Connah's Quay Low Carbon Power

Preliminary Environmental Information Report
Volume IV, Appendix 12-A: Marine Ecology Assessment Methodology

Uniper

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Appendix Summary

This appendix provides detail on the assessment methodology used to inform the potential effects on marine ecology receptors during construction, operation and decommissioning of the Proposed Development. This appendix should be read in conjunction with **Section 12.3** of **Preliminary Environmental Information Report (PEIR) Volume II, Chapter 12: Marine Ecology**.

The assessment of impacts and likely significant effects has been undertaken in line with the Chartered Institute of Ecology and Environmental Management's (CIEEM's) Guidelines for Ecological Impact Assessment in the United Kingdom (UK) and Ireland: Terrestrial, Freshwater, Coastal and Marine. The assessment methodology includes identification of the importance of an ecological receptor, identifying the value and sensitivity of a receptor and determining the magnitude of the impact through a range of different criteria, in order to reach a conclusion of significance. The significance of potential effects has been evaluated using a systematic approach together with the expert judgement of the specialist consultant. The criteria used for marine ecology are detailed in this appendix.

The CIEEM guidelines advocate a non-matrix approach, but to keep consistency with other disciplines, assessment conclusions are translated into terminology detailed in **PEIR Volume II, Chapter 2: Consultation and EIA Methodology**. These defined terminologies have been used to provide a framework for the consistent and transparent assessment of predicted effects across all receptor topics; however, it is important to note that the defined terms act as a guide and that assessments also allow for the application of expert judgement. Criteria are therefore assigned to consider the likely effects, rather than a check list whereby all definitions are met in order for the category to be used.

This appendix also details the data sources used in a desk study to inform the marine ecological assessment in the absence of marine ecology surveys. Several publicly available data sources have been considered which are relevant to the study area to understand the relative importance, geographical contexts and functionality of the receptors considered.

12. Marine Ecology Assessment Methodology

12.1 Methodology and Aims

12.1.1 This appendix describes the assessment methodology carried out in relation to marine ecological receptors. A general Environmental Impact Assessment (EIA) methodology is outlined in **Chapter 2: Assessment Methodology and Consultation (PEIR Volume II).**

12.1.2 The impacts and potential significant effects on marine ecology outlined in this chapter as part of project specific ecological impact assessments (EcIAs), have been undertaken in accordance with the CIEEM's Guidelines for Ecological Impact Assessment in the United Kingdom and Ireland: Terrestrial, Freshwater, Coastal and Marine (Ref 1) and has considered the interconnectivity of marine ecology and the small number of impacts likely to occur.

12.1.3 In accordance with CIEEM guidance (Ref 1), not all habitats and species which have the potential to occur within the Zone of Influence (ZoI) of the Proposed Development have been considered within **Chapter 12: Marine Ecology (PEIR Volume II)**. Rather, focus has been placed on those features considered to be 'important' and most likely to occur – determining importance is discussed in further detail below. To ensure compliance with National and European policy, consideration is still given to biodiversity in its entirety and the need to achieve no net loss and enhancement of biodiversity.

12.1.4 The aims of the EcIA are to:

- identify important ecological features (e.g., designated sites, habitats or species) which have the potential to be impacted by the Proposed Development;
- provide a robust assessment of the ecological impacts and resultant likely significant effects of the Proposed Development, which may be beneficial (i.e., positive) or adverse (i.e., negative);
- facilitate determination of the consequences of the Proposed Development in terms of national, regional and local policies relevant to nature conservation and biodiversity, where the level of detail provided is proportionate to the scale of the development and the complexity of its impact pathways;
- identify appropriate mitigation to reduce any potential significant effects; and
- set out the steps to be taken to adhere to legal requirements relating to the relevant ecological features concerned.

12.2 Value / Sensitivity of Receptors

12.2.1 Receptor sensitivity is defined as the degree to which a receptor is affected by an impact. The sensitivity of the receptor is characterised by three factors. All

factors interact to determine a receptor's sensitivity and resilience to a given impact:

- vulnerability – the vulnerability of the receptor relates to its capacity to accommodate change i.e., the tolerance / intolerance of the receptor to change;
- recoverability – the ability of the receptor to return to the baseline state before the Proposed Development impact caused the change; and
- importance – the importance of the receptor or feature is a measure of the value assigned to that receptor based on biodiversity and ecosystem services, social value, and economic value. The value of sites, habitats and potential for protected and notable species are evaluated with reference to both their importance in terms of 'biodiversity conservation' value (which relates to the need to conserve representative areas of different habitats and the genetic diversity of species populations) and their legal status importance of the receptor is also defined within a geographical context, based on the following conservation or legal status:
  - international (designated National Site Network sites in accordance with the Habitats Regulations– Special Areas of Conservation (SACs), Special Protected Areas (SPAs), as well as Ramsar Sites);
  - national (UK protected areas – Sites of Special Scientific Interest (SSSI), Marine Protected Areas (MPAs), and Marine Conservation Zones (MCZs)); and
  - regional or local (ecological features that do not meet criteria for valuation at an international or national level, but that have sufficient value to merit retention or mitigation e.g., for the purpose of ensuring no net loss of biodiversity).

12.2.2 Considering the interaction between these variables a receptor's sensitivity can be classified into four criteria summarised in **Table 1**. The sensitivity of an ecological feature has been defined with reference to a specific geographical context and the scale of protection, ensuring consistency with CIEEM (2019) guidance (Ref 1).

Table 1: Sensitivity / Value Criteria for Marine Ecology

Sensitivity / Value	Sensitivity / Value Criteria*
High	Designated sites and qualifying / supporting features of international importance. Species which are legally protected and / or in significant decline (i.e., classified as 'endangered' or 'critically endangered' according to the International Union for Conservation of Nature (IUCN) Red List (Ref 2)). High quality examples of rare habitats which are threatened throughout their range.
Medium	Designated sites and qualifying / supporting features of national conservational importance. Priority habitats and species or those considered to be of principal importance for the conservation of biodiversity in England and those species considered vulnerable to decline (i.e.

Sensitivity / Value	Sensitivity / Value Criteria*
	classified as 'vulnerable' or 'near threatened' according to the IUCN Red List). High quality examples of uncommon habitats which are vulnerable throughout their range.
Low	Habitats and species of regional or local importance (i.e., Annex 1 habitats, in accordance with the Habitats Regulations, which are not a qualifying feature of a nearby designated site). Those species considered to be of 'least concern' (according to the IUCN Red List or listed in the Oslo and Paris Conventions (OSPAR) list of threatened and/or declining species for the North-East Atlantic). Poor quality examples of rare or uncommon habitats which are threatened or vulnerable throughout their range.
Very Low	Habitats and species of low conservation importance, such as those generally abundant and widespread around the UK with no specific local value.

*Should there be any overlap in the description of a particular feature/receptor, the worst-case importance criteria are adopted.

12.3 Magnitude of Impacts

12.3.1 The potential magnitude of change on marine ecological features arising from activities occurring as part of the Proposed Development is determined in consideration of their beneficial or adverse nature, extent, duration, timing, frequency, and reversibility of the impact.

