codling wind park

Environmental Impact Assessment Report

Volume 4

Appendix 9.5 Onshore Substation Piling Modelling

Submitted to:

Ciaran Farrell
Natural Power

Tel: +353 87 406 1666

E-mail: ciaranf@naturalpower.com
Website: www.naturalpower.com

Submitted by:

Tim Mason
Subacoustech Environmental Ltd
Unit 2, Muira Industrial Estate
William Street
Southampton
SO14 5QH
United Kingdom

Tel: +44 (0)23 80 236 330

E-mail: tim.mason@subacoustech.com
Website: www.subacoustech.com

Codling Wind Park: Codling Onshore Substation piling modelling

Richard Barham

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1 Introduction

Codling Wind Park (Codling) is a proposed offshore wind farm (OWF) situated in the Irish Sea. As part of the Environmental Impact Assessment (EIA) process, Subacoustech Environmental Ltd. have undertaken detailed underwater noise modelling and analysis in relation to marine mammals and fish at the Codling site.

This report presents additional modelling of impact piling for the combi-wall construction on the banks of the River Liffey, Dublin. Although it is expected that vibro-piling will be used for these activities, impact piling has been presented here to represent a worst case with regards to noise.

Figure 1-1 below shows the location of Codling Onshore Substation as well as the representative modelling location used for this study for both scenarios.

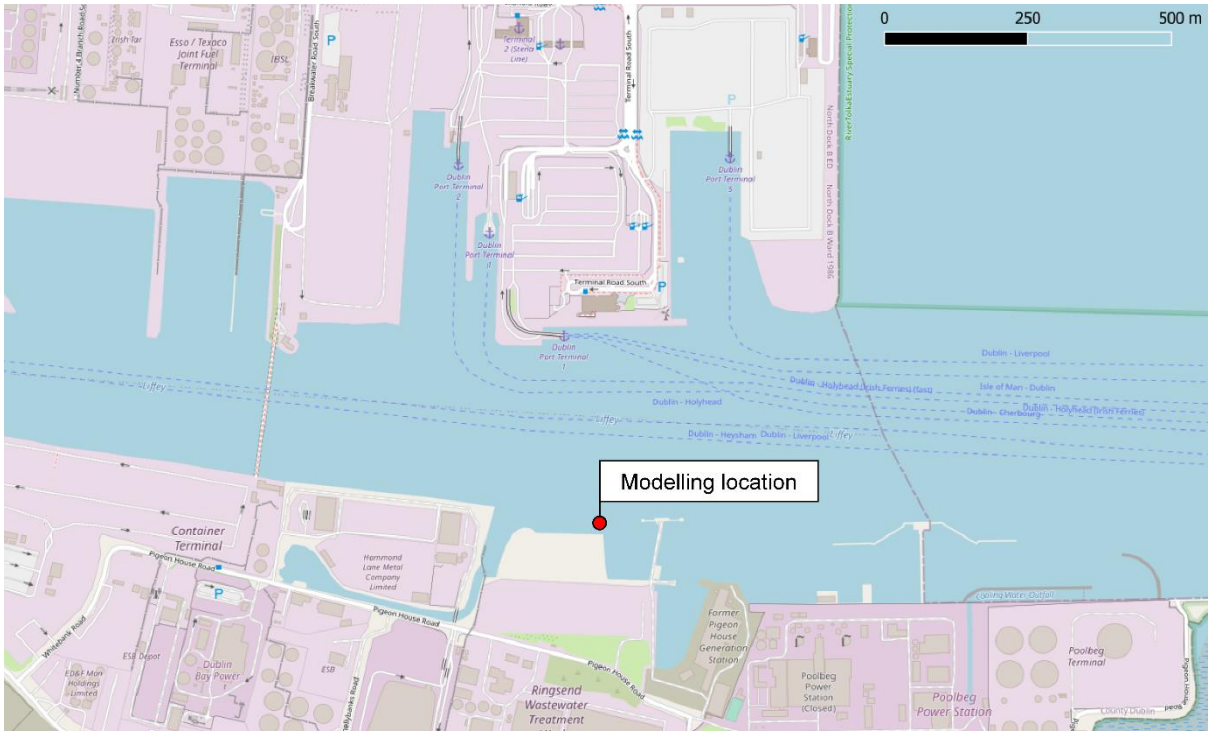

Figure 1-1 Overview map showing the Codling Onshore Sunstation area on the River Liffey and the modelling location used in this study.

