Environmental Statement
Chapter 19. Noise and Vibration

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19.0 Noise and Vibration

19.1 Introduction

19.1.0.1 This Chapter of the ES considers the likelihood and significance of impacts with regard to the construction, operation and decommissioning of the Project with respect to airborne and underwater noise and vibration.

19.1.0.2 The Chapter describes the methods used to assess the current conditions on site as well as the anticipated noise and vibration impacts of the Project. Receptors that potentially may be affected by noise and vibration due to the Project are identified, as well the effects that may be experienced at the receptors. Where required, mitigation measures are detailed to reduce, prevent or offset the impacts. It also presents the likely impact of the Project together with other schemes in the surrounding area ("cumulative impacts"). The results of this assessment have been used by the marine ecology specialists in the relevant Chapters (Chapter 9 Fish, Commercial and Recreational Fisheries and Chapter 10 Marine Mammals and Turtles) of this ES to assess the potential effects on terrestrial and marine ecological receptors and are thus not considered further in this Chapter.

19.2 Legislation, planning policy and guidance

19.2.0.1 The following planning policies and guidance have been used to shape the methodology and assessment of this Chapter.

19.2.1 Policy framework

19.2.1.1 Planning Policy Wales provides the policy framework of the Welsh Government with regards to management of environmental risks, aiming to minimise any adverse effects on present or future land uses. The document states the following:

19.2.1.2 “*The objective of a policy for noise is to minimise emissions and reduce ambient noise levels to an acceptable standard. Noise Action Plans, drawn up by the Welsh Ministers in relation to Wales under the Environmental Noise Directive, and the Welsh Regulations, aim to prevent and reduce environmental noise where necessary and preserve environmental noise quality where it is good. They are a planning consideration in the use and development of land.*

19.2.1.3 *Policies should be designed to ensure, as far as possible, that potentially noisy developments are located in areas where noise will not be such an important consideration, or where its impact can be minimised. Local planning authorities should adopt policies to prevent potentially noisy developments in areas which have remained relatively undisturbed by noise. Development plan policies should have regard to any relevant Noise Action Plan, including the need to protect urban ‘quiet areas’ against an increase in noise.”*

19.2.1.4 A case-specific combination of absolute, relative and change assessment is used, following standard practice, as outlined in section 8.5 of the Association of Noise Consultants Environmental Noise Measurement Guide.

19.2.1.5 **Absolute** assessments are used when considering the onset of an effect, introduction of new receptors and in some situations, when an impact is relatively short-lived (e.g. construction).

19.2.1.6 **Relative** comparisons are made when a new or different source of noise, generally a continuous or long term source, is introduced into an environment (e.g. plant noise).

19.2.1.7 **Change** comparisons are more appropriate for existing noise sources which vary in level or prevalence over time (e.g. traffic).

19.2.2 Relevant standards and guidance

Technical Advice Note (Wales) 11

19.2.2.1 Technical Advice Note (TAN) 11 provides advice on "*how the planning system can be used to minimise the adverse impact of noise without placing unreasonable restrictions on development or adding unduly to the costs and administrative burdens of business*". In situations where noise from industrial or commercial premises are to be assessed, it cites *BS 4142:1997 Method for rating industrial noise affecting mixed residential and industrial areas*, as the recommended standard for guidance. In addition, it states that general guidance on acceptable noise levels within buildings can be found in *BS 8233: 1987.*

19.2.2.2 TAN11 states, in its explanation of the decibel (dB) in the Glossary, that *"a change of 3 dB(A) is the minimum perceptible under normal conditions".*

19.2.2.3 TAN11 itself should not be used as a means of assessing the noise impact of a new noise source on existing residential dwellings. Its purpose is to assist in determining the suitability of land for residential development after considering the ambient noise climate. It contains helpful guidance and references.

19.2.2.4 TAN 11 advises in Annex B21 'Noise from recreational and sporting activities' that, *"For these activities the local planning authority will have to take account of how frequently the noise will be generated and how disturbing it will be, and balance the enjoyment of the participants against nuisance to other people"*.

BS 4142 Method for rating industrial noise affecting mixed residential and industrial areas (1997)

19.2.2.5 BS4142 includes a methodology for determining the likelihood of complaints from residents about industrial or fixed plant noise. This is based on a measurement of the difference between noise specifically due to industrial sources and the underlying background noise experienced at the residential premises.

19.2.2.6 BS4142 takes account of the different nature of noise impact on residential dwellings during the day and at night; a considerably shorter period of noise exposure is sufficient to produce an adverse reaction at night. Assessment of noise impact during daytime periods (07:00 - 23:00) covers a full hour, whereas a night-time (23:00 - 07:00) assessment is over a five-minute period.

19.2.2.7 The BS4142 assessment method describes the difference between the measured background noise and the rating level. BS4142 derives a rating level by comparing the Specific L_{Aeq} Noise Level (arising from the new source of noise) against the current background L_{A90}noise level. If the new noise source contains any tonal, impulsive or distinct impulsive noises, a 5dB penalty is added. If the rating level exceeds the background noise level by around 10dBA or more, complaints are assessed as being more likely. A difference of around 5dBA shows the likelihood of complaints is of marginal significance and a difference of more than 10dBA below the background noise level then this is a positive indication that the likelihood of complaints is unlikely.

19.2.2.8 BS 4142 states that "*background noise levels below about 30 dB and rating levels below about 35 dB are considered to be very low*."

Calculation Of Road Traffic Noise (CRTN) 1998

19.2.2.9 CRTN guidelines describe the procedures for calculating noise from road traffic. These procedures are primarily intended to enable entitlement under the Noise Insulation Regulations (1975-1996) to be determined, but they also provide guidance appropriate to the calculation of traffic noise for more general applications e.g. environmental appraisal of road schemes, highway design and land use planning.

BS 5228 Part 1: Noise and Vibration Control on Construction and Open Sites (2009)

19.2.2.10 Whilst this standard does not provide detailed guidance for determining whether or not noise from a site would constitute a problem in a particular location, it does reference a number of factors that are likely to affect considerations of the acceptability of site noise.

19.2.2.11 Although it is generally recognised that, for industrial noise, the likelihood of complaints is related to the difference between the industrial noise and the existing background noise level, this standard recognises that this relationship between response and noise level difference may well be different for construction noise activities and a greater difference may be tolerated when it is known that the operations are of relatively short duration.

World Health Organisation: Guidelines for Community Noise, 1999

19.2.2.12 The World Health Organisation (WHO) guidelines set community noise targets for the avoidance of noise levels which could result in annoyance or health effects during daytime and night-time periods. The guideline noise levels are shown in Appendix 19.1, Volume 3.

19.2.2.13 The guidelines correspond to the 'good' standard of internal noise environment as recommended in BS 8233:1999 *Sound insulation and noise reduction for buildings-Code of practice* with windows open.

19.2.2.14 It should be noted, however, that these absolute levels are accepted to represent aspirational targets. The current prevailing background noise conditions in the study area of the Project already exceed these levels such that comparative assessments are more appropriate.

19.2.2.15 The National Noise Incidence Study 2000/2001 found that 55±3% of the population of England and Wales live in dwellings exposed to day-time noise levels above the WHO level of 55 dB $L_{Aeq,day}$.

19.2.2.16 The National Noise Incidence Study 2000 has found that 68±3% of the population of England and Wales live in dwellings exposed to night-time noise levels above the WHO level of 45 dB $L_{Aeq,night}$.

19.2.2.17 Furthermore, in a review of health effects based noise assessment methods undertaken for the then Department of the Environment, Transport and the Regions (Porter *et al*, 1998) just before the issue of the 1999 WHO guidelines, it is noted that:

19.2.2.18 "*Perhaps the main weakness of both WHO-inspired documents is that they fail to consider the practicality of actually being able to achieve any of the stated guideline values…The percentages exposed above the WHO guideline values could not be significantly reduced without drastic action to virtually eliminate road traffic noise and other forms of transportation noise (including public transport) from the vicinity of houses. The social and economic consequences of such action would be likely to be far greater than any environmental advantages of reducing the proportion of the population annoyed by noise. In addition, there is no evidence that anything other than a small minority of the population exposed at such noise levels find them to be particularly onerous in the context of their daily lives*."

National Policy Statements

19.2.2.19 The National Policy Statement for Renewable Energy Infrastructure does not specifically refer to Tidal Lagoons within the documentation. However the Overarching National Policy Statement for Energy does allow for generic noise and vibration assessments in relation to energy generation.

19.2.2.20 It states that:

Where noise impacts are likely to arise from the proposed development, the applicant should include the following in the noise assessment:

i. a description of the noise generating aspects of the development proposal

ii. leading to noise impacts, including the identification of any distinctive

iii. tonal, impulsive or low frequency characteristics of the noise;

iv. identification of noise sensitive premises and noise sensitive areas that may be affected;

v. the characteristics of the existing noise environment;

vi. a prediction of how the noise environment will change with the proposed development;

vii. in the shorter term such as during the construction period;

viii. in the longer term during the operating life of the infrastructure;

ix. at particular times of the day, evening and night as appropriate.

x. an assessment of the effect of predicted changes in the noise environment on any noise sensitive premises and noise sensitive areas; and

xi. measures to be employed in mitigating noise.

The nature and extent of the noise assessment should be proportionate to the likely noise impact.

19.2.2.21 The methodologies already introduced will be used to assess noise and vibration on both land and underwater to satisfy the requirements of the National Policy Statements.

19.2.3 Consultation

19.2.3.1 Neath Port Talbot County Borough Council's (NPTCBC) and County and City of Swansea's (CCSC) environmental health departments were consulted on the potential noise and vibration impacts of the Project.

19.2.3.2 NPTCBC and CCSC noted that best practice as per BS5228 would generally be appropriate mitigation of site preparation and construction noise. BS8233 and WHO guidance should be used in relation to the consideration of external amenity. Noise and vibration have been assessed in the Chapter using the guidance highlighted by NPTCBC and CCSC.

19.3 Assessment methodology

19.3.0.1 This section outlines the methodology used to assess the noise and vibration impacts of the Project on both existing receptors and proposed future receptors during the construction, operation and decommissioning phases. Operational noise and vibration are considered from both onshore and offshore sources.

19.3.0.2 Initially the study area is described, then data sources for baseline data (including site specific noise surveys) are outlined. Following this, the assessment methodologies are presented.

19.3.0.3 This ES proceeds on the basis of the outline construction programme as discussed in Chapter 4, Section 4.5.2, which anticipates construction starting in 2015 and with the main construction lasting for about three years. The assessments contained in this chapter are not materially sensitive to works commencing within the anticipated validity of the DCO, which is five years, or to an extension of (say) a further year-or-so.

