Artist scale impression of Rampion 2 viewed from Littlehampton pier

Written Representation from Carlo Marogna
representing the Constructive Heritage partnership
Heritage educators, conservators, sound reinforcement/multimedia engineers and scuba divers.

SUMMARY:
This representation largely concerns potential issues regarding sound generation during the life of Rampion 2, if allowed to go ahead as planned.
As engineers, we use sound and acoustics in various ways to effect change in behavioural response and understand how high levels of sound (and certain frequencies) can affect the body and mind. This process is called psychoacoustics. Getting it wrong can be dangerous, indeed deadly, especially extreme high sound pressure or extended exposure levels beyond the threshold of pain (around 130-140dB re 20 µPa) and certain frequencies, such as high amplitude 7hz, the human body's resonant frequency.
Understanding this, and as divers, there are serious concerns that the type of noise and noise levels that will be created during construction and operation have been underplayed. The single strike levels generated with today's construction methods are way in excess of mortality figures represented in the ES and other documents.

There is need for improved modelling, including vital sound propagation decay rates, which will give more specific indications of dissipation levels in water and in air and some idea of a safe underwater diving zone. No relevant information is available.
Therefore it would not be safe to enter the water with non-specific or reliable levels of mitigation using a baseline SPL of **240 dB re 1µPa.** The information from the MMO and this representation show that levels of noise pollution will carry for many miles around and dissipate much more slowly than suggested.

Speaking with divers in the water during piling construction of Rampion 1, extreme sound pressures were exerted on them at times which ensured divers leaving their survey areas quickly. If Rampion 2 gets permission, expect similar issues with much greater intensity due to extra levels of noise pollution generated by an unprecedented array of turbines so close to shore.
There is the potential to lose a lot of aquatic diversity through destructive construction measures as well as the loss of public amenity to enjoy the underwater and coastal environment.

The red flashing lights at night of Rampion 1 create a visual disturbance, something which, compounded by many extra miles of 325m high lighting, would create a feeling of being hemmed in by an electrical compound. Reminiscent of being in a prison camp with high, electrified walls, utterly destroying well being for those who live here.

The highly important, perfect and natural kelp carbon sequestration project happening inshore in our waters. This ecosystem is at huge risk from piling sedimentation, the most significant opportunity for reducing carbon emissions naturally (natural capital, and no cost to the taxpayer) and a nationally significant infrastructure project of the highest tier. The coastline that would be affected by it has now begun to regenerate the highly important kelp beds, aided by professionals who monitor our seas to regularly update our communities. Kelp is one of the best sequesters of carbon on earth, roughly absorbing carbon 5-6 times faster than a tree.
This is our absolute best opportunity for reducing carbon emissions in our environment, is a perfectly natural process and it carries no material cost whatsoever to implement (no petroleum based products, rare earth minerals, disturbance to the sea bed, fish, noise or even decommissioning). It even sustains and supports a myriad of life, one of the most diverse ecosystems on the planet. In comparison, an industrial wind farm of this size pollutes the area in various ways and has decades of operation before it pays off its carbon footprint.

At the Kelp Summit in 2022, it was evidenced through trials that kelp thrived better in low sediment areas, high amounts of sediment serve to stifle growth and can retard growth. A number of interested parties asked how much drilling material and sediment will be created by the applicant's proposal. The applicant told the organisers that they did not know. However, in the PEIR (page 75, Vol. 2 Chapter 9) the applicant stated that 2.9 million cubic metres of drilling fluid and sediment would be released into the environment…. including releasing carbon through the benthic layer trapped in the sea bed. It's also proposed to cut across at least one SSSI site (Climping) and South Downs National Park.

Therefore, at this time, the Rampion 2 proposal would create a highly negative impact on our environment for many years, change/diminish/destroy our already fragile but burgeoning ecosystems and reduce/delay the important kelp regrowth (something not only our community is in support of, but important enough for Sir David Attenborough and the BBC to document).
Kelp is protected under the OSPAR Convention, 2007 Annex V.
We recommend an alternative, more efficient site, in an area of greater average wind capacity (eg. Dogger Bank) or much farther away, (respecting the European Convention on Landscapes (ECL) and OESEA guidelines) to reduce the impact on the community and aquatic environment.

No visual representation of the turbine array day or night along our coast were presented to the public, but hidden away in documentation. Consider an essential aspect of the project would be to share the significant changes the proposal would cause. There are many gaps in the consultation information. The lack of specifics was seen as a ruse to prevent a huge outcry from people realising what an incredible eyesore and detriment this would be. The Sussex Heritage coastline is as iconic as the White Cliffs of Dover, an archaeological treasure as well as an important visual receptor for those who live here and visit, to enjoy the undisturbed horizon, playing a fundamental role in the well being of our community.

REQUEST FOR FURTHER INFORMATION BASED AROUND CURRENT DATA
Would like to see more accurate modelling based around current noise levels.

Those presented previously are misleading. They do not show propagation of noise levels of **240 dB re 1µPa** (peak), cumulative and associated decay rates, to conclude definitively that the operations can be mitigated enough to produce negligible effects on sea life as stated in the ES.
The modelling presented in the application show mortality levels around the low 200s dB re 1µPa, frequently 207 dB SELss is mentioned for certain receptors.
During the Planning Inspectorate hearing on noise levels, the applicant's representative admitted 240 dB re 1µPa.

If mitigation cannot reduce these levels sufficiently, and evidence decay rates that show safe reduction at receptor sites, then there is great risk that much life could be subjected to noise levels in excess of mortality rates.
It would be unsafe for divers to enter the water during construction activities for the same reasons.

It cannot be emphasised enough the need for evidence of suitable and efficient mitigation (which does not seem to be capable of reducing the noise levels to the recommended MMO numbers) based on the instantaneous peak piling noise of 240 dB re 1µPa.
Without revised modelling showing decay of higher sound levels over distance, those generated could be in excess of safe levels for aquatic life or humans underwater, for many miles.
These levels could be extremely dangerous to aquatic life and humans.
The applicant needs to evidence both mitigation specifics to achieve these levels, including max SPL of 135 dB re 1µPa (MMO recommendation), and ensure these levels are adhered to during construction and operation.
There has been no modelling of noise levels generated during operation, above and below the waterline which include infrasound and how these levels will affect the environment long term.
There needs to be reduction in noise levels in all aspects of the project.
If evidence can show achievable safe levels, ensure these levels will not be exceeded, for the safety of all concerned.
If the applicant cannot be seen to meet the levels set out by the MMO then the application should be refused on these grounds alone.

Why are the JNCC not statutory consultees?
They have solid guidance on noise levels and protected species and responsibility in the 'offshore' environment. Confusing. As the 'inshore' wind farm (8-12nm) abuts the 12nm offshore limit (and therefore any disturbance from inshore would affect offshore), should this not have triggered/engaged the JNCC as Statutory Consultees, as pollution of all kinds including noise will affect the area covered by the JNCC's remit?

It seems the JNCC should be consulted. Not doing leaves a gap in the process and sets the incorrect presumption that life will only be affected within 8-12nm, not outside, almost if a magic wall will prevent any issues leaking out. JNCC guidelines should be considered and actioned along with other Statutory and other representations.

Thank you very much for your time and consideration in this matter.
Sincerely

Mr Carlo Marogna
on behalf of the Constructive Heritage Partnership

MAIN REPORT

From the Marine Management Organisation

- *Chapter 11, Marine Mammals 4.7.11 In paragraph 11.9.42, "the results of the underwater noise modelling have been misinterpreted, and it is incorrect to state that "to be at risk of auditory injury, an animal would have to stay within the immediate vicinity of the noise source for 24 hours. This is considered unrealistic and therefore, the risk of auditory injury to marine mammals from these activities is considered to be de minimis". The underwater noise assessment (presented in Appendix 11.3) concludes that for non-impulsive (or continuous) noise sources, any marine mammal would have to be less than 100 m from the continuous noise source at the start of the activity, in most cases, to acquire the necessary exposure to induce PTS as per Southall et al. (2019). This is because the noise assessment assumed a fleeing animal receptor. Furthermore, the noise assessment assumed that non-continuous sources were operating for a worst-case of 12 hours in any given 24-hour periods apart from vessel noise (which was assumed to be present for 24 hours). Thus, Chapter 11 should be corrected accordingly."*[1]

Recommendation to conduct the underwater modelling again based on current data in line with MMO guidelines.

The independent underwater acoustic assessment presentation (Thrown To the Wind, by filmmaker Jonah Markowitz) stated that any whale within half a mile would instantly and irreversibly lose their ability to hear. The excessive sound pressure from the hammer blows would render it completely deaf. One would presume that this would also have a similar or greater effect on any other sea creatures (i.e. teleost, elasmobranch species) in the vicinity with similar receptors, especially ones more delicate who could not stand the protracted noise levels, habitat displacement or be able to move far enough away to make a difference.

Seahorses are a protected species, it is an offence to disturb or destroy any seahorse or habitat. Seahorses are all along the Sussex coastline. Please see relevant representations on seahorse habitat locations. There are also cetaceans, a European Protected Species, whales, and porpoises, in the Sussex Bay. Please refer to Chapter 6, Attachment 2 for more detail.

Between Autumn 2023 and February 2024 two whales (Beaked, Minke) stranded and died on the shores to the west of Rampion 1 and directly in front of the proposed site for Rampion 2, so they are travellers in these waters. It is common knowledge that cetaceans can be profoundly affected by construction and operational noise arising from wind turbines in the sea. **Sound can be affected by many things underwater but roughly travels around 1500m per second. This is 4 times faster than on the surface.** Sound levels underwater, though affected in various ways by temperature, salinity, absorption into the sea bed, reflection and refraction, dissipate much more slowly.

