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STRATEGIC INFRASTRUCTURE DEVELOPMENT

APPLICATION TO

AN BORD PLEANÁLA

(REG NO. PL61.PA.0033)

ORAL HEARING

GALWAY HARBOUR EXTENSION

NOISE & VIBRATION

January 2015

EUGENE McKEOWN

RPS GROUP

QUALIFICATIONS AND EXPERIENCE

1.1. My name is Eugene McKeown. I hold a degree (B.E.) in mechanical engineering from University College Dublin, a degree in Law (LLB) from the National University of Ireland, Galway as well as a Master of Science Degree (M.Sc.), from the University of Derby. I hold Certificates in Industrial Emissions and Air Quality Monitoring and Industrial Ventilation.

1.2. I am a Senior Consultant with RPS Group PLC. I have over thirty years engineering experience including noise and vibration. In relation to airborne noise I have completed Continuing Professional Development (CPD) Training on noise and vibration including; Road Traffic Noise, Wind Farm Noise, The EU Physical Agents (Noise) Directive, Hand-Arm Vibration Risk assessment and Management and Environmental Noise Propagation. With respect to underwater noise, I am a qualified Marine Mammal Observer and have completed CPD Training including; Impact of Seismic Acquisition on Marine Life, Environmental Monitoring in Wave and Tidal Test Sites, Detection Classification & Localisation Workshop and Density Estimation of Marine Mammals using passive acoustics, Measurement of Underwater Noise & Monitoring Marine Mammals, Underwater Noise Measurement, Impact Mitigation and Measurement of Underwater Radiated Noise.

1.3. I have been involved in over 200 Environmental Noise Impact Studies, including marine infrastructure, transport, waste management and power supply infrastructure. I have acted for the applicants, the local community and as advisors to the planning authorities on different cases.

1.4. I have experience in impact assessment and monitoring in relation to large construction projects for over 30 years and marine projects, including underwater noise, for 10 years.

ROLE IN THE PROJECT

2.1. My role in the drafting of the Environmental Impact Statement involved preparation of Chapter 10 Noise & Vibration, while employed by Biospheric Engineering Ltd. In preparing the environmental statement I considered the proposed development and its general vicinity. The relevant information has been published with the EIS as Chapter 10 with Appendices 10.1, 10.2 and 10.3 and provides the detail supporting the summary I am presenting today.

PRESENTATION TO THIS HEARING

3.1. In the interests of brevity I do not propose to repeat in detail any material already included in the EIS or in other material already submitted in evidence to this Oral Hearing but will summarise it as follows:

3.2. The project comprises the construction of an extension to Galway Harbour to facilitate the operation of the port on a round the clock basis rather than the current tidal mode of operation. There are noise related impacts during the construction and operational phases of the proposed development and both have been addressed in the EIS.

3.3. The nature of this project is such that construction will be carried out over approximately 8 years. The intensity of operations at any one time will be limited to specific activities such as lagoon construction, dredging, dewatering and consolidation, etc. The noise emissions associated with any particular phase are therefore specific to that phase of construction.

3.4. The operational phase will be ongoing. The EIS considers noise and vibration during construction and operation phases of the project. Noise emissions considered in the EIS include both airborne and underwater noise.

NOISE

4.1. There are three sections in Chapter 10 of the EIS

1. Airborne Noise
2. Underwater Noise
3. Vibration

4.2. The sections dealing with airborne and underwater noise both refer to noise levels in decibels. For historical and scientific reasons the reference pressure chosen for airborne noise is not the same as that chosen for underwater noise. There is also a considerable difference in the acoustic impedance of air and water. This means that there is no DIRECT relationship between decibels in air and decibels in water.

AIRBORNE NOISE

Acceptable Noise Levels

4.3. Noise may have various effects on human beings exposed to it ranging from discomfort and annoyance to various psychological and pathological conditions. The degree to which it affects people depends on its nature and intensity, its duration, the frequency and time of its occurrence, the activity being undertaken by different individuals at the time of exposure, and their degree of sensitivity.

4.4. The levels of noise attributable to the proposed development are such that significant health effects outside the site boundary (such as occupational deafness, etc.) can be ruled out. Noise levels which may interfere with sleep, communications and mental stress are examined in the EIS.

4.5. The "acceptable" level of noise arising from industrial activity in Ireland is determined by the Environmental Protection Agency. Their guidance for licenced activities is based on World Health Organisation standards and best international practice. The levels adopted by the Environmental Protection Agency have been used by the Department of Environment, Heritage and Local Government to set levels for all significant developments in Ireland.

4.6. In summary the Environmental Protection Agency limits for industrial activity are as follows:

Daytime	55 dBA re 20 μPa
Night time	45 dBA re 20 μPa

4.7. These levels are recognised as striking a reasonable balance between competing land uses such as industrial activity and residential amenity.

Construction Noise

4.8. Construction noise is a special case because of the temporary nature of its activities. A certain amount of noise is inherent in all types of construction and it can never be completely eliminated. Many items of plant and equipment can be effectively silenced but there are also many other items of equipment that are not so easily silenced, e.g. pile driving equipment.

4.9. The problems of site noise control can often be complex and there are a number of practical implications, including extending the duration of the works, if unduly restrictive noise conditions are imposed. Practical noise reduction measures such as those outlined in British Standard 5228 Code of practice for Noise Control on Construction and Open Sites, can be implemented. The hours of work for noisy activities can be limited to avoid interference with residential amenity.