12.3.2 Temporary, permanent, direct and indirect impacts have been considered during the construction, operation and decommissioning phases of the Proposed Development, and any mitigation measures necessary have been identified. To ensure compliance with National and European policy, consideration is still given to the need to maintain and enhance biodiversity. The magnitude criteria for marine ecological features are shown in **Table 2**.

Table 2: Magnitude criteria for marine ecological features

Magnitude	Magnitude Criteria
High	The impact occurs over a large spatial extent resulting in widespread, long-term, or permanent changes in baseline conditions or affects a large proportion of a receptor population. The impact is very likely to occur and/or will occur at a high frequency or intensity. The impact may also relate to resources or features which are unique and which, if lost, either cannot be replaced or relocated or else may time a very long time to recover or be replaced. **Adverse:** Loss of resource and / or quality and integrity of resource; severe damage to key characteristics, features or elements. **Beneficial:** Large scale or major improvement of resource and / or quality; extensive restoration; major improvement of attribute quality.
Medium	The impact occurs over a medium spatial extent resulting in medium-term, or partial changes in baseline conditions or partially

Magnitude	Magnitude Criteria
	affects a proportion of a receptor population. The impact is likely to occur and/or will occur at a medium frequency or intensity. **Adverse**: Loss of resource, but not adversely affecting the integrity; partial loss of / damage to key characteristics, features or elements. **Beneficial**: benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality.
Low	The impact occurs over a small spatial extent resulting in short-term, or small changes in baseline conditions, or partially affects a small proportion of a receptor population. The impact has a low likelihood of occurring and/or will occur at a low frequency or intensity. **Adverse**: Some measurable change in attributes, quality, minor loss of, or alteration to, one or more key characteristics, features or elements. **Beneficial**: Minor benefit to, or in addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk or negative impact occurring.
Very Low	The impact occurs over a minor spatial extent resulting in very short-term, or minor changes in baseline conditions or partial affects to a very small proportion of a receptor population. The impact has a very low likelihood of occurring and/or will occur at a very low frequency or intensity. **Adverse**: Very minor loss of detrimental alteration to one or more characteristics, features or elements. **Beneficial**: Very minor benefit to or positive addition of one or more characteristics, features or elements.

12.4 Significance Criteria

12.4.1 To evaluate the significance of an effect, the following parameters have been considered:

- impact type – direct or indirect, positive or negative, temporary or permanent;
- magnitude of impact – the 'amount' or intensity of an impact. This may sometimes be synonymous with 'extent' (see below) for certain receptors, such as habitat loss. For mortality it may be the number of individuals killed.

12.4.2 The assessment has also given regard to the sensitivity of an ecological feature to an impact which is determined by its:

- adaptability i.e., the capacity, or lack thereof, of a feature to avoid or adapt to a change; and

- tolerance / resilience i.e., capacity, or lack thereof, of a feature to accommodate temporary or permanent change or recover to pre-existing state following exposure to a change.

12.4.3 By combining the characteristics of an impact pathway with the importance and sensitivity of ecological features or receptors, a measure of the significance of effects on marine ecology can be derived.

12.4.4 For each marine ecological receptor, only those characteristics relevant to understanding the ecological effect and determining the effect significance are described. The determination of the significance of effects has been made based on the predicted impacts as outlined in Section 12.6 in **Chapter 12: Marine Ecology (PEIR Volume II)** to designated sites, ecosystems, habitats, and species.

12.4.5 Conclusions on the significance of effects are assessed as being either:

- not significant – no effect to one or more of the features described above; or
- significant – one or more features described above are affected.

12.4.6 CIEEM does not advocate a matrix approach for determining the significance of effects on ecological receptors (Ref 1). However, maintaining consistency with other disciplines / the wider Environmental Statement (ES), where a matrix approach is suitable, should be considered. As such, the assessment conclusions presented within this chapter have been translated into the significance terminology used within the wider PEIR **(Chapter 2: Consultation and EIA Methodology, PEIR Volume II)**. However, for ecological disciplines, such as marine ecology, the matrix approach acts as a guide and assessments also allow for the application of expert judgement in considering the final significance rating. Criteria are therefore assigned to consider the likely effects, rather than a check list whereby all definitions are met in order for the category to be used.

12.5 Data Sources

12.5.1 At the time of writing the PEIR, no results from any marine ecology surveys were available. Therefore, baseline conditions for marine ecology have been determined using findings from a desk-based study. However, the findings of the marine ecology surveys will be included within the ES.

The study areas shown in **Figure 12-1: Study Area** (**PEIR Volume III**) were used to define the area of search for the desk-based study. Further information of the study area for marine ecology is described in Section 12.4 (**Chapter 12 Marine Ecology, PEIR Volume II**).

12.5.2 The desk-based study identified several publicly available data sources relevant to the study area for each marine receptor. The review study determined the nature conservation designated sites and protected species and habitats to be considered within this assessment of the potential impact pathways arising from the Proposed Development. Furthermore, the data sources were used to provide the relative importance, functionality, and geographical context of each receptor. The following sources of information have been reviewed and have informed the assessment:

- Multi Agency Geographic Information for the Countryside (MAGIC) - information on marine, coastal and estuarine habitats and species and designated site information (Ref 3);
- Joint Nature Conservation Committee (JNCC) - reasons for protected site designation and other relevant information (Ref 4);
- Natural Resources Wales Information Portal – information on species and habitats (Ref 5);
- Natural England & Countryside Council for Wales – relevant information on marine designated features of the Dee Estuary designated sites (Ref 6);
- Habitat mapping undertaken by the JNCC (Ref 7) – Marine Nature Conservation Review (MNCR) area summaries and the Environment Agency saltmarsh zonation and extent in England (Ref 8);
- Shellfish classification zones of England and Wales provided by the Centre for Environment, Fisheries and Aquaculture Science (Cefas) (Ref 9);
- Small Cetacean Abundance in the European Atlantic and North Sea (SCANS) IV data (Ref 10);
- Inter-Agency Marine Mammal Working Group (IAMMWG) publications (Ref 11);
- Sea Mammal Research Unit (SMRU) (Ref 12) and Special Committee on Seals (SCOS) (Ref 13) publications;
- International Council for the Exploration of the Sea (ICES) publications and data (Ref 14);
- Marine Evidence Based Sensitivity Assessment (MarESA) - habitat and species sensitivity assessments, where available (Ref 15);
- Environment Agency – information of transitional and coastal waters fish counts (TraC data) (Ref 16) and marine abundance invertebrate data (Ref 17) where available[1];
- Environment Agency - The extent and zonation of saltmarsh in England (Ref 18); and
- Environment Agency – Salmonid and fisheries statistics for England and Wales (Ref 19).

[1] No Environment Agency fish sampling stations were located within the River Dee and therefore no information on fish counts were available.

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Appendix Summary

12.1.1 This appendix contains an assessment on the potential underwater sound (UWS) effects on fish in the River Dee and Estuary, during construction of the Proposed Development. This appendix specifically relates to construction activities within, and associated with, the Water Connection Corridor and supplements the assessment of UWS and vibration on marine ecological receptors provided in Section 12.6 of **Chapter 12: Marine Ecology** (**PEIR Volume II**).