Looking at potential mitigation tools and how many decibels could be reduced, there does not seem that a combination of current measures can successfully reduce the levels to a safe operating level according to the MMO's recommendations of **135 dB(A) re 1 µPa**

Potential noise levels during construction would be way in excess of Marine Management Organisation or other precautionary guidelines as this is a level of noise pollution currently

[1] *https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010117/EN010117-000477-20231106_Rampion_2_MMO_Relevant_Representation%20(002)_Redacted.pdf*

unmitigable with today's tools such as bubble screens, or other measures, when working efficiently in calm waters. Given that this recent (independent) measurement of **241 dB(A) re 1 µPa** was including a level of mitigation, (confirmed as being correct for a 13.5m mono-pile by the applicant's representative though it was not asked at the time whether this was mitigated, to his understanding) this sonic blast wave of noise and the way it conducts through the water would make the area for miles around at the very least unimaginably disturbing to mammals and other aquatic life during the construction phase, remove ecological diversity and minimise life around the pilings. It would make the sea potentially harmful to divers for miles around.

The construction would be too close to the Marine Conservation Zone of Kingmere Rocks as the excessive energy created would not attenuate enough prior to entering the MCZ.

- *4.7.8 "MMO notes that some of the language and statements presented in this report are misleading and unsubstantiated.*

the MMO does not agree that the resulting predictions are "highly precautionary and very unlikely to be realised".

- *4.7.9 As raised during the PEIR consultation, the information presented in section 2.5.3 onwards (TTS Assessment) only demonstrates what is not known about the significance of TTS – there is no evidence presented to confirm that it isn't significant, only conjecture. One could equally argue that at lower received sound levels, animals are less likely to flee (see Figure 2-2 on page 24), and so proportionally more likely to induce TTS than this assessment suggests. The TTS/PTS assessment seems to consider only an animal fleeing directly away from the source, whereas Fig. 2-2 demonstrates that even at received SELss of 160 dB, around 10% of animals will not flee, so there are uncertainties which tend toward underestimation of risk here too. 4.7.10 In the ES, the sensitivity of all cetaceans to PTS-onset is assessed as Low. In the PEIR, all cetaceans were originally assessed as having a 'Medium' sensitivity to PTS. However, it was raised by MMO that the consultant had not demonstrated that PTS would have merely a medium risk, only that there is uncertainty about how significant PTS may be for individual animals. Until, and unless, empirical evidence can shed light on whether this opinion holds water, the precautionary principle will continue to apply. Thus, it is recommended that cetaceans should be assessed as having a high sensitivity to PTS."*

If you consider the much higher baseline level of noise from piling of 240dB re 1 µPa it is recommended to re-examine the methods of mitigation as an essential tool before coming to any conclusions.

"The designated features of each MCZ's and their conservation targets vary spatially, however there are recurring features such as black seabream (Spondyliosoma cantharus), lagoon sand shrimp (Gammarus insensibilis), short snouted seahorse (Hippocampus hippocampus) and subtidal sediments (chalk and mixed) present across multiple MCZs. In assessing the MCZ's from project alone effects, the magnitude of the effect is typically deemed to be negligible based on the evidence provided within this MCZ assessment. ***The development has the potential for inter-related effects including, 'proposed development lifetime effects', where multiple phases of the proposed development interact to create a potentially more significant effect on a receptor than in one phase alone. Additionally, 'receptor-led effects', where effects from different environmental aspects combine spatially and temporally on a receptor.*** ** These have been considered for potential interactions between fish and shellfish ecology and benthic ecology aspects. Through the implementation of appropriate embedded environmental measures, the MCZ assessment concluded that based on the Stage 1 assessment of relevant features, there is no significant risk of the proposed development hindering the conservation targets of the identified*

attributes or the achievement of the conservation objectives stated for the following MCZs: Kingmere MCZ; Offshore Overfalls MCZ; Beachy Head West MCZ; Beachy Head East MCZ; Selsey Bill and the Hounds MCZ; Bembridge MCZ; and Pagham Harbour MCZ."[2]

There are seven MCZs that could be affected. These seem to have been scoped out of the assessment, but all of these sensitive receptors could be affected by construction noise. Sound modelling should be conducted based around levels, both SPL and SELss as well as propagation underwater, decay levels, cumulative effects of multiple arrays etc.
*** this is quite significant. What this is saying is that the combined effects of the development may provide a more significant effect on the receptor than the individual aspects of the development, ie: turbines. That the effects on the environment will be amplified due to the array nature of the turbines. The multiple coupling of the turbines will create a sonic array that will transmit low frequency signals above the water for the duration of the operation. This has not been assessed on its effect on humans and should be added to any noise modelling exercise.**

Operational Noise Including Infrasound

- *4.7.14 Section 4 Soundscape at Kingmere MCZ:*

"MMO agrees that acoustic disturbance should only be considered for audible sound. At a minimum, an introduced noise must be (a) above the hearing threshold and (b) exceed the background noise. Nonetheless, and with reference to the following statement in Section 4: "The "loud vessel" is approximately only 25 dB above the seabream hearing threshold. This implies that as a result of the seabream sensitivity, the "loud vessel" would be audible to the fish but is unlikely to be perceived as "loud"".

- *4.7.15 MMO is unsure how this is relevant, especially as we are concerned primarily with piling noise (not vessel noise).*

Furthermore, whether a sound is perceived as "loud" does not necessarily indicate its potential for behavioural disturbance."

It is not agreed that acoustic disturbance should only be considered for audible sound.
Wind turbines create what would seem to be a lot of the wrong type of noise, such are the specific frequencies and levels generated, as well as the distance they carry above and below the waterline. Sound can be very dangerous, not just the noise you can hear. High levels of infrasound or excessive sound pressure or exposure levels carry their own risks.

<u>Sound pollution created during operation of wind turbines in water.</u>

Infrasound is classed as inaudible sound waves below 20 Hertz.
It is an issue to be aware of as although you can't hear it, it doesn't mean it does not exist, nor that organisms are not affected by it, according to its influence. **High amplitude low frequency generation underwater could affect divers considerably as well as many sea creatures.**
What may be inaudible to us as noise (but could still affect us physiologically and/or physically especially at higher amplitudes), the same frequency or level could elicit impulsive behaviour from avoidance to fatigue, even organ failure, in all kinds of life subjected to it. Humans and aquatic life all have different hearing and body frequency responses so inaudible for us might be deafening to a fish.

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[2] *https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010117/EN010117-000141-5.11%20Rampion%202%20Draft%20Marine%20Conservation%20Zone%20assessment.pdf*

Fish overall use the lower frequency ranges in the low 100's hertz to hear and communicate, while mammals such as porpoise are much higher, up to the 10khz range.
Wind turbines are very efficient large capacity sound generators indeed. They create large levels of infrasound (below 20hz), audible (20hz to 20khz) and ultrasound (above 20khz). Turbines work as a perfect transmitter through the column, in an omnidirectional manner, the pile acting as the resonator into the seabed. It also works in a directional manner, via the turbine blades. Both create high sound pressure waves that the low frequency noise created during operation will resonate through the foundations and sicken the sea and air around it with its constant droning when operating.
It is recommended that the modelling of turbine noise during operation be conducted, including the recording of infrasound (20 hertz and below, 10hz at least, according to BS5228,) to ascertain its propagation through water, individually and as an array, the frequencies generated (which one can expect to change according to stresses placed upon it, wind speed, etc) cumulative values and amplitudes be considered before assessing its potential impacts.
Operational noise should be classed as an adverse noise impact due to its capacity to introduce infrasound at high levels into the surrounding areas for the duration of the project.
Infrasound travels faster through water and solids and does not dissipate. Its physical and psychological effects are varied but the overt characteristic is an intense feeling of oppression. Fatigue, blurred vision, irritability, headache, nausea, difficulty concentrating, tingling skin and aching limbs are all effects of infrasound. Infrasound is created by the action of the gearbox and turbines and is carried into the sea by its foundations. These low frequencies generated at higher amplitudes can cause adverse reactions in sea life as well as in humans. A small percentage of the population is so sensitive to infrasound that they become nauseous near the ocean (which naturally generates low-frequency signals). NASA has documented 17 Hz infrasound produces extreme blurring of vision. Walt Disney once conducted an experiment slowing down the 60-cycle tone of a soldering iron in a short cartoon. At a low-frequency 12 cycles, they became sick for days afterwards. The issue is not so much what the cochlea "hears," but the sound pressure that messes up the vestibular organs—the sound pressure that, depending on intensity, duration of exposure, and pulse of the infrasound, can do a lot of unseen damage.

Long term exposure to high levels of infrasound during operation could have a detrimental effect on protected species and create areas of low environmental diversity

Barotrauma is trauma from intense pressure changes, in the inner ear and lungs typically—this is what bats die from when they encounter wind turbines—"exploding lungs"
If the noise from piling does not dissipate enough prior to reaching the spawning grounds MCZ it could cause issues with the Black Sea Bream such as barotrauma and affect spawning and eggs. There are also a number of protected sites of Seahorse all along the Sussex Bay coastline and an offence to disturb or harm any habitats.

These issues should be examined in much greater detail before coming to any conclusions.
There should be no piling of such large piles so close to shore and in the same bay as such sensitive receptors as the Marine Conservation Zone or protected species such as the Seahorse or cetacean.
The main potential impact to fish from the Project is from the underwater noise generated when piling. Fish sensitivity to noise varies greatly: Herring are considered to be the most sensitive.

Many fish will actively avoid affected areas, but a percentage will stay in situ. The worst-case area that this might affect a fish is potentially 80km for herring therefore impacts of piling noise are a big concern in relation to Herring. Although not protected, they are known to be both sensitive to noise and a key prey item to rare and protected breeding seabird colonies that contribute to designated SPAs (Special Protection Areas).

Piling noise would disturb both herring and nationally important black bream particularly during their most sensitive, peak spawning period. Black Sea Bream nests could be damaged. Electromagnetic fields (EMF) emitted from live power cables could have the potential to affect fish and shellfish, particularly elasmobranchs and little work has examined whether these have any implications or negative effects at habitat level. Beside the many protected species mentioned above Protection of Marine Mammals is of significant importance.