4.10. The only published construction noise limits by a government agency in Ireland are those adopted by the National Roads Authority (NRA) for the construction of road schemes. These guidelines set maximum noise levels for different times of day. These guidelines have been adopted for this project and are outlined in Table 10.2.1 of the EIS.

Traffic Noise

4.11. Traffic noise levels are governed under the Environmental Noise Directive. The criteria used by the NRA are the L_{den} criteria with a design goal of 60 dBA re 20 μPa. The 60 dBA L_{den} criteria have been adopted for this project in section 10.2.2.4 of the EIS.

Railway Noise

4.12. Railway noise is also governed under the Environmental Noise Directive. The threshold set under the Directive is relatively high (60,000 trains per year) so the Directive is not primarily applicable. There is also a Commission Decision of 23 December 2005 relating to rolling stock noise with specific limits for pass-by noise and standing noise from locomotives and rolling stock. The limits for pass-by noise apply at 80 km/hr, which is not applicable to the proposed development in section 10.2.2.5 of the EIS.

4.13. The issue of noise from rail freight is a complex one and subject to an ongoing action programme at EU level. Due to the huge volume of static and rolling infrastructure that has to be modified, allied to the fact that rail investment has a long life means that definitive

limits for rail freight yards have not yet been determined. The L_{den} criterion, while not directly applicable, is in compliance with the intention of the Directive and has been used in the EIS.

Existing Background Noise levels

4.14. Regular noise monitoring is carried out by Galway Harbour Company as part of the companies environmental management programme. This monitoring is currently carried out at 2 locations on a six monthly basis. In addition to this data monitoring was carried out at 3 other locations as part of the baseline monitoring for this study. Background noise monitoring results are set out in section 10.3.1 of the EIS.

4.15. Noise in the existing Docks area is dominated by traffic noise during the day and early evening. At night however traffic levels die down and port related activity, such as ship movements or tanker unloading, can dominate the noise climate for short periods. Due to the tidal nature of the existing Docks operation ships carrying oil are unloaded on a 24 hour basis in order to minimise the turnaround time in port. This results in the noise from shipping activity becoming more evident at night when traffic related noise dies down.

4.16. The loading/unloading of scrap metal results in noise levels in the order of 70 to 75 dBA with noise peaks in excess of 90 dBA as outlined in section 10.2.3.2 of the EIS. This activity is restricted to daytime hours.

4.17. The night time background noise level at Mellows Park is in the order of 40 dBA and 35 dBA at Grattan Road as outlined in section 10.3.1 of the EIS. These two locations are the critical night time noise sensitive locations.

Airborne Noise Prediction Model

4.18. Details of the noise prediction model used to prepare the EIS are set out in section 10.4.2 of the document. Models were prepared for different times of day and calculated to predict the sound pressure levels at the receiver points. Due to the complex modelling algorithms employed in the different standards for construction, industrial and transportation noise it is best practice to model each transport mode separately.

Construction Phase Airborne Noise

4.19. Construction phase noise is addressed in section 10.4.2 of the EIS under the following headings:

Lagoon Construction – Section 10.4.2.1

4.20. The principal activity during this phase will be the transport and placement of material on site, in particular rock armour and consolidating and levelling the material in the lagoons. The principal noise sources during this phase will be dumper trucks, loaders and bulldozers. From our database of construction equipment and reference to B.S. 5228 Noise and Vibration Control on Construction and open sites, a noise prediction model has been prepared. The result of this model can be seen in figure 10.4.1.

4.21. The model shows the noise level for a typical scenario will be in the order of 45 dBA at the site perimeter. At various stages of construction some noisy equipment will need to operate at the site boundary. In these instances noise levels at the site boundary could reach 70 dBA. The received noise level at any of the noise sensitive locations will be below daytime background levels so the potential impact will be negligible.

Trailer Suction Hopper Dredging (TSHD) – section 10.4.2.3

4.22. The mechanics of operation of this equipment are described in Chapter 3. The operation of this type of dredger is the first stage of dredging, where soft, silty material in the upper layers to be dredged is suctioned into a vessel and discharged via a pipeline into one of the lagoons. The nature of the vessel is such that the noise levels are similar to a tanker (fuel or bitumen) discharging cargo. The main engine is required to drive the vessel and additional noise sources are related to pumping the material into the lagoon.

4.23. The noise prediction model for the TSHD dredging stage of construction is presented in Figure 10.4.2 TSHD Dredging Noise Model. The noise sensitive locations are Mellows Park during the day and Frenchville at night. The operation of the TSHD close to shore at night will result in a Minor impact.

Backhoe Dredging – section 10.4.2.4

4.24. Backhoe dredging probably involves a smaller dredging vessel, but requires the support of barges, which are themselves significant noise sources. The operation of the backhoe dredger also involves the excavation of consolidated material or in some cases rock. The dredged material has also to be double handled, i.e. loaded into and out of the barges. This inevitably will result in considerably more noise than the TSHD process.

4.25. The requirement for backhoe dredging will be further offshore than the areas requiring TSHD. This will result in a greater separation between source and receiver for the vast majority of the work. The noise prediction model for the Backhoe dredging stage of construction is presented in Figure 10.4.3 Dredging Noise Model.

4.26. Noise levels in the order of 50 dB are predicted at noise sensitive locations. This does not present any difficulty during the day. Noise levels of this order have the potential to cause disturbance at night so the potential impact is classed as moderate.