This report presents an assessment of the potential underwater noise during impact piling activity during construction activities at the Codling Onshore Substation. Detailed background information on underwater noise metrics and criteria and the modelling approach are presented in Subacoustech Environmental's previous Codling report.

1.1 Modelling methodology

Impact piling noise from the combi-wall installation has been modelled using Subacoustech Environmental's INSPIRE noise modelling software at the location shown in Figure 1-1 (53.34207°N, 006.19516°W). Two modelling scenarios have been considered covering a single piling rig and two concurrently operating piling rigs:

- Combi-wall – installation of 2.5 m diameter tubular piles by impact piling. Energy through of 400 kJ assumed throughout, piling lasting 8 hours at a strike rate of 100 strikes per minute (48,000 strikes total); and
- Combi-wall (two piling rigs) – the same parameters as above, but for two concurrently operating piling rigs, resulting in double the pile strikes (96,000 total).

Unweighted source levels for modelling are given in Table 1-1.

Table 1-1 Summary of the unweighted source levels used for modelling.

Source levels	**Combi-wall** 2.5 m diameter / 400 kJ
Unweighted SPL_{peak}	230.9 dB re 1 µPa @ 1 m
Unweighted SEL_{ss}	209.4 dB re 1 μPa^2s @ 1 m

Modelling has been undertaken for the Southall *et al*. (2019), NOAA (2005) and Southall *et al*. (2007) noise criteria for marine mammals and the Popper *et al*. (2014) criteria for fish and sea turtles, as per the previous modelling undertaken by Subacoustech Environmental for Codling.

It should be noted that when two piling rigs are considered, only the SEL_{cum} criteria are affected, as the single-strike criteria will be the same for both scenarios.

2 Baseline survey

To support the underwater noise modelling, underwater noise levels at and around the modelling location in the river in Dublin Harbour were measured in March 2023, as an indicative sample baseline of the conditions prior to the construction works. This provided a first look at the underwater noise levels around the harbour prior to a comprehensive future study.

Baseline background noise levels at a static monitor located near to the position of the proposed piling averaged 133.6 dB SPL_{RMS} re 1 µPa. The baseline noise levels here were caused primarily by noise generated from activities in Dublin Port, such as berthed vessel undergoing maintenance or loading/unloading cargo, or vessels performing close quarter manoeuvres. Sporadic increases in background noise levels to a maximum of SPL_{RMS} 148.4 dB re 1 µPa were associated with large cargo ships passing by the hydrophone, which were transiting to and from the port. The measured levels throughout the survey period are shown in Figure 2-1.

Much quieter average background noise levels were recorded towards Bull Island (northeast of the work site), due to the absence of port noise and large cargo vessels here.