UXO clearance
"The maximum equivalent charge weight for the potential UXO devices that could be present at Rampion 2 has been estimated as 525 kg. This has been modelled alongside a range of smaller charge weights of 25, 55, 120, and 240 kg. It is appropriate that the estimation of the noise source level for each charge weight has been carried out in accordance with the methodology of Soloway and Dahl (2014). It is noted that an attenuation correction has been added to the Soloway and Dahl (2014) equations for the absorption over long ranges (i.e., of the order of thousands of metres), based on measurements of high intensity noise propagation taken in the North Sea and Irish Sea. The maximum PTS range (SPLpeak) calculated (based on the worst-case UXO) is 13 km for VHF cetaceans (SPLpeak criteria) (with a TTS range of 23 km). For fish, the maximum range is 810 m. MMO has conducted a spot check of the worst case predictions which look reasonable (assuming the methodology from Soloway and Dahl and no attenuation correction)."[3]

Taking these numbers as a guide and that the North and Irish Sea due to their more potentially turbulent natures would tend to attenuate sound slightly quicker than in the Sussex Bay, it is of value to note that a Permanent Threshold Shift could occur in EPS cetaceans up to 13km away from source of detonation.

Given that 13km is the approximate distance to shore from the proposed turbine park, this infers that there is increased risk for cetaceans and other life anywhere between the turbine areas and shore. Concerns are for aquatic life and health during construction. Most aquatic life would be affected; many are habitat based. It is a myth that any sea creatures can just leave the affected area, for example, the seahorse, which are living at various places in the Sussex Bay. The affected area can run into many miles in size and there cannot be an expectation that fragile life extant can just 'pack up and go'. Go where if everywhere is affected by the same disturbance?
There would be huge a habitat displacement/loss as opposed to any Net Gain.

The sound of piling has now reached a concussive level which is on par in comparison with the above biggest UXO charge weights. So counting the 45,000 concussions into the seabed at 240 dB(A) re 1 µPa it can be concluded that a similar distance of effect (or exclusion zone) as above, on marine life and users including divers would be created by the piling and construction noise.

Anecdotal Evidence from members of the Public
Reg Phillips – Facebook

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[3]*https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010117/EN010117-000811-ISH1%20Action%20Points.pdf*

"The pile driving has severe impacts on finfish, during the Angling Trust four year juvenile fish surveys along our open beaches in West Sussex we experience a drop (in) species being caught so it does disrupt the spawning, nesting and juvenile life cycles of finfish. The threat to the Kingmere black bream stocks is huge, but not just them, dover sole, plaice, turbot, brill, and just about every other demersal species that uses our nearshore waters to spawn could be severely impacted upon. There is talk of extending the Kingmere black bream spawning season from 12 to 16 weeks as more science is gathered on their spawning cycle, that is 4 months of each year construction of the site will have to stop which will extend the time in which the site is completed, the cable route laid and nature can take back the environment. We could be looking at 4 years of disruption at which point our commercial fishermen will be justly compensated but our charter skippers and clubs will be ignored like last time. There is lots to consider and digest guys."

Sound Issues Concerning Rampion 2 During Construction and Operation
After a career in sound reinforcement design, construction and maintenance, a recreational diver and fishkeeper, it is my understanding that the Rampion 2 proposal has the potential to cause far greater damage from construction and operation than is currently being understood. I have grave concerns for the noise levels of sound pressure and exposure levels that could be generated should the application be approved under seemingly understated and underrepresented parameters.

"The decibel scale is a logarithmic scale used to measure the amplitude of a sound. If the amplitude of a sound is increased in a series of equal steps, the loudness of the sound will increase in steps which are perceived as successively smaller. A decibel doesn't really represent a unit of measure like a yard or meter, but instead a pressure value in decibels expresses a ratio between the measured pressure and a reference pressure. On the decibel scale, everything refers to power, which is amplitude squared. And just to confuse things, the reference pressure in air differs from that in water. Therefore a 150 dB sound in water is not the same as a 150 dB sound in air. So, when you are describing sound waves and how they behave it is very important to know whether you are describing sound in the sea or in air.

Amplitude of Example Sounds	In Air (dB re 20µPa @ 1m)	In Water (dB re 1µPa @ 1m)
threshold of hearing	**0 dB**	**--**
whisper at 1 meter	**20 dB**	**--**
normal conversation	**60 dB**	**--**
painful to human ear	**130 dB**	**--**
jet engine	**140 dB**	**--**
blue whale	**--**	**165 dB**
earthquake	**--**	**210 dB**
supertanker	**128 dB (example conversion)**	**190 dB**
13.5m monopile single strike *(for comparison)*	**178 dB**	**240 dB**

Note on Acoustic Noise Level Units: Hydrophones measure sound pressure, normally expressed in units of micropascals (µPa). Early acousticians working with sound in air, realized that human ears perceive differences in sound on a logarithmic scale, so the convention of using a relative logarithmic scale (dB) was adopted. In order to be useful, the sound levels need to be referenced to some standard pressure at a standard distance. The reference level used in air (20µPa @ 1m) was selected to match human hearing sensitivity. A different reference level is used for underwater sound (1µPa @ 1m). Because of these differences in reference standards, noise levels cited in air do NOT equal underwater levels. To compare noise levels in water to noise levels in air, one must subtract 62 dB from the noise level referenced in water. For example, a supertanker radiating noise at 190 dB (re 1µPa @ 1m) has an equivalent noise level in air of about 128 dB (re 20µPa @ 1m). These numbers are approximate, and amplitude often varies with frequency.

Faster than the Speed of Sound…
The speed of a wave is the rate at which vibrations move through the medium. Sound moves at a faster speed in water (1500 meters/sec) than in air (about 340 meters/sec) because the mechanical properties of water differ from air. Temperature also affects the speed of sound (e.g. sound travels faster in warm water than in cold water) and is very influential in some parts of the ocean. Remember that wavelength and frequency are related because the lower the frequency the longer the wavelength. More specifically, the wavelength of a sound equals the speed of sound in either air or water divided by the frequency of the wave. Therefore, a 20 Hz sound wave is 75 m long in the water (1500/20 = 75) whereas a 20 Hz sound wave in air is only 17 m long (340/20 = 17) in air. Sound, and especially low-frequency sound, can travel thousands of meters with very little loss of signal."[4]

For extrapolation purposes, Rampion 2 documentation does not mention the instantaneous sound pressure level (SPL) of a 13.5m diameter mono-pile at every strike?

A comparable wind farm construction currently is Orsted off the east coast of the USA. Independent professional acoustician Robert Rand recorded the mitigated piling decibel level of a **13.5m diameter pile** ½ a mile (750m approx) from point of impact registered underwater at; **241 dB(A) re 1 µPa.**
Above the waterline this registered at; **188 dB(A) re 20 microPascals (µPa)**
This is described as the equivalent to the shock wave of a 155mm artillery Howitzer going off every hammer strike into the seabed.[5]
It would then radiate omni-directionally for miles.
Assuming **1 pile @ 5000 strikes per pile x 90 piles = 45,000 concussions into the seabed** (or the sonic blast equivalent of 45,000 heavy artillery shells being fired off during the construction phase into the Sussex Bay.) That is independent of and in addition to, the UXO detonations of a similar capacity of destructive noise levels.
N.B. An almost identical figure for peak instantaneous sound pressure level (Lpk) of a 13.5m diameter pile being driven into the sea bed of 240 dB re 1 µPa (underwater) was given by the

[4] *https://oceanexplorer.noaa.gov/explorations/sound01/background/acoustics/acoustics.html*
[5] "Thrown To the Wind, Part 2", filmmaker Jonah Markowitz documents acoustician Rand measuring illegal levels of noise from pile-driving by the wind industry off of Martha's Vineyard.
Public.substack.com/p/illegal-levels-of-whale-killing-pile

Rampion 2 representative at the Planning Inspectorate hearing on noise levels during construction, when specifically asked.
Quick calculation (using the applicant's figure of maximum instantaneous SPL (Lpk) of a 13.5m pile):
240 dB(A) re 1 µPa
The MMO's recommendation for maximum SPL for mitigated piling noise
135 dB(A) re 1 µPa
Difference for purposes of mitigation reduction necessary to achieve the MMO's figures
105 dB(A) re 1 µPa
<u>There are no sound mitigation methods that can reduce the noise from piling by 100 dB(A) re 1 µPa</u>
The maximum might be around -25 dB with a combination of mitigation devices, this is still way off.
At these levels more modelling should be done to evidence not just mitigation specifics which are lacking but also <u>legitimate capability to achieve levels</u> set out as the defined minimum by the MMO.
More accurate noise propagation modelling should be presented based on current data and not historic, as current size piles were not included in the modelling, so of no comparison to modern noise levels. This is significant due to the higher noise levels now being generated so close to shore with potential to affect so much life, for many miles, below and above the waterline.
The comparison figures quoted in the ES have no relevance with modern piles and the ES noise levels are much lower than can be expected.
If we use Rampion 1 as a baseline comparison, then noise levels onshore during its construction especially at night with a calm sea (worst case scenario) was at times excessive, caused a number of complaints and was something personally experienced. Rampion 2 has scoped the use of much larger turbines (up to 2.5 times larger) than Rampion 1 so there must be an expectation of that level of noise to become much more disturbing than previously.
In this case, everything is that much larger and therefore louder so more accurate modelling is necessary.