Quay Wall Construction including Pile-Driving – section 10.4.2.5

4.27. This phase will comprise the construction of the berthing facility and also some of the breakwater and lagoon containment structures. The pile driving activity will require, in a worst case scenario, impact pile driving of circular piles and impact driving of sheet piling. Pile driving is by its nature a very annoying noise source. Details of the worst case pile driving noise are set out in Figure 10.4.4.

Road Traffic Noise – section 10.4.3

4.28. The traffic noise models are based on traffic predictions produced in Chapter 13 of the EIS. Due to the nature of road traffic noise small changes in road traffic levels do not result in significant changes in road traffic noise levels. In fact it requires a doubling of traffic volumes to cause a 3dB increase in road traffic noise levels.

4.29. The scale of the impact of road traffic noise emanating from the development in 2016 is examined in section 10.4.3 of the EIS and is considered negligible.

Operation Phase Noise

4.30. Operational Phase Traffic was modelled for 2031. As can be seen from Table 10.4.4, the difference between the 2031 road traffic noise prediction with and without development is in the order of 1 dB which is within the margin of error for the prediction model. The scale of the impact of road traffic noise emanating from the development in 2031 is therefore considered negligible.

Rail Traffic Noise

4.31. Rail traffic noise including the handling of freight is modelled using the RMR 2006 method as outlined in section 10.4.4. The rail traffic comprises a siding which has a complex geometry due to a turn at high level off the main line and an incline to link the port level with the mainline level.

4.32. Due to the volume of rail traffic associated with the development there are unlikely to be in excess of any statutory limits on noise levels from the operation. A model was prepared using the standard RMR algorithm with a 1.5m high noise barrier located on the eastern side of the track from where it separates from the mainline to where it joins the new port development at grade, i.e. for the full incline. The noise model is presented in Figures 10.4.11 and an examination of noise levels at Mellows Park indicates a significant environmental benefit in installing the barrier.

Shipping Noise

4.33. The operational phase of the development will see the relocation of the shipping activity from the existing docks area to the new port area. This will significantly increase the separation between noise sources and receivers and will have major positive impacts.

4.34. Shipping noise levels under the Do-nothing and With-development are outlined in Table 10.4.5. As can be seen from the table there is a significant reduction in noise levels in the existing docks area. This will result in a major positive impact for this area.

4.35. With regard to Mellows Park, the model predicts a worst case noise level increase from shipping to a level of 40 dBA. The existing background noise level at Mellows Park (as outlined in section 10.2.3.1 is 45 dBA during the day and 40 dBA at night. This means that the worst case noise level will be lower than background during the day and equal to background levels at night. At night in a bedroom with an open window the worst case

prediction is for a noise level of 30 dBA which is within the WHO guideline for no disturbance. In any other case, i.e. 2 ships unloading in port simultaneously the impact will be 3 dB less. The impact is classed as negligible at Mellows Park for this reason.

4.36. At Frenchville the background noise levels are 52 dBA by day and 35 dBA at night. There is a negligible impact during the day and as with Mellows Park the impact at night is classed as negligible.

Potential impact of Airborne Noise on Fauna – section 10.4.6

4.37. Airborne noise was modelled extensively in the Environmental Impact Statement. The most intense noise will arise due to impact pile driving and the airborne noise contours arising from this are shown in the figure below. Noise levels at the nesting sites on Mutton and Hare Island are in the order of 55 dBA. This represents a worst case noise level but will not arise during the nesting or pupping season as pile driving will not be carried out during the period April-July inclusive. A noise level of 55 dBA is extremely unlikely to generate a startle response at any sensitive location as traffic noise, passing boats or overhead flights by aircraft regularly generate this level of noise without adverse effect.

Seals & Otters

4.38. The airborne noise disturbance thresholds for Seals and Otters are in the order of 100 dB M weighted. The M weighting in air is almost directly equivalent to the 'B' weighting for human hearing. Even in a worst case scenario the M weighted noise level will rise to 85 dBA, well below the threshold for disturbance.

Nesting Birds

4.39. Terns and other ground nesting birds show great loyalty to nesting sites. The noise levels associated with this project are below the threshold for disturbance.

Airborne Noise Mitigation Measures

4.40. The approach taken to mitigation on this project is based on the best practice hierarchical approach as set out in section 10.7.

Construction Phase

4.41. The primary concerns during the construction phase are the blasting and pile driving processes. Mitigation measures will be driven by the principle of reduction at source. In this regard trial blasting will be carried out prior to the commencement of production blasting to confirm the optimum blast ratio for the process, to test the effectiveness of the proposed mitigation measures and to provide initial monitoring data for the blasting events.

4.42. Dredging works once commenced will be carried on a round the clock basis. TSHD operations will not give rise to any significant noise levels. The operation of the backhoe dredger needs to be carefully controlled to avoid operation at night close inshore. The EIS has examined the

case where the backhoe dredger is required to work close inshore. The precise location of operation will not be clear until the TSHD dredging is complete and the locations requiring backhoe dredging are clarified. The dredge management plan must be revised to take account of night time noise levels.

4.43. Pile driving noise is such that it cannot be permitted during night time hours, i.e. 11pm to 7 am.

UNDERWATER NOISE – SECTION 10.3

4.44. This section of the EIS addresses the potential underwater noise impact of the proposed development in the inner part of Galway Bay. Regarding fish salmon is a migratory species and Salmon smolts come down the river in the March/May period and go to sea for a period of one to several years. Eels are also migratory and elvers (small eels) come from the sea to begin their freshwater life around the same time. With reference to Marine Mammals, the species of concern are the Harbour Porpoise and the Harbour Seal. The Common Dolphin, the Bottlenose Dolphin and the Grey Seal are occasional visitors to the inner bay area and also need to be considered. The Otter is also considered. The greatest risk to bird life from underwater noise on this project is the risk to diving birds.