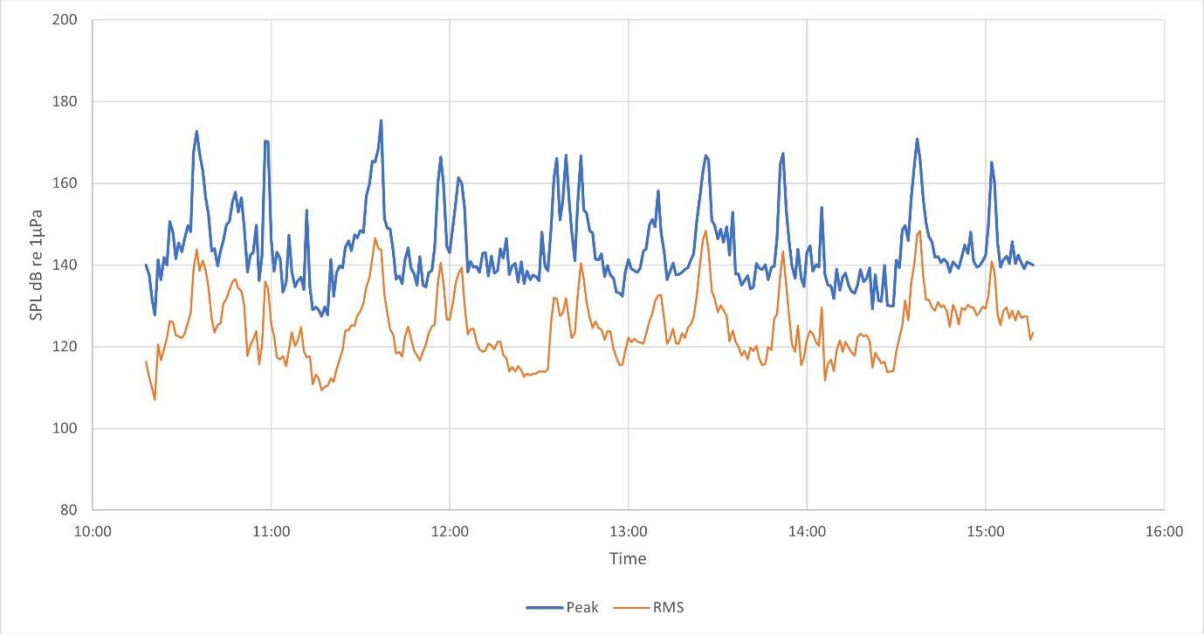

Figure 2-1 - SPL_{RMS} and SPL_{peak} recorded by the static monitor in Dublin Harbour on 23rd March 2023, 15-minute sample periods

Spot measurements around the entire survey area showed that the greatest average noise levels (SPL_{RMS} 137.2 dB re 1 µPa) were along shipping routes to the east of Dublin Port. This was mainly due to noise generated from large cargo ships, transiting to and from the Port. The quietest average noise levels (SPL_{RMS} 117.4 dB re 1 µPa) recorded were near Bull Island, as this area was furthest away from the Port out of all the sampled areas, and large cargo ships did not transit across this area.

It should be noted that this baseline survey is only intended to represent a short-term baseline. However, during the sample period the measured noise controlled by ships in the harbour will not change seasonally and thus this is expected to represent typical conditions in the Port.

Full details are available in our report ref. P348R0101 dated 5th April 2023.

3 Modelling results

This section presents the modelled impact ranges for impact piling noise for the Codling Onshore Substation covering the installation of the combi-wall.

For the results presented throughout this report, any predicted ranges smaller than 50 m and areas less than 0.01 km^2 for single strike criteria, and predicted ranges smaller than 100 m and areas less than 0.1 km^2 for cumulative criteria, have not been presented. At ranges this close to the noise source, the modelling processes are unable to model to a sufficient level of accuracy due to complex acoustic effects present near the pile. These ranges are given as "less than" this limit (e.g., "<100 m").

Also, due to the proximity to the coast of the modelling location, minimum ranges have not been presented as this minimum would be determined by the distance to the coast.

3.1 Predicted noise level at 750 m

In addition to the source levels presented in Table 1-1, it is useful to look at the predicted noise levels at a range of 750 m from the noise source as a "standardised" distance comparable to other projects or situations; in this case these levels would be up or down river from the modelling site as the width of the river at the modelling location is approximately 350 m. A summary of the modelled unweighted levels at a range of 750 m are given in Table 3-1, considering the transect with the greatest noise level while piling using the maximum energy through.

Table 3-1 Summary of the maximum predicted unweighted SPL_{peak} and SEL_{ss} noise levels at a range of 750 m from the impact piling noise sources.