Sussex Wildlife Trust have also asked for a commitment on noise abatement technology.
- *4.6.65 "To summarise MMO has major concerns outstanding and considers further information is required on modelling along with further discussions on mitigation.*

- ***Monopile foundations (worst-case assuming 2 monopiles)**: The largest ranges are predicted at the S modelling location (with the deeper water depths of 53.4 m). For marine mammals, the following maximum PTS (SELcum) injury ranges are predicted: • 15 km for low frequency cetaceans (i.e., minke whale), • 7.4 km for very-high frequency cetaceans (i.e., harbour porpoise), and • < 100 m for phocid pinnipeds (i.e., seals). TTS ranges of 46 km, 34 km and 16 km were predicted for LF Cetaceans, VHF cetaceans and phocids respectively. PTS SPLpeak ranges of <50 m, 680 m and 60 m were predicted for LF Cetaceans, VHF cetaceans and phocids respectively. For fish, a maximum range of 41 km (stationary receptor) was predicted for TTS using the Popper et al. (2014) criteria (for 2 sequentially installed piles), as well as potential mortal injury (7.4 km) and recoverable injury (12 km). Based on a (behavioural) threshold of 135 dB SELss from Hawkins et al. (2014), effects are predicted out to 67 km (for a single monopile).*

- ***Jacket pile foundations (worst-case of four sequential piles)**: The largest ranges are also predicted at the S modelling location. For marine mammals, the following maximum PTS (SELcum) injury ranges are predicted: • 13 km for low frequency cetaceans (i.e., minke whale), • 5.9 km for very-high frequency cetaceans (i.e., harbour porpoise), and • < 100 m for phocid pinnipeds (i.e.,*

seals). TTS ranges of 43 km, 31 km and 15 km were predicted for LF Cetaceans, VHF cetaceans and phocids respectively. PTS SPLpeak ranges of <50 m, 560 m and <50 m were predicted for LF Cetaceans, VHF cetaceans and phocids respectively. For fish, a maximum range of 44 km (stationary receptor) was predicted for TTS using the Popper et al. (2014) criteria, as well as potential mortal injury (8.9 km) and recoverable injury (14 km). ***Based on a (behavioural) threshold of 135 dB SELss from Hawkins et al. (2014), effects are predicted out to 63 km (for a single jacket pile).***

That's a very long distance of effect especially being omnidirectional in nature. 63 km means the whole of the Sussex Bay will be affected. As water is basically incompressible, these levels could cause hearing damage so the waters of the Bay would be out of bounds to divers. Those levels would not be safe, especially that it's not a single strike, but thousands…
This is also assuming the applicant can achieve 135dB SELss or preferably less

- *4.7.3 "Following finalisation of the project design and pre-construction surveys, if construction activities are expected to cause significant disturbance or injury to a European Protected Species (EPS) (cetaceans), an EPS licence(s) will be applied for where applicable. MMO would encourage early engagement with the MMO conservation team."*

The modelling outlined in 4.6.65 shows high potential for causing significant disturbance or injury to a European Protected Species.
- ***"The guidance document illustrates a preventative approach to ensure the strict protection of EPS in their natural range as required by Article 12 of the Habitats Directive. It provides an interpretation of the offences of deliberate capture, injury, killing or disturbance of any wild animal of an EPS, under regulations 41(1)(a) and (b) in The Conservation of Habitats and Species Regulations 2010 (HR) and 39(1)(a) and (b) in The Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (amended in 2009 and 2010, OMR)."*** [6]
- "In June 2020, JNCC together with Natural England (NE) and the Department of Agriculture, Environment and Rural Affairs in Northern Ireland (DAERA) published advice to competent authorities on what could constitute *Significant Disturbance* within harbour porpoise SACs in England, Wales and Northern Ireland marine areas. In addition, guidance was provided on a noise management approach to keep underwater noise within levels that do not affect a site's integrity."

The JNCC advise:
- *"In harbour porpoise SACs, the advice on avoiding significant disturbance applies to plans/projects alone and in-combination. For the largest SACs such as the SNS SAC, most individual operations/projects are unlikely on their own to result in an adverse effect on site integrity. This is due to a relatively small spatial footprint when compared to the area of the site combined with the temporary nature of noise effects. For smaller sites, some individual operations will likely have to modify their planned approach in order to reduce their spatial and temporal footprint. For many, this is likely to take the form of noise mitigation/abatement systems which will reduce the disturbance ranges.* ***In areas outside (but also within) the SACs, operations/projects with the potential to result in injury or disturbance can only go ahead if mitigation measures can be employed in order to reduce the risk to individual animals****.*

To reduce the risk of hearing damage in the immediate area around the noise sources, measures such as a 'soft start', marine mammal observers enforcing mitigation zones and acoustic deterrent devices are routinely employed. It is more challenging to reduce the risk of disturbance at larger

[6] *https://jncc.gov.uk/our-work/marine-mammals-and-offshore-industries/#legal-protection-for-marine-mammals*

ranges and therefore an activity can only go ahead with a licence under the EPS regulations. Licences should only be issued when there are no satisfactory alternatives (alternative methods that would not cause disturbance) and if the activity does not have an effect on a species' FCS. All projects that could result in disturbance according to the EPS regulations will need to undertake an assessment of the impacts on the species' FCS from the project alone and in combination with others.

***If an impact cannot be ruled out, then the project cannot not be licensed as planned**.*
For those licences that are issued, it is incumbent on competent authorities to monitor the effect of these on the population(s) of the species to ensure that there is no detriment to FCS from cumulative effects of the licences."

Interpretation of the injury offence.
- *"Certain activities that produce loud sounds in areas where animals of an EPS could be present have the potential to result in an injury offence, unless appropriate mitigation measures are implemented to prevent the exposure of animals to sound levels capable of causing injury. Mitigation measures such as those presented in Annexes A, B and C of this document, when used appropriately and adequately, are likely to reduce the risk of an injury offence to negligible levels. This guidance proposes that a permanent shift in the hearing thresholds (PTS) of an EPS would constitute an injury offence and suggests the use of the Southall et al. (2007) precautionary criteria for injury. These criteria are based on quantitative sound level and exposure thresholds over which PTS-onset could occur for different groups of species. If it is likely that an EPS could become exposed to sound at or above the levels proposed by Southall et al. (2007) then there is a risk that an injury offence could occur. The risk of an injury offence will be higher in areas where EPS occur frequently and/or in high densities."*

- *4.6.54 "Based on the UWN contours presented in Figure 8.20 of Chapter 8 which present the 135 dB contour, UWN from piling undertaken at the Rampion 2 array, particularly from piling activities at the west and south modelling locations, will overlap the Downs herring spawning ground. Given that the UWN abatement scenarios in the mitigation plan have been presented based on a threshold of 141 dB, the range of behavioural impact for herring will likely be higher than has been presented.* ***The Applicant should repeat the modelling exercise and present UWN modelling for the noise abatement reduction scenarios using a behavioural response threshold of 135 dB SELss. The MMO also requests to see the unmitigated UWN contours provided alongside each noise abatement scenario for comparison.*** *Piling restriction, March to June and July."*

- **1 "Vibration and noise might induce avoidance behaviour and reduce fitness of sensitive organisms, thereby potentially changing population structure and distribution patterns &**
- **30 Direct mortality or reduction in fitness through damage caused by sound waves of the natural substrates. Changes in distribution: introduced noise will cause distribution changes in natural and artificial hard-substrate fauna***"*

For fish close to piling activity, the impact of strong impulsive sound can lead to barotraumas and hair cell damage (Halvorsen et al., 2012a, 2012b, Casper et al., 2013a, 2013b; De Backer et al., 2014). The risk of barotrauma occurrence depends on the presence/absence of a connection between a swim bladder and a gut. The most numerous and most severe injuries are observed in physoclistous fishes lacking that connection, which makes them unable to adjust their swim bladder fast enough to avoid injury. In contrast, physostomous fishes which have the swim bladder

connected to their gut, are able to adjust the swim bladder relatively quickly making them less susceptible to injury. Adult flatfishes are the least susceptible to these types of injuries, since adults lack a swim bladder (Bolle et al., 2012; Halvorsen et al., 2012b). Recovery after injuries were observed under laboratory conditions for both physostomous and physoclistous fishes (Casper et al., 2012, 2013b, Halvorsen et al., 2012a, 2012b). Filed studies have shown that the severity of the swim bladder barotrauma and internal bleeding in Atlantic cod is related to a distance from piling activity (De Backer and Hostens, 2017). Physiological changes indicating stress, such as decreased oxygen consumption rate (50%) have been recorded in young sea bass during piling activities (Debrusschere *et al.*, 2016).

All fish are capable of detecting particle motion via the otolith and lateral line therefore may still be exhibit behavioural responses (Andersson et al., 2017).

Knowledge on the impact of sound on epibenthos, particularly invertebrates remains poor and is generally lacking on the impact of impulsive sound (Edmonds et al., 2016; Roberts and Elliott, 2017). Recently, offshore experiments have shown cephalopod sensitivity to noise (particle motion and sound pressure) resulting in statocyst injury with a severity which was proportional to the distance from source (Solé et al., 2017). Invertebrates (e.g. bivalves) and epibenthic life stages (e.g. eggs) that are not able to escape, may experience a higher risk of direct damage from exposure to sound and vibrations, although changes in behaviour and sensitivities are also likely to be important (Edmonds et al., 2016; Roberts and Elliott, 2017). For example, it has been shown that anthropogenic sound repressed burying behaviour in Nephrops norvegicus, with important consequences for bioirrigation and associated ecological processes (Solan et al., 2016). At present, there is not a full understanding of all the causal underwater sound parameters and their effect on marine fauna. This knowledge is needed to establish valuable mitigation measures and sound criteria.[7]

From MMO Relevant Representation

- *4.6.52 "The UWN modelling upon which the UWN mitigation plan is based has used a received noise threshold of 141 dB in relation to black seabream. The MMO does not consider this to be sufficiently precautionary and has maintained that modelling should be done based on 135 dB SELss, as per Hawkins et al., (2014), noting the threshold approach has not been agreed.*

- *4.6.53 135 dB SELss, as per Hawkins et al., (2014) is also relevant for modelling impact ranges for likely behavioural effect herring and should have been modelled in this mitigation plan. Additionally, the noise abatement options have not been modelled in the context of the Downs herring spawning ground, based on the Applicant's conclusion that "there is a low risk of any adverse effects arising even without mitigation as set out within Chapter 8: Fish and shellfish ecology". Please refer to points 4.6.38 - 4.6.39 as to why the MMO disagrees with this conclusion."*

Mitigation

- *4.6.41 "The Applicant has outlined a number of proposed environmental measures under table 8.13 in Chapter 8, which are intended to minimise significant disturbance to sensitive receptors (identified principally as black sea bream, herring and seahorse). These are outlined in Annex 2. It is noted that the Applicant has asserted that these measures will be secured either through inclusion in the DCO requirements, or through conditioning onto the DML. The MMO is*

---

[7] *Review of current knowledge on the hypothesised cause-effect relationships (hypothesised paths); a literature backbone of 233 publications (all references are publically available in a library at www.mendeley.com/community/benthic-effects-of-offshore-renewables - access date: 15.01.2019)*

supportive of the Applicant implementing targeted mitigation however, the ***MMO considers that some of these measures need further refinement, to be agreed and secured through focussed and targeted consultations in which the relevant evidence can be carefully examined, and each issue can be adequately addressed.*****"**

Please see relevant representations on the seahorse regarding habitats in the Sussex Bay. Rather than there being too few to be an issue as mentioned at the relevant Planning Inspectorate hearing, there are a number of protected seahorse habitats in the Sussex Bay.