4.45. Galway Bay is a complex area to model. Due to the extremely shallow water depth, the mixture of fresh and saline water and the significant temperature variations sound speed varies significantly. The shallow depth also significantly limits transmission of low frequency sound.

4.46. A robustly tested empirical method for shallow waters was used to model sound transmission in the bay. Using known or constant sources, transmission loss was also measured across the bay. The results of these site specific propagation tests are outlined in section 10.4.7 of the EIS and are in agreement with the site specific measurements taken.

Potential Significant Impacts – Underwater Noise

4.47. In order to determine the quantum of potential impacts the following scale has been devised and is set out in section 10.5 of the EIS:

Non-recoverable Injury

4.48. Noise levels likely to cause a permanent injury to sensitive species.

Recoverable Injury

4.49. Noise Levels likely to cause a temporary but recoverable injury to sensitive species, for example Temporary Threshold Shift.

Disturbance

4.50. Noise levels likely to cause disturbance to a sensitive species. This criterion is further divided into radii of less than 100m (close to the source), less than 1 kilometre and greater than 1 kilometre. For impact assessment purposes the likelihood of disturbance is categorized as either 'high', 'Medium' or 'Low' in each of these distance bands.

Negligible

4.51. No change in noise levels impacting sensitive locations/species

Underwater Noise Source Levels

4.52. Quoted (peak) source levels for underwater noise sources are quoted in dB re µPa at 1 metre. This is a 'notional' figure extrapolated from far field measurements as it is not practicable to measure sound levels at 1m from an active source such as a ship or a pile-driver. Measurements are taken in what is known as the far field and extrapolated back to a notional 1m from the idealised point source. It is usual to take measurements at several hundred metres or kilometres and extrapolate the measured levels to what has become known as a 1m source level. This is illustrated in Figure 10.5.1 in the EIS. This source level never arises in practice and if used incorrectly can lead to significant overestimation of underwater noise levels.

CONSTRUCTION PHASE Underwater Noise

4.53. The construction method statement is outlined in Chapter 3 of the EIS. The potential noise impacts of these activities are outlined in section 10.5.2 of the EIS. The principal underwater noise generating elements of the construction phase are:

Dredging Works

4.54. As outlined previously there are two phases to the dredging process, an initial dredge using a Trailer Suction Hopper Dredger (TSHD) to remove silty material and a second phase using a backhoe dredger to remove consolidated material.

4.55. A Backhoe dredger usually comprises a barge with a large excavator mounted on it excavating from the seabed and discharging into a transport barge.

Pile Driving

4.56. There are 2 types of pile driving proposed on this project; (a) Impact pile driving and (b) vibratory pile driving. Vibratory pile driving is normally used for sheet piles which are thin overlapping sheets and is similar to rock-breaking in implementation. A hydraulic driver provides small vibratory movement to the pile in combination with a static weight which forces the pile through the ground. Traditional impact pile driving comprises the use of a drop weight or equivalent force transmitting a downward blow to the pile until target resistance is met. It is the noisiest form of piling.

4.57. Underwater noise levels arising from pile driving have been extensively studied, in particular for the installation of offshore wind turbines. While the data for offshore wind-farms is useful it must be put in context. Offshore wind farms are typically installed on 4 to 6m diameter piles in relatively deep water. The energy required to drive a pile is proportional to the square of the diameter of the pile. In this project we are proposing to use piles 900mm to 1200mm in diameter with a consequent reduction in source level. The underwater noise model is based on published source levels for 1500mm piles.

Underwater Blasting Noise - section 10.5.2.3

4.58. Much of the literature regarding underwater blasting noise relates to unconfined blasting for seismic surveys, oil and gas infrastructure demolition or military purposes.

4.59. Underwater blasting will be required at the New Harbour to remove some rock at the deep water berths and for providing a 'key' for the piles required to construct the quay walls and sections of the breakwaters. The explosives will be placed in drilled holes to fragment rock into pieces suitable for pile driving or subsequent excavation by dredge. Charges used in this manner lose most of their energy fracturing the rock and thus produce smaller pressure changes than unconfined charges.

Operation Phase Underwater Noise – section 10.5.3

4.60. Underwater noise from shipping is regarded as a significant problem at European and a global level. Noise levels in shipping lanes in particular have increased with the volume of motorized shipping traffic over the past 100 years. The impact of this increasing level of marine noise is subject to considerable research effort to both quantify the levels and reduce noise at source by design.

4.61. In relation to the proposed development it is necessary to assess operational underwater noise under a number of headings:

Large Commercial Vessels

4.62. Shipping traffic will increase in gross tonnage terms but will be carried by fewer vessels. Current vessel size is limited to about 5000T whereas the new Port will be able to handle vessels of over 20,000T. Large vessel traffic to the port (in terms of vessels) peaked in 2005 with 432 vessels entering and leaving the port, current traffic is in the order of 180 vessels per year. Under the projections in the EIS the number of vessels entering the port in the 2035 (medium scenario) will be 239. While the vessels will be larger, there will be a net reduction in the number of large vessels entering and leaving the bay and a reduction in vessels anchoring waiting for access to the port. This combined reduction will result in a decrease in overall underwater noise levels.