19.3.1 Study area

19.3.1.1 The geographic extent of the study area for airborne noise and vibration impacts associated with the construction, operation and decommissioning of the Project is limited to sensitive receptor locations in the local vicinity (identified in section 19.3.2 below).

19.3.1.2 In consideration of underwater impacts, the Lagoon area itself and the greater area of the Swansea Bay are considered to be within the study area.

19.3.2 Onshore sensitive receptors

19.3.2.1 The following areas were identified as representative of noise and vibration sensitive receptors, or groups of receptors, in the assessment of potential impacts from offshore and onshore works. The locations are illustrated on Figure 19.1.

i. R1 - St Margaret's Court, Swansea Marina;

ii. R2 - Apartments on Kings Road;

iii. R3 - Residences on Baldwin's/Elba Crescent;

iv. R4 - Swansea University Bay Campus (SUBC) off Fabian Way (A483) – under construction;

v. R5 - Residences off Ashleigh Terrace, Jersey Marine; and

vi. R6 – Residences off Scarlet Avenue, Port Talbot.

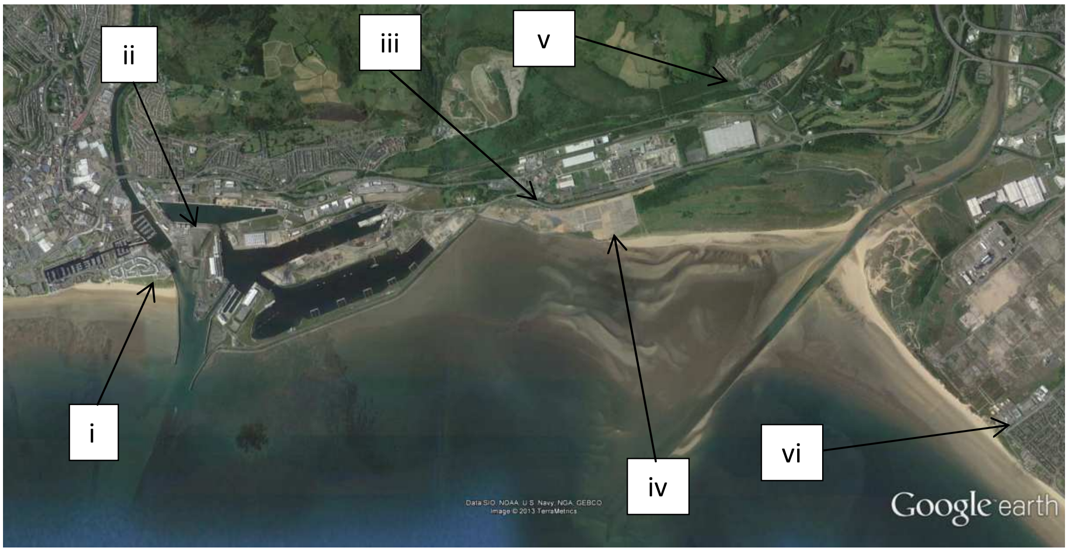

Figure 19.1 Location of key noise sensitive receptors

19.3.3 Baseline noise data

19.3.3.1 An integral part of an environmental noise impact assessment of a project is an understanding of the noise environment that exists in the area potentially affected by the development in question.

Historical data

19.3.3.2 Background noise data were reviewed for onshore and offshore areas. Data from previous noise surveys undertaken in the area (available via CCSC's and NPTCBC's planning websites at http://www.swansea.gov.uk/index.cfm?articleid=701 and http://planning.npt.gov.uk respectively) was reviewed. The Bay Science and Innovation Campus, Swansea University Environmental Statement (URS, 2010) and the Wales Noise Map (http://data.wales.gov.uk/apps/noise/) were also reviewed.

Onshore noise survey

19.3.3.3 Baseline onshore noise surveys were undertaken at seven sites along Swansea seafront past the new SUBC and the adjacent Crymlyn Burrows Site of Special Scientific Interest (SSSI) along to southern end of Aberafan seafront as shown in Table 19.1 and on Figure 19.2.

Table 19.1 Noise monitoring locations (2013)

Ref	Description	Grid Reference	Approximate Height of Monitor	Weather conditions
A	Swansea Marina	51°36'50.9"N 3°56'14.2"W	1.5m	Dry with light winds
B	Swansea Marina/ Maritime Quarter	51°36'53.3"N 3°55'49.9"W	1.5m	Dry with light winds
C	Kings Road	51°37'04.9"N 3°55'36.8"W	1.5m	Dry with light winds
D	Swansea University SUBC	51°37'04.0"N3°53'03.8"W	1.5m	Dry with light winds
E	Scarlet Avenue	51°36'08.1"N 3°49'49.71"W	1.5m	Dry with light winds
F	Princess Margaret Avenue	51°35'42.3"N 3°49'07.9"W	1.5m	Dry with light winds
G	Jersey Quay	51°35'18.0"N 3°48'34.4"W	1.5m	Dry with light winds

Figure 19.2 Location of noise sensitive receivers

19.3.3.4 The baseline noise surveys were undertaken on the 19th April 2013. Measurements were made over 15 minute sample periods and consisted of the following principal descriptors: L_{Aeq}, L_{A10}, L_{A90}, L_{Amax} (see Glossary for definitions).

19.3.3.5 Noise measurements were made using the following equipment:

i. 1 no. Norsonic Type 140 Type 1 Precision sound level meter;

ii. 1 no. Norsonic Type 118 Type 1 Precision sound level meter;

iii. 1 no. Rion Type NL32 Type 1 Precision sound level meter;

iv. Norsonic Type 1251 Acoustic calibrator.

19.3.3.6 The calibration of the meters was verified before and after the measurement period and no signal drift was found to have occurred. The accuracy of the calibrators can be traced to National Physical Laboratory Standards.

19.3.3.7 Measurements were made following guidance from ISO 1996-2:2007 Acoustics – Description, measurement and assessment of environmental noise – Part 2: Determination of environmental noise levels.

19.3.3.8 The microphone was mounted on a tripod approximately 1.5 m above ground level unless otherwise specified in Table 19.1.

19.3.3.9 Environmental windshields were used at all times throughout the survey. Weather conditions varied throughout the measurement period, with periods of wind and rain, and other times being dry and relatively calm. In general, weather conditions became progressively better throughout the survey. Sea-state noise rose during periods of less calm weather.

19.3.3.10 An automated noise survey was undertaken at position IV, Figure 19.1 and D, Figure 19.2 between Friday 19th and Monday 22nd April 2013 at the location of the SUBC.

Offshore noise survey

19.3.3.11 The Offshore Noise Survey measured underwater noise to gain an understanding of the existing noise sources within the marine environment of the Swansea Bay area close to the Project. This information was used for comparative purposes against the assessed offshore noise sources related to construction and operation of the Lagoon.

19.3.3.12 Centre for Environment Fisheries and Aquaculture (CEFAS) were consulted, and agreed the proposed underwater noise measurement methodology prior to the survey, and all measurements were undertaken in accordance with this methodology.

19.3.3.13 Underwater noise measurements were undertaken on Friday 19th April 2013 at five locations around the Project area as shown in Figure 19.3.

19.3.3.14 Measurements of a range of conditions, including specific measurements of marine traffic movements were made to provide direct comparisons and to build up a picture of prevailing activity in the bay which would be expected to occur regardless of the Project.

19.3.3.15 During the survey, the weather was clear with light winds and a relatively calm sea. The survey started before high tide, and was completed after high tide which allows the broadest possible range of frequencies to be monitored. This is because water depth influences sound propagation (Urick, 1983). This time period was chosen as Swansea docks are mainly accessed by large vessels during the high tide window, and the increased water depth enabled the study of a range of measurement depth options.

19.3.3.16 The measurements were undertaken using the following equipment, all of which was powered by batteries, independent of the survey vessel power supply:

i. 1 no. Bruel & Kjaer Type 8104 hydrophone;

ii. 1 no. Bruel & Kjaer Type 2635 charge amplifier;

iii. 1 no. Bruel & Kjaer Type 4223 hydrophonic calibrator.

19.3.3.17 Measurements were undertaken with the hydrophone suspended from a buoy at a range of depths. Measurements were recorded close to the surface, at mid-depth and close to the seabed (nominally at 1m, 4m and, where possible due to depth, 8m).

19.3.3.18 During the measurements the survey vessel's engine, active sonar and electric systems, all of which could cause interference, were turned off and the boat was allowed to drift on the tide. Headphones were used to listen directly to the underwater signal to ensure adequate signal to noise ratio and the absence of interference.

19.3.3.19 Measurements were undertaken once the buoy had been allowed to drift as far from the boat as practicable to minimise flow generated noise artefacts in-situ. The hydrophone (B&K 8104) calibration was verified with a pistonphone calibrator (B&K 4223) at the air-water sensitivity crossover frequency of 251.2Hz, with an adjustment for barometric pressure.

19.3.3.20 Handheld GPS positioning and the vessel's radar system were used to identify measurement locations and to estimate the locations of, and therefore ranges to, other points of interest, such as other noise sources including other vessels.

19.3.3.21 Approximate locations of the measurements along with the drift direction are shown in Figure 19.3.

Figure 19.3 Location of underwater noise monitoring locations

19.3.4 Assessment methodologies

Construction noise – onshore works

19.3.4.1 Noise impact from general construction activity onshore (e.g. construction compounds, Project facilities) on neighbouring receptors, including those within the Project due to phased construction, is considered in ***absolute*** terms. The assessment is based on the approved code of practice, BS5228 Part 1 ("BS5228-1") and in comparison with the existing noise climate on and around the Project site. BS5228-1 criteria indicate if a significant effect is likely to occur at noise sensitive properties.

19.3.4.2 It is expected that onshore works, where possible, will only be undertaken during the daytime and hence most assessments have been made against daytime noise levels. It is likely that works at sea will be dictated to some degree by tides and weather and, as such, may be undertaken 24 hours a day. Due to the requirement for materials, the batching plant will operate 24 hours a day when there are works at sea, therefore assessments of these elements have been undertaken for the night-time period also.

19.3.4.3 The input data was based on current knowledge of the processes occurring within each stage of the development. Where manufacturers' data cannot be provided, library data from BS5228 or similar processes measured elsewhere have been used. Similar assumptions have been made for decommissioning.

