Vattenfall Wind Power Ltd

Thanet Extension Offshore Wind Farm

Appendix 1, Annexes A to G to Deadline 1 Submission

Relevant Examination Deadline: 1

Submitted by Vattenfall Wind Power Ltd

Date: January 2019

Revision A

Drafted By:	Vattenfall Wind Power Ltd
Approved By:	Daniel Bates
Date of Approval:	January 2019
Revision:	A

Revision A	Original Document submitted to the Examining Authority
N/A	
N/A	
N/A	

Vattenfall Wind Power Ltd

Thanet Extension Offshore Wind Farm

Appendix 1, Annex A of Deadline 1 Submission – Offshore Project Description Assessed in the Environmental Statement

Relevant Examination Deadline: 1

Submitted by Vattenfall Wind Power Ltd

Date: January 2019

Revision A

Drafted By:	GoBe Consultants Ltd
Approved By:	Daniel Bates
Date of Approval:	January 2019
Revision:	A

Revision A	Original Document submitted to the Examining Authority
N/A	
N/A	
N/A	

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Tables

1 Maximum Design Parameters

1 Volume 2, Chapter 1: Project Description (Offshore) (PINS Ref APP-042/ Application Ref 6.2.1) presented the proposed design envelope for the Thanet Extension Offshore Wind Farm (Thanet Extension). This clarification note should read in conjunction with PINS Ref APP-042/ Application Ref 6.2.1; and seeks to provide the maximum design envelope for the proposed Thanet Extension.

2 This document should be read in conjunction with the "Project Description Transcription into the Environmental Statement" clarification note, in particular for the areas highlighted in the footnotes of this document.

3 Table 1 presents the maximum design parameters presented within the chapter and have been assessed by the Applicant within the Environmental Statement (ES). Table 1 also provides any assumptions applied within the ES such as design parameters of met mast foundations.

4 For ease of reference the calculated maximum total values assessed within the ES of their constituent parameters are presented in Table 2 to Table 11.

Table 1: Maximum design parameters assessed within he Thanet Extension Environmental Statement

Project Description Chapter Ref	Parameter description	Maximum parameters
Table 1.1	Development located in the North Sea approximately	8km
Paragraph 1.3.2	Electrical output capacity	Up to 340 MW
Paragraph 1.1.1	Wind Turbine Generators (WTGs)	Up to 34 Wind Turbine Generators
Paragraph 1.1.1	Meteorological mast (met mast) fixed to the seabed	up to one Meteorological Mast
Paragraph 1.1.1	Floating Lidar Device (FLD) and wave buoys fixed to the seabed	Up to one LIDAR device and up to one wave buoy
Paragraph 1.1.1	Offshore substation fixed to the seabed	Up to one Offshore Substation
Paragraph 1.1.1	Offshore subsea export cables and fibre optic cables	Up to four offshore export cables
Table 1.1	Total site area array (km^2)	70
Table 1.1	Total OECC area (km^2)	28
Table 1.1	Maximum WTG Size	12 MW+

Project Description Chapter Ref	Parameter description	Maximum parameters
Paragraph 1.4.15	Minimum WTG spacing	716 m x 480 m[i]
Provided in Application Ref 8.14.	Disposal	The disposal of inert material of natural origin.
Maximum design envelope for WTGs		
Table 1.2	Minimum height of lowest blade tip above HAT (m)[ii]	22
Table 1.2	Maximum blade tip height above HAT (m) [iii]	250
Table 1.2	Maximum rotor blade diameter (m)	220
Indicative maximum requirements for these oils and fluids for a single WTG		
Table 1.3	Grease (l)	2000
Table 1.3	Synthetic oil/ hydraulic oil (l)	2000
Table 1.3	Nitrogen (l)	200
Table 1.3	Transformer silicone oil (kg)	2000
Table 1.3	Sulphur hexafluoride (SF6) (kg)	100
Table 1.3	Water/ glycerol (l)	2000
Maximum design envelope for WTG monopile foundations		
Table 1.4	Diameter of monopile (top) (m)	7.5
Table 1.4	Diameter of monopile (bottom) (m)	10
Table 1.4	Diameter of transition piece (top diameter at TP-tower interface) (m)	7.5
Table 1.4	Diameter of transition piece (bottom diameter at MP-TP interface) (m)	10
Table 1.4	Embedment depth (below seabed) (m)	75
Table 1.4	Drill diameter (m)	7.5
Table 1.4	Volume of drill arisings per pile (m^3)	1,325
Table 1.4	Locations requiring drilling (%)	50
Table 1.4	Locations potentially installed by driven piling (%)	100

[i] See accompanying clarification note (Annex B of Appendix 1 of the Applicant's Deadline 1 submissionAnnex B of Appendix 1 of the Applicant's Deadline 1 submission) for how this has been assessed within the application.
[ii] The project description chapter references the height relative to MHWS but should state HAT. This has been assessed as such in all relevant assessments.
[iii] The project description chapter references the height relative to MHWS but should state HAT. This has been assessed as such in all relevant assessments.

Project Description Chapter Ref	Parameter description	Maximum parameters
Table 1.4	Total drill arisings for WTG monopiles (m^3)	19,627[iv]
Table 1.4	Grout volume per foundation (m^3)	120
Table 1.4	Hammer energy (kJ)	5,000
Table 1.4	Number of blows per foundation	8,000
Table 1.4	Piling time per foundation (assuming issues such as low blow rate, refusal etc.) (hours)	6
Maximum design envelope for WTG quadropod jacket foundations		
Table 1.5	Number of legs per foundation	4
Table 1.5	Separation of adjacent legs at seabed level (m)	40
Table 1.5	Separation of adjacent legs at Mean Sea Level (MSL) (m)	20
Table 1.5	Height of main access platform above HAT (m)	20
Table 1.5	Leg diameter (m)	3.5
Table 1.5	Embedment depth (below seabed) (m)	70
Table 1.5	Volume of drill arisings per foundation (four pin-piles) (m^3)	1,400
Table 1.5	Locations requiring drilling (%)	50
Table 1.5	Locations potentially installed by driven piling (%)	100
Table 1.5	Total drill arisings (m^3)	17,802
Table 1.5	Grout volume per foundation (piles) (m^3)	60
Table 1.5	Grout volume per foundation (screw piles) (m^3)	85
Table 1.5	Hammer energy (kJ)	2,700
Table 1.5	Piling time per foundation (four pinpiles) (assuming issues such as low blow rate, refusal etc.) (hours)	10
Maximum design envelope for suction caisson jacket WTG foundations		
Table 1.6	Number of legs	4
Table 1.6	Separation of adjacent legs at seabed level (m)	40
Table 1.6	Separation of adjacent legs at Mean Sea Level (MSL) (m)	20
Table 1.6	Height of platform above HAT (m)	20
Table 1.6	Leg diameter (m)	3.5

[iv] See accompanying clarification note (Annex B of Appendix 1 of the Applicant's Deadline 1 submission) for how this has been assessed within the application.

Project Description Chapter Ref	Parameter description	Maximum parameters
Table 1.6	Suction buckets per foundation	4
Table 1.6	Suction bucket diameter (m)	20
N/A	Suction bucket footprint (m^2)	1,256.6
Table 1.6	Bucket penetration depth (below seabed) (m)	20
Table 1.6	Grout volume per foundation (m^3)	105
Table 1.6	Depth of seabed preparation (m)	3
Table 1.6	Area of seabed preparation per foundation (m^2)	3,200
Table 1.6	Volume per foundation for seabed preparation work (m^3)	9,600
Table 1.6	Volume for seabed preparation works (for WTG foundations only) (m^3)	268,800[v]
Maximum design envelope for scour protection (based on suction caisson jacket foundations which represent the greatest scour protection requirement)		
Table 1.7	Median rock diameter (mm)	200
Table 1.7	Scour protection depth (rock) (m)	5
Table 1.7	Total scour protection area (WTG foundations only) (m^2)	219,912
Table 1.7	Scour protection diameter	5 x pile diameter
Table 1.7	Scour protection volume per foundation (m^3)	39,269.90[vi]
Table 1.7	Scour protection total volume (WTG foundations only) (m^3)	1,112,647.40
Paragraphs 1.4.52 to 1.4.55	Scour protection types	Rock placement, rock armour, frond mat systems
Maximum design envelope for the inter-array cables		
Table 1.8	System voltage (kV)	66
Table 1.8	External cable diameter (mm)	300
Table 1.8	Total length of inter-array cables (km)	64
Table 1.8	Maximum burial depth (m)	3
Table 1.8	Minimum burial depth (m)	0
Table 1.8	Trench width (m)	1

[v] See accompanying clarification note (Annex B of Appendix 1 of the Applicant's Deadline 1) for how this has been assessed within the application.

[vi] See accompanying clarification note (Annex B of Appendix 1 of the Applicant's Deadline 1 submission) for how this has been assessed within the application.

Project Description Chapter Ref	Parameter description	Maximum parameters
Paragraph 1.4.60	Pre-lay grapnel runs	Pre-Lay Grapnel Runs (PLGR) will be conducted to remove seabed surface debris along a 1 – 2 m wide area. The grapnel typically penetrates the seabed to 0.5 m depth and is selected and configured in accordance with the seabed conditions.
Maximum design envelope for inter-array cable installation		
Table 1.9	Burial technique	Jetting/ Ploughing/ Trenching/ Cutting/ Mass Flow Excavation/ Pre-sweeping (dredging)
Table 1.9	Length of inter-array cables (km)	64
Table 1.9	Maximum burial depth (m)	3
Table 1.9	Minimum burial depth (m)	0
Table 1.9	Percentage cable requiring additional protection (%)	25
Table 1.9	Length of cable requiring additional protection (m)	16,000
Table 1.9	Indicative trench width (m)	1
Table 1.9	Width of disturbance from jetting (m)	5
Table 1.9	Area of disturbance from jetting (km^2)	0.3
Table 1.9	Width of disturbance from ploughing (m)	10
Table 1.9	Area of disturbance from ploughing (km^2)[vii]	0.064
Table 1.9	Width of rock berm protection (m)	5
Table 1.9	Area of cable protection excluding crossings (m^2)	80,000
Table 1.9	Height of rock berm protection (m)	0.5
Table 1.9	Volume of surface protection per km (based on a 0.5 x 5, trapezoid) (m^3 km^{-1})	1,250

[vii] This was presented in the project description chapter as 0.06 km^2 as a rounding error. Please see corresponding clarification note (B of Appendix 1 of the Applicant's Deadline 1 submission).

Project Description Chapter Ref	Parameter description	Maximum parameters
Table 1.9	Length of exposed cable approaching WTG foundation requiring rock dumping/ remedial protection (m)	50
Table 1.9	Total area of WTG foundations requiring rock dumping/ remedial protection (m^2) (34 WTG and one OSS foundation)	17,500[viii]
Maximum design envelope for inter-array cable crossing protection		
Table 1.10	Crossing technique	Rock dumping/ concrete mattresses/ steel bridging/ concrete bridging
Table 1.10	Number of cable crossings	12
Table 1.10	Length of crossings (m)	100
Table 1.10	Width of crossings (m)	10
Table 1.10	Volume of post-lay rock berm protection per cable crossing (m^3)	500
Table 1.10	Number of concrete mattresses (6 x 3 x 0.3 m) per crossing	24
Table 1.10	Area of post-lay rock berm protection per cable crossing (m^2)	1,000
Table 1.10	Total area of rock berm protection for crossings (m^2)	12,000
Table 1.10	Total volume of rock berm protection for crossings (m^3)	6,000
Maximum design envelope for the OSS		
Table 1.11	Topside weight (tonnes)	2,500
Table 1.11	Topside length (m)	70
Table 1.11	Topside width (m)	50
Table 1.11	Topside height (excluding crane and helideck) (m)	30
Table 1.11	Topside height above HAT (excluding crane and helideck) (m)	55
Table 1.11	Topside height above HAT (including crane) (m)	80
Table 1.11	Annual O&M time (weeks)	2
Table 1.11	Diesel fuel (l)	200,000
Table 1.11	Gray water (m^3)	1,000

[viii] See accompanying clarification note (Annex B of Appendix 1 of the Applicant's Deadline 1 submission) for how this has been assessed within the application.

Project Description Chapter Ref	Parameter description	Maximum parameters
Table 1.11	Black water (m^3)	1,000
Table 1.11	Transformer coolant oil (kg)	600,000
Table 1.11	UPS Batteries (l)	10
Table 1.11	Fire suppression systems (l)	20,000
Table 1.11	Sulphur hexafluoride (SF6) (kg)	1,500
Table 1.11	Engine oil (m^3)	5
Table 1.11	HVAC coolant (glycol) (m^3)	5
Maximum design envelope for the installation of the OSS using driven monopiles		
Table 1.12	Pile diameter (m)	10
Table 1.12	Pile penetration depth (m)	50
Table 1.12	Hammer energy (kJ)	5,000
Table 1.12	Piling time per foundation (hr)	6
Table 1.12	Foundations by driven piling (%)	100
Table 1.12	Foundations installed by drilling (%)	50
Table 1.12	Drill diameter (m)	6
Table 1.12	Volume of risings per pile (m^3)	1,000[ix]
Table 1.12	Grout volume per foundation (m^3)	160
Table 1.12	Scour protection options [x]	Rock placement, rock armour, frond mat systems
Table 1.12	Scour protection depth (m)	5
Table 1.12	Scour protection area (excluding structure footprint (m^2)	1,964[xi]
Table 1.12	Topside indicative installation time excluding cable installation (from arrival on site) (weeks)	1
Maximum design envelope for the installation of the OSS using driven tripod jacket		
Table 1.12	Pile diameter (m)	3
Table 1.12	Pile penetration depth (m)	70
Table 1.12	Width of jacket at seabed (m)	36

[ix] See accompanying clarification note (Annex B of Appendix 1 of the Applicant's Deadline 1 submission) for how this has been assessed within the application.
[x] In project description chapter states to be the same as WTG foundations. It has been repeated in this table for clarity.
[xi] See accompanying clarification note (Annex B of Appendix 1 of the Applicant's Deadline 1 submission) for how this has been assessed within the application.

Project Description Chapter Ref	Parameter description	Maximum parameters
Table 1.12	Width of jacket at MSL (m)	28
Table 1.12	Jacket leg spacing (m)	34
Table 1.12	Hammer energy (kJ)	2,700
Table 1.12	Piling time per foundation (hr)	6
Table 1.12	Foundations by driven piling (%)	100
Table 1.12	Foundations installed by drilling (%)	100
Table 1.12	Drill diameter (m)	4
Table 1.12	Volume of risings per pile (m^3)	200
Table 1.12	Volume of risings per OSS foundation (m^3)	450
Table 1.12	Grout volume per foundation (m^3)	100
Table 1.12	Scour protection options [xii]	Rock placement, rock armour, frond mat systems
Table 1.12	Scour protection depth (m)	5
Table 1.12	Scour protection area (excluding structure footprint (m^2)	2,025
Table 1.12	Topside indicative installation time excluding cable installation (from arrival on site) (weeks)	1
Maximum design envelope for the installation of the OSS using a suction caisson jacket		
Table 1.13	Suction bucket foundation leg diameter above sea surface (m)	3
Table 1.13	Suction bucket diameter (m) (Note: for tripod foundation)	20
N/A	Suction bucket footprint (m^2)	942.5
Table 1.13	Bucket penetration depth (m)	15
Table 1.13	Grout volume per foundation (m^3)	200
Table 1.13	Total grout volume for OSS (m^3)	800
Table 1.13	Scour protection options [xii]	Rock placement, rock armour, frond mat systems
Table 1.13	Scour protection depth (rock) (m)	5
Table 1.13	Scour protection area (including structure footprint (m^2)	7,854
Maximum design envelope for the offshore Meteorological Mast (Met Mast)		

[xii] In project description chapter states to be the same as WTG foundations. It has been repeated in this table for clarity.

Project Description Chapter Ref	Parameter description	Maximum parameters
Table 1.14	Maximum elevation (mHAT)	Maximum hub height of WTGs
Table 1.14	Met Mast spacing	The Met Mast follows the minimum spacing of the 716 m x 480 m.
Table 1.14	Hazardous materials (litres)	0
Table 1.14	Indicative number of yearly O&M visits	15
Table 1.14	Indicative instruments	Anemometers and wind vanes at a minimum of three measurement heights.
Additional assumptions applied within the ES for the Met Mast – Monopile foundation		
Assumptions taken from monopile WTG foundations – Table 1.6	Diameter of monopile (bottom) (m)	Max 10
	Volume of drill arisings per pile (m^3)	1,325[xiii]
	Locations requiring drilling (%)	100
	Locations potentially installed by driven piling (%)	100
	Hammer energy (kJ)	5,000
	Number of blows per foundation	8,000
	Piling time per foundation (assuming issues such as low blow rate, refusal etc.) (hours)	6
	Seabed preparation volume (m^3)[xiv]	9,600
Additional assumptions applied within the ES for the Met Mast –Suction Caisson foundation		
Assumptions taken from suction caisson WTG foundations – Table 1.6	Number of legs	4
	Suction bucket diameter (m)	20
	Depth of seabed preparation (m)	3
	Area of seabed preparation per foundation (m^2)	3,200
	Volume per foundation for seabed preparation work (m^3)	9,600
Assumptions taken from suction caisson WTG	Scour protection depth (rock) (m)	5
	Scour protection diameter	5 x pile diameter
	Scour protection area[xv]	7,854

[xiii] See accompanying clarification note (Annex B of Appendix 1 of the Applicant's Deadline 1 submission) for how this has been assessed within the application.
[xiv] This has been derived based on the parameters for a suction caisson WTG foundation
[xv] Not presented within the project description but used within assessments. See Table 3.

Project Description Chapter Ref	Parameter description	Maximum parameters
foundations – Table 1.7	Scour protection volume per foundation (m^3)	39,269.90
	Scour protection types	Rock placement, rock armour, frond mat systems
Additional assumptions applied within the ES for the Met Mast –Jacket foundation		
Assumptions taken from jacket WTG foundations – Table 1.5	Number of legs per foundation	4
	Separation of adjacent legs at seabed level (m)	40
	Leg diameter (m)	3.5
	Embedment depth (below seabed) (m)	70
	Volume of drill arisings per foundation (four pin-piles) (m^3)	1,400
	Locations requiring drilling (%)	100
	Locations potentially installed by driven piling (%)	100
	Total drill arisings (m^3)	1,400
	Grout volume per foundation (piles) (m^3)	60
	Grout volume per foundation (screw piles) (m^3)	85
	Hammer energy (kJ)	2,700
	Piling time per foundation (four pinpiles) (assuming issues such as low blow rate, refusal etc.) (hours)	10
Maximum design envelope for offshore export cables		
Table 1.15	Cable specification	3-core XLPE (Cross-linked Polyethylene) or similar.
Table 1.15	Cable voltage (kV)	220 kV
Table 1.15	Indicative external cable diameter (mm)	300
Table 1.15	Length of cables (km)	30 per cable
Table 1.15	Total length of cables (km)	120
Table 1.15	Indicative expected duration of installation activities (days)	30 days per cable
Table 1.15	Indicative spacing between cables if unbundled (m)	50 m within pair; 120 m between pairs
Table 1.15	Spacing between adjacent cables if multiple cables (m)	250
Table 1.15	Trench width per cable (jetting) (m)	10
Maximum design envelope for offshore export cable installation		

Project Description Chapter Ref	Parameter description	Maximum parameters
Table 1.16	Maximum Burial depth (m)	3 below mean seabed depth
Table 1.16	Minimum Burial depth (m)	0
Table 1.16	Indicative trench width from jetting (m)	10
Table 1.16	Width of disturbance from jetting (m)	10
Table 1.16	Total area of disturbance from jetting (km^2)	1.2 (0.3 km^2 per cable)
Table 1.16	Width of disturbance from ploughing (m)	12
Table 1.16	Area of disturbance from ploughing (km^2)	1.4
Table 1.16	Pre-sweeping length (dredging) (km)	24 (6 km per cable)
Table 1.16	Pre-sweeping width of dredging corridor (m)	20
Table 1.16	Pre-sweeping area of dredging corridor (km^2)	0.48
Table 1.16	Pre-sweeping volume of dredging corridor (m^3)	1,440,000
Table 1.16	Pre-lay grapnel run width (m)	20
Table 1.16	Pre-lay grapnel run area (km^2)	2.4
Table 1.16	Width of cable protection per cable (m)	7
Table 1.16	Percentage of each cable requiring protection (%)	25
Table 1.16	Length of cable protection (m)	7,500
Table 1.16	Area of cable protection per export cable (m^2)	52,500
Table 1.16	Total area of cable protection (excluding cable crossings) (m^2)	210,000
Maximum design envelope for cable crossings for the offshore export cables		
Table 1.17	Number of crossing	20
Table 1.17	Total number of crossings Assuming a four-cable scenario	80
Table 1.17	Length of crossings (m)	100
Table 1.17	Width of crossings (m)	10
Table 1.17	Post-lay berm height (m)	0.5
Table 1.17	Volume of post-lay rock berm protection per crossing (m^3)	500
Table 1.17	Number of concrete mattresses (6.0 x 3.0 x 0.3 m) per crossing	50
Table 1.17	Area of post-lay rock berm protection per cable crossing (m^2)	1000
Not presented in the project	Total area of protection from export cable crossings (m^2)	80,000

Project Description Chapter Ref	Parameter description	Maximum parameters
description as a total but calculated from the parameters outlined above from Table 1.17.		
Maximum design envelope for open trenching within the intertidal area		
Table 1.18	Open trench length per cable circuit (km)	2
Table 1.18	Open trench depth (m)	3
Paragraph 1.4.95 and Figure 1.16	Trench separation and associated temporary route tracks (m)	5
Table 1.18	Width of cable route (based on 4 cable circuits, temporary route tracks and sediment storage) (m)	40
Table 1.18	Area of disturbance (m^2) for four cable circuits	80,000
Maximum design envelope for HDD landfall option		
Table 1.19	Temporary works compound area (m)	60 x 50
Table 1.19	Onshore cofferdam area (m^2)	704
Table 1.19	Excavated material from landfall/ TJBs (HDD) (m^3)	1,408
Table 1.19	Offshore cofferdam area (m^2)	1,600 (20 m x 20 m per cable with a maximum of 4 cables)
Table 1.19	Minimum punch out distance from sea wall (m)	100
Table 1.19	Volume of drilling mud volume to be released to environment (m^3)	(All drilling mud to be captured within cofferdam or other structure)
Table 1.19	Works duration (months)	18
Maximum cofferdam and over ground cable installation design parameters		
Table 1.20	Width of cofferdam (m)	165
Table 1.20	Depth of cofferdam (m)	25
Table 1.20	Temporary works compound area (m)	40 x 30
Table 1.20	Construction space required in saltmarsh (m^2)	3,872
Table 1.20	Piling Noise level (dBA)	132

Project Description Chapter Ref	Parameter description	Maximum parameters
Table 1.20	Duration of piling (days)	33
Table 1.20	Depth of sea wall extension (m)	18.5
Table 1.20	Max width of sea wall extension (m)	155
Table 1.20	Area of permanent seaward extension (m^2)	1398.9[xvi]
Table 1.20	% loss of saltmarsh in the Thanet Coast and Sandwich Bay SAC	0.13
Table 1.20	TJB and cable route bund slope (other than for crossings)	1:5
Table 1.20	Bund height of onshore cable route (m)	1.2
Table 1.20	Bund height of TJBs (m)	2.3
Table 1.20	Bund width of TJBs (m)	45
Paragraph 1.4.109	Maximum distance of TJBs from the existing sea wall (m)	350
UXO assumptions		
Table 1.21	Number of UXO	30
Table 1.21	Clearance/ Removal date (dependent on final construction programme)	2020
Table 1.21	Days to clear (based on 4 per day)	8
Table 1.21	Detonations per 24 hr period	8
Table 1.21	Minimum charge weight anticipated (kg)	0.5
Table 1.21	Maximum charge weight anticipated (kg)	130
Maximum construction vessel quantities on-site at the same time		
Table 1.22	Seabed preparation vessels	3
Table 1.22	Foundation spreads per project	1
Table 1.22	Number of vessels per foundation spread (includes tugs and feeders)	5
Table 1.22	Transition piece installation vessels	2
Table 1.22	Scour Installation Vessels	6
Table 1.22	Number of vessels engaged in foundations	5
Table 1.22	Wind turbine installation spreads	3
Table 1.22	Max vessels per WTG installation spread	3
Table 1.22	Total WTG installation vessels	6

[xvi] See accompanying clarification note (Annex B of Appendix 1 of the Applicant's Deadline 1 submission) for how this has been assessed within the application.

Project Description Chapter Ref	Parameter description	Maximum parameters
Table 1.22	Commissioning vessels	7
Table 1.22	Accommodation vessels	1
Table 1.22	Total IA cable vessels	4
Table 1.22	Number of Export Cable spreads per Project	3
Table 1.22	Number of vessels per Export Cable spread	2
Table 1.22	Total export cable vessels	6
Table 1.22	Landfall cable installation vessels	2
Table 1.22	Substation/ collector IV	3
Table 1.22	Other vessels	3
Table 1.22	Total	48
Construction period I&O Vessels Round Trips to Port for Project over 3 years		
Table 1.23	Seabed Preparation Vessel	15
Table 1.23	Foundation Installation Spread	60
Table 1.23	Transition Piece Installation	30
Table 1.23	Scour Vessel	30
Table 1.23	WTG Installation Spread	23
Table 1.23	Commissioning Vessels	480
Table 1.23	IA Cable Vessels	60
Table 1.23	Export Cable Vessels	300
Table 1.23	Landfall Cable Installation Vessels	30
Table 1.23	Substation Installation Vessels	12
Table 1.23	Other Vessels	120
Table 1.23	Total	1,160
Construction period I&O Vessels Round Trips to Port for Project over 3 years		
Table 1.24	Foundation Delivery	30
Table 1.24	Turbine Delivery	15
Table 1.24	Cable Delivery	30
Table 1.24	Scour Delivery	30
Table 1.24	Substation Delivery	3
Table 1.24	Total	108
Jack-up Vessels		

Project Description Chapter Ref	Parameter description	Maximum parameters
Construction		
Table 1.25	Individual leg diameter (m)	10
Table 1.25	Individual leg footprint area (m^2)	78.54
Table 1.25	Number of legs	6
Table 1.25	Combined leg area (m^2)	471.24
Table 1.25	Leg penetration range	15
Table 1.25	Jacking Operations per	2
Table 1.25	Turbine sites	34
Table 1.25	Total JUV visits	68
O&M		
Table 1.25	Individual leg diameter (m)	6
Table 1.25	Individual leg footprint area (m^2)	28.27
Table 1.25	Number of legs	6[xvii]
Table 1.25	Combined leg area (m^2)	169.65xvii
Table 1.25	Leg penetration range	15
Table 1.25	Jacking Operations per Turbine	10
Table 1.25	Turbine sites	34
Table 1.25	Total JUV visits	340
Decommissioning		
Table 1.25	Individual leg diameter (m)	6
Table 1.25	Individual leg footprint area (m^2)	28.27
Table 1.25	Number of legs	4
Table 1.25	Combined leg area (m^2)	113.1
Table 1.25	Leg penetration range	15
Table 1.25	Jacking Operations per Turbine	1
Table 1.25	Turbine sites	34
Table 1.25	Total JUV visits	34
Anchor footprints for construction of Thanet Extension		
Installation of foundations		

[xvii] The values were incorrectly presented within the project description chapter for Table 1.25. The values presented in Table 1.34 were however presented correctly. Please see accompanying clarification note (Annex B of Appendix 1 of the Applicant's Deadline 1 submission).

Project Description Chapter Ref	Parameter description	Maximum parameters
Table 1.26	Number of anchors for assumed construction vessel	6
Table 1.26	Individual anchor footprint area for one deployment and recovery (m^2)	25
Table 1.26	Indicative anchor penetration depth (m)	3
Table 1.26	Impacted anchor area for one deployment (m^2)	150
Table 1.26	Assumed number of anchoring operations per installation	1
Table 1.26	Total impacted area (m^2)	150
Table 1.26	Total impacted volume (m^3)	450
Installation of topside (WTG and tower)		
Table 1.26	Number of anchors for assumed construction vessel	4
Assumptions applied in the ES based upon the installation of foundations in Table 1.26.	Individual anchor footprint area for one deployment and recovery (m^2)	25
	Indicative anchor penetration depth (m)	3
	Impacted anchor area for one deployment (m^2)	150
	Assumed number of anchoring operations per installation	1
	Total impacted area (m^2)	150
	Total impacted volume (m^3)	450
Installation of topside (OSS)		
Table 1.26	Number of anchors for assumed construction vessel	6
Table 1.26	Individual anchor footprint area for one deployment and recovery (m^2)	25
Table 1.26	Indicative anchor penetration depth (m)	3
Table 1.26	Impacted anchor area for one deployment (m^2)	150
Table 1.26	Assumed number of anchoring operations per installation	1
Table 1.26	Total impacted area (m^2)	150
Table 1.26	Total impacted volume (m^3)	450
Installation of export cables		
Table 1.26	Number of anchors for assumed construction vessel	6
Table 1.26	Individual anchor footprint area for one deployment and recovery (m^2)	10

Project Description Chapter Ref	Parameter description	Maximum parameters
Table 1.26	Indicative anchor penetration depth (m)	3
Table 1.26	Impacted anchor area for one deployment (m^2)	60
Table 1.26	Assumed number of anchoring operations per cable installation	120
Table 1.26	Anchor deployments per asset crossing (per cable)	4
Table 1.26	Total anchor deployments for asset crossings (per cable)	20
Table 1.26	Anchor deployments per cable and foundation interface (per cable)	4
Table 1.26	Total anchor deployments per cable installation	144
Table 1.26	Impacted area per cable (m^2)	8,640
Table 1.26	Impacted volume per cable (m^3)	25,920
Table 1.26	Total impacted area (m^2)	34,560
Table 1.26	Total impacted volume per cable (m^3)	103,680
Installation of array cables		
Table 1.26	Number of anchors for assumed construction vessel	6
Table 1.26	Individual anchor footprint area for one deployment and recovery (m^2)	10
Table 1.26	Indicative anchor penetration depth (m)	3
Table 1.26	Impacted anchor area for one deployment (m^2)	60
Table 1.26	Assumed number of anchoring operations per installation	15
Table 1.26	Number of installations	34
Table 1.26	Total anchor deployments for inter-array installation	510
Table 1.26	Impacted area per cable (m^2)	900
Table 1.26	Impacted volume per cable (m^3)	2,700
Table 1.26	Total impacted area (m^2)[xviii]	30,600
Table 1.26	Total impacted volume (m^3)	91,800
Permanent vessel moorings[xix]		
Table 1.27	Number of installations in total	2

[xviii] Discrepancies in this value within the ES are accounted for in the accompanying clarification note (Annex B of Appendix 1 of the Applicant's Deadline 1 submission).

[xix] See accompanying clarification note (Annex B of Appendix 1 of the Applicant's Deadline 1 submission)

Project Description Chapter Ref	Parameter description	Maximum parameters
Table 1.27	Possible foundation types	Concrete Gravity Base or Standard Ground Tackle
Table 1.27	Surface structure	A floating mooring buoy up to 3 m in diameter, and 3 m above sea level.
Table 1.27	Marking & Lighting	Marked and lit as required (assume high-viz yellow colouration, radar reflector, navigation light). AIS beacon may be considered judged valuable (and acceptable to THLS).
Indicative construction programme (assuming no breaks to work)		
Table 1.28	Foundation installation	6 (includes 1 month weather downtime)
Table 1.28	Cable installation (inter-array and export)	6 (includes 1 month weather downtime)
Table 1.28	OSS (if required)	2.5 (includes 2 weeks for foundation installation and weather downtime)
Table 1.28	Met Mast (if required)	2.5 (includes 2 weeks for foundation installation and weather downtime)
Table 1.28	WTG installation	6 (includes 1 month weather downtime)
Table 1.28	Scour protection installation	1 (includes 2 weeks weather downtime)
Table 1.28	Total duration	28
Maximum O&M vessel quantities per year		
Table 1.29	Small CTV O&M vessel	2
Table 1.29	Large O&M Vessel	1
Table 1.29	Lift vessels	1
Table 1.29	Cable maintenance vessel	1
Table 1.29	Auxiliary vessels	1

Project Description Chapter Ref	Parameter description	Maximum parameters
O&M Vessel Round Trips to Port per year, per vessel[xx]		
Table 1.30	Small CTV O&M vessel	300
Table 1.30	Large O&M Vessel	2
Table 1.30	Lift vessels	1
Table 1.30	Cable maintenance vessel	1
Table 1.30	Auxiliary vessels	3
Table 1.30	Accommodation O&M	0
Table 1.30	Total (including all vessels)	307
O&M estimations – inter-array cables replacement worst-case estimates[xxi]		
Table 1.31	Number of inter-array cable failure during lifetime of wind farm	7
Table 1.31	Length of replacement (longest inter-array cable) (m)	2,000
Table 1.31	Width of seabed being disrupted for replacement of inter-array cable (m)	10
Table 1.31	Overall impact area (cable and JUV) per repair (m^2)[xxii]	20,000
Table 1.31	Total repair area (m^2)[xxiii]	140,000
O&M estimations – inter-array cables repair worst-case estimates		
Table 1.32	Cable re-burial - Reburial (total inter-array length) (m)	64,000
Table 1.32	Cable re-burial - Frequency (once every 5 years)	6
Table 1.32	Cable repair - Total width of disturbance (m)	10
Table 1.32	Cable repair - Total area (cable alone) (m^2)	640,000
Table 1.32	Overall cumulative impact area (cable +JUV) per repair (m^2)	3,840,000
Export cable repairs/ reburial worst-case estimates [xxi]		
Table 1.33	Cable inspection- One failure per cable per 5 years (total repairs in lifetime of project)	24

[xx] Please See accompanying clarification note (Ref Annex B of Appendix 1 of the Applicant's Deadline 1 submission) with respect to O&M vessels quantities assessed within the ES.
[xxi] Please See accompanying clarification note (Annex B of Appendix 1 of the Applicant's Deadline 1 submission) with respect to O&M cable activities assessed within the ES.
[xxii] This value was incorrectly presented in the project description chapter as 140,000. Please see accompanying clarification note (Annex B of Appendix 1 of the Applicant's Deadline 1 submission).
[xxiii] This value was incorrectly presented in the project description chapter as 980,000. Please see accompanying clarification note (Annex B of Appendix 1 of the Applicant's Deadline 1 submission).