Fishing Boat Traffic

4.63. There are two types of fishing boat operating in Galway Bay; small inshore boats which stay within 10km of their home port and larger fishing vessels operating offshore and landing fish or coming to Galway for repairs or inspection.

4.64. The local fishing fleet is almost exclusively engaged in shrimp, lobster or crab fishing. From discussions with BIM, the fishery is at its maximum potential and it is unlikely that the local fishing fleet will expand significantly in terms of the number of vessels or fishing effort. The local fleet is spread around the bay with about 10 boats based in Galway, 3 at Bearna, 10 at Spiddal and a few operating from Maree, Ballynacourty, Kinvara and Ballyvaughan. The total fleet numbering about 30 boats.

4.65. The larger fishing boats operate from Rossaveal and Inishmore and come from other fishing ports for supplies, inspections and repairs. Currently about 60 boats of this type visit the harbour each year.

Potential Sea Plane Traffic

4.66. There is a proposal to operate a sea plane from Galway; this was the subject of a separate planning application by a third party. The operation of a seaplane from the port does not form part of this application.

4.67. Seaplane noise is generally airborne as there are no moving parts below the waterline. Underwater noise sources would comprise hull flow noise, structure-borne noise and refracted noise from the engine. Traffic levels will be low and it is not considered significant in the context of overall underwater noise levels.

Leisure Craft Traffic

4.68. The Inner Galway Bay area has 7 main access points for leisure craft; Galway Harbour with up to 50 craft, The Claddagh with 25, Bearna with 20, Spiddal with 20 most of which are sailing vessels, Rinville Bay with 80, the majority of which are sailing vessels, Kinvara with 25 and Ballyvaughan with 20. These numbers are based on counts of vessels in harbours undertaken by Biospheric Engineering Ltd. in August 2013. Aggregate numbers are therefore in the order of 150 motorised vessels and 100 sailing vessels. At a conservative estimate, there are probably those numbers again ashore which take to the bay occasionally.

4.69. Apart from the Volvo Race or similar events, the annual blessing of the boats at the Claddagh is probably the biggest boating event on Galway Bay. The opening and closing of the dock gates leads to situations where several boats come and go together. Lusseau et al. (2012) found that leisure boat deployment is in the order of 3% with a peak of 5% in the months of June, July and August, which would tie in with casual observations of leisure craft on Galway Bay. These noise levels have been considered in the underwater noise model. The model is based on increasing leisure craft with the construction of the western marina and the conversion of the inner dock, the majority of which will be sailing vessels.

Increase in Vessel size

4.70. The introduction of 24-hour access to a deep water berthing facility and providing access to larger vessels will result in a reduction in berthing times and a reduction in the number of vessels required transporting the equivalent amount of cargo. By reducing the total number of vessels and taking in larger single loads of cargo the impact of vessel noise is reduced on a temporal basis.

4.71. The size of the vessel using the port facilities is expected to increase from the current maximum of 5,000 Tonnes to a typical 20,000 Tonne vessel. This will result in a considerable increase in engine size. Modern vessels however are being constructed to stricter noise limit values and may thus be quieter than historical research would indicate. This provides a factor of safety in the calculations which follow.

Underwater Noise Modelling

4.72. As outlined above, noise propagation in shallow water is complex in particular close to the source. The use of source level data indicates a high noise level close to the source which does not actually arise. Until better models are developed, the concept of all noise sources being reduced to a single point in space requires this to happen. The noise levels predicted close to the source are therefore considerably overestimating the actual received noise levels.

4.73. Marsh and Schulkin (1962) developed a practical tool for underwater noise modelling in shallow water. Their approach allows for the absorption of the seabed and is validated with about 100,000 measurements under different conditions. The model is based on water depths of up to 200m and surface bottom interactions are seriously underestimated in very shallow (<20m) water due to (a) cut-off frequency and (b) higher grazing angles close to the source resulting in greater absorption in the sediments.

4.74. Schulkin and Mercer (1985) reviewed the model and proposed some revisions and the near field anomaly term has been adjusted for propagation over mud in the model used as the basis of the calculations in the EIS.

4.75. The model for this project takes account of each of the sources on a case by case basis with frequency dependence built into the propagation model. The received level for each receiver type is corrected as appropriate using a type specific weighting. In order to simplify the discussion the sources are considered in three groups; impulsive sounds from blasting and pile driving, continuous noise from construction activities and noise from shipping.

Noise Model Results

4.76. Noise Model Results are presented in Appendix 10.2, with the category of impact indicated on the figure for each impacted species, i.e. Piling Noise levels impacting on seals indicating the zones in which Permanent Injury, Temporary Injury and Disturbance are likely to occur.

4.77. Appendix 10.3 comprises impact radii plots illustrating the radius in which the various impacts occur for different sources.

4.78. These figures indicate that for pile driving an exclusion zone of 64m is required, a zone of up to 128m for dredging and 1 km for blasting activities in order to avoid any possibility of temporary injury to marine fauna. The limiting factor being the impact on seals in all cases.

Underwater Noise Mitigation Measures

4.79. Where possible the final design has engineered low noise and vibration solutions into the design. In the initial design stages a significant quantity of rock was to be removed by blasting and excavation. By re-designing the location and orientation of the proposed development to take maximum advantage of the sediment thickness, the quantity of rock to be excavated has been minimised.

4.80. In order to avoid any impact on migrating fish and the seal pupping season, no blasting or pile driving will take place from April until July.