19.3.4.4 All sources have been calculated in 'worst case' terms and so they have been located as near to receivers as they would be likely to operate during the process. It has been assumed also that noise sources will operate continuously throughout each assessed period. To ensure the assessment is as robust as possible, it has been assumed that all proposed activities will occur simultaneously. This is very much a worst case since such a combination is not likely in practice.

19.3.4.5 Construction noise occurring during the daytime, will be assessed using the Fixed Limits Method within Annex E.2 of BS5228-1. Typically on demolition/construction sites, noise limits for works are set to avoid interference with speech in nearby buildings. Annex E2 provides advice on suitable maximum levels of site noise during daytime hours (07:00 – 19:00). The guidance states that external noise levels outside the window of the nearest noise sensitive room should not exceed:

i. 75dB(A) in urban areas near a main road or in heavy industrial areas; or

ii. 70 dB(A) in rural, suburban areas away from a main road and industrial noise.

19.3.4.6 For the daytime construction noise assessment, due to the location of Fabian Way and the nearby docks, the receivers at Baldwin's/Elba Crescent have been assessed against the 75dB(A) criterion. All other receivers are to be assessed using the 70dB(A) criterion.

19.3.4.7 When considering the significance of construction noise at night, the ABC method should be used as detailed in Annex E.3.2 of BS5228. The ABC method uses the ambient noise levels at the appropriate period (night, evening/weekend or daytime). A comparison is then made with the total noise level, including construction/demolition noise. If the cumulative noise level exceeds the category value for that period, then a significant effect is deemed to occur.

Table 19.2 ABC method

Assessment category & threshold value period – L_{Aeq}	Threshold value in decibels		
	Category A [A]	Category B [B]	Category C [C]
Night-time (23:00 – 07:00)	45	50	55
Evening & weekends	55	60	65
Daytime (07:00 – 19:00) & Saturdays (07:00 – 13:00)	65	70	75

1. A significant effect has been deemed to occur if the total L_{Aeq} noise level, including construction, exceeds the threshold level for the category appropriate to the ambient noise level.
2. If the ambient noise level exceeds the values given in the table (i.e. the ambient noise level is higher than the above values), then a significant effect is deemed to occur if the total L_{Aeq} noise level for the period increases by more than 3dB due to construction activity.
3. Applied to residential receptors only.

[A] Category A: Threshold values to use when the ambient noise levels (when rounded to the nearest 5dB) are less than these values.
[B] Category B: Threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as category A values.
[C] Category C: Threshold values to use when ambient noise levels (when rounded to the nearest 5B) are higher than A values.

Construction noise – offshore works (airborne and underwater)

19.3.4.8 The potential noise impacts of construction works offshore (piling, dredging, installation of turbines) have been considered in terms of impacts on sensitive receptors identified onshore and noise levels within the receiving underwater environment. The assessment for noise impacts on onshore sensitive receptors follows the methodology described above. In relation to underwater noise levels the following methodology has been adopted.

19.3.4.9 The propagation of noise as a result of the construction phase of the Project has been modelled using the 20logR relationship, which is commonly applied to propagation in water (Parvin *et al*, 2008).

19.3.4.10 The transmission loss ("**TL**"), is referred to in underwater acoustics when describing predicted or measured noise levels at varying distance ("**R**") from the source.

19.3.4.11 The general relationship **TL = NlogR + aR** is used to describe the two components of sound level reduction with distance, geometric spreading and absorption. **N** describes the divergence pattern and **a**, the rate of absorption per metre.

19.3.4.12 Spherical divergence from a point source provides an **N** term of 20. Modelling the absorption term, **a**, can be very involved, especially in shallow waters where the bottom and sediment interactions provide significant attenuation. To provide a precautionary assessment methodology, which is also consistent with the standard methodology for deriving equivalent source strength (the equivalent sound pressure level at 1m), propagation assessments have been based on 20logR only, neglecting the absorption term. This approach has been confirmed to be suitably robust in review of propagation loss approximations made in published field studies (Nedwell & Edwards, 2004; Parvin *et al,* 2008).

19.3.4.13 In order to determine the way in which the energy of sound is distributed across the frequency range, the International Standards Organisation have agreed on "preferred" bands of frequency for sound measurement and analysis. The widest and most commonly used band for frequency measurement and analysis is the Octave Band. In these bands, the upper frequency limit is twice the lower frequency limit, with the band being described by its "centre frequency" which is the average (geometric mean) of the upper and lower limits, e.g. 250 Hz octave band runs from 176 Hz to 353 Hz. The most commonly used bands are:

Octave Band Centre Frequency, Hz	63	125	250	500	1000	2000	4000	8000

Construction noise – construction traffic

19.3.4.14 As identified in Chapter 4, it is anticipated that rock armour for the seawalls will be transported by sea. Notwithstanding this, other materials will be brought to the Project by road. An assessment has been undertaken for road transport of materials using the traffic flow data provided in Chapter 15, Onshore Transport.

19.3.4.15 Calculations for road traffic noise are based on methodologies described in Calculation of Road Traffic Noise (CRTN) and the Design Manual for Roads and Bridges (DMRB) Volume 11 Section 3 part 7 (November 2011). Three dimensional noise modelling has been undertaken to predict receiver noise levels at a variety of locations. This model uses the CRTN methodology to calculate absolute road traffic noise levels, which are based upon traffic flows as advised using data from Chapter 15 Onshore Transport for roads in the vicinity, as well as potential vehicle movements associated with the servicing of the construction sites. Noise propagation from other sources will be calculated in accordance with ISO 9613 methodology.

19.3.4.16 The assessment of noise impact due to increased traffic flows generated during construction of the Project and upon completion is best assessed using a ***change*** comparison of existing against predicted levels of road traffic noise. Changes have been assessed against semantic descriptors, as suggested in the IEMA (Institute of Environmental Management and Assessment/IOA (Institute of Acoustics) guide, but based on guidance on noise level changes in DMRB. DMRB states that the impact arising from a change in noise level depends upon whether it occurs as a result of a gradual or sudden change in road traffic flow. Generally, it is found that a sudden change gives rise to a greater impact than a gradual change. The impact of a sudden change in road traffic noise levels is defined in terms of the percentage of people "*bothered very much or quite a lot*" by noise. Levels of significance have been interpreted from the "*estimation of traffic noise nuisance*" graphs in DMRB. Criteria for determining significance of impact for road traffic noise are shown in Table 19.3.

Table 19.3 Criteria for determining significance of impact – road traffic noise

Change in Noise Level	Interpreted Significance
> -10 dB	Major Beneficial
-5 - -10 dB	Intermediate Beneficial
-3 - -5 dB	Slight Beneficial
0 - -3 dB	Negligible
0 dB	No Change
0 – 3 dB	Negligible
3 – 5 dB	Slight Adverse
5 – 10 dB	Intermediate Adverse
>10 dB	Major Adverse

19.3.4.17 It should be noted that the potential impact of a noise source is dependent on the characteristics of the source, such as duration or the type of noise. In instances where this is relevant, the assessor's judgement has been used in determining the optimal approach to assess the magnitude of the impact with regard to absolute or change in noise levels.

Construction – vibration

19.3.4.18 Vibration impacts are considered in absolute terms against thresholds for human discomfort and building damage (BS6472-1: 2008 *Guide to evaluation of human exposure to vibration in buildings* and BS7385-2: 1993 *Evaluation and measurement for vibration in buildings. Guide to damage levels from ground-borne vibration* respectively). BS6472 presents recommended frequency-weighted vibration spectra (continuous vibration) and vibration dose values (intermittent vibration) above which adverse likelihood of comment is likely to occur in dwellings. BS7385 presents values for intermittent vibration above which there is a chance of cosmetic damage to buildings.

19.3.4.19 It should be noted that the vibration magnitudes at which significant adverse human response is likely are orders of magnitude lower than those which cause significant building damage. Construction activities considered in the assessment comprise piling and concrete batching.

19.3.4.20 In relation to road traffic sources, vibration can be caused by ground-borne transmission (generally due to road surface irregularities) and airborne induced excitation of lightweight structures (e.g. rattling sash windows).

Operational noise – visitor facilities and recreational activities

19.3.4.21 Assessment of noise generated by fixed plant associated with the eventual use of the visitor facilities and operation of the turbines, including ventilation and cooling, is assessed in ***relative*** terms using the rating and assessment methods set out in BS 4142.

19.3.4.22 For the assessment of recreational noise due to the operational use of the Lagoon levels have been related to the existing noise levels in the area.

Operational noise – offshore turbines (underwater noise)

19.3.4.23 During the operational phase, the assessment considered noise arising from the turbines adopting the same methodology used for assessing underwater noise during the construction phase.

Operational noise – operational traffic

19.3.4.24 Changes in noise arising from traffic arising as a result of the operation of the Project have been calculated using the same method as the calculations for traffic noise during the construction phase.

19.4 Baseline conditions

19.4.1 Description of local environment

19.4.1.1 There is a varied environment along the shoreline that will be occupied by or in proximity to the Project, with a mix of relatively recent residential developments in the marina to the west of the River Tawe, Kings Road to the north, and older housing on Baldwin's Crescent. The dwellings in Kings Road are surrounded by a mix of commercial premises including a hotel and car dealerships, as well as light industrial units. To the east end of the Project is an area of land known as Crymlyn Burrows, which is a Site of Special Scientific Interest (SSSI).

19.4.1.2 The vacant piece of land between Fabian Way and Crymlyn Burrows to the east of the Project is currently being developed into the new SUBC. It will be occupied by a combination of teaching and residential facilities.

19.4.1.3 To the north of the Project at its western extent, and likely to be affected by the Connection Works and Onshore Works, is Swansea Port, owned and operated by ABP. It contains multiple docks, all with associated industrial handling and loading equipment. Swansea Port is serviced by the A483 (Fabian Way) which is a dual carriageway running to and past the port into Swansea.

19.4.1.4 The Project is to be located within Swansea Bay, between the mouths of the River Tawe to the west and the River Neath to the east. At the mouth of the River Tawe lies the entrance to the Port of Swansea and Swansea Marina. The Port of Neath is located along the Neath River. Both the rivers have dredged channels into their entrances. To the east lies Port Talbot.

19.4.1.5 All three ports handle a range of commercial vessels, with the Port of Swansea handling containers and a range of other cargos. The Port of Neath accommodates vessels up to 600 deadweight tonnage and also has a yacht marina with approximately 75 boats. Port Talbot handles a range of large vessels which transport general cargo, minerals and ore.

