section 4.14.2 and are illustrated in Figure 4.7. Overall the ZTV confirms that views from the west and east appear to be generally within the coastal strip which covers up to 5-10km from the development. The ZTV does indicate that there would be potential for glimpsed views from slightly higher ground around Pull Ddu Head, although the reality is that this would be unlikely due to intervening features in that area.

3.4.7 From the northwest through to northeast the main views appear to be more constrained to the 5km coastal area. Places where more distant views could potentially be obtained are from elevated ground and up the Tawe and Neath valleys.

3.4.8 From the southeast and east, there would be potential for views along the coastal strip (5-15km distant) and from occasional elevated land further inshore. As discussed before many of the non-coastal views would not be obtained due to the presence of manmade structures and trees.

3.4.9 As would be expected views from the south (the sea) would be uninterrupted, but these would be seen against an industrial backdrop and therefore should be less distinctive in terms of change.

3.4.10 In summary, the results of the ZTV confirm that the main views tend to be along the coastal area which is some 5-10km distant to the west and east quarter and approx 1-5km distant from the northern quarter. There is also potential for reduced views from elevated land surrounding the bay, but these would be affected by intervening built form and vegetation. As such it is proposed to use a maximum 15km radius for the visual EIA and cumulative assessment. Further consultation concerning potential visual impacts will be undertaken with CCW Seascape officer and the Local Planning Authorities as identified in Section 4.14. Other study areas for relevant topics are discussed below.

3.5 Habitats Regulation Assessment

3.5.1 A project of this nature has the potential to impact upon internationally designated habitats and/or species. As such the EIA will provide information sufficient to allow an assessment under the Conservation of Habitats and Species Regulations 2010 (Habitats Regulation Assessment). This will enable decision makers to carry out such assessments prior to granting consents, should it be necessary to do so.

3.5.2 A summary of relevant information will be provided as a separate chapter in the ES.

4. CONTENT OF THE ENVIRONMENTAL STATEMENT

4.0.1 The following sections give details on the information or scope of assessment that it is proposed to provide for each chapter of the ES. Within the assessment section of this document, a background will be provided to the Swansea Bay area, the existing data sources which inform the baseline situation will be presented and, where required, the scope of additional survey work will be given. Finally, the scope of the assessment of impacts to be included within the EIA will be presented. As the EIA progresses, additional information or issues may come to light which should be included in the ES. The content of the chapters may vary to accommodate any such additional requirements.

4.1 Non-Technical Summary

4.1.1 A Non-Technical Summary (NTS) will be produced detailing the key aspects of the project and the findings of the EIA process in non-technical language. This will be provided as a separate document available in print and on-line, and it will be provided in response to enquiries both within the local and wider area.

4.1.2 A Welsh translation of the NTS will also be available.

4.2 Introduction

4.2.1 This Chapter will give a general description of the site, the proposed project and will introduce Tidal Lagoon Swansea Bay Ltd as developer. To set the project in context a brief outline of the history of Swansea Bay area will be given. This will include a summary of the marine and coastal environment, along with current activities in the vicinity of the site and within the wider Bay area.

4.2.2 The chapter will then identify the applications for consent for the Swansea Bay Tidal Lagoon that will be supported by the ES. A background as to the requirements for an ES will also be given.

4.2.3 Subsequent to this, relevant consultations undertaken during both the scoping and EIA process will be presented. A summary of the key responses will be provided in an Appendix, but will also be in the Consultation Report. Finally, the assessment criteria will be outlined and the scope and structure of the ES will be summarised.

4.3 Background to the Project and Site Selection

4.3.1 A major component of the UK Government's environmental strategy is committed to reducing carbon dioxide and other polluting gases through an increase in the proportion of energy generation from renewable sources. The UK has a target of cutting greenhouse gas emissions by at least 80% below 1990 levels by 2050 and, more immediately, a legally-binding EU target (2009 Renewable Energy Directive) for 15% of energy consumption to come from renewable sources by 2020. The Government believes that tidal power could play a significant role in the future generation of electricity for the UK. The UK Marine Policy Statement (March 2011) says:

4.3.2 "Studies by organisations such as the Sustainable Development Commission and Liverpool University and the Proudman Laboratory have suggested that tidal range schemes could provide up to 15% of the UK's current electricity demand. Tidal range technology is relatively mature. La Rance barrage in Brittany has been operating since the 1960s, and new innovative technologies are being investigated which could have less environmental impact and still produce significant amounts of energy."

4.3.3 Wales is seeking to achieve a renewable electricity production target of 7 TWh per annum by 2020. The Energy Statement (published by the Welsh Government) details how Wales has the potential to produce twice the amount of electricity it currently uses from renewable sources by 2025, with 40% coming from marine, a third from wind and the rest from sustainable biomass power or smaller projects using wind, solar, hydro or indigenous biomass.

4.3.4 These commitments and opportunities set the context for a development proposal such as the one presented here: the Swansea Bay Tidal Lagoon.

4.3.5 This chapter will provide details of the project in terms of wider and site-specific issues. It will cover the need for the project and the site selection process within the following framework:

a) A review of the Government commitments and obligations to renewable energy, with particular emphasis on marine renewables;
b) An overview of the contribution that Swansea Bay Tidal Lagoon will make to targets of electricity generation from renewable sources and through the reduction of carbon dioxide emissions;
c) Background to tidal lagoon energy technologies, including a history and account of recent progress at a national, regional and local scale;
d) Background to the review of alternative sites considered for a pilot project and the reasons for selecting Swansea Bay as the proposed site;
e) A review of the key factors considered in the positioning and design of the lagoon within Swansea Bay; and
f) The key environmental and socio-economic benefits of the Swansea Bay Lagoon project will be outlined. The potential local benefits discussed will include those during the construction phase as well as the long-term maintenance and monitoring of the lagoon. In addition to this, a brief overview of potential projects and opportunities which could be incorporated into the long term operation of the lagoon will be given. These would also be discussed in more detail under the Economy, Tourism and Recreation chapter of the ES.

4.4 Project Description

4.4.1 This chapter will set put the main elements of the project and the associated onshore requirements. This will include:

i. Details of the tidal lagoon components including seawall structure, turbines, sluice gates and the proposed visitor centre. The key components will be illustrated within or at the end of the chapter;
ii. An overview of the key design specifications for the lagoon and related long term viability with respect to sea level rises and adverse weather conditions;
iii. Details of the integral onshore components of the project, including temporary construction areas. Overview of other components of the project which are to be

progressed under other planning approval routes eg onshore visitor centre and sporting facilities;

iv. An overview of the construction programme including proposed construction methodologies, access routes and anticipated timescales;

v. Details about the operation of the lagoon, including features which will be continuously monitored during its operation, routine maintenance requirements and emergency procedures; and

vi. Overview of decommissioning for the lagoon and anticipated timescales.

4.5 Planning and Policy Context

4.5.1 Within this Chapter of the ES National, Regional and Local policies relating to renewable energy will be reviewed. The EIA will also include a review of local planning policies and plans which have been put in place at a high level to protect the onshore and coastal areas. Those to be reviewed will include:

a) Department of Energy and Climate Change, Overarching National Policy Statement for Energy (EN-1) (July 2011).
b) Department of Energy and Climate Change, National Policy Statement for Renewable Energy Infrastructure (EN-3) (July 2011).
c) Department of Transport, National Policy Statement for Ports (January 2012)
d) Planning Policy Wales (4th Edn, Feb 2011).
e) Technical Advice Note (Wales) 5: Nature Conservation and Planning (2009).
f) Technical Advice Note (Wales) 8: Renewable Energy (2005).
g) Technical Advice Note (Wales) 14: Coastal Planning (1998).
h) Planning Policy Guidance Note 20: Coastal Planning (1992).
i) Planning Policy Guidance Note 22: Renewable Energy (2004).
j) Planning Policy Guidance Note 25: Development and Coastal Change (2010).
k) A Low Carbon Revolution - The Welsh Assembly Government Energy Policy Statement (2010).
l) Marine Renewable Energy Strategic Framework, Approach to Sustainable Development (March 2011).
m) Ministerial Policy Statement on Marine Energy in Wales (July 2009).
n) Regional Planning Guidance, South West Wales Strategic Planning Group (April 2000).
o) The City and County of Swansea Council Unitary Development Plan (adopted 2008).
p) Neath Port Talbot County Borough Unitary Development Plan (adopted 2008) and any relevant supplementary guidance.
q) The Swansea Bay Coastal Engineering Group. Shoreline Management Plan, Sub-Cell 8b: Works Head to Lavernock Point Plan Document (Volume 4) (March 2001).

4.5.2 An assessment of the proposed project in terms of its adherence to or conflict with the above policies will then be undertaken.

4.6 Coastal Processes, Sediment Transport and Contamination

4.6.1 Overview of the Dynamics of Swansea Bay

4.6.1.1 Swansea Bay is located towards the northwest end of the Bristol Channel and can be broadly divided into an inner and outer Bay by a line drawn between Mumbles Head to the west and Port Talbot in the east. Mumbles Head is a rocky headland with two small islands, separated from the mainland on all tides at high water, while at Port Talbot there is an enclosed tidal harbour with flat sandy beaches on either side.

4.6.1.2 The inner Bay is generally shallow, particularly to the west where a wide sandy beach has formed. Swansea Bay receives freshwater inputs from several rivers to the inner Bay, namely the Rivers Tawe, Neath and Afan (Figure 1.1). There is also a minor discharge from the River Clyne at Blackpill on the western side of the Bay.

4.6.1.3 The outer area is much larger and deeper with a sequence of sand banks including Kenfig Patches, Hugo Bank and Scarweather Sands. The rectilinear tidal flow in the outer Bay generally follows the contour lines down the coast to the southeast.

4.6.1.4 The underlying geology of Swansea Bay is dominated by rocks of chiefly Devonian and Carboniferous age (365 - 275 million years old), which are arranged in a large east-west oriented syncline. The oldest rocks, the Carboniferous Limestones, have resisted erosion from tides and currents and form the Gower Peninsula, extending from Mumbles Head beneath Swansea Bay and outcrop on the Vale of Glamorgan near Porthcawl. Northward from a line extending between Mumbles Head and Porthcawl the solid geology is made up of a narrow exposure of Millstone Grits and Coal Measure sequences.

4.6.1.5 Swansea Bay as a whole probably owes its existence to the more easily erodable nature of the Coal Measure sequences; once the limestone and grits were breached, the Bay expanded through these rocks.

4.6.1.6 There are two deep-water dredged channels extending out from Swansea and Port Talbot harbour in the middle and eastern areas of the Bay respectively. Between 1957 and 1975 the dredging of the navigation channel at Port Talbot was seen to retard long shore drift from passing southward and the breakwaters may have locally increased beach levels (ABP Research and Consultancy Ltd., 2000). In addition, a dredged channel from the mouth of the River Neath in the far northeast corner is flanked by a Victorian training embankment, which has altered the foreshore by restraining the natural deltaic mouth to a single straight channel (Shoreline Management Partnership and HR Wallingford, 1999). Prior to the construction of the training walls the River Neath discharged in deltaic form.

4.6.1.7 However, since the training of the channel, the Coastline Response Study reported that long shore transfer of sediment has been inhibited giving rise to the accretion and development of the beach and dune systems at Crymlyn Burrows and less windblown sand accreting at Aberavon. The coastline at Crymlyn Burrows was approximately 0.9km inland of its present position in the mid-nineteenth century (National Rivers Authority, undated) and any loss of the training embankments and the consequential change in sediment transport would potentially have detrimental physical impacts on the Crymlyn Burrows dunes.

Sediment Quality

4.6.1.8 There are a number of inputs into Swansea Bay which have the potential to reduce the sediment quality of the area. These include changes attributed to various anthropogenic impacts, dredge disposal sites and a number of industrial and sewage discharge outfalls. However, many of the sediments of the Bay contain high proportions of sands that do not inherently contain high levels of toxic metals. Studies carried out to assess the impact of deepening the approach channel to Port Talbot Harbour and more recently for the proposed wind farm at Scarweather Sands (ABP Research and Consultancy Ltd., 1995; United Utilities Scarweather Sands Ltd, 2003) have shown that the heavy metal concentrations found in the sediments were below both the Dutch reference levels and the Interim Marine Sediment Quality Guidelines (ISQG).

Tides

4.6.1.9 The tides in Swansea Bay are semi-diurnal (twice daily) and dominate the physical processes. The mean tidal range at Swansea is 8.5m for springs and 4.1m for neap tides, and 9.4m and 3.9m respectively at Port Talbot. Tidal currents increase up the channel with speeds of 0.72 m/s in the Outer Bristol Channel increasing to 2.42m/s in the Severn Estuary. The flow patterns run approximately parallel to the shoreline and reverse between flood and ebb stages. The shallow depths within the large bays result in the main flow effectively by-passing these areas, with the vast proportion of water flowing through the main Severn Channel. The bathymetry and the shape of the adjacent coastline control the currents within the bays (including Swansea) and many eddies and backwaters are formed by the tidal flow. Around headlands the flows are far more complex and many overfalls and rip currents are noted, for example at Mumbles Head.

4.6.1.10 The tidally driven residuals are considered to be of importance in identifying the net transport of material. The tidal residual circulation patterns within the system show an ebb-dominated flow in the main Bristol Channel, some embayments have a weak gyre-like circulation system resulting in sediment accretion conditions.

Winds

4.6.1.11 Although the predominant wind directions are west and southwest, winds of any direction can occur associated with circulations around depressions and anticyclones. The governing factor in surface wind speed and direction is the prevailing pressure patterns giving very large variability in all seasons. The strongest winds usually occur when depressions are deepest and the continental high pressure system is established. Squalls and gusts are common in unstable airstreams. Wind is logged at a number of met stations within the Bristol Channel including Swansea and Port Talbot Docks.

Waves

4.6.1.12 The wave regime in the Bristol Channel is dominated by prevailing south-westerly Atlantic swells, with partial influence from locally generated wind-waves from other directions. At the location of the proposed lagoon, partial sheltering is afforded by Mumbles Head, but a considerable amount of wave energy still refracts around the bay which can lead to sizeable waves at the entrance to Swansea Docks.

4.6.2 Background to Previous Coastal Process Studies

4.6.2.1 A number of studies relating to sediment transport have been undertaken in and around Swansea Bay which broadly indicate that a combination of tidal currents and wave transport bring sand in from the south west, being driven towards Neath and Kenfig by wave processes. At times of low water, the wind can move sand onto the backshore and this material feeds the dune systems. Further reworking of the sand built up around the approaches to the River Neath is provided by the residual tidal circulations. To the west there is an anti-clockwise circulation of flows and fine sediments around the bay to The Mumbles. Mostly these fine sediments advect across the Swansea Bay entrance channel and do not provide any serious siltation for maintenance dredging (ABPmer, *pers obs*.)

4.6.2.2 Sediment transport studies (for example Posford Duvivier and ABP Research and Consultancy Ltd, 2000; Shoreline Management Partnership and HR Wallingford, 1999) have related to both the historic disposal ground in Swansea Bay, Swansea Bay Inner, and the current site further offshore, Swansea Bay Outer. Tracer studies carried out in the 1970's demonstrated that sediment deposited at Swansea Bay Inner remained there for about six months after the initial deposit before returning directly to the Port Talbot channel and harbour, providing evidence of a low energy environment. The results led to the closure of

the Inner Swansea Bay ground and the use of the current Swansea Bay Outer disposal site. At Swansea Bay Outer the main direction of movement is roughly east to west (flood and ebb tides respectively) across the bay entrance, with a clear ebb dominance in terms of flow speed and with the sediment not contributing to the sediment budget in the bay but to the sediment circulation in the Bristol Channel (ABP Research and Consultancy Ltd., 1996).

4.6.2.3 Previously undertaken studies (Jackson and Norman, 1980) indicated that wave induced flows during storms are aligned along the Port Talbot Approach Channel. The influx of sandy material to the Port Talbot area during storms was considered to come from the southwest. Although since not all storms cause highly elevated siltation rates within the Port Talbot Channel or harbour, the large influx of material must be related to the complexity of movement of sediments within the Bristol Channel and the severity of the storm. The supply of sandy material to the west side of Swansea Bay was believed to be related mainly to storm activity from the south east, which re-suspends and transports sediments in the eastern half of the bay that have been deposited by south-westerly storms. In addition, the residual circulation in the inner bay is anticlockwise, driving the sediment to the west. When the supply of sandy sediment to the bay is low, due to calmer weather conditions and a lack of south-easterly storms, silt accumulates in the dredged channel. However, during storms wave and tidal energy move coarser sediments around the bay resulting in accumulations of this material, particularly at the deeper, inner end of the channel where tidal currents are lower.

4.6.3 Existing Baseline Data and Need for Further Survey

4.6.3.1 As identified above there is a wealth of existing baseline information for the wider Swansea Bay area both historically and through more recent studies. This data includes sediment distribution (British Geological Survey), sediment quality data (ongoing maintenance dredging), sediment dispersion patterns, tide, wave and current data etc. Local data for the Swansea Bay area will be collated from the various sources and will be used to inform the baseline for this project.

4.6.3.2 In addition, the Neath Estuary Group also commissioned a number of topographic surveys and a number of reports on the physical environment in and around the Neath Estuary since 2000/2001. This data would be relevant to the EIA and will be requested to inform the baseline .

4.6.3.3 Finally, information is available from the Severn Tidal Power Strategic Environmental Assessment (SEA) on potential extent of far field effects as well as on potential long term morphological changes in the Severn Estuary (Severn Tidal Power SEA - Topic Paper Annex Geo 12: Estuary-wide morphological modeling April 2010). All relevant Severn Tidal Power SEA information will be reviewed as part of the EIA baseline.

4.6.3.4 Notwithstanding this, site-specific information is required for the lagoon footprint and the immediately surrounding area. In particular, site-specific data is required to give a better understanding of the local seabed form, sediment types and quality, waves, currents, water levels and background levels of suspended sediment. Details of the survey work which has been undertaken to collect this data are given at the end of this section.

4.6.3.5 Baseline understanding will be developed from the collated existing data and information from the additional surveys. The baseline understanding will establish the range of typical conditions likely to be experienced at the site of the project and over the period of

operation (e.g. a 50 year period). As such, changes that might be expected to occur in the baseline without the project (e.g. climate change issues) are also included.

4.6.3.6 It is anticipated that baseline understanding will include:

a) Variability in tidal conditions between spring and neap tides.
b) Variability in wave conditions between average and storm conditions.
c) Variability of waves and tides in the longer-term due to climate change influences.
d) Present day form of seabed, distribution and quality of sediments.
e) Sources of and sediment transport, including offshore sources and river sources (the rivers Tawe, Neath and Afan being the major rivers into Swansea Bay).
f) Sediment Stores (ie transient sediment sinks such as Scarweather Sands).
g) Sediment pathways linking between sources, stores and sinks and the mechanisms driving these pathways.
h) Effects of waves and tides in relation to driving sediment transport, determining sources (erosion), sinks (deposition) and transport pathways (suspended load and bedload).
i) Evidence and understanding of long-term trends (patterns of coastal erosion).
j) Ambient sediment loads (underpinned by metocean evidence).
k) Geophysical condition of the seabed (for assessment of scour risk etc).
l) Future form of seabed and distribution of sediments over the next 10 years and beyond.

4.6.3.7 Conventionally, the collation of data and information to form a baseline understanding provides the means to develop the initial conceptual (semi-qualitative and semi-quantitative) understanding of the local coastal processes. Modelling tools provide a means of supporting the baseline understanding, with the collated metocean data providing a means of supporting model validation. The validated modelling tools can then be used to support the conceptual understanding and provide a means to quantify degrees of change.

Site-specific Surveys

4.6.3.8 As discussed above, there is a general spread of existing data across Swansea Bay, but there is limited data available in the immediate area of the proposed project. As such the following site-specific survey data has been collected.

4.6.3.9 Two AWAC type devices were deployed on February 16th 2012 for a 3 month period to collect waves, water levels, current profiles, suspended sediment (acoustic backscatter) combined with OBS for suspended sediment (turbidity). One deployment location was targeted for an area in the vicinity of the proposed lagoon turbine discharge point (external to impoundment) and the other for an area in the lee of the lagoon, which is likely to remain sub-tidal. The deployment was targeted for the period when weather conditions were expected to be more adverse. Sediment samples were collected from the local seabed at each deployment location and from the water column at times of deployment and recovery of the devices.

4.6.3.10 In addition to this, sediment particle size distribution (PSD) and sediment quality data will be collected from 30 sites across the bay during the benthic sampling programme. Additional samples will be collected from varying depth during the Geotechnical Site Investigation. These samples will be analysed for particle size and quality. Further details are given in Section 4.8, Intertidal and Subtidal Benthic Ecology and in Appendix 4.1.

4.6.3.11 A geophysical survey has also been undertaken of the lagoon footprint and 500m buffer area. The geophysical survey included:

a) High resolution bathymetric survey (multi-beam / swathe),
b) Magnetometry,
c) Sub-bottom profiling, and
d) Sidescan sonar.

4.6.3.12 The geophysical survey was also extended to provide tie-in lines for existing geotechnical investigations and bathymetric data along the -5m Chart Datum contour to the east and west of the proposed lagoon (see Section 5.0).

4.6.3.13 The output from the geophysical survey will support the consenting process (including the coastal processes, water quality numerical modelling studies, benthic ecology sampling programme site selection, marine archaeology), inform further design works including detailed structural and operational design and guide the specification of the geotechnical investigations required by engineering design consultants.

4.6.4 Scope of Potential Impacts to be Assessed

4.6.4.1 Coastal process studies are a component part of the EIA scope for all marine developments and provide a means to investigate the likely scale of changes in the marine physical environment that are expected to be brought about due to the development of such schemes. The outline methodology presented below recognises current best practice; "*Severn Tidal Power – SEA topic paper: Hydraulics and Geomorphology. A methodology developed by ABPmer to investigate barrage and lagoon options within the Severn Estuary*."

4.6.4.2 And relevant industry guidance, including "*CEFAS 2011. Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy developments. ME5403 – Module 15*."

4.6.4.3 The outline methodology requires a good baseline understanding of the local area, an understanding of the construction and operation of the project and an understanding of the sensitivity of environmental receptors within the study area. Modelling tools offer a means to support baseline understanding as well as a means to investigate the scale of effects likely to occur as a consequence of the proposed development and also the scale of effects which might be expected to occur in-combination with other proposed developments in the local area.

4.6.4.4 In addition to this other relevant EIA guidance and supporting documents will be reviewed in order to assess the potential effects of the project fully. Documents to be reviewed will include:

a) Surfers Against Sewage (June 2009) Guidance on environmental impact assessment of offshore renewable energy development on surfing resources and recreation; and

b) Surfers Against Sewage (August 2010) The WAR report – Waves are our Resource.

Study Area

4.6.4.5 An initial assessment of the potential extent of any far-field effects has been determined through preliminary high level modelling. Here, model runs were undertaken by ABPmer using a 2D application of Delft 3D model and based on a curvilinear grid which covers the region from the Outer Bristol Channel into the Severn Estuary, including Swansea Bay. The

curvilinear grid has a variable resolution of 110 by 350m in the area of interest. The modelling was undertaken to gain an initial understanding of the potential effect of the lagoon in terms waves, currents as well as a conceptual understanding of potential sediment effects.

4.6.4.6 The preliminary findings of the sensitivity modelling suggest that there should be no far-field effects in the tidal regime across the wider area (downstream in the Bristol Channel and upstream in the Severn Estuary) as a result of the lagoon. As might be expected a lagoon in Swansea Bay will have a direct influence on local tidal circulations and waves arriving at the coast due to sheltering. These local changes are likely to modify sediment movements within the bay to some degree and they will be investigated during this EIA. However, the modelling showed that there appears to be less change outside of the bay and no major far-field effects.

4.6.4.7 The primary area of investigation for this project is defined as Swansea Bay, extending between Mumbles Head in the west to Port Talbot in the east and as far offshore as the 10m contour. This area is taken as the near field and represents the area within which local changes in the marine physical environment are expected, to varying degrees. The anticipated far field effects are identified as Port Eynon Point in the west to Sker Point in the east (note the extent of near field and far field effects will be reconfirmed during the detailed modelling phase).

4.6.5 Assessment of Impacts

4.6.5.1 The principle of the coastal process assessment is to understand the scale and magnitude (spatial and temporal) of any changes which might occur due to the development, and evaluate these relative to the baseline. Once this scale of potential change is determined then the significance of the change, in environmental terms, can be considered. In addition to this, due to the longevity of the project, the assessment will need to take into consideration sea level rise and increased storminess.

4.6.5.2 The assessment of potential effects from the proposed lagoon will include:

a) Disturbance of contaminated sediments during the construction phase leading to raised sediment loads and dispersal of contaminants (e.g. heavy metals). The predicted extent and changes in water quality during the construction period will be identified. The resulting impacts on marine based ecology and ornithology will be discussed within the relevant chapter of the ES.

b) Changes in the wave climate and tidal circulations which might impede safe navigation into Swansea docks, River Neath etc. The results of this assessment will be used to inform the Navigation Risk Assessment.

c) Change in wave climate and the potential effect on recreation use of local beaches.

d) Changes in local flows in the vicinity of turbines and the risk of scouring the local seabed to release contaminated sediments during operation. As with the construction phase, the results of this assessment will be reviewed in terms of potential knock-on water quality effects on marine based ecology and ornithology. This will be addressed within the relevant chapter of the ES.

e) Changes in siltation which might increase dredging requirements in the approach channel to Swansea docks, the River Neath and upstream marinas, etc. The results of this assessment will be used to inform the Navigation Risk Assessment.

f) Assessment of sediment accumulation within the lagoon during operation and need for maintenance dredging.

g) Changes in erosion and deposition patterns in the immediate vicinity of the lagoon which may affect the local and wider intertidal areas of Swansea Bay, including localised areas of muddy sands, clay and peat between Mumbles and Swansea. The results of this assessment will be used to assess the potential knock-on effects in terms of changes in intertidal habitat and marine based ecology (including ornithology and Blackpill SSSI) and potential effects on any archaeological features along the intertidal area.

h) Changes in littoral drift patterns that might alter the feed of sediments to Crymlyn Burrows SSSI sand dunes, the beaches of Swansea Bay or other similar areas in the near-field (Port Talbot to Mumbles Head).

i) In terms of the likely lesser effects in the far field area, the potential changes in littoral drift on Margam Sands, Kenfig SAC and the Gower beaches will be assessed. With respect to Kenfig SAC this will be used to undertake an assessment of likely significant effect on the internationally designated site, within the relevant chapter of the ES. The potential to affect other coastal SSSIs and NNRs will be discussed in the Terrestrial Ecology chapter.

j) If, during detailed modelling, potential far-field effects are identified beyond Sker Point or Port Eynon, further assessment will be undertaken to include other key sand related features such as Rest Bay and Merthyr Mawr SSSI sand dune.

k) Consideration will also be undertaken of the potential changes and knock-on effects as a result of the lagoon in relation to those that are naturally likely to occur over the lifetime of the project.

l) In terms of marine developments within the study area which might act in-combination with the tidal lagoon these are identified in Table 3.4. Of these the cumulative impact of maintenance dredging which occurs approximately annually for the Swansea Port entrance and more frequently for the Port Talbot Port entrance, and any dredging undertaken in the Neath River/Estuary and upstream marina, will be included in the coastal process assessment. In addition to this, potential interactions with the Swansea Campus onshore development at Crymlyn Burrows will also be considered.

m) Any proposed monitoring for the construction and operation phase will be identified.

4.6.5.3 Note: potential changes to discharges from existing outfalls and water quality effects as a result of the lagoon will be discussed in Section 4.7, Marine Water Quality.

Computer Modelling Tools

4.6.5.4 In order to determine the potential impact of the lagoon it is proposed to use a hydrodynamic computer model of the bay. Modelling tools provide a means of supporting the assessment of impacts by describing the physical environment with a representation of the scheme in place. Typically, the scale of the impact is determined as the net of the environmental description including and excluding baseline. Without applying such tools an assessment would be more reliant on a qualitative view which increases the risk of not being able to offer sufficient levels of confidence or a means to quantify any scale of change. In addition, the model can be used to provide a means to address other issues, such as:

a) Wave conditions impinging at the structure.

b) Siltation rates within the impoundment.

4.6.5.5 The modelling tools proposed will support and inform coastal process investigations, and will look at the potential changes which might be expected to occur within the marine physical environment due to the proposed development. The model will cover the far-field and will also focus in detail on the near-field.

4.6.5.6 There are various existing models which have been configured to support studies in the Bristol Channel, Severn Estuary and Swansea Bay, however these models tend to offer bespoke descriptions to meet individual project requirements. They are typically based on applications of standard coastal modelling suites such as MIKE-FM or DELFT-3D. For this project it would be proposed to take forward the modelling work used to support the SEA for the tidal barrage and lagoon options for DECC, but with the model being specifically updated and the grid refined for the lagoon study area.

4.6.5.7 In general, although this model will provide the broader view across the scale of the far-field, it will require local modifications to define detailed issues relevant to the near-field, as would any model adopted for this project. This stage of modification will draw upon the more up-to-date and detailed descriptions of the seabed using outputs from geophysical survey and AWAC deployments. Model validation will be based on representing the similar coastal process conditions to those observed during the metocean survey. Once validated, the model can proceed to describe the full range of baseline conditions required to inform the EIA.