4.81. Where it has not been possible to prevent impacts, steps have been taken to reduce the impact through minimisation of impact at source, abatement at source or abatement at the receptor. An example of this type of measure is the imposition of a limit on the maximum instantaneous charge in any underwater blast to minimise underwater noise and vibration impacts. A comprehensive monitoring and management programme is set out in Appendix 4.2 of the EIS - Environmental Management Framework.

Construction Phase

4.82. The primary concerns during the construction phase are the blasting and pile driving processes. Mitigation measures will be driven by the principle of reduction at source. In this regard trial blasting will be carried out prior to the commencement of production blasting to confirm the optimum blast ratio for the process, to test the effectiveness of the proposed mitigation measures and to provide initial monitoring data for the blasting events. Detailed mitigation measures are set out in section 10.7.2 of the EIS.

VIBRATION

4.83. This development has the potential to cause vibration from 2 sources; underwater blasting and construction traffic and to a lesser degree from pile driving. The impact from construction traffic is likely to be of the order of less than 2 mm/s peak particle velocity in close proximity to operating heavy construction machinery. Levels from blasting could be higher than this if uncontrolled.

VIBRATION SENSITIVE LOCATIONS

4.84. There are no residential areas close enough to the proposed development to warrant any concern regarding vibration. Due to the isolated nature of the site there is no significant issue regarding vibration from construction machinery or traffic. There are 3 areas of potential concern regarding underwater blasting vibration.

Sensitive structures on the Galway Harbour Enterprise Park

Ground nesting birds (in season)

Commercial Shellfish areas in Galway Bay

Vibration Design Criteria

4.85. Blasting can give rise to vibration, audible noise, and fly-rock. The levels of vibration caused by blasting are well below those which can cause structural damage to properties. Nonetheless, vibration transmitted through the ground can 'shake' buildings and people and may cause nuisance.

4.86. The EPA recommends that to avoid any risk of structural damage to properties in the vicinity of the blast, the vibration levels from blasting should not exceed a peak particle velocity of 12 millimetres per second as measured at a receiving location when blasting occurs at a frequency of once per week or less. In the event of more frequent blasting, the peak particle velocity should not exceed 8 mm/second.

Sensitive Structures in the Harbour Area

4.87. The Galway Harbour Enterprise Park has both bitumen and a fuel storage tank farms located in close proximity to the proposed development. Both sites are fully bunded, but because any spillage is regarded as having a major impact the sites are regarded as particularly vibration sensitive and appropriate mitigation measures will be applied.

Ground Nesting Birds

4.88. Vibration levels from underwater blasting are of very short duration and can be controlled to low levels. There will however be a short period each year where if blasting is required to be carried out some mitigation may be required.

Commercial Shell-Fishing

4.89. Commercial fishing in Galway Bay comprises fishing for prawns and commercial oyster rearing. In both cases the animal's habitat is the bottom of the water column. The separation distance between the site and the oyster farming in particular indicates that any impact will be negligible. There is the potential however for some disturbance to prawns in the area between Mutton Island and Hare Island. The disturbance due to vibration levels is however likely to be less than that resulting from changes to water flow which are dealt with in Chapter 7.

RESIDUAL IMPACTS OF AIRBORNE AND UNDERWATER NOISE

Noise Levels at the Existing Docks

4.90. Noise levels at the existing docks area will remain at current levels due to traffic and city centre noise sources. Noise levels due to shipping will reduce significantly and in particular night time shipping noise levels will in effect be eliminated.

Noise levels at Residential Areas at Renmore & Southpark

4.91. Minimal increase in noise levels which will generally mean that the New Harbour activity will be inaudible based on current noise levels at these locations. It is possible that on a very calm night, with no traffic noise the port will be audible out of doors at these locations. This impact is unlikely to occur other than on a few occasions during the year.

Underwater Noise Levels at the New Port

4.92. Underwater noise levels at the new port will result in localised minor adverse impacts but not on a biologically significant scale. Noise levels due to shipping at the new port will be limited in time and geographical extent. The operational noise levels due to shipping will not cause any level of disturbance at any sensitive sites.

4.93. In conclusion the mitigating effect of relocating the port to the New Harbour cannot be overstated. The airborne noise levels, particularly at night time, will reduce considerably in the existing docks area. The provision and use of shoreside electricity could also significantly reduce both airborne and underwater ship noise emissions in the future.

SUBMISSIONS AND RESPONSES

5.1. I now wish to deal with the issues raised in observations submitted to An Bord Pleanála by various parties in relation to the potential impact of the project. I have considered all submissions. I note in particular the submissions of the Statutory Consultees and where specific noise related issues were raised in submissions, I address these in the context of the relevant submission.

SUBMISSIONS RELATING TO NOISE FROM PORT OPERATIONS

5.2. Two submissions raise the issue of noise from port operations at night and difficulties experienced by 'other communities located beside docklands' in addition to rail noise.

Response:

5.3. There is a well publicised issue in Dublin where the noise complained of is reported to occur 10m from affected properties.

5.4. The relocation of the shipping activity to the Harbour Extension will reduce noise levels arising at any residential location in the existing port area. The current separation is of the order of 100m whereas the proposed Dock will be over 1000m from any residential property.

5.5. Should the proposal be granted permission noise levels will be subject to day time and night time noise limits. Most of the existing ports, including the existing Docks in Galway do not have any operating limits on noise.

5.6. Rail noise will be mitigated by the distance to any sensitive property and the proposed noise barrier on the embankment.