Project Description Chapter Ref	Parameter description	Maximum parameters
Table 1.33	Cable inspection- Assumed repair length (through removal) (m)	300
Table 1.33	Cable burial using surface protection- Total width of disturbance (same method as installation but decreased from 30 to 10 m) (m)	10
Table 1.33	Cable re-burial Total area (cable alone) (m^2)	3,000
Table 1.33	Additional cable laying- Overall cumulative impact area (cable +JUV) per repair (m^2)	72,000
WTGs O&M worst-case estimates		
Table 1.34	Individual leg diameter (m)	6
Table 1.34	Individual leg footprint area (m^2)	28.27
Table 1.34	Number of legs	6
Table 1.34	Combined leg area (m^2)	169.65
Table 1.34	Leg penetration range	15.00
Table 1.34	Jacking Operations per Turbine (1 visit every 3 years)	10
Table 1.34	Turbine sites	34
Table 1.34	Total operations	340
Table 1.34	Total footprint during operational period (m^2)	57,680
OSS O&M worst-case estimates		
Table 1.35	Individual leg diameter (m)	6
Table 1.35	Individual leg footprint area (m^2)	28.27
Table 1.35	Number of legs	6
Table 1.35	Combined leg area (m^2)	169.65
Table 1.35	Leg penetration range	15
Table 1.35	Jacking Operations (total) (1 visit every 2 years)	12.5
Table 1.35	OSS sites	1
Table 1.35	Total operations	13
Table 1.35	Total footprint during operational period (m^2)	2,121

Table 2: Maximum Disposal Volumes for Thanet Extension

Infrastructure	Project Description Chapter Ref	Activity	Maximum Volume (m^3)
Transmission	Table 1.16 and assumptions of WTGs foundations were applied for the OSS (Table 1.6)	Pre-sweeping OECC and seabed preparation for OSS suction caisson foundation	1,440,000 + 9,600 = 1,449,600
Generation	Table 1.6 and assumptions of WTGs foundations were applied for the met mast (Table 1.6)	Seabed preparation for suction caisson foundations (28 WTGs and a met mast)	29 x 9,600 = 278,400
Total			1,728,000

Table 3: Maximum scour protection area for Thanet Extension

Infrastructure	Project Description Chapter Ref	Activity	Maximum Area (m^2)
Transmission	Table 1.13	Scour protection for the OSS	7,854
Generation	Table 1.7 and assumptions of WTGs foundations were applied for the met mast (Table 1.7)	Scour protection for WTGs and the met mast	219,912 + 7,854 = 227,766
Total			235,620

Table 4: Maximum scour protection volume for Thanet Extension

Infrastructure	Project Description Chapter Ref	Activity	Maximum Volume (m^3)
Transmission	The assumptions of WTGs foundations were applied for the OSS (Table 1.7)	Scour protection for OSS	39,269.9
Generation	Table 1.7 and assumptions of WTGs foundations were applied for the met mast (Table 1.7)	Scour protection for the WTGs and the met mast	1,112,647.4 + 39,269.9 = 1,151,917.3
Total			1,191,187.2

Table 5: Maximum cable protection area for Thanet Extension

Infrastructure	Project Description Chapter Ref	Activity	Maximum Area (m^2)
Transmission	Table 1.16	Export Cable	210,000
	Table 1.17	Export Cable crossings	80 crossings x 1000 = 80,000
	Not presented as a total in the project description	Total for Export Cable	290,000
Generation	Table 1.9	Inter-array cables	80,000
	Table 1.10	Inter-array cables crossings	12,000
	Table 1.9	Total area of WTG foundations requiring rock dumping/ remedial protection (m_2)	17,500 – 500 =17,000
	Not presented as a total in the project description	Total for inter-array cables	109,000
Total			399,000

Table 6: Maximum cable protection volume for Thanet Extension

Infrastructure	Project Description Chapter Ref	Activity	Maximum Area (m^3)
Transmission	Table 1.16	Export Cable	210,000 m^2 x 0.5 m = 105,000 m^3
	Table 1.17	Export Cable crossings	80 crossings x 500m^3 = 40,000 m^3
	Not presented as a total in the project description	Total for Export Cable	145,000 m^3
Generation	Table 1.9	Total area of WTG foundations requiring rock dumping/ remedial protection (m_2)	17,500 m^2 x 0.5 m = 8,750 m^3
	Table 1.9	Inter-array cables	16 km x 1,250 m^3 km^{-1} = 20,000 m^3
	Table 1.10	Inter-array cables crossings	6,000
	Not presented as a total in the project description	Total for inter-array cables	34,750
Total			179,750

Table 7: Maximum drill arising volume for Thanet Extension

Infrastructure	Project Description Chapter Ref	Activity	Maximum Volume (m^2)
Transmission	Table 1.12	Maximum volume for to drill OSS	1,000
Generation	Table 1.4	Maximum volume to drill 50% of WTG foundations and one met mast (assuming 10MW)	19,627 + 1,155 = 20,782
Total			21,782[xxiv]

[xxiv] See accompanying clarification note (Annex B of Appendix 1 of the Applicant's Deadline 1 submission) for how this has been assessed within the application. This value was not presented as total within the project description chapter.

Table 8: Maximum disturbance sediment volume for installation of cabling for Thanet Extension (excluding pre-sweeping)

Infrastructure	Project Description Chapter Ref	Activity	Maximum Volume (m^3)
Transmission	Table 1.16	Jetting of export cables (assuming a v-shaped trench and 50% of sediment is liquidised)	10 m x 3 m x 120 km x 0.5 x 50% = 900,000[xxv]
Generation	Table 1.9	Jetting of inter-array cables (assuming a v-shaped trench and 50% of sediment is liquidised)	1 m x 3 m x 64 km x 0.5 x 50% = 48,000[xxvi]
Total			948,000

Table 9: Maximum infrastructure footprint for Thanet Extension Construction activities

Infrastructure	Project Description Chapter Ref	Activity	Maximum Area (m^2)
Transmission	Based on parameters from Table 1.13	One OSS (based on a tripod suction bucket diameter of 20 m)	942.5[xxvii]
Generation	Based on parameters from Table 1.6	28 x 12 MW WTGs and one met mast with a diameter of 20 m (assuming the same parameters as WTGs)	1,256.6 x 29 = 36,442.5
Total			37,385[xxviii]

[xxv] See accompanying clarification note (Annex B of Appendix 1 of the Applicant's Deadline 1 submission) for how this has been assessed within the application. This value was not presented as total within the project description chapter.

[xxvi] See accompanying clarification note (Annex B of Appendix 1 of the Applicant's Deadline 1 submission) for how this has been assessed within the application. This value was not presented as total within the project description chapter.

[xxvii] This is based on a tripod OSS as within the project description chapter, however this has been assessed as 1,256 m^2 within the ES.

[xxviii] Based on the discrepancy between the footprint for the OSS, this has been assessed as 37,680 m^2 within the ES. Please see accompanying clarification note (Annex B of Appendix 1 of the Applicant's Deadline 1 submission).

Table 10: Maximum disturbance area for Thanet Extension O&M activities

Infrastructure	Project Description Chapter Ref	Activity	Maximum Area (m^2)
Transmission	Table 1.33	Export Cable O&M works	72,000
	Table 1.35	JUVs for OSS	2,121
	N/A	Transmission Total	74,121
Generation	Tables 1.31 & 1.32	Inter-array cable O&M replacement and reburial	140,000 + 3,840,000 = 3,980,000
	Table 1.25	JUVs for WTGs	169.65 x 340 = 57,680
	N/A	Generation Total	4,037,860
Total			4,111,801[xxix]

Table 11: Maximum disturbance volume for Thanet Extension O&M activities

Infrastructure	Project Description Chapter Ref	Activity	Maximum Area(m^2)
Transmission	Table 1.33	Export Cable O&M works	72,000 m^2 x 3m x 0.5 x 50% = 54,000
Generation	Tables 1.31 & 1.32	Inter-array cable O&M replacement and reburial	3,980,000 m^2 x 3m x 0.5 x 50% = 2,985,000
Total			3,039,000[xxx]

[xxix] See accompanying clarification note (Annex B of Appendix 1 of the Applicant's Deadline 1 submission) for how this has been assessed within the application. This value was not presented as total within the project description chapter.

[xxx] See accompanying clarification note (Annex B of Appendix 1 of the Applicant's Deadline 1 submission) for how this has been assessed within the application. This value was not presented as total within the project description chapter.

Vattenfall Wind Power Ltd

Thanet Extension Offshore Wind Farm

Appendix 1, Annex B to Deadline 1 Submission: Project Description Transcription into the Application

Relevant Examination Deadline: 1

Submitted by Vattenfall Wind Power Ltd

Date: January 2019

Revision A

Drafted By:	GoBe Consultants Ltd
Approved By:	Daniel Bates
Date of Approval:	January 2019
Revision:	A

Revision A	Original Document submitted to the Examining Authority
N/A	
N/A	
N/A	

Contents

Tables

1 Introduction

1.1 Aim

1 This clarification note seeks to provide clarification on how the project description for Thanet Extension Offshore Wind Farm (Thanet Extension) has been transcribed and assessed in the Environmental Statement (ES). It has been drafted in response to the project description points noted in the Relevant Representations (MMO and Natural England; PINS Ref RR-049 and RR-053).

2 In responding to the relevant representations this note provides an audit of where there is some potential disparity between the design envelope for Thanet Extension and the ES assessments and the draft Development Consent Order (DCO) submitted with the Application.

3 This note should be read in conjunction with the Project Description Audit Clarification Note (Annex A of the Applicants' Response to Relevant Representations of the Deadline 1 submission), which provides the Rochdale Envelope of the project in a tabular format.

1.2 Areas of disparity

4 The areas where there may be a potential risk of disparity between the Application documents are:

- Construction Phase:
  - Minimum WTGs spacing;
  - Total volumes of material for disposal;
  - Total spoil volumes from drilling of foundations;
  - Seabed disturbance volumes for export cable installation;
  - Seabed disturbance area and volume for inter-array cable installation;
  - Impact areas from anchors; and
  - Working area within the saltmarsh.
- Operations and Maintenance:
  - Total footprint of foundations;
  - Total scour protection requirements;
  - Total cable protection requirements;

- Seabed disturbance during O&M activities; and
- O&M vessel numbers.

5 Each of these areas is clarified within sections 2 and 3 below. Table 7 provides a breakdown of parameters assessed within each of the ES chapter.

2 Clarifications of parameters – Construction Phase

2.1 Minimum WTGs spacing

Project Description

6 As identified in paragraphs 1.4.14 and 1.4.15 of Volume 2, Chapter 1: Project Description (Offshore) (PINS Ref APP-042/ Application Ref 6.2.1) the spacing of neighbouring WTGs will be a minimum of 716 x 480 m. Paragraph 1.4.74 (PINS Ref APP-042/ Application Ref 6.2.1) identifies that the met mast will also adopt a minimum spacing of 716 x 480 m.

Environmental Statement

7 All technical chapters have presented the correct values except the shipping and navigation chapter (PINS Ref APP-051/ Application Ref 6.2.10).

8 As presented in Table 7, there is a disparity in the Volume 2, Chapter 10: Shipping and Navigation (*ibid*) which has transcribed the minimum spacing from the Project Description (PINS Ref APP-042/ Application Ref 6.2.1) as 760 x 418 m. This disparity is a typographical error. The minimum spacing has been derived to align WTGs in Thanet Extension with the rows of the existing WTGs of the Thanet Offshore Wind Farm (TOWF). The assessment was undertaken on this basis, i.e. 716m x 480m and in compliance with the parameters presented in the Project Description (PINS Ref APP-042/ Application Ref 6.2.1); and therefore, this typographical error does not alter the findings of the assessment.

Draft DCO

9 Schedule 11, Part 4, Condition 1 (1)(d) of the draft DCO (APP-022/ Application Ref 3.1) sets out the correct minimum spacing of infrastructure (716 x 480 m) from the Project Description (PINS Ref APP-042/ Application Ref 6.2.1).

2.2 Total volumes of material for disposal

Project Description

10 As presented in Table 1.16 of the Project Description (PINS Ref APP-042/ Application Ref 6.2.1), a maximum pre-sweeping volume of 1,440,000 m^3 for the offshore cable corridors is required for the project. As presented in Table 1.6 (*ibid*) the maximum seabed preparation volume for WTG foundations is 268,800 m^3 (based on 28 x 9,600 m^3 (3,200 m^2 x 3 m depth) per suction caisson foundation). The technical assessments, as presented below, have also applied the same individual assumptions (i.e. 9,600 m^3) to assessments of the Offshore Substation (OSS) and met mast foundations.

11 Therefore, the Applicant is seeking a consent for a maximum disposal volume of 1,728,000 m^3 (1,440,000 m^3 (sandwave) + 268,800 m^3 (WTG foundations) + 9,600 m^3(OSS) + 9,600 m^3 (met mast).

Environmental Statement

12 All technical chapters have derived the pre-sweeping volume for the export cable corridors from the Project Description (PINS Ref APP-042/ Application Ref 6.2.1) and have all transcribed the information such that all assessments state 1,440,000 m^3. There are therefore no potential discrepancies for this value.

13 All technical chapters have correctly transcribed the correct value for the volume of sediment disturbed for foundation installation except the water quality and sediment quality chapter (PINS Ref APP-044/ Application Ref 6.2.3).

14 The Water Quality and Sediment Quality chapter derived information from the Project Description to inform the Rochdale table of the chapter (Table 3.10). The assessment states a maximum volume of sediment disturbance from foundation preparation of 268,800 m^3 for the WTG foundations and 9,600 m^3 for the OSS. There is therefore an apparent disparity between the overall volume for all infrastructure foundations (288,000 m^3) required, and the information presented in Table 3.10 (278,400 m^3). This is due to an error in transcription which did not account for the potential seabed preparation for the met mast foundation (9,600 m^3). It is important to note that this disparity is applicable to Table 3.10 only. Paragraph 3.10.2 of the water and sediment quality chapter (*ibid*) highlights that the assessment draws on the findings within the Marine Geology, Oceanography and Physical Processes assessment (PINS Ref APP-044/ Application Ref 6.2.3) (which presented the worst case accurately) and therefore the assessment is based on appropriate assumptions and the maximum parameters presented in the Project Description (PINS Ref APP-042/ Application Ref 6.2.1). As the assessment is based on information within another chapter (which is accurate), the disparity in the maximum design scenario (Rochdale) table within the water and sediment quality chapter is not material and the conclusions are accurate.

15 The Applicant is seeking consent for a maximum volume of inert material for disposal of 1,728,000 m^3.

Draft DCO

16 Schedule 1, Part 1, Further Works (c) of the draft DCO (PINS Ref APP-022/ Application Ref 3.1) has transcribed the maximum volume of inert material proposed to be disposed of (1,728,000 m^3). However, the draft DCO wording has been amended to "from the seabed required for the construction of Work Nos. 1 to 3B".

17 The revised draft DCO submitted with Deadline 1 has been amended to include total volumes for disposal of 1,449,600 m^3 (1,440,000 m^3 (pre-sweeping of export cable corridor) and 9,600 m^3 for OSS foundation seabed preparation) within the export cable dML and 278,400 m^3 (WTGs and one met mast) within the generation dML. This is the equivalent to a maximum volume of disposal for the project of 1,728,000 m^3 but split appropriately between the two dMLs.

2.3 Total area of seabed preparation for foundations

Project Description

18 As presented in Table 1.6 (PINS Ref APP-042/ Application Ref 6.2.1) the maximum seabed preparation area per WTG foundations is 3,200 m^2 (suction caisson foundations). The same assumptions for the OSS and met mast foundations have also been applied. Therefore, the total maximum disturbance area of the seabed from preparation for foundations is 96,000 m^2 ((28 x 3,200 m^2(WTGs)) + 3,200 m^2(OSS) + 3,200 m^2 (met mast).

Environmental Statement

19 All technical chapters have presented the correct values except the Offshore Archaeology and Cultural Heritage chapter (PINS Ref APP-054/ Application Ref 6.2.13). The Offshore Archaeology and Cultural Heritage chapter has derived information from the Project Description (PINS Ref APP-042/ Application Ref 6.2.1) and has presented the maximum area disturbed for WTG foundations as 89,600 $m^{2.}$ The chapter also considered the disturbance of preparing the OSS foundation (3,200 m^2), and therefore considered a maximum area of 92,800 m^2 (89,600 m^2 + 3,200 m^2). The chapter does not present the requirement for the seabed preparation of the met mast foundation (if it is required), which is equivalent to an additional 3.5% of the assessed value. Whilst there is therefore a disparity the difference is such that it would not alter the magnitude of impacts assessed within the chapter and therefore there would be no change in the overall significance.

20 The Applicant is seeking a maximum seabed preparation are of 96,000 m^2 for the installation of foundations.

Draft DCO

21 The maximum seabed preparation disturbance area for foundations is not presented within the draft DCO (PINS Ref APP-022/ Application Ref 3.1).

2.4 Total spoil volumes from drilling of foundations

Project Description

22 Table 1.4 of the Project Description (PINS Ref APP-042/ Application Ref 6.2.1) presents the worst case scenario parameters for drill arising volumes for WTGs as 19,627 m^3 (defined by 1,155 m^3 per 10 MW foundation and up to 50% of foundations requiring drilling). Table 1.12 (PINS Ref APP-042/ Application Ref 6.2.1) presents the worst case drill arising volume for the OSS as 1,000 m^3. Whilst the consideration of drilling has not been explicitly presented in the Project Description (PINS Ref APP-042/ Application Ref 6.2.1) for the met mast, reference is made to the same foundation assumptions being applied, therefore the met mast has been assessed within the technical chapters on the basis of assuming the same worst case requirements as the WTG foundations, i.e. 1,155 m^3.

23 Therefore, the maximum drill arising volume is 21,782 m^2 (19,627 m^2 (WTGs)+ 1000 m^2 (OSS) + 1,155 m^2 (met mast)), as presented in Project Description Audit Clarification Note (Annex A, of the Applicants' Response to Relevant Representations of the Deadline 1 submission).

Environmental Statement

24 The Marine Geology, Oceanography and Physical Processes; Marine Water Quality and Sediment Quality; Fish and Shellfish; Marine Mammals (Volume 2, Chapter 7); Infrastructure and Other Users chapters and the Sand Wave Clearance, Dredging and Drill Arising: Disposal Site Characterisation assessment (PINS Ref APP-043, APP-044, APP-047, APP-048, APP-052 and APP-148/ Applications Refs 6.2.2, 6.2.3, 6.2.6, 6.2.7, 6.2.11 and 8.14) have derived information from the Project Description (PINS Ref APP-042/ Application Ref 6.2.1), the transcribed volumes are presented in Table 1. Notable exceptions to this list of chapters is the benthic chapter, which assesses a worst case for suspended sediment which is based on seabed preparation.

Table 1: Transcription of the drill arising volumes in the Application

Document	Total volume for WTGs (m^3)	Total volume for OSS (m^3)	Total volume for met mast (m^3)	Total volume assessed (m^3)
APP-043/ 6.2.2	19,627	900	1,325	21,852
APP-044/ 6.2.3	22,531	1,000	0	23,531
APP0-047/ 6.2.6	19.627	900	0	20,527 β
APP-048/ 6.2.7	19,627	900	1,325	21,852
APP-052/ 6.2.11	19,627	0	1,155	20,782β
APP-148/ 8.14	19,627	1,000	1,155	21,782

β nb in the chapter the total volume is presented alone, but the constituents are presented in this table for clarity.

25 The disparities in Marine Geology, Oceanography and Physical Processes, and Marine Mammals chapters (PINS Ref APP-043 and APP-052/ Application Refs 6.2.2 and 6.2.11) have arisen from a transcription error of a drill arising volume of 900 m^3 as opposed to 1,000 m^3 for the OSS and has considered the larger 12 MW foundation for the met mast (1,325 m^3). The results in a higher maximum volume when compared to the Project Description chapter. As such the assessments have assessed a greater volume than the required consent and concluded the effect to be not significant. The apparent disparity between the assessment and the requested value for consent means that the assessments in this case are overly precautionary; and a reduced value will not alter the findings of the assessment.

26 The disparity in the Marine Water Quality and Sediment Quality chapter (PINS Ref APP-044/ Application Ref 6.2.3) has arisen from a transcription error of 22,531 m^3 as opposed to 19,627 m^3 for WTG, and OSS foundations. The assessment has assessed a greater volume than the required consent and concluded the effect to be not significant. The apparent disparity between the assessment and the requested value for consent means that the assessment in this case is overly precautionary; and a reduced value does not alter the findings of the assessment.

27 The disparity in the Fish and Shellfish chapter (PINS Ref APP-047/ Application Ref 6.2.6) has arisen from a transcription error of not including the requirement for drilling for the met mast. As described in paragraph 6.10.15 (PINS Ref APP-052/ Application Ref 6.2.6) the assessment draws on the findings within the Marine Geology, Oceanography and Physical Processes assessment (PINS Ref APP-044/ Application Ref 6.2.2) (which represented a precautionary worst case, see paragraph 26) and therefore is based on precautionary assumptions. Therefore, this disparity and will not alter the findings of the assessment.

28 The disparity in the Infrastructure and Other Users (PINS Ref APP-052/ Application Ref 6.2.11) has arisen from a transcription error of not including the requirement for drilling for the OSS. As described in paragraph 11.10.29 (PINS Ref APP-052/ Application Ref 6.2.11) the assessment draws on the findings within the Marine Geology, Oceanography and Physical Processes assessment (PINS Ref APP-044/ Application Ref 6.2.2) (which represented a precautionary worst case, see paragraph 26) and therefore is based on precautionary assumptions. Therefore, this disparity and will not alter the findings of the assessment.

29 The Applicant is therefore seeking to consent a maximum drill arisings volume for foundation installation of 21,782 m^3.

Draft DCO

30 Within the draft DCO (PINS Ref APP-022/ Application Ref 3.1) the maximum volume of drill arisings from foundation installation is incorporated within the wider volumes for disposal within the draft DCO. For consideration of the total volumes for disposal see section 2.2.

2.5 Seabed disturbance volumes for export cable installation

Project Description

31 Tables 1.15 and 1.16 of the Project Description (PINS Ref APP-042/ Application Ref 6.2.1) present the parameters to derive the total maximum disturbance volume for export cable installation (not including sandwave clearance). The total volume required for the consent is 900,000 m^3 (120 km length (4 cables x 30 km) x 10 m width x 3 m depth x v-shaped trench x 50% of the sediment is liquidised). This is based on the assumption that half of the material is ejected from the trench, via jetting, with the other half retained as sediment cover within the trench.

Environmental Statement

32 All technical chapters have presented the correct value (900,000m^3 except the Water Quality and Sediment Quality chapter (PINS Ref APP-044/ Application Ref 6.2.3). Table 2 presents the transcription of disturbed sediment volumes from the export cable installation.

Table 2: Transcription of disturbed sediment volumes from the export cable installation in the Application

Document	Total volume assessed (m^3)
APP-044/ 6.2.3	900,000
APP-047/ 6.2.6	180,000
APP-052/ 6.2.11	1,740,000
APP-031/ 3.2	900,000

33 The Water Quality and Sediment Quality chapter has derived information from the Project Description and presents the Rochdale Envelope/ maximum design scenario in Table 3.10 incorrectly due to a typographic error in which is states the volume is 1.2 km^2, however this should state area as opposed to volume. The chapter has assessed the correct value for the volume of disturbed sediment (900,000 m^3) based on the parameters presented in Table 3.10 (v-shaped trench, 50 of material ejected, 10 m width, 3m depth and 120km length). It is also important to note that as described in paragraph 3.10.2 of the chapter (PINS Ref APP-044/ Application Ref 6.2.3) the assessment draws on the findings within the Marine Geology, Oceanography and Physical Processes assessment (PINS Ref APP-043/ Application Ref 6.2.2) (which represented the worst case accurately). Therefore, the overall assessment is based on appropriate assumptions, and the maximum parameters presented in the Project Description (PINS Ref APP-042/ Application Ref 6.2.1). The overall assessment is therefore based on appropriate assumptions and the error in transcription does not alter the findings of the assessment.

34 The Fish and Shellfish chapter (PINS Ref APP-047/ Application Ref 6.2.6) has derived information from the Project Description and presents the Rochdale Envelope/ maximum design scenario in Table 6.7, as 180,000 m^3, incorrectly due to a transcription error (the table reads cable trench width of 1m instead of 10m, and overall volume of 180,000m^3 instead of 1,800,000m^3 which should in turn by reduced by 50% to account for 50% sediment being released into suspension). As described in paragraph 6.10.13 (PINS Ref APP-047/ Application Ref 6.2.6) the assessment draws on the findings within the Marine Geology, Oceanography and Physical Processes assessment (PINS Ref APP-043/ Application Ref 6.2.2) (which represented the worst case accurately). Therefore, the overall assessment is based on appropriate assumptions, and the maximum parameters presented in the Project Description (PINS Ref APP-042/ Application Ref 6.2.1). The overall assessment is therefore based on appropriate assumptions and the error in transcription does not alter the findings of the assessment.

35 The Infrastructure and Other Users chapter (PINS Ref APP-052/ Application Ref 6.2.11) has derived information from the Project Description and presents the Rochdale Envelope/ maximum design scenario in Table 11.10, as 1,740,000 m^3, incorrectly due to a transcription error and not reducing by 50% to account for 50% sediment being released into suspension. As described in paragraphs 6.11.25 to 6.10.34 (PINS Ref APP-052/ Application Ref 6.2.11) the assessment draws on the findings within the Marine Geology, Oceanography and Physical Processes assessment (PINS Ref APP-043/ Application Ref 6.2.2) (which represented the worst case accurately). Therefore, the overall assessment is based on appropriate assumptions, and the maximum parameters presented in the Project Description (PINS Ref APP-042/ Application Ref 6.2.1). The overall assessment is therefore based on appropriate assumptions and the error in transcription does not alter the findings of the assessment.

36 The RIAA (PINS Ref APP-031/ Application Ref 5.2) derived information from the Fish and Shellfish, and Benthic Intertidal and Subtidal ecology chapters (PINS Ref APP-047 and APP-052/ Application Refs 6.2.6 and 6.2.11) (as discussed in paragraphs 35 and 33). However, as presented in paragraph 11.2.29 (Application Ref 5.2) the RIAA draws the assessment draws on the findings within the Marine Geology, Oceanography and Physical Processes assessment (PINS Ref APP-043/ Application Ref 6.2.2) (which represented the worst case accurately). Therefore, the overall assessment is based on appropriate assumptions, and the maximum parameters presented in the Project Description (PINS Ref APP-042/ Application Ref 6.2.1). The overall assessment is therefore based on appropriate assumptions and the error in transcription does not alter the findings of the assessment.

37 The Applicant is therefore seeking consent for a maximum volume of disturbed sediment from the installation of the export cables of 900,000 m^3.

Draft DCO

38 The maximum volume of disturbed sediment from export cable installation is not presented within the draft DCO (PINS Ref APP-022/ Application Ref 3.1).

2.6 Seabed disturbance area for inter-array cable installation

Project Description

39 Ploughing the inter-array cable corridor represents the worst case area of disturbance of 0.64 km^2 (64 km x 10 m width (based on the parameters presented in Table 1.9 of the Project Description (PINS Ref APP-042/ Application Ref 6.2.1)). Whereas, the disturbance area for jetting would be of 0.3 km^2, as presented in Table 1.9 of the Project Description (PINS Ref APP-042/ Application Ref 6.2.1). Jetting represents the worst case for the generation of sediment plumes during cable installation.

Environmental Statement

40 All chapters have correctly transcribed the value, except for the offshore archaeology and cultural heritage chapter (PINS Ref APP-054/ Application Ref 6.2.13).

41 The Offshore Archelogy and Cultural Heritage (*ibid*) presents a maximum area of 0.6 km^2 which is a typographical error from rounding the value during transcription into Table 13.11 the chapter (0.64 km^2). The apparent disparity will not therefore alter the findings of the assessments.

42 The Applicant is seeking consent for a maximum area of disturbed sediment from inter-array cable installation of 0.64 km^2.

Draft DCO

43 The maximum area of disturbed sediment from inter-array cable installation is not presented within the draft DCO (PINS Ref APP-022/ Application Ref 3.1).

2.7 Seabed disturbance volume for inter-array cable installation

Project Description

44 Table 1.9 in the Project Description (offshore) (PINS Ref APP-042/ Application Ref 6.2.1) presents the parameters to derive the total maximum disturbance volume for inter-array cable installation. The total volume is 48,000 m^3 (64 km length x 1 m width x 3 m depth x v-shaped trench x 50% of the sediment is liquidised). This is based on the assumption that half of the material is ejected from the trench with the other half retained as sediment cover within the trench.

Environmental Statement

45 All technical chapters have presented the correct values except the Fish and Shellfish; Infrastructure and Other and the Report to Inform an Appropriate Assessment (PINS Ref APP-047, APP-052 and APP-031/ Applications Refs 6.2.6, 6.2.11 and 5.2). The values presented in their Rochdale envelope/ maximum design scenarios are presented in Table 3.

Table 3: Transcription of the disturbed sediment volumes from inter-array cable installation in the Application

Document (PINS Ref/ Application Ref)	Total volume of disturbed material from inter-array cable installation transcribed (m^3)
APP-047/ 6.2.6	96,000
APP-052/ 6.2.11	96,000
APP-031/ 5.2	96,000

46 The disparity between the chapters results from the assumptions applied, to the percentage of sediment liquidised during the jetting process (i.e. 50% fluidisation rather than 100%), not having been accurately transposed.

47 The Fish and Shellfish; Infrastructure and Other chapters and the RIAA have presented a greater worse case (96,000 m^3) than the consent requires due to an error in transcription of the 50% sediment into solution calculation, the assessments are however informed by the physical processes chapter which provides the correct assumptions and so the apparent disparities will not therefore alter the findings of the assessments.

48 The Applicant is seeking consent for a maximum volume of disturbed sediment from inter-array cable installation of 48,000 m^3.

Draft DCO

49 The maximum volume of disturbed sediment from inter-array cable installation is not presented within the draft DCO (PINS Ref APP-022/ Application Ref 3.1).

2.8 Impact areas from anchors

Project Description

50 The use of anchors is required during construction for the installation of infrastructure. Table 1.26 of the Project Description chapter (PINS Ref APP-042/ Application Ref 6.2.1) presents the consent area requirements for anchors for each of the infrastructure installation activities. The maximum requirements for anchoring disturbance area, as presented in the Project Description, are as follows:

- Foundation installation – 5,400 m^2 (34 x 150 m^2 (WTGs) + 150 m^2 (OSS) + 150 m^2 (met mast));
- OSS top side installation – 150 m^2;
- Export cable installation – 34,560 m^2; and
- Inter-array cables installation – 30,600 m^2.

51 Therefore, the total area of disturbance for anchor handling, from the constituents presented in Table 1.26 the Project Description (PINS Ref APP-042/ Application Ref 6.2.1), is 70,710 m^2 (5,400 m^2 + 150 m^2 + 34,560 m^2 + 30,600 m^2).

Environmental Statement

52 Benthic Intertidal and Subtidal Ecology; Fish and Shellfish; Infrastructure and Other Users; Offshore Archelogy and Cultural Heritage and the Report to Inform an Appropriate Assessment (PINS Ref APP-046, APP-047, APP-052, APP-054 and APP-031/ Applications Refs 6.2.5, 6.2.6, 6.2.11, 6.2.13 and 5.2) have derived information from the Project Description (PINS Ref APP-042/ Application Ref 6.2.1) for anchor handling impact areas. Table 4 presents the transcription of this information into the chapters.

Table 4: Transcription of disturbance footprint from anchor handling

Document PINS Ref/ Application Ref	Foundation Installation (m^2)	OSS Topside installation (m^2	Export Cable installation (m^2)	Inter-array cable installation (m^2)	Total (m^2)
APP-046/ 6.2.5	5,400	0	34,560	30,600	70,560
APP-047/ 6.2.6	5,400	150	34,560	29,700	69,810
APP-052/ 6.2.11	0	0	34,560	30,600	65,160
APP-054/ 6.2.13	5,400	150	34,560	29,700	69,810
APP-031/ 5.2	5,400	0	34,560	30,600	70,560

53 The Benthic Intertidal and Subtidal Ecology chapter and the RIAA have transcribed all parameters from the Project Description (PINS Ref APP-042/ Application Ref 6.2.1) accurately but did not include the anchor handling requirements for the installation of the topside on to the OSS (150 m^2). This is equivalent to less than 0.5% of the requested value for consent. The assessment concluded the effects to be not significant. Given the small increase in the requested area, the magnitude of impact and therefore overall significance would not change.

54 The Fish and Shellfish, and Offshore Archelogy and Cultural Heritage chapters (PINS Ref APP-047 and APP-054/ Application Refs 6.2.6 and 6.2.13) and the RIAA have transcribed that parameters from the Project Description (PINS Ref APP-042/ Application Ref 6.2.1) but have presented a maximum anchor handling area of 29,700 m^2 for inter-array cables. The chapters have therefore assessed 97.1% of the inter-array cable anchor handling area and 98.7% of the total requested consent area. The assessments have concluded the effects to be not significant. Given the small difference in area affected, the magnitude of impact and therefore overall significance would not change. Therefore, the disparity will not therefore alter the findings of the assessment.

55 The Infrastructure and Other Users chapter (PINS Ref APP-052/ Application Ref 6.2.11) has derived and presented the anchor handling requirements for the cable installation activities. The assessment considers the anchor handling as part of the cable installation activities, and how existing pipeline and cables may be subject to an increased bed depth as a result of construction activities. The chapter does not assess the footprint of these activities directly. As noted in paragraphs 11.10.21 and 11.10.28 *et seq.* the assessment draws on the findings of the Marine Geology, Oceanography and Physical Processes chapter (PINS Ref APP-043/ Application Ref 6.2.2.) (which represented the worst case accurately) and therefore is based on appropriate assumptions for changes in the sea bed level, and the maximum parameters presented in the Project Description (PINS Ref APP-042/ Application Ref 6.2.1).

56 The Applicant is seeking consent for a maximum area of disturbed sediment from anchor handling of 70,710 m^3.

Draft DCO

57 The maximum area of disturbance for anchor is not presented within the draft DCO (PINS Ref APP-022/ Application Ref 3.1).

2.9 Impact areas from jack-up vessels

Project Description

58 As presented in Table 1.25 of the Project Description (PINS Ref APP-042/ Application Ref 6.2.1) the maximum combined leg area for a single jack-up vessel (JUV) during construction will be 471.24 m^2. Therefore, the maximum sea bed disturbance area from JUVs during construction will be 32,044 m^2 (471.24 m^2 x 68 JUV visits).

Environmental Statement

59 The following technical chapters have derived information from the Project Description (PINS Ref APP-042/ Application Ref 6.2.1) and each presented the maximum sea bed disturbance as 33,929 m^2 (471.24 m^2 x 2 x 36):

- Benthic Subtidal and Intertidal Ecology (PINS Ref APP-046/ Application Ref 6.2.5);
- Fish and Shellfish (PINS Ref APP-047/ Application Ref 6.2.6);
- Infrastructure and Other Users (PINS Ref APP-052/ Application Ref 6.2.11); and
- Offshore Archaeology and Cultural Heritage (PINS Ref APP-054/ Application Ref 6.2.13).

60 The apparent disparity between the assessments and the values utilised for the DCO application means that the assessments are overly precautionary and a consent for a reduced value does not therefore alter the findings of the assessments.

61 The Applicant is seeking consent for a maximum area of disturbed sediment from JUVs during construction of 32,044 m^2.

Draft DCO

62 The maximum area of disturbance for JUVs during construction is not presented within the draft DCO (PINS Ref APP-022/ Application Ref 3.1).

2.10 Impact volume from jack-up vessels

Project Description

63 As presented in Table 1.25 of the Project Description (PINS Ref APP-042/ Application Ref 6.2.1) the maximum penetration depth for the JUVs during construction is 15 m. As describes in section 2.9, the maximum disturbance area for the JUVs during construction will be up to 32,044 m^2, therefore the maximum volume of disturbance will be 480,665 m^3 (15 m x 32,044 m^2).

Environmental Statement

64 The Offshore Archaeology and Cultural Heritage (PINS Ref APP-054/ Application Ref 6.2.13) has derived information from the Project Description (PINS Ref APP-042/ Application Ref 6.2.1) and presents the maximum volume as 508,935 m^3 (33,929 m^2 x 15 m). This discrepancy, as presented in section 2.9, arose from applying an area of 39,929m^2 (471.24 m^2 x (2 x 36 JUV visits)) as opposed to 32,044 m^2 (471.24 m^2 x 68 JUV visits). Similarly to section 2.9, the apparent disparity between the assessment and the requested value for consent means that the assessment in this case is overly precautionary and a consent for a reduced value does not therefore alter the findings of the assessment.

Draft DCO

65 The maximum volume of disturbance for JUVs during construction is not presented within the draft DCO (PINS Ref APP-022/ Application Ref 3.1).

2.11 Working area within the saltmarsh

Project Description

66 Table 1.20 of the Project Description (PINS Ref APP-042/ Application Ref 6.2.1) presents the maximum construction space required in the saltmarsh as 3,872 m^2. This value refers to the space required for the cofferdam in the intertidal area, including the seawall extension. This value is applicable to the Option 2 (seawall extension) landfall option only.

67 Option 1 (HDD) does not require working space in the saltmarsh. Whereas, Option 3 requires a smaller cofferdam and so a smaller working area in the saltmarsh.

Environmental Statement

68 All technical chapters have presented the correct values except the Water Quality and Sediment Quality and Benthic Subtidal and Intertidal Ecology chapters and the RIAA (PINS Ref APP-043, APP-046 and APP-031/ Applications Refs 6.2.3, 6.2.5 and 5.2 respectively) The Benthic Subtidal and Intertidal Ecology chapter and the RIAA have derived information from the Project Description (PINS Ref APP-042/ Application Ref 6.2.1) and have presented a maximum working area of 7,376 m^2, this value includes the cofferdam area plus the area of trenching within the saltmarsh. These transcription errors are of a greater area than the consent requires, and so the apparent disparities do not alter the findings of the assessments.

69 The Marine Water Quality and Sediment Quality (PINS Ref APP-044/ Application Ref 6.2.3) derived information from the Project Description (PINS Ref APP-042/ Application Ref 6.2.1) and presented a maximum working area of 4,702 m^2 which is based on a rectangular shape (165 m x (18.5 m +10 m (buffer)). These transcription errors are of a greater area than the consent requires, and so the apparent disparities do not alter the findings of the assessments.