12.1.2 The River Dee supports several species of migratory fish including Atlantic salmon (*Salmo salar*), sea and river lamprey (*Petromyzon marinus* and *Lampetra fluviatilis*), brown trout (*Salmo trutta*), European eel (*Anguilla anguilla*), twaite shad (*Alosa fallax*), and smelt (*Osmerus eperlanus*). These species migrate between marine and freshwater habitats during their life-cycle. The coastal waters at the mouth of the estuary may also provide spawning and nursery habitat for sandeel, and nursery habitat for herring. However, there is little evidence to suggest the presence of herring within the study area.

12.1.3 During construction of the Proposed Development, it will be necessary to construct a cofferdam in the Water Connection Corridor in the River Dee. It is not currently known whether the cofferdam will be constructed during low tide or high tide. Therefore, this assessment assumes the worst-case scenario that works will be conducted when water is present, allowing for the production of UWS.

12.1.4 It is also possible that intake and outfall infrastructure will require replacement or refurbishment. Construction activities for both of these assets will also require piling. It is not currently known whether piling will consist of impact piling (classed as impulsive sound and thus more impactful) or vibratory piling (continuous sound and less impactful). Therefore, this assessment includes consideration of both types of piling so that a worst-case scenario is covered. Consideration is also given to the potential use of vessels in the River Dee and Estuary during construction. If vessels are to be used, they are an additional source of continuous sound.

12.1.5 When assessing the effects of UWS on fish, they can be split up into different functional categories depending on their hearing sensitivity. High hearing sensitivity fish typically use a swim bladder for hearing and can detect both sound pressure and particle motion. Medium hearing sensitivity fish also possess a swim bladder but it is not used for hearing and can only detect particle motion. In comparison, low sensitivity hearing fish do not possess a swim bladder.

12.1.6 The fish present in the River Dee and Estuary represent low and medium hearing categories. Consideration has been given to medium (Atlantic salmon, sea trout, European eel) and low (lamprey) sensitivity fish due to their conservational importance in designated sites encompassing the study area, and the likelihood of their migratory routes crossing the area of sound production.

12.1.7 Quantitative and qualitative risk thresholds have been defined for the different fish sensitivity categories for impulsive and continuous sound respectively,

although quantitative thresholds are provided for high hearing sensitivity fish for mortal or recoverable injury and auditory injury (temporary threshold shift, (TTS)). For behavioural responses, qualitative thresholds are used based on the distance a fish is from the sound source. The thresholds are expressed as dual criteria including a single strike peak sound pressure level (SPL) and the cumulative energy over a period of impulses, called the sound exposure level (SEL_{cum}).

12.1.8 Based on these thresholds, the typical sound pressure level (SPL_{peak}) for impulsive sheet pile driving (205 dB) exceeds the thresholds for TTS to occur in low and medium hearing sensitivity fish. However, literature values used to determine a zone of influence suggest that for TTS to occur, a fish would need to be at a maximum distance of 40 m from the sound source for a 15-minute exposure period.

12.1.9 For continuous sound, the risk of mortal or recoverable injury in all fish is low even at close proximity to the sound source. Behavioural responses may occur, but these are expected to be minor on the basis of the proposed implementation of mitigation measures in line with Joint Nature Conservation Committee (JNCC) guidance for the minimisation of injury from underwater sound in marine mammals (Ref 13).

12. Underwater Sound Effects on Fish

12.1 Overview

12.1.1 This technical appendix provides additional information in relation to the potential for underwater sound (UWS) effects on relevant fish species, namely those of conservation importance. This appendix will supplement and inform the preliminary environmental assessment of the Proposed Development on marine ecology receptors in the study area. The full preliminary environmental assessment, and full detail on the different study areas for each marine ecological receptor ground are provided in **Chapter 12: Marine Ecology** (**PEIR Volume II**). UWS is only expected to be generated during the construction of the Proposed Development. Therefore, UWS effects during the operation of the Proposed Development have not been considered in this assessment.

12.1.2 The construction activities expected to generate UWS and therefore most relevant to fish is the construction of a cofferdam and the associated piling activity required for the installation of new intake and outfall infrastructure. Eel screens are fitted on the existing cooling water intake and therefore these will also need to be replaced should the option of a refurbishment of existing infrastructure be taken forwards instead of a full replacement. The use of vessels may also be required which can generate UWS. In addition, construction phase dredging will also occur, generating low level, continuous sound. A full description of the Proposed Development construction activities can be found in **Chapter 5: Construction Management and Programme** (**PEIR Volume II**).

12.1.3 A baseline of the environment of fish receptors in the River Dee and Dee Estuary is provided in **Chapter 12: Marine Ecology** (**PEIR Volume II**). The River Dee and Dee Estuary provide habitat and migratory corridors for several migratory fish species, which are Atlantic salmon (*Salmo salar*), sea and river lamprey (*Petromyzon marinus* and *Lampetra fluviatilis*), brown trout (*Salmo trutta*), European eel (*Anguilla anguilla*), twaite shad (*Alosa fallax*), and smelt (*Osmerus eperlanus*). Sea and river lamprey are Annex II features of the Dee Estuary (Aber Dyfrdwy) Special Area of Conservation (SAC). Sea and river lamprey and Atlantic salmon are also Annex II features of the River Dee and Bala Lake SAC. Atlantic salmon and brown trout are Annex II features of the River Dee (Aber Dyfrydwy) SSSI.

12.1.4 There is also the potential for nursery habitat for herring (*Clupea harengus*), in the River Dee and Estuary (based on data shown in Ref 1 and Ref 2). However, there is little evidence on the actual presence of juvenile and adult herring in the estuary (see **Chapter 12: Marine Ecology** (**PEIR Volume II**) for further information on spawning and nursery grounds).

12.2 Cofferdam construction

12.2.1 The activities required for the construction of a cofferdam and the replacement or refurbishment of existing intake and outfall structures are described in **Chapter 5: Construction Management and Programme** (**PEIR Volume II**). The activities are anticipated to require the production of impulsive sounds

(where impact piling is used) and continuous sound (vibratory piling and movement of Proposed Development vessels). Both impulsive and continuous sound will be sources of UWS disturbance to fish (see Section 12.4).

12.2.2 The exact materials to be used for the construction of the cofferdam are not known and so the assessment is informed by typical cofferdam construction methods within marine and tidal conditions and is based on previous project experience and information available in literature. The cofferdam construction assumptions used as the basis for this assessment are therefore as follows:

- the exact method of piling is not yet known, but vibratory or press piling is recommended where this is reasonably practicable to reduce effects on the marine environment. However, it is often necessary to drive the final stages of a pile with a hammer and thus the impacts of (hammer driven) piling and vibratory piling have both been assessed below;
- it is anticipated that sheet piles will be used for the cofferdam, similar to an AZ-36 700N (700 x 499 mm);
- the cofferdam is expected to require a worst-case of 850 m of interlocking sheet piling in the Water Connection Corridor (dependent on the replacement or refurbishment of cooling water infrastructure), which equals to approximately 1,214 sheet piles;
- based on the relatively shallow depth of water in which the cofferdam is proposed, it is assumed that the cofferdam will comprise a single wall, but the structure will require bracing and pile ties to secure the cofferdam wall before dewatering. Thus, periods of piling activity will be intermittent, regularly interspersed with other construction activities that will not generate underwater sound;
- it is estimated that each pile will take 1-2 hours to install, depending on conditions, and that 4-5 piles can be installed per day based on the core construction working hours from 07:00 to 19:00 Monday to Friday and 08:00 to 13:00 on Saturdays (**Chapter 5**: **Construction Programme and Management** (**PEIR Volume II**)); and
- a jack-up barge will be required for installation of the piles.