19.4.1.6 Swansea Marina is accessed via the River Tawe and currently has provision for 780 boats.

19.4.1.7 It is understood that the large cargo vessels leaving the Ports of Swansea and Neath follow the dredged channel from the harbours out in the Bristol Channel. The extent of the dredged channels roughly comprises the limits of the borders of the Offshore Works for the Project. Other marine traffic which traverses the current location of the Project comprises recreational and pilot vessels.

19.4.1.8 The full extent of marine traffic in the area is not documented, as only larger vessels are required to have GPS locating and tracking systems. However, the Navigation Chapter of this ES (Chapter 14) shows that during surveys undertaken in August 2013, there were on average 11 large vessel movements per day, which skirt around the edge of the Offshore Works area. In addition, the report noted that a number of small vessels, military vessels and pleasure craft currently pass beside or traverse the Project. These results show that the area is well trafficked and the current underwater soundscape contains significant marine vessel noise.

19.4.1.9 Dredging works also occur on occasion in the dredged channels of all three of the ports, with the channels to the ports of Swansea and Neath being maintained in close proximity to the proposed seawalls of the Project.

19.4.2 Onshore baseline noise levels

Historical data sources

19.4.2.1 An overview of environmental noise levels in the wider area can be gained from the Welsh Noise Map (http://data.wales.gov.uk/apps/noise/, accessed April 2013) which gives a good impression of the prevalence of road, rail and industrial noise sources in the study area and are shown in Figures 19.4 – 19.6.

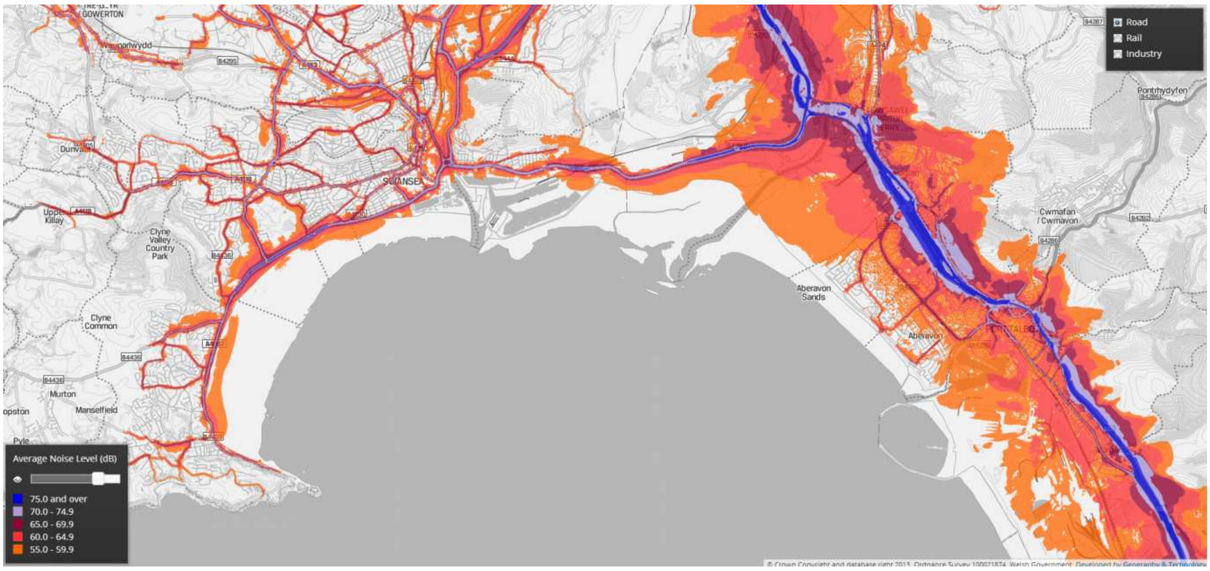

Figure 19.4 Welsh noise map: road noise

Figure 19.5 Welsh noise map: rail noise

Figure 19.6 Welsh noise map: industrial noise

19.4.2.2 It should be noted that industrial noise is generally accepted to be under-reported in this mapping process, with only larger industrial sites included in the estimation process. Road and rail noise exposure levels are based on flow rates speeds and timetables, which provide a reasonable degree of representative accuracy, but cannot be relied upon for site specific assessments. The Welsh Government noise mapping website points out that *"The noise levels in these maps are calculated rather than measured and are based on some assumptions. So the maps should not be relied upon to tell how noisy it really is outside specific properties."*

19.4.2.3 Noise data from the Welsh Noise Map – Road Noise for 2012 has been used in this assessment for the key receptors identified on Figure 19.1 and shown in Table 19.4.

Table 19.4 Noise Map Wales – Road noise data for key receptor locations (2012)

Ref	Daytime (dB)	Night-time (dB)
	L_{Aeq}	L_{Aeq}
R1 St Margarets Court	<55	<50
R2 Kings Road	55-60	50-55
R3 Baldwins Crescent	60-65	55-60
R4 Swansea University Bay Campus	55-60	<50
R5 Jersey Marine	55-60	50-55
R6 Scarlet Avenue	<55	<50

19.4.2.4 Recent survey information has been found in the public domain for locations within the vicinity of the Project and this has been used for two additional reference points in this assessment (Hunter Acoustics Report, 2008 & 2012) as shown in Table 19.5 and Figure 19.2. The first site is on Elba Crescent (position 2, Figure 19.2, 2008) approximately 90m to the north of Fabian Way, and the other is on Langdon Road (position 1, Figure 19.2, 2012) at the currently vacant site to the west of the Premier Inn.

Table 19.5 Additional noise data- Hunter Acoustics Report (2008 and 2012)

Ref	Description	Calculated Daytime L_{Aeq} CRTN	Measured Night-time L_{A90}
1*	Langdon Road	63 dB(A)	-
2*	Baldwins/Elba Crescent	58 dB(A)	47dB(A)

19.4.2.5 In addition, noise monitoring data has been located in the SUBC Environmental Statement (ES), which had a monitoring location to the south of Fabian Way, at the northern boundary of the new campus site.

Table 19.6 Additional noise data- SUBC

Ref	Description	Daytime	Night-time
SUBC ES	Northern boundary of SUBC site	L_{Aeq} 65 dB(A)	L_{Aeq} 58 dB(A)
		Min L_{A90} 35 dB(A)	Min L_{A90} 32 dB(A)

Noise survey 2013 data

19.4.2.6 The results of the noise monitoring surveys undertaken in 2013 are shown in Table 19.7 and presented in Appendix 19.2, Volume 3.

Table 19.7 Summary of measured noise levels (2013)

Ref	Daytime (dB)	
	L_{Aeq}	L_{A90}
A - Swansea Marina	43 – 49	43 – 51
B – Maritime Quarter	43 – 49	40 – 46
C – Kings Road	49 – 53	43 – 52
D – Swansea University Bay Campus	54	42
E- Scarlet Avenue	55 – 61	42 – 59
F – Princess Margaret Ave	59	56
G – Jersey Quay	57	54

19.4.2.7 Existing ambient noise levels are dominated by traffic noise from the A483 and surrounding roads, with a contribution from rail noise at the eastern receivers and noise from the sea at many of the receivers on the seafront.

19.4.2.8 As shown in table 19.5, noise levels measured on Langdon Road (location 1) were used to predict average noise levels using the CRTN shortened measurement procedure, with daytime noise levels of L_{Aeq} 63dB, which would be expected to fall by 6-7dB during the night-time period.

19.4.2.9 The results of the automated noise survey carried out between Friday 19th and Monday 22nd April 2013 at the location of southern boundary of the SUBC are summarised in Table 19.8, with full details in Appendix 19.2.

Table 19.8 Summary of automated noise survey results – SUBC (3 (Figure 19.1), D (Figure 19.2))

Ref	Daytime (dB)	Night-time (dB)
L_{Aeq}	54	52
Typical L_{A90}	42	46

Comparison of measured and historical onshore noise data

19.4.2.10 Noise levels from the Wales Noise Map have been compared with the noise levels measured in the 2013 surveys. The sound pressure levels at the different receivers predicted in the Wales Noise Map – road noise, shown in Table 19.4 correlate reasonably well with the noise levels measured during the 2013 manned daytime and the automated night-time surveys (Tables 19.6 and 19.7). This is consistent with the Wales Noise Map disclaimer regarding site specific precision, which does not alter the baseline appraisal undertaken.

19.4.3 Underwater baseline noise levels

Historical data

19.4.3.1 Underwater noise levels are compared by convention in terms of the equivalent broadband source level (SL)[1]. Previous studies in Swansea Bay have shown background noise levels during calm conditions ranging from values in the low 90s close to low tide to between 105 and 110dB approaching high tide (Willis *et al*, 2010).

19.4.3.2 By way of comparison, a large tanker may generate noise levels between 172 and 190 dB re 1µPa @ 1m from the source (Richardson *et al,* 1995). Marine mammal calls can also generate noise levels of 190 dB or more for communication and echolocation.

19.4.3.3 In the shallow water in which the Lagoon is proposed (5-10m) there is less opportunity for sound decay due to geometric dispersion, but this is offset by increased bottom and sediment absorption effect. Noise levels are affected by sea state, rain, biological sources and anthropogenic sources related to maritime activity in the area.

Underwater noise survey results

19.4.3.4 The ambient noise levels in this area are dominated by sea state and tidal noise; and existing marine traffic entering Swansea, Neath and Port Talbot Ports.

19.4.3.5 A summary of the results of the 2013 underwater noise monitoring at the five monitoring locations are presented in Table 19.9, with full results presented in Appendix 19.2, Volume 3.

19.4.3.6 Measurements of noise generated by other vessels in the vicinity were undertaken with attendant range estimates to enable Source Levels to be determined, calculated back to 1m from the source in question. The results are summarised below in Table 19.9.

Table 19.9 Summary of underwater noise measurements of sources

Vessel Type	Source Level, dB re 1µPa @1m
Medium Tanker – Arco Faith	190 – 192
Small tanker – Countess Ann	161 – 169
Pilot boat – Nocaluca (hydrographic survey)	179
Pilot boat – leading in tanker	173

[1] The RMS sound pressure level In dB ref 1µPa

19.4.3.7 The dominant sources of underwater noise identified during the survey measurements were vessel movements, including the large commercial vessels (Arco Faith and Countess Ann), locally moored yachts and smaller craft including the pilot boat, Nocaluca, undertaking hydrographic surveys of the channels into Swansea and Neath Ports. Vessel movements were relatively frequent during the site visit in April (2-3 an hour). Due to the seasonal and diurnal pattern associated with the use of the marina, it is likely that the activity, and hence ambient noise levels, would increase dramatically during the summer months.