Predicted level at 750 m range	**Combi-wall** 2.5 m diameter / 400 kJ
Unweighted SPL_{peak}	181.9 dB re 1 µPa
Unweighted SEL_{ss}	161.1 dB re 1 µPa^{2}s

3.2 Marine mammal criteria

Table 3-2 to Table 3-8 present the impact piling modelling results in terms of the Southall *et al*. (2019), NOAA (2005) and Southall *et al*. (2007) criteria for marine mammals. The older Southall *et al*. (2007) criteria has been included in line with the current guidance from the Department of Arts, Heritage and the Gaeltacht (2014).

The largest marine mammal impact ranges are predicted for the tubular pile installation for the combi-wall. Maximum PTS ranges are predicted for LF and VHF cetaceans with impact ranges of 2.0 km and 3.0 km respectively when considering the tubular pile installation for the combi-wall with two piling rigs. It is likely that these PTS ranges would cover the width of the River Liffey, which measures approximately 350 m at this point.

The largest ranges are predicted to the east of the modelling location into the deeper water of Dublin Bay and the Irish Sea.

3.2.1 Southall et al. (2019)

Table 3-2 Summary of the unweighted SPL_{peak} impact ranges for marine mammals using the Southall et al. (2019) impulsive criteria

Southall *et al*. (2019) Unweighted SPL_{peak} (Impulsive)		**Combi-wall**		
		Area	**Max range**	**Mean range**
PTS	LF (219 dB)	< 0.01 km²	< 50 m	< 50 m
	HF (230 dB)	< 0.01 km²	< 50 m	< 50 m
	VHF (202 dB)	0.01 km²	50 m	< 50 m
	PCW (218 dB)	< 0.01 km²	< 50 m	< 50 m
TTS	LF (213 dB)	< 0.01 km²	< 50 m	< 50 m
	HF (224 dB)	< 0.01 km²	< 50 m	< 50 m
	VHF (196 dB)	0.03 km²	120 m	100 m
	PCW (212 dB)	< 0.01 km²	< 50 m	< 50 m

Table 3-3 Summary of the weighted SEL_{cum} impact ranges for marine mammals using the Southall et al. (2019) impulsive criteria assuming a fleeing animal

Southall *et al*. (2019) Weighted SEL_{cum} (Impulsive)		**Combi-wall (single piling rig)**			**Combi-wall (two piling rigs)**		
		Area	**Max range**	**Mean range**	**Area**	**Max range**	**Mean range**
PTS	LF (183 dB)	0.7 km²	1.1 km	350 m	1.4 km²	2.0 km	470 m
	HF (185 dB)	< 0.1 km²	< 100 m	< 100 m	< 0.1 km²	< 100 m	< 100 m
	VHF (155 dB)	1.5 km²	2.0 km	490 m	2.8 km²	3.0 km	600 m
	PCW (185 dB)	< 0.1 km²	130 m	< 100 m	< 0.1 km²	300 m	140 m
TTS	LF (168 dB)	18 km²	10 km	1.1 km	37 km²	15 km	1.4 km
	HF (170 dB)	< 0.1 km²	200 m	110 m	0.1 km²	390 m	190 m
	VHF (140 dB)	28 km²	13 km	1.3 km	51 km²	18 km	1.6 km
	PCW (170 dB)	2.8 km²	3.2 km	600 m	5.3 km²	4.9 km	740 m

Table 3-4 Summary of the weighted SEL_{cum} impact ranges for marine mammals using the Southall et al. (2019) non-impulsive criteria assuming a fleeing animal.