12.2.3 The assumptions made above, including the estimated number of piles required, will be revisited in the Environmental Statement.

12.3 Refurbishment / replacement of existing outfall and intake infrastructure

12.3.1 The cooling water infrastructure will either require refurbishment or replacement. In line with the construction of a cofferdam, the exact method of piling for the replacement of outfall and intake infrastructure is not currently known, but vibratory or press piling is recommended where this is reasonably practicable to reduce effects on the marine environment. However, impact piling may also be required, for example to toe the pile into bedrock, and therefore both methods have been assessed.

12.3.2 The exact number of piles to be used for the cofferdam during refurbishment or replacement of the cooling water infrastructure will be determined from the design which is currently ongoing, although it is currently considered to be a

worst-case of 850 m. As with the cofferdam construction, the installation of the new outfall and intake infrastructure will be spread through the construction period, with periods of time where piling, and therefore UWS production, are not occurring.

12.4 Underwater Sound Background

12.4.1 Sound sources can be either impulsive (such as piling) or non-impulsive and continuous (including dredging and vessel movement). Activities during the construction phase of the Proposed Development will be both impulsive (piling during cofferdam construction) and continuous (use of vessels and construction phase dredging).

12.4.2 Impacts of man-made UWS generated during the construction phase depend on the intensity (amplitude of the sound pressure wave), frequency and duration of the sound source, the surrounding environment such as water depth, and the sensitivity of fauna.

12.4.3 Sound metrics are typically described as sound pressure level (SPL) and sound exposure levels (SEL). SPL measures the peak amplitude or intensity of a sound and is typically measured as the peak or root-mean-square (rms) value for impulsive sounds. SEL provides a time-integrated measurement of sound energy, taking into account the sound level and the duration of the sound.

Effects of UWS on fish

12.4.4 Fish use sound for communication, prey location and predator avoidance (Ref 4). They perceive sound through their ears and lateral line (termed the 'acoustico-lateralis system') which are sensitive to vibrations created by sound sources. Some teleost or bony fish also have a gas-filled sack known as a swim bladder which can also be used for sound detection (Ref 5) but can be vulnerable to rapid changes in pressure. Responses to sound depend on whether the sound source is present at a level and within a range of frequencies to which the animal is sensitive. Most fish cannot hear sound above 1 kHz, though some sub-members of the clupeiform family (herring and Alosidae or shads) are capable of detecting significantly higher frequencies to around 4,000 Hz (Ref 6).

12.4.5 Several impacts on fish can occur as a result of UWS exposure, including:

- physical or physiological effects – generally only occur when exposed to very high amplitude, impulsive sounds such as explosions or military sonar. Such effects are not considered likely for impact piling;
- auditory injury or damage, including damage to the inner ear, sensory hair cells and otoliths (Ref 7), which can be categorized into two different effects as follows:
  - permanent threshold shift (PTS) is a permanent elevation in hearing threshold (i.e. reduction in hearing sensitivity) which can occur due to several causes but is most often the result of intense and / or repeated impulsive noise exposure;

  - temporary threshold shift (TTS) is a recoverable elevation in hearing threshold. This most commonly results from long-term exposure to sounds which are not high enough to result in PTS but can still result in injury;
- masking of auditory cues; and
- behavioural changes, including changes in movement and swimming direction, alterations to migratory routes, changes in feeding patterns and breeding, and displacement / avoidance behaviour.

12.4.6 The impacts of UWS on fish is largely evaluated on physiology, including the absence or presence of a swim bladder, and the potential use of the swim bladder for hearing sensitivity and range. Three categories of fish sensitivity to underwater sound have been defined, based on physiological features (Ref 8; **Table 1**).

12.4.7 Where more sensitive fish species (i.e. those with swim bladders, so excluding lamprey species) are in very close proximity to a sound source of very high sound pressure level, such as impact pile driving of very large tubular steel piles, physical injury (e.g. swim bladder rupture) and subsequent mortality could occur. The extent of injury is related to sound intensity (the sound pressure level) and the number of pile-driving strikes (Ref 9).

12.4.8 Behavioural responses can also occur (and this can also have a bearing on the likelihood of injury occurring, as explained later) and include startle reactions, changes in swimming patterns and orientation, disrupted schooling patterns, altered horizontal or vertical distributions, disrupted feeding, and displacement. The behavioural response to adverse underwater sound levels are of most concern when works are being undertaken during periods of high seasonal sensitivity. In particular, underwater sound can lead to abandonment of fish spawning sites and diversion or delay of fish migration. This is a potential concern, particularly where the affected species are of conservation concern (threatened or specifically protected).

Table 1: Categories of sensitivity to UWS in fish

Sensitivity	Description	Examples of species (known to be on site)
High hearing sensitivity fish	Hearing involves a swim bladder or other gas volume. Species such as these are susceptible to barotrauma and can detect both sound pressure and particle motion.	Atlantic cod Herring Other species of the Clupidae family
Medium hearing sensitivity fish	Species possess a swim bladder but it is not used in hearing. These species can only detect particle motion, not sound pressure, but they are still susceptible to barotrauma.	Atlantic salmon Sea trout European eel
Low hearing sensitivity fish	These species do not have a swim bladder or any other gas-filled chamber. Such species only detect particle motion rather than sound pressure and are less susceptible to barotrauma.	Lamprey Flatfish

12.5 Technical Assessment of UWS Effects on Fish

Impact Piling

12.5.1 Qualitative risk ratings for impacts to fish (low, medium and high hearing sensitivities) resulting from exposure to impulsive sound sources have been defined (Ref 8). **Table 2** below summarises the thresholds defined for impulsive sound, such as impact piling, for low and medium hearing sensitivity categories for impact criteria ranging from injury to behavioural responses. Based on fish sensitivity categories and thresholds (**Table 1**; **Table 2**; Ref 8), none of the migratory fish species present in the study area are considered to be high hearing sensitivity fish and therefore, effects of impact piling to high hearing sensitivity migratory fish have not been considered further in this section.

12.5.2 For impulsive sound, the injury thresholds are expressed as dual criteria including a single strike peak SPL and the cumulative energy over a period of impulses, called the sound exposure level (SEL_{cum}). The thresholds cover physical injury (mortality / mortal injury and recoverable injury), and auditory injury, TTS (**Table 2**).