70 The Applicant is seeking consent for a maximum working area within the saltmarsh of 3,872 m^2.

Draft DCO

71 The maximum working area within the saltmarsh is not presented within the draft DCO (Application Ref 3.1).

3 Clarification of parameters – Operations and Maintenance

3.1 Total footprint of foundations

Project Description

72 As described in Table 1.6 (PINS Ref APP-042/ Application Ref 6.2.1) the maximum foundation diameter is 20 m (for the 12MW), which is equivalent to a footprint area per WTG foundation of 1,256.6 m^2. It is important to note that this value is applicable to the 12MW scenario, which is the worst case for this parameter, but has 28 WTGs rather than the maximum of 34 WTGs. Table 1.13 (PINS Ref APP-042/ Application Ref 6.2.1) presents the maximum foundation diameter for the OSS is 20 m (in a tripod configuration), which is equivalent to a footprint area of 942.5 m^2. The assumptions applied for the met mast foundation, in terms of footprint, are the same as for the WTGs, and will have a maximum footprint of 1,256.6 m^2. Therefore, the maximum footprint from foundations will be 37,385 m^2 (29 x 1,256.6 m^2 (28 WTGS + met mast) + 942.5 m^2 (OSS)).

Environmental Statement

73 The Benthic Subtidal and Intertidal Ecology, Fish and shellfish chapters and the RIAA (PINS Ref APP-046, APP-047 and APP-031/ Applications Refs 6.2.5, 6.2.6 and 5.2) have derived information from the Project Description (PINS Ref APP-042/ Application Ref 6.2.1) and have presented a maximum footprint area as 37,680 m^2 (1,256 m^2 x 30). This disparity is due to applying the WTG foundation assumptions to the OSS (1,256 m^2) instead of applying those set out above (942.5 m^2). These transcription errors are of a greater area than the consent requires and therefore the apparent disparities do not alter the findings of the assessments.

74 The Applicant is seeking consent for a maximum foundation footprint will be 37,385 m^2.

Draft DCO

75 The maximum footprint area of the foundations is not presented within the draft DCO (PINS Ref APP-022/ Application Ref 3.1).

3.2 Total Scour Protection Area Requirements

Project Description

76 Table 1.7 of the Project Description (PINS Ref APP-042/ Application Ref 6.2.1) presents the worst case scenario parameters for scour protection for WTGs as 219,912 m^2 (defined as 7,854 m^2 per WTG foundation). Table 1.13 (PINS Ref APP-042/ Application Ref 6.2.1) presents the worst case scour protection area for the OSS (including the footprint of the structure) as 7,854 m^2. Whilst the scour protection area for the met mast has not been explicitly presented in the Project Description (PINS Ref APP-042/ Application Ref 6.2.1) it has been assessed within the technical chapters on the basis of assuming the same worst case requirements as the WTG foundations, i.e. 7,854 m^2. Therefore, the maximum scour protection area is 235,620 m^2 (219,912 m^2 (WTGs)+7,854 m^2 (OSS) + 7,854 m^2 (met mast)).

Environmental Statement

77 All technical chapters have correctly presented this figure, with the exception of the Fish and shellfish chapter (PINS Ref APP-047Applications Ref 6.2.6).. Table 5 presents the transcription of the information into the chapter.

Table 5: Transcription of maximum scour protection area

Document (PINS Ref/ Application Ref)	Derived total scour protection area (m^2)
APP-047/ 6.2.6	267,036

78 The disparity in the Fish and Shellfish chapter (Application Ref 6.2.6) has arisen from a transcription error of 8,901.2 m^2 as opposed to 7,854 m^2 per foundation (28 x 8,901.2 m^2 (WTGs) + 8,901.2 m^2 (OSS) + 8,901.2 m^2 (met mast) = 267,036 m^2). The assessment has assessed a greater area than the required consent and concluded the effect to be not significant. The apparent disparity between the assessment and the requested value for consent means that the assessment in this case is overly precautionary and a consent for a reduced value does not alter the findings of the assessment.

79 The Applicant is seeking consent for a maximum scour protection for the foundations of 235,620 m^2.

Draft DCO

80 The draft DCO (PINS Ref APP-022/ Application Ref 3.1) does not present the maximum scour protection area for foundations.

3.3 Total Scour Protection Volume Requirements

Project Description

81 Table 1.7 of the Project Description (PINS Ref APP-042/ Application Ref 6.2.1) presents the worst case scenario parameters for scour protection volume for WTGs as 1,112,674.4 m^3. Whilst the scour protection volume for the offshore substation (OSS) (including the footprint of the structure) or the met mast, has not been explicitly presented in the Project Description (PINS Ref APP-042/ Application Ref 6.2.1) they have been assessed within the technical chapters on the basis of assuming the same WTG foundation worst case requirements for all infrastructure. The worst case volume for the OSS and the met mast is 39,269.9 m^3 as per a WTG foundation presented in Table 1.7 of the Project Description (PINS APP-042/ Application Ref 6.2.1).

82 Therefore, the maximum scour protection area, as presented in Project Description Audit Clarification Note (Annex A of the Applicants' Response to Relevant Representations of the Deadline 1 submission (Appendix 1)), is 1,191,187.2 m^3 (1,112,647.4 m^3 (WTGs)+39,269.9 m^3 (OSS) + 39,269.9 m^3 (met mast)).

Environmental Statement

83 The technical chapters do not assess the maximum scour protection volume.

Draft DCO

84 Requirement 5 of the draft DCO (PINS Ref APP-022/ Application Ref 3.1) provides a total volume of scour protection of 1,112,647 m^3. This disparity has arisen from a transcription of the scour protection volume for the WTGs only, and this figure does not include the requirements for the OSS and met mast. This disparity has been addressed in the revised draft DCO submitted with Deadline 1, which will include a maximum value of 1,191,187.2m^3. Within the revised draft DCO, the updated generation DML will include a maximum value of 1,151,917.3 m^3 (WTGs (1,112,674.4 m^3) and a met mast (39,269.9 m^3)) and the updated export cable DML will include a maximum value of 39,269.9 m^3 (for the OSS); to account for the potential scour protection volume required within the consent.

3.4 Total Cable Protection Area Requirements

Project Description

85 As presented in Table 1.16 in the Project Description (offshore) (PINS Ref APP-042/ Application Ref 6.2.1), a maximum of 25% of the export cables may require cable protection, which is equivalent to an area of 210,000 m^2. In addition, there may be a requirement for an additional 80,000 m^2 of cable protection for cable crossings (80 x 1000 m^2), as presented in Table 1.17 in the Project Description (PINS Ref APP-042/ Application Ref 6.2.1). Therefore, the export cables will require a maximum of 290,000 m^2 of cable protection.

86 As presented in Table 1.9 (PINS Ref APP-042/ Application Ref 6.2.1), a maximum of 25% of the inter-array cables may require cable protection, which is equivalent to an area of 80,000 m^2. There may be a requirement for up to additional 12,000 m^2 of cable protection for cable crossings (12 x 1000 m^2), as presented in Table 1.10 in the Project Description (PINS Ref APP-042/ Application Ref 6.2.1). In addition, Table 1.9 (PINS Ref APP-042/ Application Ref 6.2.1) presents the requirement for remedial protection of 17,500 m^2 for j-tubes. Therefore, the inter-array cables will require a maximum of 109,500 m^2 of cable protection.

87 Therefore, the maximum area of cable protection presented within in the Project Description Audit Clarification Note (Annex A of the Applicants' Response to Relevant Representations of the Deadline 1 submission (Appendix 1)) is 399,000 m^2 ((290,000 m^2 (export cables) + 109,5000 m^2 (inter-array cables)).

Environmental Statement

88 The following ES chapters have derived information from the Project Description (PINS Ref APP-042/ Application Ref 6.2.1) and have assessed the area of cable protection within their assessments, as presented in Table 6.

Table 6: Transcription of cable protection area in the Application

Document (PINS Ref/ Application Ref)	Inter-array cable protection (m^2)	Inter-array cable crossing protection (m^2)	Export cable protection (m^2)	Export cable crossing protection (m^2)	Remedial protection for j-tubes (m^2)	Total (m^2)
APP-043/ 6.2.2	80,000	12,000	210,000	80,000	0	382,000
APP-046/ 6.2.5	80,000	12,000	210,000	80,000	17,500	399,500
APP-047/ 6.2.6	80,000	12,000	210,000	80,000	0	382,000
APP-054/ 6.2.13	80,000	12,000	210,000	80,000	0	382,000
APP-031/ 5.2	80,000	12,000	210,000	80,000	17,500	399,500

89 Each of the technical chapters derived the requirements for the cable protection (including crossings) from the Project Description (PINS Ref APP-042/ Application 6.2.1) and state a maximum cable protection area of 290,000 m^2 for export cables and 92,000 m^2 for inter-array cables (80,000 m^2 for the cables and 12,000 m^2 for cable crossings). As presented in Table 6, there are disparities in applying the remedial protection requirement for the j-tubes.

90 The Benthic Subtidal and Intertidal Ecology chapter and the RIAA (PINS Ref APP-046 and APP-031/ Application Refs 6.2.5 and 5.2) have transcribed and considered the cable protection requirements for j-tubes (17,500 m^2) in addition to the inter-array cable protection and crossings. Therefore, these assessments present a total of cable protection area of 399,500 m^2.

91 It should be noted that the worst case, in terms of calculating area of habitat loss or change, is derived from new material being put on the seafloor. Protection for J-tubes would in reality be coincidental with the scour protection material for foundations. Therefore, under this worst case scenario the use of protection for j-tubes would be placed on top of the foundations scour protection, and so would essentially be double counting of the area. Therefore, the magnitude of impacts assessed within the technical chapters have been appropriately assessed (PINS Ref APP-043, APP-047 and APP-054/ Application Refs 6.2.2, 6.2.6 and 6.2.13) and therefore there would be no change in the overall significance.

92 The Applicant is seeking to consent a maximum protection area of 382,000 m^2 for cabling.

3.5 Total Cable Protection Volume Requirements

Project Description

93 As presented in Project Description Audit Clarification Note (Annex A of the Applicants' Response to Relevant Representations of the Deadline 1 submission) a maximum area of cable protection is presented, a post lay berm height of which is 0.5m. The volume of cable protection of 105,000 m^3 (210,000 m^2 x 0.5 m) is required for the export cables. In addition, there may be a requirement for an additional 40,000 m^3 of cable protection for cable crossings (80 x 500 m^3), as presented in Table 1.17 (PINS Ref APP-042/ Application Ref 6.2.1). Therefore, the export cables will require a maximum volume of 145,000 m^3 of cable protection.

94 Based on the parameters presented in Table 1.9 (PINS Ref APP-042/ Application Ref 6.2.1) this is the equivalent volume of 20,000 m^3 (16 km x 1,250 m^3 km^{-1}) for inter-array cables. There may be a requirement for up to additional 6,000 m^3 of cable protection for inter-array cable crossings as presented in Table 1.10 (Application Ref 6.2.1). In addition, Table 1.9 (PINS Ref APP-042/ Application Ref 6.2.1) presents the requirement for remedial protection of 8,750 m^3 for j-tubes (17,500 m^2 x 0.5 m depth). Therefore, the inter-array cables will require a maximum volume of 34,750 m^3 of cable protection.

95 Therefore, the maximum volume of cable protection presented within in the Project Description (PINS Ref APP-042/ Application Ref 6.2.1) is 179,750 m^3 (145,000 m^3 (export cables) + 34,750 m^3 (inter-array cables)).

Environmental Statement

96 The technical chapters do not assess the maximum cable protection volume.

97 The Applicant is seeking to consent a maximum scour protection volume of 179,750 m^3 for cabling.

Draft DCO

98 Schedule 11, Part 4, Condition 3 of the draft DCO (PINS Ref APP-022/ Application Ref 3.1) provides a total volume and length of cable protection of 92,000 m^3 for the inter-array cables. This will be amended in the revised draft DCO to a maximum value of 34,750 m^3. Schedule 12, Part 4, Condition 3 of the draft DCO (ibid) has transcribed information from the Project Description and presents a total volume for export cables of 145,000 m^3.

3.6 Seabed disturbance area during O&M activities

Project Description

99 As presented in Project Description Audit Clarification Note (Annex A of the Applicants' Response to Relevant Representations of the Deadline 1 submission) the maximum disturbance area is 4,111,801 m^2 for O&M activities, consisting of:

- Export Cable O&M works – 72,000 m^2 (Table 1.33 of the Project Description);
- Inter-array cable O&M replacement – 140,000 m^2 (Table 1.31 of the Project Description);
- Inter-array cable O&M reburial – 3,840,000 m^2 (Table 1.32 of the Project Description);
- JUV foot prints for OSS O&M operations - 2,121 m^2 (Table 1.35 of the Project Description); and
- JUV for prints for WTG O&M operations – 57,680 m^2 (169.65 m^2 x 340) (Table 1.34 of the Project Description).

Environmental Statement

100 All technical chapters correctly transcribe the parameters for O&M activities.

101 The Applicant is seeking to consent a maximum disturbance area for the O&M activities of 4,111,801 m^2.

Draft DCO

102 The maximum disturbance area for O&M activities is not presented within the draft DCO (PINS Ref APP-022/ Application Ref 3.1). However, the O&M activities are presented in the Summary of Environmental Impact Assessment for Offshore Maintenance Activities (PINS Ref APP-145/ Application Ref 8.10) accurately.

3.7 Seabed disturbance volume during O&M activities

Project Description

103 As presented in Project Description Audit Clarification Note (Annex A of the Applicants' Response to Relevant Representations of the Deadline 1 submission (Appendix 1)) the maximum disturbance volume is 3,039,000 m^3 for O&M activities, consisting of:

- Export cable O&M works – 54,000 m^3 (72,000 m^2 x 3 m (depth) x v-shaped trench x 50% of sediment liquidised) (Table 1.33 of the Project Description); and

- Inter-array cable O&M works – 2,985,000 m^3 (3,980,000 m^2 x 3 m (depth) xv-shaped trench x 50% of sediment liquidised) (Table 1.31 and Table 1.32 of the Project Description).

Environmental Statement

104 The Fish and Shellfish chapter (PINS Ref APP-047/ Application Ref 6.2.6) derived the maximum sediment disturbance area for the O&M activities from the constituents provided within the Project Description (PINS Ref APP-042/ Application Ref 6.2.1) and the assessment states a maximum value of 596,700 m^3.

105 As highlighted in paragraphs 6.11.53 to 6.11.56 the assessment of the O&M phases draws on the information presented in the construction phases of work, including the assessment, of increased suspended sediment concentrations arising from cable installation activities, undertaken in the Marine Geology, Oceanography and Physical Processes (PINS Ref APP-043/ Application Ref 6.2.2) chapter. As stated in paragraph 6.11.54 of the Fish and Shellfish chapter (PINS Ref APP-047/ Application Ref 6.2.6) "the potential impact in the O&M phase will be more limited, less frequent, intermittent and localised, they will fall within the envelope assessed for the construction phase" which has been appropriately assessed. Therefore, despite the transcription errors into the maximum design envelope table within the Fish and Shellfish chapter the magnitude and so the significance of the effect have been adequately assessed and the findings of the assessment are based on appropriate assumptions and the maximum parameters presented in the Project Description (PINS Ref APP-042/ Application Ref 6.2.1).

106 The Applicant notes that the Marine Geology, Oceanography and Physical Processes chapter (PINS Ref APP-043/ Application Ref 6.2.2) does not explicitly present the maximum disturbance volume for O&M activities. However, as stated in paragraph 2.11.101 of the Marine Geology, Oceanography and Physical Processes chapter (PINS Ref APP-043/ Application Ref 6.2.2) the assessment (in paragraphs 2.10.32 *et seq.*) of SSC and associated bed level change during the construction phase utilises similar techniques, if the activities are required.

107 The Applicant notes that the Benthic Subtidal and Intertidal Ecology chapter (PINS Ref APP-046/ Application Ref 6.2.5) does not explicitly present the maximum disturbance volume for O&M activities. However, the assessment of cable repair works, including reburial, is provided in paragraphs 5.11.26 *et seq* and is based on appropriate assumptions and the maximum parameters presented in the Project Description (PINS Ref APP-042/ Application Ref 6.2.1). Therefore, this disparity will not alter the findings of the assessment.

108 Therefore, the Applicant is seeking to consent a maximum disturbance volume for the O&M activities of 3,039,000m^3.

Draft DCO

109 The maximum disturbance sediment volume for O&M activities is not presented within the draft DCO (PINS Ref APP-022/ Application Ref 3.1).

3.8 O&M vessel numbers

Project Description

110 As presented in Table 1.30 of the Project Description (PINS Ref APP-042/ Application Ref 6.2.1) the total number of O&M round trips to port undertaken by O&M vessels will be 307 per year. These trips will be undertaken by six vessels in total (two small CTV O&M vessels, one large O&M vessel, one lift vessel, one cable maintenance vessel and three auxiliary vessels).

Environmental Statement

111 The Offshore Ornithology, Marine Mammals, Infrastructure and Other Users and Shipping and Navigation chapters (PINS Ref APP-045, APP-048, APP-052 and APP-051/ Application Refs 6.2.4, 6.2.7, 6.2.11 and 6.2.10) each derived the O&M vessel parameters from the Project Description (PINS Ref APP-042/ Application Ref 6.2.1). The Marine Mammals and Infrastructure and Other Users chapters have assessed 307 vessel movements per year, but both have presented the number of vessels as five, this is a typographical error and does not affect the findings of the assessments as the total vessel movements have been accurately transcribed and considered.

112 The Shipping and Navigation chapter (PINS Ref APP-051/ Application Ref 6.2.10) has assessed two transits per day, this is precautionary, as 307 transits per year is equivalent to approximately 0.84 transits per day. The assessments have assessed a greater number of transits than the required consent and concluded the effect to be not significant. The apparent disparity between the assessment and the requested value for consent means that the assessment in this case is overly precautionary and a consent for a reduced value does not therefore alter the findings of the assessment.

Draft DCO

113 The maximum number of vessels and trips are not presented within the draft DCO (PINS Ref APP-022/ Application Ref 3.1).

3.9 Safety zones

Environmental Statement

114 The safety zones are not provided within the Project Description (PINS Ref APP-042/ 6.2.1) but are considered to be best working practice. The following safety zones may be applied for:

- 500 m surrounding all construction activities and vessels; and
- O&M activities:
  - 50 m surrounding WTGs;
  - 50 m surrounding the Met Mast;
  - 50 m surrounding the OSS substation; and
  - 500 m surrounding any major maintenance activities.

115 Commercial Fisheries; Shipping and Navigation; and Infrastructure and Other Users (PINS Ref APP-047, APP-050, APP-051 and APP-052/ Application Refs 6.2.9, 6.2.10 and 6.2.11) have each presented the safety zones as defined in paragraph 115.

116 The Fish and Shellfish chapter (PINS Ref APP-047/ Application Ref 6.2.6) presents the maximum safe working area surrounding the infrastructure of 1,052,035 m^2 during the O&M phase, there is a slight disparity as the chapter has not accounted for the met mast foundation and a typographic error where the chapter considered a 500 m safety zone surrounding the OSS. The maximum extent of permanent safety zonesis 282,743 m^2 (34 WTG (50 m buffer), one met mast (50 m buffer) and one OSS (50 m buffer)). Paragraph 6.11.71 of the Fish and Shellfish chapter (PINS Ref APP-047/ Application Ref 6.2.6) identifies that the overall effect will be Negligible beneficial, therefore reducing this area to account for the disparity, will not alter the findings of this assessment and net beneficial effect is still anticipated.

Draft DCO

117 The safety zones are not presented within the draft DCO (PINS Ref APP-022/ Application Ref 3.1) as they would be applied for under separate legislation.

Table 7: Project Transcription audit

Phase	Infra Type	Description	Requested consent value	PINS Ref /Application Ref															
				APP-043/ 6.2.2	APP-044/ 6.2.3	APP-045/6.2 .4	APP-046/6.2 .5	APP-047/6.2 .6	APP-048/6.2 .7	APP-049/ 6.2.8	APP-050/ 6.2.9	APP-051/6.2 .10	APP-052/6.2 .11	APP-053/6.2 .12	APP-054/6.2 .13	APP-055/6.2 .14	APP-148/ 8.14	APP-083/6.4 .5.3	APP-031/ 5.2
Construction	Export Cables	Width per cable jetting (m)	10	10	10	N/A	10	1	n/a	N/A	N/A	N/A	10	n/a	10	N/A	N/A	N/A	1
		Width per cable ploughing (m)	12	12	N/A	N/A	12	12	12	N/A	N/A	N/A	N/A	n/a	12	N/A	N/A	N/A	N/A
		Length per cable (m)	30,000	30,000	30,000	N/A	30,000	30,000	30,000	N/A	N/A	23,000	30,000	n/a	30,000	N/A	N/A	20,000	30,000
		Depth (m)	3	3	3	N/A	3	3	3	N/A	N/A	N/A	3	n/a	3	N/A	N/A	N/A	3
		Disturbance Area (jetting) (km^2)	1.2	N/A	1.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	n/a	1.2	N/A	N/A	N/A	N/A
		Pre-sweeping Area of the OECC (km^2)	0.48	0.48	0.48	N/A	0.48	0.48	N/A	N/A	5kmper cable≠	N/A	0.48	N/A	0.48	N/A	N/A	N/A	0.48
		Disturbance area for pre-lay grapnel run along EC route (km^2)	2.4	N/A	N/A	N/A	N/A	2.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Disturbance area for EC in intertidal (m^2)	80,000	N/A	N/A	N/A	80,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Disturbance area for EC in subtidal (m^2)	1,440,000	1,440,000	1,440,000	N/A	1,440,000	1,440,000	1,440,000	N/A	N/A	N/A	1,440,000	N/A	N/A	N/A	1,440,000	N/A	1,440,000
		Total volume of sediment removed via pre-sweeping(m^3)	1,440,000	1,440,000	1,440,000	n/a	1,440,000	1,440,000	n/a	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1,440,000	N/A	N/A
		Seabed Volume disturbed during export cable installation (m^3)	900,000	900,000	1,200,000	N/A	900,000	180,000	N/A	N/A	N/A	N/A	1,740,000	N/A	N/A	N/A	N/A	N/A	180,000 & 1,740,000
		Disturbance area for EC in intertidal (m^2)	80,000	N/A	N/A	N/A	80,000.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	80,000
		HDD pit dimensions (m)	20x20	20x20	20x20	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20x20	N/A	N/A	N/A	N/A
		Cofferdam dimensions (m)	165x25	165x25	165x25	N/A	165x25	N/A	165x25	N/A	N/A	N/A	N/A	N/A	165x25	N/A	N/A	N/A	165x25
		Seawall dimensions (m)	155x18.5	155x18.5	N/A	N/A	155x18.5	N/A	155x18.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	155x18.5
		Permanent Saltmarsh Loss (m^2)	1,398.9	1,398.9	N/A	N/A	1,400	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1,399
		Working area in saltmarsh (m^2)	3,872	N/A	4,702	N/A	7,376	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3,872	N/A	N/A	N/A	7,376
	Inter-array cables	Length (km)	64	64	64	N/A	6	64	64	N/A	64	N/A	64	N/A	64	N/A	N/A	N/A	64
		Width (m)	1	1	*	N/A	1	1	1	N/A	N/A	N/A	1	N/A	1	N/A	N/A	N/A	1
		Depth (m)	3	3	3	N/A	N/A	3	3	N/A	N/A	N/A	3	N/A	N/A	N/A	N/A	N/A	3
		Disturbance Area (km^2)	0.64	*	0.30	N/A	0.64	0.64	0.30	N/A	N/A	N/A	N/A	N/A	0.60	N/A	N/A	N/A	0.64
		Disturbance Volume (m^3)	48,000	48,000	N/A	N/A	48,000	96,000	*	N/A	N/A	N/A	96,000	N/A	N/A	N/A	N/A	N/A	96,000
		Disturbed sediment areafrom IAC installation (km^2)	0.64	N/A	N/A	N/A	0.64	1	0.3	N/A	N/A	N/A	N/A	N/A	0.6	N/A	N/A	N/A	N/A

Phase	Infra Type	Description	Requested consent value	PINS Ref /Application Ref															
				APP-043/ 6.2.2	APP-044/ 6.2.3	APP-045/6.2 .4	APP-046/6.2 .5	APP-047/6.2 .6	APP-048/6.2 .7	APP-049/ 6.2.8	APP-050/ 6.2.9	APP-051/6.2 .10	APP-052/6.2 .11	APP-053/6.2 .12	APP-054/6.2 .13	APP-055/6.2 .14	APP-148/ 8.14	APP-083/6.4 .5.3	APP-031/ 5.2
	Foundations	Total seabed preparation volume per WTG (m^3)	9,600	9,600	9,600	N/A	9,60	9,600	9,600	N/A	N/A	N/A	*	N/A	N/A	N/A	N/A	N/A	9,600
		Total seabed preparation volume per OSS (m^3)	9,600	9,600	9,600	N/A	9,600	9,600	N/A	N/A	N/A	N/A	*	N/A	N/A	N/A	N/A	N/A	9,600
		Total seabed preparation volume for the met mast (m^3)	9,600	9,600	N/A	N/A	9,600	9,600	N/A	N/A	N/A	N/A	*	N/A	N/A	N/A	N/A	N/A	9,600
		Total seabed preparation volume (m^3)	288,000	288,000	268,800	N/A	288,000	288,000	N/A	N/A	N/A	N/A	288,000	N/A	N/A	N/A	N/A	N/A	288,000
		Seabed preparation area per WTGs (m^2)	3,200	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3,200	N/A	N/A	N/A	N/A
		Total seabed prep for foundations (m^2)	96,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	89,600 & OSS	N/A	N/A	N/A	N/A
		Maximum spoil (drilling) volume per foundation (m^3) (max)	1,325	1,325	1,325	N/A	*	*	1,325	N/A	N/A	N/A	N/A	N/A	*	*	1,325	N/A	N/A
		Spoil (drilling) volume WTGs (m^3)	19,627	19,627	22,531	N/A	*	20,527	19,627	N/A	N/A	N/A	N/A	N/A	*	*	19,627	N/A	N/A
		Spoil (drilling) volume per OSS (m^3)	1,000	900	1,000	N/A	*	*	900	N/A	N/A	N/A	N/A	N/A	*	*	1,000	N/A	N/A
		Spoil (drilling) volume per foundation (met mast) (m^3)	1,155	1,325	1,325	N/A	*	*	*	N/A	N/A	N/A	N/A	N/A	*	*	1,155	N/A	N/A
		Spoil (drilling) Volume Total(m^3)	21,782	21,852	23,531	N/A	N/A	n/a	21,852	N/A	N/A	N/A	20,782	N/A	*	*	21,782	N/A	N/A
		Maximum Hammer energy (kJ)	5,000	N/A	N/A	5,000	5,000	5,000	5,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5,000
		Maximum total piling duration (hours)	300	N/A	N/A	*	N/A	300	300	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	300
		Minimum Spacing of WTGs (m)	716x480	716x480	716x480	716x480	N/A	N/A	N/A	N/A	716x 480	760x 418	N/A	WCS∞	N/A	N/A	N/A	N/A	716x 480
	Anchor Handling	Seabed disturbance area from foundations (m^2)	5,400	N/A	N/A	N/A	5,400	5,400	N/A	N/A	N/A	N/A	N/A	N/A	5,400	N/A	N/A	N/A	5,400
		Seabed disturbance area from OSS topside installation (m^2)	150	N/A	N/A	N/A	*	150	N/A	N/A	N/A	N/A	N/A	N/A	150	N/A	N/A	N/A	*
		Seabed disturbance area from export cable installation (m^2)	34,560	N/A	N/A	N/A	34,560	34,560	N/A	N/A	N/A	N/A	34,560	N/A	34,560	N/A	N/A	N/A	34,560
		Seabed disturbance area from inter-array cable installation (m^2)	30,600	N/A	N/A	N/A	30,600	29,700	N/A	N/A	N/A	N/A	30,600	N/A	29,700	N/A	N/A	N/A	30,600
		Total Seabed disturbance area (m^2)	70,710	N/A	N/A	N/A	70,560	69,810	N/A	N/A	N/A	N/A	65,160	N/A	69,810	N/A	N/A	N/A	70,560
	JU Vs	Seabed disturbance area per foundations (m^2)	942.5	N/A	N/A	N/A	942.5	*	N/A	N/A	N/A	N/A	*	N/A	N/A	N/A	N/A	N/A	942.5

Phase	Infra Type	Description	Requested consent value	PINS Ref /Application Ref															
				APP-043/ 6.2.2	APP-044/ 6.2.3	APP-045/6.2 .4	APP-046/6.2 .5	APP-047/6.2 .6	APP-048/6.2 .7	APP-049/ 6.2.8	APP-050/ 6.2.9	APP-051/6.2 .10	APP-052/6.2 .11	APP-053/6.2 .12	APP-054/6.2 .13	APP-055/6.2 .14	APP-148/ 8.14	APP-083/6.4 .5.3	APP-031/ 5.2
		Seabed disturbance area from OSS topside installation (m^2)	942.5	N/A	N/A	N/A	942.5	*	N/A	N/A	N/A	N/A	*	N/A	N/A	N/A	N/A	N/A	942.5
		Seabed disturbance area from export cable installation (m^2)	942.5	N/A	N/A	N/A	942.5	*	N/A	N/A	N/A	N/A	*	N/A	N/A	N/A	N/A	N/A	942.5
		Total seabed disturbance area from foundations (m^2)	32,044	N/A	N/A	N/A	33,929	33,930	N/A	N/A	N/A	N/A	39,329	N/A	33,929	N/A	N/A	N/A	33,929
		Disturbance volume from JUV footprints during foundation installation assuming maximum penetration (m^2)	480,665	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	508,935	N/A	N/A	N/A	N/A
	Vessels	Construction vessel round trips per year	1,160	N/A	N/A	N/A	1,160	N/A	1,160	N/A	N/A	N/A	1,160	N/A	N/A	N/A	N/A	N/A	1,160& 1,268±
		Maximum number of construction Vessels on site	48	N/A	N/A	48	N/A	N/A	48	N/A	48	48	N/A	N/A	48	N/A	N/A	N/A	48
O&M	Export Cable	Total area of cable protection in OECC (excluding crossings) (m^2)	210,000	*	N/A	N/A	*	210,000	N/A	N/A	N/A	*	N/A	N/A	210,000	N/A	N/A	N/A	210,000
O&M		% of EC requiring protection	25	25	N/A	N/A	25	25	25	N/A	N/A	N/A	N/A	N/A	25	N/A	N/A	N/A	25
O&M		Total area for cable crossings in the OECC (m^2)	80,000	80,000	N/A	N/A	*	80,000	N/A	N/A	N/A	N/A	N/A	N/A	80,000	N/A	N/A	N/A	80,000
O&M		Total area of cable protection in OECC (including crossings) (m^2)	290,000	*	N/A	N/A	*	290,000	N/A	N/A	N/A	N/A	N/A	N/A	290,000	N/A	N/A	N/A	290,000
O&M	Inter-array cables	Area of cable protection for IAC (excluding crossing)(m^2)	80,000	*	N/A	N/A	80,000	80,000	N/A	N/A	N/A	N/A	N/A	N/A	80,000	N/A	N/A	N/A	80,000
O&M		Area of protection for J-tubing (m^2)	17,500	N/A	N/A	N/A	17,500	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	17,500
O&M		Area of cable protection for IAC (crossing)(m^2)	12,000	12,000	N/A	N/A	12,000	12,000	N/A	N/A	N/A	N/A	N/A	N/A	12,000	N/A	N/A	N/A	12,000
O&M		Total cable protection for IAC (including crossings) (m^2)	92,000	*	N/A	N/A	*	92,000	N/A	N/A	N/A	N/A	N/A	N/A	*	N/A	N/A	N/A	*
O&M	Scour protectio	Maximum area of scour protection for WTGs (m^2)	219,912.0	N/A	N/A	N/A	219,912	251,328	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	219,912
O&M		Maximum area of scour protection for a OSS (m^2)	7,854	N/A	N/A	N/A	7,854	8901.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7,854

Phase	Infra Type	Description	Requested consent value	PINS Ref /Application Ref															
				APP-043/ 6.2.2	APP-044/ 6.2.3	APP-045/6.2 .4	APP-046/6.2 .5	APP-047/6.2 .6	APP-048/6.2 .7	APP-049/ 6.2.8	APP-050/ 6.2.9	APP-051/6.2 .10	APP-052/6.2 .11	APP-053/6.2 .12	APP-054/6.2 .13	APP-055/6.2 .14	APP-148/ 8.14	APP-083/6.4 .5.3	APP-031/ 5.2
O&M		Maximum area of scour protection for a met mast (m^2)	7,854	N/A	N/A	N/A	7,854	8901.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7,854
O&M		Total Maximum area of scour protection (m^2)	235,620	N/A	N/A	N/A	235,620	267,036	N/A	N/A	N/A	N/A	N/A	N/A	235,620	N/A	N/A	N/A	235,620
O&M	Foundations	Maximum footprint area per WTGs (m^2)	1,256.6	N/A	N/A	N/A	1,256	1,256	N/A	N/A	N/A	N/A	N/A	N/A	*	N/A	N/A	N/A	1,256
O&M		Maximum footprint area per OSS (m^2)	942.5	N/A	N/A	N/A	1,256	1,256	N/A	N/A	N/A	N/A	N/A	N/A	*	N/A	N/A	N/A	1,256
O&M		Maximum footprint area per met mast (m^2)	1,256.6	N/A	N/A	N/A	1,256	1,256	N/A	N/A	N/A	N/A	N/A	N/A	*	N/A	N/A	N/A	1,256
O&M		Maximum footprint area for foundations (m^2)	37,385	N/A	N/A	N/A	37,680	37,680	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	37,680
O&M	JUVs	Maximum JUV disturbance area for WTG O&M activities (m^2)	57,680	N/A	N/A	N/A	N/A	38,453	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
O&M		Maximum JUV disturbance area for OSS O&M activities (m^2)	2,121	N/A	N/A	N/A	N/A	1,470	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
O&M	General	Safe working area surrounding infrastructure (m^2)	1,060,288	N/A	N/A	N/A	N/A	1,052,035	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
O&M	O&M activities	Maximum area of disturbance for IAC replacement (m^2)	140,000	N/A	N/A	N/A	*	140,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
O&M		Maximum area of disturbance for IAC reburial (m^2)	3,840,000	N/A	N/A	N/A	*	3,840,000	*	N/A	*	N/A	N/A	N/A	*	N/A	N/A	N/A	N/A
O&M		Maximum area of disturbance for export cable O&M works (m^2)	72,000	N/a	N/A	N/A	*	72,000	*	N/A	*	N/A	N/A	N/A	*	N/A	N/A	N/A	N/A
O&M		Total maximum area of disturbance for O&M cable works (m^2)	4,111,801	N/a	N/A	N/A	*	4,111,801	*	N/A	*	N/A	N/A	N/A	*	N/A	N/A	N/A	N/A
O&M		Maximum volume of disturbance for IAC replacement (m^3)	105,000	N/A	N/A	N/A	*	576,000	*	N/A	*	N/A	N/A	N/A	*	N/A	N/A	N/A	N/A
O&M		Maximum volume of disturbance for export cable O&M works replacement (m^3)	54,000	N/A	N/A	N/A	*	2,700	*	N/A	*	N/A	N/A	N/A	*	N/A	N/A	N/A	N/A
O&M		Total maximum volume of disturbance for O&M cable works (m^3)	3,039,000	N/A	N/A	N/A	*	596,700	*	N/A	*	N/A	N/A	N/A	*	N/A	N/A	N/A	N/A

Phase	Infra Type	Description	Requested consent value	PINS Ref /Application Ref														
				APP-043/ 6.2.2	APP-044/ 6.2.3	APP-045/6.2 .4	APP-046/6.2 .5	APP-047/6.2 .6	APP-048/6.2 .7	APP-049/ 6.2.8	APP-050/ 6.2.9	APP-051/6.2 .10	APP-052/6.2 .11	APP-053/6.2 .12	APP-054/6.2 .13	APP-055/6.2 .14	APP-148/ 8.14	APP-083/6.4 .5.3	APP-031/ 5.2
O&M	WTGs	Maximum rotor blade diameter (m)	220	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	220	N/A	220	N/A	N/A	N/A	N/A	N/A
O&M		Minimum height of lowest blade tip above HAT (m)	22	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	22	N/A	22	N/A	N/A	N/A	N/A	N/A
O&M	Vessels	Maximum number of O&M vessels on site	6	N/A	N/A	6	N/A	N/A	5	N/A	N/A	*	5	N/A	N/A	N/A	N/A	N/A	N/A
O&M		O&M vessel round trips per year	307	N/A	N/A	307	307	N/A	307	N/A	N/A	N/A	307	N/A	307	N/A	N/A	N/A	307
O&M		Safe working distance around all infrastructure during construction (m)	500	N/A	N/A	N/A	N/A	N/A	N/A	N/A	500	500	500	N/A	N/A	N/A	N/A	N/A	N/A
O&M		Advisory safe working distance around all construction vessels (m)	500	N/A	N/A	N/A	N/A	N/A	N/A	N/A	500	500	500	N/A	N/A	N/A	N/A	N/A	N/A
O&M		Safe working distance from WTGs (m)	50	N/A	N/A	N/A	N/A	50	N/A	N/A	50	50	50	N/A	N/A	N/A	N/A	N/A	N/A
O&M		Safe working distance from OSS (m)	50	N/A	N/A	N/A	N/A	500	N/A	N/A	50	50	50	N/A	N/A	N/A	N/A	N/A	N/A
O&M		Safe working distance around all major maintenance activities (m)	500	N/A	N/A	N/A	N/A	500	N/A	N/A	500	500	500	N/A	N/A	N/A	N/A	N/A	N/A

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Vattenfall Wind Power Ltd

Thanet Extension Offshore Wind Farm

Appendix 1, Annex C of Deadline 1 Submission: Red-throated diver cumulative (EIA) and in-combination (HRA) impact assessment methodology

Relevant Examination Deadline: 1

Submitted by Vattenfall Wind Power Ltd

Date: January 2019

Revision A

Drafted By:	APEM Ltd
Approved By:	Daniel Bates
Date of Approval:	January 2019
Revision:	A

Draft 0	Draft Document submitted to Natural England for Consultation
Draft 1	Second Draft Document submitted to Natural England post-consultation ahead of Written Representations
Revision A	Original Document submitted to the Examining Authority
N/A	

Contents

Figures

Tables

1 Introduction

1.1 Background

1 Vattenfall Wind Power Ltd (VWPL) is developing the Thanet Extension Offshore Wind Farm (Thanet Extension) off the coast of Kent. This proposal has been the subject of detailed assessment both as the project alone and cumulatively / in-combination with other developments.