5.7. Ongoing monitoring will ensure compliance with any conditions.

SUBMISSION FROM: DEPARTMENT OF ARTS HERITAGE AND THE GAELTACHT (DAHG)

Harbour Seal and Cetaceans

5.8. *1.6.1 DAHG note that there is the potential for direct disturbance and/or injury due to sound and intensified motorized vessel/plant/construction activities and requested an analysis of potential impacts be undertaken by a suitably qualified ecologist.*

Birds

5.9. *1.6.2 DAHG note that the potential impact of underwater noise on diving birds has been considered in the EIS. The submission does not indicate any issues arising in this regard.*

Further Submission Following Further Information Response

5.10. *DAHG has requested clarification regarding the potential use of Acoustic Deterrent Devices (ADDs).*

5.11. *DAHG has requested clarification on the data supporting the assessment in the marine mammal Risk Assesment, in particular data relating to drilling, blasting and shipping noise. In particular the DAHG requested that the approach follow DAHG Guidance (2014).*

5.12. *DAHG requested that the long term impact of marine traffic noise be clarified.*

Response:

5.13. Kelp Marine Research were engaged as marine mammal ecologists on the project and prepared a Risk Assessment Report based on the underwater noise data presented in the EIS.

5.14. I note that DAHG not not consider that there was a risk to hearing damage to diving birds arising from the project. This presumably is based on the implementation of the comprehensive mitigation proposed in section 10.7 of the EIS.

5.15. Regarding the use of Acoustic Deterrent Devices (ADDs) the Edren et al (2013) paper referred to is inconclusive regarding the use of ADDs. Underwater noise levels were not measured as part of that study. Reference is made to extremely high noise levels measured on other projects using a different method of piling which is significantly louder than that used during the Edren et. al. study. The majority of the piles driven during the Edren et. al. study were either smaller diameter piles or driven using vibratory drivers. Noise levels from vibratory piling are in the order of 175-182 dB[1]. Edren et. al. state that the seal deterrent used in their study had a source level of 189 dB. It is therefore probable that the seal deterrent has an effect equal to or greater than the pile driving activity. The Edren et. al. study found a significant short-term decrease in the number of seals on land during sheet pile driving. It is possible that the seal deterrent displaced the seals from the area but the study is inconclusive on this issue also.

5.16. Schakner & Blumstein (2013)[2] conducted a review of current practice regarding the use and effectiveness of marine mammal deterrents. They describe at least four potential management concerns regarding their use: impacts on non-target wildlife, animal welfare, applicability and overall effectiveness. Describing Acoustic Deterrent Devices (ADDs) as one of the most widespread non-lethal deterrent methods implemented for marine mammal/fishery conflict. They cite the 'so called "dinner bell effect" observed when depredators learn to associate the deterrent sound with food resources'. In order to avoid the dinner bell effect, the source level of most ADDs on the market can potentially influence hearing by causing temporary threshold shifts or even risk permanent hearing damage. They recommend a cautious approach to deterrents and 'emphasise that the value of using a threatening or painful stimuli is that if effectively conditioned, it can create long-term learned avoidance that does not require using the painful stimulus in the future.' They view the use of deterrents, ultimately, as a welfare-friendly solution to human-wildlife conflict.

5.17. While Schakner & Blumstein (2013) concluded that acoustic pingers were effective for dolphin and porpoise species, the evidence indicates that seals tend to habituate to the sound if it is not sufficiently loud to cause 'fear conditioning' in the animals and thus risk hearing damage. The unintended consequence of 'fear conditioning' on this project may be to deprive species with a qualifying interest of a foraging area post-construction. For this reason it is not proposed to use ADDs unless there is a greater risk to an animal which has habituated to blasting or pile driving and is at risk of permanent hearing damage from construction noise. If such a case were to arise during the course of construction a derogation licence would be sought from the National Parks and Wildlife Service for the use of ADDs.

5.18. The Risk Assessment needs to be read in conjunction with the EIS. Section 10.5.1 of the EIS sets out in detail the various underwater noise sources. While drilling is not given a section of its own Table 10.5.1 does provide a source level for an offshore drilling rig at 185 dB. Kyhn et. al. (2014)[3] measured the source level of another offshore drillship at 184 dB. The drilling

[1] Reyff, J., (2007) Compendium of Pile Driving Sound Data, California Department of Transportation, Illingworth & Rodkin, California.

[2] 5.18. Schakner, Z., Blumstein, D., (2013), Behavioural biology of marine mammal deterrents: a review and prospectus, Biological Conservation, 167 380-389.

[3] Kyhn, L., Sveegaard, S., Tougaard, J., (2014), Underwater noise emissions from a drillship in the Arctic, (2014) Marine Pollution Bulletin, **86** 424-433.

required for this development will be significantly quieter than either of these two examples. Noise from dredging, which will take place in the same area and will be louder than drilling noise and this has been addressed in section 10.5.2.1 of the EIS.

5.19. Blasting noise is dealt with in section 10.5.2.3 of the EIS.

5.20. Appendix 10.2 of the EIS provides detailed plots of underwater noise levels arising from activities along with species specific threshold values. The threshold values are set out in Tables 10.3.1 and Table 10.3.2 of the EIS and conform with best international practice. Based on the plots in Appendix 10.2, Appendix 10.3 provides detailed maps indicating the areas underwater noise could have a potential impact. This methodology is based on the DAHG Guidance (2014). Appendices 10.2 and 10.3 formed the basis from which the ecologists prepared the risk assessment. This is stated on pages 6, 7 and 20 of the Risk Assessment. Table 1 of the Risk Assessment is based on Table 10.5.3 and Table 10.5.4 of the Environmental Impact Statement.