12.5.3 The SPL is a measure of the amplitude or intensity of a sound. For impulsive sound sources this is typically measured as a peak value (i.e. the highest amplitude of the pulse). In contrast, the SEL is a time-integrated measurement of the sound energy, which takes account of the level of sound as well as the duration over which the sound is present in the acoustic environment. The assessment of effects to fish and other marine species is based on dual criteria, with a threshold for both the SPL and the SEL metric, and the impact zone is determined by whichever results in the largest estimated distance.

12.5.4 There are no generally accepted quantitative thresholds available for behavioural responses, largely due to a lack of experimental evidence and high levels of context specific variation in behaviour depending on factors such as sex, age, size and motivation (e.g. foraging) of individual fish. Instead, behavioural impact criteria are provided in terms of a relative risk rating (high, moderate, low) at a distance from the impulsive sound source defined in relative terms as 'near' (N), 'intermediate' (I), and 'far' (F) (**Table 2**). Whilst absolute values cannot be ascribed to these categories, near can be defined to be in the range of tens of metres from the source, intermediate in the hundreds of metres, and far in the thousands of metres.

Table 2: Underwater sound impact threshold for low and medium hearing sensitivity fish in relation to impulsive sound sources

Fish Hearing Sensitivity	Mortality / mortal injury	Recoverable injury	TTS	Behaviour
Low e.g. lamprey species	213 dB_{peak} 219 dB SEL_{cum}	213 dB_{peak} 216 dB SEL_{cum}	186 dB SEL_{cum}	(N) High (I) Moderate (F) Low
Medium e.g. Atlantic salmon, sea trout, European eel	207 dB_{peak} 210 dB SEL_{cum}	207 dB_{peak} 203 dB SEL_{cum}	186 dB SEL_{cum}	(N) High (I) Moderate (F) Low

Fish Hearing Sensitivity	Mortality / mortal injury	Recoverable injury	TTS	Behaviour

Source: Ref 8

12.5.5 The SPL_{peak} for impulsive sound from sheet pile driving is considered to be 205 dB with a SEL_{cum} of 198 dB (Ref 10). For medium and low hearing sensitivity fish (Atlantic salmon, sea / brown trout, European eel and lamprey species), these values are below the thresholds (as defined in Ref 8) for mortality, potential mortal injury and recoverable injury. The thresholds for low level disturbance and TTS are exceeded.

12.5.6 The risk of behavioural change for fish that are near[1] to the sound source is considered high, with a moderate risk at intermediate distances and a low risk at far distances. However, the level of perceptible sound production is expected to decrease with an increased distance from the piling location.

12.5.7 The threshold for TTS is only expected to be exceeded during sheet piling for fish which are within 40 m of the sound source for a duration of 15 minutes or more (Ref 11).

12.5.8 Based on previous assessments for similar construction requirements (i.e. Ref 12), impact piling is expected to occur for 15–30-minute continuous periods with breaks in between. However, fish are highly mobile receptors and therefore the possibility that fish will stay within 40 m of the piling for the entire duration of sound generation is low. Furthermore, the maximum width of the River Dee, where the Proposed Development is located, is approximately 169 m, providing sufficient space for fish to pass by and avoid TTS.

12.5.9 Despite a low risk of injury or TTS, several mitigation measures will be incorporated into the piling activities. It will be required that JNCC standard mitigation guidelines for impact piling in marine waters are adopted (Ref 13). The JNCC guidelines are specifically for the minimisation of injury to marine mammals from impact piling, but provide mitigation, in the form of a soft-start, which also confers benefits for fish. Thus, a soft-start or slow ramp-up of piling hammer power will be employed at the commencement of any impact piling activity or after a break of more than 10 minutes. This will assist in allowing sound levels to increase gradually, and any fish in the immediate vicinity (40 m) of piling has an opportunity to make a behavioural response to the sound and move away before any permanent or temporary injury is likely to occur.

12.5.10 With these mitigation measures in place during piling for both the cofferdam construction and replacement of intake and outfall infrastructure, it is anticipated that no physical injury or hearing impairment is likely to occur in any fish species within the River Dee and Estuary, even during migration periods. This is due to the periodic and short-term nature of the piling activity which will result in regular periods of no piling activity, allowing fish time to pass by without disturbance.

12.5.11 There is the potential for disturbance to fish in response to impact piling for both the cofferdam construction and replacement of intake and outfall infrastructure, which could range from startle reactions to fleeing behaviour or

[1] Popper et al. (2014; Ref 8) state that while it may not be appropriate to define particular distances for effects from UWS, for the purposes of assessment 'near' may be considered to be tens of metres from the source, 'intermediate' may be hundreds of metres and 'far' may be considered thousands of metres from the source of disturbance.

changes in foraging patterns. Based on thresholds defined by Popper *et al*. (Ref 8), the risk of behavioural disturbance is high when fish are 'near' the sound source but decreases with increasing distance. However, behavioural responses are still considered to be moderate at intermediate distances (100s of metres) from the sound source. Due to the width of the River Dee where the Proposed Development is located (approximately 169 m), some behavioural responses may occur. However, with mitigation measures in place in line with JNCC (Ref 13) guidance for the protection of marine mammals during impact piling, intermittent, short-term durations of piling and restrictions to construction working hours, the ecological effects to fish resulting from behavioural responses are expected to be limited. In addition, due to the presence of the existing power station and the industrial land use upstream of the Proposed Development, residential fish in the river and estuary (i.e. those that are regularly present rather than species only migrating through) are expected to have some habituation to UWS.

12.5.12 For any behavioural responses that do occur, they are expected to be intermittent and only occurring during the core daytime working hours. Due to the use of a soft-start, there will be time for nearby fish to move away from the Water Connection Corridor before the generated sound reaches levels which could result in significant behavioural responses and / or injury. There will also be a considerable time period during each day where construction, and therefore UWS production, are not occurring.

12.5.13 As the sound levels produced during impact piling are not expected to exceed thresholds for injury, and the risk of TTS is small, there is little potential for piling to affect migratory movements of fish within the River Dee. In addition, key migratory fish species in the River Dee, including Atlantic salmon and European eel have certain life stages that migrate predominately at night (juveniles/smolts of Atlantic salmon and adult European eel) (Ref 14). Thus, there is also limited potential for disturbance to downstream migration of juvenile Atlantic salmon or adult European eel during the piling works. There remains potential for disturbance during the upstream migration of adult Atlantic salmon and juvenile European eel as this could occur during daylight hours when intermittent piling takes place. However, this is expected to be minor.

12.5.14 The upstream migration of juvenile European eel is not limited to a particular timeframe. The time that juvenile eels spend in estuaries before moving into freshwater can vary between a few weeks to years with migration correlated with body condition (Ref 15). Therefore, there is no clear period in which the overall population is likely be affected. Juveniles also tend to utilise the tidal flood current to assist movement and given the limited period over which such tidal movements occur, this also serves to limit the potential for movements of juvenile European eels to coincide with piling (Ref 15).