4.6.5.8 In particular, the details which will be used will define the outline of the scheme, which will impede free passage of waves and tides, and also details of the hydraulic exchanges which are expected to occur through sluices and turbines which might also alter local flows.

4.6.5.9 Potential changes in coastal processes during construction and the knock-on effect on the surrounding environment are likely to be a gradual process as the lagoon structure is built over 2 years, with the final coastal process pattern forming once the lagoon is in place. At this stage details of the construction methodology and programme are still being discussed and finalised and as such it is not known what effect the different interim stages of the structure will have on the environment. However, through modelling the baseline and the final lagoon layout a good understanding can be gained of the changes likely to occur in the interim. As with the approach for the proposed Severn Tidal Power Project, a qualitative view of what effects might occur during key stages of construction will be undertaken by drawing on the key phases of construction available at the time of assessment. This type of approach is proposed as there is likely to remain only a high level understanding of the stages of construction until a Contractor is appointed to establish the final planned methodology. Until this point, sufficient detail to offer any firm certainty for modelling descriptions will not be available. However, if substantial advanced ground preparation works are proposed, for instance to remove sediments for geotextile tubing to be laid, then the need for modelling of sediment plumes would be determined.

4.6.5.10 For the proposed development detailed modelling would be undertaken for the long term baseline and operation scenario. The modelling will focus on typical conditions and include for spring and neap tides and average and storm wave conditions. In addition, climate change scenarios will be included to determine changes that might occur without the proposed development in place. The model specifications and the detailed coastal modelling requirements for the lagoon will be discussed with relevant key statutory consultees.

4.7 Marine Water Quality Assessment

4.7.1 Overview of Existing Situation

4.7.1.1 Swansea Bay has two bathing waters designated under the current EU Bathing Waters Directive (76/160/EEC) (cBWD) within the bay and an additional four along the Gower coast (Figure 4.1). The water quality at these beaches is monitored fortnightly throughout the bathing season (May to September) and the bacterial levels recorded are compared against standards within the directive. The number of samples meeting the standards gives the beach quality for that year, namely Guideline (higher standard), Imperative (minimum standard) and Fail (below minimum standard). Further information on the current bathing water quality is given in Section 4.7.2, Existing Baseline Data. Note, in 2015 the cBWD will be repealed and the revised Bathing Water Directive (2006/7/EC) (rBWD) will come into force. This directive aims to set more stringent water quality standards and it also puts a stronger emphasis on beach management and public information. The quality of the water at the bathing beaches will be based on a four year rolling data set.

4.7.1.2 The entire waters shown within Swansea Bay area (Figure 4.1) are also designated under the EU Shellfish Waters Directive (2006/113/EC). The shellfish waters are routinely monitored for a range of parameters including pH, metal levels, salinity, bacteria etc. In 2008, all three monitoring points were Guideline Fail/Imperative Pass. As with the Bathing Waters Directive changes are proposed for the Shellfish Waters Directive. In 2013 the existing Directive is to be replaced by the EC Water Framework Directive (WFD), which must provide at least the same level of protection to shellfish waters as the Shellfish Waters Directive (http://www.environment-agency.gov.uk/business/regulation/31931.aspx).

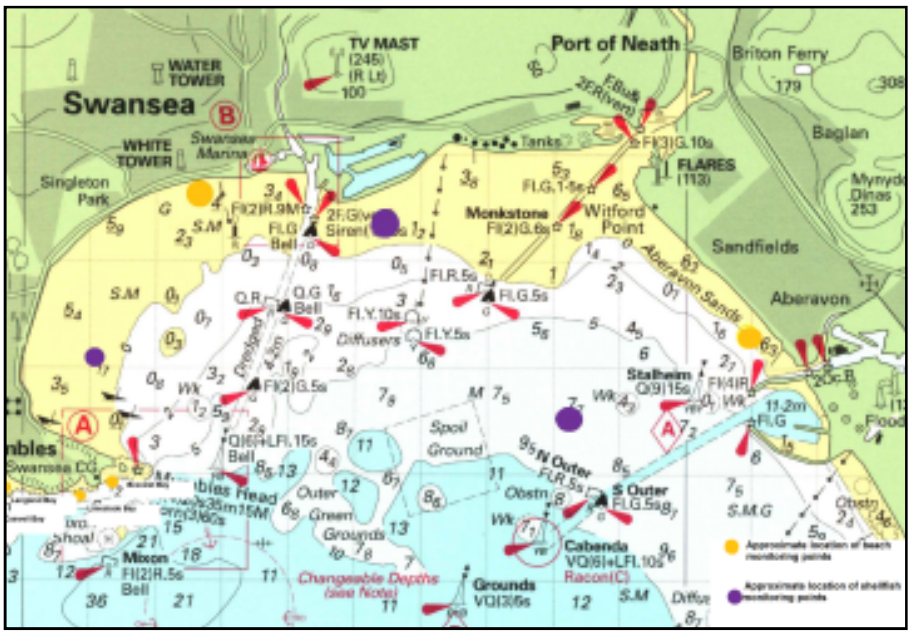

Figure 4.1 Bathing Beaches and Shellfish Water Monitoring Points

4.7.1.3 Finally there are two areas identified under EU Regulation 854/2004, which is to do with the treatment of shellfish before consumption (Shellfish Hygiene). One area is for Mussels, which is located on the west of the Bay between Blackpill and Mumbles, and the other is for Oyster. The Oyster area covers the majority of the Bay, excluding an inner area between the River Tawe and Port Talbot Docks (see Section 4.9). These areas are routinely

monitored at a number of locations stretching from Mumbles Head and along the inner bay. Mussel areas are classified under a long term classification, LT Class B and Oysters are Class B (CEFAS, 2011). Overall it can be seen that water quality within and around the Bay is important to the shellfish, tourism and recreation industry of the area.

4.7.1.4 Even with these water designations the Bay has a long history of industry and the Environment Agency has provisionally characterised Swansea Bay, under terms of the implementation of the Water Framework Directive (2000/60/EC), as a heavily modified water body that is at risk from diffuse pollution (surface water run-off from land) and physical/morphological alteration. It is not thought, however, to be at risk from point source pollution (River Basin Management Plan Western Wales, Environment Agency, 2009).

4.7.1.5 The River Basin Management Plan also identifies a number of objectives for the protected areas within the Bay. Of relevance to this project are the following types of protected areas: Freshwater Fish Waters; Shellfish Waters; Bathing Waters; water dependent Special Areas of Conservation (SAC); and water dependent Special Protection Areas (SPAs).

4.7.2 Existing Baseline Data and Need for Additional Survey

4.7.2.1 Data specifically for the Swansea Bay area is available from various sources. Broad scale context is provided by the OSPAR Quality Status Report (OSPAR, 2000), which indicates that industrial and domestic discharges from, amongst others, Newport, Cardiff, Port Talbot, Swansea and Milford Haven have resulted in the coastal waters of South Wales being subject to pollution.

4.7.2.2 Bathing water quality information is available from the Environment Agency Wales (EA-W) website. A summary of the bathing water quality at the designated bathing beaches around Swansea for the last 16 years is given below.

Table 4.1 Summary of Water Quality at Designated Bathing Beaches around Swansea

	96	97	98	99	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11
Aberafan Sands																
Swansea Bay																
Bracelet Bay																
Limeslade Bay																
Langland Bay																
Caswell Bay																

Green = Higher (Guideline standard), Amber = Minimum (Imperative Standard); Red = Fail

4.7.2.3 As can be seen from Table 4.1, significant improvements have been made since 1999 in terms of water quality in Swansea Bay. In general the beaches of the Gower and Aberafan Sands have tended to meet guideline standards since 2003. However, the water quality at the inner Swansea Bay beach, although achieving mandatory standards, is not so consistently good.

4.7.2.4 The revised Bathing Water Directive (rBWD), which will fully repeal the current BWD (cBWD - in place since 1976) comes in to effect in 2015. While the majority of the beaches in and around Swansea Bay are expected to meet the minimum (Sufficient) standard under the rBWD, the EA-W have identified that the Swansea Bay Bathing Water is at risk, i.e. is currently unlikely to meet the minimum Sufficient Class under the rBWD.

4.7.2.5 Table 4.2 presents the bathing water quality data from Table 4.1 for the Swansea Bay, but processed to assess water quality under the rBWD. A similar pattern in bathing water quality is seen under rBWD, with the water quality improving in particular during 2004 to 2007 when "Sufficient" class would have been achieved. However since then it has declined and in all other years the class would have been "Poor".

Table 4.2 Summary of Water Quality at Swansea Bay Designated Bathing Beach Under rBWD

YEAR	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Class	P	P	P	P	P	P	P	P	S	S	S	S	P	P	P	P

4.7.2.6 As with many sites around the coast the water quality within Swansea is closely linked to known waste water and storm discharges to the area, as well as to diffuse inputs (run off from land to rivers entering an area). EA-W are working towards achieving "Sufficient" standard by 2015, as such it is essential that the proposed lagoon does not inhibit this objective.

4.7.2.7 In addition to the bathing water data, the last 10 years routine water quality and shellfish monitoring data for the Swansea Bay area will be sought from the EA-W and Centre for Environment Fisheries and Aquaculture Science (CEFAS). Finally, discussions will be held with DCWW concerning obtaining the required information on the current performance of the various outfalls around the bay to enable a detailed assessment to be undertaken.

4.7.2.8 As there is extensive existing water quality data for the area and the model proposed for the assessment work has been calibrated, validated and accepted as fit for use (Section 4.7.4), it is proposed that no additional survey work be undertaken for the marine water quality assessment.

4.7.3 Scope of Potential Impacts to be Assessed

4.7.3.1 Even though the lagoon itself will not add any compounds or effluent to the Bay, rather just controlling the movement of a body of seawater, there is still potential for it to affect water quality during the construction, operation and decommissioning phases of the project.

Chemical Water Quality

4.7.3.2 During construction, with the dredging and re-suspension of sediments, there is a potential to temporarily affect water quality. Issues to do with sediment contamination and deposition will be addressed within the coastal process section (see Section 4.6).

4.7.3.3 In addition to this there is a potential for accidental release of contaminants from construction vessels/plant working in the area or even during maintenance work during the lagoon's operation. An assessment of potential effects will be undertaken within the EIA and mitigation measures will be proposed where necessary. The findings of this assessment will be incorporated into a Marine Pollution Contingency Plan (MPCP). The potential risk to navigation in terms of collision will be addressed in Section 4.12, Navigation and Marine Transport Assessment. The findings of this assessment and mitigation measures will be incorporated into the MPCP.

Bacterial Water Quality

4.7.3.4 In terms of bacterial water quality, the formation of the lagoon walls around the existing WwTW outfall will alter the hydrodynamic flow patterns and therefore the dispersion of the WwTW's discharged effluent. Under normal operating conditions the discharge from the WwTW is UV disinfected and therefore would be expected to be barely detectable in the marine environment. As such, in terms of water quality, the designated bathing beaches are not at risk during normal operation of the WwTW and the lagoon construction and operation will not change this.

4.7.3.5 Under heavy rainfall conditions intermittent storm water discharges can occur from a number of outfall locations around the bay and from the WwTW outfall. The spills from these outfalls are currently set with the objective of maintaining bathing beach compliance under the cBWD. However, as outlined above, the implementation of the rBWD will require further action to ensure Swansea Bay Bathing Water meets the minimum "Sufficient" standard. The presence of the lagoon may change the localised flow patterns near these outfalls and therefore may affect beach water quality, for better or worse. As such, it is proposed to focus the assessment of water quality on the infrequent occurrence of storm water discharges and this has been further discussed below.

4.7.3.6 In terms of the storm discharge from the main WwTW, the spills frequency was based on the worst case storm event in a seven year period such that 98.2% mandatory levels would still be achieved at the beach (Acer Environmental, 1994). As discussed above the hydrodynamics around the outfall will change as a result of the lagoon. Furthermore, the timing of the release of water through the turbines in relation to the tidal phase in the wider marine environment will also be modified. The potential effect of the lagoon on the storm water discharge from the main outfall will therefore be investigated for the baseline (no lagoon) and operation phase of the lagoon. Note: The construction stage will not be modelled at this stage as the conditions discussed above will provide a spectrum of impacts between current and operation and the construction would not be expected to produce significantly different impacts from the "no lagoon" and "lagoon" conditions. However, if during the assessment it is considered that potential construction effects are deemed to be significantly different to the completed project, additional assessment will be undertaken.

4.7.3.7 An initial review will be undertaken to determine if the presence of the lagoon will have a detrimental effect on hydrodynamics and therefore water quality at key points. The proposed modelling which will be used to investigate the storm discharge from the main outfall is discussed further in Section 4.7.4 below. During operation the lagoon will function like an ebb tide discharge and this will be considered in the model run selection.

4.7.3.8 In addition to the main Swansea WwTW outfall there is also a secondary treated long sea outfall at Afan and a number of other combined storm water overflows (CSO) discharging into the bay and, on occasion, onto the foreshore. There are also a number of CSO discharges to the rivers entering Swansea Bay, most notably the Tawe and the Clyne. Finally there are a number of trade outfalls associated with industries around the Bay including Tata Steel. The need for their inclusion in the water quality assessment will be determined.

4.7.3.9 The outfall at Mumbles Head stores excessive storm water flows in the old Mumbles tanks and discharges them on an ebb tide only (HW+1 to HW+5) (Acer Environmental, 1994). As with the Swansea WwTW, the spills from the tanks were set such that 98.2% compliance of designated beaches would be maintained. The proposed lagoon will not affect the frequency or fate of the ebb tide discharge from these tanks as it is carried away from the

Bay. However, there is some potential for a small amount of storm water to be carried back into the Bay with returning tide. It is unknown whether the presence of the lagoon within the inner Bay would affect the returning storm water movement at all. As such a preliminary assessment will be undertaken within the EIA for the operation phase and any increased risk to the inner bathing beach water quality will be identified. If necessary, further assessment would be undertaken and mitigation measures would be proposed.

4.7.3.10 The overflows onto the inner Swansea beach were set to a required spill frequency (three spills per bathing season or one spill in every five years, depending on their position with respect to low water on the beach) such that mandatory bathing beach compliance is not affected. However, some of these assets may need upgrading or improvement to account for changes within the sewerage catchment and/or to meet the higher standards of the rBWD. While these overflows are remote from the lagoon and their current operation (spill frequency) would not be affected by the proposed project, changes in hydrodynamics in the bay could affect the fate of the discharge plumes from some of the discharges. CSOs discharging to the coast that are considered potentially significant in terms of future bathing water quality will be included within the assessment.

4.7.3.11 Afan long sea outfall discharges secondary treated effluent and storm water from the eastern side of the Bay. It is assumed that in terms of storm it is set to achieve 98.2% beach compliance. The outfall is located beyond Port Talbot docks and the dredged access channel, some 6.5km to the southeast of the lagoon. Although distant, a preliminary assessment will be made as to the potential for the treated effluent and storm water discharge from this and other outfalls to be affected. If a potential effect is anticipated, additional assessment work will be undertaken to determine the risk, if any, to the water quality at the beaches from the presence of the lagoon.

4.7.3.12 Finally, as identified in the River Basin Management Plan (2009), the Swansea Bay area is at risk from diffuse pollution inputs. These diffuse inputs include bacterial loading in the rivers Tawe and Neath through run-off from land and inputs from riverine CSOs during adverse weather conditions. Diffuse loads from smaller streams entering Swansea Bay have also been identified as potential impacts on Swansea Bay Bathing Water. EA-W have taken steps to reduce some of the bacterial loads to these streams, principally through reduction of sewerage misconnections. However, a number of CSO discharges in the river Clyne and Singleton Park Stream may impact Swansea Bay. Although the lagoon itself will not affect the loads discharged to these rivers, it may result in a change to the fate of the rivers when they enter the bay. As such it is proposed to undertake an assessment within the ES to determine if there is any change in the river dispersion patterns within the bay and therefore an increased or decreased risk to water quality at the beaches from the loads in the rivers.

4.7.4 Overview of Bacterial Water Quality Model

4.7.4.1 In order to undertake the detailed bacterial water quality assessment a numerical computer model will be used. It is proposed to use a high resolution 2D hydrodynamic and water quality model of the mid / eastern Bristol Channel and lower Severn Estuary, operating within the industry standard Delft3D software suite. A purpose built model for the assessment of the impacts of sewage releases (treated effluent, intermittent and diffuse) on Bathing Water Quality in and around Swansea Bay, which includes consideration of dispersion and bacterial mortality, was commissioned by DCWW. This model has been calibrated and validated against comprehensive field datasets for a range of hydrodynamic and water quality parameters and has been audited and accepted as fit

for purpose by the Environment Agency-Wales. DCWW has confirmed that this model can be used for the lagoon assessment and any additional requirements for an environmental permit (http://www.environment-agency.gov.uk/business/topics/permitting/default.aspx).

4.7.4.2 As discussed above, it is proposed to undertake the modelling work for the baseline and operation stage of the lagoon. The object of the assessment would be to examine the potential changes in water quality from treated and storm water discharges, and diffuse inputs into the bay as a result of the lagoon. It is proposed that the study will compare the changes to the predicted bacterial concentrations at key locations, under a number of ambient conditions for the operational phase, against the concentrations predicted for baseline simulations. Key locations are:

a) Three Shellfish Water monitoring points within Swansea Bay (East, South & West)
b) Bathing Water monitoring points within Swansea Bay (Aberafan Sands and Swansea Bay); and
c) Bathing Water monitoring points at Bracelet, Limeslade, Langland and Caswell Bay.

4.7.4.3 In addition, the findings of the modelling will be used to assess the potential effect of the proposed project on relevant current and future objectives of the Water Framework Directive.

4.7.4.4 An outline of the proposed scope of modelling for the water quality assessment is given below in Table 4.3. The approach outlined will provide a preliminary comparative assessment of the effects of the lagoon on water quality within Swansea Bay and the potential effects on bathing water performance. The existing Swansea Bay model will be updated with the new bathymetric and validation data to form a Baseline model. The baseline model will be modified to represent the presence of the lagoon and this will be the “Operation” model. A range of conditions will be assessed, ranging from typical dry weather conditions to worst case storm conditions, for Baseline and Operation conditions. Comparison of results from the Baseline and Operation models will be used to determine if the presence of the lagoon is likely to have a significant impact on the bathing and/or shellfish waters in Swansea Bay and along the adjacent coastline.

4.7.4.5 In the event that the preliminary modelling indicates a potentially significant risk to water quality a more extensive study may be required to quantify potential changes in bathing water classification under rBWD, or shellfish class under the Shellfish Waters Directive. In this event a more detailed water quality assessment would be undertaken in consultation with EA-W. The scope of the study would be reviewed with EA-W prior to commencement. The assessment will be based upon the methodology currently adopted for UK bathing water assessments by Intertek METOC, using their STORM-IMPACT software. This method provides a robust means of predicting water quality and has been used for bathing water assessments in England, Scotland and Wales since 2005. The methodology has been accepted by EA-W and is currently in use for bathing water studies at a number of Welsh beaches including Swansea Bay. STORM-IMPACT permits detailed assessment of bathing water impacts by determining bacteria concentration distributions in the receiving waters under a wide range of environmental and discharge conditions. Statistical analysis of the results permits direct prediction of bathing water class under current and revised bathing water standards.

4.7.4.6 An outline of the proposed scope of modelling for the water quality assessment is given below in Table 4.3. These details will be discussed with the EA-W.

4.7.4.7 Finally the scope of the modelling work would also meet the requirements to support any changes to or review of the existing Environmental Permit for the WwTW discharges. Any additional requirements to the scope as identified above will be discussed with the EA-W and DCWW.

Table 4.3 Summary of Proposed Modelling for Marine Water Quality Assessment

Input	Comment	Assessment Required	Conditions for Assessment
Input from main WwTW at Swansea and Afan. Treated and storm discharges.	Outfalls discharge on all states of tide. Swansea outfall lies within lagoon area, discharge plume may be affected by the change in local hydrodynamics, the position of the discharge point from the lagoon and tidal phasing. Afan outfall discharge may be affected by changes in the hydrodynamics.	Preliminary comparative modelling assessment of treated and storm water from the outfall for baseline and during operation phase. Construction – not modelled as: conditions will provide a spectrum of impacts between current and operation and would not be expected to produce significantly different impacts from the pre- and post-construction conditions.	Model will be applied to the following conditions / scenarios **Normal Dry Weather Conditions** ***WwTW*** Continuous treated discharge from WwTWs under dry weather flow conditions (1.5 DWF). ***CSOs*** N/A, no discharge in dry weather ***Rivers*** Typical dry weather (base) flow and load. ***Tides*** Spring and Neap Tides ***Wind*** No wind **Wet Weather / Storm Discharge Conditions** ***WwTW*** Continuous treated discharge from WwTWs under wet weather / high flow conditions (FFT). ***CSOs*** Significant storm discharge, i.e. third largest storm in a typical bathing season. 12 hour or longer discharge to account for potential effects of tidal phasing. ***River*** High / wet weather flow and load. ***Tides*** Spring and Neap Tides ***Wind*** Typical summer 'storm' wind condition (5 to 10 m/s, South West / South East) Conditions will be applied to the following Scenarios ***Baseline*** Current hydrodynamic conditions ***Operation*** Change in hydrodynamics for various lagoon configurations. ***Construction*** N/A
Storm input from Mumbles Head Outfall	Storm water discharged on ebb tide only. Storm water may be carried back into bay, although distant from lagoon, plume could be altered affecting beach water.	Preliminary comparative modelling assessment for baseline and operational phase, to identify potential for effect/change to existing situation. Further assessment if necessary.	
Storm input from CSOs direct to beach	Spill frequency will not be altered as a result of the project. Changes to local hydrodynamics could affect plume transport with potential changes to impacts on local beaches.	Preliminary comparative modelling assessment for baseline and operational phase, to identify potential for effect/change to existing situation. Significant discharges / assets only. Further assessment if necessary.	
Storm Baglan Outfall	Baglan pumping station discharges via long sea outfall to bay. Spill frequency not affected by lagoon. Changes to local hydrodynamics could affect plume transport with potential changes to impacts on local beaches.	Preliminary comparative modelling assessment for baseline and operational phase, to identify potential for effect/change to existing situation. Further assessment if necessary.	
Diffuse inputs from River Tawe, Neath, Afan and Clyne	Lagoon will not affect the river loadings. Proximity of the lagoon may affect the transport of river plumes entering the bay.	Preliminary comparative modelling assessment for baseline and operational phase, to identify potential for effect/change to existing situation. Further assessment if necessary.	
Swansea, Aberafan, Baglan and Mumbles outfalls, River Tawe and Neath.	Cumulative assessments of discharges in the Bay.	The results of the above assessments will be used to determine the cumulative effect under worst case scenario for each beach.	

4.8 Intertidal and Subtidal Benthic Ecology

4.8.1 Overview of Existing Situation

4.8.1.1 As identified in Coastal Process Section 4.6, Swansea Bay is a dynamic area with a high tidal range. This, along with the curved nature of the Bay resulting in varied exposure, gives a range of sediments grading from gravely sand, through fine sand to sandy mud and muddy sand in the subtidal area (Figure 4.2).

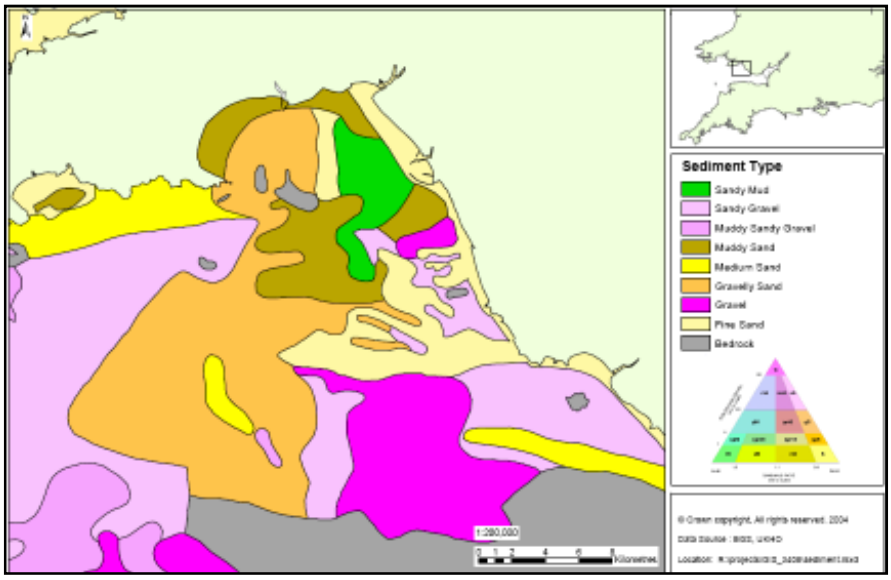

Figure 4.2 British Geological Survey Sediments in Swansea Bay Area

4.8.1.2 Benthic ecology within the bay has been well studied over years. Recently CCW have completed extensive mapping of the intertidal areas around Wales. An extract of the mapping for Swansea Bay is given below (Figure 4.3).

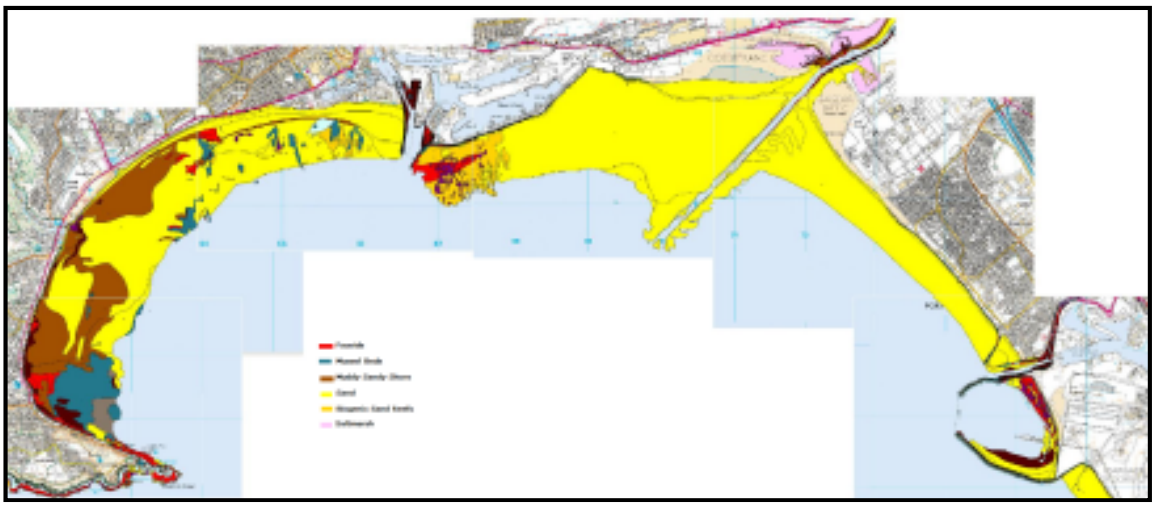

Figure 4.3 Extract of CCW Phase 1 Map
(Crown copyright. All rights reserved. Countryside Council for Wales, 100018813 (2011))

4.8.1.3 As can be seen starting from the west, Mumbles Head is characterised by intertidal boulders and rock, which is backed by unimproved calcareous grassland on the headland. The rocky headland foreshore is characterised by fucoids with occasional pockets of sand.

4.8.1.4 Progressing north, the foreshore is dominated by mussel interspersed algae which are dominated by fucoids on the upper shore. The beach then becomes a muddy sandy shore, which gradually changes to a more sand dominated beach. As with the previous area there are occasional outcrops supporting mussels and fucoids.

4.8.1.5 With progression towards the River Tawe the beach continues to be dominated by sand, with mussel beds and barnacles on the occasional cobbles and stones to the west of the Tawe, and biogenic sand reefs (*Sabellaria* sp). On the east side of the River Tawe similar habitat is found, with biogenic sand reefs immediately adjacent to the River entrance and patches of cobbles and rocks which support fucoids and algal turf. The intertidal shore then becomes consistent sand up to and past the River Neath and this extends down to Port Talbot dock. Immediately before the River Neath the sandy shore is backed by dune grassland and dense continuous saltmarsh, which are features of Crymlyn Burrows SSSI.

4.8.1.6 Within the subtidal areas, research undertaken by Shackley and Collins in 1984 confirmed that sediment type is important in determining species composition of the macrobenthic community of the inner Bay. Figure 4.2 illustrates the broad sediment types across Swansea Bay and the wider area. Interestingly, Shackley and Collins also noted that the overall biodiversity of the Bay was low, which probably reflects the dominance of more mobile sandy and muddy substrates.

4.8.1.7 The various data (Shackley and Collins, 1984; ABP Research, and Consultancy Ltd., 1995 and 1996a; United Utilities, 2003) shows that the Bay is characterised by species such as the bivalve *Spisula subtruncata* (sand), the bivalve *Nucula nucleus* (muddy sand) and the polychaete *Nephtys hombergii* (sandy mud). Gravelly sand supported a range of polychaetes including *Nepyhtys hombergii*, *Cirriformia tentaculata* and *Aphelochaeta marionii*, the bivalve *Gari fervensis* and the amphipod crustaceans *Ampelisca spinipes* and *Urothoe elegans*. Survey work carried out along the Port Talbot approach also noted the amphipod *Corophium arenarium* and the cumacean crustacean, *Diastylis rathkei,* as common in samples of the sandy mud. Coarser sediments support species such as the polychaete *Lanice conchilega* and a diverse assemblage of amphipods. All these species are typical for these types of sediments.