2 Assessments were initially undertaken and published through the Preliminary Environmental Information Report (PEIR) process, with the reports being released for public consultation in November 2017, and through the Habitats Regulations Assessment (HRA) process, with the Screening Report (APP-032/ Application Ref 5.2.1) released for public consultation in November 2017 alongside the PEIR.

3 The cumulative effect of Thanet Extension and other OWFs on red-throated diver *Gavia stellata* was assessed in the PEIR process and an in-combination impact with other OWFs on red-throated diver that is an interest feature of the Outer Thames Estuary SPA was screened in for likely significant effects in the Thanet Extension HRA Screening Report (APP-032/ Application Ref 5.2.1).

4 The cumulative assessment in the PEIR was conducted having regard to the published guidance and SNCB advice (JNCC & NE, 2013; King et al., 2009; RenewableUK, 2013; The Planning Inspectorate, 2012 and 2015) and follows the practice of environmental statements (ESs) submitted by other OWF developers. The result of the cumulative assessment was that for all but one receptor the significance of effects were predicted to be minor or negligible. The exception was red-throated diver for which the prediction was of moderate cumulative effects.

1.2 Consultation with stakeholders and responses to the PEIR

5 The methodology applied in the PEIR and the resulting outcomes were discussed with stakeholders through the Evidence Plan process (APP-137/ Application Ref 8.5) with meetings held on 2nd October 2017 in relation to the HRA and on 4th October 2017 in relation to the offshore environment.

6 After publication of the PEIR, but prior to the deadline for responses to be submitted, a conference call was held with Natural England and the RSPB on 12th December 2017. Attendees from Natural England and the RSPB were provided with a briefing paper about the issues arising from the method by which cumulative / in-combination assessment had been carried out for red-throated diver and a possible resolution using a new approach. That new approach was supported in principle and details such as on data sources, assessment parameters and assumptions were requested to be included in the report on the new approach.

7 The responses to the PEIR that related to the assessment of cumulative impacts on red-throated diver are tabulated in Appendix G1.1 (APP-029/ Application Ref 5.1.1) of the Consultation Report. Those responses, who they came from and where they were located in the response document, can be summarised as:

- *We advise that the assessment should be based on an assumption of 100 % displacement occurring out to 4 km, as per the 2017 joint SNCB advice note on assessing disturbance.* (Natural England: Final paragraph on page 4 and summary of comments on offshore ornithology on page 20);
- *.. we deem it inappropriate to assess the cumulative impacts on red-throated diver by taking figures from environmental statements, and instead data should be taken from a single source such as JNCC designation data.* (Natural England: Final paragraph on page 4);
- *.. it would be more appropriate to base the assessment of cumulative effects by taking a diver density distribution from a single source (e.g. JNCC designation data) and overlaying all the OWF footprints and a 4km buffers.* (Natural England: Summary of comments on offshore ornithology on page 20);
- *.. we suggest the use of a 'common' underlying dataset of diver abundance, which covers the region of interested; to which the same impact (100% displacement over 4km buffers) could be applied to all sites of interest.* (RSPB: Page 4 of appendix responding to paragraph 4.14.34/Table 4.27);
- *.. the need for further displacement mortality assessment in order to include all species across all phases including across cumulative assessments for all seasons.* (Natural England: First paragraph on page 5); and
- *.. displacement impacts calculated for individual seasons should be summed across seasons to allow assessment of the annual impact on the population. .. applies for cumulative assessments .. .* (Natural England: Summary of comments on offshore ornithology on page 20).

1.3 Resolution of issues using an alternative approach for ES

8 It is considered that the outcome of the cumulative assessment that was prepared as part of the PEIR process, that followed standard industry practice, was skewed by a number of factors. This includes that a number of the ESs submitted for developments (which are now consented OWFs) that formed the basis of the cumulative assessment in the PEIR:

- Did not assess red-throated diver displacement at all;
- Did not assess red-throated diver displacement in a quantitative fashion; and/or
- Applied a buffer that was significantly less than current recommended practice.

9 In addition, a number of the OWFs have been built out at a scale that is less then that which was assessed as the worst case.

10 An alternative approach and methodology was developed, following the discussions and agreements presented in Section 1.2, that sought to overcome the shortcomings that result from relying on the predictions included in ESs. It is one that considered offshore wind farm projects and red-throated diver distribution in a consistent and standardised fashion. The method for this alternative approach is provided in this report, expanding on that provided in Paragraphs 4.2.37 to 4.2.53 of Volume 2, Chapter 4: Offshore Ornithology (APP-045/ Application Ref 6.2.4) of the Environmental Statement.

1.4 Further consultation with stakeholders and responses to the ES

11 After publication of the ES Chapter stakeholders, including Natural England and the RSPB, provided responses to the results of the cumulative / in-combination assessment of red-throated diver displacement through their Relevant Representations (RR-053 and RR-057 respectively. The responses to the ES Chapter within Natural England's Relevant Representations (RR-053) relating to the assessment of cumulative / in-combination impacts on red-throated diver can be summarised as:

- *The methodology for a cumulative assessment for red throated diver was discussed late in 2017, but disappointingly no detail on exactly how this would be carried out has been provided since a brief paper in December 2017.* (Appendix 1 – Additional Detailed Comments Point 4.2.38);

- *The principle and general approach was agreed with Natural England. However, despite requests before submission we have yet to see the detail, and therefore have no confidence in the accuracy of the results presented. We suggest that the maps showing the extent of the overlay boundaries and the red throated diver density data area are presented so there is clarity and transparency around how the figures in Table 4.32 to Table 4.35 have been derived.* (Appendix 1 – Additional Detailed Comments Point 4.2.41);
- *It states that the 4 km overlapped with buffers from other sites, and that 'double-counting' was avoided using GIS. However, it is not clear what criteria was used to decide which project to assign the displaced birds to. This method needs much more detailed explanation of how this was carried out.* (Appendix 1 – Additional Detailed Comments Point 4.2.43);
- *It is not clear how the analysis has been carried out. A full report is required, which should include a full explanation of the methodology used, and what red throated diver density data used were used in order to derive the proportions.* (Appendix 1 – Additional Detailed Comments Point 4.2.44);
- *Without understanding how the analysis was carried out it is not possible to have confidence in the relative contributions in Table 4.32 & 4.33 or Tables 4.34 & 4.35.* (Appendix 1 – Additional Detailed Comments Point 4.2.45 and Point 4.2.46);
- *To be able to comment on Thanet Extension's relative contribution and whether or not the proposed project makes a material contribution to the cumulative total Natural England need to have a better understanding of how the cumulative analysis for red throated diver has been undertaken.* (Appendix 1 – Additional Detailed Comments Point 4.2.47 to 4.2.53);

1.5 Further consultation with stakeholders in the post-submission stage

12 In response to the Relevant Representation (RR-053) received from Natural England the first post-submission Statement of Common Ground (SoCG) meeting was held on 5th October 2018. This meeting (held between Vattenfall, Natural England, APEM and GoBe) provided clarification of the methodology applied in the ES Chapter and the resulting outcomes in relation to the findings of the cumulative / in-combination assessments of red-throated diver displacement.

13 The outcome of the meeting on 5th October 2018 was that Natural England agreed that the methodology applied within the cumulative / in-combination assessments of red-throated diver for displacement were fit for purpose and that the results were appropriate for use in the assessment at an EIA and HRA level. It was also agreed that the methodology for the cumulative / in-combination assessments would be issued in full in order to provide Natural England with certainty on the agreed approach.

14 A document containing the full cumulative / in-combination assessment methodology was provided to Natural England on 24th October 2018. A written response from Natural England was received on the 16th November 2018. A summary of the matters raised by Natural England in that written response was presented in a series of bullet points that are reproduced below:

- *Natural England advise that the numbers displaced, not just the % figures, need to be provided to enable us to check the percentage values. The project names can be anonymised but we need to see the figures that the percentages are based on.*
- *We would like see a list in terms of numbers of divers displaced by each windfarm in isolation and not lump all non-Thanet sites into Tiers. This will enable the reader to see where Thanet Extension sits in the rank order of effects.*
- *The cumulative increase in baseline mortality of the BDMPS population appears to exceed 1% in some scenarios considered (e.g. 1% vs 5%, no buffer vs 4k buffer). This could be considered as a significant effect under EIA (particularly as all continental OWFS inside the BDMPS region have been omitted).*
- *Although Natural England agreed broadly in principle with the general methodology of using a single source, we had recommended using the JNCC designation data and overlaying all the OWF footprints and a 4km buffers. This includes all the visual aerial survey data c 2001-2007 that formed the basis of the KDE maps generated by JNCC and from which the SPA was derived. That had a much finer spatial resolution than 3 x 3km i.e. 1 x 1km and is likely to have produced a far more heterogeneous density surface than the smoothed SeaMaST surface.*
- *Whilst we agree that the contribution from Thanet Extension is comparatively small, we do not think it is possible to state: "There is, therefore, no potential for AEoI to the red-throated diver feature of the Outer Thames Estuary SPA in relation to in-combination disturbance and displacement effects."*

- *In terms of HRA for the Outer Thames Estuary SPA the cumulative scale of displacement (10 % - 21 %) is in line with previous estimates that have led Natural England to advise an AEOI cannot be ruled out. We therefore cannot agree with the statement in the concluding paragraph. Our advice on the scale of the cumulative displacement must remain the same as before.*

15 A meeting to discuss Natural England's response to the document containing the full methodology was held between Natural England, GoBe and APEM on 23rd November 2018.

16 This version of the report on the cumulative and in-combination impact assessment methodology reflects the agreement made at that meeting on appropriate revisions. Those agreed, appropriate revisions build upon the response received on 16th November 2018.

17 The results of the assessment presented in this version of the report do not differ from that provided and concluded in the ES Chapter on potential cumulative and in-combination impacts. The information provided in this version of the report simply include more detail with respect to the methodology applied and the data used in coming to the conclusions in the ES Chapter.

2 Methodology

2.1 Overall approach

19 This methodology adopts a number of standard approaches to assessing the scale of red-throated diver that might potentially be displaced by any individual proposed, consented or constructed offshore wind farm in order to produce a cumulative or in-combination assessment that has been undertaken in a more consistent fashion. These standard approaches are:

i. Placing the 'alone' contribution of Thanet Extension in context, relative to all other proposed, consented or constructed offshore wind farms, mitigating the false confidence that can arise when considering absolute numbers derived from uncertain sources;

ii. Applying a single source of red-throated diver density across all the offshore wind farms included in the assessment;

iii. Applying, where relevant, the as-built layout of the array rather than the worst case design for the array as assessed in the application;

iv. Considering the two ends of the range of scenarios over which standardised displacement matrices are prepared; and

v. For the HRA, apportioning a percentage of birds to the relevant SPA where the wind farm is located outside the SPA.

20 These are considered in more detail in turn below.

i. Placing the 'alone' contribution of Thanet Extension in context

21 As described in the Introduction, the outcome of the cumulative assessment undertaken as part of the PEIR process is skewed by the dependence on predictions (or lack of them) in environmental statements and high confidence cannot be placed on the absolute numbers of divers predicted to be displaced given that they are derived from inconsistent source material.

22 A means to inform the assessment that is based on a consistent set of parameters about proposed, consented or constructed offshore wind farms is to consider each offshore wind farm alone and collectively and to evaluate the proportional contribution of Thanet Extension. The consistent set of parameters that can be used in such an assessment are:

- The area of the proposed/consented/constructed turbine array;
- The area of the proposed/consented/constructed turbine array with the addition of a standardised buffer extending from the turbine array; and
- The density of red-throated divers (see ii below) at the location of the proposed/consented/constructed turbine array.

23 The process of considering the 'alone' contribution of Thanet Extension in relation to the total of other proposed, consented or constructed offshore wind farms enables Thanet Extension to be placed in its context (either as a percentage contribution or its position in the rank order). This removes the dependence on the published ESs and the inconsistent availability of quantitative predictions of displacement.

ii. Applying a single source of red-throated diver density

24 Not all ESs present a 'baseline' figure for the density of red-throated diver at the location of the proposed turbine array, particularly in the circumstance that the ES does not present a quantitative prediction for displacement. This can be overcome by considering all the offshore wind farms in the cumulative / in-combination assessment against a common source for the density of red-throated diver in the North Sea. This common source is the predicted density map and the underlying dataset of the SeaMaST project (Seabird Mapping and Sensitivity Tool) described in Bradbury et al. (2014) with the underlying dataset being accessed from Natural England following a specific data-request. No other data set is able to provide this wide geographical area coverage, the finer scale data (1 x 1 km grid cells) modelled by JNCC for the identification of specific SPAs is restricted to particular areas of sea. Only the SeaMaST modelled density figures and not the sensitivity outputs, were used for this work.

25 The SeaMaST data were compiled from offshore boat and aerial observer surveys spanning the period 1979–2012. The data were analysed using distance analysis and Density Surface Modelling to produce predicted bird densities across a grid at a resolution of 3 km x 3 km. Coefficients of Variation (CV) were estimated for each grid cell density, as an indication of confidence in predictions. Bradbury et al. (2014) noted that the initial model "*produced unfeasible predictions further offshore where there was no aerial survey coverage*" with a high CV associated with those predictions. Bradbury et al. (2014) excluded density predictions with CVs of >0.5 in those grid cells with low survey coverage. This resulted in the exclusion of higher red-throated diver densities at locations more than 30 km offshore.

26 Predicted densities from the density surface model for red-throated diver (with exclusion of predictions with a high CV from areas of low survey coverage) for marine waters around England and extending to the coast of North Wales and that part of the Solway Firth in Scotland are presented in Figure 1.

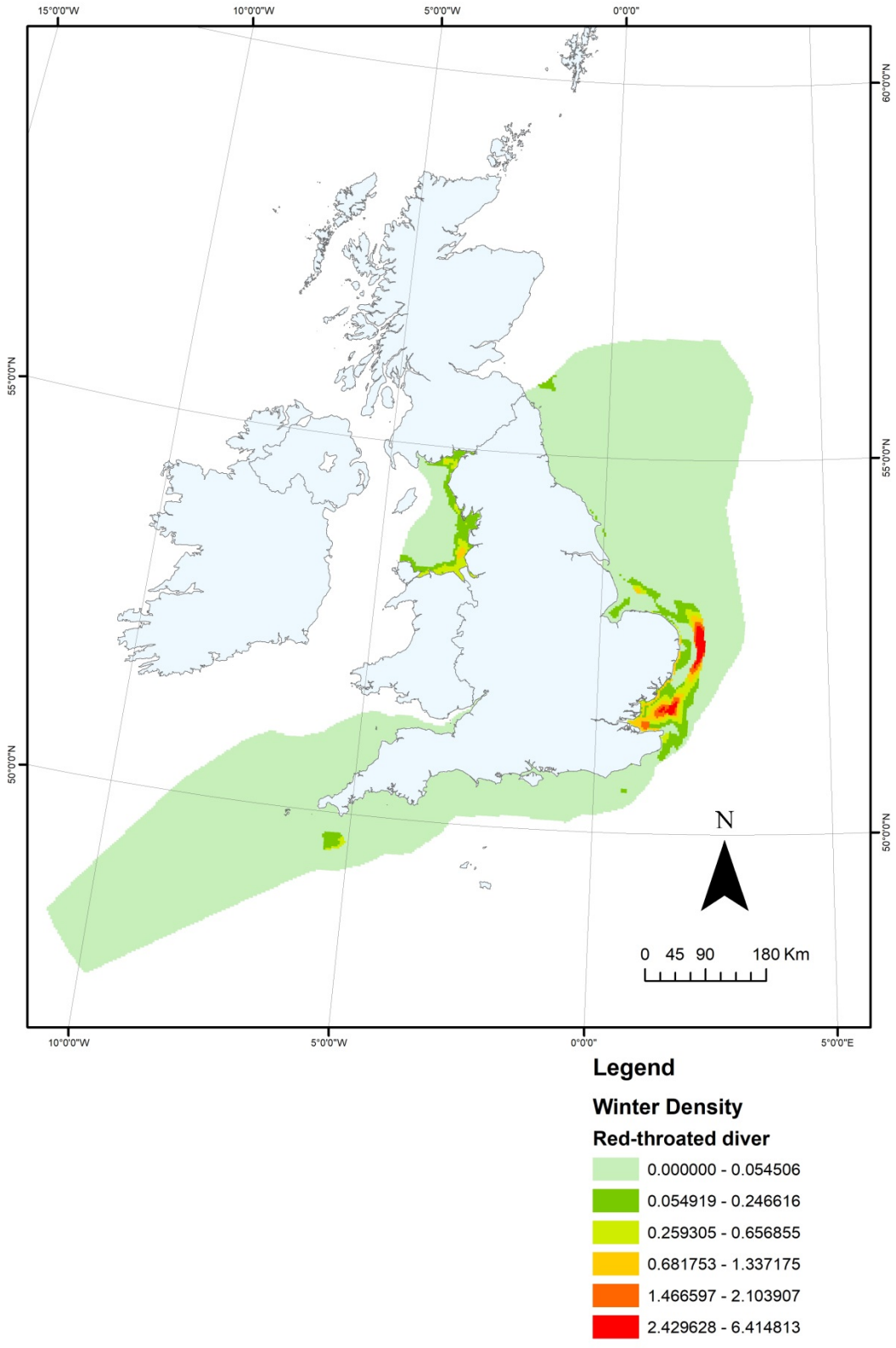

Figure 1: Modelled red-throated diver density from the SeaMaST data set.

27 As described in Section i above, from this dataset it is possible to place the red-throated diver density that occurs at Thanet Extension in the context of other proposed, consented or constructed offshore wind farms in the English part of the North Sea by comparing and ranking the density at different locations.

iii. Applying, where relevant, the as-built layout of the array

28 As described in the Introduction, the quantitative predictions of red-throated diver displacement in ESs is based on the proposed worst case design and not based on the as-built design. To remedy this, for relevant offshore wind farms the following information was obtained:

- For operational and under construction offshore wind farms, the built out area of the array; and
- For consented offshore wind farms, the area of the array based on the maximum dimensions that have been consented.

29 In the case of proposed offshore wind farms, the area of the array based on the maximum dimension stated in the ES (i.e. the 'Rochdale Envelope') will continue to be used.

30 As described in Section i above, from this information it is possible to place Thanet Extension in the context of other proposed, consented or constructed offshore wind farms (either as a percentage contribution or its position in the rank order).

iv. Considering the two ends of the range of displacement scenarios

31 One aspect of the discussions at the Evidence Plan meetings has been what should be the scale of the two key parameters for displacement applied in the assessment and are those parameters applied consistently (either accounting, or not, for local site based evidence). The two key parameters in a displacement assessment are:

A. The spatial extent of displacement i.e. does it occur within the turbine array and how many, if at all, kilometres from the boundary of the turbine array; and
B. The degree of displacement, expressed as a percentage of the baseline population, considered within the turbine array and at varying distances from the boundary of the turbine array (with that consideration being in the form of a slope or sudden cut-off).

32 In relation to red-throated diver a set of end points in the range of scenarios is:

I. The SNCBs default scenario of 100% displacement within the turbine array and 100% displacement out to 4 km from the boundary of the turbine array (SNCBs, 2017); and

II. The scenario developed from the local site based evidence that results from the monitoring of the Thanet Offshore Wind Farm of 100% displacement within the turbine array and no displacement outside the boundary of the turbine array (Royal HaskoningDHV (2013).

33 From this information it is possible to consider the two ends of the range of displacement scenarios and the place of Thanet Extension when considered in relation to those two ends of the range applied to the sum of the proposed, consented or constructed offshore wind farms.

iv. Apportionment of displaced birds to relevant SPAs

34 Specifically for the HRA in-combination assessment it is necessary to identify with which classified or proposed SPA the displaced red-throated diver population might be associated. This can be done on the basis of geographical proximity – is the proposed, consented or constructed offshore wind farm inside the boundary of a classified or proposed SPA (e.g. London Array), or if outside, which is the nearest classified or proposed SPA. For Thanet Extension it is outside of any SPA and the nearest SPA is the Outer Thames Estuary SPA. This process can be carried out for each proposed, consented or constructed offshore wind farm that is part of the in-combination assessment.

35 Once that is identified the second step is to identify what proportion of the displaced red-throated diver population can be attributed to the relevant classified or proposed SPA. Where the proposed, consented or constructed offshore wind farm is inside the classified or proposed SPA then 100% of the displaced population can be attributed to that classified or proposed SPA. Where the proposed, consented or constructed offshore wind farm is outside the classified or proposed SPA then a proportioning exercise is required. This is to recognise that there is regular daily and seasonal movement of red-throated diver across areas of shallow coastal water that occurs irrespective of administrative boundaries (e.g. as shown by tracking studies in the eastern North Sea/Baltic Sea: Zydelis et al., 2016). This means that some red-throated diver normally residing outside the classified or proposed SPA might move in and make use of its resources for a proportion of the non-breeding season.

36 Proportioning is based, taking the Outer Thames Estuary SPA as an example, on the percentage of birds that the Outer Thames Estuary SPA classified population is out of the total population that was estimated to occur in the UK waters from Kent to east Norfolk (more northerly populations are apportioned to the Greater Wash SPA).

3 Data sources and data analysis

3.1 Red-throated diver

37 As described above and illustrated in Figure 1, the data source for red-throated diver is the modelled density distribution in a 3 km x 3 km grid of the SeaMaST data set. The SeaMaST data set incorporated those exclusions to the predictions that were implemented by Bradbury et al. (2014) for reasons of the high CV of red-throated diver density predictions in areas of low survey coverage that were more than 30km offshore (as described in Section 2.1(ii) above). The data set was provided by Natural England.

38 The data set was imported in to ArcGIS and by overlaying the red-throated diver density with offshore wind farm areas in GIS the number of red-throated divers within any particular area can be calculated. A 'sense check' was carried out of the functioning of the GIS analysis of the SeaMaST data set by identifying what was the total population of red-throated diver that it calculated to occur in the relevant Biologically Defined Minimum Population Scale (BDMPS) area defined for red-throated diver in the UK waters of the southern North Sea (Furness, 2015). This BDMPS area was the "SW North Sea", defined as being those UK North Sea waters between the Dover Strait and a line running east from the Scottish Border, for which Furness (2015) states a population of 10,177 red-throated divers in winter. Within that same area the SeaMaST data set provided a population estimate of 7,639.

39 Red-throated diver populations are known to fluctuate from winter to winter as shown by the repeated surveys and population estimates of the Greater Thames Estuary area and the Liverpool Bay area. For example Webb et al. (2009) identified a five year mean peak for red-throated diver across the wider Greater Thames area of 6,618 from aerial surveys over the winters of 2002/03 to 2006/07 and within this data set the individual winter peaks varied from 2,460 to 10,884. Subsequent to that period Goodship et al. (2015) determined a peak winter count of 14,161 in 2012/13. The SeaMaST data set is derived from surveys from the years 1979 to 2011 for boat based data and 2001 to 2011 for aerial surveys. The wider Greater Thames area contains the highest densities of red-throated diver from within the SW North Sea BDMPS area (see Figure 1) and thus will contribute by far the largest proportion to the BDMPS estimate.

40 The estimate from the GIS output for this study from the SeaMaST data set of a population of 7,639 for the SW North Sea BDMPS area falls within the range that might be expected and strongly suggests that the calculations carried out for this study are not in error. In addition, this study takes an approach of comparing proportions of red-throated diver between geographical areas and comparing the contributions of OWFs to predicted cumulative displacement. Those comparisons are not affected by absolute population estimates derived from different sources.

3.2 Offshore wind farms

41 The potential list of offshore wind farms that could be considered in the analysis are listed in **Error! Reference source not found.** and presented visually in Figure 2. These are the developments within the UK waters of the North Sea and English Channel that are considered potentially relevant to the cumulative / in-combination assessment of Thanet Extension. The developments are at various stages in their project lifecycle and this is identified in the Table along with the 'Tier' that it is placed in based on the project stage. Projects that are fully constructed but not yet commissioned are included within Tier 1, rather than Tier 2, as the potential effects from displacement will be the same as those projects that are commissioned. Within Tier 4 any projects that are at the PEIR stage are identified from those at the later ES stage. Also included in the Table is the location of the offshore wind farm in relation to the areas over which the BDMPS are defined for red-throated diver (Furness, 2015).

Table 1: Offshore wind farms initially considered for inclusion in this analysis

Project	Status	Tier	Location (BDMPS)
Beatrice Demonstrator	Built, formerly operational but at present out of commission	1	NW North Sea
Blyth	Built, formerly operational but at present out of commission	1	SW North Sea
Dudgeon	Operational	1	SW North Sea
Galloper	Fully constructed but not commissioned	1	SW North Sea
Greater Gabbard	Operational	1	SW North Sea
Gunfleet Sands I & 2	Operational	1	SW North Sea
Humber Gateway	Operational	1	SW North Sea
Inner Dowsing	Operational	1	SW North Sea
Kentish Flats	Operational	1	SW North Sea
Kentish Flats Extension	Operational	1	SW North Sea
Lincs	Operational	1	SW North Sea
London Array	Operational	1	SW North Sea
Lynn	Operational	1	SW North Sea
Race Bank	Operational	1	SW North Sea
Scroby Sands	Operational	1	SW North Sea
Rampion	Fully constructed but not commissioned	1	SW and Channel
Sheringham Shoal	Operational	1	SW North Sea
Teesside	Operational	1	SW North Sea
Thanet	Operational	1	SW North Sea
Westermost Rough	Operational	1	SW North Sea
Beatrice	Under construction	2	NW North Sea
East Anglia ONE	Under construction	2	SW North Sea
EOWDC [Aberdeen]	Under construction	2	NW North Sea
Hornsea Project One	Under construction	2	SW North Sea
Hornsea Project Two	Under construction	2	SW North Sea
Dogger Bank Creyke Beck Projects A and B	Consented but not implemented	3	SW North Sea
Dogger Bank Teesside Projects A and B	Consented but not implemented	3	SW North Sea

Project	Status	Tier	Location (BDMPS)
Firth of Forth (Seagreen) Alpha and Bravo	Consented but not implemented	3	NW North Sea
Inch Cape	Consented but not implemented	3	NW North Sea
Moray Firth (Eastern DA)	Consented but not implemented	3	NW North Sea
Neart na Gaoithe	Consented but not implemented	3	NW North Sea
Triton Knoll	Consented but not implemented	3	SW North Sea
East Anglia THREE	Consented but not implemented	3	SW North Sea
Thanet Extension	ES stage	4	SW North Sea
Hornsea Project 3	ES stage	4	SW North Sea
Norfolk Vanguard	ES stage	4	SW North Sea
Moray Firth (Western DA)	ES Stage	4	NW North Sea
Norfolk Boreas	Pre-application (PEI Report submitted)	5	SW North Sea
East Anglia ONE North	Pre-application (Scoping Report submitted)	5	SW North Sea
East Anglia TWO	Pre-application (Scoping Report submitted)	5	SW North Sea

42 Those projects that occur in the NW North Sea BDMPS area – Beatrice, Beatrice Demonstrator, EOWDC, Firth of Forth (Seagreen) Alpha and Bravo, Inch Cape, Moray Firth (East), Moray Firth (West) and Neart na Gaoithe – are all in Scottish waters for which diver density data is not available in the SeaMaST dataset. As a consequence they cannot be included in the analysis.

3.3 Apportionment of displaced birds to relevant SPAs

43 The population estimate for the wider Thames Estuary area from which the Outer Thames Estuary SPA was derived was 8,132 birds (O'Brien et al., 2012). From the same population distribution data the boundary of the Outer Thames Estuary SPA was defined and identified as including 6,466 individuals. From these two population figures it can be determined that 79.5% of the total population can be attributed to the Outer Thames Estuary SPA at any one time. This value can also be used to attribute the proportion of the birds using the Thanet Extension site that might, given regular mixing of the population between areas within and outside the SPA, to be associated with the SPA.

44 A similar process can be carried out for the OWFs that occur within the Outer Thames Estuary SPA or are adjacent to it such that it is functionally linked to the OTE SPA (with a proportion of those functionally linked birds being attributed to the Outer Thames Estuary SPA). There are OWFs that are distant from the area within which the Outer Thames Estuary SPA occurs that could be attributed to another SPA, but such instances are not a matter for an assessment of Thanet Extension.

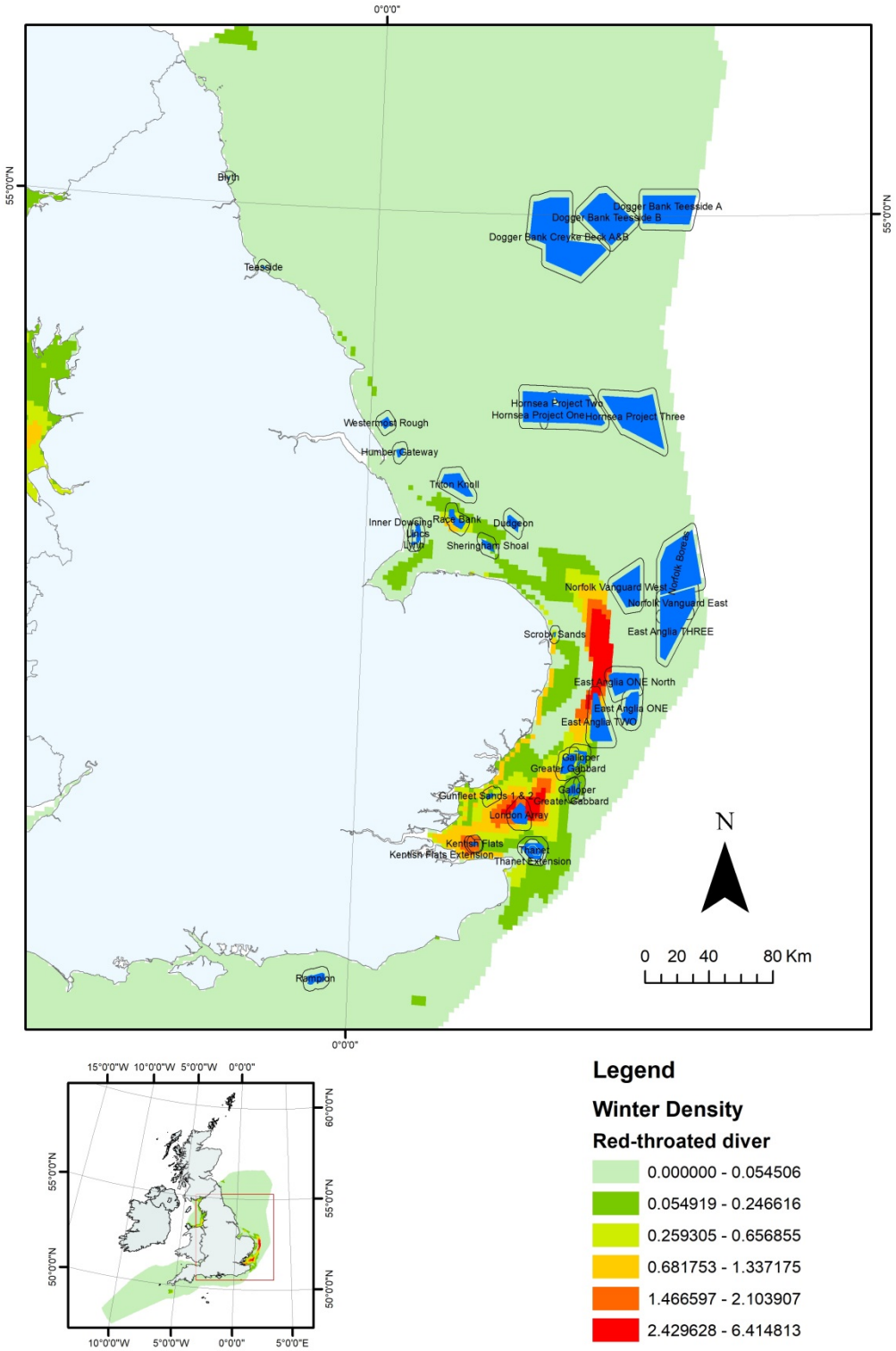

Figure 2: OWF WTG boundaries, with buffers, overlain on red-throated diver density

4 Results

4.1 Key assessment scenarios and mortality significance (EIA level)

45 The following text and tables, within this section (Section 4.1), contain the same information that was presented in Paragraphs 4.2.37 to 4.2.53 of Volume 2, Chapter 4: Offshore Ornithology (APP-045/ Application Ref 6.2.4) of the Environmental Statement. At the request of Natural England, Tables 2 to 5 contain an additional column that provides the number of red-throated diver that are potentially displaced (all figures are given to one decimal place).

46 The analysis using GIS, of the OWF development boundary overlaps and the red-throated diver density as described above, coupled with the 'tiered' approach to examining OWFs also described above allowed a number of key quantitative comparisons to be made to inform the cumulative assessment.

47 Table 2 and Table 3 identify the relative contribution that Thanet Extension makes to the red-throated diver that are predicted to be displaced by the OWFs included in the cumulative assessment. This identifies that when the scenario is applied of 100% displacement within each OWF and no displacement outside then the relative contribution that Thanet Extension makes is 0.8%. This increases to 1.6% under the scenario of 100% displacement within each OWF and within a 4 km buffer around each OWF. The large majority (approx. 98%) of the contribution to red-throated diver potential displacement is made by OWFs that have been consented and are already operational (Tier 1).

Table 2: The relative contribution of Thanet Extension to the cumulative displacement of red-throated diver, scenario no displacement outside OWF

Offshore wind farms in the English North Sea summed by Tier Scenario: 100% displacement in OWF, no displacement outside	Number of RTD potentially displaced	Relative contribution to RTD potentially displaced
Tier 1: Operational	770.9	98.3%
Tier 2: Under construction	2.2	0.3%
Tier 3: Consented but not constructed	3.0	0.4%
Tier 4: Application in process – other than Thanet Extension	2.1	0.3%
Tier 4: Thanet Extension	6.3	0.8%

Table 3: The relative contribution of Thanet Extension to the cumulative displacement of red-throated diver, scenario 100% displacement in 4 km buffer

Offshore wind farms in the English North Sea summed by Tier Scenario: 100% displacement in OWF, 100% displacement in 4 km buffer	Number of RTD potentially displaced	Relative contribution to RTD potentially displaced
Tier 1: Operational	1,540.8	97.6%
Tier 2: Under construction	3.7	0.2%
Tier 3: Consented but not constructed	6.7	0.4%
Tier 4: Application in process – other than Thanet Extension	1.5	0.1%
Tier 4: Thanet Extension	25.4	1.6%

48 Table 4 and Table 5 identify the contribution that Thanet Extension makes to the proportions of red-throated diver that are predicted to be displaced relative to the SW North Sea winter BDMPS red-throated diver population. This identifies that when the scenario is applied of 100% displacement within each OWF and no displacement outside then the relative contribution that Thanet Extension makes is 0.06% of the SW North Sea winter BDMPS red-throated diver population. This increases to 0.25% under the scenario of 100% displacement within each OWF and within a 4 km buffer around each OWF. The largest contribution made to red-throated diver potential displacement relative to the SW North Sea winter BDMPS red-throated diver population is made by OWFs that have been consented and are already operational (Tier 1).