Southall *et al*. (2019) Weighted SEL_{cum} (Non-impulsive)		**Combi-wall (single piling rig)**			**Combi-wall (two piling rigs)**		
		Area	**Max range**	**Mean range**	**Area**	**Max range**	**Mean range**
PTS	LF (199 dB)	< 0.1 km²	< 100 m	< 100 m	< 0.1 km²	< 100 m	< 100 m
	HF (198 dB)	< 0.1 km²	< 100 m	< 100 m	< 0.1 km²	< 100 m	< 100 m
	VHF (173 dB)	< 0.1 km²	< 100 m	< 100 m	< 0.1 km²	100 m	< 100 m
	PCW (201 dB)	< 0.1 km²	< 100 m	< 100 m	< 0.1 km²	< 100 m	< 100 m
TTS	LF (179 dB)	1.8 km²	2.3 km²	510 m	3.3 km²	3.6 km	640 m
	HF (178 dB)	< 0.1 km²	< 100 m	< 100 m	< 0.1 km²	< 100 m	< 100 m
	VHF (153 dB)	2.3 km²	2.6 km	570 m	4.0 km²	3.9 km	680 m
	PCW (181 dB)	0.1 km²	380 m	170 m	0.4 km²	760 m	270 m

3.2.2 NOAA (2005)

Table 3-5 Summary of the unweighted SPL_{RMS} impact ranges for marine mammals using the NOAA (2005) Level B disturbance criteria

NOAA (2005) Unweighted SPL_{RMS}		**Combi-wall**		
		Area	**Max range**	**Mean range**
Level B disturbance	160 dB	2.2 km²	2.0 km	580 m

3.2.3 Southall et al. (2007)

Table 3-6 Summary of the unweighted SPL_{peak} impact ranges for marine mammals using the Southall et al. (2007) criteria.

Southall *et al*. (2007) Unweighted SPL_{peak}		**Combi-wall**		
		Area	**Max range**	**Mean range**
Injury	230 dB (M_{lf}, M_{mf}, M_{hf})	< 0.01 km²	< 50 m	< 50 m
	218 dB (M_{pw})	< 0.01 km²	< 50 m	< 50 m
Behaviour	224 dB (M_{lf}, M_{mf}, M_{hf})	< 0.01 km²	< 50 m	< 50 m
	212 dB (M_{pw})	< 0.01 km²	< 50 m	< 50 m

Table 3-7 Summary of the M-weighted SEL_{ss} impact ranges for marine mammals using the Southall et al. (2007) single pulse criteria.

Southall *et al*. (2007) M-weighted SEL_{ss} (Single pulse)		**Combi-wall**		
		Area	**Max range**	**Mean range**
Injury	M_{lf} (198 dB)	< 0.01 km²	< 50 m	< 50 m
	M_{mf} (198 dB)	< 0.01 km²	< 50 m	< 50 m
	M_{hf} (198 dB)	< 0.01 km²	< 50 m	< 50 m
	M_{pw} (186 dB)	< 0.01 km²	< 50 m	< 50 m
Behaviour	M_{lf} (183 dB)	< 0.01 km²	< 50 m	< 50 m
	M_{mf} (183 dB)	< 0.01 km²	< 50 m	< 50 m
	M_{hf} (183 dB)	< 0.01 km²	< 50 m	< 50 m
	M_{pw} (171 dB)	0.01 km²	70 m	70 m

Table 3-8 Summary of the M-weighted SEL_{cum} impact ranges for marine mammals using the Southall et al. (2007) multiple pulse and nonpulsed criteria assuming a fleeing animal.

Southall *et al*. (2007) M-weighted SEL_{cum} (Multiple pulse/Nonpulse)		**Combi-wall (single piling rig)**			**Combi-wall (two piling rigs)**		
		Area	**Max range**	**Mean range**	**Area**	**Max range**	**Mean range**
Injury (multiple pulse)	M_{lf} (198 dB)	< 0.1 km²	< 100 m	< 100 m	< 0.1 km²	< 100 m	< 100 m
	M_{mf} (198 dB)	< 0.1 km²	< 100 m	< 100 m	< 0.1 km²	< 100 m	< 100 m
	M_{hf} (198 dB)	< 0.1 km²	< 100 m	< 100 m	< 0.1 km²	< 100 m	< 100 m
	M_{pw} (186 dB)	1.0 km²	1.6 km	420 m	2.1 km²	2.6 km	540 m
Injury (nonpulse)	M_{lf} (215 dB)	< 0.1 km²	< 100 m	< 100 m	< 0.1 km²	< 100 m	< 100 m
	M_{mf} (215 dB)	< 0.1 km²	< 100 m	< 100 m	< 0.1 km²	< 100 m	< 100 m
	M_{hf} (215 dB)	< 0.1 km²	< 100 m	< 100 m	< 0.1 km²	< 100 m	< 100 m
	M_{pw} (203 dB)	< 0.1 km²	< 100 m	< 100 m	< 0.1 km²	< 100 m	< 100 m

3.3 Fish criteria

Table 3-9 and Table 3-10 present the impact piling modelling ranges in terms of the Popper *et al*. (2014) criteria for fish and sea turtles.