- *4.6.51 "A series of mitigated piling scenarios have been presented using various noise abatement techniques in Figures 5.4 – 5.9. Some of these scenarios present multiple noise abatement techniques (low noise hammer technology and double bubble curtains (DBBC)) which appear to produce significant noise reductions (up to 25dB), however, the* ***MMO notes from previous advice that the likely achievable noise reduction in dB will depend on the site conditions at Rampion 2. This should be taken into account and presented within the documents*****"**

- *4.6.37 "Further to this, Figures 8.18, 8.19 and 8.21, which present UWN for sequential pin-piling, sequential mono-piling, and simultaneous pin-piling, all indicate that the likely range of impact of TTS in fish is also anticipated to overlap the herring spawning grounds. Given the proximity of the Rampion Array to the active Downs herring spawning ground, the* ***MMO has serious concerns as to the level of impact that piling within the Rampion Array will have on spawning herring unless suitable mitigation is implemented.*****"**

More noise assessment is needed including propagation and decay rates.

Herring and Black Seabream UWN Conclusions

- *4.6.36 "The MMO disagrees with the Applicant's assessment of potential impacts to herring from UWN. The MMO notes from the Underwater Noise Impact Assessment that the Applicant has calculated that* ***the range of effect of behavioural responses in herring, based on the recommended modelled threshold of 135dB (Hawkins et al., 2014) may occur as far as 67km from the source of piling****.*

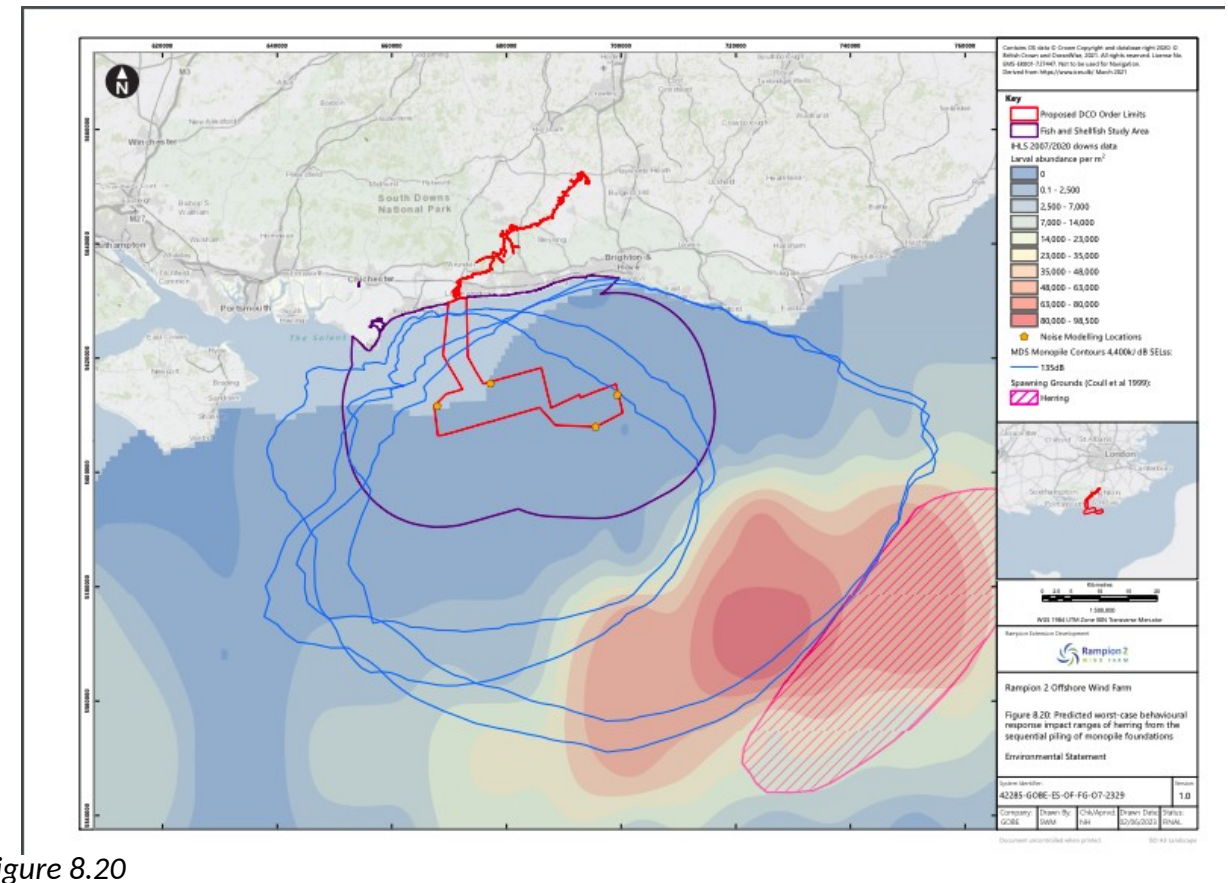

Figure 8.20
Predicted worst-case behavioural response impact ranges of herring from the sequential piling of monopile foundations. Rampion 2 Environmental Statement

Figure 8.20 presents the SELss contours for sequential mono-piling in the four modelling locations of Rampion Array, with noise contours presented based on the unweighted SELSS 135dB as per Hawkins et al. (2014). This is appropriate, and Figure 8.20 indicates significant overlap with the Downs herring spawning ground, as indicated by IHLS larval abundance data."[8]

[The modelling evidences high sound pressure levels travelling across dozens of miles with little attenuation. This is likely to cause severe disturbance.]

- *4.6.34 "The Applicant has acknowledged that the installation of foundations within the Rampion 2 Array Area has the potential to lead to significant injury and/or disturbance to fish species due to underwater noise generated during pile driving. UWN modelling is based on worst-case scenarios of a 13.5m diameter monopile installed with a maximum hammer energy of 4,400kJ, and for a 4.5m diameter pin pile installed with maximum hammer energy of up to 2,500kJ. Tables 8.20 and 8.21 outline the likely impact ranges for mono- and pin-piling at the south location, carried out as a single piling scenario and sequential piling scenario. Likely impact ranges for mortality and potential mortal injury (207 Sound Exposure Level, cumulative (SELcum)), recoverable injury (203 SELcum), and temporary threshold shift (TTS) (186 SELcum) for stationary fish receptor, as per the pile driving threshold guidelines described by Popper et al. (2014) have been presented."*

[8]*https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010117/EN010117-000477-20231106_Rampion_2_MMO_Relevant_Representation%20(002)_Redacted.pdf*

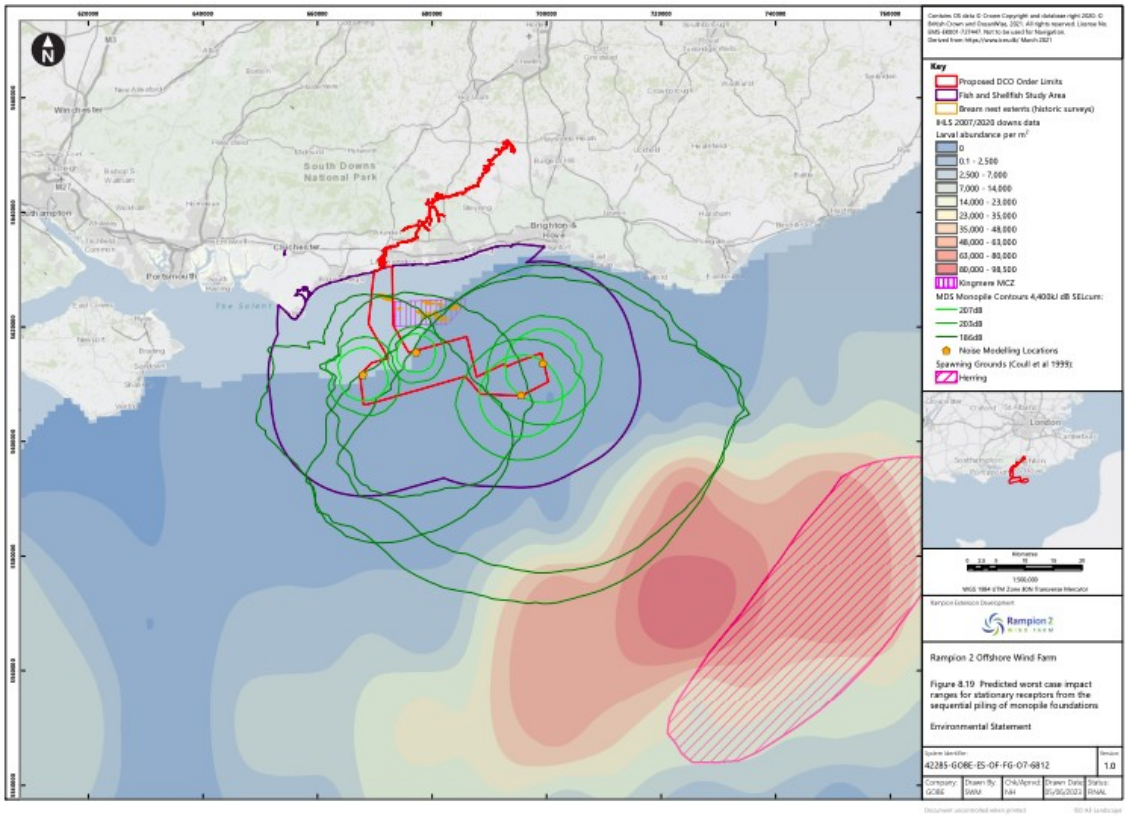

Figure 8.19
Predicted worst case impact ranges for stationary receptors from the sequential piling of monopile foundations. Rampion 2 Environmental Statement

The Sound Exposure levels cumulative or otherwise, are likely to be much higher than these.