5.21. The potential zones of disturbance have been set out in Tables 10.5.3, 10.5.4 and 10.5.5 and Appendices 10.1 and 10.2. These have been examined by Kelp Marine Research, marine mammal ecologists.Kelp Marine Research concluded that 'Marine mammals either are unlikely to be affected at a population level (grey seal, minke whale, common dolphin, bottlenose dolphin), or are likely to recover from any impacts of the construction activities (harbour seal, harbour porpoise).

5.22. Regarding the long term impact of shipping noise, the zone of disturbance from a moving vessel is shown on the plots in Appendix 10.2. This is shown in the shipping channel on each plot. When at the dockside the noise emissons from a ship will be lower than this as the main propulsion engine will be shut down. The footprint will be smaller as a consequence.

5.23. With the introduction of shore power the noise emissions from ships in port will be lower again. There is no risk to species in the outer bay as due to low frequency noise cut-off, shipping noise does not propagate effectively out the bay.

SUBMISSION FROM: THE HEALTH SERVICE EXECUTIVE

5.24. The submission states: '***Noise and Vibration*** – *The existing noise levels, particularly when certain operations are being undertaken are excessive. The section on noise mitigation measures in Chapter 10 for airborne noise affecting the general population is not as comprehensive as it should be.*

5.25. *Additional* mitigation *measures must be put in place to limit the impact of noise from the development and future operations. It is acknowledged the difficulty that exists in accurately predicting future excessive noise. Additional monitoring at existing locations and other noise sensitive locations must be undertaken at regular intervals and when certain operations are taking place. These future noise measurements may therefore necessitate further mitigation measures being imposed in consultation with the relevant authorities'*

Response:

5.26. Noise and vibration have been fully considered in Chapter 10 of the EIS. Mitigation measures are outlined over three pages (10-70, 10-71 and 10-72) of the EIS. The proposed development will have the effect, if permitted, of relocating all the port activities a considerable distance further away from residential properties.

5.27. The residual impact on properties near the existing docks is categorised as 'Beneficial', the residual impact at Renmore and Southpark is categorised as 'Minor Adverse' due to the possibility that noise may be audible on a limited number of occasions during the year. It is anticipated that if permission is granted, noise limits will be imposed that must be complied with. The minor adverse assessment is based on audibility, which is a significantly lower threshold than any anticipated noise limits.

5.28. A noise monitoring programme will form part of the environmental management plan for the port.

SUBMISSION FROM: INLAND FISHERIES IRELAND

5.29. The submission requests: *'consideration may have to be given to the introduction of some mitigation measures such as an acoustic deterrent device at the mouth of the river.'*

Response:

5.30. This matter relates to seal predation. The use of an acoustic deterrant requires the introduction of an additional anthropogenic noise source underwater. Any additional man-made noise needs to be carefully examined and is generally not best practice. The use of such a device may have unintended consequences for other species such as the Otter. The introduction of such a device has been considered in the response to the DAHG above.

SUBMISSION FROM: GALWAY CITY COUNCIL

5.31. The submission requests:

No pile driving after 9pm
The impact of rail transport at night be further assessed

Response:

5.32. It is not proposed to carry out pile driving at night. Further restrictions on pile driving activity may cause the period over which the activity takes place to be prolonged. The actual driving of piles constitutes a much smaller proportion of the overall time and could be considered as an additional mitigation measure.

5.33. Section 10.4.4 sets out the detailed measures proposed in the EIS to control rail traffic noise. In order to ensure the impact of such noise would be minimised, the mitigation measures include the provision of a 1.5m high noise barrier on the eastern side of the proposed embankment. The proposed track curves are in line with international best practice to

minimise rail noise. These measures ensure that the proposed construction will not be the cause of noise due to design.

5.34. With regard to cumulative impacts of rail traffic at night on the route east from the city, the existing line has capacity for 3 additional trains within the existing operating envelope. An additional 2 runs can be accomodated with additional signalling. This is outlined in Table 13.3.7. Additional capacity on the rail line can be provided with limited upgrades to the line.

5.35. Should the proposed development be granted permission operational noise will be limited by noise conditions. Ongoing monitoring will ensure compliance with any conditions imposed.

CONCLUSIONS

6.1. The overall impact of the proposal will be to reduce the noise levels in the existing harbour area. There will be an increase in the intensity of the noise levels at the new harbour area due to larger vessels. The impact of these increased intensity levels is mitigated by the fact that the elevated levels will be of shorter duration as docking, entering and leaving the port will be quicker and less vessels will be required for the same throughput of cargo. The new port operational area is relocated significantly further away from major residential areas.

6.2. Operating noise levels due to the proposed development are below the level that has the potential to cause any hearing damage to fish or marine mammal species in the long term. Significant mitigation measures will be employed during the construction phase to avoid potential impacts on these species.

6.3. The proposed noise level due to larger vessels using the new port facility will be comparable with existing noise levels that currently arise at the head of Nimmo's pier in both intensity and temporal effect. It is possible that shipping noise could create an avoidance response in marine species for a short time while a vessel is berthing. The impact of this avoidance response will be further out to sea, of short duration (minutes) and of no long term significance.

6.4. With the proposed noise and vibration mitigation measures in place no significant long term noise related impact in the bay is expected.