4.8.1.8 Surface dwelling, mobile fauna typically include larger species of crustaceans, echinoderms and crustaceans. Data from the Joint Nature Conservation Committee (JNCC) Mermaid website (www.jncc.gov.uk/mermaid) describes the sandy substrate off the coast as being sparse and limited to a few hermit crabs, whelks and common starfish. The local conditions (tide swept and lacking in surface relief) suggest that this level of population is typical.

4.8.1.9 Notwithstanding this there are a range of UK Biodiversity Action Plan (UK BAP) and nationally important habitats noted within Swansea Bay. These are also identified within the local BAP for Swansea Bay, which is currently being reviewed. The UKBAP include biogenic reef forming species such as *Sabellaria alveolata*, as well as the native oyster (*Ostrea edulis*).

4.8.1.10 In terms of distribution of biogenic reefs, information is available on the JNCC website (http://jncc.defra.gov.uk/). Here “reefs”, where rocky areas or concretions made by marine animals arise from the surrounding seafloor, are shown to occur on the east side of the approaches to the River Tawe, as discrete areas along the inner Swansea Bay beach and around the Mumbles headland (Figure 4.4).

4.8.1.11 With respect to the native oyster, in the 1860s to 1870s the harvesting of this species from around the Bay was at its peak, with over 600 people being employed in the industry. Historically, the oyster beds appear to have been quite extensive, with the main focus around Mumbles (Oystermouth). However, with over-fishing in the late 1800's and pollution in the Bay the oyster industry started to go into decline. This was exacerbated in the 1920's when a blood parasite affected the native oyster and most of the beds were wiped out (http://www.welshwales.co.uk/oyster_harvesting.htm).

4.8.1.12 Since then a study was undertaken (CCW, 2003) to investigate the distribution and abundance of native oysters at locations thought to support them. Within Swansea Bay two locations were looked at namely East of Mumbles Head and Outer Green Grounds (which is further offshore of the East Mumbles site). During these diver surveys, suitable habitat was found at Outer Green Grounds to support this species, but no native Oysters were found. The report stated "Although no *Ostrea edulis* was found at this site the mix of substrate and current conditions suggest that it may be present, albeit at low density, based on historic occurrence."

4.8.1.13 In September 2011 the majority of Swansea Bay was identified under EU Regulation 854/2004 as LT Class B for Oyster (see Section 4.7.1). However, it was confirmed by the Swansea Bay Port Health Authority that although small numbers of Oyster can be found in the area, there are no commercial Oyster operations currently in the bay.

4.8.1.14 Finally, in June 2012, newspaper articles reported the intention to develop a sustainable Oyster fishery within the bay, with the support of European funding. Although in its early stages, discussion will be held with the Swansea Bay Local Fisheries Action Group to see if this objective can be facilitated through the lagoon project.

4.8.1.15 Other UKBAP and nationally important habitats and species are found within Swansea Bay as a whole. These include hydroid rock pools, piddocks (elongated burrowing bivalves with paired, hinged shells) in clay with mussels, piddocks in peat with red algae, mudflats (which are important for feeding birds), and sublittoral sands and gravels. The key habitats within Swansea Bay are shown on the figure below. The proximity of these with respect to the proposed development and their potential to be affected is discussed further in Section 4.8.3.

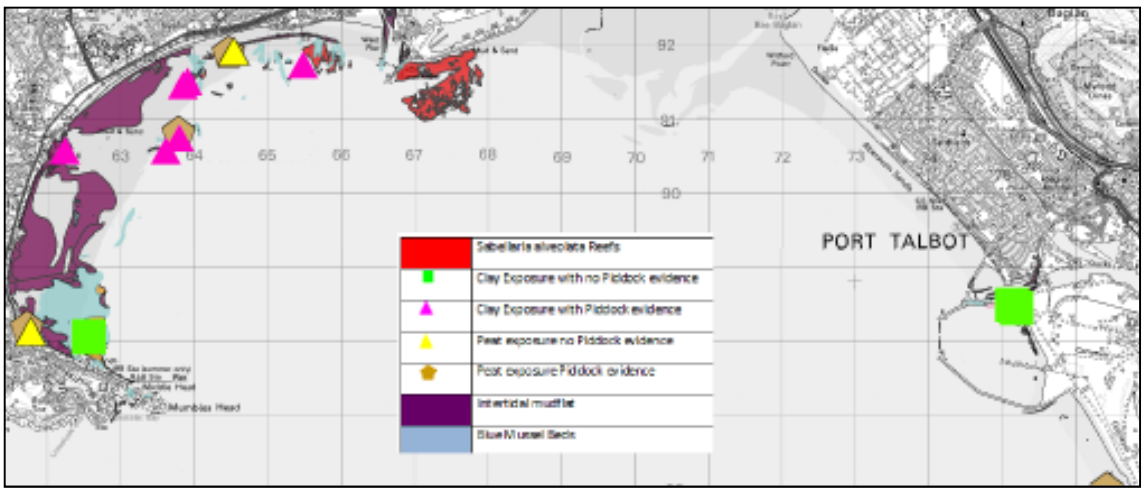

Figure 4.4 Key Habitats in Swansea Bay
(extracted from Swansea and Carmarthen Bay Coastal Engineering Group; Swansea Bay Habitats)

4.8.2 Existing Baseline Data and Need for Survey

4.8.2.1 As identified above, Swansea Bay as a whole has been well studied over the years and there is a good understanding of the intertidal and subtidal benthic ecology in the area. In addition to this there is information available with respect to protected species and habitats (JNCC), UKBAP (www.ukbap.org.uk) and LBAP species in the area (although Swansea LBAP is currently under review).

4.8.2.2 Notwithstanding this, there is limited site-specific data relating to the subtidal benthic ecology within the footprint and the area immediately surrounding the lagoon. As such it is proposed to undertake a characterisation benthic sampling programme as outlined in Table 4.4 below. It is proposed to undertake a further baseline benthic survey once consents for the lagoon have been approved and prior to construction work commencing.

4.8.2.3 In the characterisation survey grab samples will be collected from 30 sites. The actual sample locations have been chosen to reflect the range of substrates present within certain subtidal and intertidal zones (lagoon, buffer area etc). The position of the sample sites within the zone have been identified based on the findings of the recently completed geophysical survey. The substrate types within the lagoon area and the location of the proposed sampling sites are discussed further in Appendix 4.1. Specific details of the proposed sampling methods and analysis are also given in Appendix 4.1.

Table 4.4 Summary of Proposed Benthic Sampling for Lagoon

Proposed Sampling Zone	Number of Samples	Benthic	PSD	Metals
Within lagoon footprint	13	All	All	7
East, west and seaward edge of 500m buffer around site	6	All	All	3
Upstream and downstream tidal extent	9	All	All	4
Reference sites	2	All	All	0
Total number for analysis	30	30	30	14

4.8.2.4 In addition to the benthic sampling survey, seven epifauna/fish trawls will be used to obtain qualitative samples of the epibenthos from across the area. The epifauna will be sampled using a 2m beam trawl with 5mm cod end mesh, over 200m distance. The material collected in the trawl will be fixed in a 10% buffered formalin and seawater solution.

4.8.2.5 Four trawls will be taken within the footprint of the development envelope, each reflecting a different substrate and being located near to a benthic sampling site. The proposed locations of the trawls within lagoon footprint are shown in Figure A4.1, Appendix 4.1. In addition to this it is proposed to undertake two trawls, one up and one down tide, and a final trawl remote from the proposed development area to represent a reference site. The locations of these trawls are also near a benthic sampling site and they are shown on Figure A4.2, Appendix 4.1.

4.8.2.6 For the intertidal area, the biotope maps provided by Countryside Council for Wales (CCW) and from the internet (Figures 4.3 and 4.4) provide an excellent description of the habitats adjacent to the lagoon site and around the bay as a whole. Notwithstanding this, as the lagoon requires the construction of walls crossing the intertidal area, a site walkover will be undertaken of this area. The objective of the walkover survey will be:

a) to confirm the presence, distribution and condition of the Sabellaria reefs adjacent to the Tawe Dock entrance,
b) to confirm the presence and distribution of any nationally important biotopes or rare species, and
c) to assess the sensitivity of the intertidal habitat directly impacted by the proposals.

4.8.3 Scope of Potential Impact to be Assessed

4.8.3.1 The potential effects from the proposed lagoon on benthic intertidal and subtidal ecology can be broadly categorised as direct and indirect impacts during construction and operation and maintenance. Direct impacts would affect the ecology within the footprint of the lagoon, whereas potential indirect impacts would be within the wider Swansea Bay area. The extent and degree of the latter would be determined by the coastal process assessment.

4.8.3.2 In terms of direct impacts these would be classified as direct physical disturbance or loss of habitat or species within the footprint of the development. The direct impacts would occur during construction through a permanent loss of habitat from the lagoon structure. Although a proportion of the inner lagoon area would be dredged as a source of material for the lagoon wall construction, during operation there would be potential for the sediments to be re-colonised (although maintenance dredging maybe required). In addition to this, during operation, the lagoon walls would provide new rocky intertidal and subtidal habitat for colonisation.

4.8.3.3 Indirect effects on ecology, during construction, could come from smothering through settlement of re-suspended sediments or deterioration in water quality, again from the sediments or accidental spillages. During operation, there could potentially be indirect loss of habitat through erosion; increased sediment deposition resulting in change of habitat and change of wave exposure affecting habitats and hence ecology.

4.8.3.4 With respect to the direct and indirect impacts on benthic ecology all of the above will be reviewed within the EIA, taking into consideration the species which are present both in the immediate and wider area, their relevant status (common, UKBAP, Nationally important), and their sensitivity to various disturbances. An assessment, taken in context of the wider area, will then be made of the potential for the lagoon to affect the various habitats and associated species during the various stages of the project. Mitigation measures will be recommended, where appropriate. For the UKBAP species, Oyster: as there are proposals to re-introduce this species to the Bay an assessment will be made as to the potential to change the substrate within the historic Oyster bed and hence the suitability of the site to support Oyster in the future. In addition to this, the opportunity of the lagoon to facilitate the re-introduction of Oyster through a sustainable fishery will also be investigated.

4.8.3.5 Finally, any potential change to intertidal and subtidal habitat as a whole will be assessed based on the results of the coastal process modelling. The assessment will take into consideration the area potentially affected with respect to the total area of that habitat within the Bay. An assessment of any change in this habitat will be linked into the assessment of effects on feeding birds within the coastal ornithology chapter.

4.8.3.6 For completeness, a summary of UK BAP and nationally important habitats to be considered within this assessment is identified in Table 4.5. The table also identifies the proximity of the known species/habitats to the proposed development and identifies the likely potential effects which will be looked at within the EIA.

Table 4.5 Summary of Proposed Assessment of UK BAP and Nationally Important Species

Species/Habitat	Proximity to Lagoon and initial comments	Assessment proposed
Sabellaria alveolata reefs (MLR.Salv)	*Sabellaria* reefs are present on the eastern and western side of the approaches to the River Tawe. As such it will be affected by the development.	This worm requires some degree of suspended sediment in the area to build its tubes and can survive smothering for a number of weeks (MarLIN website). The direct impact (loss of habitat) and the potential indirect effects on this species during construction and operation will be assessed.
Hydroid rockpools (LR.H)	This specific biotope was not recorded on recent mapping (Figure 4.4) and information could not be found on the MarLIN website. However, LR.FLR.Rkp.H Hydroids, ephemeral seaweeds and *Littorina littorea* in shallow eulittoral mixed substrata pools have been recorded off Port Talbot (MarLIN).	The location of this UK BAP species needs to be confirmed. Depending on its proximity to the development it may or may not be affected by physical disturbance and smothering.
Piddocks in clay with mussels (MLR.Myt.Pid)	There are a number of sites in Swansea Bay of "Clay exposure" with and without Piddocks (Figure 4.4). These are at varying distances ranging from approximately 2.5km to 6km from proposed development.	Although this species will not be directly impacted through physical disturbed by the proposal it maybe sensitive to smothering from suspended sediments. The results of the coastal process assessment will be used to determine if there will be any significant potential effect.
Piddocks in peat with red algae (MLR.RPid)	There are three areas identified (Figure 4.4) at approximately 3.5km to 6.5km distant.	Although this species will not be directly impacted by the proposal it maybe sensitive to smothering from suspended solids. The results of the coastal process assessment will be used to determine if there will be any potential effect.
Mudflats (LMU and LMS)	There are a number of mudflats within Swansea Bay at varying distance from the proposed development.	This habitat is sensitive to changes in wave exposure (increase) and an assessment of any potential change to the existing situation will be undertaken, based on the findings of the coastal process assessment. The assessment will be put in context of the habitat present in the wider bay area.
Sublittoral sands and gravels (IGS.FaG, IGS.FaS, CGS.Ven)	This habitat is covered by the sea at all states of the tide. The geophysical and benthic survey results will help determine the sediments and species present in the footprint of the development and the immediately surrounding area.	Degree of potential effect will depends on specific habitat present and any changes in the exposure regime. Any direct loss of habitat would be assessed based on the findings of the coastal process assessment and put in context of the wider bay area.
Ostrea edulis (IMX.Ost)	The historic oyster beds located off Mumbles was surveyed in 2003 and, although suitable habitat was found, no native oysters were recorded. Notwithstanding this, it is understood that they are present in the area in small numbers.	The results of the coastal process assessment will be used to assess any potential effects in terms of change in substrate for future colonisation. The potential to facilitate a sustainable fishery will also be investigated and assessed.

4.8.3.7 Finally, any proposed monitoring for the construction and operation phase will be identified.

4.8.4 Invasive Non-native Marine Species

4.8.4.1 In addition to the potential direct and indirect effects on native marine species for construction and operation there is also a potential effect during construction through the introduction or spread of invasive non-native marine species. In general non-native species find their way into UK coastal waters by a variety of means, e.g. floating debris, aquaculture activities, aquatic imports (Marine Life Topic Note, 2005). However, the most significant mode is via shipping by attachment to hulls or in ballast water, with ballast water being identified as one of the four greatest means of transfer. Overall, there are a range of mitigation measures which can be used to minimise the movement of non-native species to new areas which include:

i. Controlling which species to import/export, especially for mariculture.
ii. Sterilising ship's ballast water.
iii. Changing ship's water ballast by controlled and appropriate means.
iv. Proper disposal of aquarium species.
v. Limiting sport fish release.
vi. Using native species in restoration and mitigation programmes.

4.8.4.2 Swansea Bay is thought to already have a fairly high level of marine non-native species. In particular, towards Porthcawl fishermen have reported that the slipper limpet, which is an invasive species, have increased as a by-catch at the expense of catching other shellfish such as Oysters (Section 4.9.1). As such, as part of the EIA, a preliminary risk assessment for the construction phase will be undertaken. The risk assessment will identify measures to minimise the import of invasive species into the area and minimise the risk of spreading those which are already present. In addition to this, a review will be undertaken for the operation phase into the potential to increase the opportunities for invasive species to colonise or thrive. Mitigation measures will be identified to minimise potential effects where possible.

4.9 Fish including Recreational and Commercial Fisheries

4.9.1 Overview of Existing Situation

4.9.1.1 Swansea Bay has a long history with the commercial shellfish and finfish fishing industries. As discussed previously, the Oyster shellfish industry was important in the late Victorian era but has since declined. The bay as a whole is designated under the Shellfish Waters Directive and areas are identified under the Shellfish Hygiene Directive as a Mussel Production Area for harvesting Mussels and Oysters (Figure 4.5). Apart from the historic Oyster beds off Mumbles there are a number of mussel orders dating back to 1995. The Mussel Orders prevent the deployment of fishing gear within their boundaries and four areas are shown on Figure 4.5, below. It is understood that of these four order areas, three have lapsed in recent years and only the "Swansea Bay" area is currently in force (renewed January 2012). In addition to this there are two main wild mussel beds on the beach between Mumbles and the River Tawe.

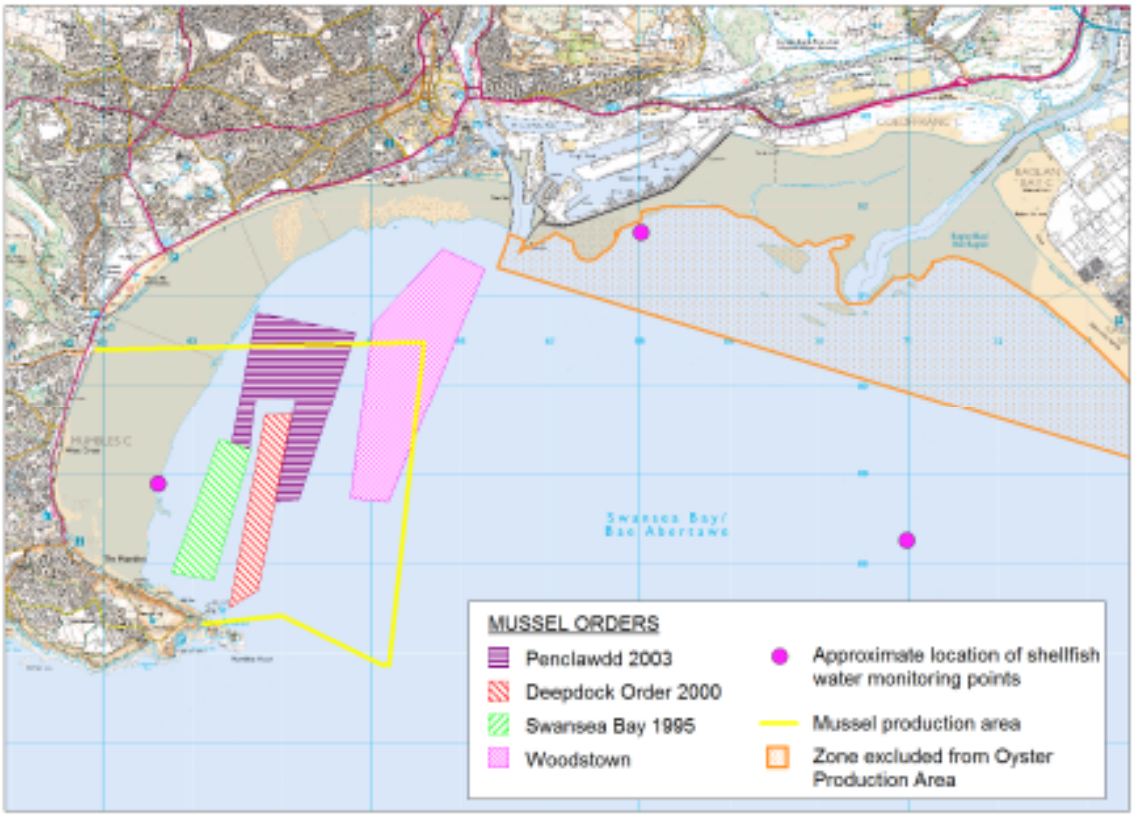

Figure 4.5 Shellfish Areas in Swansea Bay

4.9.1.2 The 2009 – 2010 South Wales Sea Fishery report (SWSF, 2009 -2010) confirmed that Oyster fishing in South Wales was centred on Nayland near Milford Haven, with between three to five boats operating. The report also states that some dredging for Oysters also occurs off Porthcawl as well and that fishermen have reported an increasing amount of slipper limpet pests (*Crepidula fornicate*), which is a marine non-native invasive species. As identified previously, informal discussion with the Swansea Bay Port Authority confirmed that small numbers of the native Oyster can be found within Swansea Bay, although it is not commercially fished.

4.9.1.3 Cockles also used to be fished in Swansea Bay off Crymlyn Burrows (DCWW 1994), however this has ceased. The SWSF report states that as in previous years the on-going unexplained spring cockle mortality continues to affect the wider industry with local estuaries almost devoid of adult cockle. The main cockle industry appears to be centred around Burry Inlet and Three Rivers, further down the coast.

4.9.1.4 In terms of mussels, the 2009-2010 SWSF report, states that in the absence of cockle and with the routine closure of the Dee licensed cockle fishery the demand for local mussel was high. The areas where mussels were collected along the South Wales coast were Burry Inlet training wall, St Ishmaels, Penryhn Gwyn and Burry Port. Finally some whelk fisheries may also be present in the eastern extremity of the lagoon area although this is understood to be very small.

4.9.1.5 In terms of pelagic and demersal fish, until the late 1970's around 50 full time trawlers operated out of Swansea supporting a fish market and associated industries. These numbers have since declined and the old fish dock has been developed into a Marina complex. The remaining inshore fishing vessels have been allocated berths in a small area of the Marina outer basin. The majority of fishing boats now based at Swansea and the few operating from

Port Talbot, Oxwich and Porthcawl, tend to be smaller, inshore boats. The extent of commercial fishing activity within the Swansea Bay area will be determined as part of the baseline assessment stage.

4.9.1.6 The 2009 – 2010 SWSF report confirmed that in terms of finfish the usual species were in evidence, namely codling, whiting, various flatfish, dogfish and rays and some bass. In particular numerous codling in the 20-25cm size range were found especially to the east of Swansea and some were also found inside lobster pots to the west. The report also stated that whilst there were also the occasional cod up to 20lbs present, numbers in between sizes were conspicuous by their absence. Overall some trawling and netting had taken place for the above species in 2009 – 2010 when the weather allowed, but catches were unremarkable.

4.9.1.7 With respect to spawning and nursery areas, information is available from the Offshore Energy SEA Appendix 3 (January 2009) and Fisheries Sensitivity Maps in British Waters (CEFAS, 1998). The latter confirms that there are no significant spawning grounds in Swansea Bay, whilst both documents identify that Swansea Bay and adjacent coast are used as a nursery area by Plaice, Sole and Whiting.

4.9.1.8 In terms of migratory fish, there is a small run of salmon and sea trout in the River Tawe, as well as the river Neath and Afan. The Salmon run in the Tawe is presently considered to be at a sub-optimal level with an average run of just 62 for the period 1997 – 2001 (CEFAS and Environment Agency, 2003). More recent survey data (Environment Agency, 2010) shows that average densities of juvenile Salmon in the Tawe have been highly variable over the last 10 years but still only achieve a “fair” classification. Juvenile trout in the Tawe fell from “excellent” to “poor” between 2006 and 2008, but returned to better densities in 2010.

4.9.1.9 As with the Tawe, the Neath also showed significant variation in juvenile trout and salmon over 2003 - 2010. Juvenile salmon on the whole have increased over the years, although in 2009 there was a significant temporary decline in numbers. Juvenile trout fluctuated with peak numbers recorded in 2006 and 2010.

4.9.1.10 In addition to the salmonids in the local rivers, there are other migratory fish which move up the Severn Estuary as a whole to the River Usk, Wye and the Severn itself. These fish include Salmonids, Lamprey spp, Bullhead, Twait Shad and Allis Shad. Finally, elasmobranchs are also known to be present in Swansea Bay and there are important egg case deposition sites and nursery areas recorded in the wider area.

4.9.1.11 In terms of recreational fishing, some commercial fishing boats derive a large part of their income from chartering to angling parties. In addition to this there are a number of other charter boats which operate out of Swansea Marina, as well as privately owned boats and boats owned by fishing clubs operating in the area. Recreational fishing is also popular from the coast in the Swansea Bay area, with Langland, Port Eynon, Caswell, Oxwich and Llangennith bays along the Gower coast being reported as outstanding locations.

4.9.2 Existing Baseline Data and Need for Survey

4.9.2.1 Information on fishing activity within Swansea Bay has been obtained from the scoping study undertaken in 2006 (Tidal Electric Ltd, 2006), the Environmental Statement prepared for Scarweather Sands Offshore Wind Farm (2003), SWSF report (2009-2010) and various CEFAS and EA-W documents. The location and extent of the grounds identified above and the current fishing activity will be confirmed through consultation during the EIA process.

4.9.2.2 It is anticipated that consultation will be undertaken with and data sought from the following organisations:

a) Burry Inlet Waiting List Association
b) CEFAS
c) CCW
d) DEFRA
e) Environment Agency-Wales
f) Inshore Fisheries Units for South and North Wales
g) Marine Management Organisation
h) South and West Wales Association of Sea Angling Clubs
i) Welsh Federation of Sea Anglers

4.9.2.3 In addition to this the following data sets and information sources will be used for the baseline assessment. Note in the cases of certain ICES data sets from DEFRA, the spatial areas for recording data is large relative to the area of the development.

i. Commercial Fisheries Landings Values and Effort Data (2000-2009)
ii. EA Wales Results from fishery reports/studies.
iii. Evidence from monitoring undertaken in similar projects (e.g. La Rance Tidal Barrage)
iv. Fisheries Sensitivity Maps in British waters (Coull et al., 1998);
v. Information gathered through consultation with relevant angling organisations and clubs and river trusts;
vi. Mapping spawning and nursery areas of species to be considered in Marine Protected Areas (Ellis et al., 2010).
vii. North Atlantic Salmon Conservation Organisation (NASCO).
viii. South and West Wales Association of Sea Angling Clubs.
ix. UK Offshore Energy – Strategic Environmental Assessment; DECC, January 2009.

4.9.2.4 Finally, as discussed in Section 4.8 (Intertidal and Subtidal Benthic Ecology) it is proposed to undertake 7 beam trawls for epifauna which will also be used to determine the presence of demersal fish and shellfish in the area. Four of the trawls will be taken within the footprint of the development reflecting areas of different substrates, two will be selected to represent the major biotypes upstream and downstream of the development area and a single control site has been chosen. Further details are given in Appendix 4.1.

4.9.3 Scope of Potential Impact to be Assessed

4.9.3.1 Notwithstanding this it is appreciated that any development in the Bay would be of local concern. Recreational fishing within and around the Bay is of importance with sea angling and salmonid fishing within the rivers contributing to the Swansea economy by attracting anglers from all over the UK. In addition to this migratory fish (Annex II species) returning to other rivers (SACs) further up the coast may pass through the Swansea Bay area and therefore may have the potential to be affected. The assessment of the potential impact on SAC species is discussed within Section 4.20.

4.9.3.2 As with benthic ecology, there would be potential to have direct and indirect impacts. Direct impacts during construction would be more associated with sessile species (shellfish and benthos), or juvenile stages of fish, as adult fish are more likely to move out of the area to avoid such impacts temporarily. In particular, there may be temporary displacement of adult fish from some localised areas which could potentially affect seasonal movements, for instance, towards the rivers. The timing of the works with respect to migratory species movement patterns will be considered within the EIA.

4.9.3.3 In terms of direct impacts during operation, the lagoon would form a new subtidal and intertidal rocky substrate which could attract a range of valuable species and these could be

of benefit to the ecology within the Bay. In contrast to this, although not spanning any of the rivers, there could be a potential impact on fish species being accidentally drawn into the lagoon when operating and/or interacting with turbines. The assessment for migratory fish will therefore include:

a) determination of the baseline situation in the area, including forecasts on fish populations and the extent of migratory pattern knowledge currently available for the Severn and Swansea Bay specifically;
b) review and assessment of the potential effects of the construction and operation of the lagoon on migratory (and other) fish (including collision modelling/risk assessment as appropriate). Note the findings of the coastal process modelling will be reviewed with respect to water quality etc;
c) review of precedent projects, if available, using suggested mitigation measures and any indication available of their success rates and issues arising;
d) examine the pros & cons of appropriate mitigation options available, including possible requirements;
e) provide recommendations and guidance as to how to minimise potential impacts of the lagoon for instance through input into engineering design or seasonal timing of construction works; and
f) identify and detail potential opportunities for positive impacts from additional marine habitat and enclosed marine area.

4.9.3.4 The findings of this assessment will be discussed with EA-W.

4.9.3.5 Indirect effects during construction could arise from increased suspended sediments which may smother shellfish or benthic species (which are a food source for fish), or from reduced water quality for juvenile fish. Indirect effects during operation maybe associated with change in coastal processes and therefore sediment deposition/erosion which could change habitats in the Bay. Finally, potential effects could also occur on elasmobranchs from the export cable of a marine energy development running to shore. At present it is proposed to contain the lagoon cables within the main seawall structure of the lagoon or within existing river crossings. As such no impacts are anticipated. Should these proposal change an assessment on elasmobranchs from the cable will be included in the EIA.

4.9.3.6 Within the EIA the results of the coastal process assessment will be used to inform the potential extent and degree of effect from the construction and operation of the lagoon. The results of this will be used to assess the potential effects on the commercial and recreational fishing activity within the Bay. In addition to this as discussed for migratory fish, the potential opportunity to utilise the lagoon for the enhancement of shellfish stocks would be further investigated.

4.10 Marine Mammals

4.10.1 Overview of Existing Situation

4.10.1.1 The Gower Marine Mammal Project (GMMP) carried out monitoring work in the inshore waters of South Wales using hydrophone devices (TPODs) and sea-watches. The results of the work over a two year period suggest that the South Wales coast supports a population of harbour porpoise. In addition, porpoise tend to favour sites which are higher energy environments, which in turn support increased concentrations of fish (Watkins and Colley, 2004). These areas include:

i. Headlands such as Mumbles Head; and

ii. Estuaries with restricted mouths such as Port Talbot Harbour.