Table 4: The contribution of Thanet Extension to the cumulative displacement of red-throated diver relative to the SW N Sea winter BDMPS population, scenario no displacement outside OWF

Offshore wind farms in the English North Sea summed by Tier Scenario: 100% displacement in OWF, no displacement outside	Number of RTD potentially displaced	Relative contribution to RTD potentially displaced
Tier 1: Operational	770.9	7.58%
Tier 2: Under construction	2.2	0.02%
Tier 3: Consented but not constructed	3.0	0.03%
Tier 4: Application in process – other than Thanet Extension	2.1	0.02%
Tier 4: Thanet Extension	6.3	0.06%

Table 5: The contribution of Thanet Extension to the cumulative displacement of red-throated diver relative to the SW N Sea winter BDMPS population, scenario 100% displacement in 4 km buffer

Offshore wind farms in the English North Sea summed by Tier Scenario: 100% displacement in OWF, 100% displacement in 4 km buffer	Number of RTD potentially displaced	Relative contribution to RTD potentially displaced
Tier 1: Operational	1,540.8	15.1%
Tier 2: Under construction	3.7	0.04%
Tier 3: Consented but not constructed	6.7	0.07%
Tier 4: Application in process – other than Thanet Extension	1.5	0.01%
Tier 4: Thanet Extension	25.4	0.25%

49 Displacement may result in the mortality of a proportion of the birds displaced. Definitive mortality rates associated with displacement for any seabird are not known and precautionary estimates have to be used (SNCBs, 2017). The approach taken in the assessment of Thanet Extension is to consider a range of mortality rates, for this species the lower limit is 1% mortality resulting from displacement and the upper limit is 5%. The assessment also considers that resultant mortality in the context of the background mortality in the population. The key parameter is the percentage change relative to background mortality in the SW North Sea winter BDMPS red-throated diver population. Table 6 and Table 7 identify that change for both 1% and 5% resultant mortality.

50 Table 6 identifies the change under the scenario of 100% displacement within each OWF and no displacement outside which for Thanet Extension alone is 0.003% and 0.014% for 1% and 5% resultant mortality. When applying the matrix approach to impact assessment, the magnitude of impact on the SW North Sea winter BDMPS population of red-throated diver is Negligible. As the species is of High sensitivity to disturbance and displacement, the effect significance is Minor adverse.

51 Table 6 identifies the change under the scenario of 100% displacement within each OWF and no displacement outside which cumulatively with all the OWFs potentially affecting the SW North Sea winter BDMPS red-throated diver population is 0.338% and 1.691% for 1% and 5% resultant mortality, respectively.

52 Table 7 identifies the change under the scenario of 100% displacement within each OWF and within a 4 km buffer around each OWF which for Thanet extension alone is 0.011% and 0.055% for 1% and 5% resultant mortality. When applying the matrix approach to impact assessment, the magnitude of impact on the SW North Sea winter BDMPS population of red-throated diver is Negligible. As the species is of High sensitivity to disturbance and displacement, the effect significance is Minor adverse.

53 Table 7 identifies the change under the scenario of 100% displacement within each OWF and within a 4 km buffer around each OWF which cumulatively with all the OWFs potentially affecting SW North Sea winter BDMPS red-throated diver population the resultant mortality is 0.68% and 3.401% for 1% and 5% resultant mortality, respectively.

54 The very small percentage change resulting from Thanet Extension alone identifies that the great majority of the contribution to the cumulative percentage change arises from OWFs that have been consented and are already operational (Tier 1).

Table 6: Change in background mortality predicted to result from Thanet Extension alone and for the cumulative OWFs giving rise to 1% or 5% mortality, scenario no displacement outside OWF

Offshore wind farms in the English North Sea Scenario: 100% displacement in OWF, no displacement outside	TE alone number of RTD potentially subject to mortality	Thanet Extension alone	Cumulative OWFs
Increase in mortality from background resulting from 1% resultant mortality by displacement	0.06	0.003%	0.338%
Increase in mortality from background resulting from 5% resultant mortality by displacement	0.32	0.014%	1.691%

Table 7: Change in background mortality predicted to result from Thanet Extension alone and for the cumulative OWFs giving rise to 1% or 5% mortality, scenario 100% displacement in 4 km buffer

Offshore wind farms in the English North Sea Scenario: 100% displacement in OWF, 100% displacement in 4 km buffer	TE alone number of RTD potentially subject to mortality	Thanet Extension alone	Cumulative OWFs
Increase in mortality from background resulting from 1% resultant mortality by displacement	0.25	0.011%	0.680%
Increase in mortality from background resulting from 5% resultant mortality by displacement	1.27	0.055%	3.401%

55 The cumulative assessment of potential impacts on red-throated diver identifies that the largest predicted number of red-throated diver subject to mortality is 1.27 birds per annum under the scenario of 100% displacement within each OWF and within a 4 km buffer around each OWF and 5% resultant mortality of displaced birds. This prediction identifies that Thanet Extension does not make a material contribution to the potential effects that have been attributed to OWFs that have been consented and are already operational.

56 The cumulative assessment of potential impacts on red-throated diver, considering the displacement relative to the SW North Sea winter BDMPS red-throated diver population and the change in mortality relative to background mortality of the same population varies between 0.338-0.68% (under the scenario of 100% displacement within each OWF and no displacement outside) and 1.691-3.401% (the scenario of 100% displacement within each OWF and within a 4 km buffer around each OWF) for 1% and 5% resultant mortality. This assessment has identified that the contribution of Thanet Extension is very small and that the addition it makes to mortality relative to baseline is Negligible adverse.

57 Therefore, it is judged that whilst under the most precautionary scenarios of cumulative displacement and resultant mortality, the 1% increase in mortality from background is exceeded, Thanet Extension does not make a material contribution to potential effects that have been attributed to OWFs that have been consented and are already operational. If the contribution of Thanet Extension were to be removed from this cumulative assessment, the predicted increase in mortality from background would still be above 1% in the scenario of 5% resultant mortality for both no displacement outside the OWF and 100% displacement from a 4 km buffer.

4.2 Key assessment scenarios and mortality significance (HRA level)

58 The following text and tables, within this section (Section 4.2), contain the same information that was presented in Paragraphs 12.4.11 to 12.4.24 of the Report to Inform Appropriate Assessment (APP-031/ Application Ref 5.2). At the request of Natural England, Tables 9 to 12 contain an additional column that provides the number of red-throated diver that are potentially displaced (all figures are given to one decimal place).

59 Those OWFs screened in for consideration were identified based on geographic proximity. Those OWFs were a) those within the boundary of the Outer Thames Estuary SPA (being the extended SPA boundary, classified in October 2017); and b) those for which the Outer Thames Estuary SPA was the nearest SPA or pSPA with red-throated diver as an interest feature. Those OWFs screened in are listed in Table 8, ordered by Tier. Those OWFs further to the north have been attributed to the Greater Wash SPA, as it is geographically closer, and they do not form part of this in-combination assessment.

Table 8: OWFs whose potential displacement effects were attributed to the Outer Thames Estuary SPA

Offshore wind farm	Tier	Location relative to the SPA
Gunfleet Sands	1	Within the OTE SPA
Kentish Flats	1	Within the OTE SPA
Kentish Flats Extension	1	Within the OTE SPA
London Array	1	Within the OTE SPA
Scroby Sands	1	Within the OTE SPA (part)
Galloper	1	Outside of, but functionally linked to OTE SPA
Greater Gabbard	1	Outside of, but functionally linked to OTE SPA
Thanet	1	Outside of, but functionally linked to OTE SPA
East Anglia ONE	2	Outside of, but functionally linked to OTE SPA
East Anglia THREE	3	Outside of, but functionally linked to OTE SPA
Norfolk Vanguard East & West	4	Outside of, but functionally linked to OTE SPA
Thanet Extension	4	Outside of, but functionally linked to OTE SPA

60 In the process of adding up relative contributions from each OWF, account had to be taken of the fact that when considering adjacent, nearby or extended OWFs there was a possibility that they were being developed within the 4 km buffer of a preceding OWF or that the 4 km buffer of the more recently proposed OWF overlapped with the site of, or the 4 km buffer extending from, a preceding OWF. In such instances, in the assessment scenario that displacement does occur in the 4 km buffer, then 'double-counting' of red-throated diver displacement would occur. This 'double-counting' was avoided in the analysis using GIS by only accounting for the additional contribution made by the subsequent OWF.

61 The analysis using GIS, of the OWF development boundary overlaps and the red-throated diver density, coupled with the 'tiered' approach to examining OWFs (detailed in Section 8.5) allowed a number of key quantitative comparisons to be made to inform the in-combination assessment.

62 Table 9 and Table 10 identify the relative contribution that Thanet Extension makes to the red-throated diver that overall are predicted to be displaced by those OWFs included in the in-combination assessment because they have geographic proximity to the Outer Thames Estuary SPA. This identifies that when the scenario is applied of 100% displacement within each OWF and no displacement outside then the relative contribution that Thanet Extension makes is 0.7%. This increases to 1.5% under the scenario of 100% displacement within each OWF and within a 4 km buffer around each OWF. The large majority (>98%) of the contribution to red-throated diver potential displacement is made by OWFs that have been consented and are already operational (Tier 1).

Table 9: The relative contribution of Thanet Extension to the in-combination displacement of red-throated diver within and adjacent to the Outer Thames Estuary SPA, scenario no displacement outside OWF

Offshore wind farms within and adjacent to the OTE SPA summed by Tier Scenario: 100% displacement in OWF, no displacement outside	Number of RTD potentially displaced	Relative contribution to RTD potentially displaced
Tier 1: Operational	661.4	98.6%
Tier 2: Under construction	1.7	0.3%
Tier 3: Consented but not constructed	1.3	0.2%
Tier 4: Application in process – other than Thanet Extension	1.6	0.2%
Tier 4: Thanet Extension	5.0	0.7%

Table 10: The relative contribution of Thanet Extension to the in-combination displacement of red-throated diver within and adjacent to the Outer Thames Estuary SPA, scenario 100% displacement in 4 km buffer

Offshore wind farms within and adjacent to the OTE SPA summed by Tier Scenario: 100% displacement in OWF, 100% displacement in 4 km buffer	Number of RTD potentially displaced	Relative contribution to RTD potentially displaced
Tier 1: Operational	1,357.1	98.1%
Tier 2: Under construction	2.9	0.2%
Tier 3: Consented but not constructed	1.9	0.1%
Tier 4: Application in process – other than Thanet Extension	1.2	0.1%
Tier 4: Thanet Extension	20.2	1.5%

63 Table 11 and Table 12 identify the relative contribution that Thanet Extension makes to the proportions of red-throated diver that are predicted to be displaced relative to the Outer Thames Estuary SPA red-throated diver population. This identifies that when the scenario is applied of 100% displacement within each OWF and no displacement outside then the relative contribution that Thanet Extension makes is 0.08% of the Outer Thames Estuary SPA red-throated diver population. This increases to 0.31% under the scenario of 100% displacement within each OWF and within a 4 km buffer around each OWF. The largest contribution made to red-throated diver potential displacement relative to the Outer Thames Estuary SPA red-throated diver population is made by OWFs that have been consented and are already operational (Tier 1).

Table 11: The contribution of Thanet Extension to the in-combination displacement of red-throated diver relative to the OTE SPA population, scenario no displacement outside OWF

Offshore wind farms within and adjacent to the OTE SPA summed by Tier Scenario: 100% displacement in OWF, no displacement outside	Number of RTD potentially displaced	Contribution to RTD potentially displaced relative to OTE SPA population
Tier 1: Operational	661.4	10.2%
Tier 2: Under construction	1.7	0.03%
Tier 3: Consented but not constructed	1.3	0.02%
Tier 4: Application in process – other than Thanet Extension	1.6	0.03%
Tier 4: Thanet Extension	5.0	0.08%

Table 12: The contribution of Thanet Extension to the in-combination displacement of red-throated diver relative to the OTE SPA population, scenario 100% displacement in 4 km buffer

Offshore wind farms within and adjacent to the OTE SPA summed by Tier Scenario: 100% displacement in OWF, 100% displacement in 4 km buffer	Number of RTD potentially displaced	Contribution to RTD potentially displaced relative to OTE SPA population
Tier 1: Operational	1,357.1	21.0%
Tier 2: Under construction	2.9	0.05%
Tier 3: Consented but not constructed	1.9	0.03%
Tier 4: Application in process – other than Thanet Extension	1.2	0.02%
Tier 4: Thanet Extension	20.2	0.31%

64 Displacement may result in the mortality of a proportion of the birds displaced. Definitive mortality rates associated with displacement for any seabird are not known and precautionary estimates have to be used. The approach taken in the assessment of Thanet Extension is to consider a range of mortality rates, for this species the lower limit is 1% mortality resulting from displacement and the upper limit is 5%. This range has been presented at the Evidence Plan meetings (APP-137/ Application Ref 8.5) and discussed with stakeholders. The assessment also considers that resultant mortality in the context of the background mortality in the population. The key parameter is the percentage change relative to background mortality in the Outer Thames Estuary SPA red-throated diver population. Table 13 and Table 14 identify that change for both 1% and 5% resultant mortality. Table 13 identifies the change under the scenario of 100% displacement within each OWF and no displacement outside which for Thanet Extension alone is 0.005% and 0.024% for 1% and 5% resultant mortality and for the in-combination set of OWFs potentially affecting the Outer Thames Estuary SPA population is 0.65% and 3.24% respectively. Table 14 identifies the change under the scenario of 100% displacement within each OWF and within a 4 km buffer around each OWF which for Thanet Extension alone is 0.020% and 0.098% for 1% and 5% resultant mortality and for the in-combination set of OWFs potentially affecting the Outer Thames Estuary SPA population is 1.34% and 6.69% respectively. The very small percentage change resulting from Thanet Extension alone identifies that the great majority of the contribution to the in-combination percentage change arises from OWFs that have been consented and are already operational (Tier 1).

Table 13: Change in background mortality predicted to result from Thanet Extension alone and for the OWFs in or adjacent to the OTE SPA giving rise to 1% or 5% mortality, scenario no displacement outside OWF

Offshore wind farms within and adjacent to the OTE SPA Scenario: 100% displacement in OWF, no displacement outside	TE alone number of RTD potentially subject to mortality	Thanet Extension alone	All OWFs affecting OTE SPA
Increase in mortality from background resulting from 1% resultant mortality by displacement	0.05	0.005%	0.65%
Increase in mortality from background resulting from 5% resultant mortality by displacement	0.25	0.024%	3.24%

Table 14: Change in background mortality predicted to result from Thanet Extension alone and for the OWFs in or adjacent to the OTE SPA giving rise to 1% or 5% mortality, scenario 100% displacement in 4 km buffer

Offshore wind farms within and adjacent to the OTE SPA Scenario: 100% displacement in OWF, 100% displacement in 4 km buffer	TE alone number of RTD potentially subject to mortality	Thanet Extension alone	All OWFs affecting OTE SPA
Increase in mortality from background resulting from 1% resultant mortality by displacement	0.20	0.020%	1.34%
Increase in mortality from background resulting from 5% resultant mortality by displacement	1.01	0.098%	6.69%

65 The in-combination assessment of potential impacts on red-throated diver connected with the Outer Thames Estuary SPA population identifies that the largest predicted number of red-throated diver subject to mortality is 1.01 birds per annum under the scenario of 100% displacement within each OWF and within a 4 km buffer around each OWF and 5% resultant mortality of displaced birds. This prediction identifies that Thanet Extension does not make a material contribution to the potential effects that have been attributed to OWFs that have been consented and are already operational.

66 The in-combination assessment of potential impacts on red-throated diver, considering the displacement relative to the Outer Thames Estuary SPA population and the change in mortality relative to background mortality in the Outer Thames Estuary SPA population has identified that the contribution of Thanet Extension is very small and is considered not to make a material contribution to potential effects arising from OWFs that have been consented and are already operational.

67 The proposed Thanet Extension does not make a material contribution to in-combination disturbance and displacement to the red-throated diver feature of the Outer Thames Estuary SPA. If the contribution of Thanet Extension were to be removed from this in-combination assessment, the predicted increase in mortality from background would still be above 1% in the scenario of 1% resultant mortality for 100% displacement from a 4 km buffer and in the scenario of 5% resultant mortality for both no displacement outside the OWF and 100% displacement from a 4 km buffer.

68 There is, therefore, no material contribution to any potential for AEoI to the red-throated diver feature of the Outer Thames Estuary SPA in relation to in-combination disturbance and displacement effects. Therefore, subject to natural change, Thanet Extension does not alter the ability to maintain red-throated diver as a feature in the long-term with respect to the potential for adverse effects from in-combination disturbance and displacement.

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Vattenfall Wind Power Ltd

Thanet Extension Offshore Wind Farm

Appendix 1, Annex D to Deadline 1 Submission: Displacement of red-throated divers for Thanet Extension project alone

Relevant Examination Deadline: 1

Submitted by Vattenfall Wind Power Ltd

Date: January 2019

Revision A

Drafted By:	APEM Ltd
Approved By:	Daniel Bates
Date of Approval:	January 2019
Revision:	A

Draft	Original Document submitted to Natural England ahead of SoCG Meeting on 23rd November 2018
Revision A	Post consultation document submitted to the Examining Authority
N/A	
N/A	

Contents

Tables

1 Introduction

1.1 Displacement of red-throated diver

1 This report considers the potential for the proposed Thanet Extension to displace red-throated divers *Gavia stellata* from the area that it is proposed to be occupied by the offshore array (as a project alone) and from the area around the proposed offshore array. The potential for displacement of red-throated diver at a cumulative (and in-combination) level is considered in a separate report [Appendix 1, Annex E]. The focus of this report is on providing evidence in support of the unique nature of the Thanet Extension project with respect to the potential for the displacement of red-throated diver, with that potential being less than that found at other, larger offshore wind farms that have been studied elsewhere across its non-breeding range.

2 Advice received from Natural England in the Evidence Plan process (PINS Ref APP-137/ Application Ref 8.5) was that the standard advice to offshore wind farm developers on displacement (SNCBs, 2017) should be followed.

1.2 Assessment of displacement in the ES Chapter

3 Displacement is assessed by applying a combination of factors to the population of red-throated diver that has been identified as occurring in and around the proposed area of the offshore array. Those factors are;

i. the spatial extent of displacement;

ii. the proportion displaced (expressed as a percentage); and

iii. the proportion of birds that suffer subsequent mortality.

4 For the purpose of concluding the assessment in the ES Chapter(PINS Ref APP-045/ Application Ref 6.2.4), the parameters that were applied for red-throated diver for Thanet Extension are set out in **Error! Reference source not found.** and **Error! Reference source not found.** in Section 2.1. The potential for displacement is presented in those Tables and was assessed in the ES Chapter (PINS Ref APP-045/ Application Ref 6.2.4) only for those bio-seasons where a species was present and occurred in numbers that made an assessment on displacement possible.

5 To enable stakeholders to understand how the particular parameters that were used in concluding the assessment relate to the full range of possible values for the parameters (e.g. from 0-100% for the proportion displaced) a series of matrices were presented in Volume 2 Chapter 4 Annex 4-3 (PINS Ref APP-079/ Applicant Ref 6.4.4.3) of the Environmental Statement. The data within Annex 4-3 presented displacement matrices for red-throated diver for all bio-seasons where the species was present (even when present in very low numbers) and separately presented potential displacement within the site and within a 4 km buffer for each. The preparation and presentation of such matrices is an element of the advice provided by Natural England (SNCBs, 2017).

1.3 Consultation with stakeholders and responses to the ES and RIAA

6 After the submission of the application for consent and the publication of the ES on The Planning Inspectorate website, stakeholders, including Natural England (2018) and the Royal Society for the Protection of Birds (RSPB), provided responses to a range of matters, including on the assessment of displacement, in their Relevant Representations (PINS Ref RR-053 and RR-057 respectively). With regard to displacement, the comments included on the methodology used, the application of site specific data and the presentation of the assessment outputs.

7 The responses to the ES Chapter within Natural England's Relevant Representations (PINS Ref RR-053) relating to the assessment of displacement was summarised in Section 5.3 and detailed in Appendix 1. The following matters are taken from the detailed points made in Appendix 1 in place of the summary information in Section 5.3:

- *SNCB advice is to consider displacement for red throated diver out to 4km.* [for the construction period]*, alongside any values.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.74 ;
- *By applying only an 82 % displacement rate to the winter population of red-throated divers within the Thanet Extension site and assuming no displacement in the buffer, then 159 individuals is likely to be a significant underestimate of the number of displaced birds.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.76;
- *The total number of red throated diver potentially displaced using the SNCB joint guidance of 100% out to 4km would result in 44+217+194+241=696.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.77;

- *Agree for assessing impacts on cable laying assuming 100% displacement out to 2km is reasonable.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.78;
- *Whilst Natural England welcome the use of site specific evidence to provide evidence of bird behaviour in response to the project, we advise that levels of displacement using the advice in the SNCB advice note should be presented alongside.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.104;
- *Red throated diver - SNCB guidance (SNCBs, 2017) is to sum the seasons, and not to place into individual displacement matrices according to season. The assessment does not present a site-specific worst-case displacement. There is strong evidence that more than 82 % of divers are likely to be displaced from the windfarm area. In particular, to assume no displacement from the 4 km buffer is unrealistic and likely to underestimate the number of red throated divers displaced. Therefore Natural England's advice is that the assessment is based on the impact of 100 % of birds being displaced out to 4 km.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.111;
- *It is recommended that the presentation of 0-100 % mortality of displaced birds for all species taken forward to the matrix stage. However, Natural England acknowledge that the level of both adult mortality resulting from displacement are likely to be in the lower range (i.e. 1-10 %) it is appropriate to have a finer gradation of percentage mortality impacts at the lower range of the scale. Any assessment will be made on mortality levels up to 10 %.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.112;
- *Assuming that zero divers are displaced from the 4 km is not realistic. The assessment should include 100 % displacement out to 4 km.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.113;

- *Using the average baseline mortality rate for red-throated diver is 0.228 (Horswill and Robinson, 2015) and the winter Biologically Defined Minimum Population Scales (BDMPS) for red-throated divers is 10,177 (Furness, 2015) then the total number of individuals lost from this BDMPS population per year is 2,320. If 435 divers are displaced and assuming 10 % mortality, a maximum of 44 individuals would be predicted to be lost from this BDMPS population due to the proposed development, which would equate to 1.87 % above baseline mortality. Therefore, we disagree that the impacts can be described as negligible.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.114;
- *Again the conclusion of negligible is based on a likely under estimate of the level of displacement.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to 4.1.116;
- *There appears to be an error in the table where the highlighted line has been cut and pasted from Table 4.13.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Table 4.14;
- *As highlighted in other sections, the number of divers displaced does not include any displaced from the 4 km buffer. Further consideration is required on how significant an effect the displacement of up to 693 divers from within the windfarm and a 4 km buffer would be. This represents 2.99 % above baseline mortality and therefore would be more than a minor significant effect. The matrices in 6.4.4.3 do not present the summed totals for the site plus 4 km buffer.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.117;

8 The responses to the RIAA (PINS Ref APP-31/ Application Ref 5.2) within Natural England's Relevant Representations relating to the assessment of displacement was summarised in Section 5.3 and detailed in Appendix 1 (PINS Ref RR-053). The following matters are taken from the detailed points made in Appendix 1 in place of the summary information in Section 5.3 (PINS Ref RR-053):

- *The summary of consultation relating to the HRA process proposed confirms that the applicant has not applied the recommended SNCB methodology or used the recommended buffers advocated by the SNCBs. By disregarding our advice, it is not possible to have any confidence in the conclusions.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Table 4.1;

- *Natural England do not think it is sufficiently precautionary to assume no displacement occurs beyond the windfarm boundary based on the post construction monitoring at Thanet OWF. As stated in the evidence plan meetings NE advise that 100 % displacement should be assumed out to 4 km.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 11.4.8;
- *Natural England advise that 100 % out to 4 km is used to assess displacement.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 11.4.9;
- *Natural England note the assertion that none of the red-throated diver that were recorded within Thanet Extension can be directly attributed to the Outer Thames Estuary SPA population. We agree that due to the expected mixing we would expect that red-throated diver are mobile across the general area and that birds that occur at any one time outside the SPA might occur within it at another time. Whilst on balance we would agree that there is unlikely to be an adverse effect on integrity resulting from the construction phase, we are concerned that suitability precautionary assumptions on the numbers of birds displaced are not being used.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 11.4.12;
- *Natural England disagree that there is no potential for AEoI to the red-throated diver feature of the Outer Thames Estuary SPA in relation to disturbance and displacement effects from Thanet Extension alone. However, due to the temporary nature of any displacement effects from Thanet Extension alone during the construction period we would agree that adverse effects from displacement are unlikely.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 11.4.14;
- *As stated previously, and on the draft RIAA before submission, Natural England do not consider that it is realistic assumption that no displacement occurs beyond the boundary of the windfarm. As stated in our comments on the PEIR, we advise that the assessment is revised based on the assumption that 100 % of divers are displaced out to 4 km.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 11.4.67;
- *Table 11.11 and 11.12 are flawed due to not taking account of any displacement in the 4km buffer, and therefore it is not possible to fully assess the potential extent of the likely displacement.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Tables 11.11 and 11.12;

1.4 Further consultation with stakeholders in the post-submission stage

9 In response to the Relevant Representations received from Natural England (RR-053) the first post-submission Statement of Common Ground (SoCG) meeting was held on 5th October 2018. This meeting (held between Vattenfall, Natural England, APEM and GoBe) provided clarification on the unique nature of the Thanet Extension project and the data available in support of site-specific displacement rates from local sources.

10 The outcome of the meeting on 5th October 2018 was that a number of actions were proposed in order to aid the understanding of the unique position that Thanet Extension is in with respect to data on disturbance and displacement rates for red-throated divers. This includes consideration of a number of data sources in order to provide Natural England with a range of displacement rates that further support the use of site-specific evidence. These include:

i. Site-specific data from the post-consent monitoring (pre-, during and post construction) surveys of Thanet offshore wind farm (OWF);

ii. Site-specific data from the baseline characterisation surveys of Thanet Extension (that include data within and surrounding the operational Thanet Offshore Wind Farm (OWF) site);

iii. Draft outputs from Kentish Flats Extension OWF post-consent monitoring (pre-, during and post construction) reports; and

iv. Signposting to generic displacement matrices for each species in the ES Chapter for comparison and correction of one matrix (Table 4.14) that contained a typographical error.

11 The matters identified above have been included in this clarification note.

12 A draft of this clarification note (Annex D, Appendix 1 (Draft)) was provided to Natural England on the 15th November 2018 and a meeting held with Natural England on 23rd November 2018 during which the draft of the clarification note was discussed. At that meeting Natural England raised the following matters:

i. Additional explanation should be provided as to how the percentages provided in Table 1 and 2 had been calculated.

ii. Reference to displacement evidence sources should include those that show greater displacement distances at other sites.

iii. For each of the displacement evidence sources there should be a statement on the survey platform used, the area surveyed, the analytical method applied and the limitations.

iv. Given the different degree of displacement identified by the studies cited and the hypothesis that there are site specific factors acting, then the validation of that hypothesis should be considered as a key element of the post-construction monitoring programme for Thanet Extension.

v. Additional displacement matrices should be presented using rates in accordance with SNCB guidance (100% displacement out to 4 km)

13 This version of the clarification note accounts for that input from Natural England.

2 Responses to Natural England Relevant Representations

2.1 Displacement rates from site-specific evidence: Post-consent monitoring of Thanet OWF

14 The assessment of displacement for the Thanet Extension EIA was aided by the extensive post-consent monitoring survey data, analysis and reporting available on non-breeding seabirds within and in close proximity to the Thanet OWF (Royal HaskoningDHV, 2013). The post-consent monitoring programme had a particular focus on red-throated divers during the non-breeding season. This programme of monitoring provided site-specific evidence of bird behaviour in response to the construction and operation of Thanet OWF. Its findings are directly relevant to and applicable in the Thanet Extension EIA. Given that this data source on red-throated diver disturbance and displacement was recent and site-specific it was given greater weight over other data sources from constructed OWFs in more distant parts of the North Sea.

15 The site-specific evidenced displacement rates and spatial extent of the displacement that were applied for red-throated diver in the assessment (Volume 2 Chapter 4 (PINS Ref APP-045/ Applicant Ref 6.2.4) of the Environmental Statement) are set out in **Error! Reference source not found.** and **Error! Reference source not found.**. Within this ES Chapter (PINS Ref APP-045/ Applicant Ref 6.2.4) displacement matrices were presented and assessed only for those bio-seasons where a species was present and occurred in numbers that made an assessment on displacement possible. As well as seasonal estimates, annual displacement estimates were calculated and assessed for each species in both the construction and operational phases, in line with SNCB guidance (SNCBs, 2017).

Table 1: Red-throated diver specific parameters applied in the assessment of displacement (construction phase)

Species	Spatial extent (km)	Proportion (%)	Subsequent mortality (%)
Spring migration	Site	82%	1-5%
	4 km buffer	0%	1-5%
Winter	Site	82%	1-5%
	4 km buffer	0%	1-5%
Breeding and Autumn migration	Zero birds present		

Table 2: Red-throated diver specific parameters applied in the assessment of displacement (operational phase)

Species	Spatial extent (km)	Proportion (%)	Subsequent mortality (%)
Spring migration	Site	73%	1-5%
	4 km buffer	0%	1-5%
Winter	Site	73%	1-5%
	4 km buffer	0%	1-5%
Breeding and Autumn migration	Zero birds present		

16 To enable stakeholders to understand how the particular parameters that were used in concluding the assessment relate to the full range of possible values for the parameters (e.g. from 0-100% for the proportion displaced) a series of matrices were presented in Volume 2 Chapter 4 Annex 4-3 (PINS Ref APP-079/ Applicant Ref 6.4.4.3) of the Environmental Statement. The data within Annex 4-3 (PINS Ref APP-079/ Applicant Ref 6.4.4.3) presented displacement matrices for red-throated diver for all bio-seasons where the species were present (even when present in very low numbers) and separately for potential displacement within the site and within a 4 km buffer for each. The preparation and presentation of such matrices is an element of the advice provided by Natural England (SNCBs, 2017). In order to provide the Examining Authority (and Natural England) with clarity on the range of displacement using SNCB guidance, this information is presented in Appendix B of this document. See also Section 2.5 for further information about these displacement matrices.

2.2 Displacement rates from site-specific evidence: Baseline characterisation surveys for Thanet Extension

17 Within the Thanet Extension Offshore Ornithology Baseline Technical Report (PINS Ref APP-077/ Application Ref 6.4.4.1) a second set of site-specific data on seabird distribution is available, the findings of the 24 month aerial digital survey programme undertaken by APEM between March 2016 and February 2018. These surveys covered Thanet OWF, Thanet Extension and a 4 km buffer surrounding it (the Survey Area). These surveys act as a second set of post-construction surveys for Thanet OWF and provide additional data that has not been analysed for that purpose.

18 In order to make use of these data for the purpose of providing additional evidence on site-specific displacement rates for use in the assessment of potential impacts from Thanet Extension, an account is provided below on the findings for red-throated diver. In support of this species account the relevant red-throated diver distribution maps prepared from the aerial surveys have been included in Appendix A of this report.

19 The aerial survey data set, separated out by bio-season, has been analysed to provide abundance estimates for four different areas within that surveyed. The method used is described in Section 3.1.3 of the Offshore Ornithology Baseline Technical Report (PINS Ref APP-077/ Application Ref 6.4.4.1). The four different areas are:

1 Thanet OWF;

2 4 km buffer surrounding Thanet OWF offshore wind farm;

3 Thanet Extension; and

4 4 km buffer surrounding Thanet Extension.

20 From these four area specific abundance estimates it is then possible to calculate area specific densities. Then, by comparing the density estimates between the areas it is possible to calculate displacement rates according to these differences in density, subject to the application of a set of simple assumptions. These assumptions include that following the construction of Thanet Extension:

a. The density of birds within Thanet Extension would change to that within Thanet OWF; and

b. The density of birds within a 4 km buffer of Thanet Extension would change to that of the 4 km buffer of Thanet OWF.

21 The use of data on the basis of the second assumption described above (b) with reference to a 4 km buffer does not imply that the red-throated diver population considered in this report is subject to a displacement rate to that distance. The use of data from the 4 km buffer was used due to it being available for assessment at this stage of the project and that it matched the requirements of the SNCB guidance (SNCBs, 2017) and not because there is site specific evidence that birds are displaced to that distance. It has been assessed and presented in this report in order to provide further evidence of the unique nature of this project and bird behaviour in response to the operational Thanet OWF site and the waters surrounding it being different to other locations.

22 The analysis of the available aerial survey data has been carried out dividing the survey year in to red-throated diver specific 'bio-seasons'. The movement and behaviour of red-throated divers are considered to be split between four bio-seasons (Furness, 2015): spring migration, breeding, autumn migration and wintering. During these bio-seasons birds migrate towards their breeding sites during the spring bio-season, reside mostly within mean maximum foraging range of those sites within the breeding bio-season, move away from sites during the autumn migration bio-season and remain resident within non-breeding areas during the winter bio-season.

23 These four bio-seasons define the distribution and abundance of red-throated diver within the Survey Area for the baseline characterisation of Thanet Extension. Visually, the distribution maps within the baseline technical report (PINS Ref APP-077/ Application Ref 6.4.4.1) (reproduced in Appendix A of this document) support the expected occurrence of birds throughout the different bio-seasons, which can be described as;

i. During the **spring migration bio-season** birds were loosely recorded in low densities across the Survey Area, with very few individuals within the Thanet offshore wind farm footprint. Birds were less densely recorded in the north west and south west of the Survey Area, but there were no obvious reasons for this;

ii. There were no red-throated divers recorded within the Survey Area during the **breeding bio-season** or the **autumn migration bio-season**. This is a reflection of the area being well outside of the mean–maximum foraging range (Thaxter *et al*., 2012) from the nearest known breeding sites in northern Scotland and Scandinavia. With respect to the lack of birds recorded within the autumn migration period, it is not clear why this may be the case, but provides evidence that this is not a chosen location for birds to move through during this period and not being a first choice location early in the non-breeding period; and

iii. During the **winter bio-season** birds were loosely distributed across the Survey Area, with no obvious areas of preference or avoidance, except for a lack of individuals within the Thanet offshore wind farm footprint. There was a reduced density of birds towards the south west of the Survey Area between Thanet offshore wind farm and the coast of Kent.

24 Accordingly, the only bio-seasons that may contribute to a further understanding of potential displacement of red-throated diver from Thanet Extension are during the spring migration and winter. The total abundances covering the spring months over the survey period and the average monthly density within each of these separate areas are presented in Table 3.

Table 3: Total (and average monthly) cumulative abundance and average monthly density of red-throated divers during the spring migration bio-season within the Survey Area.

Area	Total abundance of all months	Average Monthly Abundance over Bio-season	Average Monthly Density over Bio-season (birds/km^2)
Thanet OWF	45	11.25	0.32
Thanet OWF 4 km Buffer	469	117.25	0.81
Thanet Extension	215	53.75	0.74
Thanet Extension 4 km Buffer	770	192.5	0.91

25 From these data an estimate for the displacement rate of red-throated divers from the area within Thanet Extension is 57%, based on the assumption that the current density within the Thanet Extension site would change to being similar to that within Thanet offshore wind farm (0.74 birds/km^2 to 0.32 birds/km^2). When applying the same logic to these data an estimate for the displacement rate of red-throated divers from the area within the Thanet Extension 4 km buffer is 11%, based on the assumption that the current density within the Thanet Extension 4 km buffer would change to being similar to that within the Thanet OWF 4 km buffer (0.91 birds/km^2 to 0.81 birds/km^2).

26 If the spatial extent of displacement applied to red-throated divers were to be followed using SNCB guidance (SNCBs, 2017) then the resultant displacement rates during the spring migration bio-season from using the aerial digital data in this manner would be to consider displacement rates of 57% within Thanet Extension and 11% within the Thanet Extension 4 km buffer.