"The installation of driven piles in the marine environment without mitigation is likely to produce noise levels capable of causing injury and disturbance to marine mammals."

"Such effects, although incidental to consented activities, have the potential to conflict with the legislative provisions of The Conservation of Habitats and Species Regulations 2010 (the 'Habitats Regulations', HR), which applies to English and Welsh waters <u>inside 12 nautical miles</u> (nm), and the Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (the 'Offshore Marine Regulations', OMR, as amended 2009 and 2010), which apply on the United Kingdom Continental Shelf." [9]

The Conservation of Offshore Marine Habitats and Species Regulations 2017

"UK Regulations make it an offence to kill, injure or disturb marine European Protected Species (EPS) in UK waters, which includes all cetaceans. Compliance with JNCC's mitigation guidelines is considered best practice and will, in most cases, reduce the risk of deliberate injury to marine mammals to negligible levels."

Although not statutory consultees on this occasion, the JNCC have responsibility with the offshore environment, after 12nm, rather than inshore waters, between 8-12nm, in which Rampion 2 'Offshore' Windfarm would be situated. However, as sea life would frequently cross

[9] *https://data.jncc.gov.uk/data/31662b6a-19ed-4918-9fab-8fbcff752046/JNCC-CNCB-Piling-protocol-August2010-Web.pdf*

between these distances, and the sound effects not contained within the 12nm limit, then the JNCC's recommendations on this subject should be referred to.

From: JNCC Offshore Industries Advice <OIA@jncc.gov.uk>
Date: On Wednesday, 21 February 2024 at 13:32
Subject: 'Contact us' JNCC Rampion 2 windfarm project
CC: Feedback <Feedback@jncc.gov.uk>, JNCC Offshore Industries Advice <OIA@jncc.gov.uk>

> Good Afternoon Carlo,
>
> Thank you for contacting JNCC regarding the Rampion 2 windfarm project
> As the Rampion 2 windfarm project is located inshore (within 12nm from shore) and therefore within the territorial limits, this falls outside of JNCC's offshore remit and Natural England would be the relevant Statutory Nature Conservation body.
>
> Kind regards,
>
> **Jon Connon**
> *Offshore Industries Advice Officer*
> *Marine Management Team*
> JNCC, Inverdee House, Baxter Street, Aberdeen, AB11 9QA

Seeing that sea creatures within the 12nm mile limit would also be affected by sound and particle wave motion effects, surely guidance should also be referred to from the JNCC as appropriate?

"JNCC has also developed marine mammal mitigation guidelines covering key activities, adherence to which is considered to minimise the risk of committing an injury offence.
When considering potential impacts to marine mammals, a key consideration is whether there might be any impacts from noisy activities, for example piling, explosive use or geophysical surveys. A noise risk assessment is undertaken, which considers how loud the noise could be, at what distance from the activity could marine mammals be injured or disturbed, what could be done to reduce the level of noise and animal exposure and whether impacts could have an effect at the population level.
Typically, noise propagation modelling is undertaken to estimate distances at which hearing damage may occur. Depending on the results, mitigation may be required to ensure no marine mammals are in the vicinity before the activity begins. Regulators review these assessments and consult with country nature conservation bodies (CNCBs) including JNCC before deciding whether to consent the project.
Consideration should also be given to supporting habitats and processes important to marine mammals including those that relate to the seabed, water column and prey, particularly in protected areas. For example, activities that directly impact the seabed, such as dredging/burial, sweeping and deposits, ***could potentially affect a preferred prey species such as sandeel, making them unavailable to marine mammals as a food source****".*

Underwater noise

Why is underwater noise a problem?

Underwater noise from human activities can affect marine species from fish to invertebrates and to marine mammals in a variety of ways, from masking sounds used to communicate and find food, to physical injury and even death.

JNCC

- *"Marine mammals use sound for a number of biologically important behaviours, including foraging, avoiding predators, breeding, socialising, parental care and travelling. Man-made underwater noise has the potential to hamper or prevent marine mammals from undertaking these key behaviours. For example:*

•*an animal could stop hunting for food;*

•*noise could prevent an animal from hearing other important sounds, such as the approach of a predator or communications from mates or their young;*

•*noise may force animals away from important areas such as key foraging grounds (i.e. cause displacement).*

•*In addition, some loud sounds may cause physical injury, such as hearing loss or tissue damage, and in some cases may cause death.*

Effects may be temporary and be of little consequence to an individual animal or conversely, they could directly impact an individual's ability to survive or breed, particularly if an animal is subjected to repeated exposures to noise. If many individuals are affected, this could result in population-level impacts (i.e. a reduction in population size)."

The Conservation of Habitats and Species Regulations 2017

"The term European Protected Species (EPS) originates from the Habitats Directive and refers to species listed in Annex IV. For these species, member states are required to implement measures to prevent their capture, killing or disturbance throughout their natural range.

Similar legislation exists for Scottish and Northern Irish inshore waters. EPS whose natural range includes UK waters consist of cetaceans (whales, dolphins and porpoises), marine turtles and Atlantic sturgeon. In UK waters, the latter two are at the limit of their natural range and only occur in low numbers around the UK. UK Regulations make it an offence to kill, injure or disturb marine EPS.

JNCC, Natural England and Natural Resources Wales (formerly the Countryside Council for Wales) provided guidance regarding the protection of cetacean EPS from injury and disturbance. This guidance provides a useful resource for marine users, regulators, advisers and enforcement authorities when considering whether an offence of deliberate disturbance or injury/killing a cetacean EPS is likely to or has occurred as a result of an activity."*

"Projects that include piling over a prolonged period could constitute disturbance under UK Regulations" (JNCC et al. 2010)

JNCC Guidelines

- *"In areas outside (but also within) the SACs, operations/projects with the potential to result in injury or disturbance can only go ahead if mitigation measures can be employed in order to reduce the risk to individual animals. To reduce the risk of hearing damage in the immediate area around the noise sources, measures such as a 'soft start', marine mammal observers enforcing mitigation zones and acoustic deterrent devices are routinely employed. It is more challenging to*

reduce the risk of disturbance at larger ranges and therefore an activity can only go ahead with a licence under the EPS regulations. Licences should only be issued when there are no satisfactory alternatives (alternative methods that would not cause disturbance) and if the activity does not have an effect on a species' FCS. All projects that could result in disturbance according to the EPS regulations will need to undertake an assessment of the impacts on the species' FCS from the project alone and in combination with others. If an impact cannot be ruled out, then the project cannot not be licensed as planned. For those licences that are issued, it is incumbent on competent authorities to monitor the effect of these on the population(s) of the species to ensure that there is no detriment to FCS from cumulative effects of the licences."

Background to the advice on noise management within harbour porpoise SACs in England, Wales and Northern Ireland JNCC Report No. 653

- *"Population consequences models such as DEPONs (Disturbance Effects on the Harbour Porpoise Population in the North Sea) and iPCoD (interim Population Consequences of Disturbance model) can be very useful in helping understand the mechanisms and magnitude of effects of disturbance and to compare different disturbance scenarios and may help, together with other available evidence, inform wider scale population level assessments. For example, work commissioned by NE and JNCC used iPCOD and estimated that the risk to the North Sea harbour porpoise population from English offshore windfarms is low, but outcomes are heavily dependent on a range of assumptions and estimated parameters with considerable associated uncertainty. The use of these models in the context of assessing effects on harbour porpoise SAC site integrity, namely when addressing the CO on avoiding significant disturbance was considered not appropriate. One issue is that the number of animals affected (even if it could be robustly determined) would need to be assessed against a "site population". However, the variability in numbers within the site at any one time varies given the wide ranging and mobile nature of the species and so there is no such thing as 'site population'. In addition, as EC Guidance*1 states: 'The expression 'integrity of the site' shows that the focus is here on the specific site. Thus, it is not allowed to destroy a site or part of it on the basis that the conservation status of the habitat types and species it hosts will anyway remain favourable within the European territory of the Member State.' In this case we are not faced with destruction of a site but with temporary habitat loss, nonetheless the principle is the same - model predictions on the potential effects on the Favourable Conservation Status (FCS) of the species in UK waters, whilst useful context under Environmental Impact Assessment (EIA)/ European Protected Species (EPS) assessments in particular, do not provide the robust evidence that would allow us to conclude no 'significant disturbance' of the species within the site. The key here is to devise an approach to assess whether the site is contributing in the 'best possible way to achieving FCS'. b) Temporary habitat loss The second approach considers that assessments, and consequently management, could be couched in terms of loss of habitat to harbour porpoise within the site. This seemed a more logical approach given that sites are designated for the "habitats of the species"; **EC Guidance on article 6.4. considers that that significant disturbance of a species in a Natura 2000 site could be: 1. Any event which contributes to the long-term decline of the population of the species on the site can be regarded as a significant disturbance 2. Any event contributing to the reduction or to the risk of reduction of the range of the species or reduction of the size of the habitat within the site can be regarded as a significant disturbance."** [10]
- *"A habitat-based approach is also part of impulsive noise management in Germany, in addition to the dual legal threshold value for impulsive noise sound level (190dB SPL/160dB SEL at 750m). To limit disturbance, the sound level thresholds were coupled with additional spatial thresholds to ensure there were enough areas unaffected by noise from pile driving available for*