4.10.1.2 These findings concur with the Sea Mammals Research Unit (SMRU) report on marine mammals in SEA6 (May 2005). The report's recordings of various marine mammal species around the Swansea bay coast is summarised in Table 4.6 below.

Table 4.6 Summary of Marine Mammals in Swansea Bay (extracted from SMRU 2005)

Species	Comments on distribution
Minkie Whale	None within Bay area, closest off west Wales
Harbour Porpoise	Main survey did not identify any within Bay, but a number off Worms Head. Opportunistic observations noted them mainly around the Gower and off the north Devon Coast. Some observations from within the Bay.
Risso Dolphin	Main survey did not identify any within Bay, with the closest sightings off west Wales. Opportunistic sightings include Swansea Bay and Gower area.
Short-beaked Common Dolphin	None within Bay area, closest off west Wales
Bottlenose Dolphin	Main survey did not identify any within Bay, with the closest sightings off Cardigan Bay. Opportunistic sightings include limited observation in Swansea Bay and Gower area.
Fin Whale	No opportunistic records for Swansea Bay area, closest sighting off West Wales.
Pilot Whale	No opportunistic records for Swansea Bay area, closest sighting off West Wales.
Killer Whale	Limited opportunistic sighting off west Gower, main sighting off West Wales.
Grey Seal	No haul outsides near Swansea Bay or the Gower peninsular. Closest site west Carmarthen bay. Swansea Bay area not identified as a high usage area.
Harbour Seal	None in area. Closest site southern Ireland.

4.10.1.3 Scarweather Sands ES (UUSSL, 2003) also provides information on marine mammal activity within the area. Data was obtained from three sources:

a) Constant-effort shore-based watches from the Gower peninsular (principally, Burry Holms 1995 – with other data from various Gower headlands);
b) Casual data, largely gathered during the 1999 – 2000 Gower Marine Mammals Project (GMMP) which sought records from boaters, anglers, public, etc; and
c) Observations during Birds Surveys (UUSSL, 2003).

4.10.1.4 In summary, the first survey showed year-round Porpoise use of the sea off the south Gower coast, which suggests that Harbour Porpoise are resident in the area. This data is supported by the GMMP findings, where there were sightings from "approaches to Port Talbot" and anecdotal records of "very occasional" sightings from Flatholm and Porthcawl further to the east.

4.10.1.5 As per the SMRU study Common Dolphin and Risso's Dolphin were also occasionally recorded which suggest that these species are "occasional or seasonal". The incidental observations during the bird surveys recorded a couple of porpoise sightings in April and August off Scarweather.

4.10.1.6 In addition to the above, more recent studies have been undertaken as part of the Marine Renewable Energy Strategic Framework (MRESF). This work included collecting data with

regard to the distribution of marine mammals in high energy environments. Field research included boat based and shore based observations as well as tracking studies and literature review. The findings of these studies and any other recent surveys will be sought during the EIA process and will be used to inform the assessment.

4.10.2 Existing Baseline Data and Need for Survey

4.10.2.1 As identified above there is a good source of existing baseline data which confirms the usage of the area by marine mammal species. As such, it is not proposed to undertake any site-specific survey work for marine mammals. Notwithstanding this data updates and information on marine mammal behaviour will be sought through consultation with the following organisations:

i. Sea Watch Foundation (Wales Region);
ii. Gower Marine Mammals Projects;
iii. Marine Management Organisation;
iv. Inshore Fisheries Units for South and North Wales.
v. Sea Mammal Research Unit (SMRU)
vi. Scottish Association for Marine Science (SAMS)
vii. Low Carbon Research Institute (LCRI)

4.10.3 Scope of Potential Impact to be Assessed

4.10.3.1 As the inner Bay has limited use by marine mammals, displacement from the lagoon site during construction and operation is not believed to be potentially significant. This will be confirmed during the EIA process. Temporary noise impacts during construction, particularly during piling work would have the potential to impact on cetaceans. As such, this will be considered further within the EIA. Issues to be reviewed will include:

a) Determining the characteristics and timing of noise disturbance during construction and any significant noise during operation;
b) Prediction of the potential area of disturbance, primarily through comparison with published work with respect to, for example, the offshore wind industry and other coastal/nearshore infrastructure work;
c) Identification of the nature of the disturbance (temporary displacement, risk of mortality etc.);
d) Identification of critical sensitivities (for example breeding periods) and whether these apply to the predicted area of impact;
e) Consideration of the implications of the impacts (for example if displacement occurs, does it have a material effect on receptors life cycle and general activity);
f) Assessment and determination of potential for collision risk with turbines;
g) Identification of mitigation measures if a significant impact is predicted; and
h) Determining the extent of the residual effects and the need for potential monitoring.

4.11 Coastal Birds

4.11.1 Overview of Existing Situation

4.11.1.1 Although Swansea Bay is not as important as the Severn Estuary SAC, SPA and Ramsar, there are two main areas of interest for birds within the Bay. Firstly there is Blackpill SSSI, on the western edge of the Bay. This site provides an over-wintering and a passage site for a large number of waders who predominantly stop over to refuel between October and March before moving onwards. Of particular note are Sanderling and Ringed Plovers (both exceed 1% of both British and Western European populations) as well as Oystercatchers, Grey

Plover, Bar-tailed Godwit, Knot and Dunlin which are all of local significance. The area is of importance due to its topography and the seasonal remoteness of the foreshore at low tide which provides good habitat for many marine invertebrates (a rich source of food for the bird species). There are also areas around the Bay outside the SSSI which provide suitable roosting spots, especially on the highest tides.

4.11.1.2 In addition to Blackpill there is Crymlyn Burrows SSSI located on the eastern side of the Bay to the west of the mouth of the river Neath. The main focus of this designation is linked to the fact that it is one of the last remaining sections of coastline which has remained relatively unmodified by the industry in the Bay. The area has several plant species with local distribution as well as associated invertebrates. Part of the Neath estuary is also used by some of the population of small waders over-wintering at Blackpill SSSI.

4.11.1.3 Slightly away from the coast to the north beyond the A483 (Fabian Way), is a further SAC/Ramsar site at Crymlyn Bog. This site is of national importance for its rich plant and invertebrate fauna including many rare and other highly localised species associated with mires. It is also notable for supporting summer populations in excess of 400 pairs of reed warblers and 200 pairs of sedge warblers.

4.11.1.4 Finally located on the southeast side of the Bay is Eglwys Nunydd Reservoir SSSI and Kenfig Pool and Dunes SSSI, the latter also being a National Nature Reserve. Both large freshwater lakes are valuable as a stopping-off point for wintering waterfowl and passage migrants. Notable species include Great Crested and Little Grebes, Mallard, Gadwall and Coot.

4.11.2 Existing Baseline Data and Need for Survey

4.11.2.1 In order to undertake a robust assessment, the existing situation has to be determined. As identified during previous consultation with CCW, bird data is available from WeBS and local bird reports. In terms of existing data, Blackpill SSSI and Neath Estuary both form “Sectors” of the Swansea Bay Major WeBS Site. As such, bird counts have been undertaken on an annual basis at both locations for over 20 years. From the website it appears that over 10 visits occur at each site annually. In addition to this data is also collected at Eglwys Nunydd and Kenfig Pools, as well as a number of other sites in the area. WeBS data for the last five years will be requested for all relevant sites. In addition West Glamorgan RSPB group and the Gower Ornithological Society will be contacted concerning data availability for Blackpill and the wider Bay area.

4.11.2.2 With regard to sea ducks, observations were made, in a CCW response to a previous scoping report for Swansea Bay in 2006, that although there is no evidence of the presence of important populations of sea ducks or sea birds in the vicinity of the site, some survey may be needed to confirm this. In 2003, an Environmental Statement (ES) was prepared in support of the Scarweather Sand Offshore Wind Farm development (UUSSL, 2003). As part of this ES a number of aerial and boat-based surveys were undertaken to ascertain the distribution of sea ducks within Swansea Bay (the methodology having been agreed with CCW in advance). The results of the aerial surveys showed that overall bird numbers in the area were low. No Common Scoter or other species of conservation significance were recorded and those observed were common species in low aggregations. The findings of the boat surveys confirmed those of the aerial surveys and data obtained for the ES from local bird clubs also confirmed that only small numbers of Common Scoter occur in the bay, with Carmarthen Bay being their more favoured location.

4.11.2.3 For this EIA it is proposed that the above information, more recent data obtained from local bird clubs and the findings from the surveys outlined below (details Appendix 4.2) will be used as the baseline for the EIA. It has been noted that the issue of importance will be the bird usage of the area, in particular the actual lagoon location and its surrounds, and the potential effects on feeding and roosting in these areas. As such survey work was undertaken to gain a better understanding of the bird usage of the lagoon area with respect to that of the wider bay.

4.11.2.4 The main objectives of the bird survey work were to:

i. Obtain site-specific data on the numbers of, and primary areas used by, birds within the Blackpill SSSI and River Neath WeBS count areas. To ensure compatibility with the WeBS survey data an amended BTO Low Tide Count and Core (High Tide) Count methodology was used. The data collected is comparable with BTO data for the central areas of the Swansea Bay WeBS area and it will be assigned to WeBS count sub-division areas during data processing.

ii. Collect data on bird movement areas around the Bay.

4.11.2.5 Monthly bird surveys have been undertaken by two experienced ornithologists to cover Swansea Bay. The surveys were conducted between October 2011 and March 2012, inclusive. The areas covered by the surveys were the whole of Blackpill SSSI and the intertidal area at Crymlyn Burrows/Neath Estuary. A detailed survey methodology and Figures illustrating the survey compartments are given in Appendix 4.2.

4.11.3 Scope of Potential Impact to be Assessed

4.11.3.1 With respect to the proposed Swansea Bay Tidal Lagoon, the development area is outside the SSSI designations and as such there should be no direct impacts on these habitats. However there remains potential for indirect impacts, for instance from noise during the construction phase and also potentially during operation. In order to ascertain the scope of issues relating to birds to be addressed within the EIA, informal consultation has been undertaken with CCW and the RSPB (Appendix 1.2) and their comments have been taken onboard.

4.11.3.2 Within the EIA it is acknowledged that the impacts on birds require consideration, particularly over-wintering waders using Blackpill and Crymlyn Burrows SSSI foreshore. In addition, other SSSIs in the vicinity of the proposed site (including Eglwys Nunydd Reservoir SSSI and Kenfig Pool and Dunes SSSI) also form part of the wider network of these sites which help support the nationally important wintering wader populations around Swansea Bay. As such the impacts on these other sites, and on the overall Swansea Bay wintering bird populations, will be considered.

4.11.3.3 The key issues that will be assessed within the EIA for the tidal lagoon will include:

a) Temporary disturbance (noise, temporary lighting and activity) during construction phase (24 months). This will include an assessment of the potential effect on birds using the closer River Neath/Crymlyn Burrows intertidal feeding area, as well as those moving around the Bay to use other sites.

b) As discussed in the coastal processes section the high level assessment of the lagoon construction will be used to determine the extent of potential changes on intertidal and subtidal habitat and ecology. This in turn will be used to make an assessment of the potential effects on birds in the area during this stage of the project.

c) For the operation stage, the assessment will look at the final coastal process situation and the potential for loss or increase of intertidal and subtidal habitat and the resulting potential changes in the quality of intertidal feeding habitat and the impact of such changes on over-wintering and migratory birds. The findings of this assessment will be reviewed against the predicted "natural" changes and transitions of the habitats around the bay and these effects on birds.

d) Bird disturbance during operation and maintenance; potential effects on bird movement around the Bay and the possible effect of birds being attracted to the site by lighting, sheltered water or the development creating roosting will also be assessed.

e) Any proposed monitoring for the construction and operation phase will be identified.

4.12 Navigation and Marine Transport Assessment

4.12.1 Overview of Existing Situation

Overview of Commercial Marine Activity

4.12.1.1 The main commercial navigation routes within Swansea Bay are to the three main ports of Swansea to the west, Neath and Port Talbot to the east of the proposed development (Figure 1.1). Swansea and Port Talbot Ports are both operated by Associated British Ports (ABP), the River Neath is controlled by Neath Harbour Commissioners, whilst the three landings up the river Neath, including Briton Ferry, are privately owned (see below).

4.12.1.2 The Port of Swansea in the River Tawe comprises an impounded dock system with entrance jetties and covered storage. The port is tidal and is approached via a channel dredged to 4.2m below Chart Datum (CD). The port can accommodate a maximum vessel size of 30,000 dry weight tonnes (dwt) and up to 200m in length. Its' throughput comprises handling containers, dry bulks, minerals and Ores, forest products (from the Far East, Southern Europe and South America), steel and other metals such as aluminium and palletise copper. In 2011 (up to September) it had handled 604,000 tonnes of cargo. Swansea also used to receive the Ro-Ro Swansea–Cork Ferry operated by Fastnet Line at its dedicated berthing facility, although this service was suspended in November 2011 for the foreseeable future.

4.12.1.3 Upstream of the Tawe Barrage, there are extensive marina facilities. A number of recreational craft and inshore fishing vessels use these facilities which add to the small craft movements and general patterns of shipping traffic to the west of the development site.

4.12.1.4 On the River Neath it is understood that there used to be three landings/wharfs, although one is currently not operational. Slightly further upstream at Briton Ferry there is a 35acre, privately owned landing operated by Briton Ferry Stevedoring Ltd. The terminal can handle vessels up to 6500 tonnes on its three berths and can accommodate bulk or containerised products including steel, precious metals, aggregates, timber, coal and other bulk palletised and bagged materials. There are four purpose-built bulk stores, totalling 30,000 square feet with a further 60,000 square feet of warehousing. On the quayside the port can accommodate and store in excess of 20,000 tonnes of bulk products on its three berths with capacity for a further 40,000 tonnes upon its 6 acres of concrete hard standing. The maximum current size of vessel operating at the port is 125m in length, up to 6.0m draught and 3,500dwt with traffic movements being restricted by tidal height and occasionally weather conditions. The port is approached from Swansea Bay by a 250ft wide channel and pilotage is compulsory.

4.12.1.5 To the east of Neath is Port Talbot. The entrance to the port is protected by a breakwater with a 5km long approach channel and berthing areas capable of receiving very large bulk vessels up to 170,000dwt. The large bulk carriers enter the port via the approach channel at high tide but can leave at low tide once unloaded. The port handles cargoes of coal, iron ore, sand, cement, steel and processed and granulated slag. It also has the capacity to handle large volumes of renewable energy-related cargoes, such as wood chip and biomass. In 2011 (up to September) the port had a throughput of 8,832,000 tonnes.

4.12.1.6 All three ports are approached by channels which are dredged at different frequencies to maintain their advertised depths. It is understood that the spoil from dredging is taken to the Swansea Outer Bay disposal ground. At Swansea Port, there are potential opportunities during the construction and operation phases of the project to contribute to increasing the use of the port facilities, as well as more long term public use and recreational opportunities.

4.12.1.7 The location for the proposed development lies partly within the Harbour Limits of the Port of Swansea (which has powers as the Harbour Authority under the Swansea Harbour Act 1907) and the Port of Neath Harbour Limit. Responsibilities for operations within these limits are vested with the ports by way of specific Harbour Acts (for example Swansea Harbour Act, 1907). Detailed discussions will be held with ABP and Neath Harbour Commissioners to progress this development without hindering the ports responsibilities or operation.

Overview of Recreational Marine Activity

4.12.1.8 In addition to the commercial shipping activities in the bay, the area is popular for recreational sailing, with Swansea marina being one of the main focal points in the Bay. Swansea marina was originally opened in 1982 with 385 berths, and was later expanded to accommodate 780 boats. It is understood that the marina is currently used by 550 permanent boats and approximately 500 visitors over the year. With the completion of the Swansea Barrage in 1992, 200 more berths were provided behind the lock outside of the main marina. These berths are used by Swansea Yacht and Sub-Aqua Club and approximately 20 fishing boats. Further plans are proposed for the area with the redevelopment of the Prince of Wales Dock. Once complete, 400 new berths will be provided taking the berthing capacity of Swansea to over 1000 boats.

4.12.1.9 Finally apart from Swansea Marina, there is also a small marina just below the M4 road bridge. This is the marina of the Monkstone Sailing and Cruising Club and it accommodates approximately 70 small leisure craft. There are also several sailing clubs located around the Bay including Mumbles Yacht Club, Swansea and Sub-Aqua Club and Swansea Sailing Club. Informal dinghies and small recreational craft also use the area. Finally there is a regional coastguard station located on Mumbles Head and planning permission was secured for the construction of a new Lifeboat Station, which is aimed to be complete in autumn 2014.

4.12.2 Existing Baseline Data and Need for Survey

4.12.2.1 Information on the existing operation of the three ports, Swansea Marina, Neath Marina and other vessels activity in the vicinity of the proposed lagoon will be obtained through consultation, to include the following organisations:

a) Associated British Ports
b) Briton Ferry Stevedoring Ltd
c) British Ports Association
d) British Marine Aggregates
e) Chamber of Shipping
f) Fastnet Line

g) Inshore Fisheries Units for South and North Wales.
h) Marine and Coastguard Agency
i) Monkston Cruising and Sailing Club
j) Mumbles Motorboat and Fishing Club
k) Mumbles Yacht Club
l) Neath Estuary Group
m) Neath Harbour Commissioner
n) Royal National Lifeboat Institute
o) Swansea Marina
p) Swansea Yacht and Sub-Aqua Club
q) Swansea Sailing Club
r) The Royal Yachting Association
s) The Welsh Yachting Association
t) Trinity House Lighthouse Services

4.12.2.2 Data on existing dredging activities for the port access channels, frequency and quality of sediments will be requested from ABP. Sediment quality data and particle size data will be obtained from the footprint of the lagoon during the benthic sampling programme and the geotechnical survey. No additional site-specific survey work is proposed.

4.12.3 Scope of Potential Impact to be Assessed

4.12.3.1 It is proposed that the EIA will identify and assess the degree of the potential impact on the following receptors:

i. Commercial navigation into the local ports,
ii. Leisure and fishing vessel navigation, and
iii. Recreational vessel navigation.

4.12.3.2 During the preliminary scoping meeting with Associated British Ports and other maritime organisations two potential issues were identified as follows:

4.12.3.3 First, for all ports it will be necessary to ensure the maintenance of operational movements of shipping without interruption or disadvantage. As part of this, the development must allow for situations where vessels may need to depart from the navigation channel. As such an offset of a distance of around 100m between the edge of the existing navigation channel and the lagoon wall is required within the design; and

4.12.3.4 Second, the introduction of the structure will result in changes to tidal flow and sediment transport patterns. As such, the following issues will be assessed during the EIA process:

a) Changes in tidal flow patterns and potential effect on pilot operations of vessels brought in or out of docks/ports;
b) Changes in sediment transport and potential effect on maintenance dredging operations;
c) Development of sandbars or other changes in the shallow seabed and potential effect on vessel safety and the economics of port operations; and
d) Change in local wave climate which may affect small craft approaching the marina.

4.12.3.5 The proximity to the port approaches and the risk to navigation that the lagoon structure poses will be addressed in design iterations and during the EIA process. Any requirements for mitigation identified will be discussed with Trinity Lighthouse Services and integrated into the detailed project design.

4.12.3.6 With respect to the other potential impacts, effects on the maintenance dredging and vessel piloting operations of the ports, these will be addressed with reference to coastal process modelling outputs and a review of existing activities.

4.12.3.7 A full navigation risk assessment will be carried out, taking into account information provided in the:

i. MCA guidance document MGN 371 (M+F), Offshore Renewable Energy Installations (OREIs) - Guidance on UK Navigational Practice, Safety and Emergency Response Issues.

ii. "Offshore Renewable Energy Installations (OREIs) - Guidance to Mariners operating in the vicinity of UK OREIs".

4.12.3.8 Finally, during construction and operation any temporary or permanent structures will be marked for navigation and safety, as necessary, and close liaison will be maintained with the ports, the marina, yacht clubs and RNLI throughout the construction phase of the works. Following completion, the resulting lagoon and associated facilities will be lit in accordance with Trinity Lighthouse Services, Port Authority and Health & Safety Executive requirements.

4.13 Terrestrial Ecology

4.13.1 Overview of Existing Situation

4.13.1.1 The terrestrial footprint of the lagoon project will comprise:

a) the terrestrial component of the power export cable route,
b) any new infrastructure required to connect to the transmission network,
c) operations and control room for management of the generating station, including car parking,
d) onshore ancillary infrastructure, and
e) temporary construction compound.

4.13.1.2 It is proposed to use Swansea Dock as the main access for the lagoon during construction and operation and for the temporary construction compound. Discussions with ABP South Wales have confirmed that this can easily be accommodated within the docks. The location of the substation has still to be confirmed. As discussed above, cable route options are currently under consideration and, once finalised a site for the substation will be identified during EIA. Note: The potential impact of the lagoon construction on the intertidal habitat is discussed under Section 4.6.

4.13.1.3 Discussion with National Grid (NG) has indicated that the most likely connection point will be direct to the 275kV substation within Baglan Energy Park, to the east of the site across the river Neath. A provisional route to Baglan substation is identified in Figure 4.6 and this or a similar option would be subject to wayleaving and further discussion with Councils, other landowners and interested parties, as well as a final NG offer.

Figure 4.6 Possible Grid Connection Route

4.13.1.4 For the connection to Baglan substation it is proposed to use a brownfield route or follow existing road and pipework alignments wherever possible to minimise potential impacts. The route to Baglan substation will require laying a cable to the shore, which would have to traverse the river Neath. A suitable burial depth, the use of existing river crossing or directional drilling will be considered.

4.13.1.5 In addition to direct impacts within the footprint of the proposed terrestrial components of the scheme CCW identified, in correspondence relating to the 2006 proposal, that there maybe potential to affect designated sites in the wider area. The potential to affect these sites would be linked to the potential changes in coastal processes and the zone of influence of the proposed works. The assessment of potential impact on internationally designated sites is discussed in Section 4.20. With respect to national ecological designations these would include Sites of Special Scientific Interest and National Nature Reserves. Sites which were identified by CCW in the earlier correspondence included the following (Sites which have been identified for their bird interest eg Blackpill SSSI will be discussed in the Coastal Bird Chapter):

i. Crymlyn Burrows SSSI
ii. Blackpill SSSI
iii. Kenfig Pool and Dunes SSSI and Kenfig NNR
iv. Merthyr Mawr Warren SSSI
v. Eglwys Nunydd Reservoir SSSI
vi. Southerndown Coast SSSI
vii. Monknash Coast SSSI
viii. Nash Lighthouse Meadow SSSI
ix. Caswell Bay SSSI
x. Bracelet Bay SSSI
xi. Langland bay SSSI
xii. Minchin Hole SSSI
xiii. Pwll Ddu Head & Bishopston Valley SSSI
xiv. Pennard Valley SSSI
xv. Oxwich Bay NNR & SSSI
xvi. Horton, Eastern & Western Slade SSSI
xvii. Gower Coast: Rhossili to Port Eynon SSSI
xviii. Burry Inlet and Loughor Estuary SSSI

4.13.1.6 As with the preliminary screening of the Internationally Designated Sites, a number of these sites are likely to be well outside the field of coastal effect or contain features, such as geology, which would not be affected. With respect to “inland sites” the potential to be affected will be determined once the cable route and substation location has been finalised. As an initial step a preliminary screening of the sites has been undertaken based on citation information available on the website and the distance from the proposed development. For ease of reference those which will be considered further within the EIA have been highlighted.

Table 4.7 Preliminary Screening for Proposed Assessment for SSSI and NNR Sites

Site	Outline key features	Distance and Observation on need for Further Assessment
Crymlyn Burrows SSSI	One of the last remaining sections of the Swansea Bay Coastline which has remained substantially unmodified by industrial development. Dunes interspersed by tongues of saltmarsh which grade westwards into wet dune slacks and carr woodland.	Approx 2km. The results of the detailed coastal processes study will be used to further assess the potential effect on this SSSI.
Blackpill SSSI	Blackpill SSSI provides an over-wintering and a passage site for a large number of waders who predominantly stop over to refuel between October and March before moving onwards. Of particular note are Sanderling and Ringed Plovers.	Approx 2.5km. The results of the detailed coastal processes study will be used to further assess the potential effect on the habitat of this SSSI and the potential knock on effect to birds.
Kenfig Pool and Dunes SSSI and Kenfig NNR	Large coastal dune system near Porthcawl, Bridgend. It hosts a variety of coastal habitats including wetlands, dune slacks, the River Kenfig and Kenfig Pool.	Approx 11.5km. Although distant this site could potentially be affected by changes in sediment erosion and accretion processes along the coastline. The results of the detailed coastal processes study will be used determine if there is potential for an effect. If so further assessment would be undertaken.
Merthyr Mawr Warren SSSI	This site is important for its sand dune habitats and saltmarsh. Limestone grassland, swamp and intertidal areas add to the interest.	Approx 20.5km. Potential impacts not anticipated. No further assessment proposed.
Eglwys Nunydd Reservoir SSSI -	The largest sheet of fresh water in the county. The reservoir attracts large numbers of wintering waterfowl and passage migrants. Notable species including Great Crested and Little Grebes, Mallard, Gadwall and Coot now breed.	Approx 12.5km. Freshwater birds present. Due to distance it is unlikely to be affected by proposed development. No further assessment proposed.
Southerndown Coast SSSI	5km stretch of coastline lies to the south east of Ogmore-by-Sea. Important for its rock exposures, and for the vegetation of the cliff-tops and valleys which include several rare plant species.	Approx 24km. Potential impacts not anticipated. No further assessment proposed.
Monknash Coast SSSI	The Liassic Limestone cliffs and wave-cut platforms are important for coastal geomorphology. The cliffs and valleys support a diverse range of coastal vegetation types which are notable in the county context for the occurrence of several rare plant species.	Approx 30km. Potential impacts not anticipated. No further assessment proposed.
Nash Lighthouse Meadow SSSI	This site has two special features, species-rich neutral grassland and the tuberous thistle.	Over 30km. Cliff top SSSI. Potential impacts not anticipated. No further assessment proposed.
Caswell Bay SSSI	Fine cliff sections through Carboniferous Limestone sequence with evidence of strong earth movements and glacial deposits resting on a raised beach. Plant species with limited distribution in Britain occur in grassland at Newton Cliffs and Seven Slades.	Approx 10km. Designated for its rock features and plants associated with grassland. Potential impacts not anticipated. No further assessment proposed.
Bracelet Bay SSSI	Designated for its rock outcrops which provide excellent exposures of geological structures formed during the Variscan mountain building episode (orogeny) which took place during the Carboniferous Period.	Approx 5.5km. Designated for its rock features. Potential impacts not anticipated. No further assessment proposed.
Langland Bay SSSI	Designated for best evidence available for the limit of Late Devensian glaciation on east Gower.	Approx 7.5km. Designated for its rock features. Potential impacts not anticipated. No further assessment proposed.
Minchin Hole SSSI	A large, coastal fissure cave containing vital evidence for the Pleistocene history of South Wales.	Approx 12km. Designated for its rock features. Potential impacts not anticipated. No further assessment proposed.
Pwll Ddu Head & Bishopston Valley SSSI	This site is of special interest for its geological and biological features. Extensive bedrock platforms in the intertidal support the Honeycomb worm reef.	Approx 11km. Potential impacts not anticipated although this will be confirmed by the results of the detailed coastal process assessment.

Site	Outline key features	Distance and Observation on need for Further Assessment
Pennard Valley SSSI	Designated for semi natural broadleaf woodland, sand-dunes, saltmarsh and wild asparagus.	Approx 15km. Potential impacts not anticipated although this will be confirmed by the results of the detailed coastal process assessment.
Oxwich Bay NNR & SSSI	A coastal area of national nature conservation importance sustaining a rich assemblage of plants and animals. The central part of the bay accommodates sandy shore, calcareous dune, dune slacks, saltmarsh.....etc	Approx 17km. Potential impacts not anticipated although this will be confirmed by the results of the detailed coastal process assessment.
Horton, Eastern & Western Slade SSSI	The site is of special interest for its geology which comprises landforms and unconsolidated Pleistocene deposits. The special interest also extends to a variety of associated habitats including maritime heath and calcareous grassland.	Approx 20km. Designated for its geology and associated plants. Potential impacts not anticipated. No further assessment proposed.
Gower Coast: Rhossili to Port Eynon SSSI	The whole section of coastline represents one of the most extensive exposures of the south crop of the South Wales Coalfield with steep cliffs of Carboniferous Limestone rising 70 metres above sea level. The site is noted especially for the range of habitats from intertidal rocks and the exposed maritime grasslands of Worms Head.	Approx 21km. Designated for its geology and intertidal rock areas. Potential impacts not anticipated. No further assessment proposed.
Burry Inlet and Loughor Estuary SSSI.	Designated for birds. Underpins SPA designation.	Approx 30km. Due to distance potential impacts not anticipated. No further assessment proposed.

4.13.2 Existing Baseline Data and Need for Survey

4.13.2.1 Given the assumption that development will occur on a brownfield site, and that the grid connection would follow existing linear networks where possible, direct construction impacts should be significantly reduced compared to that of a greenfield site. In addition to this, preliminary discussions with ABP confirmed that they were unaware of any protected species or sensitive habitats in the vicinity of land which could be used for a construction compound in the docks (informal meeting 23/08/11).