12.5.15 Similarly, lamprey species are considered as low hearing sensitivity fish species (Ref 8) because they lack specialist hearing structures and consequently their ear is relatively simple (they have no swim bladder or anatomical structure tuned to amplify sound signals). Instead, lamprey species are generally only considered to be sensitive to sound particle motion within a narrow bandwidth of frequencies. Therefore, physical (both mortal and recoverable) injuries are unlikely to occur as the sound level will not exceed

the relevant thresholds as defined by Popper *et al*. (Ref 8), with behavioural disturbance and TTS only expected in very close proximity (tens of metres from the sound source). Both European eel and lamprey are therefore considered less sensitive to potential disturbance from piling, particularly given the limited timeframe over which piling is expected to occur.

12.5.16 With mitigation measures in place including adherence to JNCC (Ref 13) guidelines for minimising marine mammal injury from impact piling such as the use of a soft-start, the potential for adverse underwater sound impacts and effects on low and medium hearing sensitivity fish from impact piling is, at this stage, considered to be **minor** and is not currently expected to affect the conservation status of any fish species. However, this will be further assessed at the Environmental Statement (ES) stage.

Continuous Sound

12.5.17 Vibratory piling on the River Dee during construction also has the potential to produce underwater sound. This sound source is continuous in nature, for which a mixture of qualitative and quantitative thresholds are defined (Ref 8), as set out in **Table 3**. Therefore, whilst vibratory piling is much quieter than impact piling, it will occur over a longer period of time and thus will be of a longer duration. Construction phase dredging will also produce continuous underwater sound. However, the full extent of construction phase dredging is not currently understood and therefore will be further assessed at ES stage.

12.5.18 The River Dee has existing port facilities such as Port of Mostyn and Connah's Quay North (15.57 km downstream in the estuary and 0.62 km from Water Connection Corridor respectively) and is therefore used by vessel traffic. Any vessels deployed are likely to be relatively small due to the depth of the river at the cofferdam and outfall and intake locations. In addition, the jack-up barge used for piling activities will be stationary for much of the time, with its legs jacked down onto the riverbed. Thus, the limited vessel movements during construction are not anticipated to materially alter the baseline underwater sound conditions or affect fish species. Consequently, the impact assessment is concerned only with additional noise sources from vibratory piling.

12.5.19 For continuous sound sources such as vibratory piling, the only available thresholds for the fish species in the river of conservation importance (Atlantic salmon, European eel, trout and lamprey) are qualitative, using relative risk ratings such as those applicable for behavioural responses to impulsive sound as described in above in Section 12.4.

Table 3: Underwater sound impact thresholds for continuous sound sources

Fish Hearing Sensitivity	Mortality / mortal injury	Recoverable injury	TTS	Behaviour
Low e.g. lamprey	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Moderate (F) Low
Medium e.g. Atlantic salmon, sea trout and European eel	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Moderate (F) Low

Fish Hearing Sensitivity	Mortality / mortal injury	Recoverable injury	TTS	Behaviour
Eggs and larvae	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Moderate (F) Low

Source: Ref 8

12.5.20 The thresholds indicate that the risk of mortality from vibratory piling, for all hearing categories of fish at all distances, even in very close proximity from the activity, is low (**Table 3**). The potential for recoverable injury is also considered to be of low risk for low hearing sensitivity (lamprey species) and medium hearing sensitivity (Atlantic salmon and European eel) fish species. With restrictions in place on construction working hours, and the intermittent nature of vibratory piling (with each pile expected to take 1-2 hours), the risk of significant harm to fish from vibratory piling is considered to be negligible.

12.5.21 **Table 3** indicates that the most important impact on all fish receptors from continuous sound sources anticipated during construction relates to the potential for behavioural responses (e.g. displacement and disturbance) rather than physical or physiological effects. There is a moderate risk for low and medium sensitivity fish in the near and intermediate distance[1] (probably between 10s to 100s of metres from the sound source).

12.5.22 Behavioural responses are likely to include swimming away and a change of swimming direction, orientation, or position in the water column, or emerging from the surface. Behaviour is expected to return to normal a few minutes after piling has stopped (Ref 16). However, the risk of the more significant responses such as startle reactions from vibratory piling and vessel movements is low.

12.5.23 Migratory species such as Atlantic salmon and lamprey are also known to be sensitive to particle motion created by vibratory piling (with lamprey needing to make contact with a vibrating surface for a response to be likely). Very little information has been found to be available on the impact of vibratory piling in terms of particle motion. Even the most recent studies of the impact of sound on fish (e.g. see Ref 17 and Ref 18) concentrate mainly on the effect of sound pressure. However, it is considered that many of the effects determined in studies to date may actually be a result of exposure to particle motion, or a combination of particle motion and sound pressure, rather than just sound pressure (Ref 19).

12.5.24 It is anticipated that most of the piling activity will be vibratory in nature (subject to detailed design). However, as several construction activities need to take place between piles, vibratory piling will also be intermittent. Thus, as soon as the vibratory piling stops, fish may return to areas around the cofferdam construction. Fish are also known to habituate to sound over time, particularly when there is high motivation to do so (Ref 8) e.g. during migration or access to feeding habitats.

12.5.25 With mitigation in place for vibratory piling, including following JNCC (Ref 13) guidelines and restricting construction working hours, and the relatively low magnitude of any potential behavioural responses over the limited period of piling (which includes breaks in activity), any potential impact to fish is

considered negligible and is not likely to be adverse for the conservation status of any fish species.

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Connah's Quay Low Carbon Power

Preliminary Environmental Information Report
Volume IV, Appendix 12-C: Relevant Designated Sites

Uniper

The Planning Act 2008
The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017
PINS Reference: EN010166
September 2024

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Tables

12. Relevant Designated Sites for Marine Ecology Receptors

12.1.1 There are five nature conservation designations (Special Areas of Conservation (SACs) and Sites of Special Scientific Interest (SSSI's)) with relevant marine / estuarine receptors within the study area. These designated sites are listed in **Table 1** and shown in **Figure 12-2 (PEIR Volume III)**.

Table 1: Relevant Designated Sites in the study area

Site Name	Country Designation	Relevant Reason(s) for Designation[1]	Distance from the Site
The Dee Estuary (Aber Dyfrdwy) SAC / RAMSAR / SSSI	Wales and England	**SAC** **Primary Qualifying Features** Annex I habitats 1140 Mudflats and sandflats not covered by seawater at low tide 1310 Salicornia and other annuals colonizing mud and sand 1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) **Qualifying features but not a primary reason for site selection** Annex I habitats 1130 Estuaries 1210 Annual vegetation of drift lines 1230 Vegetated sea cliffs of the Atlantic and Baltic Coasts 2110 Embryonic shifting dunes 2120 "Shifting dunes along the shoreline with *Ammophila arenaria* (""white dunes"")" 2130 "Fixed coastal dunes with herbaceous vegetation (""grey dunes"")"* Priority feature 2190 Humid dune slacks Annex II species Sea lamprey *Petromyzon marinus* River lamprey *Lampetra fluviatilis* **SSSI** The SSSI supports intertidal mud and sandflats, grey seal *Halichoerus grypus* and smelt *Osmerus eperlanus*. **Ramsar** The Ramsar site supports intertidal sandflats and mudflats.	Within the Water Connection Corridor

[1] Only marine and estuarine qualifying features are considered in this chapter.