27 The total abundances covering the winter months over the survey period and the average monthly density within each of these separate areas are presented in Table 4.

Table 4: Total (and average monthly) cumulative abundance and average monthly density of red-throated diver during the winter bio-season within the Survey Area.

Area	Total abundance of all months	Average Monthly Abundance over Bio-season	Average Monthly Density over Bio-season (birds/km^2)
Thanet OWF	0	0.00	0.00
Thanet OWF 4 km Buffer	627	156.75	1.08
Thanet Extension	388	97	1.33
Thanet Extension 4 km Buffer	700	175	0.83

28 From these data an estimate for the displacement rate of red-throated divers from the area within Thanet Extension is 100%, based on the assumption that the current density within the Thanet Extension site would change to being similar to that within Thanet OWF (1.33 birds/km^2 to 0.00 birds/km^2). When applying the same logic to these data an estimate for the displacement rate of red-throated divers from the area within the Thanet Extension 4 km buffer is 30%(an increase in density), based on the assumption that the current density within the Thanet Extension 4 km buffer would change to being similar to that within the Thanet OWF 4 km buffer (0.83 birds/km^2 to 1.08 birds/km^2).

29 If the spatial extent of displacement applied to red-throated divers were to be followed using SNCB guidance (SNCBs, 2017) then the resultant displacement rates during the winter bio-season from using the aerial digital data in this manner would be to consider displacement rates of 100% within Thanet Extension and an increase in density of 30% within the Thanet Extension 4 km buffer.

2.3 Displacement rates from site-specific evidence: Post-consent monitoring of Kentish Flats Extension OWF

30 The assessment of displacement for the Thanet Extension EIA is further aided by the draft post-consent monitoring survey data and report made available from the Kentish Flats Extension OWF (Percival & Ford, 2018). The Kentish Flats OWF lies within the Outer Thames Estuary SPA, for which red-throated diver is a qualifying feature. The main purpose of the Kentish Flats Extension OWF monitoring programme was to assess a number of seabird species (with divers identified as the primary ornithological sensitivity) and the key questions addressed for these species through spatial analysis were as follows;

- How have numbers changed within the Kentish Flats Extension OWF site since construction of the wind farm?
- How do these numbers compare with those in the wider survey area?
- Is there any evidence for any displacement beyond the Kentish Flats Extension OWF site itself, and if so over what spatial extent did this occur? and;
- What are the cumulative displacement effects of Kentish Flats Extension OWF with the original Kentish Flats OWF

31 The Kentish Flats Extension OWF monitoring draft report (Percival & Ford, 2018) provides an assessment of diver densities within the site and then within distance zones out from the site, including 500 m, 1 km, 2 km, 3 km, 4 km and >4 km for pre-construction and post-construction periods. Statistical analysis undertaken for this study to investigate the effect of the OWF on red-throated divers incorporated other factors that could affect their distribution, including;

- Distance from the main shipping lane;
- Distance from shore;
- Water depth;
- Seabed habitat; and
- Distance zone from the OWF.

32 The modelling of the above environmental and spatial variables provided further insight into observed displacement effects for red-throated diver. The resulting analysis were summarised to provide comparison between the pre-construction and post-construction phases of the Kentish Flats Extension OWF (noting that analysis was not carried out for the construction period). The analysis concluded no statistically significant differences between diver density in the Kentish Flats Extension zones prior to construction, and no statistically significant relationship with any of the other variables.

33 The analysis concluded that red-throated diver densities were approximately 89% lower within Kentish Flats Extension OWF after construction and approximately 70% lower in the 0-500 m zone. However, there was no statistically significant effect detectable beyond 500 m from the wind turbines, which had higher diver densities post construction.

34 Similar results were evident from the analysis of the combined displacement effect of Kentish Flats Extension OWF with Kentish Flats OWF. The diver density within the two OWF areas combined reduced by 91% in comparison with the zones more than 500 m from the wind turbines, whilst the reduction in the 0-500 m buffer zone was 61%. This combined displacement effect is very similar, comparing favourably with the outcome of the analysis of displacement from Kentish Flats OWF alone.

35 The concluding statement of the Kentish Flats Extension OWF monitoring report recommends that these displacement rates (i.e. 89% within an OWF and 70% within 0-500 m buffer of an OWF) should be the primary values used for future assessments of wind farm disturbance to wintering divers. Following this recommendation these displacement rates provide an additional source of data in support of the concluding assessments in the Thanet Extension ES Chapter (PINS Ref APP-045/ Applicant Ref 6.2.4), that divers are not 100% displaced from operational OWFs or 4 km buffers surrounding them. If the displacement rates concluded for the Kentish Flats Extension OWF were to be applied to Thanet Extension then these would be applied to both the spring migration and winter bio-seasons (as presented in Table 5), as the analysis of Percival & Ford (2018) did not split these two bio-seasons.

Table 5: Red-throated diver displacement measured at Kentish Flats Extension OWF in the operational phase

Season	Spatial extent (km)	Proportion (%)
Spring migration	Site	89%
	500 m buffer	70%
Winter	Site	89%
	500 m buffer	70%

2.4 Comparison of the three sources of empirical evidence for displacement in the operational phase

36 A comparison of the empirical evidence for displacement of red-throated diver from the three studies of operational OWFs close to the coast of Kent is presented in Table 6.

Table 6: Comparison of the empirical evidence for the displacement of red-throated diver obtained from surveys of operational OWFs close to the coast of Kent

Operational OWF	Thanet		Thanet		Kentish Flats	
Source	Royal HaskoningDHV (2013).		This study		Percival & Ford (2018)	
Season	Spatial extent	% displaced	Spatial extent	% displaced	Spatial extent	% displaced
Spring migration	Site	73	Site	57	Site	89
	2 km buffer	0	4 km buffer	11	0.5 km buffer	70
Winter	Site	73	Site	100	Site	89
	2 km buffer	0	4 km buffer	0	0.5 km buffer	70

37 The 70% displacement over 0.5 km recorded at Kentish Flats Extension OWF is equivalent to 9% displacement over 4 km if the density of birds were even across that buffer prior to the construction of the OWF.

38 Studies of three other operational OWFs in the southern North Sea that have identified some degree of displacement of red-throated diver (noting that it was not 100%) around or beyond the 4 km distance provided in SNCB guidance (SNCBs, 2017). Those three studies are of London Array (APEM, 2016), Lincs OWF (HiDef, 2017) and of a cluster of OWFs in the German Bight (Mendel et al. 2019). Table 7 presents and compares the areas of the OWFs, their location in relation to SPAs classified for red-throated diver (this being a surrogate for areas of high diver density), the analysis approaches and the distance at which displacement was determined not to be significantly different from zero percent.

Table 7: OWF post-construction studies of red-throated diver displacement

OWF	Array area (km^2)	Relationship to SPA	Pre-const'n survey platform	Post-const'n survey platform	Analysis method	Distance at which displacement % was zero (km)
Thanet Royal HaskoningDHV, 2013	35	Outside	Boat	Boat	GLS model	0
Kentish Flats Extension Percival & Ford, 2018	7.8 [+ KF of 10]	Within	Boat	Boat	GLS model	0.5 - 1.0
London Array APEM, 2016	101	Within	Aerial	Aerial	MRSea model	6
Lincs HiDef, 2017	35 [+ LID of 20]	Enclosed	Boat	Aerial	MRSea model	8
Butendiek and Helgoland cluster Mendel et al, 2019	130 33 + 32 + 24 + 41	Within	Boat	Aerial	GAM model	16

2.5 Signposting to generic displacement matrices for red-throated diver in the ES Chapter for comparison and correction to a matrix

39 All displacement matrices for red-throated diver were provided in Volume 2 Chapter 4 Annex 4-3 (PINS Ref APP-079/ Applicant Ref 6.4.4.3) of the Environmental Statement. For red-throated diver a complete matrix was provided for each biological season that the species occurred in. The abundances presented in these displacement matrices corresponds with the generic spatial extent for red-throated diver within the SNCB guidance (SNCB, 2017), which is to consider 100% displacement within the site and out to a 4 km buffer.

40 For clarity and ease of reference by stakeholders those matrices are reproduced in Appendix B.

41 Natural England identified in their Relevant Representation (PINS Ref RR-053) that a typographical error had been made in the red-throated diver displacement matrix for the Thanet Extension site only, during the migration-spring bio-season, that was Table 4.14 in the assessment (PINS Ref APP-045/ Applicant Ref 6.2.4). Correction of that typographical error was an action agreed with Natural England at the meeting on 5th October 2018. The corrected Table 4.14 is presented in Appendix C.

3 Conclusion

42 Three sources of local site data have been examined for the information that they provide about displacement of red-throated diver within and around operational OWFs. The common feature of the three OWFs examined (Thanet, Kentish Flats and Kentish Flats Extension) is that they are relatively small in scale, relatively close to the shore and do not contain the highest densities of red-throated diver. The density in the area of Thanet and Thanet Extension at the time of investigation of the potential for classification of a SPA was below the threshold that justified classification.

43 The three OWFs examined (Thanet, Kentish Flats and Kentish Flats Extension) show a consistency of pattern, exhibiting a high degree of displacement within the footprint of the OWF and very little displacement across a 4 m buffer outside the OWF. This was the set of displacement parameters assessed for Thanet Extension OWF in the submitted ES Chapter (PINS Ref APP-045/ Applicant Ref 6.2.4) and based on the conclusion above it is considered that the assessment in those documents is robust and evidence based and should remain as submitted. In light of the evidence presented within this report it is apparent that Thanet Extension may be considered somewhat unique in that the displacement exhibited at this location is lower than that measured at other OWF locations within SPAs classified for red-throated diver within the North Sea.

44 Given the consistency of pattern between the three OWFs examined (Thanet, Kentish Flats and Kentish Flats Extension) it is considered that there is little benefit to be gained by producing additional displacement matrices based on presenting the three individual empirical sources of evidence on the degree and spatial extent of displacement.

4 References

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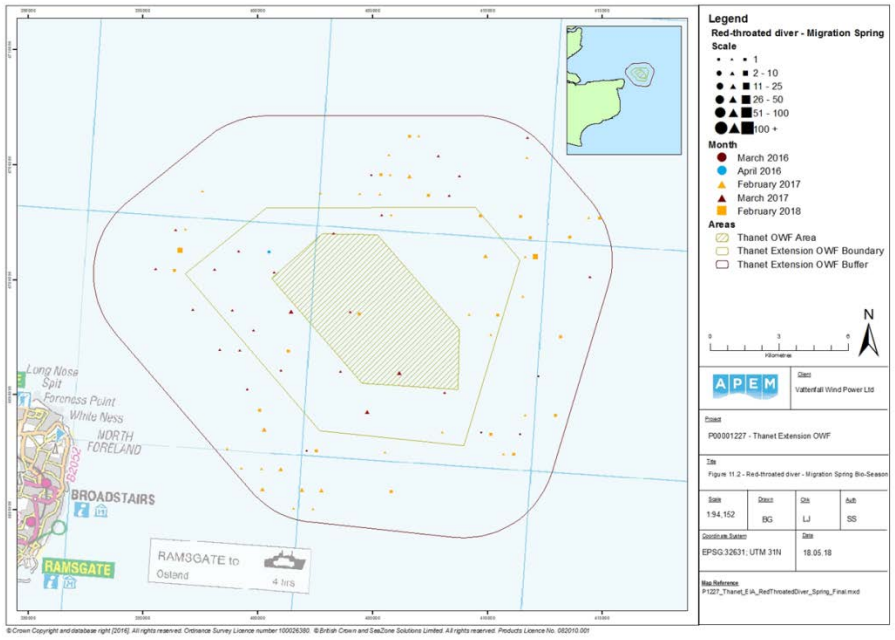
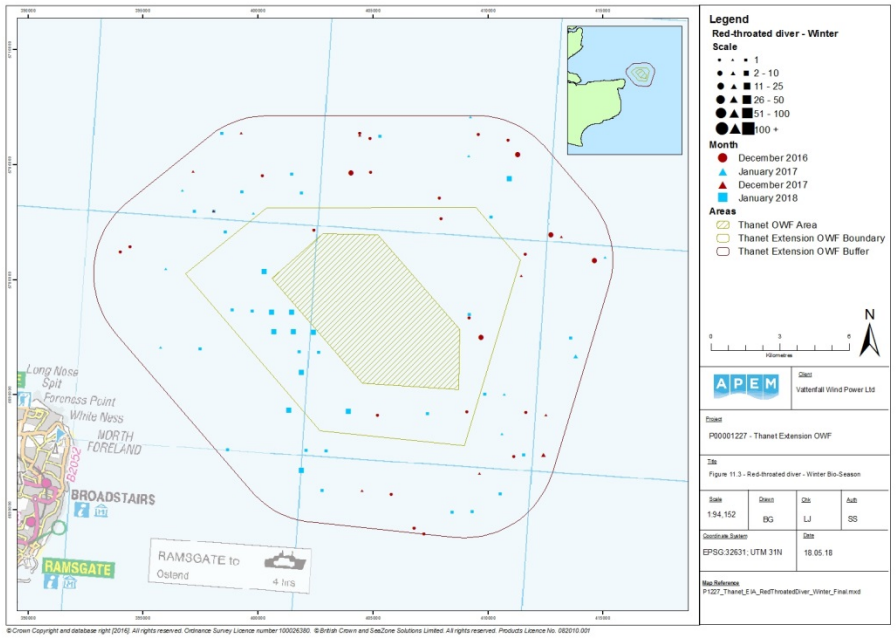
Appendix A – Thanet Extension Distribution Maps for Red-throated Diver



Red-throated diver – Spring migration bio-season



Red-throated diver – Winter bio-season

Appendix B – Displacement Matrices for Red-throated Diver Reproduced from Annex 4-3 of the Environmental Statement

Displacement matrix presenting the number of red-throated divers in the Thanet Extension site only, during the Migration-spring bio-season. [This was Table 3 in Annex 4-3]

Displacement (%)	Mortality Rates (%)												
	0	1	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	1	1	2	2	3	3	4	4	4
20	0	0	0	1	2	3	4	4	5	6	7	8	9
30	0	0	1	1	3	4	5	7	8	9	11	12	13
40	0	0	1	2	4	5	7	9	11	12	14	16	18
50	0	0	1	2	4	7	9	11	13	15	18	20	22
60	0	0	1	3	5	8	11	13	16	18	21	24	26
70	0	0	2	3	6	9	12	15	18	22	25	28	31
80	0	0	2	4	7	11	14	18	21	25	28	32	35
90	0	0	2	4	8	12	16	20	24	28	32	36	40
100	0	0	2	4	9	13	18	22	26	31	35	40	44

Displacement matrix presenting the number of red-throated divers in the Thanet Extension 4 km Buffer only, during the Migration-spring bio-season.
[This was Table 4 in Annex 4-3]

Displacement (%)	Mortality Rates (%)												
	0	1	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	1	1	1	1	2	2	2	2
10	0	0	1	2	4	7	9	11	13	15	17	20	22
20	0	0	2	4	9	13	17	22	26	30	35	39	43
30	0	1	3	7	13	20	26	33	39	46	52	59	65
40	0	1	4	9	17	26	35	43	52	61	69	78	87
50	0	1	5	11	22	33	43	54	65	76	87	98	109
60	0	1	7	13	26	39	52	65	78	91	104	117	130
70	0	2	8	15	30	46	61	76	91	106	122	137	152
80	0	2	9	17	35	52	69	87	104	122	139	156	174
90	0	2	10	20	39	59	78	98	117	137	156	176	195
100	0	2	11	22	43	65	87	109	130	152	174	195	217

Displacement matrix presenting the number of red-throated divers in the Thanet Extension site only, during the Winter bio-season. [This was Table 5 in Annex 4-3]

Displacement (%)	Mortality Rates (%)												
	0	1	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	1	1	1	1	1	2	2	2
10	0	0	1	2	4	6	8	10	12	14	16	17	19
20	0	0	2	4	8	12	16	19	23	27	31	35	39
30	0	1	3	6	12	17	23	29	35	41	47	52	58
40	0	1	4	8	16	23	31	39	47	54	62	70	78
50	0	1	5	10	19	29	39	49	58	68	78	87	97
60	0	1	6	12	23	35	47	58	70	81	93	105	116
70	0	1	7	14	27	41	54	68	81	95	109	122	136
80	0	2	8	16	31	47	62	78	93	109	124	140	155
90	0	2	9	17	35	52	70	87	105	122	140	157	175
100	0	2	10	19	39	58	78	97	116	136	155	175	194

Displacement matrix presenting the number of red-throated divers in the Thanet Extension 4 km Buffer only, during the Winter bio-season. [This was Table 6 in Annex 4-3]

Displacement (%)	Mortality Rates (%)												
	0	1	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	1	1	1	1	2	2	2	2
10	0	0	1	2	5	7	10	12	14	17	19	22	24
20	0	0	2	5	10	14	19	24	29	34	39	43	48
30	0	1	4	7	14	22	29	36	43	51	58	65	72
40	0	1	5	10	19	29	39	48	58	67	77	87	96
50	0	1	6	12	24	36	48	60	72	84	96	108	121
60	0	1	7	14	29	43	58	72	87	101	116	130	145
70	0	2	8	17	34	51	67	84	101	118	135	152	169
80	0	2	10	19	39	58	77	96	116	135	154	174	193
90	0	2	11	22	43	65	87	108	130	152	174	195	217
100	0	2	12	24	48	72	96	121	145	169	193	217	241

Appendix C – Corrected copy of Table 4.14 of Volume 2 Chapter 4 of the Environmental Statement

It is the row relating to the predicted displacement rate of 73% that contained the typographical error – the number of red-throated divers had been inadvertently copied across from Table 4.13.

Table 4.14: Displacement matrix presenting the number of red-throated divers in the Thanet Extension site only, during the migration-spring bio-season that may be subject to mortality (highlighted in pink)

Displacement (%)	Mortality Rates (%)												
	0	1	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	1	1	2	2	3	3	4	4	4
20	0	0	0	1	2	3	4	4	5	6	7	8	9
30	0	0	1	1	3	4	5	7	8	9	11	12	13
40	0	0	1	2	4	5	7	9	11	12	14	16	18
50	0	0	1	2	4	7	9	11	13	15	18	20	22
60	0	0	1	3	5	8	11	13	16	18	21	24	26
70	0	0	2	3	6	9	12	15	18	22	25	28	31
73	0	0	2	3	6	10	13	16	19	22	26	29	32
80	0	0	2	4	7	11	14	18	21	25	28	32	35
90	0	0	2	4	8	12	16	20	24	28	32	36	40
100	0	0	2	4	9	13	18	22	26	31	35	40	44

Vattenfall Wind Power Ltd

Thanet Extension Offshore Wind Farm

Appendix 1, Annex E to Deadline 1 Submission:

Displacement of seabirds (other than red-throated diver)

Relevant Examination Deadline: Deadline 1

Submitted by Vattenfall Wind Power Ltd

Date: January 2019

Revision A

Drafted By:	APEM Ltd
Approved By:	Daniel Bates
Date of Approval:	January 2019
Revision:	A

Draft	Original Document submitted to Natural England ahead of SoCG Meeting on 23rd November 2018
Revision A	Post consultation document submitted to the Examining Authority
N/A	
N/A	

Contents

Tables

1 Introduction

1.1 Displacement of seabirds other than red-throated diver

2 This report considers the potential for the proposed Thanet Extension to displace seabirds from the area that it is proposed to be occupied by the offshore array. The potential for displacement of red-throated diver *Gavia stellata* for Thanet Extension alone is considered in a separate report [Appendix 1, Annex D: Red Throated Diver Displacement Note]. The focus of this section is on the potential for the displacement of auks, specifically guillemot *Uria aalge* and razorbill *Alca torda*, and gannet *Morus bassanus*. The other group of seabird species occurring frequently in the areas of the proposed Thanet Extension array, gulls *Laridae*, are not known to be displaced by offshore structures (Dierschke *et al.*, 2016) and are not considered further.

3 Advice received from Natural England in the Evidence Plan process (PINS Ref APP-137/ Application Ref 8.5) was that the standard advice to offshore wind farm developers on displacement (SNCBs, 2017) should be followed.

3.1 Assessment of displacement in the ES Chapter

3 Displacement is assessed by applying a combination of factors to the population of each relevant species that has been identified as occurring in and around the proposed area of the offshore array. Those factors are;

i. the spatial extent of displacement;

ii. the proportion displaced (expressed as a percentage); and

iii. the proportion of birds that suffer subsequent mortality.

4 For the purpose of concluding the assessment in the ES Chapter (PINS Ref APP-045/ Application Ref 6.2.4), the parameters that were applied for each species for Thanet Extension are set out in Table 1 and Table 2 in Section 2.1. The potential for displacement is presented in those Tables and was assessed in the ES Chapter (PINS Ref APP-045/ Application Ref 6.2.4) only for those bio-seasons where a species was present and occurred in numbers that made an assessment on displacement possible.

5 To enable stakeholders to understand how the particular parameters that were used in concluding the assessment relate to the full range of possible values for the parameters (e.g. from 0-100% for the proportion displaced) a series of matrices were presented in Volume 2 Chapter 4 Annex 4-3 (PINS Ref APP-079/ Document Ref 6.4.4.3) of the Environmental Statement. The data within Annex 4-3 of the ES Chapter (PINS Ref APP-079/ Document Ref 6.4.4.3) presented displacement matrices for gannet, guillemot and razorbill for all bio-seasons where the species were present (even when present in very low numbers) and separately presenting potential displacement within the site and within a 2 km buffer for each. The preparation and presentation of such matrices is an element of the advice provided by Natural England (SNCBs, 2017). In order to provide the Examining Authority (and Natural England) with clarity on the range of displacement using SNCB guidance, then this information is presented in Appendix D to F of this document.

3.2 Consultation with stakeholders and responses to the ES and RIAA

6 After the submission of the application for consent and the publication of the ES on The Planning Inspectorate website, stakeholders, including Natural England (2018) and the Royal Society for the Protection of Birds (RSPB), provided responses to a range of matters, including on the assessment of displacement, in their Relevant Representations (PINS Ref RR-053 and RR-057 respectively). With regard to displacement, the comments included on the methodology used, the application of site specific data and the presentation of the assessment outputs.

7 The responses to the ES Chapter within Natural England's Relevant Representations (PINS Ref RR-053) relating to the assessment of displacement was summarised in Section 5.3 and detailed in Appendix 1. The following matters are taken from the detailed points made in Appendix 1 in place of the summary information in Section 5.3:

- *Whilst Natural England accept that there is some evidence from the windfarm TOWF during-construction monitoring surveys we recommend that the displacement is considered up to 2 km away from the OWF when considering displacement effects on razorbill* [for the construction period]*, alongside any values.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.84-87;

- *Natural England would agree that the displacement in the construction period is unlikely to be significant effect for the project alone. However, we still advise that the rates advised for considering displacement by the SNCBs are still presented in the ES for razorbill, so a cumulative assessment using common currency can be undertaken.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.88;
- *Guillemot – Natural England note that there is some evidence from the TOWF during-construction monitoring surveys that displacement of guillemots within a 1 km buffer occurred. However, we advise that alongside these data, potential effects to a limit of 2 km are also presented* [for the construction period]. Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.91;
- *Whilst it states that SNCB interim displacement advice note have shaped the assessment, it appears to have been disregarded.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.102;
- *Whilst Natural England welcome the use of site specific evidence to provide evidence of bird behaviour in response to the project, we advise that levels of displacement using the advice in the SNCB advice note should be presented alongside.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.104;
- *It is recommended that the presentation of 0-100 % mortality of displaced birds for all species taken forward to the matrix stage. However, Natural England acknowledge that the level of both adult mortality resulting from displacement are likely to be in the lower range (i.e. 1-10 %) it is appropriate to have a finer gradation of percentage mortality impacts at the lower range of the scale. Any assessment will be made on mortality levels up to 10 %.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.112;
- *Gannet – The statement 'there is no evidence that gannets are displaced beyond wind farm boundaries' is quite surprising given what is said in 4.1.118 regarding macro avoidance.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.119;
- *As stated in the SNCB advice note on displacement, Natural England advise that displacement assessment is considered out to 2 km for gannet* [in the operational phase]. *However, we acknowledge that with the inclusion of birds displaced from a 2 km buffer, it is unlikely to change the overall conclusion of effect.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.121;

- *These tables only present displacement values for the project site only. SNCB advice is to include displacement from a 2 km buffer.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Tables 4.15 and 4.16;
- *Whilst Natural England disagree with the methodology, i.e. not considering gannets are displaced from a 2 km buffer, we acknowledge that even if the recommended methodology was used it is unlikely to change the conclusions.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.123;
- *The displacement estimates for auks are not in line with SNCB guidance. SNCB guidance for auks if to consider displacement out to a 2 km buffer* [in the operational phase]. Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.125;
- *By only focussing on a single displacement value not the range advocated by the SNCBs and not including the summed seasonal displacement totals out to 2 km, this does not adequately deal with Natural England's response to the consultation.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.126;
- *The razorbill displacement totals for the spring migration season do not include a 2 km buffer.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.127;
- *There is no table which includes the project site and a 2 km buffer.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph Table 4.17 and 4.18;
- *Natural England disagrees with the methodology used (using a buffer less than that recommended by the SNCBs), however we acknowledge that magnitude of impact is unlikely to change.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.130;
- *The number of guillemots potentially displaced may be under estimated. SNCB advice is to consider displacement potentially occurring out to 2 km.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.131;
- *Natural England disagrees with the methodology used (using buffer less than that recommended by the SNCBs), however we acknowledge that magnitude of impact is unlikely to change.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.133;

- *The Thanet Extension alone assessment does not follow the advice given by the SNCBs on assessing displacement. The figures using the methodology advocated by Natural England (and other SNCBs) should be presented alongside those presented by the Applicant.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.2.31;
- *Whilst we acknowledge that the relative contribution from Thanet is relatively small, and is likely to remain so if the recommended methodology is used, we think it is important to include figures using SNCB agreed methodology to include in cumulative totals.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.2.32;
- *As stated above Table 4.30 should include figures using methodology agreed by the SNCBs.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.2.35;
- *Natural England agree that the numbers of gannet displaced from Thanet Extension, even using the recommended methodology, are likely to be negligible. However, these figures should be combined with any predicted mortality from collision and considered in the cumulative assessment.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.2.36;

8 The responses to the RIAA (PINS Ref APP-31/ Application Ref 5.2) within Natural England's Relevant Representations relating to the assessment of displacement was summarised in Section 5.3 and detailed in Appendix 1 (PINS Ref RR-053). The following matters are taken from the detailed points made in Appendix 1 in place of the summary information in Section 5.3 (PINS Ref RR-053):

- *The summary of consultation relating to the HRA process proposed confirms that the applicant has not applied the recommended SNCB methodology or used the recommended buffers advocated by the SNCBs. By disregarding our advice, it is not possible to have any confidence in the conclusions.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Table 4.1;
- *The figures are also based on displacement based on a 1 km buffer and not 2 km buffer.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 8.5.13;
- *As advised in the Evidence Plan process, and on the draft RIAA, displacement figures for guillemots follow the SNCB guidance, and 2 km buffers are presented alongside the displacement based on a 1 km distance. This will allow a range of potential displacement to be considered, as well as presenting a common currency to enable an in-combination assessment.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 11.4.6;

- *Tables 11.7 and 11.8 only include a 1km buffer, as previously advised displacement out to 2 km should also be presented.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Tables 11.7 and 11.8;
- *As stated guillemot displacement assessment should follow SNCB guidance, and 2 km buffer should be used to calculate potential displacement, and these figures should be presented alongside figures based on a 1 km buffer.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 11.4.19-20;
- *As stated previously, razorbill displacement assessment should follow SNCB guidance, and 2 km buffer should be used to calculate potential displacement, and these figures should be presented alongside figures based on a 1 km buffer.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 11.4.26;
- *Tables 11.9 and 11.10 do not include figures based on a 2 km displacement.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Tables 11.9 and 11.10;
- *Comments relating to assessing guillemot displacement during construction phase also apply to the Operations phase.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 11.4.73-81;
- *Comments relating to assessing razorbill displacement according to SNCB advice during construction also apply to operations phase.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 11.4.82-90;

3.3 Further consultation with stakeholders in the post-submission stage

9 In response to the Relevant Representations received from Natural England (PINS Ref RR-053) the first post-submission Statement of Common Ground (SoCG) meeting was held on 5th October 2018. This meeting (held between Vattenfall, Natural England, APEM and GoBe) provided clarification on the unique nature of the Thanet Extension project and the data available in support of site-specific displacement rates from local sources.

10 The outcome of the meeting on 5th October 2018 was that a number of actions were proposed in order to aid the understanding of the unique position that Thanet Extension is in with respect to data on disturbance and displacement rates for species of interest (gannet, guillemot and razorbill). This includes consideration of a number of data sources in order to provide Natural England with a range of displacement rates that further support the use of site-specific evidence. These include;

i. Site-specific data from the post-consent monitoring (pre-, during and post construction) surveys of Thanet;

ii. Site-specific data from the baseline characterisation surveys of Thanet Extension (that include data within and surrounding the operational Thanet site);

iii. Signposting to generic displacement matrices for each species in the ES Chapter for comparison and correction of any matrices with errors in them.

11 The matters identified above have been included in this clarification note.

12 A draft of this clarification note (Appendix 1, Annex E: Displacement of seabirds, Revision A) was provided to Natural England on the 15th November 2018 and a meeting held with Natural England on 23rd November 2018 during which the draft of the clarification note was discussed. At that meeting Natural England raised the following matters:

i. Additional displacement matrices should be presented using rates in accordance with SNCB guidance (100% displacement out to 2 km)

ii. The culmination of potential displacement rates across a single year was discussed, but due to Thanet Extension having very low abundances or no birds present during the breeding period it was agreed that this would not be of benefit

iii. Additional clarity should be added to explain the use of aerial digital survey data used to estimate site-specific displacement rates

iv. Make reference to Thanet Extension being unique in comparison to other offshore wind farms, as it is in a area of low seabird abundance / density across all biological seasons

v. To acknowledge the limitations in using aerial digital survey data from Thanet Extension

2 Responses to Natural England Relevant Representations

2.1 Displacement rates from site-specific evidence (post-consent monitoring of Thanet OWF)

13 The assessment of displacement for the Thanet Extension EIA was aided by the extensive post-consent monitoring survey data and reporting available on non-breeding seabirds within and in close proximity to the Thanet OWF (Royal HaskoningDHV, 2013). This programme of monitoring provided site-specific evidence of bird behaviour in response to that project, the data, analysis and reporting of which were subject to review in order to incorporate the findings into the Thanet Extension EIA. In order to validate the monitoring effort these data were given priority over other data sources available on disturbance and displacement, as they are recent and site-specific, offering as robust an assessment as possible.

14 For the purpose of concluding the assessment in the Thanet Extension ES Chapter (PINS Ref APP-045/ Application Ref Ref 6.2.4), the site-specific evidenced displacement rates and spatial extent of the displacement that were applied for gannet, guillemot and razorbill are set out in **Error! Reference source not found.** and **Error! Reference source not found.**. Within the ES Chapter (PINS Ref APP-045/ Application Ref 6.2.4) displacement matrices were presented and assessed only for bio-seasons where a species was present and occurred in numbers that made an assessment on displacement possible. Additional annual displacement estimates were estimated and assessed for each species accounting for both the construction and operational phases, in line with SNCB guidance.

Table 1: Species specific parameters applied in the assessment of displacement (construction phase) in ES Chapter (PINS Ref APP-045/ Application Ref 6.2.4)

Species	Spatial extent of Displacement (km)	Proportion Displaced (%)	Subsequent mortality (%)
Guillemot (spring migration)	Site	67%	1-5%
	1 km buffer	25%	1-5%
Razorbill (spring migration)	Site	89%	1-5%
	500 m buffer	25%	1-5%
Razorbill (autumn migration)	Site	89%	1-5%
	500 m buffer	25%	1-5%
Razorbill (winter)	Site	89%	1-5%
	500 m buffer	25%	1-5%

Table 2: Species specific parameters applied in the assessment of displacement (operational phase) in ES Chapter (PINS Ref APP-045/ Application Ref 6.2.4)

Species	Spatial extent of Displacement (km)	Proportion Displaced (%)	Subsequent mortality (%)
Guillemot (spring migration)	Site	79%	1-5%
	1 km buffer	25%	1-5%
Razorbill (spring migration)	Site	95%	1-5%
	500 m buffer	25%	1-5%
Razorbill (winter)	Site	95%	1-5%
	500 m buffer	25%	1-5%
Gannet (spring migration)	Site only	100%	0-5%
Gannet (autumn migration)	Site only	100%	0-5%

15 To enable stakeholders to understand how the particular parameters that were used in concluding the assessment relate to the full range of possible values for the parameters (e.g. from 0-100% for the proportion displaced) a series of matrices were presented in Annex 3 to the ES Chapter (PINS Ref APP-079/ Application Ref 6.4.4.3). In order to provide the Examining Authority (and Natural England) with clarity on the range of displacement using SNCB guidance, this information is presented in Appendix D to F of this document. The data within Annex 3 to the ES Chapter (PINS Ref APP-079/ Application Ref 6.4.4.3) presented displacement matrices for gannet, guillemot and razorbill for all bio-seasons where the species were present (even when present in very low numbers) and separately for representing potential displacement within the site and within a 2 km buffer for each. The preparation and presentation of such matrices is an element of the advice provided by Natural England (SNCBs, 2017).

2.2 Displacement rates from site-specific evidence (baseline characterisation surveys for Thanet Extension)

16 Within the Thanet Extension offshore ornithology baseline technical report (PINS Ref APP-77/ Application Ref 6.4.4.1) a secondary set of site-specific data on seabird distribution, abundance and densities is available, which includes the findings of the 24 month aerial digital survey programme undertaken by APEM between March 2016 and February 2018. These surveys covered Thanet, Thanet Extension and a 4 km buffer surrounding it (the Survey Area) and essentially act a post-monitoring set of surveys for Thanet and provide additional data that has not been analysed for that purpose.

17 In order to make use of these data for the purpose of providing additional narrative to the site-specific displacement rates for use in the assessment of potential impacts from Thanet Extension, separate accounts are provided below for gannet, guillemot and razorbill. In support of these species accounts the relevant distribution maps from the baseline technical report (PINS Ref APP-77/ Application Ref 6.4.4.1) have been included in Appendix A - C of this report.

18 Accordingly, where a bio-season may contribute to a further understanding of potential displacement of each species this has been attempted. This has been done by providing abundance and density estimates for four different areas within the Survey Area;

i. Thanet offshore wind farm;

ii. 4 km buffer surrounding Thanet offshore wind farm;

iii. Thanet Extension; and

iv. 4 km buffer surrounding Thanet Extension.

19 From these area specific abundance estimates it is then possible to calculate area specific densities. By comparing the density estimates between the areas it is possible to postulate potential displacement rates according to these differences if applying a set of simple assumptions. These assumptions would include the following;

i. That the density of birds within the proposed Thanet Extension site (where no wind turbines exist at present) would change to densities similar to that within Thanet offshore wind farm (where wind turbines are currently in operation) should the Array Area be built out in the manner proposed in the ES Chapter (PINS Ref APP-045/ Application Ref 6.2.4); and

ii. That the density of birds within a 4 km buffer of the proposed Thanet Extension site (where no turbines exist at present) would change to densities similar to that within the 4 km buffer surrounding Thanet offshore wind farm should the Array Area be built out in the manner proposed in the ES Chapter (PINS Ref APP-045/ Application Ref 6.2.4).

20 The use of data in the second set of assumptions described above (b) with reference to a 4 km buffer does not imply that the three species considered in this report are subject to displacement rates to that distance. The use of data from the 4 km buffer was used due to it being available for assessment at this stage of the project and not because birds are displaced to that distance. The Applicant recognises there are limitations in the use of data in this manner, but it has been assessed and presented in this report in order to provide further evidence of the unique nature of this project and bird behaviour in response to the operational Thanet site and the waters surrounding it being different to other locations.

Gannet

21 The movement and behaviour of gannets are considered to be split between three bio-seasons (Furness, 2015), spring migration, breeding and autumn migration. During these bio-seasons birds migrate towards their breeding colonies during the spring bio-season, reside mostly within mean maximum foraging range of those colonies within the breeding bio-season and move away from colonies during the autumn migration bio-season.