19.4.3.8 In comparison with the previous studies in Swansea Bay which showed background noise levels during calm conditions ranging from the low 90s (LW) to 105 and 110dB (HW), the ambient noise levels measured at the locations around the Lagoon area were approximately 110 – 120dB. Overall the high water data results are slightly higher than the previously recorded data, but sufficiently low that the specific sources studied below could be measured reliably with a good signal to noise ratio.

19.5 Assessment of potential effects

19.5.0.1 The following section presents the findings of the assessments examining the potential impacts of the construction, operation and decommissioning phases of the Project.

19.5.1 Construction noise – Onshore Works

19.5.1.1 The key elements of the onshore construction works which have been assessed are as follows:

i. Formation of new access road

ii. Formation of temporary construction compounds in Swansea Port;

iii. Operation of construction compound/onshore construction activity

iv. Landfall works; and

v. Construction of cable route.

19.5.1.2 The western landfall building will be located approximately in the same area as the construction compound location i, highlighted below. Airborne noise levels due to the construction of the landfall building are likely to be lower than that from the formation of the temporary construction compound and so similar or lower noise levels can be assumed for the construction of the western landfall building as the formation of the construction compound at location i, hence no further assessment has been undertaken in this Chapter.

Formation of new access road

19.5.1.3 A Lagoon access road will be constructed to provide vehicular access through the port area to the south of the Queen's Dock. No noise impact is anticipated from the occasional vehicular use intended. Construction of the road will be a daytime activity which will primarily comprise the connection of existing roadways between the light industrial / distribution units to form a junction with Langdon Road. A short term minor impact, consistent with typical roadwork activities, may be experienced at the residential properties on Bevans Row.

Formation of temporary construction compounds in Swansea Port

19.5.1.4 Construction compounds will be required for storing rock required for the seawall brought into the port by ship; concrete batching and storage of materials, equipment, staff facilities etc. The indicative locations of the construction compounds are shown in Chapter 4, Project Description.

I. Western end of Swansea Port;

II. Centre of Swansea Port;

III. To the south of Fabian Way, between the eastern Docks access South Wales Transport Group site.

19.5.1.5 To model the construction of the compounds, a total sound power level has been calculated for a likely plant to be operating on site which includes dumpers, bulldozers, excavators, diesel generators, cement mixers and cement mixer lorries. To ensure a robust assessment, it has been assumed that all plant activities will operate constantly. The cumulative noise level has been predicted at the different receiver locations using standard propagation theory, as described in ISO 1996 and implemented via proprietary noise mapping software, DataKustic CadnaA v4.3.

19.5.1.6 Table 19.10 shows predicted levels of noise during daytime hours due to the formation of the three construction compounds. As can be seen, the predicted noise levels are all below the BS5228-1 fixed limits criteria.

Table 19.10 Predicted daytime noise levels from the formation of construction compounds (fixed limits method)

Ref	Description	Predicted Sound Level (dB(A)) Compound i	Predicted Sound Level (dB(A)) Compound ii	Predicted Sound Level (dB(A)) Compound iii	Criterion BS5228-1 dB(A)
R1	St Margarets Court	41	30	27	70
R2	Kings Road	39	33	30	70
R3	Baldwins Crescent	25	34	39	75
R4	Swansea University Bay Campus	23	31	34	70
R5	Ashleigh Terrace	17	22	24	70
R6	Scarlet Avenue	11	13	14	70

19.5.1.7 The results show that activities associated with the construction of the site compounds will be within BS5228-1 recommended noise fixed limit criteria, by a significant margin, and hence will have no significant effect.

Operation of construction compounds

19.5.1.8 Table 19.11 shows predicted levels of daytime noise as a result of the use of the construction compounds at each potential location.

Table 19.11 Predicted daytime noise levels from the operation of construction compounds (fixed limits method)

Ref	Description	Predicted Sound Level (dB(A)) Compound i	Predicted Sound Level (dB(A)) Compound ii	Predicted Sound Level (dB(A)) Compound iii	Criterion BS5228-1 dB(A)	Significant Effects
R1	St Margarets Court	36	26	22	70	No
R2	Kings Road	35	28	25	70	No
R3	Baldwins Crescent	19	29	34	75	No
R4	Swansea University Bay Campus	18	26	30	70	No
R5	Ashleigh Terrace	12	17	20	70	No
R6	Scarlet Avenue	6	9	9	70	No

19.5.1.9 The results show that activities associated with the operation of the site compounds during daytime hours will be well within BS5228-1 recommended noise criteria and hence there will be no significant effect.

19.5.1.10 Table 19.12 shows the assessment of night-time noise levels at noise sensitive receivers in the surrounding area.

Table 19.12 Predicted night time noise levels as a result of operation of construction compounds (ABC Method)

Receiver	Night-time Existing Ambient Level (L_{Aeq})	Rounded to nearest 5dB	Compound i		Compound ii		Compound iii		Category	Threshold BS5228-1 dB(A)
			Predicted site noise (dB(A))	Total noise (dB(A))	Predicted site noise (dB(A))	Total noise (dB(A))	Predicted site noise (dB(A))	Total noise (dB(A))		
R1	45*	45	36	46	26	45	22	45	B	50
R2	45*	45	35	45	28	45	25	45	B	50
R3	55*	55	19	55	29	55	34	55	C	55
R4	52	50	18	50	26	50	30	50	C	55
R5	50*	50	12	50	17	50	20	50	C	55
R6	45*	45	6	45	9	45	9	45	B	50

* Levels derived from noise map or manual measurements

19.5.1.11 When the threshold values are compared with the Total Noise levels predicted at the noise sensitive receivers due to the operation of the site compounds, no significant impacts are indicated.

Landfall works

19.5.1.12 In order to assess the worst case impact on receivers during daytime hours, an assessment of noise associated with the landfall works for both the eastern and western landfall was undertaken at the nearest point to the receivers.

Table 19.13 Predicted daytime noise levels resulting from landfall works (fixed limits method)

Ref	Description	Predicted Sound Level (dB(A))	Criterion BS5228-1 dB(A)	Significant Effects
R1	St Margarets Court	42	70	No
R2	Kings Road	39	70	No
R3	Baldwins Crescent	40	75	No
R4	Swansea University Bay Campus	48	70	No
R5	Ashleigh Terrace	33	70	No
R6	Scarlet Avenue	21	70	No

19.5.1.13 The results show that the predicted sound level will be well within the BS5228-1 recommended noise criteria and hence can be considered to be acceptable.

19.5.1.14 Table 19.14 shows the assessment of night-time noise levels at noise sensitive receivers in the surrounding area.

Table 19.14 Predicted night time noise levels arising from landfall works (ABC method)

Receiver	Existing Night-time Ambient Level (L_{Aeq})	Rounded to nearest 5dB	Predicted site noise (dB(A))	Total noise (dB(A))	Category	Threshold BS5228-1 dB(A)	Significant Effect
R1	45*	45	42	47	B	50	No
R2	45*	45	39	46	B	50	No
R3	55*	55	40	55	C	55	No
R4	52	50	48	52	C	55	No
R5	50*	50	33	50	C	55	No
R6	45*	45	21	45	B	50	No

* Levels derived from noise map or manual measurements

19.5.1.15 The comparison of threshold values with the Total Noise levels predicted at the noise sensitive receivers from landfall works indicate that the impact will not be significant.

Construction of cable route

19.5.1.16 It is proposed to run the cable underground from the shore to connect to the grid following existing routes, where possible. The proposed route will run from the western landfall via existing land at Swansea Port, land within or adjacent to the SUBC and adjoining land parallel to Fabian Way or through the Crymlyn Burrows SSSI, crossing the River Neath and terminating at the existing Baglan substation (see Chapter 4 Project Description). These would include routes alongside roads and pavements. Noise from this activity would be transient as the works progress along the path of the cable route. However, noise levels from this activity would be no louder than typical roadwork activities and would only be undertaken during the daytime. They are not expected to have a significant noise impact on receivers.

19.5.1.17 Where the cable route runs under the River Neath, it is intended to use existing conduits. However, should these be unsuitable, it is proposed to directional drill a small bore diameter route beneath the river. Underwater noise measurements (maximum) of directional drilling will result in very low levels of noise at the river bed of less than 130dB re. 1µPa (Nedwell *et. al.,* 2012) whilst directly above the noise source. These levels are only slightly higher than the background noise levels previously discussed, and are considered to be at a low enough level that impact on underwater receivers can be discounted.

19.5.2 Construction noise – Offshore Works

Airborne Noise

Installation of Turbines

19.5.2.1 In order to assess the worst case impact on receivers during daytime hours, an assessment of noise associated with the construction of the turbine housing area at the nearest point to the receivers was undertaken.

Table 19.15 Predicted daytime noise levels resulting from turbine installation (fixed limits method)

Ref	Description	Predicted Sound Level (dB(A))	Criterion BS5228-1 dB(A)	Significant Effects
R1	St Margarets Court	17	70	No
R2	Kings Road	15	70	No
R3	Baldwins Crescent	10	75	No
R4	Swansea University Bay Campus	10	70	No
R5	Ashleigh Terrace	6	70	No
R6	Scarlet Avenue	5	70	No

19.5.2.2 The results show that the predicted sound level will be well within the BS5228-1 recommended noise criteria and hence can be considered to be acceptable.

19.5.2.3 Table 19.16 shows the assessment of night-time noise levels at noise sensitive receivers in the surrounding area.

Table 19.16 Predicted night time noise levels arising from installation of turbines (ABC method)

Receiver	Existing Night-time Ambient Level (L_{Aeq})	Rounded to nearest 5dB	Predicted site noise (dB(A))	Total noise (dB(A))	Category	Threshold BS5228-1 dB(A)	Significant Effect
R1	45*	45	17	45	B	50	No
R2	45*	45	15	45	B	50	No
R3	55*	55	10	55	C	55	No
R4	52	50	10	50	C	55	No
R5	50*	50	6	50	C	55	No
R6	45*	45	5	45	B	50	No

* Levels derived from noise map or manual measurements

19.5.2.4 The comparison of threshold values with the Total Noise levels predicted at the noise sensitive receivers from installation of the turbines indicate that the impact will not be significant.