Site Name	Country Designation	Relevant Reason(s) for Designation[1]	Distance from the Site
River Dee and Bala Lake SAC	Wales	**Primary Qualifying Features** Annex II species Atlantic salmon *Salmo salar* **Qualifying features but not a primary reason for site selection** Annex II species Sea lamprey River lamprey	Located adjacent to the Water Connection Corridor
River Dee (Aber Dyfrdwy) SSSI	Wales	Annex II species Atlantic salmon Brown trout *Salmo trutta*	Approximately 0.1 km upstream of the Water Connection Corridor
North Anglesey Marine / Gogledd Môn Forol SAC/ Marine Protection Area (MPA)	Wales	Annex II species 1351 Harbour porpoise *Phocoena phocoena*	80 km from the Water Connection Corridor (hydrologically)
Lleyn Peninsula and the Sarnau (Pen Llŷn â'r Sarnau) SAC	Wales	**Primary Qualifying Features** Annex I habitats 1110 Sandbanks which are slightly covered by sea water all the time; 1130 Estuaries 1150 Coastal lagoons Priority feature 1160 Large shallow inlets and bays 1170 Reefs **Qualifying features but not a primary reason for site selection** Annex I habitats 1140 Mudflats and sandflats not covered by seawater at low tide 1310 Salicornia and other annuals colonizing mud and sand 1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) 8330 Submerged or partially submerged sea caves Annex II species 1349 Bottlenose dolphin *Tursiops truncatus* 1364 Grey seal	160 km from the Water Connection Corridor (hydrologically)

Connah's Quay Low Carbon Power

Preliminary Environmental Information Report
Volume IV, Appendix 12-D: Marine Ecology Plates

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Plates

12. Plates from Marine Ecology PEIR Chapter

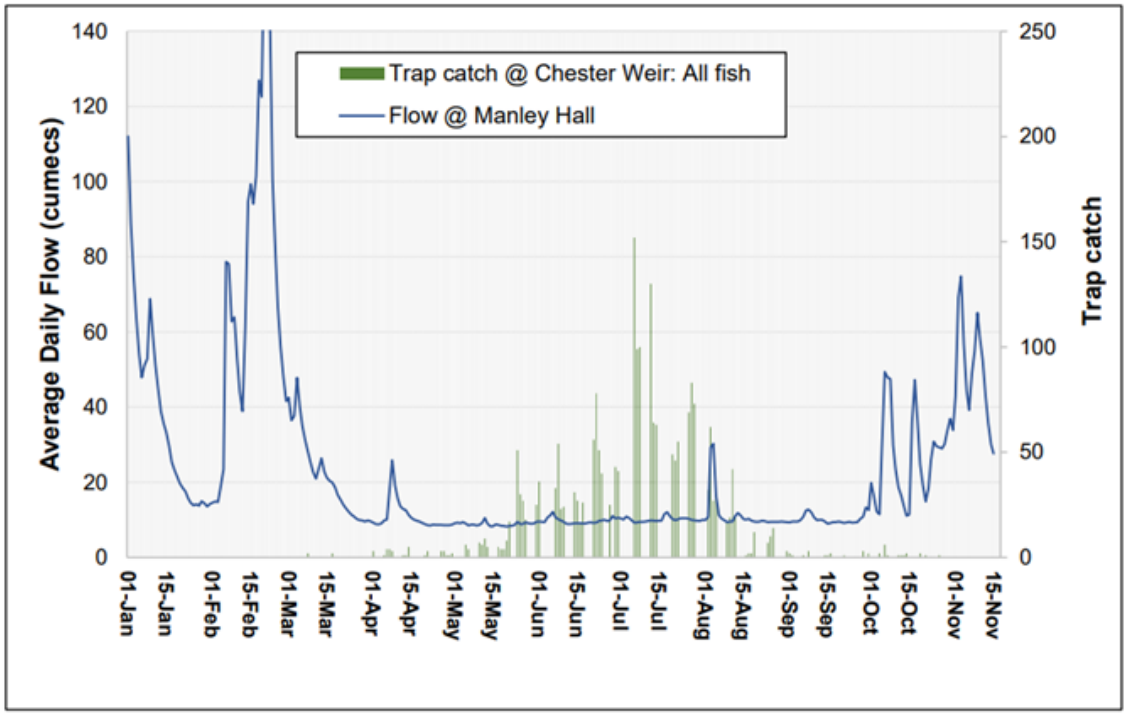

Plate 12-1: Combined Atlantic salmon and sea trout trap catch counts at Chester Weir between January – November 2022 (Ref 1)

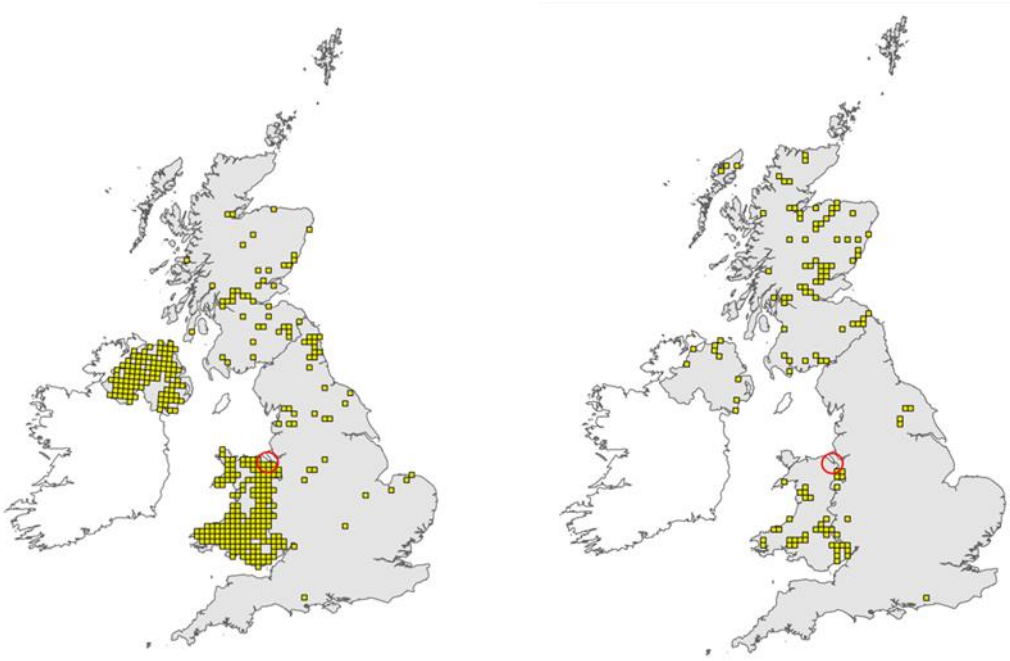

Plate 12-2: UK Distribution of River Lamprey (left) (Ref 2) and Sea Lamprey (right) (Ref 3)