22 These three bio-seasons define the distribution and abundance of gannet within the Survey Area for the baseline characterisation of Thanet Extension. Distribution maps of gannet across each of the three bio-seasons were presented within the baseline technical report in Annex A of the ES Chapter (PINS Ref APP-077/ Application Ref 6.4.4.1). In order to provide the Examining Authority (and Natural England) with this information they are also presented in Appendix A of this document. Visually, these distribution maps support the expected occurrence of birds throughout the different bio-seasons, which can be described as;

i. During the **spring migration bio-season** birds were recorded in the west, south and east of the Survey Area, with very few individuals within the Thanet wind farm footprint. There was a reduced density of birds immediately to the north of Thanet. The lower density to the north of Thanet may be explained by birds migrating up through the Strait of Dover and then flying east or west to avoid Thanet, hence by default avoiding the area immediately to the north in their pursuit of migrating in a general northerly direction through the southern North Sea;

ii. There were relatively few gannets recorded within the Survey Area during the **breeding bio-season**. This is a reflection of the area being well outside of the mean–maximum foraging range (Thaxter *et al*., 2012) from the nearest colony at Flamborough Head; and

iii. During the **autumn migration bio-season** birds were recorded mostly in the east of the Survey Area, with very few individuals in the north, west and south or within the Thanet wind farm footprint. The higher density of birds being recorded in the east of the Survey Area may be explained by birds staying within the centre of the southern North Sea whilst migrating south towards the Strait of Dover, so therefore more naturally avoiding Thanet.

23 Accordingly, the only bio-season that may contribute to a further understanding of potential displacement of gannet from Thanet Extension is during spring migration. The total abundances covering the spring months over the survey period and the average monthly density within each of these separate areas are presented in Table 3.

24 From these data an estimate for the displacement rate of gannets from the area within Thanet Extension is 96%, based on the assumption that the current density within the Thanet Extension site would change to being similar to that within Thanet (0.73 birds/km^2 to 0.03 birds/km^2). When applying the same logic to these data an estimate for the displacement rate of gannets from the area within the Thanet Extension 4 km buffer is 16%, based on the assumption that the current density within the Thanet Extension 4 km buffer would change to being similar to that within the Thanet offshore wind farm 4 km buffer (1.02 birds/km^2 to 0.86 birds/km^2).

25 If the spatial extent of displacement applied to gannets were to be followed using SNCB guidance (SNCBs, 2017) then the resultant displacement rates from using the aerial digital data in this manner would be to consider displacement rates of 96% within Thanet Extension and 16% within the Thanet Extension 2 km buffer.

Table 3: Total (and average monthly) cumulative abundance and average monthly density of gannets during the spring migration bio-season within the Survey Area.

Area	Total abundance of all months	Average Monthly Abundance over Bio-season	Average Monthly Density over Bio-season (birds/km^2)
Thanet OWF	9	1	0.03
Thanet OWF 4 km Buffer	996	125	0.86
Thanet Extension	426	53	0.73
Thanet Extension 4 km Buffer	1,721	215	1.02

Guillemot

26 The movement and behaviour of guillemots are considered to be split between four bio-seasons (Furness, 2015), spring migration, breeding, autumn migration and winter. During these bio-seasons birds migrate towards their breeding colonies during the spring bio-season, reside mostly within mean maximum foraging range of those colonies within the breeding bio-season, move away from colonies during the autumn migration bio-season and spend a period of time residing in a wintering location.

27 The bio-seasons used for Thanet Extension were amended for the purpose of the EIA, to account for a flux of birds in March that were considered migratory. This meant an extended spring migration bio-season for this species between December and March. These four bio-seasons define the distribution and abundance of gannet within the Survey Area for the baseline characterisation of Thanet Extension. Distribution maps of guillemot across each of the four bio-seasons were presented within the baseline technical report in Annex A of the ES Chapter (PINS Ref APP-077/ Application Ref 6.4.4.1). In order to provide the Examining Authority (and Natural England) with this information they are also presented in Appendix B of this document. Visually, these distribution maps support the expected occurrence of birds throughout the different bio-seasons, which can be described as;

i. During the **spring migration bio-season** birds were recorded in the west, south and east of the Survey Area, with fewer individuals within the Thanet wind farm footprint. There was a reduced density of birds immediately to the north of Thanet. The lower density to the north of Thanet may be explained by birds migrating up through the Strait of Dover and then flying east or west to partly avoid Thanet, hence by default avoiding the area immediately to the north in their pursuit of migrating in a general northerly direction through the southern North Sea;

ii. If records from March are not included in the **breeding bio-season** then there were relatively few guillemots recorded within the Survey Area. This is a reflection of the area being well outside of the mean maximum foraging range (Thaxter *et al*., 2012) from the nearest large guillemot colonies at the Flamborough Head and northwards; and

iii. During the **autumn migration** and **winter bio-seasons** very few birds were recorded in the Survey Area. The most logical reason for birds not being recorded in the Survey Area during these two bio-seasons is that it is not a regular location to migrate through to reach wintering grounds and does not offer suitable habitat of preference to this species to reside in during the winter.

28 Accordingly, the only bio-season that may contribute to a further understanding of potential displacement of guillemot from Thanet Extension is during spring migration. The total abundances covering the spring months over the survey period and the average monthly density within each of these separate areas are presented in Table 4.

29 From these data an estimate for the displacement rate of guillemots from the area within Thanet Extension is 35%, based on the assumption that the current density within the Thanet Extension site would change to being similar to that within Thanet (3.12 birds/km^2 to 2.02 birds/km^2). When applying the same logic to these data an estimate for the displacement rate of guillemots from the area within the Thanet Extension 4 km buffer is 5%, based on the assumption that the current density within the Thanet Extension 4 km buffer would change to being similar to that within the Thanet offshore wind farm 4 km buffer (3.13 birds/km^2 to 2.98 birds/km^2).

30 If the spatial extent of displacement applied to guillemots were to be followed using SNCB guidance (SNCBs, 2017) then the resultant displacement rates from using the aerial digital data in this manner would be to consider displacement rates of 35% within Thanet Extension and 5% within the Thanet Extension 2 km buffer.

Table 4: Total (and average monthly) cumulative abundance and average monthly density of guillemots during the spring migration bio-season within the Survey Area.

Area	Total abundance of all months	Average Monthly Abundance over Bio-season	Average Monthly Density over Bio-season (birds/km^2)
Thanet OWF	565	71	2.02
Thanet OWF 4 km Buffer	3,446	431	2.98
Thanet Extension	1,815	227	3.12
Thanet Extension 4 km Buffer	5,298	662	3.13

Razorbill

31 The movement and behaviour of razorbills are considered to be split between three bio-seasons (Furness, 2015), spring migration, breeding and autumn migration. During these bio-seasons birds migrate towards their breeding colonies during the spring bio-season, reside mostly within mean max foraging range of those colonies within breeding bio-season and move away from colonies during the autumn migration bio-season.

32 These three bio-seasons define the distribution and abundance of razorbill within the Survey Area for the baseline characterisation of Thanet Extension. Distribution maps of razorbill across each of the three bio-seasons were presented within the baseline technical report in Annex A of the ES Chapter (PINS Ref APP-077/ Application Ref 6.4.4.1). In order to provide the Examining Authority (and Natural England) with this information they are also presented in Appendix C of this document. Visually, these distribution maps support the expected occurrence of birds throughout the different bio-seasons, which can be described as;

i. During the **spring migration bio-season** birds were recorded in the west, south and east of the Survey Area, with fewer individuals within the Thanet wind farm footprint. There was a reduced density of birds immediately to the north of Thanet. The lower density to the north of Thanet may be explained by birds migrating up through the Strait of Dover and then flying east or west to partly avoid Thanet, hence by default avoiding the area immediately to the north in their pursuit of migrating in a general northerly direction through the southern North Sea;

ii. There were relatively few razorbills recorded within the Survey Area during the **breeding bio-season**. This is a reflection of the area being well outside of the mean–max foraging range (Thaxter *et al*., 2012) from the nearest large razorbill colonies at the Flamborough Head and northwards; and

iii. During the **autumn migration bio-season** very few birds were recorded in the Survey Area. The most logical reason for birds not being recorded in the Survey Area during these this bio-season is that it is not a regular location to migrate through and does not offer suitable habitat of preference to this species to reside in throughout this period.

33 Accordingly, the only bio-season that may contribute to a further understanding of potential displacement of razorbill from Thanet Extension is during spring migration. The total abundances covering the spring months over the survey period and the average monthly density within each of these separate areas are presented in Table 5.

34 From these data an estimate for the displacement rate of razorbills from the area within Thanet Extension is 36%, based on the assumption that the current density within the Thanet Extension site would change to being similar to that within Thanet (0.47 birds/km^2 to 0.30 birds/km^2). When applying the same logic to these data an estimate for the displacement rate of razorbills from the area within the Thanet Extension 4 km buffer is 15%, based on the assumption that the current density within the Thanet Extension 4 km buffer would change to being similar to that within the Thanet offshore wind farm 4 km buffer (1.04 birds/km^2 to 0.88 birds/km^2).

35 If the spatial extent of displacement applied to razorbills were to be followed using SNCB guidance (SNCBs, 2017) then the resultant displacement rates from using the aerial digital data in this manner would be to consider displacement rates of 36% within Thanet Extension and 15% within the Thanet Extension 2 km buffer.

Table 5: Total (and average monthly) cumulative abundance and average monthly density of razorbills during the spring migration bio-season within the Survey Area.

Area	Total abundance of all months	Average Monthly Abundance over Bio-season	Average Monthly Density over Bio-season (birds/km^2)
Thanet OWF	62	10	0.30
Thanet OWF 4 km Buffer	1,509	252	0.88
Thanet Extension	206	34	0.47
Thanet Extension 4 km Buffer	1,315	219	1.04

2.3 Signposting to generic displacement matrices for species presented in the ES Chapter for comparison

36 In addition to the displacement matrices presented within the ES Chapter (PINS Ref APP-045/ Application Ref 6.2.4), which the assessments were based upon, a further set of displacement matrices for gannet, guillemot and razorbill were provided in Annex 3 to the ES Chapter (PINS Ref APP-079/ Application Ref 6.4.4.3). For these three species a complete matrix was provided for each biological season that the species occurred in. The abundances presented in these displacement matrices corresponds with the generic spatial extent for each species within the SNCB guidance (SNCB, 2017), which is to consider;

i. Gannet within the site and out to a 2 km buffer;

ii. Guillemot within the site and out to a 2 km buffer; and

iii. Razorbill within the site and out to a 2 km buffer.

37 In order to provide the Examining Authority (and Natural England) with clarity on the range of displacement using SNCB guidance, the displacement matrices from Annex 3 of the ES Chapter that provide this information are presented in Appendix D to F of this document.

3 Conclusion

38 Two sources of local site data have been examined for the information that they provide about displacement of gannet, guillemot and razorbill within and around operational OWFs. The common feature of the two sets of data examined (both from within and in close proximity to Thanet) is that the OWF is relatively small in scale, relatively close to the shore and does not contain the highest densities of gannet, guillemot or razorbill. The density in the area of Thanet and Thanet Extension are well below regional, national and international thresholds of importance.

39 For gannet, the operational OWF examined (Thanet and its surrounding waters) show a consistency of pattern, exhibiting a high degree of displacement within the footprint of the OWF and very little displacement outside the OWF. This is similar to the set of displacement parameters assessed for Thanet Extension OWF in the submitted ES Chapter (PINS Ref APP-045/ Application Ref 6.2.4) and RIAA (PINS Ref APP-031/ Application Ref 5.2) and based on the conclusion above it is considered that the assessment in those documents is robust and evidence based and should remain as submitted.

40 For guillemot, the operational OWF examined (Thanet and its surrounding waters) also show a consistency of pattern, exhibiting a medium degree of displacement within the footprint of the OWF and very little displacement outside the OWF. This is similar to the set of displacement parameters assessed for Thanet Extension OWF in the submitted ES Chapter (PINS Ref APP-045/ Application Ref 6.2.4) and RIAA (PINS Ref APP-031/ Application Ref 5.2) and based on the conclusion above it is considered that the assessment in those documents is robust and evidence based and should remain as submitted.

41 For razorbill, the operational OWF examined (Thanet and its surrounding waters) also show a consistency of pattern, exhibiting a medium degree of displacement within the footprint of the OWF and very little displacement outside the OWF. This is similar to the set of displacement parameters assessed for Thanet Extension OWF in the submitted ES Chapter (PINS Ref APP-045/ Application Ref 6.2.4) and RIAA (PINS Ref APP-031/ Application Ref 5.2) and based on the conclusion above it is considered that the assessment in those documents is robust and evidence based and should remain as submitted.

42 In light of the evidence presented within this report it is apparent that Thanet Extension may be considered somewhat unique in that the displacement exhibited at this location is lower, particularly for guillemot and razorbill, than that measured at other locations within UK waters.

43 Given the consistency of pattern between the two data sets examined it is considered that there is little benefit to be gained by producing additional displacement matrices for each species based on presenting the two individual empirical sources of evidence on the degree and spatial extent of displacement.

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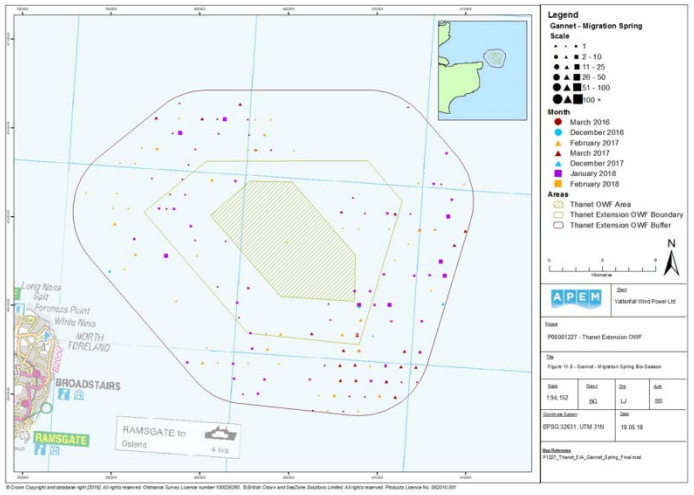
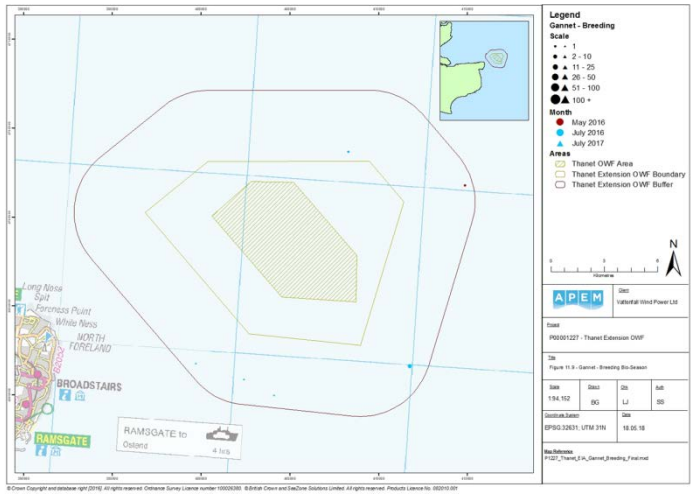
- Statutory Nature Conservation Bodies. (2017). Advice on how to present assessment information on the extent and potential consequences of seabird displacement from Offshore Wind Farm (OWF) developments.
- Thaxter, C. B., Lascelles, B., Sugar, K., Cook A., Roos, S., Bolton, M., Langston, R. and Burton, N. (2012). Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas. *Biological Conservation* 156: 53-61.

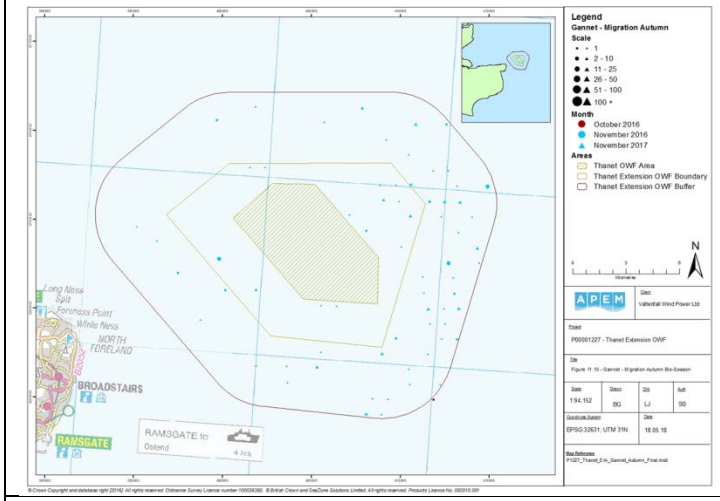
Appendix A – Thanet Extension Distribution Maps for Gannet



Gannet – Spring migration bio-season

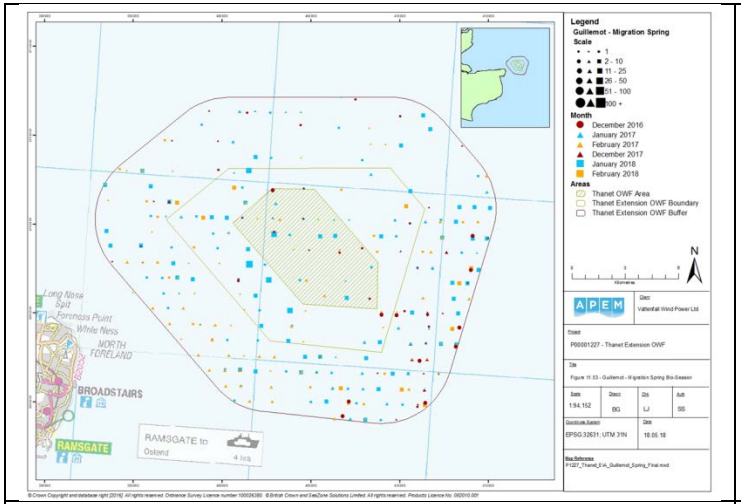


Gannet – Migration free breeding bio-season

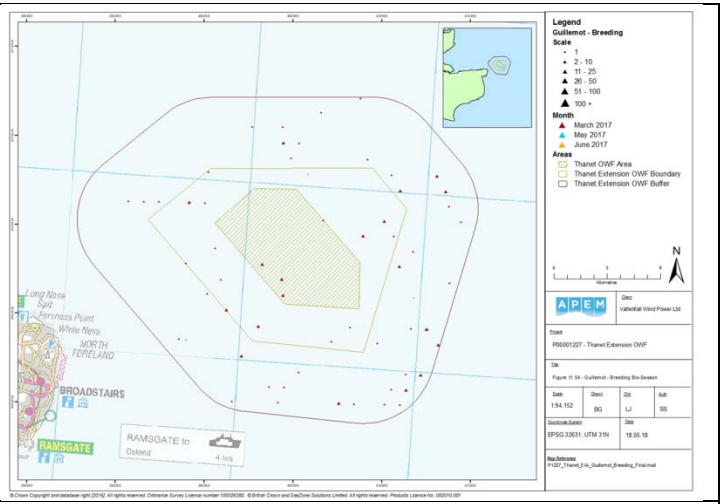


Gannet – Autumn migration bio-season

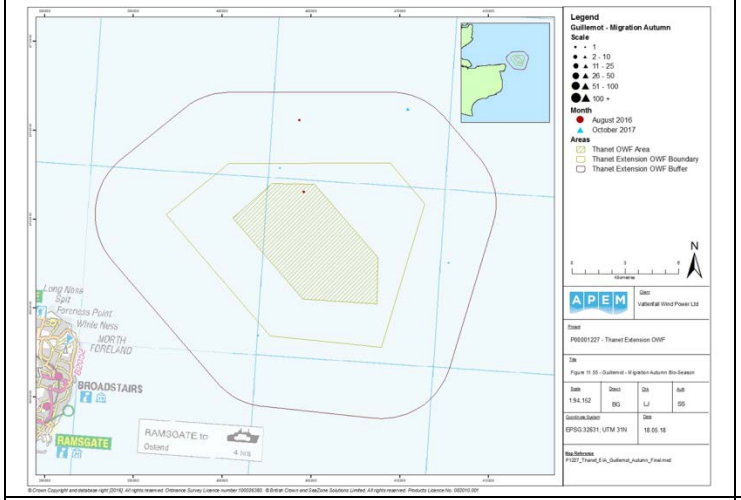
Appendix B – Thanet Extension Distribution Maps for Guillemot



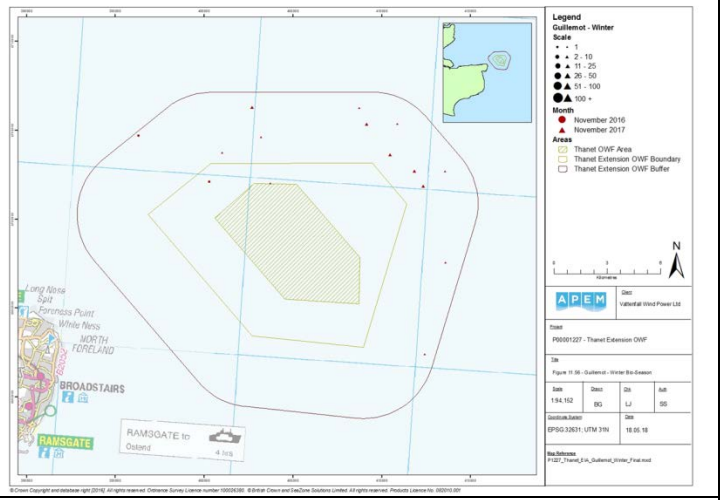
Guillemot – Spring migration bio-season



Guillemot – Migration free breeding bio-season

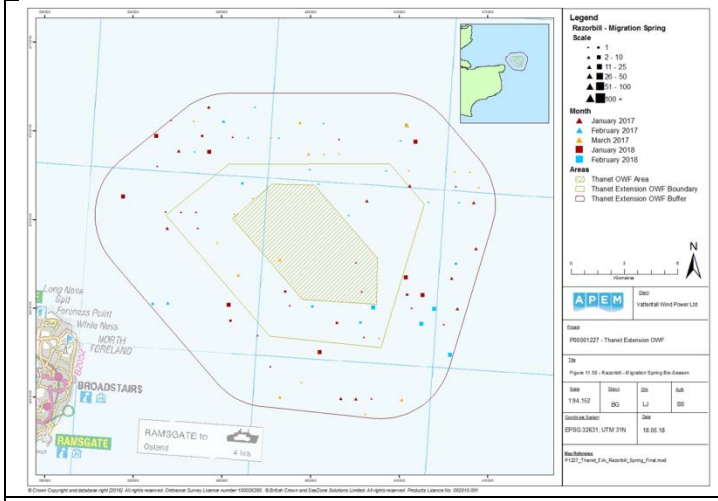


Guillemot – Autumn migration bio-season



Guillemot – Migration free winter bio-season

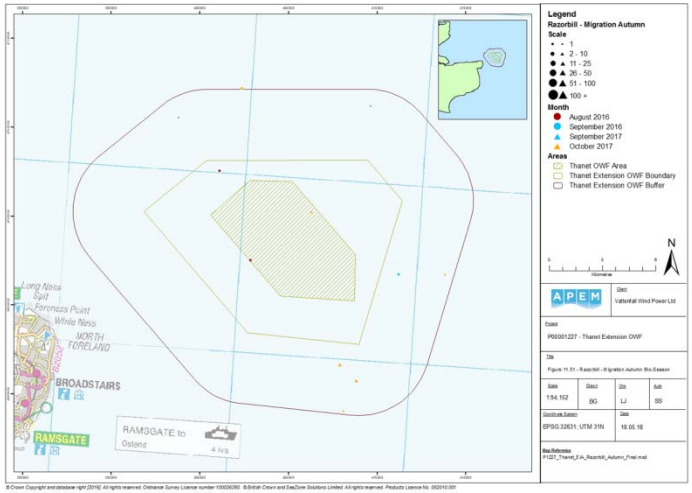
Appendix C – Thanet Extension Distribution Maps for Razorbill



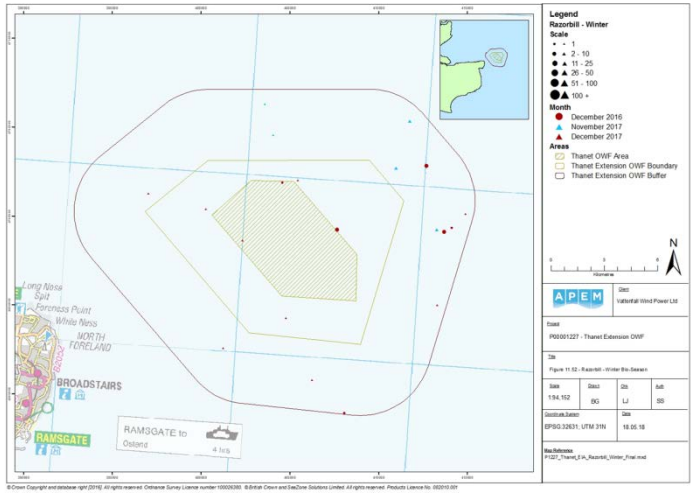
Razorbill – Spring migration bio-season

No Birds present

Razorbill – Migration free breeding bio-season



Razorbill – Autumn migration bio-season



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Appendix D – Gannet displacement matrices

Table 6: Displacement matrix presenting the number of gannets in the Thanet Extension site only, during the Migration-spring bio-season.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
10	0	0	0	0	0	0	1	2	3	4	5	6	7	8	9	10
20	0	0	0	1	1	1	2	4	6	8	10	12	13	15	17	19
30	0	0	1	1	1	1	3	6	9	12	14	17	20	23	26	29
40	0	0	1	1	2	2	4	8	12	15	19	23	27	31	35	38
50	0	0	1	1	2	2	5	10	14	19	24	29	34	38	43	48
60	0	1	1	2	2	3	6	12	17	23	29	35	40	46	52	58
70	0	1	1	2	3	3	7	13	20	27	34	40	47	54	60	67
80	0	1	2	2	3	4	8	15	23	31	38	46	54	61	69	77
90	0	1	2	3	3	4	9	17	26	35	43	52	60	69	78	86
100	0	1	2	3	4	5	10	19	29	38	48	58	67	77	86	96

Table 7: Displacement matrix presenting the number of gannets in the Thanet Extension 2 km Buffer only, during the Migration-spring bio-season.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	2	2
10	0	0	0	1	1	1	2	3	5	7	8	10	12	14	15	17
20	0	0	1	1	1	2	3	7	10	14	17	20	24	27	30	34
30	0	1	1	2	2	3	5	10	15	20	25	30	35	41	46	51
40	0	1	1	2	3	3	7	14	20	27	34	41	47	54	61	68
50	0	1	2	3	3	4	8	17	25	34	42	51	59	68	76	84
60	0	1	2	3	4	5	10	20	30	41	51	61	71	81	91	101
70	0	1	2	4	5	6	12	24	35	47	59	71	83	95	106	118
80	0	1	3	4	5	7	14	27	41	54	68	81	95	108	122	135
90	0	2	3	5	6	8	15	30	46	61	76	91	106	122	137	152
100	0	2	3	5	7	8	17	34	51	68	84	101	118	135	152	169

Table 8: Displacement matrix presenting the number of gannets in the Thanet Extension 2 km Buffer only, during the Non-migratory Breeding bio-season.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
20	0	0	0	0	0	0	0	0	1	1	1	1	2	2	2	2
30	0	0	0	0	0	0	0	1	1	1	2	2	3	3	3	4
40	0	0	0	0	0	0	0	1	1	2	2	3	3	4	4	5
50	0	0	0	0	0	0	1	1	2	2	3	4	4	5	5	6
60	0	0	0	0	0	0	1	1	2	3	4	4	5	6	7	7
70	0	0	0	0	0	0	1	2	3	3	4	5	6	7	8	8
80	0	0	0	0	0	0	1	2	3	4	5	6	7	8	9	10
90	0	0	0	0	0	1	1	2	3	4	5	7	8	9	10	11
100	0	0	0	0	0	1	1	2	4	5	6	7	8	10	11	12

Table 9: Displacement matrix presenting the number of gannets in the Thanet Extension site only, during the Migration-autumn bio-season.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
10	0	0	0	0	0	0	1	2	2	3	4	5	5	6	7	8
20	0	0	0	0	1	1	2	3	5	6	8	9	11	12	14	15
30	0	0	0	1	1	1	2	5	7	9	12	14	16	18	21	23
40	0	0	1	1	1	2	3	6	9	12	15	18	22	25	28	31
50	0	0	1	1	2	2	4	8	12	15	19	23	27	31	35	39
60	0	0	1	1	2	2	5	9	14	18	23	28	32	37	42	46
70	0	1	1	2	2	3	5	11	16	22	27	32	38	43	49	54
80	0	1	1	2	2	3	6	12	18	25	31	37	43	49	55	62
90	0	1	1	2	3	3	7	14	21	28	35	42	49	55	62	69
100	0	1	2	2	3	4	8	15	23	31	39	46	54	62	69	77

Table 10: Displacement matrix presenting the number of gannets in the Thanet Extension 2 km Buffer only, during the Migration-autumn bio-season.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
10	0	0	0	0	1	1	1	3	4	6	7	9	10	11	13	14
20	0	0	1	1	1	1	3	6	9	11	14	17	20	23	26	29
30	0	0	1	1	2	2	4	9	13	17	21	26	30	34	39	43
40	0	1	1	2	2	3	6	11	17	23	29	34	40	46	51	57
50	0	1	1	2	3	4	7	14	21	29	36	43	50	57	64	71
60	0	1	2	3	3	4	9	17	26	34	43	51	60	69	77	86
70	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
80	0	1	2	3	5	6	11	23	34	46	57	69	80	91	103	114
90	0	1	3	4	5	6	13	26	39	51	64	77	90	103	116	128
100	0	1	3	4	6	7	14	29	43	57	71	86	100	114	128	143

Appendix E – Razorbill displacement matrices

Table 11: Displacement matrix presenting the number of razorbills in the Thanet Extension site only, during the Migration-spring bio-season.

Displacement (%)	Mortality Rates (%)												
	0	1	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	1	1	1	1	2	2	2	3	3
20	0	0	0	1	1	2	2	3	3	4	5	5	6
30	0	0	0	1	2	3	3	4	5	6	7	8	9
40	0	0	1	1	2	3	5	6	7	8	9	10	12
50	0	0	1	1	3	4	6	7	9	10	12	13	15
60	0	0	1	2	3	5	7	9	10	12	14	16	17
70	0	0	1	2	4	6	8	10	12	14	16	18	20
80	0	0	1	2	5	7	9	12	14	16	19	21	23
90	0	0	1	3	5	8	10	13	16	18	21	23	26
100	0	0	1	3	6	9	12	15	17	20	23	26	29

Table 12: Displacement matrix presenting the number of razorbills in the Thanet Extension 2 km Buffer only, during the Migration-spring bio-season.

Displacement (%)	Mortality Rates (%)												
	0	1	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	1	1	1	1	1
10	0	0	0	1	2	3	4	5	6	7	8	9	10
20	0	0	1	2	4	6	8	10	11	13	15	17	19
25	0	0	1	2	5	7	10	12	14	17	19	21	24
30	0	0	1	3	6	9	11	14	17	20	23	26	29
40	0	0	2	4	8	11	15	19	23	27	30	34	38
50	0	0	2	5	10	14	19	24	29	33	38	43	48
60	0	1	3	6	11	17	23	29	34	40	46	51	57
70	0	1	3	7	13	20	27	33	40	47	53	60	67
80	0	1	4	8	15	23	30	38	46	53	61	69	76
90	0	1	4	9	17	26	34	43	51	60	69	77	86
100	0	1	5	10	19	29	38	48	57	67	76	86	95

Table 13: Displacement matrix presenting the number of razorbills in the Thanet Extension site only, during the Migration-autumn bio-season.

Displacement (%)	Mortality Rates (%)												
	0	1	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	1	1	1	1
30	0	0	0	0	0	0	0	1	1	1	1	1	1
40	0	0	0	0	0	0	1	1	1	1	1	1	2
50	0	0	0	0	0	1	1	1	1	1	2	2	2
60	0	0	0	0	0	1	1	1	1	2	2	2	2
70	0	0	0	0	1	1	1	1	2	2	2	3	3
80	0	0	0	0	1	1	1	2	2	2	3	3	3
90	0	0	0	0	1	1	1	2	2	3	3	3	4
100	0	0	0	0	1	1	2	2	2	3	3	4	4

Table 14: Displacement matrix presenting the number of razorbills in the Thanet Extension 2 km Buffer only, during the Migration-autumn bio-season.

Displacement (%)	Mortality Rates (%)												
	0	1	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	1	1
40	0	0	0	0	0	0	0	0	0	1	1	1	1
50	0	0	0	0	0	0	0	0	1	1	1	1	1
60	0	0	0	0	0	0	0	1	1	1	1	1	1
70	0	0	0	0	0	0	1	1	1	1	1	1	1
80	0	0	0	0	0	0	1	1	1	1	1	1	1
90	0	0	0	0	0	1	1	1	1	1	1	2	2
100	0	0	0	0	0	1	1	1	1	1	1	2	2

Table 15: Displacement matrix presenting the number of razorbills in the Thanet Extension site only, during the Non-breeding bio-season.

Displacement (%)	Mortality Rates (%)												
	0	1	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	1	1	1	1	2	2	2	3	3
20	0	0	0	1	1	2	2	3	3	4	4	5	6
30	0	0	0	1	2	3	3	4	5	6	7	8	8
40	0	0	0	1	2	3	4	6	7	8	9	10	11
50	0	0	0	1	3	4	6	7	8	10	11	13	14
60	0	0	0	2	3	5	7	8	10	12	13	15	17
70	0	0	0	2	4	6	8	10	12	14	16	18	20
80	0	0	0	2	4	7	9	11	13	16	18	20	22
90	0	0	0	3	5	8	10	13	15	18	20	23	25
100	0	0	0	3	6	8	11	14	17	20	22	25	28

Table 16: Displacement matrix presenting the number of razorbills in the Thanet Extension 2 km Buffer only, during the Non-breeding bio-season.

Displacement (%)	Mortality Rates (%)												
	0	1	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	1	1	1	1	2	2	2	3	3
20	0	0	0	1	1	2	2	3	3	4	4	5	6
30	0	0	0	1	2	3	3	4	5	6	7	8	8
40	0	0	0	1	2	3	4	6	7	8	9	10	11
50	0	0	0	1	3	4	6	7	8	10	11	13	14
60	0	0	0	2	3	5	7	8	10	12	13	15	17
70	0	0	0	2	4	6	8	10	12	14	16	18	20
80	0	0	0	2	4	7	9	11	13	16	18	20	22
90	0	0	0	3	5	8	10	13	15	18	20	23	25
100	0	0	0	3	6	8	11	14	17	20	22	25	28

Appendix F – Guillemot displacement matrices

Table 17: Displacement matrix presenting the number of guillemots in the Thanet Extension site only, during the Migration-spring bio-season.

Displacement (%)	Mortality Rates (%)												
	0	1	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	1	1	2	2	3	4	4	5	5	6
10	0	1	3	6	12	18	24	30	36	42	48	54	60
20	0	1	6	12	24	36	48	60	72	84	96	108	120
30	0	2	9	18	36	54	72	90	108	126	144	163	181
40	0	2	12	24	48	72	96	120	144	169	193	217	241
50	0	3	15	30	60	90	120	151	181	211	241	271	301
60	0	4	18	36	72	108	144	181	217	253	289	325	361
70	0	4	21	42	84	126	169	211	253	295	337	379	421
80	0	5	24	48	96	144	193	241	289	337	385	433	482
90	0	5	27	54	108	163	217	271	325	379	433	488	542
100	0	6	30	60	120	181	241	301	361	421	482	542	602

Table 18: Displacement matrix presenting the number of guillemots in the Thanet Extension 2 km Buffer only, during the Migration-spring bio-season.

Displacement (%)	Mortality Rates (%)												
	0	1	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	1	1	2	2	3	3	4	4	5	5
10	0	1	3	5	10	15	20	25	30	35	40	45	50
20	0	1	5	10	20	30	40	50	60	70	80	91	101
30	0	2	8	15	30	45	60	75	91	106	121	136	151
40	0	2	10	20	40	60	80	101	121	141	161	181	201
50	0	3	13	25	50	75	101	126	151	176	201	226	251
60	0	3	15	30	60	91	121	151	181	211	241	272	302
70	0	4	18	35	70	106	141	176	211	246	282	317	352
80	0	4	20	40	80	121	161	201	241	282	322	362	402
90	0	5	23	45	91	136	181	226	272	317	362	407	453
100	0	5	25	50	101	151	201	251	302	352	402	453	503

Table 19: Displacement matrix presenting the number of guillemots in the Thanet Extension site only, during the Non-migratory Breeding.