Construction activities including dredging

19.5.2.5 Construction of the seawall will involve the use of a dredger to fill geotextile tubes (Geotubes®) which will be used to contain the core material inside of the Lagoon walls. Once the geotextile tubes are placed, the area in between the tubes will be filled with more dredged material to form the central wall element, with rock armour installed over the geotextile tubes for protection. An alternative option for constructing the seawall would be by using dregded gravel or quarry run material instead of Geotubes® for containing the sediment in the core (Chapter 4, Section 4.3.1). If quarry run material were used, then potentially this option would involve less dredging. Construction of the seawall using the Geotube® option has therefore been assessed for noise as this option will involve more dredging and thus would be considered the worst case scenario.

19.5.2.6 A cutter suction dredger is to be used to fill the geotextile tubes. This uses a large suction tube with a cutter head at the inlet that loosens debris and sediment on the marine floor. The dredged material is sucked then into a hopper, ready for transfer into the tubes. The dredger excavates sediment from the bottom of the seabed in shallow areas and fills the geotextile tubes in situ. The Geotubes® form the two sides of the main structure of the seawall and the centre is filled with a sand core of further dredged material.

19.5.2.7 It is proposed that rock will be brought to site by sea and taken to a temporary storage area. When required, the rock will be loaded onto a barge or dumper truck depending on its proposed final location on the seawall. In terms of marine noise generated from the import of rock to site by ship, this will be of the same order as existing ships which currently access the three ports in the area.

19.5.2.8 To provide a robust assessment, noise levels from seawall construction activities, including dredging, nearest to the receivers have been assessed for each location as presented in Table 19.17. The highest sound pressure level across all piling locations for each receiver has been reported.

Table 19.17 Prediction of daytime noise levels resulting from construction of seawall (fixed limits method)

Ref	Description	Predicted Sound Level (dB(A))	Criterion BS5228-1 dB(A)	Significant Effect
R1	St Margarets Court	43	70	No
R2	Kings Road	41	70	No
R3	Baldwins Crescent	38	75	No
R4	Swansea University Bay Campus	41	70	No
R5	Ashleigh Terrace	32	70	No
R6	Scarlet Avenue	29	70	No

19.5.2.9 The results show that activities associated with the dredging and construction of the seawall will be within the BS5228-1 recommended noise criteria and hence will have no significant effect.

19.5.2.10 Table 19.18 shows the assessment of night-time noise levels at noise sensitive receivers in the surrounding area.

Table 19.18 Prediction of night-time noise levels resulting from construction of seawall (ABC method)

Receiver	Existing Night-time Ambient Level (L_{Aeq})	Rounded to nearest 5dB	Predicted site noise (dB(A))	Total noise (dB(A))	Category	Threshold BS5228-1 dB(A)	Significant Effect
R1	45*	45	43	47	B	50	No
R2	45*	45	41	47	B	50	No
R3	55*	55	38	55	C	55	No
R4	52	50	41	51	C	55	No
R5	50*	50	32	50	C	55	No
R6	45*	45	29	45	B	50	No

* Levels derived from noise map or manual measurements

19.5.2.11 The comparison of threshold values with the Total Noise levels predicted at the noise sensitive receivers during the construction of the seawall indicate that the impact will not be significant.

Piling at turbine housing/lagoon wall

19.5.2.12 The Piling proposed for this location involves driving a sheet pile into the seabed. The noise generated by the piling is a function of the material type, size, the method of driving (gravity, hammer, vibro-piling, etc.) and the characteristics of the substrate into which it is being driven. Vibro-piling is likely to be the most extensively used technique, with impact/percussive piling techniques employed in situations where more resistance is encountered. Both piling methods have been assessed for impact.

19.5.2.13 To assess the worst case impact on receivers, an assessment of offshore impact piling at the nearest point to the receivers has been undertaken as presented in Table 19.19.

Table 19.19 Predicted day-time noise levels arising from impact piling (fixed limits method)

Ref	Description	Predicted Sound Level (dB(A))	Criterion BS5228-1 dB(A)	Significant Effect
R1	St Margarets Court	49	70	No
R2	Kings Road	48	70	No
R3	Baldwins Crescent	43	75	No
R4	Swansea University Bay Campus	43	70	No
R5	Ashleigh Terrace	38	70	No
R6	Scarlet Avenue	36	70	No

19.5.2.14 The results show that the predicted sound level will be well within the recommended noise limit levels and hence can be considered to be acceptable.

19.5.2.15 Table 19.20 shows the assessment of night-time impact piling noise levels at noise sensitive receivers in the surrounding area.

Table 19.20 Predicted night-time noise levels arising from impact piling activities (ABC method)

Receiver	Existing Ambient Level (L_{Aeq})	Rounded to nearest 5dB	Predicted site noise (dB(A))	Total noise (dB(A))	Category	Threshold BS5228-1 dB(A)	Significant Effect
R1	45*	45	49	50	B	50	No
R2	45*	45	48	50	B	50	No
R3	55*	55	43	55	C	55	No
R4	52	50	43	51	C	55	No
R5	50*	50	38	50	C	55	No
R6	45*	45	36	46	B	50	No

* Levels derived from noise map or manual measurements

19.5.2.16 The comparison of threshold values with the Total Noise levels predicted at the noise sensitive receivers from impact piling activities indicates that the impact will not be significant, although the margin of compliance is not as great as during the daytime.

19.5.2.17 An assessment of offshore vibro-piling at the nearest point to the receivers has also been undertaken as presented in Table 19.21.

Table 19.21 Predicted day-time noise levels arising from vibro-piling (fixed limits method)

Ref	Description	Predicted Sound Level (dB(A))	Criterion BS5228-1 dB(A)	Significant Effect
R1	St Margarets Court	23	70	No
R2	Kings Road	21	70	No
R3	Baldwins Crescent	15	75	No
R4	Swansea University Bay Campus	15	70	No
R5	Ashleigh Terrace	10	70	No
R6	Scarlet Avenue	8	70	No

19.5.2.18 The results show that the predicted sound level will be well within the recommended noise limit levels and hence can be considered to be acceptable.

19.5.2.19 Table 19.22 shows the assessment of night-time vibro-piling noise levels at noise sensitive receivers in the surrounding area.

Table 19.22 Predicted night-time noise levels arising from vibro-piling activities (ABC method)

Receiver	Existing Ambient Level (L_{Aeq})	Rounded to nearest 5dB	Predicted site noise (dB(A))	Total noise (dB(A))	Category	Threshold BS5228-1 dB(A)	Significant Effect
R1	45*	45	23	45	B	50	No
R2	45*	45	21	45	B	50	No
R3	55*	55	15	55	C	55	No
R4	52	50	15	50	C	55	No
R5	50*	50	10	50	C	55	No
R6	45*	45	8	45	B	50	No

* Levels derived from noise map or manual measurements

19.5.2.20 The comparison of threshold values with the Total Noise levels predicted at the noise sensitive receivers from vibro-piling activities indicate that the impact will not be significant.

Underwater noise

19.5.2.21 Much of the research material and literature concerning underwater noise levels is ambiguous with regard to units of source noise levels i.e. zero to peak, peak to peak, etc. To ensure a robust assessment, a worst case approach has been used assuming in each case where the source material does not confirm the type of peak value measured.

Dredging

19.5.2.22 Dredging works will generate underwater noise. Table 19.23 shows a range of sound source levels at 1m for dredging activity reviewed in the source data compilation exercise described above.

Table 19.23 Source underwater sound levels for dredging

Event	Source level, Peak dB re 1µPa @ 1m
Beaver Mackenzie (Miles *et al,* 1987)	167, broadband 172
Aquarius (Miles *et al,* 1987)	178, broadband 185.
Cutter Suction Dredging (MALSF, 2009*)*	172 -180
TSHD Dredging (MALSF, 2009)	179 – 180
Dredging (MALSF, 2011)	(broadband) 188

19.5.2.23 In addition, research (MALSF, 2011) has shown that for many dredgers, source levels at frequencies lower than 500Hz are similar to those of a cargo ship travelling at modest speed, with elevated levels of broadband noise above 1000Hz due to the aggregate extraction process. The extent of the elevation is dependent on the aggregate, with gravel generating higher noise levels than sand extraction.

19.5.2.24 Spectral source levels for the dredging from MALSF (2011) are shown in Table 19.24, which are taken as the worst case activity level representative of the Geotube® construction process.

Table 19.24 Source divergence noise levels for dredging at 1m

Frequency Band Hz	63	125	250	500	1000	2000	4000	8000	Total
Dredging (dB re 1µPa @1m)	184	179	180	179	176	175	173	172	188

19.5.2.25 Table 19.25 shows noise levels at a range of distances from the source. These are overall linear levels, which provide a high level overview of the underwater noise impact. These levels are then capable of being used to consider effects upon ecological receptors. Species specific impact assessments on marine species are provided in Chapter 9 Fish, Commercial and Recreational Fisheries and Chapter 10 Marine Mammals and Turtles.

Table 19.25 Predicted underwater noise levels for dredging at a range of distances

Distances from Source	25m	50m	100m	200m	300m	400m	500m	750m	1000m
Dredging (dB re 1µPa)	160	154	148	142	138	136	134	130	128

19.5.2.26 Based on the background noise measurements in the bay of 110dB-120dB, increasing to between 151 – 179dB with shipping, the potential noise levels generated by dredging activities will occupy the same range.

Piling

19.5.2.27 Most of the energy from the piling will be transferred into the sea bed as the pile is driven in, but a very small fraction will be emitted into the surrounding water as noise, as the pile itself acts as a radiating source. A lesser component is still re-radiated from the sea-bed, excited by the piling force.

19.5.2.28 Table 19.26 details the findings of previous studies examining piling works.

Table 19.26 Source underwater noise levels for piling

Event	Source level, RMS/Peak dB re 1µPa @ 1m
Impact Sheet Piling (Illinworth *et al*, 2007)	204/220
High-frequency (vibro) piling (Illinworth *et al*, 2007)	178/192

19.5.2.29 Nedwell *et al*. (2003) noted that hammer piling activities generate most energy between 40Hz and 1000Hz, with tonal elements at 200Hz, 250Hz, 600 Hz, 800 Hz and 1600Hz.

19.5.2.30 Published underwater source measurements data have been reviewed, compiled and compared to establish a consistent and robust set of source input data.

19.5.2.31 Table 19.27 shows the source levels for the different types of piling, based on published measurement data and professional experience. Reference has also been made to the differences in spectral content between the different piling techniques found in BS5228, which assists in describing the relationships between frequency content and pile driving force which can be applied to both airborne and underwater vibration source terms.