4.13.2.2 Notwithstanding this, it is proposed to undertake a desk-based assessment and an extended phase 1 walkover survey of the temporary construction compound, the terrestrial section of the grid connection route and the substation location. The walkover survey would map the broad habitats present, identify the potential for protected species, the need for further survey and the presence of any controlled invasive species (e.g. Japanese Knotweed, Himalayan Balsam).

4.13.2.3 In terms of indirect impacts on nearby habitats and sites, there is detailed information available on the internet with respect to designated sites and their features. As such no specific survey work is proposed.

4.13.3 Scope of Potential Impact to be Assessed

4.13.3.1 The proposed EIA would assess the potential direct and indirect impact on habitat within and adjacent to the proposed construction compound area, cable route and substation. Where appropriate route refinement would be recommended or mitigation would be proposed.

4.13.3.2 An assessment will also be made of the potential impacts during operation on designated sites. As discussed above this will be linked to the potential changes in coastal processes and zone of influence of the proposed works. The assessment will be based on the findings of the detailed coastal process assessment and this information will be used to assess the effects on the features of the designated sites identified in Table 4.7 above.

4.14 Seascape and Visual Assessment

4.14.1 Overview of Existing Situation

4.14.1.1 Swansea, located on the edge of Swansea Bay, is Wales' "City by the Sea" or Waterfront City. The Swansea Bay area encompasses a range of landscape features from rugged coastal areas through formal parklands and residential development to areas of industrial back drop. It has a number of areas designated for its landscape including:

a) The Gower Area of Outstanding Natural Beauty;
b) Margam Abbey and Mountain, Merthyr Mawr and Kenfig Margam Burrows - Historic landscapes;
c) Clyne Castle, Singleton Abbey and Sketty Hall, Margam Park, Cwmdonkin Park, Brynmill Park, Penllergaer, Victoria Park and The Gnoll - Historic Gardens and Parks; and
d) Clyne Valley Country Park.

4.14.1.2 To better understand the Seascapes, CCW undertook a project to assess the character and special qualities of seascapes around the entire Welsh coast. The project was to inform WAG Marine Renewable Energy Strategic Framework (MRESF) and the DECC Offshore Energy Strategic Environmental Assessment (SEA). The assessment not only characterised the various seascape units, it also identified how the units were experienced by receptors,

identified the inter-visibility between the land and the sea and provided an overview of the sensitivity of the area to different forms of offshore development.

4.14.1.3 The seascape unit encompassing Swansea Bay is regional Unit 46, which runs from Mumbles Head to Porthcawl Point. The area is described as a large, sweeping, curving, sandy bay with the headland at Mumbles as the focal point to the west. It has a predominantly urban coast from Mumbles in the west to Kenfig in the east and the seascape is dominated by development on rising land in Swansea and by heavy industry around Port Talbot including the Corus (Margam) steel works, whose tall apparatus and chimneys are clearly visible from the beach. There are extensive coastal dune systems to the east at Kenfig, Margam and Crymlyn Burrows.

4.14.1.4 In terms of sensitivity to accommodate offshore renewable developments, it concludes that "east of the Tawe and around Porthcawl would be more sensitive to a development just off shore and such development would be better located in close proximity to existing industrial and man-made elements on the coast".

4.14.1.5 Further information on the landscape of the Swansea Bay area is available through Landmap. Landmap is a planning tool which was developed by CCW in conjunction with the Unitary Authorities. The objective of Landmap is to aid in the assessment of landscape giving a consistent resource for landscape planning and decision-making across Wales. Landmap, which was introduced in 1997, is a GIS (Geographical Information System) based landscape resource where landscape characteristics, qualities and influences on the landscape are recorded and evaluated into a nationally consistent data set. Information on five areas, the Geological Landscape, Landscape Habitats, Visual & Sensory, Historic Landscape and Cultural Landscape, has been collected and mapped across Wales. In Swansea Bay the visual and sensory aspect layer for the intertidal area and Mumbles is identified as High evaluation.

4.14.1.6 CCW have advised that they now adopt a definition of seascape based on the European landscape Convention, which attaches greater emphasis on character. CCW use the following: A 'seascape' is "an area of sea, coastline and land, as perceived by people, whose character results from the actions and interactions of land and sea, by natural and/or human factors."

4.14.1.7 Although the proposed development generally has a low profile (compared to an offshore wind development), with a main wall height above high tide level of around 2.5-3.5m, and the offshore visitors centre extending a potential 10-20m above the wall, its linear extent is such that a robust assessment of the potential impacts on the seascape and visual amenity needs to be undertaken. In particular initial informal feedback from discussions with County and City of Swansea Council and CCW identified the following elements would need to be considered:

i. The assessment will identify the zone of visual influence (a draft ZTV has been undertaken and this would be re-confirmed based on the final design);
ii. Identify the sensitive visual receptors (people) in the vicinity of the proposed site;
iii. Effectively illustrate the proposals with photomontages/visualisations from a selection of key viewpoints, so that an assessment can be made on the development within context of the setting. Points to include popular viewing locations at the edge of the Bay, elevated viewing locations in Swansea, higher ground viewpoints from the hills or designated landscapes;

iv. Assess the effect of the development on visual receptors, whether this is positive or negative, to what magnitude and significance;
v. Assess the effects of the development on seascape character, through defining the character and identifying the effects. Particular attention to be paid to the setting of the AONB. The quality, value and capacity to accommodate the proposed changes should be evaluated for the different parts of the seascape identified;
vi. Consider the effect of morning, high sun and low evening lighting conditions, night lighting, high and low tide differences;
vii. Consider the effect of navigational lighting; and
viii. Consider any longer term changes as a result of changes in coastal processes and the effect this may have on the "character" or uses of areas.

4.14.2 Proposed Assessment Methodology

4.14.2.1 The following scope has been developed with reference to suitable best practice guidance including: 'Guidance on The Assessment of the Impact of Offshore Wind Farms, Seascape and Visual Impact Assessment', widely referenced as the principal seascape best practice guidance, 'Guidelines for Landscape and Visual Impact Assessment (2nd Edition)' (2002) Guidance published by The Landscape Institute and Institute of Environmental Management and Assessment; and 'Landscape Character Assessment' (2002) published by The Countryside Agency and Scottish Natural Heritage.

4.14.2.2 'Seascape' represents *'the coastal landscape and adjoining areas of open water, including views from land to sea, from sea to land and along the coastline'* (Guidance on the assessment of the impact of offshore wind farms: Seascape and Visual Impact Report).

4.14.2.3 Although a 30 to 40km radius study area is recommended as best practice for off-shore wind farms with turbines well over 100m tall, guidance acknowledges that this should be tailored to the development. For the lagoon which is a more low-lying, linear development an initial ZTV has been undertaken for the outline project design. The ZTV has been based on a wall height of 3.5m above high water, with an offshore visitors centre as a block extending a further 20m above the wall. The maximum potential height of the off shore visitors centre has been used to give a worst case visual envelope.

4.14.2.4 The provisional ZTV is given in Figure 4.7 (also shown in Appendix 4.3). This figure shows where the lagoon wall could potentially be seen based on topography (landform) only, with no intervening buildings or vegetation such as trees.

4.14.2.5 Figure 4.7 illustrates that generally the majority of the views to the lagoon from east and west will be at a distance of 5km or greater. Views from the north (northwest through to northeast) will be from a closer proximity (5km), whereas those from the south would be uninterrupted views from the sea.

4.14.2.6 In more detail, views from the west appear mainly to be from the coastal area some 5-10km from the development, with the potential for glimpsed views from slightly higher ground around Pull Ddu Head and Three Crosses (10-15km). In reality, it is unlikely that views would be obtained from these locations due to intervening manmade and natural features, although this will be confirmed.

4.14.2.7 From the northwest through to northeast again the main views appear to be more constrained to the 5km coastal area. Places where more distant views could potentially be obtained are from elevated ground and up the Tawe and Neath valleys. Potential areas

where the view is extended to 10km include Townhill, Mayhill, Lisbon, Mynydd Drumau, Briton Ferry and parts of Neath. Further afield the ZTV indicates that distant views (up to 15km) may be obtained from hills north of Clydach and further up the Neath Valley, views from the latter being less likely due to built form.

4.14.2.8 From the southeast and east, again there would be potential for views along the coastal strip generally at a distance of 5 -10km and from occasional elevated land form further inshore (10-15km). As discussed before many of the non-coastal views would not be obtained due to the presence of manmade structures and trees.

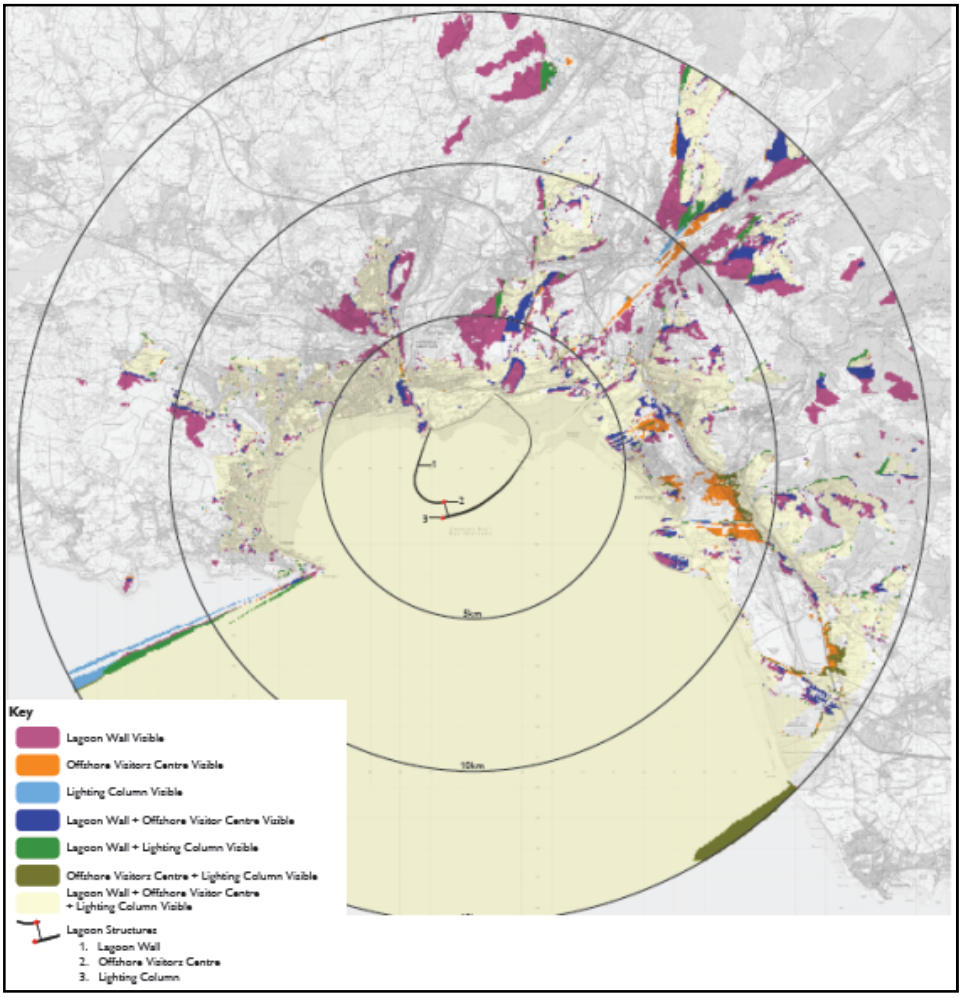

Figure 4.7 Preliminary Zone of Theoretical Visibility

4.14.2.9 For the purpose of the proposed EIA, the scope will be focused on a maximum 15km radius coastal area, which includes potential viewpoints from Mumbles Head through Sandfields to Sker point (as illustrated on Figure 4.7, also shown in Appendix 4.3). The following stages of assessment will be undertaken within the EIA:

Stage 1 - Data collation and desk study review of baseline information

4.14.2.10 Collation of baseline data including:

a) Digital terrain model tiles and OS mapping digital data for a coastal study zone based on a 15km radius from the proposed development.

b) Admiralty charts.
c) Landmap and Seascape baseline data.
d) Data on national Registers for Historic Parks and Gardens.
e) Relevant Local Development Plan baseline information.

4.14.2.11 Subsequent to this a desk-based study and review of information will be undertaken and map bases and desk-based viewpoint options assessment will be prepared. Specialist software will then be re-run to generate the Zones of Theoretical Visibility (ZTV) based on the detailed project design.

Stage 2 - Preliminary reconnaissance of the site and study area and viewpoint review

i. A familiarisation visit to the 15km-radius land-based seascape and visual study area will be undertaken with baseline information.
ii. The potential visual receptor locations will be confirmed and any refinement of land based viewpoints undertaken (see Provisional Description of Viewpoints for Seascape Assessment, Table 4.8).
iii. Consultation will be undertaken with CCW, City and County of Swansea, Neath Port Talbot County Borough Council and Bridgend CBC to confirm the final viewpoints to be used in the assessment.

Stage 3 - Field Assessment and Viewpoint Photography

4.14.2.12 Each approved viewpoint (a maximum of 15 view points) will be visited and a 50mm focal length photograph will be taken, following best practice guidance, for illustration/visualisation purposes. It is proposed that each viewpoint would have one photograph and the combined viewpoint images from the 15 sites would result in a selection of low tide, mid tide and high tide representative views.

4.14.2.13 During the photographic visits it is proposed to validate the seascape characterisation, sensitivity and value. In addition, the ability of the areas to accommodate change based on CCW Seascape and Landmap data for the study area would also be undertaken. Finally an appraisal of the potential effects on visual amenity from observations in the field would be undertaken by a fully qualified and experienced Landscape Architect.

Stage 4 - Preparation of Visualisations

4.14.2.14 A wireline model of the development will be produced and final viewpoint wirelines and refined ZTVs would be generated. All viewpoint visualisations will be presented as A3 or A3 extended size figures. The figures would also include viewing angle, grid reference and distance from the development. It is proposed that of the 15 viewpoints, depending on the view afforded and discussions with the statutory consultees, some would be represented by visualisations/photomontage and some by wirelines (specific details to be confirmed with CCW, CCS and NPTCBC). The 15 suggested preliminary viewpoints based on informal discussion with CCS and NPTCBC are given in Table 4.8.

Stage 5 – Seascape and Visual Assessment

4.14.2.15 The Seascape and Visual Assessment chapter will include:
a) An assessment of effects on seascape character based on an appraisal of available CCW Seascape data for coastal area study zone.

b) Assessment of effects on visual amenity from each of the selected viewpoints.
c) Assessment of sensitivity, value and ability to accommodate change.
d) Using a refined methodology, draw conclusions on the magnitude of change during construction and operation.
e) Consideration of potential longer term effects based on output of coastal processes model.
f) The assessment will be supported by the preparation of the following figures (A3):
g) Admiralty and Ordnance Survey Baseline Maps
h) Rights of Way and Open Access land
i) Site location and viewpoint location plan
j) Landmap Character Areas Plans (inc. cultural and historic layers)
k) Seascape Unit boundaries
l) Landscape Designations Plan
m) 15 visualisations/ wireline representations as discussed above.

Cumulative Impact Assessment

4.14.2.16 Although there are no other marine renewable projects present or proposed in the Swansea Bay area, there are other coastal developments which will be considered in this EIA. These include the proposed Swansea University Innovation Campus to the east of the Docks and the proposed Bay Sports Ltd Watersports Centre at St Helens.

Overview of proposed Viewpoints

4.14.2.17 In Swansea Bay the coastline and relative sensitivity of the area is highly variable, as is the range of receptors. As such it is proposed that the assessment will consider a number of landscape settings, receptors of variable sensitivity and a range of representative viewpoints. Initial discussions with Neath Port Talbot CBC identified three key viewpoints which should be considered within the EIA and the CCS identified 11 viewpoints. To aid further discussion these preliminary viewpoints are shown in Figure 4.8, below and an outline description of the viewpoints is given in Table 4.8. For each viewpoint Table 4.8 provides the following information: a name; an approximate grid reference and elevation (where identified); approximate distance/direction from the development; details of the unitary authority; any designations; the potential key receptors and initial comments.

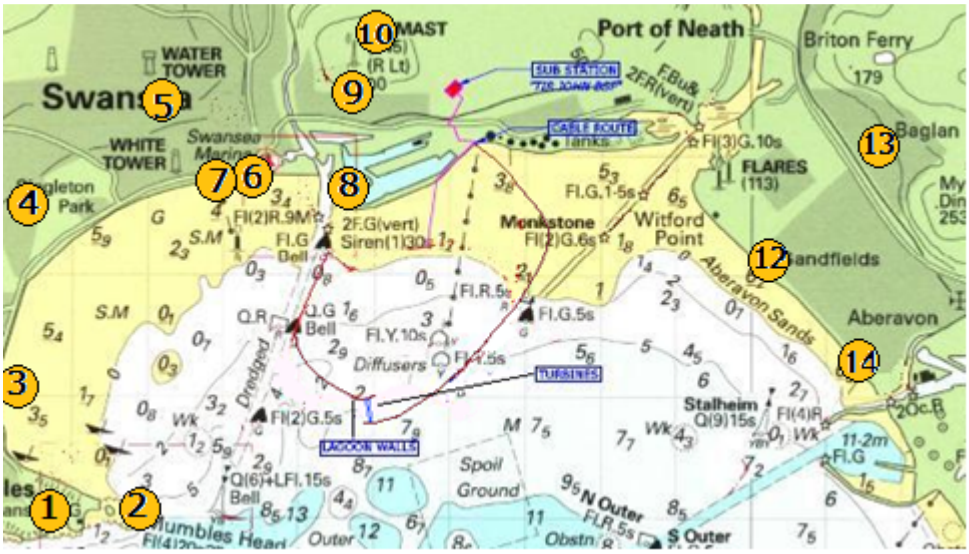

Figure 4.8 General Location of Potential Viewpoints

Table 4.8 Provisional Description of Viewpoints for Seascape Assessment

Vp no	Location	NGR	Elev^{n} (m)	Approx Distance /Direction	LPA	Landscape designation	Visual receptor	Initial comments
1	Mumbles Hill – top of hill beside trig point	2624 1876	80	7km/SW	CCS	Gower AONB, Gower HC, LOHI	Visitors/ tourist	Distant views from popular location.
2	Mumble Pier Boardwalk	263290 187513	3	7.5km SW	CCS	Gower AONB, Gower HC, LOHI	Visitors/ tourist	Popular tourist location –improvements undertaken in this area.
3	Swansea seafront – beside Lido	TBC	2	6km/W	CCS	Swansea Cycle Path - Sustran 4	Cyclists, Walkers, Visitors	Views across bay from popular location.
4	Clyne Gardens or from Golf Course.	TBC	TBC	6.5km	CCS	Gower HC, LOHI AONB	Visitors, walkers, golfers	Elevated views across bay from AONB. Number of public access points/bridleways.
5	Townhill – Nicander Parade	2640 1936	160	6.5kmNW	CCS	None	Residents	Elevated residential area. Nicander Parade provides good views across bay.
6	Meridian Quay	265820 192439	TBC	4.5km/WNW	CCS	None	Residents/ diners	Views from elevated café/dining and residential development.
7	Promenade – back of library	TBC	3	2 KM/N	CCS	None	Visitors/ Tourists	Closer views from city centre seafront.
8	SA1 residential development	TBC	TBC	2KM/N	CCS	None	Residents	Number of locations within this area would be good for photomontage – consider public area and 11 storey residential areas.
9	St Thomas/Port Tennant	TBC	40	4km/NW	CCS	None	Residents	Elevated housing area with some views across the bay. Dan-y-graig and cemetery possible points.
10	Kilvey Hill	TBC	190	3Km/N	CCS	None	Residents, walkers	Possibly from public footpath near top.
11	Margam Country Park	2799 1867	170	11km/SE	NPTCBC	LSHI	Visitors, walkers	Ruined chapel in Margam Estate as possible point (although not sure if views would be available of low lying lagoon structure).
12	Aberavon Beach seafront north	273245 190945	2m	3Km/E	NPTCBC	Designated Beach	Visitors, Tourist' Bathers	Popular beach area, with potential views from number of locations.
13	Ascot Drive, Baglan	2754 1913	100m	5km/NE	NPTCBC	Residential Area	Residents	Elevated housing area with views across the bay.
14	Aberavon Beach seafront south	274702 189275	2m	5Km/SE	NPTCBC	Seafront/Beach	Visitors, Tourist, Bathers	Popular beach area, with potential views from number of locations.
15	Sker Point	279280 179460	5m	13km/SE	BCBC	LSHI	Walkers/ Golfers	Possible view from public footpath, top of coast, just south of Kenfig Burrows.

CCS – County and City of Swansea, NPTCBC – Neath Port Talbot County Borough Council, BCBC – Bridgend County Borough Council, AONB – Area of Outstanding Natural Beauty, LSHI – Landscape of Special Historic Interest, HC – Heritage Coast.

4.15 Marine and Terrestrial Archaeology and Historic Seascape Assessment

4.15.1 Overview of Existing Situation

4.15.1.1 Swansea has a long history linked to the sea with the city originally thought to have developed as a Viking trading post. The oldest remains in the area are found on the Gower, where there is evidence of Stone Age, Bronze Age and Iron Age finds. The Red Lady of Paviland (a human male skeleton dyed in red ochre) dates back to 33,000 before present, and was found in a cave between Port Eynon and Rhossili. Along the intertidal foreshore of the Bay itself there are remnants of a submerged petrified forest, stone and wooden fish traps and trackways (~1000BC).

4.15.1.2 The City of Swansea itself became more prominent in the mediaeval period when it was the main town of its region. In 1106 a motte and bailey castle was built in Swansea, which was later destroyed and then rebuilt in 1220. With the industrialisation of Swansea, in particular from the Victorian era onwards, the nature of the coastline changed featuring a more rural setting towards the west of the bay and industry to the east. Within the wider area there are a number of important landscapes which are acknowledged through the Register of landscapes of outstanding historic/special interest in Wales.

4.15.2 Existing Baseline Data and Need for Survey

4.15.2.1 Initial informal consultation has been undertaken with Glamorgan Gwent Archaeological Trust (GGAT), Cadw and the Royal Commission on the Ancient and Historical Monuments of Wales (RCAHMW). It was confirmed that there are good baseline data sources for the area and it is known that there are a number of fish traps within the bay. Further consultation will be undertaken GGAT, Cadw and RCAHMW during the progression of the project.

4.15.2.2 Baseline information will be sought from a number of sources to encompass the intertidal and subtidal lagoon footprint and surrounding areas and the area potentially affected by the terrestrial cable route/substation. The sources will include:

i. Archaeological and historical records held by the Royal Commission on the Ancient and Historical Monuments of Wales (RCAHMW) (including maritime records).

ii. Aerial photographs held by RCAHMW.

iii. Intertidal data held by RCAHMW.

iv. Archaeological and historical records held by Welsh Historic Monuments (CADW).

v. Records of archaeological sites held by the Glamorgan Gwent Archaeological Trust (GGAT) Sites and Monuments Record (SMR).

vi. Records held by the Receiver of Wreck (Maritime and Coastguard Agency).

vii. Records of wrecks and obstructions held by the UK Hydrographic Office (UKHO), including a review of cartography, historic charts and sailing directions.

viii. The Swansea Record Office and Port Talbot library.

4.15.2.3 In addition to this site-specific data collected during the geophysical survey will be reviewed by a marine archaeologist. The survey area included the footprint of the development and 500m beyond its extent. Data collected included:

a) Bathymetric survey to provide the bathymetry of the seabed and the location to within 1m, giving approximate size, of any natural or man-made object lying on the seabed.

b) Magnetometer survey - in order to identify ferrous or ferric objects (e.g. wrecks, cables, ordnance) on or below the seabed. A 50m line spacing was utilised.
c) Sub-bottom profiling – to provide geophysical information regarding the sea-bed and submerged objects. Max 50m line spacing.
d) Side scan: to map seafloor textures, sediment boundaries, seabed features and hazards or obstructions.

4.15.2.4 Finally a walkover survey will be undertaken of intertidal and terrestrial area potentially affected by the lagoon infrastructure, cable route and substation as well as adjacent areas.

4.15.3 Scope of Potential Impact to be Assessed

4.15.3.1 Guidance on assessment methodology for marine developments such as offshore wind farms can be found in the following documents.

i. http://www.offshorewind.co.uk/Assets/archaeo_guidance.pdf
ii. http://www.offshorewind.co.uk/Assets/final%20GEORARCH-09%20Offshore%20Geotech%20Guidance%20web.pdf
iii. http://we-at-sea.org/docs/ecologicalReports/General/cowrie_ciarchweb.pdf
iv. http://www.thecrownestate.co.uk/media/122834/wsi_renewables.pdf
v. http://www.thecrownestate.co.uk/media/122838/pad_offshore_renewables.pdf

4.15.3.2 The above documents will be reviewed and the guidance appropriate to the lagoon development taken onboard. Notwithstanding this it is proposed that the Institute of Field Archaeologists (IFA) *Standard and Guidance* be followed. In particular a desk-based assessment, as identified by the IFA *Standard and Guidance for Archaeological Desk-based Assessment* (IFA 1999) will be undertaken. Although this assessment is based on desk-based (i.e. secondary) sources, provision is made for the archaeological interpretation of new primary data arising from a marine geophysical survey of an offshore development area.

4.15.3.3 The approach would also reflect the requirements of Environmental Assessment arising from European Council Directive 85/337/EEC as amended by Directive 97/11/EC. And the following stages are proposed:

a) Consultation/baseline data collation;
b) Baseline description of known and potential archaeological resource;
c) The identification of development-related impacts on the archaeological heritage, based on information about the construction and operation of the proposal including potential changes in coastal processes;
d) Consideration of the significance of the effects – including indirect, secondary and cumulative effects – of any such impacts, taking into account previous disturbance and the importance of the known and potential archaeological heritage;
e) Proposals for mitigating significant adverse effects on the archaeological heritage;
f) Identification of any residual effects, being effects that will occur notwithstanding mitigation.

4.15.3.4 In terms of Registered Historic Landscapes Margam Abbey and Mountain, and Merthyr Mawr, Kenfig and Margam Burrows are all relatively distant (approx 9 – 11km). The preliminary results of the initial worst case ZTV for the lagoon indicates that there is potential for some limited views from the elevated land around Margam and also distant views from along the coast. Preliminary informal discussion with GGAT has indicated that as the Registered Historic Landscapes are distant and, although it maybe visible, the lagoon will be generally a low lying structure such that a significant impact on the historic landscapes is not anticipated. As such an assessment of the significance of the impact of the development on historic landscape areas on the register of historic interest in Wales (ASIDOHL) should not be required. However an assessment of potential effect on the seascape from viewpoints within Margam and Sker/Kenfig has been included within the seascape and visual Impact assessment (Table 4.8, View point 11 and 15). The findings of this assessment will be used to inform the historic landscape assessment (see below).

4.15.3.5 An assessment will also be undertaken of the wider historic seascape/landscape. This assessment will address the degree to which the proposed lagoon accords with or detracts from the historic seascape, including the maritime cultural landscape. The historic sea/landscape appraisal will be informed by the *Guide to Best Practice in Seascape Assessment* (Hill *et al.* 2001). This methodology is currently being reviewed and a pilot study is being undertaken by CCW in North Wales. If available, the findings of this pilot study will be reviewed and any relevant changes in methodology taken on board. Overall it is proposed that the assessment will identify the likelihood of significant effects of the scheme on the historic landscapes.

4.16 Marine and Terrestrial Noise Assessment

4.16.1 Overview of Existing Situation

4.16.1.1 Swansea Bay comprises a diverse range of components varying from the more remote tranquil areas of the Gower, to a popular seafront frequented by residents and visitors, backed by a busy town and city centres and with coastal ports and industrial areas. The waters within the bay also have a number of varied uses ranging from water based recreational activities, to fishing and commercial port activities. As such the baseline noise levels across and within the bay will vary depending on geographic location, time of day and season.

4.16.2 Existing Baseline Data and Need for Survey

4.16.2.1 Discussions will be held with the Environmental Health Departments of Swansea and Neath Port Talbot Councils. Existing baseline data will be sought and information on sensitive receptors or historic noise issues would also be requested. In addition to this baseline surveys will be carried out during appropriate “conditions”. Proposed conditions cover sea state, maritime activity and meteorological conditions in the case of the underwater measurements; and meteorological conditions and terrestrial activity in the case of the measurements on land.

4.16.2.2 In addition to requests for baseline data from the local councils it is proposed to undertake the following surveys:

i. one week of continuous terrestrial noise monitoring data at four locations to quantify the terrestrial noise climate (further details are given below);
ii. three “survey vessel days” for the underwater element of the project.

4.16.2.3 Seasonal variations will be considered with respect to differences in both baseline and sensitivity (human) related to tourist activity.

Terrestrial Noise Survey

4.16.2.3 An environmental noise monitoring survey will be undertaken to quantify the prevailing background and ambient noise levels at up to four selected assessment locations. The locations would be representative of sensitive receptors e.g. affected residential premises, public amenity areas or other relevant positions (e.g. habitat areas). The locations chosen would have to be secure such that the survey equipment is not tampered with.

4.16.2.4 Survey measurements will be carried out following guidelines described in BS 7445: 1991 *Description and measurement of environmental noise Part 2 - Acquisition of data pertinent to land use.* The survey would include continuous monitoring to establish trends in noise variations throughout daytime/night-time and weekday/weekend periods. Manual measurements would also be undertaken to determine the character and level of the specific noise source(s) of interest and to describe in more detail variations in noise levels around the Bay.