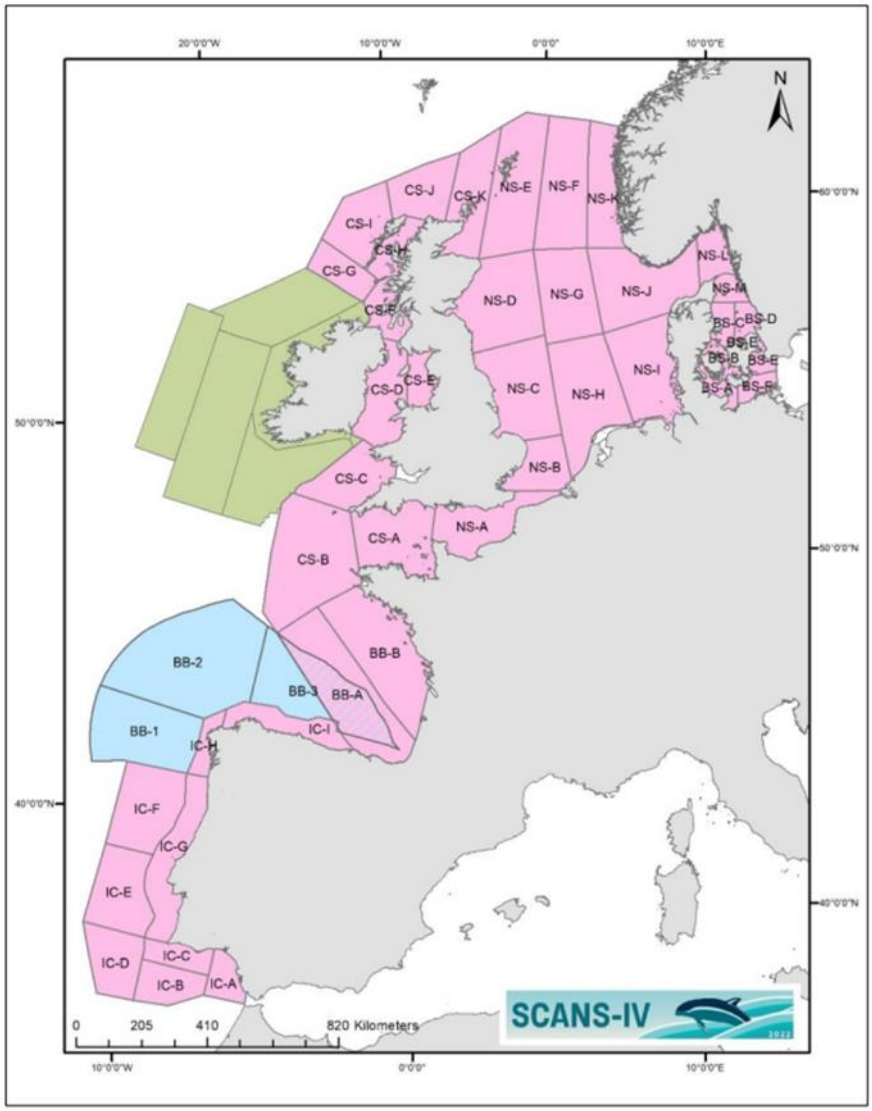

Plate 12-3: SCANS IV survey blocks

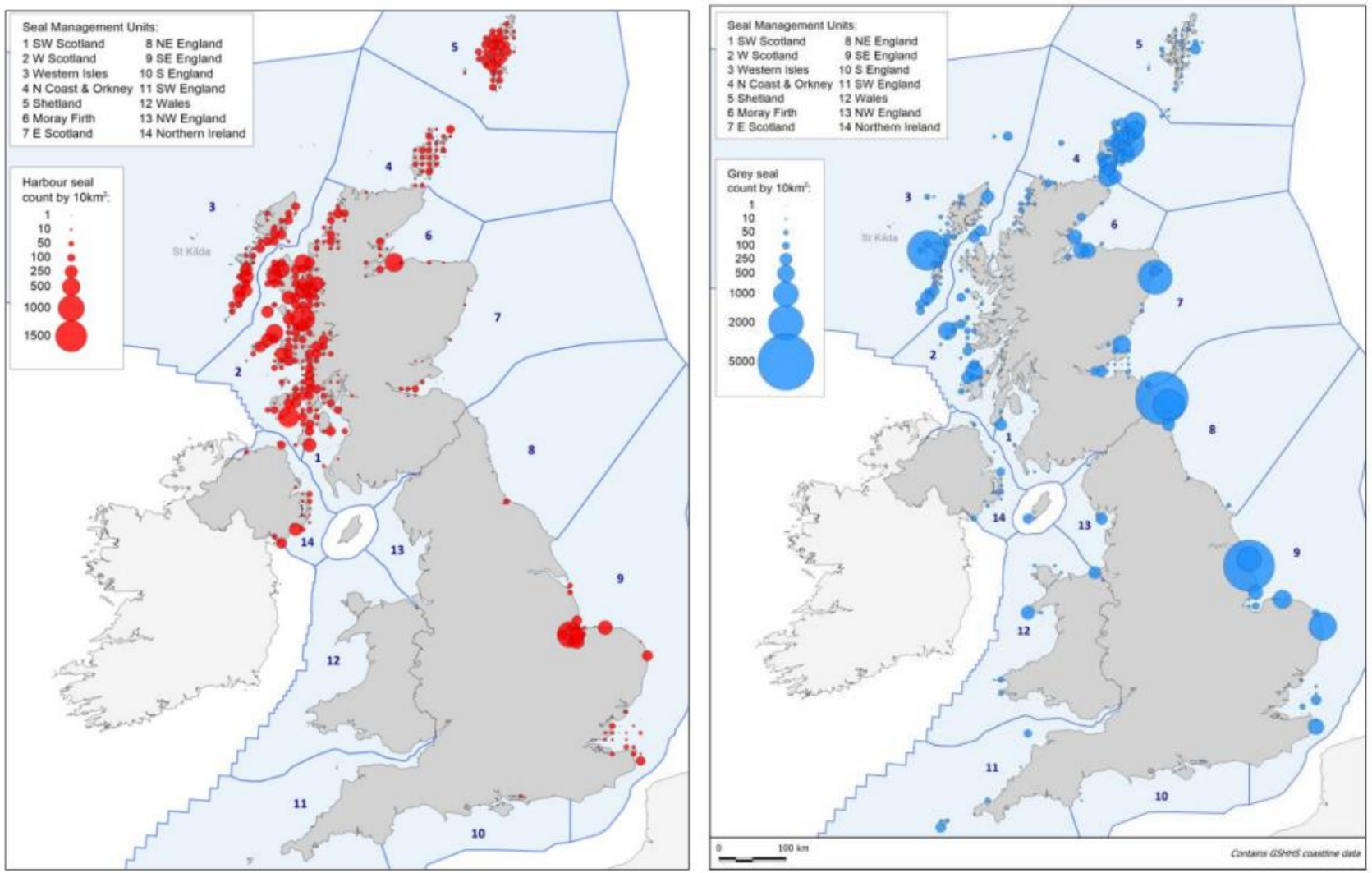

Plate 12-4: SCOS Mus and haul-out sites for harbour (left) and grey (right) seal

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