Table 19.27 Source underwater noise levels for piling @1m

Frequency Band Hz	63	125	250	500	1000	2000	4000	8000	Total*
Percussive/impact piling+ (dB re 1µPa @1m)	217	213	208	209	211	202	198	188	220
Vibro-piling- (dB re 1µPa @1m)	191	179	170	178	183	177	172	161	192

***** total levels from Illinworth *et al*, 2007

+ spectral shape from URS, 2007; adjusted to meet total value

- spectral shape adapted from delta airborne noise levels between activities in BS5228.

19.5.2.32 Table 19.28 shows noise levels at a range of distances from the source. These are overall linear levels, which provide a high level overview of the underwater noise impact.

Table 19.28 Predicted underwater noise levels for piling at a range of distances

Distances from Source	25m	50m	100m	200m	300m	400m	500m	750m	1000m
Percussive/impact piling+ (dB re 1µPa)	192	186	180	174	170	168	166	162	160
Vibro-piling- (dB re 1µPa)	164	158	152	146	142	140	138	134	132

***** total levels from Illinworth *et al*, 2007

+ spectral shape from URS, 2007; adjusted to meet total value

- spectral shape adapted from delta airborne noise levels between activities in BS5228.

19.5.2.33 Measurements show that background noise measurements in the bay were in the order of 110dB-120dB, with noise levels increasing to between 151 – 179dB with shipping associated with the ports.

19.5.2.34 The potential noise levels generated by vibro-piling will be within this baseline range. Percussive/impact piling will generate higher noise levels, which will be difficult or impossible to reduce. The only viable mitigation strategy will be rigorously to observe a 'soft start' procedure to facilitate controlled avoidance behaviour in marine mammals (see Chapter 10, Marine Mammals) if this method of piling were used.

19.5.3 Construction noise – construction traffic

19.5.3.1 Traffic flow data, as described in Chapter 15 Onshore Transport, have been used to determine the potential increase in noise as a result of construction traffic.

19.5.3.2 The intention is to import the material for rock armour by sea, which will help to limit the number of vehicle movements on the roads.

19.5.3.3 Using figures provided in the Onshore Transport Assessment for predicted traffic flows during the daytime periods, noise levels are expected to change by a negligible amount and hence will not have an impact on nearby receivers during the construction phase.

19.5.4 Construction vibration

19.5.4.1 It is proposed that all road traffic access to the site will be along Fabian Way, which currently has high traffic flows of cars and HGVs (Department for Transport, http://www.dft.gov.uk/traffic-counts/, accessed April 2013), and are a considerable distance from nearby dwellings. As such, vibration levels due to traffic related to the site are anticipated to cause an imperceptible change and hence are considered entirely acceptable.

19.5.4.2 Significant levels of vibration from construction related HGV movements could occur however, if significant road surface degradation were to occur on Fabian Way during the course of its increased use for construction traffic. This potential impact would be precluded by anticipated good practice activities from construction and haulage contractors, regular highway condition surveys and, if necessary, highway maintenance.

19.5.4.3 Piling will be the highest vibration energy source during the construction process. Other sources, such as concrete batching will transfer considerably lower levels of energy into the ground and hence vibration at nearby receptors will be at lower levels.

19.5.4.4 Due to the very large distances between the construction activities (concrete batching area and offshore piling) and residential or other buildings, vibration due to piling or other construction activities will be imperceptible at receptor locations, and therefore generate no impact.

19.5.5 Operational noise – visitor facilities and recreational activities

Visitor facilities

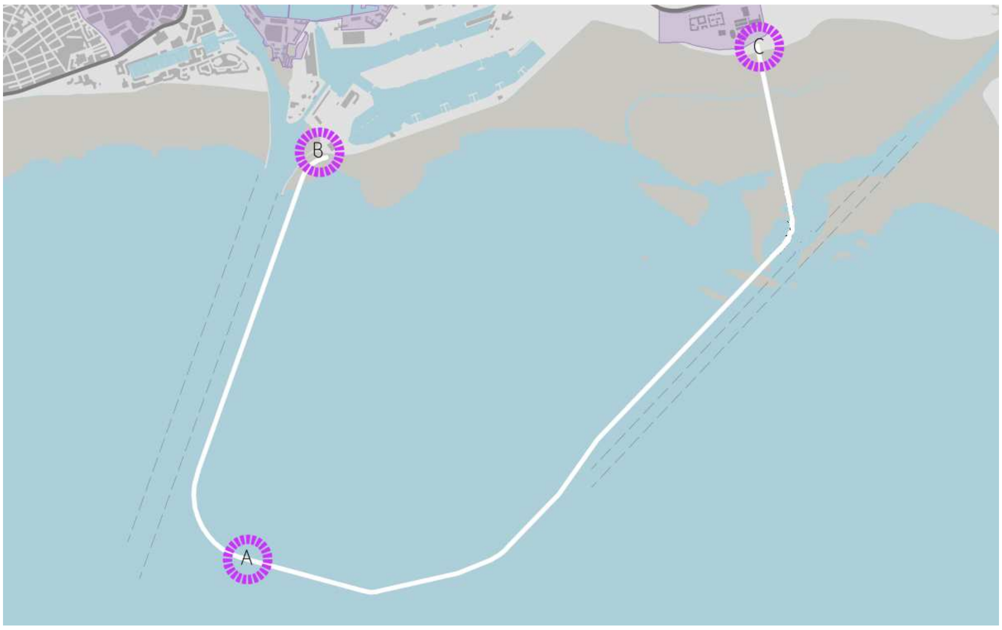

Figure 19.7 Visitor facilities locations

19.5.5.1 The three key facilities - the offshore visitor centre (location A), the boating centre at the western landfall (location B) and a small viewing platform structure (Location C) - have been considered within operational noise assessment. These visitor facilities are likely to be served by a small number of plant items, and to ensure a robust assessment, it has been assumed that these will have a combined sound power level of 85dB(A). The three locations have been assessed in accordance with the methodology stated BS4142, with the results summarised in Tables 19.29-19.31.

Table 19.29 BS4142 Predicted daytime noise levels for offshore visitor centre (Location A)

Ref	Description	Specific Noise Level dB(A)	Acoustic Feature Correction	Rating Noise Level dB	Background Noise Level dB(A)	Assessment Level
R1	St Margarets Court	2	5	7	40	-33
R2	Kings Road	1	5	6	43	-34
R3	Baldwins Crescent	-1	5	4	45*	-41
R4	SUBC	-1	5	4	42	-38
R5	Ashleigh Terrace	-4	5	1	45*	-44
R6	Scarlet Avenue	-5	5	4	45*	-41

* Levels derived from noise map or manual measurements

Table 19.30 BS4142 Predicted daytime noise levels for onshore visitor facility (Location B)

Ref	Description	Specific Noise Level dB(A)	Acoustic Feature Correction	Rating Noise Level dB	Background Noise Level dB(A)	Assessment Level
R1	St Margarets Court	15	5	20	40	-20
R2	Kings Road	13	5	18	43	-25
R3	Baldwins Crescent	4	5	9	45*	-36
R4	SUBC	3	5	8	42	-34
R5	Ashleigh Terrace	-1	5	4	45*	-41
R6	Scarlet Avenue	-4	5	1	45*	-44

* Levels derived from noise map or manual measurements

Table 19.31 BS4142 assessment for visitor centre plant (Location C)

Ref	Description	Specific Noise Level dB(A)	Acoustic Feature Correction	Rating Noise Level dB	Background Noise Level dB(A)	Assessment Level
R1	St Margarets Court	1	5	6	40	-34
R2	Kings Road	2	5	7	43	-36
R3	Baldwins Crescent	15	5	20	45*	-25
R4	SUBC	22	5	27	42	-15
R5	Ashleigh Terrace	10	5	15	45*	-30
R6	Scarlet Avenue	2	5	7	45*	-33

* Levels derived from noise map or manual measurements

19.5.5.2 The Rating Levels for the three visitor facilities are considerably better than 10dB below the L_{A90} background. This would indicate that the likelihood of complaints is extremely unlikely.

Recreational noise

19.5.5.3 The proposed uses of the Lagoon and seawall include sailing, extreme sailing, rowing, fishing and triathlon and creation of new natural environments such as the oyster beds and rocky reef. These proposed activities are all low noise activities and would again be considered to have a negligible impact both above and below water, as they are unlikely to affect the ambient noise climate at nearby receivers.

19.5.5.4 Cyclists and pedestrians walking along the seawall would likewise produce very low levels of noise and no impact to nearby residences is anticipated.

19.5.5.5 For most spectator events at the Lagoon, it is expected that there will be modest spectator attendance, with viewing from seating on the inside of the Lagoon wall. For these events it is expected that there will be insignificant noise levels at receptor location, with no negative impact.

19.5.5.6 During occasional major spectator events, audiences comprising several thousand people are possible. However, it is proposed that any seating for the events would likely be on the inside of the Lagoon wall, with spectators accessing the site on foot or via shuttle buses. Noise levels at receptor locations due to such events would be low and unlikely to be higher than ambient conditions. If there is likely to be an extended hospitality area nearer the shore, for example at the western landfall, a temporary events licence would be required under which noise impact controls would be specified if required. Major spectator events of this nature are likely to be one-off events, and any modest noise impact would be very occasional, short-lived and controlled by licensing in any event. Major Event Travel Plans will also be prepared, as outlined in Chapter 15 Onshore Transport, with regard to managing additional traffic associated with these events.

19.5.6 Operational noise – offshore turbines

19.5.6.1 The turbines proposed for the Project are of a new design, and operate in both flow directions, maximising efficiency. While there is no specific noise data for this new type of turbine, Anderson *et al* (1989) undertook measurements of bulb head turbines at three different sites and a variety of locations which provide a range of source levels for similar turbine installations, and represent older machinery than would be used for the Project.

19.5.6.2 A precautionary approach has been used in adopting this comparative data, by basing the assessment on a composite maximum spectrum of the highest noise levels measured at each frequency across the three sites. This input data is shown in Table 19.32, assumed to characterise the source level output from a single turbine.

Table 19.32 Source levels for turbine operation @1m

Frequency Band (Hz)	63	125	250	500	1000	2000	4000	8000	Total
Turbine Noise (dB ref 1µPa)	106	115	115	105	106	104	-	-	119

19.5.6.3 A correction of +12dB (ie 10log16) has been applied to account for the 16 turbines proposed for the Project.

19.5.6.4 Levels at a range of distances, as shown in Table 19.33, have been calculated on this basis. It should be noted that at close range, this assumption is particularly pessimistic as, for example, it would be impossible to be equidistant from all 16 turbines at a range of 25m.