[10] *https://data.jncc.gov.uk/data/2e60a9a0-4366-4971-9327-2bc409e09784/JNCC-Report-653-FINAL-WEB.pdf*

harbour porpoises. No more than ten per cent of the area of the Economic Exclusive Zone (EEZ) in the German North Sea can fall within the disturbance radiuses. Additionally, within MPAs with porpoise as qualifying feature, no more than 1% of the site is to be located within the disturbance radius during May – August (defined as breeding season)2 . 3. Effective Deterrence Range (EDR) Questions have been raised by stakeholders regarding the use of fixed Effective Deterrent radii in the guidance; this has subsequently led to amendments of the guidance to consider additional EDRs based on available scientific evidence for pin piles, conductor piling, piling using noise abatement and high-resolution geophysical surveys. These EDRs are considered the initial starting point for consideration in any environmental assessments. Case-by-case EDRs may be considered, providing there is robust peer-reviewed evidence on which to do so. Field studies looking at porpoise abundance and behaviour around these activities are needed to validate the EDRs. In German waters, a fixed distance is also advised; the disturbance range is defined as a radius of 8 km around the centre of an offshore wind farm. This distance is deemed equivalent to a sound exposure level of approximately 140 dB re 1µPa²s. The current SNCB advice for England and Northern Ireland favours the use of fixed EDRs based on empirical evidence as opposed to disturbance ranges estimated from noise modelling. The latter carries considerable uncertainty, in particular: there are no agreed quantitative thresholds for disturbance as there are for auditory injury; depending on the choice of numerical models to estimate sound source and propagation one can end up with several orders of magnitude different predictions for disturbance ranges; ***received sound levels are not the single most influencing factor in triggering disturbance; other characteristics of sound and how they propagate with distance will influence how an animal perceives the noise; behavioural context, individual animal motivation and previous exposure will also all play a role in determining response.****"*

Noise abatement techniques and alternative foundations for wind farms

- *"Techniques to abate noise at source and alternative foundations have been raised by stakeholders as a potential management measure to reduce disturbance in the sites. The SNCB approach has been criticised for not incentivising the use of noise mitigation through limits (as per German approach). However, the German sound thresholds (e.g. 160db SEL at 750m) were imposed to address the risk of injury and not disturbance. In the UK this is dealt with via a suite of mitigation measures, such as the use of marine mammal observers and acoustic deterrent devices focussed on minimising the risk of animals occurring in the potential auditory injury zone. In relation to disturbance, there has been no requirement for noise abatement since the* ***previous rounds of wind farm installation were of a considerably smaller scale than current ones*** *and there were no sites designated for harbour porpoise. With the increase in scale of current and future offshore wind installation rounds overlapping with a site designated to protect harbour porpoise habitats* **it has become likely that without alternative methods of installation not all projects can go ahead as planned** *if these are to meet the SNCBs' area-time thresholds.* ***There is therefore an incentive to implement noise abatement measures/ alternative foundations****. These should be considered alongside other options, such as scheduling of piling operations.*

- *"In 2013, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) developed a concept for the protection of harbour porpoise in the North Sea. The aim is to protect the habitats of the animals from impact noise by avoiding cumulative effects. The input of sound into the marine environment as well as the effective range can be greatly reduced by the use of technical noise abatement systems. Binding noise protection values apply to impulsive noise emissions from pile driving at a distance of 750 m from the source (binding in BSH approval notices since 2008).*

Noise protection values for ramming. The noise protection value for impact sound in BSH approval notices, which has been binding since 2008, is defined as a dual criterion. At a distance of 750 metres from the pile-driving point, the following limits may not be exceeded:
unweighted broadband single event level (SEL) von 160 dB re 1µPa2s
peak level (Lp,pk) of 190 dB re 1µPa"

[Current peak level of 13.5m diameter pile 240 dB re 1µPa]

- *"Frequency-dependent reduction of the sound emission*
Technical noise abatement systems, used individually or in combination, may reduce the sound exposure level (SEL) by more than 20 dB. The reduction in noise emission from pile driving depends on the frequency range. Reduction in higher frequency ranges (kHz range) is particularly important for the protection of harbour porpoise.
Noise reduction is achieved by using various techniques. These include the Big Bubble Curtain, the IHC Noise Mitigation Screen or the Hydro-Sound-Damper."[11]

- *"Due to the vicinity of the edge of the site to Kingmere MCZ, mitigation may still be necessary to reduce the underwater noise to 141 dB SEL within the closest proximity array area to the MCZ. Note the attenuations suggested are only intended as indicative targets to be determined with detailed future investigation based on site specific conditions and parameters. The following generic performances of mitigation options being explored are offered as a guide (although other emergent technology and suppliers may also be considered, prior to any commitment to which if any mitigation would be applied):"*
• IHC Pulse hammer (4-6 dB reduction) • MENCK MNRU hammer (9-11 dB reduction)
• Double bubble curtain (potential 15 dB reduction) • Double bubble curtain and MENCK MNRU hammer (potential 25 dB reduction)[12]

Not enough mitigation or combination of available to reduce levels to MMO recommendations. Noise modelling should also take into consideration worse case scenario, should mitigation not be efficient enough.

Application of guidance in UK waters The guidance is advice from JNCC, NE and DAERA and therefore it applies to UK offshore areas, English and Northern Irish waters (within 12nm).

- *3.1.3 "The ES concludes that No Significant effects will arise from the construction, operation and maintenance, and decommissioning of the Proposed Development, as a consequence of the embedded environmental measures provided in the Commitments Register (Document Reference 7.22). Therefore, with these measures in place a statutory nuisance will not arise as a result of the Proposed Development."*[13]

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[11] *https://www.bsh.de/EN/TOPICS/Offshore/Environmental_assessments/Underwater_sound/underwater_sound_node.html*

[12] *https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010117/EN010117-000297-6.4.8.3%20Rampion%202%20ES%20Volume%204%20Appendix%208.3%20Underwater%20noise%20study%20for%20sea%20bream%20disturbance.pdf*

Audible and masked sounds from operation across the water
The cumulative sound effect of up to 90 325m high turbines creating a sonic array system, including low frequencies and infrasound. The array of turbines will create more noise the faster they turn. The coupling effect of these will create a wide affected area of constant noise when they operate. If sited farther out, it would be of less significant effect to users of the sea and people living on the coast as the wind and effects of wave motion would absorb much of it. However, whilst absolute numbers for operating noise are not generally available, the principles of sound propagation are such that if the wind is going towards land, and the noise levels are of a high enough amplitude, then the sea will act as a great carrier wave (hard surface) and benefit that transmission. The idea is similar as to how analogue radio frequencies propagated over long distances, use a longer frequency to 'piggy back' the shorter wavelength farther. The higher frequencies above the waves will be attenuated more so than the lower frequencies, but the **infrasound carried this way broadcast over time could literally depress the well being of coastal communities, being so close to the source of that low frequency generation and even severely diminish the enjoyment of the area.**

Sound propagates very efficiently over water, it is both reflected by the sea and refracted by wind shear (wind speed increases with height above sea level). The sound waves would benefit from the masking and carrier wave effect of the sea and tides to send constant low frequency signals across the water towards our communities and visitors, adding to even more Net Loss.
Please consider the affected communities above and below the waterline including potential effects on divers as the infrasound continues underwater.

The Damage Noise at certain frequencies and amplitutes can cause to a diver in the water

Loud noise (above 55 dB) can cause non life threatening issues such as:
- loss of focus
- diminished cognitive abilities
- increased stress levels

Loud noise (above 85 dB) can cause:
- tinnitus
- hearing damage
- hearing loss
- increased blood pressure levels
- cardiovascular issues

Loud noise (above 150 dB) can cause:
- eardrum rupture
- pulmonary contusions
- embolisms
- Infrasound or low frequency noise (below 20 hertz) can cause
- blurred vision
- erratic breathing
- joint issues
- nausea
- visual impairment

[13] *https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010117/EN010117-000133-5.3%20Rampion%202%20Statutory%20Nuisance%20Statement.pdf*

- inner organ damage
- 7 hertz infrasound (the frequency of the brain and the internal organs) can affect the human central nervous system and cause
- general confusion
- anxiety and panic
- bowel spasms
- nausea and vomiting
- organ rupture
- death (in cases of prolonged exposure)
- Sounds that could kill you on the spot
- sounds above 185 dB
- infrasound especially at 7 Hz

When the volcano on Krakatoa erupted in 1883, the energy created was registered by a survey vessel 40km away from source. The noise level, recorded at 185 dB, burst the eardrums of half the crew onboard the vessel.

The potential negative effects from noise are so severe and varied it might be perceived as an experiment in human behaviour through subduing a stretch of the coastal community by the constant emissions of negatively charged high pressure sound generation for the life of the proposed project.

The opinion is that the noise levels have been underplayed as current levels experienced at similar size sites are recording much higher levels, 240 decibels ½ mile away from the source. This would mean that excessive sound pressure levels would radiate omnidirectionally across the whole of the Sussex Bay, everywhere, with minimum dissipation, in a matter of seconds.

The ES references do not take into account that the 325mtr supported monopile is much larger than previously used, and the mitigation measures such as use of 'double bubble' screens, reduce some of the compression, maybe by about 20db (when they work).

Gaps in data / more evidence needed
Excessively high spl levels according to current data especially considering how close and big they are.

No underwater sound maps outlining piling propagation data over distance including decay rates
No cumulative mapping of turbines with sound frequencies generated and propagation levels during operation and how these can affect certain aquatic life, not just the protected ones.

Modelling on:
- sound propagation over water as an array, frequencies and amplitudes generated and its potential effect on shore (human) receptors.
- infrasonic issues with fish and inaudible frequencies potentially affecting divers long term.
- ultrasonic issues especially with mammals such as bats.