Displacement (%)	Mortality Rates (%)												
	0	1	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	1
20	0	0	0	0	0	0	0	1	1	1	1	1	1
30	0	0	0	0	0	0	1	1	1	1	1	1	2
40	0	0	0	0	0	1	1	1	1	1	2	2	2
50	0	0	0	0	1	1	1	1	2	2	2	2	3
60	0	0	0	0	1	1	1	2	2	2	2	3	3
70	0	0	0	0	1	1	1	2	2	2	3	3	4
80	0	0	0	0	1	1	2	2	2	3	3	4	4
90	0	0	0	0	1	1	2	2	3	3	4	4	5
100	0	0	0	1	1	2	2	3	3	4	4	5	5

Table 20: Displacement matrix presenting the number of guillemots in the Thanet Extension 2 km Buffer only, during the Non-migratory Breeding bio-season.

Displacement (%)	Mortality Rates (%)												
	0	1	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	1	1	1
20	0	0	0	0	0	0	1	1	1	1	1	1	1
30	0	0	0	0	0	1	1	1	1	1	2	2	2
40	0	0	0	0	1	1	1	1	2	2	2	2	3
50	0	0	0	0	1	1	1	2	2	2	3	3	3
60	0	0	0	0	1	1	2	2	2	3	3	4	4
70	0	0	0	0	1	1	2	2	3	3	4	4	5
80	0	0	0	1	1	2	2	3	3	4	4	5	5
90	0	0	0	1	1	2	2	3	4	4	5	5	6
100	0	0	0	1	1	2	3	3	4	5	5	6	7

Table 21: Displacement matrix presenting the number of guillemots in the Thanet Extension site only, during the Migration-autumn bio-season.

Displacement (%)	Mortality Rates (%)												
	0	1	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	1
20	0	0	0	0	0	0	0	1	1	1	1	1	1
30	0	0	0	0	0	0	1	1	1	1	1	1	2
40	0	0	0	0	0	1	1	1	1	1	2	2	2
50	0	0	0	0	1	1	1	1	2	2	2	2	3
60	0	0	0	0	1	1	1	2	2	2	2	3	3
70	0	0	0	0	1	1	1	2	2	2	3	3	4
80	0	0	0	0	1	1	2	2	2	3	3	4	4
90	0	0	0	0	1	1	2	2	3	3	4	4	5
100	0	0	0	1	1	2	2	3	3	4	4	5	5

Table 22: Displacement matrix presenting the number of guillemots in the Thanet Extension 2 km Buffer only, during the Migration-autumn bio-season.

Displacement (%)	Mortality Rates (%)												
	0	1	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	1	1	1	1	1	1
20	0	0	0	0	0	1	1	1	1	1	2	2	2
30	0	0	0	0	1	1	1	2	2	2	2	3	3
40	0	0	0	0	1	1	2	2	2	3	3	4	4
50	0	0	0	1	1	2	2	3	3	4	4	5	5
60	0	0	0	1	1	2	2	3	4	4	5	6	6
70	0	0	0	1	1	2	3	4	4	5	6	6	7
80	0	0	0	1	2	2	3	4	5	6	7	7	8
90	0	0	0	1	2	3	4	5	6	6	7	8	9
100	0	0	0	1	2	3	4	5	6	7	8	9	10

Table 23: Displacement matrix presenting the number of guillemots in the Thanet Extension site only, during the Non-breeding bio-season.

Displacement (%)	Mortality Rates (%)												
	0	1	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	1	1	1	1	1
20	0	0	0	0	0	1	1	1	1	1	1	2	2
30	0	0	0	0	1	1	1	1	2	2	2	2	3
40	0	0	0	0	1	1	1	2	2	3	3	3	4
50	0	0	0	0	1	1	2	2	3	3	4	4	5
60	0	0	0	1	1	2	2	3	3	4	4	5	5
70	0	0	0	1	1	2	3	3	4	4	5	6	6
80	0	0	0	1	1	2	3	4	4	5	6	6	7
90	0	0	0	1	2	2	3	4	5	6	6	7	8
100	0	0	0	1	2	3	4	5	5	6	7	8	9

Table 24: Displacement matrix presenting the number of guillemots in the Thanet Extension 2 km Buffer only, during the Non-breeding bio-season.

Displacement (%)	Mortality Rates (%)												
	0	1	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	1	1	2	2	3	3	4	4	5
20	0	0	0	1	2	3	4	5	6	7	8	9	10
30	0	0	0	1	3	4	6	7	9	10	12	13	15
40	0	0	0	2	4	6	8	10	12	14	16	17	19
50	0	0	0	2	5	7	10	12	15	17	19	22	24
60	0	0	0	3	6	9	12	15	17	20	23	26	29
70	0	0	0	3	7	10	14	17	20	24	27	31	34
80	0	0	0	4	8	12	16	19	23	27	31	35	39
90	0	0	0	4	9	13	17	22	26	31	35	39	44
100	0	0	0	5	10	15	19	24	29	34	39	44	49

Vattenfall Wind Power Ltd

Thanet Extension Offshore Wind Farm

Appendix 1, Annex F to Deadline 1 Submission:

Collision Risk Modelling Parameters and Thanet Extension's Contribution to Cumulative and In-Combination Totals

Relevant Examination Deadline: Deadline 1

Submitted by Vattenfall Wind Power Ltd

Date: January 2019

Revision A

Drafted By:	APEM Ltd
Approved By:	Daniel Bates
Date of Approval:	January 2019
Revision:	A

Draft	Original Document submitted to Natural England ahead of SoCG Meeting on 23rd November 2018
Revision A	Post consultation document submitted to the Examining Authority
N/A	
N/A	

Contents

Tables

1 Introduction

1.1 Collision risk modelling

1 The Band (2012) collision risk model (CRM) has been used to estimate potential seabird mortality rates for all of the offshore wind farms applications in English waters whose consent has been considered and granted through the Nationally Significant Infrastructure Project (NSIP) planning process. The Band (2012) CRM is considered best practice and recommended by the statutory nature conservation bodies (SNCBs) albeit with requests to adopt improvements as they came forward (see below).

2 In order to incorporate an element of variation in the CRM input parameters, Masden (2015) developed the Band (2012) model through the creation of the package 'BandModel' in the R statistical program (http://www.r-project.org). The Masden (2015) version of the Band (2012) model included uncertainty in particular CRM parameters in the form of Standard Deviations (SD) around mean values and applied a method of Monte Carlo simulation used by McAdam (2005) to allow for these. In addition, the packaging of the CRM within the R statistical program dealt with an issue identified by stakeholder interviews that the Microsoft Excel version of the Band (2012) model was occasionally difficult to use and error-prone.

3 Advice received from Natural England in the Evidence Plan process (Application Ref 8.5) was that the Masden (2015) application of the Band (2012) model was the preferred method of CRM.

1.2 CRM for the Preliminary Environmental Information Report

4 Based on the advice described above, the collision risk modelling undertaken for the Thanet Extension Preliminary Environmental Information Report (PEIR) (APEM, 2017) was based on the use of Masden (2015). A number of inconsistencies were evident when using the Masden (2015) programme, which led to concern about the reliability and accuracy of the potential collision risk outputs. Following a review funded by Natural England of the Masden (2015) programme undertaken by MacArthur Green (Trinder, 2017), it was determined that a number of improvements were required before the 'BandModel' R package would be deemed as being the agreed method for CRM for proposed offshore wind farm developments.

5 Following the Trinder (2017) review, the advice from SNCBs was to revert to using the Band (2012) spreadsheet with an element of variation to coincide with the Band (2012) guidance (paragraph 14, page 7), which was previously overlooked in applications for offshore wind farm developments: "*…it is recommended that 'best estimates' are deployed, and with them an analysis of the uncertainty or variability surrounding each estimate and the range within which the collision risk can be assessed with confidence."* It was agreed that the variability in the input parameters for this report would relate to the density estimates of birds in flight and the generic SOSS-02 flight height distribution data (Johnston *et al.*, 2014).

1.3 CRM for the ES Chapter

6 Collision risk modelling undertaken for the Thanet Extension ES Chapter (PINS Ref APP-045/ Application Ref 6.2.4) included the outputs from the use of two Band CRM options: i) the Basic Band CRM Option 1 with site-specific flight heights, and ii) the Basic Band CRM Option 2 with generic flight heights. The CRM technique and the input parameters used were explained in Section 2 of Annex 4 to the ES Chapter (PINS Ref APP-080/ Application Ref 6.4.4.4).

7 For the purpose of concluding the assessment in the ES Chapter (PINS Ref APP-045/ Application Ref 6.2.4), what was relied on was the Basic Band CRM Option 2 with generic flight heights from the SOSS-02 flight height distribution data within Johnston *et al*. (2014). The outputs from Basic Band CRM Option 2 with generic flight heights were presented and assessed within Paragraphs 4.1.138 to 4.1.152 and Tables 4.23 to 4.27 of the ES Chapter (PINS Ref APP-045/ Application Ref 6.2.4).

8 Outputs from the Basic Band CRM Option 1 with site-specific flight heights to determine the proportion of birds flying at potential collision height (PCH) were also presented in Appendix 7 of Annex 4 to the ES Chapter (PINS Ref APP-080/ Application Ref 6.4.4.4). The PCHs used for this modelling option were calculated from flight heights estimated from high-resolution aerial digital still imagery collected by APEM. Due to all species only having a very small sample size (a reflection of the low density of birds in the Thanet Extension study area) these data were deemed unsuitable for impact assessment purposes.

9 A third draft data set was also received that had the potential to provide site specific data from which PCH values could be calculated. This was from the Offshore Renewables Joint Industry Programme (ORJIP) Bird Collision Avoidance Study conducted at Thanet Offshore Wind Farm (Skov *et al*., 2018). This data set was discussed with Natural England who, along with the other SNCBs, had sufficient concerns about its application to commission a review from the British Trust for Ornithology (BTO). That review was not concluded within the period of the preparation of the CRM for the ES Chapter. Given those unresolved uncertainties, that data set was not considered further for impact assessment purposes.

10 The impact assessment in the ES Chapter (PINS Ref APP-045/ Application Ref 6.2.4) relied on the application of the Basic Band CRM Option 2 with generic flight heights from the SOSS-02 flight height distribution data within Johnston *et al*. (2014). Within this modelling framework applied in the ES Chapter there were four elements of parameter variation: i) upper and lower confidence limits (CLs) of SOSS-02 flight height distribution data; ii) upper and lower CLs of the density of birds in flight; iii) avoidance rates; and iv) nocturnal activity rates.

11 Within the Band CRM the nocturnal activity rate for each species is based on a 1 to 5 scoring index from Garthe and Hüppop (2004) or King *et al.* (2009). The Band CRM spreadsheet converts these factors into nocturnal activity as follows; 1 = 0%, 2 = 25%, 3 = 50%, 4 = 75%, 5 = 100%. It is considered that these nocturnal activity figures are precautionary (MacArthur Green, 2015). As such, the potential mortality estimates provided in the assessment of potential collision risk for Thanet Extension that were presented in the ES Chapter (PINS Ref APP-045/ Application Ref 6.2.4) are based on the reduced nocturnal activity factors. These reduced nocturnal activity figures have been based on a review undertaken by MacArthur Green (MacArthur Green, 2015: Appendix 7) for the East Anglia THREE application that was of a series of seabird research studies that used activity data loggers attached to seabirds. This review found that the nocturnal activity recorded was much lower than the values derived from Garthe & Hüppop (2004). Additional support for this conclusion has come from a more recent peer reviewed paper by Furness *et al*. (2018), published after the ES Chapter was submitted, which provided further evidence for the use of a reduced nocturnal activity rate for gannet.

12 Outputs from this model framework were presented in the ES Chapter (PINS Ref APP-045/ Application Ref 6.2.4). The variation in the number of birds predicted to collide with the wind turbines per year were presented in Section 3 of Annex 4 of the ES Chapter (PINS Ref APP-080/ Application Ref 6.4.4.4).

1.4 Further consultation with stakeholders and responses to the ES

13 After the submission of the application for consent and the publication of the ES on The Planning Inspectorate website, stakeholders, including Natural England (2018) and the Royal Society for the Protection of Birds (RSPB), provided responses to a range of matters, including on the CRM, in their Relevant Representations. With regard to CRM, the comments included on the use of different Band (2012) models and the parameters used in the modelling.

14 The responses to the ES Chapter within Natural England's Relevant Representations relating to the assessment of collision risk modelling was summarised in Section 5.3 and detailed in Appendix 1. The following matters are mostly taken from the detailed points made in Appendix 1 in place of the summary information in Section 5.3:

a) *It is stated that due to uncertainties in the ORJIP data, no assessments are included using the ORJIP data. We are not clear what these are, and would advise that these site specific flight heights are used in Option 1 of the Band model, and these outputs considered alongside Option 2 outputs.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Table 4.2, Page 4-11;

b) *The technical difficulties in not being able to use the site specific flight height data are not adequately explained. We advise that the site specific flight height data from TOWF generated by the ORJIP project should be used to produce Option 1 Collision Risk Model (CRM) outputs.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.34;

c) *Collision risk - It is stated that the Band CRM Option 2 has been used, however it is not clear why site specific flight heights generated from the ORJIP BCA study at TOWF were not used.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.141;

d) *Natural England note that bird behaviour data has been released from the ORJIP project but has not been included in the CRM to inform the assessment. These data have been used in collision risk modelling by the BTO for work commissioned by JNCC to determine what avoidance rates are appropriate to be used in CRM (Bowgen & Cook, 2018 in prep).* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.142;

e) *Natural England note that the collision mortalities have been summed and presented in table 4.27. We would like to see the results of the CRM using Option 1 and the site specific data from the ORJIP study before commenting on the scale of the potential impact.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.149;

f) *Before Natural England are able to agree with the conclusion that the level of mortalities fall below 1 % of baseline mortality we would want to examine the results of the CRM in more detail, and consider what the predicted levels of mortality are when using option 1 outputs using flight height data from the ORJIP study.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.1.150;

g) *The assessment for the Thanet Extension alone is based on generic flight height data. To assess the extent of predicted mortality from collision Natural England would like to see assessments using site specific flight height data alongside the Option 2 CRM outputs.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.2.58;

h) *Natural England welcome the attempt to include figures for Hornsea 3 and Norfolk Vanguard. However, we assume these figures are from the Preliminary Environmental Information Reports (PEIR) for these projects and note that there are issues with these. So, whilst we understand this is beyond the applicant's control, as the three projects are in the system at the same time, they must all include one another in their assessments, and therefore we need the agreed//best figures based on the data to be included for each project. Therefore, at present given the issues with the Thanet Extension figures alone and those around the Hornsea 3 and Norfolk Vanguard figures, we cannot currently make any conclusions regarding cumulative CRM (will also apply to cumulative displacement).The table does not state whether the figures are based on Option 1 2 or 3.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Table 4.38;

i) *Natural England note the comparisons of the cumulative collision predictions and Thanet Extension's contribution, however before commenting we would like to review the CRM results, including considering outputs from Option 1.* Natural England (2018) Appendix 1 – Additional Detailed Comments: Point relating to Paragraph 4.2.66;

j) *Due to the unresolved issues around methodology used to assess …. collision risk we are unable to agree with the applicant's conclusions in Table 4.2 on AEoI for …. kittiwake as a feature of the Flamborough and Filey Coast pSPA.* Natural England (2018) Relevant Representations: Point relating to Paragraph 5.3.1.13.

15 In response to the Relevant Representations received from Natural England the first post-submission Statement of Common Ground (SoCG) meeting was held on 5th October 2018. This meeting (held between Vattenfall, Natural England, APEM and GoBe) provided clarification on the points raised and listed above (bullet points a to i), with additional written responses to Natural England's Relevant Representations to be submitted within a technical note (this note).

16 The outcome of the meeting on 5th October 2018 was that Natural England agreed:

- That the sample size of flying birds collected from the aerial digital survey data from within the Thanet Extension site over the 24 month period was too low to be relied upon for use in CRM (See Section 2.1).
- That if the data from the ORJIP project (alongside suitable guidance) were available in the early examination phase then the sensitive species could, if necessary, be re-modelled and through agreement with Natural England (see Section 2.2).
- That due to the timing of the Development Applications for the Hornsea Three and Norfolk Vanguard offshore wind farms coinciding with that of Thanet Extension it was difficult to align numbers within the cumulative assessment for collision risk. It was agreed that Thanet Extension is likely to make a minor contribution to any cumulative collision risk mortality totals within the southern North Sea and that Natural England would enquire internally for a current total cumulative collision rate for the southern North Sea for each of the five species assessed for CRM (gannet, kittiwake, herring gull, lesser black-backed gull and great black-backed gull).

17 The outcome of the meeting on 5th October 2018 was that Natural England did not agree that:

- Lower nocturnal activity rates be used in the CRM from the recent reviews (e.g. Furness *et al*., 2018) and that the standard rates following Garthe & Hüppop (2004) should be presented in a range with that from Furness *et al*., (2018) (See Section 2.4).

18 A second post-submission Statement of Common Ground (SoCG) meeting was held on 23rd November 2018 (held between Natural England, APEM and GoBe) at Natural England's offices in Exeter. The purpose of this second SOCG meeting was in order to consult with Natural England on the initial draft report on CRM (this document, Revision A) and clarify any further actions in order to come to agreement on the conclusions on collision risk from Thanet Extension.

19 The outcome of the meeting on 23rd November 2018 was that Natural England agreed:

- Additional clarity should be added to explain why the Masden (2015) programme was not used beyond the PEIR

- CRM outputs using a range of nocturnal activity, accounting for Natural England request to use Garthe & Huppop (2004) rates, would be presented
- CRM outputs using a range avoidance rates would be presented
- That in order to provide evidence that Thanet Extension is of no material contribution to cumulative collision mortality totals comparison should be provided against the final agreed mortality totals for East Anglia Three as well as those most recently presented in the latest Norfolk Vanguard submissions.

20 Natural England also raised the possibility of using the latest Marine Scotland Science R-programme (Marine Scotland, 2018) to undertake further collision risk modelling in order to provide a revised set of outputs for assessment. It is understood that at present this collision risk model is a beta version and it comes without assurance that no issues with its operation and outputs might be found in the same manner as when Masden's R-programme (Masden, 2015) was used at the PEIR stage. Therefore, APEM considered Natural England's request, but instead agreed to provide a further set of collision risk modelling outputs that accounted for any new variance around parameters in relation to nocturnal activity rates and avoidance rates. These revised outputs are presented in Section 2.

2 Responses to Natural England Relevant Representations

2.1 Site-specific flight heights from aerial digital survey data

22 With reference to paragraph 8 in this document, an initial assessment was undertaken as to the appropriateness of using flight height data collected from seabirds recorded within the 24 months of aerial digital surveys completed by APEM between March 2016 and February 2018. The findings from this initial assessment were that no species was recorded in sufficient quantity to provide a robust enough dataset deemed fit for purpose for use in Band (2012) CRM. This was due to all species having a sample size of far fewer than the 100 individuals considered to be the minimum threshold a sample size requires before being used in CRM. Natural England agreed in the SoCG meeting of 5th October 2018 that this rationale of small sample size was a reasonable approach.

23 During the SoCG meeting of 5th October 2018, APEM provided Natural England with clarification on the sample size for all species subject to CRM (SoCG Meeting Minutes, 5th October 2018), from those seabirds recorded within the Thanet Extension site over the 24 months of data collection. These totals are provided in Table 1 and provide evidence that such an approach was valid for this project. Natural England agreed in the SoCG meeting of 5th October 2018 that the TEOWF site-specific flight height data from aerial digital surveys had a small sample size and was not appropriate for inclusion in the assessment.

Table 1: Sample size of bird species recorded in flight within Thanet Extension of 24 month survey period (March 2016 to February 2018)

Species	No. Individuals recorded in flight within Thanet Extension
Gannet	46
Kittiwake	38
Herring gull	26
Lesser black-backed gull	5
Great black-backed gull	24

2.2 Site specific data on bird behaviour from ORJIP project

24 With reference to paragraph 9 in this document the use of the ORJIP Bird Collision Avoidance Study conducted at Thanet Offshore Wind Farm (Skov *et al*., 2018) is currently not possible due to ongoing questions about the most appropriate application of the data within the current Band (2012) CRM. During the SoCG meeting of 5th October 2018 Natural England noted that the use of the ORJIP data may result in similar results to those already presented in Section 4.1 the ES Chapter (PINS Ref APP-045/ Application Ref 6.2.4), but considered it would be worth re-running the CRM with these site specific data and providing an accompanying clarification note once there had been a resolution of the questions as a result of the work contracted to the BTO.

25 The project team agreed to re-assess the suitability to undertake revised CRM using ORJIP data on receipt of the finalised report and data set alongside appropriate guidance on the use of such data in the Band (2012) CRM. If these data were available in the early examination phase then the sensitive species could be re-modelled and assessed for submission to the Examining Authority through agreement with Natural England.

26 A further update on the progress made on the ORJIP data through the Bird Collision Avoidance Study was provided by Natural England during the SoCG meeting of 23rd November 2018. This was with reference to the BTO led report, commissioned by the JNCC, in draft format (JNCC, 2018 in prep). The conclusions from this draft report from this report include recommendations for updated avoidance rates for some species in the Band (2012) CRM. Since the SoCG meeting of 23rd November a final report is now publically available from the JNCC, published in January 2019 (Bowgen and Cook, 2018). These recommendations are further explained in Section 2.5 of this note.

2.3 The use of a range of Nocturnal Activity Rates in CRM

27 With reference to paragraph 11 in this document it was agreed that should further CRM be undertaken then it would be presented and considered using the range of nocturnal activity rates to include those corresponding to MacArthur Green's evidence put forward for the East Anglia THREE application (MacArthur Green, 2015: Appendix 7) and those from Garthe & Hüppop (2004).

28 It should be noted that CRM outputs have already been provided to the Examination, the Examining Authority and Interested Parties that use the nocturnal activity rates from Garthe & Hüppop (2004). Those CRM outputs are in Section 3 of Annex 4 of the ES Chapter (PINS Ref APP-080/ Application Ref 6.4.4.4). However, in order to provide Natural England and the Examining Authority with clarity on the range of mortalities that would be predicted by CRM, should both sources of nocturnal activity rates be used, then this information is presented in Table 2. The Table presents the predicted number of birds that would be subject to mortality per annum along with the associated nocturnal activity on a scale of 1 – 5 in parenthesis.

Table 2: Annual predicted collision mortality rates for Thanet Extension when applying reduced or standard nocturnal activity rates

Species	Nocturnal Activity Rate	Mortality Rate	Difference in Mortality Rate
Gannet	1*	14	+5
	2**	19	
Kittiwake	2*	15	+3
	3**	18	
Lesser black-backed gull	2*	2	+1
	3**	3	
Herring gull	2*	14	+3
	3**	17	
Great black-backed gull	2*	22	+6
	3**	28	
Table Note: Nocturnal Activity Rates according to * MacArthur Green (2015): Appendix 7 and ** Garthe & Huppop (2004)			

29 It is considered that given the minimal difference to mortality rates estimated for collision risk from Thanet Extension alone (Table 2), when applying a range of nocturnal activity rates, it is anticipated that Natural England will be content that collision risk is minimal from Thanet Extension for all five seabird species assessed.

2.4 The use of a range of Avoidance Rates in CRM

30 A revised set of avoidance rates were presented to APEM by Natural England on 23rd November 2018, the source of which was a draft of the now published report contracted by JNCC to the BTO on bird collision avoidance (Bowgen & Cook, 2018) for which Natural England were part of the peer review process. The avoidance rates presented in this report for use in Band (2012) CRM are as follows:

- Gannet 0.995
- Kittiwake 0.990
- Large gulls 0.995

31 For gannet and kittiwake the avoidance rates have increased from those applied within the Thanet Extension collision risk modelling, which was 0.989 for both species. For large gulls (lesser black-backed gull, herring gull and great black-backed gull) there is no change in the avoidance rate used for all three species to that used in the Thanet Extension ES Chapter. As a result of the avoidance rate remaining the same for large gulls, there is no further collision risk analysis outputs presented for those gull species in this document.

32 The Band (2012) CRM outputs for Thanet Extension have already been calculated using a range of different avoidance rates for gannet and kittiwake in Appendix 1 of Annex 4 to the ES Chapter (PINS Ref APP-080/ Application Ref 6.4.4.4). The alternate CRM outputs for gannet and kittiwake using the avoidance rates of 0.995 for gannet and 0.990 for kittiwake, were not submitted as part of Annex 4 to the ES Chapter (PINS Ref APP-080/ Application Ref 6.4.4.4), but have since been calculated and are presented in Table 3.

Table 3: Annual predicted collision mortality rates for Thanet Extension when using revised avoidance rates

Species		Avoidance Rate	Mortality Rate	Difference in Mortality Rate
Gannet	ES Chapter	0.989	14	-8
	Revised	0.995	6	
Kittiwake	ES Chapter	0.989	15	-2
	Revised	0.990	13	

33 Applying this new range of avoidance rates reduces CRM outputs by 8 individuals (approx. 60%) for gannet and 2 individuals (approx. 15%) for kittiwake. This provides further evidence that the outputs from Thanet Extension collision risk modelling were precautionary in nature. It is anticipated that, following receipt of these additional CRM output variances Natural England will be content that collision risk is minimal from Thanet Extension for all five seabird species assessed, no matter which of the two sets of avoidance rates are applied.

2.5 Cumulative and In-Combination Collision Risk and Thanet Extension's Contribution

34 With respect to cumulative collision risk total for the North Sea and the in-combination collision risk to species attributed to the Flamborough and Filey Coast (FFC) Special Protection Area (SPA) Natural England disagree with the current totals presented in all three active Development Applications (Thanet Extension, Hornsea 3 and Norfolk Vanguard). Natural England also recognises that the values presented for Norfolk Vanguard and Hornsea 3 are likely to alter during the next phase of their respective applications for consent.

35 In response to Natural England's request to include the latest data on other projects for cumulative assessments for collision risk it was requested that Natural England provide their current cumulative values for each species of interest (gannet, kittiwake, herring gull, lesser black-backed gull and great black-backed gull) so that Thanet Extension's contribution can be added on to each for consideration.

36 In response to Natural England's request to include the latest data on other projects for in-combination assessments for collision risk with respect to the FFC SPA it was also requested that Natural England provide their current total values for the two species of interest (gannet and kittiwake) so that Thanet Extension's contribution to the in-combination totals can be added on to each for consideration.

37 This was an agreed action, with Natural England noting that Thanet Extension is a lower risk project given its size and location, but that they cannot commit to it being non-material at this stage. However, they did agree that the principle of adding Thanet Extension to their cumulative and in-combination totals for each species is a reasonable approach. It was agreed that on receipt of Natural England's cumulative and in-combination collision mortality rate totals that a range of CRM outputs for Thanet Extension would be provided in order to further support the previous evidence of a non-material contribution to each species' cumulative and in-combination totals.

38 Should cumulative and in-combination totals not be received from Natural England then Thanet Extension would rely on such totals submitted by Vattenfall's other project, Norfolk Vanguard, which is currently also working through its examination phase with the Hearing ongoing and timetabled to finish in June 2019.

39 Following further consultation with Natural England during the second SoCG meeting on 23rd November 2018, APEM agreed that the cumulative totals for each of the five seabirds species assessed in the ES Chapter (PINS Ref APP-045/ Application Ref 6.2.4) would be presented from the East Anglia Three (SPR, 2016) and Norfolk Vanguard projects. This would provide Natural England with a range of cumulative collision mortality rates for each species in order to demonstrate that Thanet Extension's collision mortality rates are of no material contribution.

40 The results of comparing a new range of collision mortality rates from Thanet Extension against those cumulative estimates for East Anglia Three and Norfolk Vanguard are presented in Table 4.

Table 4: Annual predicted cumulative collision mortality rates from East Anglia Three and Norfolk Vanguard in comparison to Thanet Extension (and its contribution to both)

Species	Cumulative Mortality Rates Agreed by Natural England for East Anglia Three*	Cumulative Mortality Rates Submitted for Norfolk Vanguard(minus Thanet Extension)**	Thanet Extension Mortality Rates Range	Percentage contribution to EA3 & NV Cumulative Totals	
				EA3	NV
Gannet	2,874.5	2,665.6	6-19	0.2-0.7%	0.2-0.7%
Kittiwake	3,446.9	3,845.1	13-18	0.4-0.5%	0.3-0.5%
Lesser black-backed gull	474.6	520	2-3	0.4-0.6%	0.4-0.6%
Herring gull	701.1	n/a	14-17	2.0-2.4%	n/a
Great black-backed gull	840.4	928.6	22-28	2.6-3.3%	2.4-3.0%
Table Note: *These totals do not include projects since East Anglia Three					
Table Note: **These totals are from an additional submission of data from Vattenfall to PINS in Response to Section 51 Advice from the Planning Inspectorate (Vattenfall, 2018b)					

41 The contribution of Thanet Extension to the cumulative totals agreed by Natural England for East Anglia Three is between 0.2-0.7% for gannet, 0.4-0.5% for kittiwake, 0.4-0.6% for lesser black-backed gull, 2.0-2.4% for herring gull and 2.6-3.3% for great black-backed gull. This provides further evidence in support of the Thanet Extension ES Chapter (PINS Ref APP-045/ Application Ref 6.2.4) and RIAA (PINS Ref APP-031/ Application Ref 5.2) concluding the collision risk totals estimated as a consequence of Thanet Extension alone are of no material contribution to the overall cumulative mortality totals.

42 The contribution of Thanet Extension to the cumulative totals most recently submitted for Norfolk Vanguard is between 0.2-0.7% for gannet, 0.3-0.5% for kittiwake, 0.4-0.6% for lesser black-backed gull and 2.4-3.0% for great black-backed gull. Please note that no cumulative totals were submitted for Norfolk Vanguard up to the point at which this note was prepared. Consideration of these data provides further evidence in support of the Thanet Extension ES Chapter (PINS Ref APP-045/ Application Ref 6.2.4) and RIAA (PINS Ref APP-031/ Application Ref 5.2) concluding the collision risk totals estimated as a consequence of Thanet Extension alone are of no material contribution to the overall cumulative mortality totals of any seabird.

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Vattenfall Wind Power Ltd

Thanet Extension Offshore Wind Farm

Appendix 1, Annex G to Deadline 1 Submission: Clarification Note on the implications of adopting the Joint Cetacean Protocol derived density estimates for harbour porpoise

Relevant Examination Deadline: 1

Submitted by Vattenfall Wind Power Ltd

Date: January 2019

Revision A

Drafted By:	SMRU Consulting
Approved By:	Daniel Bates
Date of Approval:	January 2019
Revision:	A

Revision A	Original Document submitted to the Examining Authority
N/A	
N/A	
N/A	

Contents

Tables

1 The implications of adopting the Joint Cetacean Protocol derived density estimates for harbour porpoise

1 The following comment was received from Natural England in their Relevant Representation (EN010084) submitted to the planning inspectorate on 12th September 2018.

"Natural England question why the JCP density estimates aren't being used within the impact assessment (as requested in Natural England's PEIR comments)? The JCP provides the most comprehensive collation of porpoise sightings data in the UK and as such should be used as one of the densities to assess impact on porpoise in the area. Furthermore, it is unclear why both the SCANS III and site specific densities have been used when they are so similar. The JCP would have provided a bit more of a range (1.16 porpoises/km² compared to 0.607 and 0.61 porpoises/km² respectively). In terms of Table 7.27 (and the subsequent assessment), this would almost double the number of porpoises and % of the reference population affected, which has implications for the CEA."

2 Following a teleconference with Natural England on 20th November, the Applicant agreed to provide a note outlining the implication for the assessment if the JCP III density values were used in the quantitative impact assessment. The remainder of this note provides that information.

3 There have been several studies that have produced density estimates for harbour porpoise in the vicinity of Thanet Extension, using a variety of survey methods and resulting in a range of density estimates. Each of these surveys have been conducted differently and different data analysis methods have been applied to the data, each of which differ in terms of assumptions such as cluster size, g(0) estimates etc. Given the limitations inherent in surveying animals at sea, which spend the majority of time underwater, and the well documented spatial and temporal variation in marine mammal abundance and density patterns, no density estimates can be considered to accurately reflect "true density" but are our best estimates intended to provide a basis for quantitative impact assessment. Harbour porpoise densities are known to vary considerably both spatially and temporally, as is evident from the Thanet Extension APEM survey data where densities ranged from 0.00 to 4.11 porpoise/km^2 between monthly surveys (average across all surveys of 0.610 porpoise/km^2). Therefore a range of densities from a variety of sources were presented and discussed.

4 At the time of writing the Thanet Extension ES, there was concern regarding the JCP Phase III densities obtained from the JNCC R code as the densities calculated from the code did not match the data provided in the corresponding JNCC density surface maps provided, this meant that the Applicant did not have confidence in basing any quantitative assessment on these values, but they were presented in the baseline for information. Since then, JNCC have confirmed that there was an error with the density surface maps and that the R code should now be providing the correct density estimate for the user specified area.

5 Therefore, at the request of Natural England, the worst case behavioural disturbance scenario (monopile 5,000 kJ at the East Location) has been modelled using the average JCP Phase III density estimate of 1.16 porpoise/km^2. This resulted in an estimate of 3,609 porpoise potentially experiencing noise levels high enough to elicit a behavioural response (Table 1). This equates to 1.04% of the reference population.

6 This is higher than the average estimates presented in the ES, which were obtained using the SCANS III density estimate (0.607 porpoise/km^2) and the average APEM survey density estimate (0.610 porpoise/km^2). The number of animals potentially affected (3608) is with the minimum and maximum vales based on the monthly APEM surveys and close to value based on the upper 95% confidence interval of the SCANS III estimate. Overall, given the low percentage of the population predicted to be affected, the limited duration of the activity, the magnitude of the impact remains **Low**. Given that harbour porpoise have been assessed as having a **Medium** sensitivity to the impact the assessment conclusion remains at **Minor** significance, which is not significant in EIA terms.

Table 1: Number of harbour porpoises within the monopile 5,000 kJ East Location impact area of the behavioural dose response method based on Thompson et al. (2013).

Data source Mean density value Lower and Upper estimates[1]	SCANS III 0.607/km^2 (0.221-1.137)	APEM 0.610/km^2 (0-4.11)	JCP III 1.16/km^2 (0.221-1.137)
Number of animals	1,880 (688-3,537)	1,888 (0-12,786)	3,609 (2,053-5,351)
% of MU	0.54% (0.20-1.02)	0.55% (0-3.70)	1.04% (0.59-1.55)
Sensitivity	Medium	Medium	Medium
Magnitude	Low	Low	Low
Impact Significance	Minor (Not significant)	Minor (Not significant)	Minor (Not significant)

1.2 CEA of disturbance/displacement resulting from offshore underwater noise produced during offshore wind farm construction

7 As presented in the ES, using the SCANS III density estimate for Thanet Extension cumulatively with the worst case scenario of Tier 1 and Tier 2 Projects resulted in an impact to a maximum of 31,455 porpoise (9.1% of the MU). Using the JCP Phase III estimate for Thanet Extension increases this total cumulative impact to a maximum of 33,184 porpoise (9.6% of the MU) (Table 2). This does not represent a significant change in the number of porpoise impacted nor in the proportion of the population that is impacted, and therefore there is no change to the conclusions of the cumulative effects assessment.

8 As stated in the ES, the effects are likely to be temporary and any short-term changes in the ability of individual porpoises to find food over the period experiencing disturbance, are likely to be reversible. In addition, as noted in the ES, this assessment is very precautionary as it is based on the highly implausible scenario of complete overlap between all these construction projects, and multiple piling vessels working concurrently on each site.

[1] For modelled density sources indicating a single average density (SCANS III and JCP III) the 95% confidence interval around the mean was used to define upper and lower values, for the monthly APEM surveys the monthly minimum and maximum values were used to indicate the minimum and maximum potential magnitude of disturbance. The former are intended to indicate average levels of impact with the latter intended to indicate how much magnitude may vary over time.

Table 2 Cumulative effects assessment of disturbance/displacement resulting from offshore underwater noise produced during offshore wind farm construction for Thanet Extension cumulatively with Tier 1 and Tier 2 Projects.

	Thanet Extension (SCANS III) plus Tier 1 & 2 Projects		Thanet Extension (JCP III) plus Tier 1 & 2 Projects	
	Concurrent	Single	Concurrent	Single
Number of porpoise	31,455	19,427	33,184	21,156
% of MU	9.1%	5.6%	9.6%	6.1%