Table 19.33 Predicted underwater noise levels for turbines at a range of distances

Distance from turbines	25m	50m	100m	200m	300m	400m	500m	750m	1000m
Turbine Noise (dB ref 1µPa)	103	97	91	85	81	79	77	73	71

19.5.6.5 Once operational, it can be seen that the Project is not anticipated to increase underwater sound levels apart from in very close proximity to the turbines.

19.5.7 Operational noise – operational traffic

19.5.7.1 Traffic flow data, as described in Chapter 15 Onshore Transport, have been used to determine the potential increase in noise as a result of operational traffic.

19.5.7.2 Using figures provided in the Onshore Transport Assessment for predicted traffic flows during the daytime periods, noise level changes are expected to be negligible and hence not impact on nearby receivers during the operation of the Project.

19.5.8 Decommissioning

19.5.8.1 In terms of decommissioning, as identified in Chapter 4, Project Description, there are two potential options under consideration which vary in terms of physical intervention. The decommissioning options are:

i. at the end of the working life of the facility, the turbines and sluice gates could be removed, and the tide allowed to flow through the resultant gaps in the structure; and

ii. it is equally likely that at the nominal end of the working life of this facility, power generation by tidal lagoons will have further developed, and the Project will be progressively updated so that the facility can be kept in use as an energy source as well as its ongoing leisure use.

19.5.8.2 If the Project remains operational, impacts will be as demonstrated above. Any works associated with removal of the turbines and sluice gates will generate noise levels that would likely be considerably lower than those generated during the construction process, especially with the absence of impact piling. As it has already been shown that these processes would result in no significant impact, this conclusion can be extended to the decommissioning exercise.

19.6 Mitigation and residual impacts

19.6.0.1 No significant noise or vibration impacts are anticipated to be created by the construction, operation and decommissioning phases of the Project. As such residual impacts will be insignificant.

19.6.0.2 Standard mitigation for reducing the potential for noise and vibration will however be included within the Construction Environmental Management Plan and the Operational Environmental Management Plan (see Chapter 4 Project Description for further details). Chapter 15, Onshore Transport details traffic management plans (Construction Phase Travel Plan and Major Event Travel Plan) which will be agreed with the local authority and implemented, which will also minimise potential noise and vibration impacts resulting from changes to traffic flows. Mitigation measures will include, as appropriate:

i. good practice activities from construction and haulage contractors as per BS5228, regular highway condition surveys and, if necessary, highway maintenance to minimise potential vibration impacts, as well as import materials, where possible, by sea;

ii. screening of potentially noisy construction works; working hours; regular maintenance of construction equipment; and

iii. soft start procedures for percussive piling.

19.7 Cumulative and in-combination impacts

19.7.0.1 As noted in Chapter 2, EIA Process and Assessment of Significance, a number of projects have been identified which potentially require assessment in terms of cumulative and in-combination effects. Cumulative and in-combination effects arise from multiple actions on receptors and resources over time and are usually additive or interactive (synergist) in nature. They can also be viewed as effects arising from incremental changes caused by past, present or reasonably foreseeable actions together with those of the Project. In relation to those projects identified in Chapter 2, EIA Process and Assessment of Significance, Table 19.34 identifies those for which a cumulative and in-combination assessment of noise and vibration impacts has been undertaken.

Table 19.34 Screening of plans and projects in the wider study area for noise and vibration

Project and location	Current Status	Screening for Noise and Vibration
Swansea University Bay Campus, adjacent to Crymlyn Burrows	Construction Feb 2013 – Sept 2015	The Campus is scheduled to be open 2015 which means that the main construction works will complete by that date. As such no cumulative impact is anticipated. An assessment of the potential effect of the Project construction on SUBC as sensitive receptor has been undertaken in the main body of this chapter.
St Modwens land development - east of Swansea Docks, to west of Neath estuary.	Remediation of land, and potential future developments – no details available	Potential for noise based cumulative impacts – although no information available at time of application
Mumbles pier, foreshore and coastal strip redevelopment	Due to be completed by the end of 2013	Works complete. No cumulative effect anticipated.
Construction of new RNLI Lifeboat Station, Mumbles	Expected completion 2014	Works complete. No cumulative effect anticipated.
SA1 development, Swansea	Development currently taking place, completion date unknown	Details of information on SA1 as a sensitive receptor has been included in the main body of this chapter.
Construction of the southern access road to Coed Darcy Urban Village, crossing nearby Crymlyn Bog	Yet to commence.	Works distant - cumulative impact not anticipated.
Swansea Boulevard project – work between Princess Way and The Strand, and the River Tawe bridges and The Strand.	Phase to be complete in November 2013. Phase 2 to start 2014.	Works distant - cumulative impact not anticipated.
Wind turbine – on Welsh Water site on Fabian Way	Application – Unsuccessful 25/10/2013	Not considered since the project application was unsuccessful.
Five wind turbines – at Mynydd Marchywel between Rhos and Cilfrew Neath	Submitted Jan 2012. Consultation finished Jan 2013. Still in planning.	Works distant - cumulative impact not anticipated.

Project and location	**Current Status**	**Screening for Noise and Vibration**
Sixteen wind turbines – at Mynydd Y Gwair, Swansea	Approved – unknown construction timetable	Works distant - cumulative impact not anticipated.
Five wind turbines – on land at Mynydd Brombil Farm, Margam Port Talbot	Submitted June 2012, still in planning. Consultation finishes April 2013.	Approx 16km distant – no cumulative effect anticipated.
Atlantic Array Wind Farm – off North Devon Coast approx 35km distant	DCO application submitted but withdrawn in November 2013.	Not considered any further.
Seventy six turbine Pen y Cymoedd windfarm near Neath.	Planning approved – construction 2014	Works distant - cumulative impact not anticipated.
Llynfi Afan Renewable Energy Park - fifteen turbine windfarm – on land 500m southwest of Cynnonville Port Talbot	Planning permission refused. Application was allowed on appeal 27/08/2013	Works distant - cumulative impact not anticipated.
Mynydd y Betws- fifteen turbine windfarm located on land to the east of Ammanford in Carmarthenshire	Granted planning consent 2009. Started operating April 2013.	Works distant - cumulative impact not anticipated.
Mynydd y Gwrhyd- windfarm in the Upper Amman and Swansea valleys	Approved on appeal 07/05/2009	Works distant - cumulative impact not anticipated
Newlands Farm, single wind turbine-Margam	Application submitted January 2013	Works distant - cumulative impact not anticipated
Kenfig Industrial Estate single wind turbine	Application submitted. Expected decision by Feb 2014	Works distant – cumulative impact not anticipated
Port Talbot Harbour redevelopment	Potential future activities/development. Status unknown.	Works distant – cumulative impact not anticipated.
Upgrading of the existing coastal defence of Aberavon West Promenade, Sandfields, Port Talbot	Completed August 2013	Completed – no cumulative impact anticipated.
Porthcawl regeneration scheme includes Porthcawl Marina project and 19th century lighthouse restoration.	Approved by BCBC – timescale unknown.	Works distant – cumulative impact not anticipated
Tata Steel works – Internal Power generation enhancement for Port Talbot steel works- installation of two new boilers and two new turbines housed in new power station building	Application expected to be submitted 2014	Works distant – cumulative impact not anticipated.
Underground coal gasification under Swansea Bay	License potentially to be extended.	No further information available - cumulative impact not anticipated
Underground coal gasification under Llanelli	Conditional Licence issued	Work distant and not anticipated in the foreseeable future. No cumulative impact anticipated.
Maintenance (navigational) dredging along the Swansea (Tawe), Neath and Port Talbot Channels.	On-going	Intermittent operations – no significant cumulative impact anticipated.
Marine dredging- Monkstone cruising and sailing club and Swansea Marina	On-going maintenance as required	Works distant – cumulative impact not anticipated
Mumbles Oyster project: Plan to put 10,000 oyster on seabed off the village of Oystermouth	Permission granted September 2013	No cumulative impact anticipated.
Severn Barrage	Not within foreseeable future	See note in Chapter 2.

Project and location	Current Status	Screening for Noise and Vibration
Swansea Barrage	Operational	No cumulative impact anticipated.
Cardiff Barrage	Operational	Works distant cumulative impact not anticipated
Baglan Power station	Operational	Works distant – cumulative impact not anticipated
Prenergy Biomass Power Station – 350MW wood chip fuelled thermal generating station – Port Talbot	Granted condition approval by BERR on the 20 November 2007. While large scale construction has not been begun, a lawful start of development has occurred and as such the planning permission remains extant.	No cumulative impact anticipated.
Abernedd Power Station was granted conditional approval by DECC on the 23 February 2011 for construction of a 870MW gas fired combined cycle gas turbine power plant	No lawful start has yet been made to this development	No cumulative impact anticipated.
Nobel banks aggregate extraction site	Ongoing	Works distant – cumulative impact not anticipated
The Swansea Bay (Thomas Shellfish Limited) Mussel Fishery Order	Ongoing	Screened out.
Ro-Ro Ferry	Currently not operational	Not considered. Ferry not anticipated to recommence in the foreseeable future.
Rhiannon Offshore Windfarm	Pre-application stage	Works distant. No cumulative impact anticipated.
Burbo Bank Offshore Windfarm extension	Existing and extension sought 2013	Works distant. No cumulative impact anticipated.
Tidal Energy Ltd Deltastream Installation Ramsey Sound	Consent secured. Installation 2014	Works distant. No cumulative impact anticipated
Seagen Skerries Tidal Stream Array	Consent secured. Installation 2014	Works distant. No cumulative impact anticipated
Tidal Stream Energy Demonstration Array St David's Head, Pembrokeshire	Construction is planned to commence in 2017	Works distant. No cumulative impact anticipated

19.8 Conclusion

19.8.0.1 The noise and vibration impacts of the construction, operation and decommissioning of the Project have been assessed on nearby noise sensitive receptors. In addition, underwater source noise levels have been calculated and predicted noise levels at a range of distances presented to aid the marine ecology specialists in their assessments of impacts on marine mammals and fish.

19.8.0.2 Onshore works have been assessed to nearby receivers for both daytime and night-time works and no impact has been shown in most instances. In cases where modest impacts have been identified, practical mitigation measures have been identified.

19.8.0.3 The noise impact from offshore works has been assessed for terrestrial receivers. Due to the very large distances involved, all activities have been shown to have no appreciable impact on the receivers during both daytime and night-time works.

19.8.0.4 Noise generated by operation of the Project and leisure activities has been assessed and shown to have no negative impact on receptors.

19.8.0.5 Overall, it can be concluded that the noise and vibration impacts related to all aspects of the development are likely to be negligible.

19.9 References

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