4.16.2.5 The acoustic parameters LAmax, LA10, LAeq and LA90 will be measured during the survey at suitably representative locations. Meteorological conditions will then be observed to establish the validity of the noise data.

Underwater Noise Baseline Study

4.16.2.6 Calibrated reference standard hydrophone recordings are proposed for three depths at key locations in the study area. The locations would be related to both likely species activity and noise sources in the area. Precise GPS locations of each data capture sequence will be logged during the survey and standoff distances from other noise sources (ie vessels) estimated.

4.16.2.7 The calibrated signal chain would provide data acquisition using industry standard precision equipment, with the 'dry side' of the system housed in a site-proofed weather resistant enclosure. This equipment would either be battery powered or run from mains power if available on the survey vessel. The measurement data would be post-processed and reported in a format which enables direct comparison against any future monitoring.

4.16.3 Scope of Potential Impact to be Assessed

Terrestrial Noise

4.16.3.1 In terms of acceptable noise limits in the UK no fixed limits apply to the construction site noise. However, advice and guidelines to local planning authorities and developers can be found in TAN (11), British Standard BS 5228 (3) and Department of the Environment (DoE) Advisory Leaflet (AL) 72 (4). Although AL 72 is out of print it remains as guidance on acceptable levels of noise.

4.16.3.2 The DoE AL72 gives advice as to maximum levels of construction site noise at residential locations during daytime hours (0700-1900). The document states that the noise level outside the nearest occupied room should not exceed 75 dB(A) in urban areas near to main roads in heavy industrial areas; or 70 dB(A) in rural, suburban and urban areas away from main road traffic and industrial noise. These levels are generally taken as being facade L_{Aeq} (that is average sound levels at the building façade). AL72 also suggests that in the evening period a level of 10 dB(A) below that during the day may be appropriate. Generally

daytime hours are taken to be from 07.00 to 19.00, evening from 19.00 to 23.00 and night time from 23.00 to 07.00.

4.16.3.3 The proposed activities linked to the lagoon's construction will be assessed against baseline conditions and other guidance standards in relation to the significant elements, for instance piling works and any activities which are required out of normal working hours. This would also include consideration of additional HGV movements generated as a result of the rock armouring importation, if the road option is progressed. It is not anticipated that there will be any other significant traffic generated noise impact.

4.16.3.4 To provide a visual reference to the extent of any noise impact, a noise map will be presented as colour contour plots at an appropriate scale, typically 1:25000. Calculations would be undertaken in accordance with ISO 9613: 1996 *Acoustics - Attenuation of sound during propagation outdoors Part 2: General method of calculation.* Any significant adverse impacts would be highlighted and mitigation measures proposed.

4.16.3.5 The results of the terrestrial noise assessment will then be used to input the ecology and ornithology assessment such that the potential effect could be assessed in relation to sensitive wildlife areas and species. Consideration will be given to the timing of any noisy work activity and the presence of receptors such as migratory birds associated with Blackpill SSSI or the intertidal areas of the bay. The findings of the assessment will be reported in the relevant chapter and mitigation measures proposed where necessary.

Underwater Noise

4.16.3.6 The proposed lagoon scheme will be reviewed in detail to establish all activities likely to give rise to significant underwater noise levels. This is likely to include dredging works, piling and general increased activity levels from vessels on the water.

4.16.3.7 The underwater noise levels predicted from these activities will be determined by reference to previous recorded measurements and other published sources. The predicted noise levels can then be compared with the baseline conditions and the impact assessed in relation to species sensitivities. The species sensitivities would be identified in liaison with the project marine biologist. Any significant adverse impacts would be highlighted and mitigation options proposed.

4.16.3.8 Finally an assessment would also be made of the potential underwater noise impact on marine species from the turbines during operation.

4.17 Onshore Transport Assessment and Air Quality

4.17.1 Overview of Existing Situation

4.17.1.1 The City of Swansea is well served by the A483, Fabian Way, dual carriageway which connects to the M4 motorway. These roads provide good transport links across Wales and further afield. On a more local level there are good connections from the A483 directly to Swansea docks. In addition to this Swansea is also served by the national rail network with railway lines accessing directly to the docks, providing existing suitable transport infrastructure for the construction phase of the project.

4.17.1.2 In terms of air quality City and Council of Swansea (CCS) established a programme of automatic and continuous air quality monitoring dating back to 1994. More recently the CCS declared the Hafod district of Swansea, parts of the lower Swansea Valley, as an Air

Quality Management Area (AQMA). An AQMA is an area where air pollution is expected to be above the National Air Quality Standards and where people could be exposed to air pollution. Actions must be identified to reduce the pollution in these areas in order to attempt to resolve the problem. As air quality improves the AQMA may be reduced in size or removed completely.

4.17.1.3 Within Swansea there are currently 5 air quality monitoring stations (two with basic meteorological data), one 30 metre meteorological mast, one street canyon meteorological monitoring station and one AQ500 SODAR (wind profiler) providing data. Additionally, real-time PM_{10} (dust) data is available from 10 locations in Swansea, mainly situated around busy junctions.

4.17.1.4 Neath and Port Talbot CBC also have declared AQMA, namely Taibach / Margam Air Quality Management Area for PM_{10} (dust). Neath Port Talbot also have a range of monitoring sites for determinands including carbon monoxide, nitrogen dioxide, ozone, PM_{10} particulate, sulphur dioxide and weather sensors.

4.17.1.5 During the construction phase, increased traffic with associated noise and dust may be generated through delivery and installation of materials for the lagoon. In terms of access ABP has indicated that any construction compound within the docks can be accessed from their eastern gateway (which was closed to daily use in 2009) and this has a direct link to Fabian Way.

4.17.1.6 For the lagoon wall construction a significant amount of the material to be used will be sourced on-site by sea-based vessels, through appropriate dredged sediment being used to fill the geotextile tubes or wall foundation. It is proposed that the rock armour that will surround the geotextile tubing will be appropriately sourced in the most economically and environmentally efficient way. If taken from an existing operational quarry, it is assumed that any potential local effects and required mitigation (e.g. noise, dust, transport ecology etc) will be addressed under the current operational requirements of the quarry. Notwithstanding this if transported by road the import of the rock armour to the local Swansea area would generate a significant number of HGV movements and the impact of this on the existing road network will need to be assessed. Alternative transport routes, such as rail, are also being investigated at this scoping stage and final details of the rock source and import route will be presented in the EIA.

4.17.2 Existing Baseline Data and Need for Survey

4.17.2.1 Existing baseline traffic data for the A483 road, dock access route and the M4 junction (if available) will be sought from the Highways department of the City and County of Swansea. As such no site-specific survey is proposed, to the extent that sufficient data is available.

4.17.2.2 Data on existing air quality will be sought from the local councils, CCS and NPTCBC.

4.17.3 Scope of Potential Impact to be Assessed

4.17.3.1 The proposed assessment will:

a) Identify access routes to the Swansea Dock area and present the baseline situation with respect to the surrounding roads.

b) Determine the potential impact of the increased traffic associated with the key stages of construction and proposed mitigation where necessary.

c) The assessment will also take into account potential knock-on effects like increased noise or dust. These parameters will be assessed against the relevant standards and mitigation measures will be recommended where necessary.

d) Traffic associated with the operation and maintenance of the lagoon is anticipated to be minimal. However, it is intended that the lagoon will form a new focal point as a tourist attraction within the bay. Transport consideration (access and parking) to address future "tourist" opportunities will be reviewed.

4.18 Economy, Tourism and Recreation

4.18.1 Overview of Existing Situation

4.18.1.1 As discussed in previous sections, Swansea Bay is important in terms of the tourist industry and its impact on the area's economy. In 2008 tourism contributed over £300 million to the local economy, with over 4.1 million people visiting the area. Recently a £4 million funding package was put in place which takes the Bay closer to being a watersports centre of excellence. Watersports such as sailing, canoeing, kayaking, rafting, surfing, rowing, windsurfing and kite-surfing all feature under the proposals.

4.18.1.2 The Gower Peninsula to the west of Swansea Bay is one of the largest tourist attractions in Wales and is designated as an Area of Outstanding Natural Beauty (AONB). Swansea Bay's beaches are one of its most important tourism and recreational assets, providing facilities for numerous leisure activities. The award-winning Swansea Maritime Quarter is another attraction and includes Swansea Marina, which acts as a platform for marine-based recreational activities.

4.18.1.3 Port Talbot, on the eastern edge of Swansea Bay, provides a more industrial backdrop. However tourism and recreation interests are still present, with Aberafan Sands blue flag bathing beach located just to the north, popular for its surfing opportunities amongst others. South of the docks are areas of nature conservation importance, with country parks and open spaces. The beaches to the south east of the Bay are important for recreation and tourism, with the coastline from Porthcawl towards Nash being a designated Heritage Coast. Water-based recreation occurs in many inshore parts, including boating, surfing, windsurfing and jet skiing.

4.18.1.4 Recreational navigation occurs throughout the Bay as a whole, with small craft using the marinas in the Rivers Tawe and Neath. Finally recreational fishing (Section 4.9) is another significant activity within the region which contributes to the local economy.

4.18.1.5 Given the importance of tourism and recreation for Swansea Bay's economy, the proposed lagoon and associated infrastructure, offers potential for both positive and negative impacts from the scheme during its construction and operation. As such an assessment of potential effect is required with mitigation being proposed where necessary.

4.18.2 Existing Baseline Data and Need for Survey

4.18.2.1 Existing baseline data on the current uses of the area will be obtained from the internet and through consultation with the following groups (non-exhaustive list). A more extensive list of consultees is provided in Appendix 1.2. No site-specific survey work is proposed.

i. City and County of Swansea,
ii. Neath Port Talbot County Borough Council,
iii. Welsh Government - Visit Wales (formerly Wales Tourist Board),

iv. South West Wales Tourism Partnership,
v. Marine leisure groups (sailing, watercraft, angling and diving),
vi. The Gower Society,
vii. Swansea Bay Golf Club.

4.18.3 Scope of Potential Impact to be Assessed

4.18.3.1 It is evident that the general area supports a significant amount of recreational activities. However it is also apparent that these activities are localised to some parts of the Bay more than others. It does potentially appear that the areas to the north of the Bay, between the accesses to the River Tawe and the River Neath, are used less than other areas for recreation, likely due to more limited coastal access in that location. As such the proposed lagoon may impinge less on recreational activities than if another site within the Bay had been proposed; in addition proposals may offer the opportunity for increased recreational activity within the intended area. Notwithstanding this the ES will undertake the following assessment.

4.18.3.2 Initially national guidance, policies and strategies relating to tourism within the area potentially affected would be reviewed. These will include:

a) Planning Guidance (Wales), Technical Advice Note (Wales) 13: Tourism (1997)
b) Policies within City and County of Swansea LDP
c) Policies within Neath Port Talbot County Borough Council LDP

4.18.3.3 An overview of the existing uses of the Bay, based on the findings of the consultation will then be provided.

4.18.3.4 An assessment of potential impacts (both positive and negative) during construction will be undertaken reflecting the various uses. Mitigation measures will be proposed where necessary. Note: during construction and operation, the potential impacts associated with landscape, marine craft usage, navigation, noise and recreational fishing will be addressed within the relevant chapter. For completeness, the findings from those chapters will be included within this assessment.

4.18.3.5 Finally, there is scope for the proposed Swansea Bay Tidal Lagoon to present an opportunity to further develop the local tourist or fishing industries. For instance, in France La Rance Estuary barrage is widely advertised as a visitor attraction and attracts around 70,000 visitors per year (with numbers as high as 200,000 also quoted). It is the intention of the developer for Swansea Bay tidal lagoon to integrate and optimise opportunities for recreational and sporting use of the seawall and internal water area, as well as using the development as a platform for a renewable energy centre for education and cultural programmes. Potential opportunities will be identified during the detailed design of the project and through the consultation process. Information on these opportunities will be presented in this chapter of the ES, though specific onshore developments related to these opportunities will be dealt with under a separate planning application.

4.19 Overall Conclusions and Summary of Proposed Mitigation

4.19.1 The conclusions of the assessments from each chapter of the ES will be presented within this section. Any mitigation identified within the chapter will be identified and residual impacts will be presented.

4.19.2 Finally an outline of any monitoring proposals identified in the various environmental subject areas during the EIA process will be given.

4.20 Habitats Regulation Assessment

4.20.1 Introduction

4.20.1.1 The proposed Swansea Bay Tidal Lagoon is not located within any internationally designated Special Areas of Conservation (SAC), Special Protection Areas (SPA) or Ramsar site (collectively known as Natura 2000 Sites) and therefore there will be no direct impacts. Notwithstanding this, projects taking place outside a Natura 2000 site might also be subject to appropriate assessment if it is considered that the project or development may have an impact on the conservation interests of the site.

4.20.1.2 As such, there is a requirement for the Competent Authorities to carry out a Significance Test under Regulation 61 of the Conservation (Natural Habitats, &c.) Regulations 2010. For Natura 2000 sites the process by which the impacts of a project are assessed against the conservation objectives of a European site is known as Habitats Regulations Assessment (HRA). The HRA determines whether there will be any likely significant effects (LSE) on any European site and, if so, whether these effects will result in an adverse impact on its integrity. The European Commission guidance details a four-stage process (see table below) for HRA, although not all stages are necessarily required here:

Table 4.9 Habitats Regulations Assessment: Key Stages

Stage 1	
Screening for likely significant effect	• Identify international sites within the influence of the plan agreed with the Statutory Body – Countryside Council for Wales (CCW) in this case. • Examine conservation objectives of the interest feature(s) (where available). • Review plan policies and proposals and consider potential effects on European sites. • Examine other plans and programmes that could contribute to 'in combination' effects.
	• *If no effects likely – report no significant effect (taking advice from CCW as necessary).* • *If effects are judged likely or uncertainty exists, the precautionary principle applies go to **stage 2***
Stage 2	
Appropriate Assessment (AA)	• Complete additional scoping work including the collation of further information on sites as necessary to evaluate impact in light of conservation objectives. • Agree scope and method of AA with CCW. • Consider how plan 'in combination' with other plans and programmes will interact when implemented (the Appropriate Assessment). • Consider how effect on integrity of site could be avoided by changes to plan and the consideration of alternatives. • Develop mitigation measures (including timescale and mechanisms). • Report outcomes of AA including mitigation measures, consult with CCW and wider [public] stakeholders as necessary. • If plan will not significantly affect European site, proceed without further reference to Habitats Regulations.
	• *If effects or uncertainty remain following the consideration of alternatives and development of mitigations proceed to **stage 3.***
Stage 3	
Assessment of alternative solutions	• Consider alternative solutions, delete from plan or modify. • Consider if priority species/ habitats remain affected.
Stage 4	
Procedures where Sig effect on integrity of International site remains.	• Identify 'imperative reasons of overriding public interest' (IROPI) economic, social, environmental, human health, public safety. • Notify Assembly Government. • Develop and secure compensatory measures.

4.20.1.3 With regard to major projects subject to examination by PINS guidance can be found in former IPC guidance "Habitats Regulation Assessment – Advice note ten: Habitats Regulation Assessment relevant to nationally significant infrastructure projects". In this document it states that "The developer should carry out the necessary preparatory work during pre-application to a level of detail that will enable the competent authority to meet its duty under the 2010 Habitats Regulations (as amended). This work should result in information which will show beyond reasonable doubt whether any European sites are likely to be affected by the NSIP proposal, either alone or in combination with other plans or projects, describe the likely impacts on the conservation objectives of the European sites (which may be direct or indirect, temporary or permanent, or a combination of these) and describe whether the impacts are likely to be significantly adverse."

4.20.2 Scope of Potential Impact to be Assessed

4.20.2.1 As the first step in providing information for the competent authority to undertake an assessment, an initial identification of potential sites has been undertaken within this scoping document as discussed below.

4.20.2.2 Within the wider Swansea Bay coastal area there are a number of SACs, SPA and Ramsar sites and Table 4.10 presents a preliminary screening of these sites. In the table details of these sites and the primary reason for their selection is presented. Subsequent to this, the approximate distance of the lagoon to the site along with comments on the potential for the features to be affected and the need for further review and therefore potential assessment within the EIA is given.

4.20.2.3 The potential for each SAC/SPA to be affected has been based on the initial findings of the high level coastal process modelling completed for the project. High level modelling suggests that the proposed lagoon will cause some changes to localised wave and current movement and this in turn may affect localised sediment deposition and accretion. As might be expected, the lagoon in Swansea Bay is shown to have a direct influence on local tidal circulations and waves arriving at the nearby coast. These local changes are likely to modify sediment movements within the bay but there appear to be less change outside of the bay and no major far-field effects. The high level modelling also suggests no far-field effects in the tidal regime across the wider area (downstream in the Bristol Channel and upstream in the Severn Estuary). These findings and the potential extent of effect will be confirmed during the detailed modelling for the EIA and this preliminary screening of sites will be reviewed.

4.20.2.4 For those specific sites identified as requiring further assessment (highlighted for ease of reference), information for and the findings of a test of likely significant effect (LSE) for the proposed lagoon development will be undertaken. To facilitate the LSE test a staged approach is proposed.

4.20.2.5 Initially for those sites identified, the findings of the coastal assessment study will be used to determine if there will or will not be an affect on sediment erosion/deposition patterns and therefore potentially habitats/species in:

i. the short term (construction), and
ii. long term (operation of the project).

4.20.2.6 If a potential effect on coastal process and subsequent sediment movement patterns is predicted adjacent to the site, the conservation objectives for the site will be reviewed. An assessment will then be made of the potential for the proposed project to affect these and the overall integrity of the site will be determined.

4.20.2.7 Mobile species associated with the SAC/SPA, for instance migratory fish or birds, which may pass through Swansea Bay will be subject to assessment regarding the potential of these to be affected by the construction and operation of the project. The assessment will focus on determining if there is a potential to affect the integrity of the Natura sites.

4.20.2.8 With regard to other designations in the area, SSSI and UK BAP habitats and species these will be addressed within the relevant section of the ES as discussed in this document.

Table 4.10 Preliminary Screening for Proposed Assessment for Natura 2000 sites

Site	Key Designation	Distance and Observation on need for Further Assessment
Kenfig SAC	**Annex I habitats – primary reason for selection**. **2130** Fixed dunes with herbaceous vegetation (`grey dunes`) **2170** Dunes with *Salix repens* ssp. *Argentea* (*Salicion arenariae*) **2190** Humid dune slacks **3140** Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.	Approx 11.5km. Although distant this site could potentially be affected by changes in sediment erosion and accretion processes along the coastline. As such the results of the coastal processes study will be used to determine if there is a potential for effect and, if so, an assessment the potential effect will be undertaken.
Dunraven SAC	**Annex II species that are a primary reason for selection of this site:** This site is designated for the presence of 20 or so plants of shore dock (*Rumex rupestris*) which grows on damp coastal limestone. They are the only remnant of the species' former Bristol Channel range.	This site is located some 26km from the proposed lagoon. Due to the distance and the fact that the plant species in question are associated with damp coastal limestone, no impacts are anticipated from the proposed development. As such no further assessment will be undertaken in the EIA.
Limestone Coast of South West Wales SAC	**Annex I habitats – primary reason for selection**. **1230** Vegetated sea cliffs of the Atlantic and Baltic coasts **2130** Fixed dunes with herbaceous vegetation (`grey dunes`) There are also a number of Annex I habitats that are not a primary reason for selection. These include dry heaths, semi-natural grasslands, caves and partially submerged sea caves.	Based on the JNCC website this SAC appears to be located off the south Pembroke coast some 70km from Swansea bay. Due to the distance and the nature of the Annex I features no potential impacts are anticipated. As such no further assessment will be undertaken.
Carmarthen Bay and Estuaries SAC	**Annex I habitats – primary reason for selection**. **1110** Sandbanks which are slightly covered by sea water all the time **1130** Estuaries **1140** Mudflats and sandflats not covered by seawater at low tide **1160** Large shallow inlets and bays **1310** *Salicornia* and other annuals colonising mud and sand **1330** Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)	This SAC extends from south of Tenby in the West to Port Eynon in the east. The eastern extent being approximately 20km from the proposed lagoon development. The main annex 1 feature is associated with the inner SAC bay area and it is not anticipated that there will be any effect from changes in coastal process from the proposed development on this area. This will be confirmed by the detailed coastal process assessment during the EIA.
Burry Inlet SPA/Ramsar	This site qualifies under Article 4.2 of the Directive (79/409/EEC) by supporting populations of European importance of the following migratory species: **Over winter;** Oystercatcher *Haematopus ostralegus*, 13,590 individuals representing at least 1.5% of the wintering Europe & Northern/Western Africa population (5 year peak mean 1991/2 – 1995/6). Pintail *Anas acuta*, 1,772 individuals representing at least 3.0% of the wintering Northwestern Europe population (5 year peak mean 1991/2 – 1995/6) **Assemblage qualification: A wetland of international importance.** The area qualifies under Article 4.2 of the Directive (79/409/EEC) by regularly supporting at least 20,000 waterfowl.	The SPA extends between the Gower Peninsula and Llanelli, and at its closest it is approximately 27km from the lagoon development. With the location of this SPA/Ramsar site tucked in around the Gower peninsular no potential impacts on the sites integrity are anticipated. No further assessment of the SPA/Ramsar will be undertaken.
Severn Estuary SAC/SPA/Ramsar	The SAC is designated for the following features and species. **Annex I habitats – primary reason for selection**. **1130** Estuaries **1140** Mudflats and sandflats not covered by seawater at low tide	The SAC/SPA/Ramsar extends from the upper Severn and the southern boundary runs from Lavernock Point near Cardiff to Bridgwater Bay in Devon. The site is approximately 60km upstream of the proposed Lagoon and therefore no direct impacts are anticipated on the designated features.

Site	Key Designation	Distance and Observation on need for Further Assessment
	1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) **Annex I habitats – present as a qualifying feature but not a primary reason for site selection.** **1110** Sandbanks which are slightly covered by sea water all the time **1170** Reefs **Annex II species that are a primary reason for selection of this site:** **1095** Sea lamprey **1099** River lamprey **1103** Twait Shad The SPA qualifies under Article 4.1 of the Directive for supporting populations of European important numbers of over wintering Bewick's Swan (*Cygnus columbianus bewickii*). It also qualifies under Article 4.2 for supporting populations of European importance of a range of migratory species which are on passage or over winter and it also supports a wetland of international importance. The Severn Estuary is also designated for a number of Ramsar criterion including the sites tidal range, unusual estuarine communities, diverse fish as a whole, migratory fish and winter counts of migratory birds.	Notwithstanding this there maybe a potential to affect migratory species associated with the SAC/SPA, such as migratory fish. As such further assessment will be undertaken within this EIA.
River Wye SAC	The River Wye is designated for its Water courses of plain to montane levels In addition to this it also has a number of Annex II species that are a primary reason for site selection which include: **1095** Sea lamprey **1096** Brook lamprey **1099** River lamprey **1103** Twait Shad **1106** Atlantic Salmon **1163** Bullhead	Although the River Wye is distant from Swansea bay, there are a number of the Annex II species which migrate along the coast and may have the potential to be affected by the proposed lagoon. Further assessment of potential effects will be undertaken within the EIA.
River Usk SAC	The River Usk also has a number of Annex II species that are a primary reason for site selection which include: **1095** Sea lamprey **1096** Brook lamprey **1099** River lamprey **1103** Twait Shad **1106** Atlantic Salmon **1163** Bullhead	Although the River Usk is distant from Swansea bay, there are a number of the Annex II species which migrate along the coast and may have the potential to be affected by the proposed lagoon. Further assessment of potential effects will be undertaken within the EIA.

5. Summary of Proposed Surveys

Proposed Survey work	No./Locations	To inform
An AWAC device was deployment for 3 months of continuous tidal period to collect waves, water levels, current profiles, suspended sediment (acoustic backscatter) combined with OBS for suspended sediment (turbidity).	Two locations - 1. vicinity of the proposed lagoon turbine discharge . 2. sub-tidal area in the lee of the lagoon.	Coastal Processes Marine Water quality Navigation – small craft
The following water and sediment samples were collected at times of deployment and recovery of devices. Water Samples (SSC) Deployment - 42 Suspended Sediment Samples for OBS calibration and to aid ABS data calibration Recovery – 6 Suspended Sediment Samples, 3 per site (bottom, mid depth, surface) Grab Samples (PSA) 4 samples in total - 1 per site, at the start and end of the deployment.	As above.	Coastal Processes Benthic Assessment Marine Water quality
The geophysical survey included: a) Bathymetric survey to provide the bathymetry of the seabed and the location to within 1m, and approximate size of, any natural or man-made object lying on the seabed. b) Magnetometer survey - in order to identify ferrous of ferric objects (e.g. wrecks, cables, ordnance) on or below the seabed. A 50m line spacing wsa utilised. c) Sub-bottom profiling – to provide geophysical information regarding the sea-bed and submerged objects. Max 50m line spacing. d) Side scan: to map seafloor textures, sediment boundaries, seabed features and hazards or obstructions.	Lagoon footprint, 500m buffer area as well as potential cable/ landfall points; it was extended to provide tie-in lines for existing geotechnical investigations, and give lines along the coastline to the east and west of the proposed lagoon.	Coastal Processes Benthic Ecology Marine Water Quality Marine Archaeology
Samples to be collected as part of benthic sampling programme. Samples to be analysed for benthic species, Carbon content and particle size distribution on all sites. Metals analysis on approximately 50% of the sites.	Samples to be collected at 30 sites - 13 within site, 6 no. at edge of 500m buffer around site, 9 upstream and downstream tidal extent and 2 controls (see Appendix 4.1).	Coastal Processes Benthic Ecology Marine Water quality

Proposed Survey work	No./Locations	To inform
Epifauna/fish trawls to obtain qualitative samples of the epibenthos from across the area. The survey will comprise beam trawls for a distance of 200m (as pre WFD) using a 2m beam trawl with 5mm cod end mesh. The material collected in the trawl to be fixed in a 10% buffered formalin and seawater solution.	7 trawls in total; 4 within development area; 2 to represent the major biotypes upstream and downstream of development area; one trawl up tide to represent a control.	Benthic Ecology Fisheries
Intertidal walkover survey : a) to confirm the presence and distribution of the Sabellaria in the intertidal area, and b) to assess the sensitivity of the intertidal habitat directly impacted by the proposals.	Landward connection with a 50m buffer either side. In addition to this a general walkover to check for the presence of *Sabellaria* will be undertaken.	Intertidal Ecology
Phase 1 walkover survey. The walkover survey would map the broad habitats present, identify the potential for protected species, the need for further survey and the presence of any controlled invasive species (e.g. Japanese Knotweed, Himalayan Balsam).	Temporary construction compound, substation and grid connection route.	Terrestrial Ecology
Bird Surveys - Monthly low water and high tide core counts (WeBS) and movement surveys which covered the months of October 2011 to March2012, inclusive.	The vantage points were positioned to cover Blackpill SSSI and the intertidal area at Crymlyn Burrows/Neath Estuary.	Coastal Bird Assessment
Viewpoint analysis and photography.	Photography from 15 viewpoints.	Seascape and Visual Amenity Impact Assessment. Historic Landscape Assessment
Archaeological Walkover survey.	Walkover survey of intertidal area and cable route where appropriate.	Archaeological assessment
Baseline marine and terrestrial noise surveys.	One week continuous terrestrial noise monitoring at 4 locations. Manual measurements would also be undertaken to determine the character and level of the specific noise source(s). Three survey vessel days to characterise baseline marine noise.	Noise Assessment Ornithology Marine ecology/fisheries Marine Mammals