National Library of Medicine publishing Airborne sound propagation over sea during offshore wind farm piling

- Abstract -
“Offshore piling for wind farm construction has attracted a lot of attention in recent years due to the extremely high noise emission levels associated with such operations. While underwater noise levels were shown to be harmful for the marine biology, the propagation of airborne piling noise over sea has not been studied in detail before. In this study, detailed numerical calculations have been performed with the Green's Function Parabolic Equation (GFPE) method to estimate noise levels up to a distance of 10 km. Measured noise emission levels during piling of pinpiles for a jacket-foundation wind turbine were assessed and used together with combinations of the sea surface state and idealized vertical sound speed profiles (downwind sound propagation). Effective impedances were found and used to represent non-flat sea surfaces at low-wind sea states 2, 3, and 4. Calculations show that scattering by a rough sea surface, which decreases sound pressure levels, exceeds refractive effects, which increase sound pressure levels under downwind conditions. **This suggests that the presence of wind, even when blowing downwind to potential receivers, is beneficial to increase the attenuation of piling sound over the sea. A fully flat sea surface therefore represents a worst-case scenario.”**[14]

Turbines would need to be sited much further from the shore (or somewhere with greater wind density, a connection to the National Grid without going through a National park) to have less of an impact, namely respecting the OESEA guidelines and a minimum distance to be 20-25 miles offshore, not inshore. Most of our aquatic environment lives inshore in reefs etc.

Local environmentalists and divers have revealed seahorse habitats all along the Sussex coast, from near Beachy Head, to Brighton and also Littlehampton harbour.

Proposed piling mitigation such as a ‘soft start’ doesn’t remove all creatures from affected areas. They will not be able to get away in time or find safe refuge from the sonic blasting. We have reports of the compression generated underwater during the construction of Rampion 1, which ensured the relevant divers had to leave their own survey areas many miles away from the noise source quickly due to the intense pressure created during piling.

If Rampion 2 gets permission, we expect to lose a lot of our aquatic diversity through destructive construction measures. There is no proposal for any Net Gain for the environment or biodiversity.

We would like to see the ExA:
Require the applicant to present another, more detailed risk assessment and addendum to the ES adding current noise level data for construction and operation and provide specific mitigation measures rather than ambiguity and reassurances.

(1) specify, completely assess and monitor future safe operating noise levels and to ensure strict adherence to levels such as stated in the Marine Management Organisation’s recommendations, namely a maximum of 135dB(A) re 1 µPa (inc mitigation) during construction.
For the applicant to evidence capacity to achieve MMO levels.
Reference EN010117-000477-20231106_Rampion_2_MMO_Relevant_Representation (002)_Redacted. Section 4. Page 44.

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[14]National Library of Medicine publishing
Airborne sound propagation over sea during offshore wind farm piling, T Van Renterghem, D Botteldooren, L Dekoninck, PMID: 25234870 DOI: 10.1121/1.4861244 Accessed 21/02/24

(2) not take the applicants claims regarding max decibel numbers as offered in the Environmental Statement, (taken from a much smaller piling conducted in 2007), but consider them against current real world data for size turbine/monopile.
Have the applicant evidence reliable mitigation measures to ensure safe levels are achievable prior to the granting of any permissions. Consider higher levels than MMO guidelines to be unsafe for divers.
The sonic blast for a 13.5m monopile (240 dB(A) re 1 µPa will cause unprecedented noise levels over the water and under it and due to a greater extended noise period be potentially much more dangerous to all forms of life. Excessive noise levels would mean that it would not really be safe for divers until after piling has ceased. By way of mitigating construction noise 'most divers wear a hood' (recommended by the applicant's representative on this subject at the Planning Inspectorate hearing). A hood won't be much use if your ears burst. High levels of sound can carry for miles.
From a noise pollution perspective an improved solution might be to look at floating technology, so close inshore is this proposal with such a potential to cause severe disturbance.
A pile of 13.5m pile and method of siting could cause much damage to the underwater life and environment and would be a huge detriment to our biodiversity during construction.

(3) there should be a project cut off point if noise levels are deemed to be too high to allow construction of this nature so close inshore and so near to sensitive marine receptors, protected species and conservation areas. To refuse consent if suitable methods of mitigation cannot be obtained. Consider the figure of 135dB(A) re 20 µPa as the threshold of pain in humans. Evidence shows excessive levels and/or certain frequencies can affect life detrimentally in many ways, in the sea this noise effect can easily carry for tens of miles.

(4) Concern that noise levels purported during construction/piling are heavily underplayed. Measured noise levels (with mitigation) now coming out of other similar size offshore wind farm construction is at levels reaching up to 240dB(A) re 1 µPa during piling.
To model more accurate data on noise levels above and below the waterline, propagation (extrapolation including baseline of 240dB(A) re 1 µPa pile strike), individual turbine and cumulative array (frequency and amplitude) modelling to include wave and wind shear with relation to on shore noise receptors.

(5) OWF of this size should ideally be sited much farther out, more than 25 miles from land and ideally the same minimum safe distance away from any Marine Conservation Zones and protected spawning grounds.
An alternative could be Dogger Bank, farther out and of greater wind density than the Sussex Bay, (as agreed by the applicant's representative in the relevant Hearing).

(6) This Application does not meet basic standards for sustainability – ecological, social, and economic

-socially it is not beneficial nor any form of net gain to use an already economically depressed community to become host of an industrial power plant
-the mental health degradation of an obstructed horizon of electrical turbines creating a high decibel, low frequency sonic array. The permanent reminder of their presence through red flashing light disturbance at night.
-**degradation of the local area, historic environment, the views from the South Downs National Park**

(7) Concern for aquatic life and health during construction. Most aquatic life would be affected, displaced, some will not relocate, many are habitat based. It is a myth that any aquatic life can just leave the affected area, larger mammals of course but not for example the seahorse, which are living at various places along the Sussex Bay. The areas affected by construction noise can run into many miles in size.

Taken from Natural England and JNCC advice on key sensitivities of habitats and Marine Protected Areas in English Waters to offshore wind farm cabling within Proposed Round 4 leasing areas September 2019

- "Kingmere MCZ. This MCZ is designated for Black bream (Spondyliosoma cantharus), infralittoral rock and thin mixed sediment, and subtidal chalk. All features have a recover conservation objective. Cabling impacts to this MCZ should be avoided on the basis of impacts to nesting black bream and their breeding habitat which is rock covered in a thin layer of sediment. Impacts to the rock habitat are not able to recover morphologically. The breeding season is currently understood to be April 1st to June/July; during which time there is high sensitivity to smothering and siltation rate changes. Consideration should also be given to avoiding noise impacts out with the MCZ during nesting periods for black bream. It is considered that there is little space in the MCZ to micro-route around these sensitive habitats given existing aggregates licence areas within the sites and the need to also avoid impacts on sensitive chalk habitat."

Rampion 2 ES Marine Archaeology Chapter 16

- *Paragraph 5.9.25 "When considering the impact of a proposed development on the significance of a designated heritage asset, the Secretary of State should give great weight to the asset's conservation. The more important the asset, the greater the weight should be. This is irrespective of whether any potential harm amounts to substantial harm, total loss, or less than substantial harm to its significance."*

The Sussex Bay is a nationally significant heritage asset and its natural conservation should be of the highest importance.

Rampion 2 statutory nuisance statement

- 3.1 *"Noise and vibration 3.1.1 The potential impacts and mitigation for this nuisance have been informed by the noise and vibration impact assessment which is presented in Chapter 21: Noise and vibration, Volume 2 of the ES (Document Reference 6.2.21). 3.1.2 The ES considers the impacts that could lead to potential Significant noise effects arising from: - noise emissions from the construction and operation of temporary construction compounds; - noise emissions from construction of landfall Transition Joint Bay and trenchless crossings; - noise emissions from onshore substation and the existing National Grid Bolney substation extension during construction and operation; and - noise emissions from trenched onshore cable routing. 3.1.3 The ES concludes that No Significant effects will arise from the construction, operation and maintenance, and decommissioning of the Proposed Development, as a consequence of the embedded environmental measures provided in the Commitments Register (Document Reference 7.22). Therefore, with these measures in place a statutory nuisance will not arise as a result of the Proposed"*

Understanding greater impacts from noise, would the levels from all phases of operation be interpreted as a statutory nuisance?

The lack of due diligence on behalf of the applicant regarding sound and its pollutive potential could yield disastrous results, such as extinction of endangered species, loss of fisheries, ecological collapse, and the loss of the coastal culture that sustains this region.

The area at risk is extremely important by way of archaeological diversity, nationally significant receptors have been identified and are at risk from cabling, trenching, boulder relocation etc.

In respect to the Rule 6 Letter Advice by the ExA to us as Interested Parties,

- "*in making a decision, the relevant Secretary of State "must decide the application in accordance with any relevant NPS" (s104(3)), subject to certain provisos. Essentially, the provisos are that the application must not breach legal or treaty obligations, and that any adverse impact of the Proposed Development would not outweigh its benefits."*

The European Convention on Landscapes to which the UK is a signatory is important and relevant to the first point the ExA makes.
The ECL emphasizes the protection, management, and planning of landscapes. It specifically recognizes the values and importance of landscapes for cultural, ecological, and recreational purposes.
This ECL relates to the Examination consideration of both the offshore and onshore elements of Rampion 2.
It overlaps many preliminary principal issues identified for this Examination - and is highly relevant to ecological and environment matters discussed today.
We see that as important in the Rampion 2 case-specific Examination also, where relevant UK policy and law essentially **reinforces and interprets the ECL** , namely:

- the Marine Policy Statement (2021);
- The new Levelling up and Regeneration Act (2023), under the strengthened Landscape provisions for protection of national parks; Littlehampton is a deprived community, it relies on tourism for its businesses as a seaside resort town. This construction would likely negatively impact tourism. This projected outcome does not pass the metrics for Sustainable Development)
- Of course the Offshore Energy SEA (OESEA) strategic environment advice effectively interpreting and applying the ECL, as can be seen in OESEA-4 (2022);
- These of course converge on the objectives of sustainable development, where there is a presumption for sustainable development in the UK planning system (not just development) defined as achieving net positive gains across the 3 objectives: environment, social and economic

The Marine Policy Statement, the Regeneration and Levelling up Fund and the OESEA-4 all reenforce and interpret the ECL

Thank you for your time and consideration in this vitally important matter