The maximum recoverable injury ranges (203 dB SEL_{cum} threshold) are predicted out to 2.4 km when considering a stationary receptor for the combi-wall (tubular pile) scenario, and these ranges reduce to 100 m when a fleeing animal is assumed.

3.3.1 Popper et al. (2014)

Table 3-9 Summary of the of the unweighted SPL_{peak} impact ranges for fish using the Popper et al. (2014) pile driving criteria.

Popper *et al*. (2014) Unweighted SPL_{peak} (Pile driving)	**Combi-wall**		
	Area	**Max range**	**Mean range**
213 dB	< 0.01 km²	< 50 m	< 50 m
207 dB	< 0.01 km²	< 50 m	< 50 m

Table 3-10 Summary of the unweighted SEL_{cum} impact ranges for fish using the Popper et al. (2014) pile driving criteria assuming both a fleeing and stationary animal.

Popper *et al*. (2014) Unweighted SEL_{cum} (Pile driving)		**Combi-wall (single piling rig)**			**Combi-wall (two piling rigs)**		
		Area	**Max range**	**Mean range**	**Area**	**Max range**	**Mean range**
Fleeing (1.5 ms^{-1})	219 dB	< 0.1 km²	< 100 m	< 100 m	< 0.1 km²	< 100 m	< 100 m
	216 dB	< 0.1 km²	< 100 m	< 100 m	< 0.1 km²	< 100 m	< 100 m
	210 dB	< 0.1 km²	< 100 m	< 100 m	< 0.1 km²	< 100 m	< 100 m
	207 dB	< 0.1 km²	< 100 m	< 100 m	< 0.1 km²	< 100 m	< 100 m
	203 dB	< 0.1 km²	< 100 m	< 100 m	< 0.1 km²	100 m	< 100 m
	186 dB	1.7 km²	2.2 km	500 m	3.2 km²	3.5 km	630 m
Stationary	219 dB	0.1 km²	250 m	190 m	0.3 km²	370 m	260 m
	216 dB	0.3 km²	370 m	260 m	0.4 km²	550 m	330 m
	210 dB	0.4 km²	780 m	390 m	1.0 km²	1.1 km	450 m
	207 dB	1.0 km²	1.1 km	450 m	1.6 km²	1.6 km	520 m
	203 dB	1.8 km²	1.8 km	550 m	2.8 km²	2.4 km	630 m
	186 dB	16 km²	8.1 km	1.1 km	25 km²	11 km	1.3 km

4 Summary and conclusions

Subacoustech Environmental have undertaken a study to assess the potential underwater noise and its effects during impact piling activity at the Codling Onshore Substation, part of the proposed Codling Wind Farm offshore wind farm.

For marine mammals, maximum PTS ranges are predicted for LF and VHF cetaceans with impact ranges of 2.0 km and 3.0 km respectively when considering two concurrent installations of tubular piles for the combi-wall. It is likely that these PTS ranges would cover the width of the River Liffey at the installation location.

For fish, the maximum recoverable injury ranges (203 dB SEL_{cum} threshold) are predicted out to 2.4 km when considering a stationary receptor for the combi-wall (tubular pile) scenario, and these ranges reduce to 100 m when a fleeing animal model is assumed.

The outputs of this modelling, in conjunction with Subacoustech Environmental's previous modelling report for Codling have been used to inform analysis of the impacts of underwater noise on marine mammals and fish in their respective reports.

References

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