6. References

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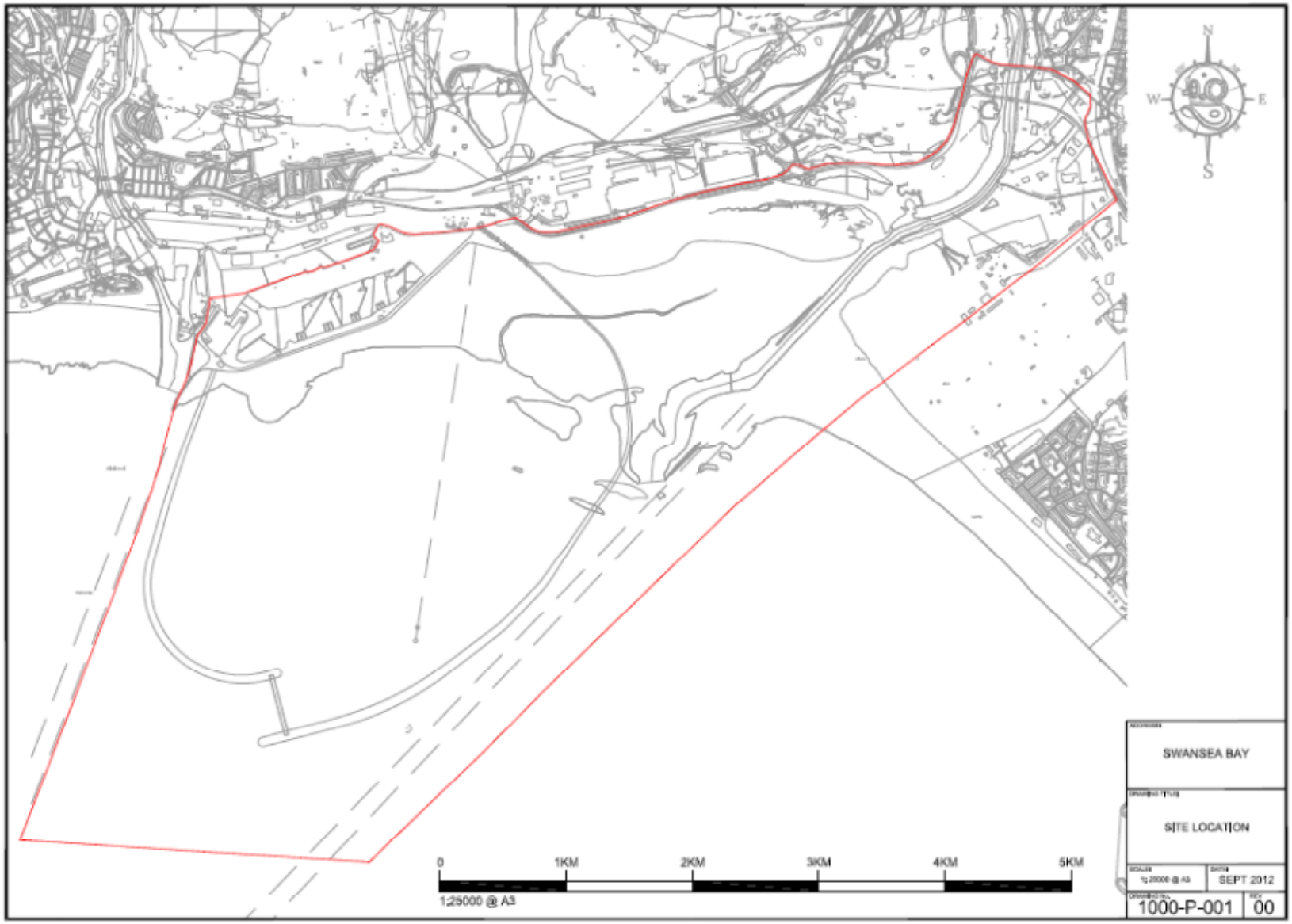
Appendix 1.1 Proposed Location of Anticipated Main Tidal Lagoon Works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SWANSEA BAY
SITE LOCATION
SEPT 2012
1000-P-001
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Appendix 1.2 Preliminary list of Consultees and initial informal feedback

Tidal Lagoon Swansea Bay Ltd

Preliminary list of Consultees and initial informal feedback

Organisation	Met/Contacted?	Comments/Key issues
3M Road Runners	Meeting 22.3.12	Positive feedback on future lagoon uses.
Aberavon Canoe Club	25/6/12 tel con.	Made contact - very supportive.
Aberavon Green Stars	Meeting 18.7.12	Positive response on project.
Aberavon Lifeguard Club	8/5/12 tel cons	Requested project information.
Aberavon RFC	23/4/12 tel cons	Initial contact made.
Aberavon Surf Clubs	19/6/12 tel cons	The surf club has disbanded but there are surfers actively using the beach. Sent project details for information.
Active Swansea (ladies only running club)	7/2/12 tel con	Made contact – meeting not wanted at this stage.
Afan Boat Club	Meeting 18.5.12	Attended the Monkston sailing club presentation.
Afan Lido Football Club	24/4/12 tel cons	Provide project information – meeting not wanted at this stage.
Afonydd Cymru	Meeting 31.5.12	Concerns about fish migration
All Whites' Former Players' Association	Tel cons21/3/12	Made contact – meeting not wanted at this stage.
Arts Care Gofal Celf	Meeting 9.3.12	Met to discuss art project for the lagoon.
Arts Council of Wales	Meeting 13.3.12	Met to discuss art project for the lagoon.
ABP	Meeting 23/08/11	Navigation and maintenance dredging of the port accesses. Space would be available within the docks for construction compound. Should be able to accommodate landfall connection and grid connection. Arrange site meeting.
	Meeting 13/10/11	Site meeting to discuss grid connection options.
Association for the Welfare of Children in Hospital (AWCH)	24/2/12 tel cons	Made contact – meeting not wanted at this stage.
Bay Leisure Ltd	Meeting 23.3.12	Visual impact would be important, but positive about the overall benefit to Swansea.
BikeAbility Wales	16/3/12	Made contact – meeting not wanted at this stage.
Blackpill Derwen Fawr and Mayals Res Assoc'n	16/3/12 tel cons	Made contact – meeting not wanted at this stage, but really positive about the project.
Bridgend County Borough Council	25/04/2012	Presented project and draft SOCC.
British Petroleum Queen's Dock		
British Sub-Aqua Club	4/9/12 tel cons	Made contact – forwarded information on project.
British triathlon	Meeting 18.9.12	Meeting to discuss project and future opportunities.
Briton Ferry Town Cricket Club	18/4/12 tel cons	Made contact – forwarded information on project.
Briton Ferry Town Sports Association	18/4/12 tel cons	Made contact – forwarded information on project.
Brynmill & District Angling Club	24/2 tel cons	Made contact – forwarded information on project.
Bryn Residents Action Group	Postponed.	To be rearranged.
Cadw	06/01/2012 tel con	Discussed proposed project, available baseline data and likely scope of EIA chapter.
Canoe Wales	14/5/12	Meeting to discuss project and future opportunities. Water quality would need to be considered and changing facilities provided.
Carmarthen County Borough Council	Meeting 25/04/2012	Presented project and draft SOCC.
CBI	Meeting 14.8.12 & 18.5.12	Attending SWEFF meeting, Positive about the economic benefit to Wales.

Organisation	Met/Contacted?	Comments/Key issues
CCW (Countryside Council for Wales)	Meeting 15/07/11 and 20/12/2011, various emails	Number of issues highlighted that would need to be addressed within EIA for project, including coastal processes, birds, marine ecology, water quality etc. Guidance given on ornithological survey methodology. Submit scoping document and then arrange meeting to discuss further.
CEFAS (Centre for Environment, Fisheries & Aquaculture Science)		Meeting to be arranged to discuss scope of benthic survey etc.
Chamber of Shipping		To be arranged.
City and County of Swansea Council	09/12/2011	Presented overview of proposed project. Received initial feedback and thoughts on seascape and visual impact assessment.
	8/02/2012	Meeting to discuss project progress and location of potential viewpoints for SLVIA for EIA.
	20/04/2012	Presented update of project and draft SOCC.
	14/08/12	Attended SWEFF meeting.
City of Swansea Rowing Club	Meeting 19.6.12	Positive about the lagoon and the potential it offers as a sporting venue.
Clyne Farm	Meeting 5.7.12	Positive about the lagoon and the tourism it will bring to the area.
Clyne Golf Club	26/6/12 tel cons	Made contact – forwarded information on project.
Clyne Valley Community Project	9/7/12 tel cons	Made contact – would like to wait till formal consultation.
Communities First Briton Ferry West	Meeting 17.5.12	Would like to see Community benefit from the project.
Cynnal Cymru	Meeting 16.2.12	Water quality should be addressed in EIA
Campaign for the Protection of Rural Wales		Meeting to be arranged.
Carbon Trust Wales		Meeting to be arranged.
Cwmtawe Sub-Aqua Club	17/4/12 tel cons	Made contact – forwarded information on project.
DECC	21/10/11	On-going communication with DECC tidal team updating on project developments.
Defence Estates (MOD)		To be contacted.
Disability Sport Wales (NPT)	19/6/12 tel cons	Interested in the project. Arranging a convenient time to meet.
Disability Sport Wales Swansea	12/7/12 tel cons	Interested in the project. Arranging a convenient time to meet.
Dwr Cymru Welsh Water	Email 7/10/11 and meeting 28/11/2011 and 18.7.12	Meeting to present overview of project. Key issues would be water quality linked to bathing beaches and shellfish waters, during normal and wet weather operation. Also outfall integrity and navigational issues. Continue meetings to discuss further.
Environment Agency- Wales	Email 8/11/11 Meeting 20/12/2011	Discussed project and progress. EA provided comments and guidance on a number of key environmental areas which have been identified in scoping document.
Environment Wales	Meeting 23.03.12	Discussed proposals and context of sustainable initiatives in Wales. Positive feedback on current approach.
Federation of Small Businesses (Wales)	Meeting 4.8.12	Attended Swansea business forum meeting. Positive about economic benefits
Friends of the Earth Wales	24/05/2012	Meeting to discuss project and get feedback.

Organisation	Met/Contacted?	Comments/Key issues
Glamorgan Gwent Archaeological Trust (GGAT)	5/1/2012 tel con	Outlined proposed project. GGAT commented that their initial thoughts were that the lagoon was some distance from Historic Landscapes and therefore an ASIDOHL should not be required. They requested that a walkover survey of intertidal area affected by causeway/gird connection be included in the EIA.
Gower SOS		Meeting to be arranged.
Gower Marine Mammals Project (GMMP)	18/05/2012	Presentation on project. Discussed available data for area and thoughts on project.
Gower Ornithological Society	27/4/12 tel cons	Discussed project. Would need to consider Jersey Marine beach, potential change in habitats and effect on the birds.
Kenfig Burrows Nature Reserve		Meeting to be arranged.
Inshore Fisheries Units for South and North Wales		Meeting to be arranged.
Joint Nature Conservation Committee		Meeting to be arranged.
Grange Primary School	Meeting 13.7.12	Discussing the time and tide project
Green Party	Meeting 18.5.12	Attended GMMP meeting, positive feedback.
GSP / St Thomas residents.	Meeting 25.3.12	Visual impact would be a key consideration.
Institute of Directors	Meeting 18.5.12	Positive about economic benefits
Job Centre Plus	14.8.12	Attended Swansea business forum meeting.
Low Carbon Research Institute	18.5.12	Attended GMMP meeting.
Local Fisheries		Meeting to be arranged.
Long Distance Walkers' Association	23/2/12 Tel cons	Meeting to be arranged.
Marine Conservation Society	18.5.12	Attended our Gower marine mammals presentation.
Marine Consents Unit (WAG)	Meeting 13/07/11	The consenting route options were discussed and guidance was given on the process.
Marine Management Organisation (MMO) includes Marine Fisheries Agency	Meeting 13/07/11	As above.
Maritime Quarter Residents Association	Meeting 12.3.12	Generally quite positive, landscape effect would be a key issue.
Monkstone Cruising and Sailing Club	Meeting 18/05/2012	Presentation on project and received feedback from members.
Metropolitan University - Mount Pleasant	30/4/12 tel cons	Initial contact made.
Mount Pleasant Resident Association Swansea	Meeting 29.312	Positive feedback, identified a few issues. Can see how it will improve the area.
Mumbles Amateur Rowing Club	Meeting 4.7.12	Positive about how we can use the lagoon for rowing and the increase participation in the sport.
Mumbles Development Trust	6/7/12 email cons	Very positive about the project.
Mumbles Motorboat and Fishing Club	Meeting 22/3/12	Main concerns would be effect on the fishing and potential change in the sea bed.
Mumbles RFC	Meeting 22.2.12	Attended Mumbles RFC, Angling Club event.
Mumbles Yacht Club	Meeting 30.07.12	Commodore and VC supportive of renewables and lagoon proposals; interested in WQ during construction. No major navigation concerns.
National Waterfront Museum	Meeting 1.6.12	Discussed project – positive feedback.
National Trust		Meeting to be arranged.
Neath and Port Talbot County Borough	09/12/2011	Presented overview of proposed project. Received initial feedback and thoughts on locations for visual

Organisation	Met/Contacted?	Comments/Key issues
		impact assessment.
	20/04/2012	Presented update of project and draft SoCC.
Neath Borough Football Club	30/4/12 tel cons	Would like to be involved during formal consultation.
Neath Estuary Group	Meeting22/2/12	Provided information on project and discussed the current state of the estuary.
Neath Harbour Commissioners	12/10/2011	Initial contact concerning geophysical survey.
	22/02/2012	Attended quarterly meeting. Presented overview of project and answered questions.
	20.4.12	Initial planning meeting about SoCC and planning application.
	18.5.12	Attended GMMP meeting.
Neath Harriers running club	19/6/12 tel cons	Made contact – forwarded information on project.
Neath Marlins Sub-Aqua Club	16/7/12 tel cons	Made contact –information forwarded on project. Will wait for info form WASAC.
Neath Port Talbot Biodiversity Forum	21/5 tel cons	Received project information and will wait for formal consultation.
Neath Port Talbot Business Club	Meeting 2012	Met to discuss potential jobs that the lagoon could bring to NPT.
NSA - Communities First Sandfields & Aberavon (NSASR)	Meeting 17.5.12	NSA were supportive of the project and would like to be kept up to date.
Neath Docks Landowner		Meeting to be arranged.
Offshore Renewable Energy Deployment (ORED)		Meeting to be arranged.
OREIN	2012	Conference meeting; discussion over Bay history.
Porthcawl Environmental Trust		Meeting to be arranged.
Pembrokeshire County Council	Meeting 18.5.12	Attended SWWEF
Pontardawe & Swansea Angling Society	Meeting 1.4.12	Mainly concerned about the fish migration patterns and also the affect on their fishing rights.
Port Tennant Communities First	Meeting 27.2.12	Presentation to committee; potential community benefits discussed, questions raised for EIA input.
RCAHMW	9/1/12	Discussed scoping report and data available for EIA.
Regen South West	6/10/2011	Initial meeting to introduce project.
Royal Commission on the Ancient Historical Monuments of Wales	9/1/2012	Initial telephone conversation to introduce project and discuss outline scope of work.
RSPB	Meeting 05/09/11 and follow up emails	Discussed issues relating to Blackpill SSSI and birds in the area. Key issue would be affecting intertidal feeding areas for birds. Provided contact for RSPB West Glam group.
RSPB West Glamorgan local group	Emails Sept 11	Discussed potential availability of bird data.
RNLI	12/08/2011	Pleased to make borehole and other data collected for new RNLI station available.
	18/5/12	Meeting cancelled, but sent plans and will await formal consultation.
SA1 Development Team	05/12	Discussed SA1 proposals and complementary lagoon proposals. Positive feedback.
Sandfields Community Association	Meeting 12.4.12	Overall quite supportive.
Sandfields Residents Assoc	Meeting 12.4.12	See notes for Uplands Community & SSCI
Seawatch Foundation		Meeting to be arranged.
SmartCoasts - team members	23/11/11	Provide information on SmartCoast project and discussed interaction with lagoon.
South and West Wales Fishing Communities Ltd	Meeting 18.5.12	Attended Monkston sailing club meeting.

Organisation	Met/Contacted?	Comments/Key issues
South Wales Evening Post	Meeting 14.8.12	Attended Swansea business forum meeting.
South Wales police	Meeting 12.4.12	See notes for Uplands Community & SSCI.
South West Wales Economic Forum	Meeting 18.5.12	Overall supportive of the project and the economic opportunity for the area.
South West Wales Tourism Partnership	Meeting 18.5.12	Attended SWWEF meeting. Positive feedback on project.
Sport Wales	Meeting 5.7.12	Positive about the benefits of the lagoon and the opportunity for a sporting venue.
St Thomas Community Primary School	13.7.12	Would like to take part in the Tide and time project.
Surf GB.	6/8/12 email cons	Emailed outline of proposals. No meeting arranged.
Surfers Against Sewage	14/5/12 tel	Discussed project. Key issues would be potential effect on the surf, water quality and landscape.
Surf school Wales	18/6/12 tel cons	No particular comments but would pass information to Aberavon lifeguard club.
Sustrans Wales	17.9.12	Meeting to discuss cycle route opportunities involving lagoon and sustainable transport to site.
Swansea and Carmarthen Bay Coastal Engineering Group		Meeting to be arranged.
Swansea bay Partnership	Meeting 29.6.12	Met at Swansea Economic forum.
Swansea Business Forum	Meeting 14.8.12	Very positive about the lagoon and the opportunities it will bring to Swansea.
Swansea Bay Port Health Authority	17/9/12	Discussed project and existing shellfishery activity in the bay. Discussed potential opportunities for mariculture.
Swansea Business Club	14/8/12 tel cons	Positive feedback on project.
Swansea Civic Society	12.4.12	Attended Uplands and SSCI meeting.
Swansea Council for Voluntary Service	18.5.12	Attended SWEFF meeting, very positive about the project and would like a separate meeting.
Swansea Council Recycling Team	14.8.12	Attended Swansea business forum. Positive feedback.
Swansea Environmental Forum	25/4/12 tel cons	Outlined project. Would like to wait till formal consultation phase.
Swansea Harriers	11/9/12	Outlined project. Will await further information on project before giving a considered opinion.
Swansea Marina	Meeting 2.10.12	Raised issue about craft approach the docks and marina and how the flows will be affected by the lagoon.
Swansea Metropolitan University	Meeting 18.5.12	Attended GMMP meeting. Positive feedback.
Swansea Sustainable Community Initiative (SSCI).	Meeting 12.4.12	Visual impact would be a consideration and the benefits to the community.
Swansea Tidy Towns campaign	Meeting 12.4.12	Visual impact would be a consideration and the benefits to the community.
Swansea Tourist Board		Meeting to be arranged.
Swansea U3A Residents Association	3/7/12	Interested in the lagoon - will wait for formal consultation.
Swansea University /SEACAMS	Meeting 20/09/11	Discussed project, baseline data and potential collaboration where possible.
The Crown Estate	11/07/11 and 29/07/11	Multiple meetings with Marine and Tidal teams to update on development, progress and discuss Leasing.
The Gower Society		Meeting to be arranged.
The Joint Fishing Communities of South and West Wales		Meeting to be arranged.

Organisation	Met/Contacted?	Comments/Key issues
The Maritime and Coastguard Agency		Meeting to be arranged.
The Otter Consultancy	18.5.12	Attended GMMP meeting.
Monkstone Cruising and Sailing Club	18/05/2012	Meeting to present project. Provided thoughts on project and issues to be considered.
The Royal Yachting Association	11/6/12	Would like further information as project progresses.
The Welsh Yachting Association	11/6/12	Positive about the lagoon and opportunity the enclosed water could bring to sailing.
Trinity House Lighthouse Services	19/7/12	Sent plans, will await formal consultation.
Tourism Swansea Bay	24.2.12	Good meeting, supportive of project.
Transition Swansea Steering Group	2011	Committee meeting presentation of outline proposals. Well-received. Keen to support community outreach.
Twyn Primary School	13..12	Met to discuss tide and time project.
UK Cable Protection Committee		Meeting to be arranged.
UK Dredging Co.		Meeting to be arranged.
UK Hydrographic Office		Meeting to be arranged.
Velindre Community School	1/5/12 tel cons	Email sent in first instance and they will come back if a meeting is required.
Visit Wales	4/9/12 tel cons	Email sent in first instance and they will come back if a meeting is required.
Wales Tourist Board		Meeting to be arranged.
Wales Wildlife and Countryside Link		Meeting to be arranged.
Welsh Arts Council	8/6/12 tel cons	Very supportive of the scheme.
Welsh Association Sub-Aqua Club	12/6 /12	Interested in the project – would like updates sent.
Welsh Athletics	6/9/12 tel cons	Supportive of project.
Welsh Cycling Association	27.9.12	Booked meeting
Welsh Coastal Inshore Fisherman's Association		Meeting to be arranged.
Welsh Federation of Sea Anglers		Meeting to be arranged.
Welsh Assembly Government see MCU		Meeting to be arranged.
Welsh Rowing Association	Met 4.7.12	Quite supportive, as can see benefit this could can bring to Swansea and the potential venue.
Welsh Triathalon	18.7.12	Overall quite supportive of the lagoon and how Swansea could benefit from the leisure facilities.
West Wales Chamber of Commerce	14.8.12	Attended Swansea business forum – positive feedback.
Whale and Dolphin Conservation Society		Meeting to be arranged.
Wildfowl and Wetlands Trust	17/10/12	Meeting booked.
Wildlife Trust Wales		Meeting to be arranged.
Wildlife Trust South & West Wales	Emails	Informal chat and emails to arrange meeting date.
WPD	Meeting 20/08/11 and site visit 13/10/11	Initial discussions to concerning grid connection. Site visit to identify options.
WWF	Meeting 13/9/12	Discussed project and received input.

Appendix 4.1 Proposed Scope of Subtidal Benthic Survey

Proposed Subtidal Benthic Sampling Programme

It is proposed to undertake a site specific characterisation benthic sampling programme to provide data on the species present within the major substrates found in the area. The results of the recently completed geophysical survey have been used to identify the major sediment types present and this is shown on Figure A4.1 overleaf.

As can be seen there are five main types all dominated by sand; namely sand (pale yellow), sand with rare gravel (darker yellow), sand with frequent gravel (pale peach), sand and gravel (pale pink) and gravel (darker pink). It is proposed that grab samples be collected from a total of 30 sites, with the sample locations reflecting the range of substrates present within the lagoon and surrounding area. In addition samples will be collected from up and down tide of the lagoon and reference samples will be collected from sites unlikely to be affected by the development. The locations of sample sites are shown on Figure A4.1 and Figure A4.2 with a summary of the proposed analysis given in the table below.

Table A4.1 Summary of Proposed Benthic Sampling

Proposed Sampling Zone	Number of Samples	Benthic	PSD	Metals
Within lagoon footprint	13	All	All	7
East, west and seaward edge of 500m buffer around site	6	All	All	3
Upstream and downstream tidal extent	9	All	All	4
Reference sites	2	All	All	0
Total number for analysis	30	30	30	14

Detailed information on the proposed sampling locations is given in Table A4.2 and further information about sampling procedures and analysis is given in the subsequent sections.

Epifauna Trawls

In addition to the benthic sampling survey, seven epifauna/fish trawls will be used to obtain qualitative samples of the epibenthos from across the area. The epifauna trawls will comprise approximately 200m trawls using a 2m beam trawl with 5mm cod end mesh. The material collected in the trawl to be fixed in a 10% buffered formalin and seawater solution.

Four trawls will be taken within the footprint of the development envelope as shown on Figures A4.1 and A4.2. The locations of the beam trawls have been selected to represent the major sediments and therefore biotypes within the development area. They have also been positioned adjacent to a benthic sampling site such that more detailed information is obtained. In addition, it is proposed to undertake two trawls (one up tide and one down tide) of the development area and one trawl remote to represent a reference site. Again these trawls have been positioned next to a benthic sampling site.

Figure A4.1 Lagoon Benthic Sampling Sites (Insert Area of Figure A4.2)

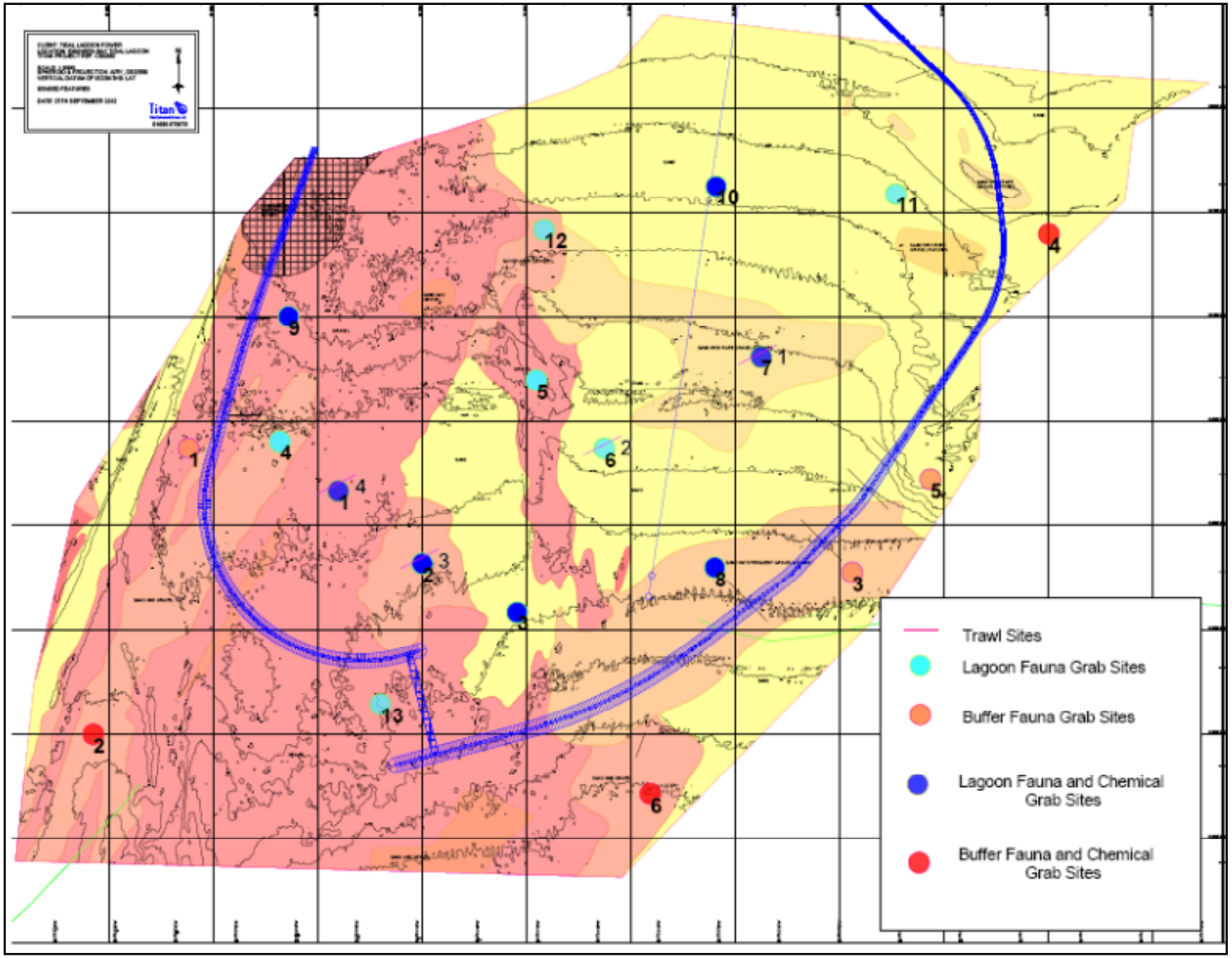


Figure A4.2 Proposed Benthic Sampling Sites Wider Swansea Bay Area

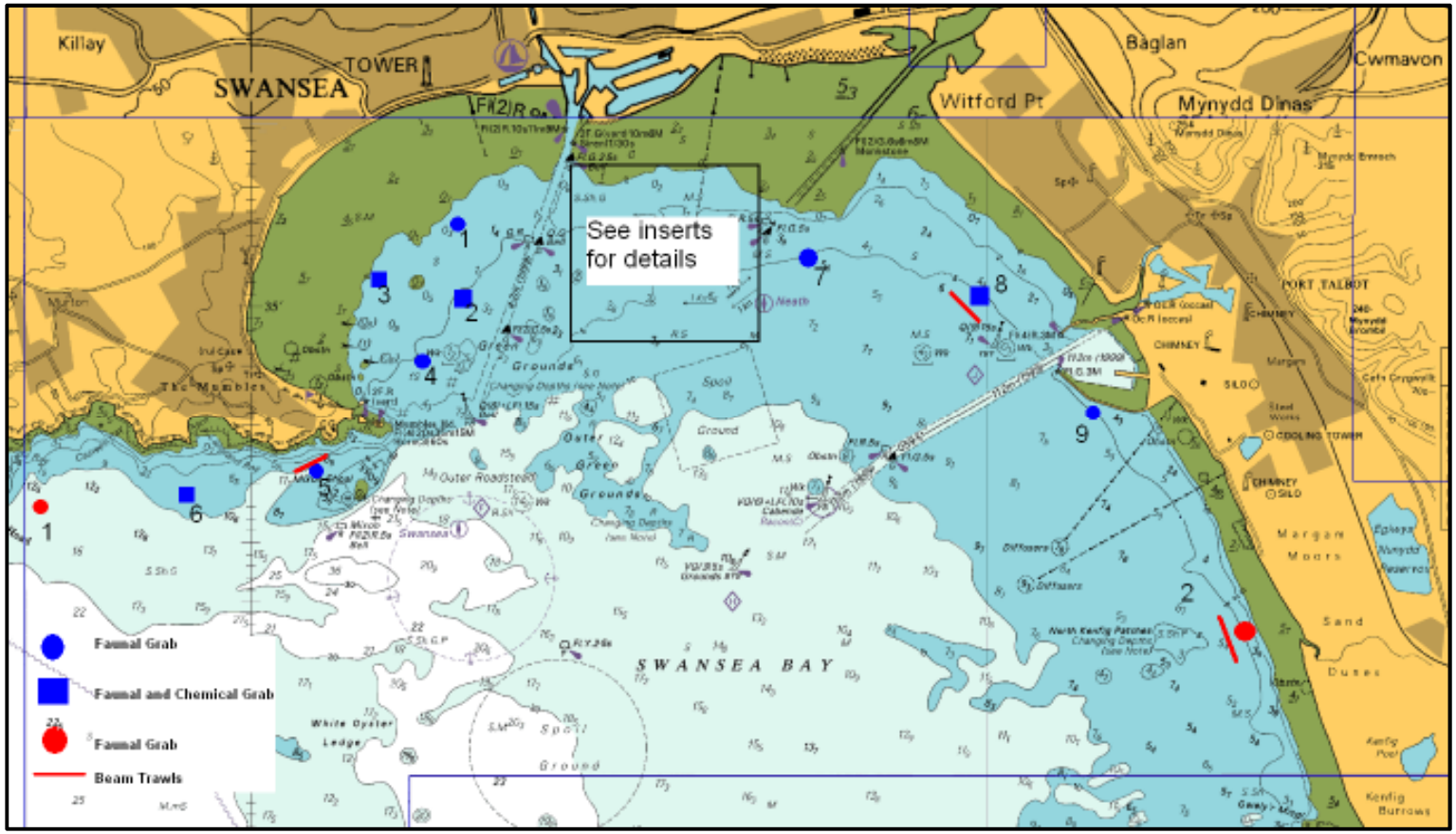


Table A4.2 Benthic Sampling Locations

Area	Sample No.	Ref ID	Sediment from Geophysical Survey	Type of Analysis	OSGB36		WGS84	
					Easting	Northing	Latitude	Longitude
Lagoon	1	L1	Gravel	Fauna and Chemical Grabs	267098.12	190163.89	51°35.6762'N	3°55.2045'W
Lagoon	2	L2	Sand and gravel	Fauna and Chemical Grabs	267500.00	189816.81	51°35.4947'N	3°54.8487'W
Lagoon	3	L3	Sand	Fauna and Chemical Grabs	267954.33	189583.20	51°35.3752'N	3°54.4502'W
Lagoon	4	L4	Sand and gravel	Fauna Grab	266818.75	190403.15	51°35.8012'N	3°55.4518'W
Lagoon	5	L5	Gravel	Fauna Grab	268046.54	190695.91	51°35.9764'N	3°54.3955'W
Lagoon	6	L6	Sand	Fauna Grab	268372.36	190370.09	51°35.8053'N	3°54.1060'W
Lagoon	7	L7	Sand with rare gravel	Fauna and Chemical Grabs	269122.36	190806.56	51°36.0512'N	3°53.4665'W
Lagoon	8	L8	Sand with frequent gravel	Fauna and Chemical Grabs	268901.05	189798.37	51°35.5045'N	3°53.6355'W
Lagoon	9	L9	Gravel	Fauna and Chemical Grabs	266860.07	191000.00	51°36.1236'N	3°55.4296'W
Lagoon	10	L10	Sand	Fauna and Chemical Grabs	268907.20	191624.18	51°36.4890'N	3°53.6711'W
Lagoon	11	L11	Sand	Fauna Grab	269767.85	191587.30	51°36.4811'N	3°52.9250'W
Lagoon	12	L12	Sand and gravel	Fauna Grab	268083.43	191415.17	51°36.3648'N	3°54.3798'W
Lagoon	13	L13	Gravel	Fauna Grab	267381.37	189092.62	51°35.1025'N	3°53.9349'W
Buffer	1	B1	Gravel	Fauna Grab	266381.93	190370.92	51°35.7776'N	3°55.8292'W
Buffer	2	B2	Sand and gravel	Fauna and Chemical Grabs	265925.64	189000.00	51°35.0320'N	3°56.1928'W
Buffer	3	B3	Sand with frequent gravel	Fauna Grab	269558.84	189773.78	51°35.5004'N	3°53.0655'W
Buffer	4	B4	Sand	Fauna and Chemical Grabs	270500.00	191395.51	51°36.3878'N	3°52.2868'W
Buffer	5	B5	Sand	Fauna Grab	269932.48	190221.20	51°35.7468'N	3°52.7520'W
Buffer	6	B6	Sand and gravel	Fauna and Chemical Grabs	268592.20	188712.91	51°34.9149'N	3°53.8785'W
Up/down	1	UD1		Fauna Grab	190258.442	264777.012	51°35.6940'N	3°57.2160'W
Up/down	2	UD2		Fauna and Chemical Grabs	189089.157	264808.164	51°35.0640'N	3°57.1620'W
Up/down	3	UD3		Fauna and Chemical Grabs	189435.480	263,514.17	51°35.2320'N	3°58.2900'W
Up/down	4	UD4		Fauna Grab	188149.518	264159.023	51°34.5480'N	3°57.7020'W
Up/down	5	UD5		Fauna Grab	186459.091	262469.728	51°33.6120'N	3°59.1240'W
Up/down	6	UD6		Fauna and Chemical Grabs	186159.161	260415.21	51°33.4200'N	4°00.8940'W
Up/down	7	UD7		Fauna Grab	189614.727	270235.781	51°35.4240'N	3°52.4760'W
Up/down	8	UD8		Fauna and Chemical Grabs	188923.075	272935.461	51°35.0880'N	3°50.1240'W
Up/down	9	UD9		Fauna Grab	187065.739	274684.896	51°34.1100'N	3°48.5700'W
Reference	1	R1		Fauna Grab	186022.141	258136.026	51°33.3120'N	4°02.8620'W
Reference	2	R2		Fauna Grab	183583.277	276944.203	51°32.2620'N	3°46.5420'W

Table A4.3 Beam Trawl Sampling Locations

Area	Nearest benthic site	Ref ID	Substrate	Length (m)	SOL Easting	SOL Northing	EOL Easting	EOL Northing
Lagoon	L7	T1	Sand with rare gravel	201.7	269195.35	190863.02	269015.35	190772.02
Lagoon	L6	T2	Sand	201.7	268449.38	190429.02	268269.38	190338.02
Lagoon	L2	T3	Sand with frequent Gravel	201.7	267576.11	189884.96	267396.11	189793.96
Lagoon	L1	T4	Gravel	201.7	267028.39	189498.08	266848.39	189407.08
Up/Down	UD5	T5		201.7	186556.916	262555.621	186356.916	262555.621
Up/Down	UD8	T6		201.7	188697.018	273075.366	188497.018	273075.366
Reference	R2	T7		201.7	183339.643	276896.656	183339.643	277096.656

SOL – start of Line
EOL – end of line

Benthic Sampling Procedures

It is proposed that a single benthic grab sample would be collected from each site. The benthic samples will be collected using a refined compact 0.1m^2 Hamon grab. Samples for metal analysis would be collected by a Day grab as this gives reduced disturbance to the sediment as the sample is brought to the surface.

The compact Hamon Grab can be deployed from smaller vessels and can be used closer inshore, therefore sampling from the boat in the intertidal zone should be possible. Manufactured from galvanised steel its single shovel action makes this unit the ideal sampler for coarse sediments and is routinely used in areas where the standard Day grab is deemed unsuitable. The mini-Hamon grab consists of a rectangular frame forming a stable support for a sampling bucket attached to a pivoted arm. On reaching the seabed, tension in the wire is released which activates the grab; the pivoted arm is rotated through 90°, driving the stainless-steel sample bucket through the sediment. At the end of its movement, the sample locates onto an inclined rubber-covered steel plate, sealing it completely and preventing the sample washing out during recovery.

Strict quality control procedures for horizontal control (DGPS) would be adhered to, target station locations being entered into a suitable navigation software package (eg. HydroPro). These, together with acceptable limits for sampling at each station, are displayed on a helmsman monitor during the grab sampling operations. Comprehensive logging of sampling coordinates, times and all on-board activities/observations are undertaken (including placing a waterproof identification tag in each sample). Where detailed bathymetric data exist at sampling locations, depths are taken from bathymetric digital terrain models. Where no such recent detailed bathymetric data exists, depths are recorded at each sampling location from the vessel echo-sounder.

Mini Hamon Grab

Samples for infaunal analysis will be collected from each site identified in Table A4.2. Samples for infaunal analysis will be rejected where jaws are not completely closed, as this would result in a loss of material when it is brought to site. Where samples are retained for faunal analysis, the grab will be opened and the sample photographed. Notes will be taken on the nature of sediment and any obvious larger epifauna recovered within the grab. A single grab sample will be collected per each site for the characterisation survey. The minimum acceptance volume for hard-packed sand will be 2.5L and for muddy sands /muds 5L.

A sub-sample would be taken from the Hamon grab sample for particle size and organic content analysis (loss on ignition). In coarse or heterogeneous sediment areas with large pebbles or shell material, where small volumes of material will not adequately reflect the sediment composition, sub-samples for PSA will be taken from the grab sample. Samples for PSA will be stored chilled, but not frozen, as this would break down any clay mineral lattice

bonds present altering the natural particle size distribution. Samples will then be delivered to a specialist laboratory with proven expertise in such analysis on marine sediment samples.

The remainder of the faunal samples will be sieved on board through a 1mm mesh [Note: Sieve trials at 0.5mm and 1mm on Scarweather Sands Offshore Windfarm ES (UU, 2003) showed very little difference in returns at the two sieve sizes and hence the 1mm sieve was used] – all retained material being preserved in 4% buffered formaldehyde solution. Preserved samples will be transported in airtight containers to specialist laboratories with proven expertise in sorting and identification of benthic invertebrate samples.

At those sites where metal analysis is also to be undertaken a Day or mini Hamon grab will be used to collect a single sample.

Note for samples within the intertidal area (potentially sites 4, 10, 11 and 12) if samples cannot be obtained by boat at high water, sampling would be undertaken from the shore during low water. Five replicate core samples would be taken using JNCCs Marine Nature Conservation Review (MNCR) standard methodology. In addition a sediment sample would be collected at each location for particle size analysis and Loss of Ignition.

Analytical Procedures

Macro-invertebrate analysis of benthic samples: standard policy.

Samples are rinsed with freshwater over a 1 mm mesh. Sieve residues are initially elutriated with fresh water to extract the majority of "light" organisms, notably crustaceans and small worms (care being taken to retain all specimens adhering to the surface film). Subsequent sample examination of the residue is under x10 magnification (binocular microscope) where necessary. Routine procedures require the resorting of at least 10% of samples, with the aim of extraction of 95% of individuals and 100% of species in each sample.

All animal specimens are identified to species where possible, by experienced taxonomists using the latest identification keys and by referring to voucher material held by the biological laboratory. Species names are attributed in accordance with the most recent publications available (e.g. Howson & Picton, 1997 for the British Marine Fauna and Flora) except where such publications have been superseded. Relevant experts in certain taxonomic groups are consulted for any difficult specimens. Specimens are counted as "heads", or as oral disks for ophiuroids/asteroids.

Voucher material is retained if required, or routinely to supplement the laboratory's collections.

Animal specimens and sample residues (as required) are retained in formalin or alcohol. Should staining, for example with Rose Bengal (to enhance specimen extraction efficiency), or sub-sampling be considered efficacious, such practices would only undertaken after confirmation with the agreed CCW/CEFAS contact. The taxonomic laboratory would also undertake all univariate and multivariate statistical analyses on macrofaunal results.

Traditionally these include the use of Bray-Curtis similarity index, Multidimensional Scaling (MDS) and rank-correlation with environmental variables – along with basic community statistics such as species richness, evenness and equitability.

Sediment Particle Size Analysis

Particle size analysis is undertaken using traditional sieve analysis – with pipette analysis of fines where these are present in significant amounts (the <63 micron fraction only analysed if <10% present in the sample). Samples are analysed at ½ phi intervals and results reported together with all traditional statistical parameters (median diameter, sorting coefficient, skewness and kurtosis).

Metals analysis

It is proposed to undertake the following analysis where identified.
Al - Aluminium
B - Barium
Cd - Cadmium
Cr - Chromium
Fe - Iron
Hg – Mercury
Ni - Nickel
Pb - Lead
Sn - Tin
V - Vanadium
Zn - Zinc
TPH - Total Petroleum Hydrocarbons
PSA – particle size analysis
LoI – loss of ignition
TBT – Tributyl Tin

Note: Contamination testing will also be undertaken as part of the geotechnical survey. Samples will be collected from a minimum of 3 samples per vibrocore between the surface and 6m depth. The exact depths at which samples are taken shall be varied to give complete coverage but shall always include a sample in the top 0.5m. Samples will be taken to allow characterisation of materials as hazardous or non-hazardous. Solid testing will include as a minimum metals (as listed above), cyanide, phenols, Banded TPH (DRO/GRO) with interpretation, speciated PAH (including Coronene).

Appendix 4.2 Coastal Bird Survey Details

Objective of Surveys

The objective of the bird surveys was to obtain site-specific data to establish the presence of bird species listed under the Blackpill and Crymlyn Burrows (intertidal area) SSSIs and the River Neath WeBS count area, their numbers and the function/need of the areas used by birds (foraging, roosting, loafing). In addition data was collected on bird movement around the bay and the presence of sea duck, grebe and diver species.

General

The surveys were undertaken by two experienced ornithologists to cover two main areas once per month between October 2011 and March 2012. The survey areas were selected to cover the whole of Blackpill SSSI and the intertidal area of Crymlyn Burrows SSSI to the west of the River Neath. The surveys were designed to be able to gather information on the general usage and movement of birds within the Bay in particular in relation to the proposed lagoon site, on a variety of tidal cycles and weather conditions and not to record every single bird using the area. The data gathered will supplement the more extensive longer term WeBS data.

Count Method

The survey methodology adopted for the Wintering Bird survey was based on the methodologies developed by the British Trust for Ornithology for the Wetland Bird Survey (WeBS) utilising both Core Count and Low Tide Count methods (Gilbert *et al* 1998).

Low tide counts were undertaken within Blackpill SSSI and the other areas of interest within a window 2 hours either side of Low tide. One surveyor was located in the west (River Tawe-Mumbles Figure A4.3a) of the bay and one in the east (Figure A4.3b River Neath-River Tawe). The surveyors systematically moved from west to east through the survey area by foot and vehicle between suitable vantage points and utilised a 'look and see' methodology to record all birds utilising the foreshore and bay area. The number, species and behaviour of the birds were then recorded on the field map (See Additional Recording Detail below). Any significant movements of birds were also noted.

Core Counts/High tide counts were undertaken 1.5hrs either side of high tide, using the same 'look and see' methodology as discussed above.

Additional Recording Detail

In addition to the peak counts all significant concentrations or movements of birds across the survey area were recorded on the field maps. If there was significant movement during the survey the surveyor did not record every bird movement but focused on larger group activity eg if a flock of birds was seen feeding/roosting/loafing etc these would be marked on the field maps. A significant flock would be judged by the observers own professional judgement. A field map was used for each hour's observations (the need for increasing the numbers of maps was reviewed after the first round of survey).

Any birds observed flying over the site were recorded including height and direction of flight and location of where they land (if inside or adjacent to the survey area).

The activity of the birds using the area was also recorded as it is acknowledged that this is important in terms of determining the functionality of the bay. This was to include, where

possible, locations where birds feed at various stages in the tidal cycle, where birds don't feed, and where birds roost or loaf.

Any disturbance events and their frequency were also noted as was the action of the birds disturbed i.e. where do they go? etc. Any significant movement inland was also recorded.

The following basic information was completed for each survey on the recording sheet:

- Date of survey
- Location (Blackpill or Crymlyn Burrows)
- Visit Number (to the site – *i.e.* Oct V1)
- Start time and end time
- High tide time and height
- Cloud cover (Octas)
- Wind speed – based on Beaufort Scale
- Wind direction (wind coming from)
- Weather – information was recorded on other general weather records/observations. If there was significant changes to the weather this was noted.

The following was recorded on the maps:

- Species and number
- Activity (feeding, loafing, roosting etc)
- Movements and direction of movement
- Flight heights (either over the site or height of movement)
- Location landed (if recordable)
- Tidal state (low, mid, high, rising, falling)

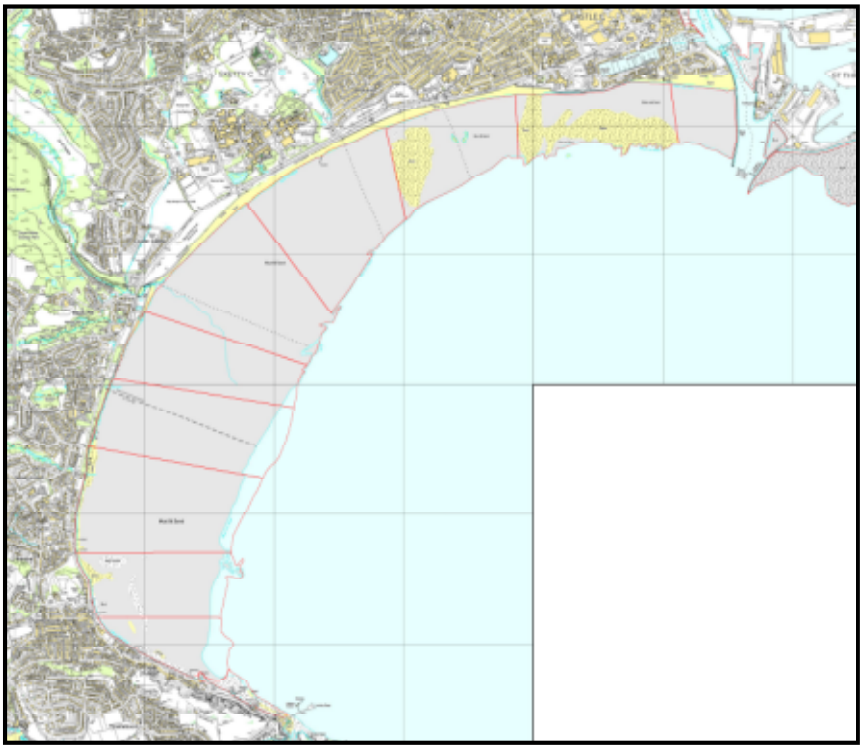


Figure A4.3a Field Map West Area

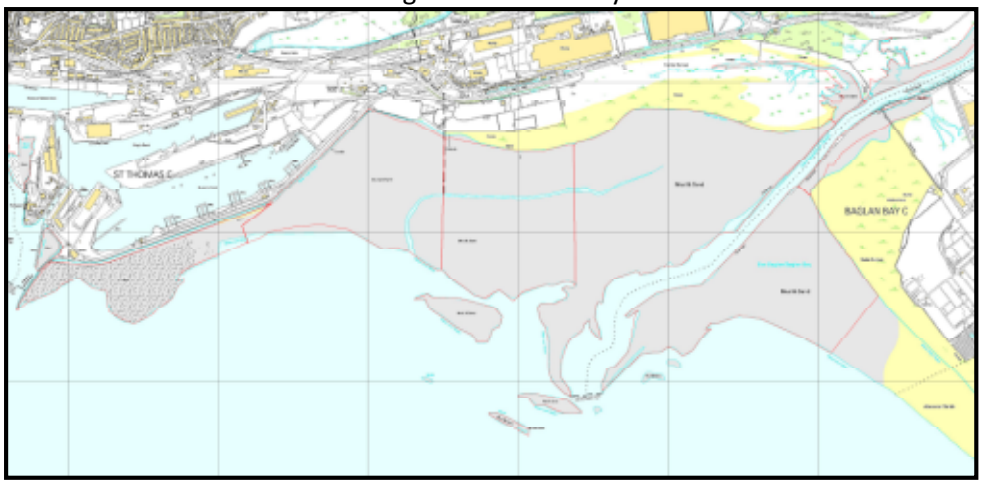
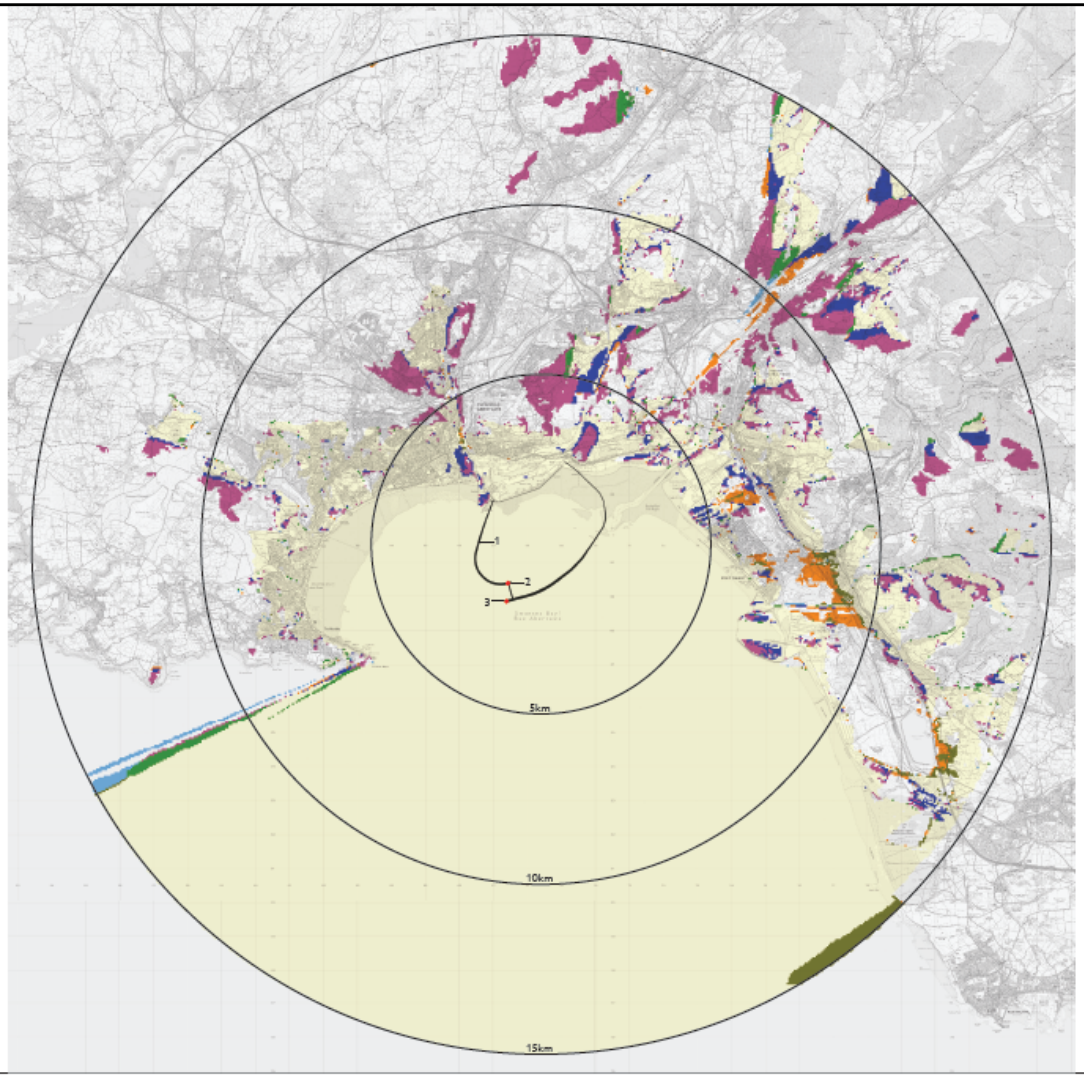


Figure A4.3b Field Map East Area

Appendix 4.3 Preliminary Zone of Theoretical Visibility



Key

- Lagoon Wall Visible
- Offshore Visitors Centre Visible
- Lighting Column Visible
- Lagoon Wall + Offshore Visitor Centre Visible
- Lagoon Wall + Lighting Column Visible
- Offshore Visitors Centre + Lighting Column Visible
- Lagoon Wall + Offshore Visitor Centre + Lighting Column Visible
- Lagoon Structures
  1. Lagoon Wall
  2. Offshore Visitors Centre
  3. Lighting Column

Scale

0 1.0km 5.0km

Note:
ZTV indicates where structures may be visible in full or in part.
ZTV mapping is based on landform alone and does not take account of buildings, vegetation cover or other surface features

Assumes 8.0m AOD to top of lagoon wall
Assumes 28.0m AOD to highest point of visitors centre
Assumes 18.0m AOD to highest point of lighting column

Client/Project
Inazin Power Ltd.
Swansea Bay Tidal Lagoon

Figure Name
Zone of Theoretical Visibility

Figure Number	Scale	Drawn	Approved	Date
01	NTS	ES	RC	June 2012

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Abbreviations

2D	Two dimensional
3D	Three Dimensional
AA	Appropriate Assessment
ABP	Associated British Ports
ABPmer	Associated British Ports marine environmental research
AONB	Area of Outstanding Natural Beauty
AQMA	Air Quality Management Area
ASIDOHL	Assessment of Significant Impact of Development on Historic Landscape
AWAC	Acoustic doppler Wave and Current profiler
BAP	Biodiversity Action Plan
BCBC	Bridgend County Borough
BERR/DBERR	Department of Business, Enterprise and Regulatory Reform
BGS	British Geological Society
BTO	British Trust for Ornithology
cBWD	Current Bathing Waters Directive
CCC	Carmarthenshire County Council
CCS	City and County of Swansea
CCTV	Closed Circuit Television
CCW	Countryside Council for Wales
CD	Chart Datum
CEFAS	Centre for Environment, Fisheries & Aquaculture Science
COWRIE	Collaborative Offshore Wind Research Into the Environment
cSAC	Candidate Special Area of Conservation
CSO	Combined Sewer Overflow
CPA	Coast Protection Act 1949
dB	Decibel
DCO	Development Consent Order
DCWW	Dwr Cymru – Welsh Water
DECC	Department of Energy and Climate Change
DEFRA	Department of the Environment and Rural Affairs
DoE	Department of the Environment
1.5DWF	1.5 times Dry Weather Flow
dwt	Dry weight tonnes
EA-W	Environment Agency - Wales
EC	European Commission
Edn	Edition
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPS	European Protected Species
ES	Environmental Statement
EU	European Union
FEPA	Food and Environment Protection Act 1985
FFT	Full Flow to Treatment
GGAT	Glamorgan Gwent Archaeological Trust
GIS	Geographic Information System
GMMP	Gower Marine Mammal Project
HGV	Heavy Goods Vehicle

HRA	Habitats Regulation Assessment
HW; HW+1	High Water; High water plus 1 hour, etc.
IALA	International Association for Marine Aids to Navigation and Lighthouse Authorities
ICE	International Council for the Exploration of the Seas
IFA	Institute of Field Archaeologists
IEEM	Institute of Ecology and Environmental Management
IFUSNW	Inshore Fisheries Units for South and North Wales
IPC	Infrastructure Planning Commission
ISQG	Interim Marine Sediment Quality Guidelines
IUCN	International Union for Conservation of Nature
JNCC	Joint Nature Conservation Committee
km	Kilometre
Kv	Kilovolts
kW	Kilowatt
LAT	Lowest Astronomical Tide
LCRI	Low Carbon Research Institute
LBAP	Local Biodiversity Action Plan
LDP	Local Development Plan
LoSHI	Landscape of Special Historic Interest
LSE	Likely Significant Effect
LW	Low Water
m	Metre
M^2	Metre squared
MarLIN	Marine Life Information Network
MCA	Maritime and Coastguard Agency
MCAA	Marine and Coastal Access Act
MCU	Marine Consents Unit
Mg/l	Milligram per litre
MHWS	Mean High Water Spring
MLW	Mean Low Water
MLWN	Mean Low Water Neap
MLWS	Mean Low Water Spring
MMO	Marine Management Organisation
MNCR	Marine Nature Conservation Review
MNR	Marine Nature Reserve
MOD	Ministry of Defence
MPCP	Marine Pollution Contingency Plan
MRESF	Marine Renewable Energy Strategic Framework
m/s	Metre per second
MW	Mega Watt
MWh	Mega Watt hours
N/A	Not Applicable
NASCO	North Atlantic Salmon Conservation Organisation
NBN	National Biodiversity Network
NGR	National Grid Reference
NM	Nautical Miles
NHC	Neath Harbour Commissioner
NPTCBC	Neath Port Talbot County Borough Council
NSIP	Nationally Significant Infrastructure Project

NTS	Non Technical Summary
NNR	National Nature Reserve
O&M	Operation and Maintenance
OBS	Optical Back Scatter
ORED	Offshore Renewable Energy Deployment
OREI	Offshore Renewable Energy Installations
OSGB36	Ordnance Survey Great Britain 1936
OSPAR	Oslo-Paris Convention
Pers. comms	Personal communication
PINS	Planning Inspectorate
pSAC	Proposed Special Area of Conservation
PSA	Particle Size Analysis
PSD	Particle Size Distribution
pSPA	Proposed Special Protection Area
rBWD	Revised Bathing Waters Directive
RCAHMW	Royal Commission for Ancient and Historic Monuments in Wales
RNLI	Royal National Lifeboat Institution
RSPB	Royal Society Protection of Birds
RYA	Royal Yachting Association
SAC	Special Area of Conservation
SAM	Scheduled Ancient Monument
SAMS	Scottish Association for Marine Science
SEA	Strategic Environmental Assessment
SMR	Sites and Monuments Records
SMRU	Sea Mammal Research Unit
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
SWSF	South Wales Sea Fishery
SWWFC	South West Wales Fisheries Community
TAN	Technical Advice Note
TCPA	Town and Country Planning Act
TCE	The Crown Estate
TEL	Tidal Electric Ltd
TSS	Total Suspended Solids
TWh	Terra watt hours
UK	United Kingdom
UKBAP	UK Biodiversity Action Plan
UKHO	United Kingdom Hydrographic Office
UUSSL	United Utilities Scarweather Sands Ltd
WG	Welsh Government
WeBS	Wetlands Bird Survey
WTD	Water Framework Directive
WPD	Western Power Distribution
WwTW	Waste Water Treatment Works
YC	Yacht Club
ZTV	Zone of Theoretical Visibility